Bruce Highway Cooroy to Curra (Section D: Woondum to Curra)

EPBC Act Ref: 2017/7941 Preliminary Documentation (Revision 2)

May 2018

Australian Government

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Document control options

Departmental approvals

Refer to the appropriate Risk Assessment Tool for relevant reviewer and approver

Date	Name	Position	Action required *(Review/endorse/approve)*	Due
4/12/17	Don Pitt	Project Director	For Submission	5/12/17
8/5/18	Brendan Clancy	A/ District Director	For submission	15/5/18

Risk level

☐ GACC major ☐ GACC minor ☐ High risk (but not GACC) ☒ Medium risk

Prepared by	Madeleine Page
Title	Senior Environmental Officer
District & Region	Wide Bay/ Burnett
Branch & Division	PDO
Project/program	232/10A/7
Project number	WBYD-1335
Project location	Gympie
Status	Final v2
DMS ref. no.	108193 - PDO

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Proponent and Proposed Action

Detail	Applicable details
EPBC Reference Number:	2017/7941
Project Name:	Bruce Highway Cooroy to Curra (Section D: Woondum to Curra)
Proponent:	Department of Transport and Main Roads
ABN:	39 407 690 291
Proposed Action:	The Department of Transport and Main Roads proposes to upgrade and realign an existing 26 kilometre section of the Bruce Highway, between Woondum and Curra including a bypass to the east of Gympie, Queensland.
Location of the Action:	Between Woondum and Curra, including a bypass to the east of Gympie South East Queensland.
Date Prepared:	May 2018

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:

Full name: Brendan Clancy

Organisation: Department of Transport and Main Roads

Date: 8 May 2018

Glossary

Term	Description
AU	Assessment Unit
BBBQ	Black-breasted Button-quail
DAF	Department of Agriculture and Fisheries
DEE	Commonwealth Department of the Environment and Energy
DNPSR	Department of National Parks, Sports and Racing
DNRM	Department of Natural Resources and Mines
DSD	Department of State Development
EHP	Department of Environment and Heritage Protection
EMP(C)	Environmental Management Plan (Construction)
EPBC Act 1999	*Environment Protection and Biodiversity Conservation Act 1999*
ESCP	Erosion and Sediment Control Plan
GED	General environmental duty
GKAG	Gympie Koala Action Group
GRC	Gympie Regional Council
IECA Manual	International Erosion Control Association (IECA) Best Practice Sediment and Erosion Manual
MNES	Matter of National Environmental Significance
MRCCC	Mary River Catchment Co-ordinating Committee (MRCCC)
OESCP	Overarching Erosion and Sediment Control Plan
PESCP	Progressive Erosion and Sediment Control Plan
RFI	Request for Additional Information
SF	State Forest
SMP	Species Management Program
SPRAT	Species Profile and Threat
TEC	Threatened Ecological Community
TMR	Department of Transport and Main Roads
VM Act	Vegetation Management Act

1. Introduction

1.1 Project Overview

The Department of Transport and Main Roads (TMR) proposes to upgrade and realign 26 km of the Bruce Highway (requiring construction of 30 km of new highway and tie-in works), including a bypass to the east of Gympie, Queensland. This project, entitled the Bruce Highway Cooroy to Curra (Section D: Woondum to Curra) project (herein referred to as the Project), is the fourth and final section of a 62 km upgrade of the Bruce Highway between Cooroy and Curra. This highway upgrade is one of Queensland's high priority road projects, providing an effective transport link as part of the national highway network and improved safety and flood immunity (Queensland Government, 2012).

The Project has been separated into two contracts, Contract 1 and Contract 2, for administrative purposes to assist in the future management of contractual risks inherent with such a large project. The Southern Contract (Contract 1), approximately 10km in length) will extend from the northern tie in to the Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum) project at Woondum, to approximately 200m north of Sandy Creek Road. The Northern Contract (Contract 2) of approximately 18 km in length will extend from north of Sandy Creek Road to Curra. Both contracts have been referred as a single action under the Environment and Biodiversity Conservation Act 1999 (EPBC Act).

1.2 Environment Protection and Biodiversity Conservation Act Referral

TMR submitted a referral to the Commonwealth Department of the Environment and Energy (DEE) for impacts on matters of national environmental significance (MNES) under the EPBC Act on 10 May 2017 for the Project.

A decision on the assessment of the referral was delivered by the DEE on 7 June 2017 which determined the Project (the proposed action) to be a 'controlled action' due to the likelihood of significant impacts on MNES protected under Section 18 and 18A of the EPBC Act. Section 18 and 18A relate to actions with significant impact on listed threatened species and communities. The determination required the proposed action to be assessed by the submission of preliminary documentation. A request for additional information (RFI) outlining the documentation to be submitted to the DEE for assessment was provided on 26 June 2017 (refer to Appendix A for a copy of the RFI). This document has been prepared to provide the preliminary documentation requested in the RFI and was submitted on 5 December 2017. Further information was requested by DEE on 17 April 2018 (refer Appendix A) and the report has subsequently been updated.

1.3 Report Layout

This report serves to provide the necessary preliminary documentation requested by the DEE in their RFI. A summary of how the report has been structured to respond to the RFI is provided below.

Table 1 Summary of Report Structure

RFI Clause	Section in Report
Clauses 2.1 and 2.3 to 2.6 Avoidance and Mitigation	Avoidance and mitigation measures are provided in Section 2.3 and 2.4 of the report. Section 2.3 outlines measures relevant for more than one MNES as relevant. Section 2.4 outlines measures specific to each MNES.

RFI Clause	Section in Report
Clause 2.2 Pre-clearance measures	Provided in Section 2.2 of the report
Clause 3.1 Offset Strategy	Provided in Section 3.3 of the report for each MNES
Clause 3.2 Compliance with Environment Offsets Policy	Provided in Section 3.3.5 of the report
Clause 3.3 Limitations	Provided in Section 3.5 of the report
Clause 4 Economic and social matters	Provided in Section 4 of the report
Clause 5 Ecologically sustainable development	Provided in Section 5 of the report

2. RFI Clause 2 - Avoidance and Mitigation

2.1 General

This section provides the details pertaining to avoidance and mitigation measures requested in Clause 2 of the RFI for the following listed threatened species and communities upon which the Project is likely to have a significant impact:

- Lowland Rainforest of Subtropical Australia Threatened Ecological Community (TEC)
- Black-breasted button quail (*Turnix melanogaster*)
- Koala (*Phascolarctos cinereus*)
- Pineapple zamia (*Macrozamia pauli-guilielmi*) (herein referred to as *M. pauli-guilielmi*)

In addition, Clause 2 requires information to be provided in relation to the following aquatic species which DEE considers may be impacted by the Project due to water pollution, sedimentation and erosion:

- Mary River cod (*Maccullochella mariensis*)
- Australian lungfish (*Neoceratodus forsteri*)
- Mary River turtle (*Elusor macrurus*)
- White-throated snapping turtle (*Elseya albagula*)

Construction specific management plans noted in Clause 2.4 of the RFI have not been prepared at this stage of the Project and will be the responsibility of the successful Construction Contractor in accordance with the contract documents. Notwithstanding, details relating to the performance criteria, environmental outcomes and audit regimes for the listed threatened species and communities have been documented in Sections 2.3 and 2.4 of this report. The pre-clearance procedures required in accordance with Clause 2.2 of the RFI are provided below in Section 2.2 for all MNES.

2.2 RFI Clause 2.2 - Pre-Clearance procedures

A number of pre-clearance procedures for the protection of MNES will be adopted for this Project, as outlined in Table 2.

Table 2 Pre-clearance Procedures

Procedure	Details	Audit	Outcomes
Planning and implementation of erosion and sediment control	Two stage approach to development of erosion and sediment control plans (ESCP): • Stage 1 – develop Overarching ESCP (OESCP) in accordance with the International Erosion Control Association (IECA) Best Practice Sediment and Erosion Manual – prepared in accordance with MRTS52 (refer Appendix B) – prepared and independently verified by appropriately qualified persons as defined under the Contract – a separate OESCP shall be prepared prior to the commencement of the following milestones; ▪ clearing and grubbing ▪ cut and fill works ▪ creek diversions, cross drainage (culverts) ▪ rehabilitation / asphalt works All plans shall include all type 1 sediment controls, all clean and dirty water drains, all erosion control measures, as well as all applicable type 2 and 3 sediment controls for each stage. • Stage 2 - The OESCP's are to be reviewed and updated on a weekly basis, referred to as Progressive Erosion and Sediment Control Plans (PESCPs). They are to be provided to the Administrator with the monthly report and are to be prepared by the appropriately qualified person on site as defined under the Contract.	All OESCPs shall be reviewed and deemed suitable by the Contract Administrator's suitably qualified person. Work shall not be permitted until the OESCP for each stage in each zone is approved. Weekly site inspections shall be undertaken by the Contract Administrator. Monthly independent audits shall be undertaken by a suitably qualified person.	• ESCP designed in accordance with the IECA manual • Staged approach to implementation of erosion and sediment control (ESC) designed in accordance with the construction phases, catchment sizes and level of risk • Protection of downstream water quality and habitat for aquatic species This staged approach was undertaken on Cooroy to Curra Section C and enabled detailed planning of ESC to occur and further refinement as construction works progressed. All plans are produced and reviewed by suitably qualified personnel to ensure they are designed in accordance with industry standards and the IECA manual.

Procedure	Details	Audit	Outcomes
Staged clearing approach	The Cooroy to Curra Section C project adopted a staged clearing approach which required the following: – Stage 1 - Clearing undertaken for pioneering works only. Pioneering works include fencing and sediment basins. – Stage 2 - installation of fencing, sediment basins, clean water drains and cross drainage. – Stage 3 - Commence bulk clearing as required	All works shall be inspected by the Contract Administrator.	• Clearing limited to minimal works activities • Installation of cross drainage prior to bulk earthworks in each stage of works enables clean water to be directed through the site • Cross drainage and major sediment controls installed prior to bulk clearing occurs, assists in protecting water quality of waterways and therefore habitat of threatened aquatic species. This approach was very successful on Section C and assisted in the protection of downstream water quality throughout the bulk clearing and earthworks phases.
Suitably qualified persons	*Terrestrial fauna specialist* A suitably qualified and experienced fauna spotter/ catcher (Terrestrial Fauna Specialist) shall be engaged by the Contractor prior to construction to manage and supervise all terrestrial fauna management activities prior to and during all clearing works, including monitoring. *Aquatic fauna specialist* A suitably qualified and experienced Aquatic Fauna Specialist shall be engaged by the Contractor to manage and supervise all aquatic fauna management activities including preclearing surveys, dewatering activities and fauna monitoring. The aquatic fauna specialist must hold all relevant permits including a current General Fisheries Permit, a Rehabilitation Permit and an Animal Ethics Permit.	To be approved by the Contract Administrator	• Suitably qualified personnel are responsible for supervising all relevant activities associated with both terrestrial and aquatic species.
Pre-clearing activities	The following pre-clearing activities shall be undertaken: • No-go zones will be clearly set out and marked prior to construction activities commencing	All works shall be inspected by the Contract Administrator.	• Clearing limited to areas required to be cleared for construction activities • All site personnel aware of the procedures and processes to be followed during clearing

Procedure	Details	Audit	Outcomes
	• Induction of site personnel of responsibilities in complying with the protection of fauna and flora within no-go zones. • No clearing or works beyond the defined clearing limits may proceed without approval from the Administrator. • Pre-clearing survey undertaken by the terrestrial fauna specialist to identify and mark habitat features		• Pre-clearing survey will assist in identifying conservation significant species present within the clearing to be cleared and allow these species to be moved away from the impact area, where possible.
Immediate Pre-clearance survey	The terrestrial fauna specialist is required to undertake an immediate pre-clearance survey 24 hours prior to vegetation clearing in each stage to search habitat features previously marked for fauna and/or breeding activity. The aquatic fauna specialist is required to undertake pre-clearance surveys prior to any dewatering activities (including those relating to dams, waterway diversions etc.) to identify whether any burrows are present within the Project area.	All works shall be inspected by the Contract Administrator.	Assist in identifying conservation significant species present within the clearing to be cleared and allow these species to be moved away from the impact area, where possible.
Sequential clearing	A sequential approach to clearing will be implemented where hollow bearing trees have been identified. Non-hollow bearing trees will be cleared before hollow bearing trees, to allow fauna an opportunity to move away and allow time to concentrate rescue efforts on the trees that are most likely to be inhabited. Sequential vegetation clearing is to occur from disturbed areas and clear towards areas of vegetation to be retained. Hollow bearing trees will be felled after a minimum 24 hr delay after clearing non-habitat trees. The terrestrial fauna specialist will be on site for all clearing works including individual clearing of hollow	All works shall be inspected by the Contract Administrator.	Sequential clearing aims to protect fauna and allow them to move of their own accord as part of the clearing process.

Procedure	Details	Audit	Outcomes
	bearing trees. Individual hollows of felled hollow bearing trees will be inspected using a torch or similar by the terrestrial fauna specialist and the relevant fauna contingency actions initiated. Once the trees are deemed clear by the terrestrial fauna specialist, further processing can occur. If more than one machine clearing vegetation is used, more than one terrestrial fauna specialist will be required.		

2.3 Avoidance and Mitigation Measures for All Species

A number of avoidance and mitigation measures have been established for the Project and are relevant for all species as detailed in Table 3 below. Specific measures for each of the listed threatened species and communities that are likely and may be impacted by the Project are provided in Section 2.4. The **management objective** of the proposed measures is to prevent or minimise unavoidable impacts on the MNES and associated habitat within the required alignment of the Project.

Table 3 Avoidance and Mitigation Measures

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
Design	Dual bridges proposed over major waterways have been separated to allow natural light to filter between the two structures.	Bridges are able to act as fauna connectivity structures by allowing fauna to move underneath each bridge as referenced in TMR's *Fauna Sensitive Road Design Manual Volume 2: Preferred Practises*. Insufficient light under a bridge is noted in the aforementioned guidelines as a inefficiency of underpasses and therefore by allowing light to penetrate through to the existing ground surface, the use of these structures as an underpass increases	N/A	Dual bridges that have natural light penetrating between them increases the use of the underpass by fauna.	N/A		✓	✓		✓
	Fauna fencing (koala exclusion fencing) has been included in the design along retained bushland and on either side of nominated fauna connectivity structures, including both fauna underpasses and bridges. Fauna fencing will be installed in accordance with Road and Traffic Authority (NSW's) Standard Drawing and include the following specifications:	Fauna fencing is referenced in TMR's Fauna Sensitive Road Design Manual Volume 2: Preferred Practises as an effective management measure to reduce vehicle collisions with fauna on linear infrastructure.	Fencing installed as per the design drawings and additional locations as determined by the Contract Administrator. Fence is to be maintained by TMR. Three metre clearance either side of fence to be maintained.	Prevent increased fauna mortality from the Project and guide and direct fauna movement between retained bushland habitat and on either side of nominated fauna connectivity structures.	6-monthly during construction and post construction.		✓	✓		

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
	Galvanised wire 50 chain-link fence, with additional 0.5 m overhang “floppy top” (outward of road formation). 3 m buffer free of vegetation (excluding grasses) on habitat side of the fence (refer Appendix X for drawing)									
Contract documents	Contract documentation will be prepared for the Project that provides site specific requirements for the protection of MNES during the construction phase of the Project. Documents include the following: - MRTS51 – Environmental Management annexure, - MRTS52 – Erosion and Sediment Control annexure - MRTS16 – landscape and Revegetation Works annexure - Supplementary specifications providing details of the qualifications and experience required for relevant suitably qualified personnel	This mitigation measure will reduce impacts on MNES through inclusion of management measures for vegetation clearing and general vegetation management.	Contractor will be required to comply with all clauses of the contract documentation and include the relevant requirements in an Environment Management Plan (Construction) EMP(C)	Site specific environmental management requirements relevant to each MNES	The annexures will be prepared by the design consultant and reviewed and approved by TMR.	✓	✓	✓	✓	✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
	These documents are currently being prepared and will include the relevant state and federal government conditions of approval. The annexures provide site specific requirements that must be adhered to by the Construction Contractor in addition to the standard TMR specifications (MRTS 51, MRTS 52 and MRTS 16) provided in Appendix B of this report.									
	Vegetation clearing limits will be defined under the contract documentation, to minimise the extent of vegetation clearing whilst allowing construction to occur, taking into account erosion and sediment control devices.	Vegetation clearing limits will ensure minimisation of clearing required for the Project and reduce impacts on the black-breasted button-quail and their supporting habitat.	N/A	Avoid unnecessary removal of fauna habitat.	In accordance with the contract documentation .	✓	✓	✓	✓	✓
	Revegetation and landscaping plans are required to be developed in accordance with TMR's MRTS16 – Landscape and Revegetation Works and associated annexures.	Recreate habitat for MNES following disturbance from the Project.	N/A	Revegetate disturbed areas to recreate habitat for protected species.	In accordance with TMR's MRTS16 – Landscape and Revegetation Works	✓	✓	✓		✓
	A provisional sum for the payment of the implementation and management of erosion	The measure was recently adopted for the Bruce Highway Cooroy to Curra Section C (Woondum to Traveston) Project	N/A – TMR will specify a provisional sum in	Improved ESC on site and protection of downstream	N/A	✓	✓	✓	✓	✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
	and sediment control (including the preparation of erosion and sediment control plans) will be specified in the contract documentation.	(Section C Project) and ensured that the tenderers did not under-price ESC and ensured best practice measures were adopted on site. A collaborative approach between TMR, the contact administrator and the construction contractor was achieved and no environmental incidents to water quality occurred throughout construction. The approach was recognised in the 2017 IECA award for which the project was awarded first prize.	the contract documentation	water quality. The approach was commended by the Department of Environment and Heritage Protection (DEHP).						
Pre-clearing	The contractor shall prepare an EMP(C) prior to any works commencing on site.	The requirement for an EMP(C) is standard on all TMR projects of this size and is an effective measure to ensure environmental management is planned and implemented in accordance with the legislation, project approvals and contract documentation.	Submission of EMP(C) Contract Administrator's acceptance of the EMP(C)	Clearly outlines all control, mitigation, and management measures to be adopted throughout the construction phase, including incident management, reporting and auditing requirements to ensure compliance with all relevant approval conditions for the protection of	The Contract Administrator will undertake regular audits of the EMP(C) to ensure compliance with all procedures and control measures.	✓	✓	✓	✓	✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
				MNES and other species.						
	Undertake an environmental induction to all site personnel to outline responsibilities in relation to the avoidance and management of fauna, flora and significant habitat areas.	This will assist in training all onsite personnel in regards to their environmental obligations where MNES are found onsite.	All site personnel have undertaken the environmental induction prior to commencing work.	Avoid any unnecessary and avoidable fauna collisions and mortalities as all personnel will be trained on their appropriate obligations.	In accordance with the contract documentation .	✓	✓	✓	✓	✓
	Establishment of no-go zones to minimise potential impacts to MNES and habitat that is not to be cleared located outside the Project area. These will be clearly set out and marked prior to construction activities commencing. No works are to be undertaken in these areas, nor are these areas to be used as storage of materials/plant.	Nomination of No-Go zones have been incorporated into TMR projects for a number of years and is effective in keeping machinery and personnel out of environmentally sensitive areas.	No clearing outside in no-go zone areas	Avoid mortality to species and impact to habitat from construction equipment and clearing Incorporation of No-Go zones will assist in minimising additional impacts to MNES.	Daily inspection by contract administrator	✓	✓	✓	✓	✓
	Additional workspace areas and haul routes are to be placed in previously cleared areas, where possible, as specified in the Contract documentation.	The measure has been used previously on TMR projects and assist in reducing the extent of clearing required for a project.	Haul routes and workspace areas to be constructed in areas approved by the Contract Administrator.	Minimise the vegetation clearing required for the Project. Minimise additional	Haul routes to be included on the OESCP to be approved by the Contract Administrator. Daily inspection by	✓	✓	✓	✓	✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
				impacts to MNES.	contract administrator					
	Undertake a pre-clearing weed survey treatment and management and report areas of existing weed infestation.	Identification of weed species and locations of infestations will facilitate appropriate management strategies.	Existing weed species are identified and controlled onsite.	Avoid introduction and spread of weeds to MNES habitat.	Weekly inspection to include weeds onsite and in adjacent MNES habitat if present	✓	✓	✓	✓	✓
	A terrestrial fauna specialist will be appointed and approved by the Contract Administrator for the handling, capture and release of native fauna (e.g. a license spotter catcher issued under the *Nature Conservation (Administration) Regulation 2006)*, for the assessment and/or removal of native fauna. Fauna will be given the opportunity to move away to avoid stress through handling and relocation. Fauna spotter will be experienced in terrestrial and/or aquatic species, as required by the nature of the site works.	This will assist in detecting fauna that are present within the clearing area and allow these individuals to move away from the impacted area, where possible.	No injury or death to native fauna during clearing activities.	Avoid fauna injury and mortality due to individuals remaining within the clearing area.	The terrestrial fauna specialist will prepare and submit a post-clearing report within the Construction Contractors monthly report submitted to the Construction Administrator. This will allow for records to be kept of black-breasted button-quails that have been moved from the Project area.		✓	✓		✓
	Prior to vegetation clearing in each zone, the terrestrial fauna specialist will	This will assist in detecting fauna that are present within the clearing area directly prior to	No injury or death to native fauna	Avoid fauna injury and mortality due to	The terrestrial fauna specialist will		✓	✓		

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
	undertake a pre-clearing survey to identify and mark habitat features (i.e. hollow bearing logs, hollow bearing trees, areas of wetland vegetation, banks along waterways with burrows etc.)	vegetation clearing and allow these individuals to move away from the impacted area, where possible.	during clearing activities	individuals remaining within the clearing area.	prepare and submit a post-clearing report within the Construction Contractors monthly report submitted to the Construction Administrator. This will allow for records to be kept of black-breasted button-quails that have been moved from the Project area.					
	Undertake pre-clearing fauna surveys of pre-approved boundaries in areas known to support habitat for the MNES prior to and in advance of vegetation clearing.	Pre-clearance surveys will be undertaken by appropriately qualified ecologists for specific protected species to facilitate any relocation required as appropriate.	No injury or death to native fauna during clearing activities.	Avoid fauna injury and mortality due to individuals remaining within the clearing area.	Fauna survey report provided to the Contract Administrator. Weekly site inspection undertaken by Contract Administrator. Incidents reported to the contract Administrator,			✓	✓	

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
					documented in the monthly report.					
Clearing	The terrestrial fauna specialist will undertake an immediate pre-clearance survey 24 hours ahead of vegetation clearing for each stage, to search habitat features previously marked for fauna and/or breeding activity.	This will assist in detecting fauna that are present within the clearing area directly prior to vegetation clearing and allow these species to move away from the impacted area, where possible.	No injury or death to native fauna during clearing activities.	Avoid fauna injury and mortality due to individuals remaining within the clearing area.	The terrestrial fauna specialist will prepare and submit a post-clearing report within the Construction Contractors monthly report submitted to the Construction Administrator. This will allow for records to be kept of black-breasted button-quails that have been moved from the Project area.		✓	✓		
	Staged clearing approach to be adopted on site as outlined in Section 2.2 of this document.	Hold point must be released by Contract Administrator prior to each clearing stage commencing, therefore effective in avoiding areas of the site being cleared unnecessarily. Staging protects habitat for as long as reasonably	A plan of clearing limits will be prepared by the Construction Contractor.	Avoid unnecessary clearing and minimise erosion and sediment	Daily site inspection undertaken by the Contract Administrator.	✓	✓	✓	✓	✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
		practical and assists in the management of ESC.	Hold point released by Contractor Administrator to commence clearing in a defined zone.	impacts on waterways.						
	Sequential clearing process	Sequential clearing undertaken as per Section 2.2	A plan of clearing limits will be prepared by the Construction Contractor. Hold point released by Contractor Administrator to commence clearing in a defined zone.	Sequential clearing practices allow more mobile fauna species to disperse away from cleared areas and clearing activities.	Daily site inspection undertaken by the Contract Administrator.		✓	✓		
	Grubbing and removal of groundcover and understory will be delayed until immediately prior to earthworks occurring within that particular zone of works.	Delaying grubbing activities enables the contractor to manage ESC and limit downstream impacts prior to earthworks commencing.	Hold point released by Contractor Administrator to commence clearing in a defined zone.	Minimise unnecessary erosion and sediment impacts on waterways.	Daily site inspection undertaken by the Contract Administrator.		✓	✓		✓
	Hollow timber, woody debris and bush rock which is suitable for fauna habitat will be relocated to retained habitat areas outside of clearing area adjacent to the Project area, where possible.	This will assist in providing shelter habitat for MNES including: the black-breasted button-quail where habitat features are moved within the Woondum State Forest.	Timber collected where possible and Contract Administrators notified	Will increase the suitable habitat available for the black-breasted button-quail within the relocated area.	As collected		✓			✓
Weed management	Weed management to be undertaken throughout the construction phase.	Will assist in minimising indirect impacts to the black-breasted button-quail and its habitat	Weeds managed throughout construction	Weed management will assist in the	Reported monthly to	✓	✓	✓	✓	✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
	Requirement for all machinery to follow wash down procedures. Hygiene declaration forms to be provided for all plant/vehicles working within the Project area	through a reduction in weed invasion and habitat degradation.		reduction of habitat degradation and will minimise the indirect impacts on the black-breasted button-quail.	Contract Administrator Inspected weekly.					
Revegetation	Where possible, cleared native vegetation will be mulched and reused onsite during rehabilitation and stabilisation activities. Should the mulch be required to be stockpiled, the material will be stockpiled in a matter where endemic seeds remain viable and weeds are treated.	Assists in erosion and sediment control and establishment of native species	Compliance with condition of contract	This will ensure that seeds from endemic species will be able to establish new growth.	In accordance with TMR's MRTS16 – Landscape and Revegetation Works					
	Upon completion of the works within the bed and banks of waterways, banks are to be stabilised (through appropriate measures) and revegetated, where appropriate, within similar native endemic species appropriate to their position in the landscape or in accordance with a Landscape Plan for the specific waterway.	Recreate habitat and reduce erosion	Establishment of vegetation and management of weeds	This will ensure that endemic species are reinstated along the waterways, encouraging establishment of local native species and stabilising the banks of the waterways.	In accordance with TMR's MRTS16 – Landscape and Revegetation Works	✓				✓

Project phase and activity	Avoidance/ mitigation measure	Clause 2.3 Effectiveness of avoidance/ mitigation measure	Clause 2.4 (a) Performance criteria	Clause 2.4 (b) Environmental outcomes / specifications	Clause 2.4 (c) Audit activity & frequency	Relevant MNES				
						TEC	BBBQ	Koala	*M. pauli-guilielmi*	Aquatic Species
Additional Fauna Management	Implement a construction vehicle speed limit within the Project area.	This will assist in minimising direct impact on protected species	Compliance with condition of contract	Avoid any unnecessary damage to the habitat of protected species	Monitored daily		✓	✓		
	Where possible, avoid positioning direct artificial lighting towards retained bushlands.	This will assist in minimising direct impact on protected species	Compliance with condition of contract	Avoid any unnecessary damage to the habitat of protected species	Monitored daily when in use		✓	✓		
	Dust and noise impacts to MNES will be managed in accordance with the procedures in the EMP(C).	This will assist in minimising direct impact on protected species	Compliance with condition of contract	Avoid any unnecessary damage to the habitat of protected species	Monitored daily		✓	✓		

2.4 Species Specific Avoidance and Mitigation Measures

2.4.1 Lowland Rainforest of Subtropical Australia Threatened Ecological Community

Specific avoidance and mitigation measures for the TEC, in addition to those outlined in Section 2.3 of this report, are provided in Table 4.

The following **key performance criteria** have been considered in the development of the avoidance and mitigation measures:

- No clearing outside the specified, pre-approved boundaries where the TEC is known to occur
- Clearing undertaken immediately prior to construction commencing
- Erosion and sediment control is installed and maintained prior to and during clearing and construction
- Reduce and control the impact of weeds within the TEC remaining in the vicinity of the Project
- Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction

The following are the environmental outcomes to be achieved by the avoidance and mitigation measures for the TEC potentially impacted by the Project:

- Maintain or improve Lowland Rainforest of Subtropical Australia habitat
- Restore or maintain corridors of Lowland Rainforest of Subtropical Australia habitat

These outcomes have been nominated with consideration of the priority actions listed in the conservation advice for the TEC (TSSC, 2011), the onsite habitat characteristics and the potential impacts of the Project.

Table 4 Avoidance and Mitigation Measures – Lowland Rainforest of Subtropical Australia TEC

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
DESIGN PHASE					
Specific construction methods for the construction of the Six Mile Creek and North Coast Railway bridges will be included in the contract documentation • **Bank stabilisation to occur during dry periods and prior to the commencement of piling for Six Mile Creek** • **Short-term construction related works including crane pads to be constructed once instream ESC measures are installed (i.e. sediment bunds, etc.) at Six Mile Creek** • **Nomination of maximum timeframes for construction of bridges**	This mitigation measure will assist in avoiding unnecessary impacts to the TEC during construction by requiring planning and timing of specific requirements prior to construction	Erosion and sediment control is installed and maintained prior to and during clearing and construction	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
Timing requirements for construction of the bridge structure and for instream and bank stability works on either bank of Six Mile Creek to avoid peak flow periods as much as possible	This mitigation measure will assist in avoiding unnecessary impacts to the TEC during construction by requiring planning and timing of specific requirements prior to construction	Erosion and sediment control is installed and maintained prior to and during clearing and construction	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
Positioning of the bridge piers have been done so as to avoid disturbance of the confirmed TEC on the northern bank of	This measure will assist in avoiding impacts to TEC habitat	No clearing outside the specified, pre-approved boundaries	Maintain Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
Six Mile Creek (through the use of sheet piles)					interference with its recovery
Progressive design review including construction methodologies employed for the construction of the bridge over Six Mile Creek during the Detailed Design Phase	Assist in reducing impacts to Six Mile Creek and the TEC.	Minimise clearing and impact to TEC	Maintain Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced impact area from 0.82 ha in referral to 0.79 ha from revised design footprint
CONSTRUCTION PHASE					
The Construction Contractor shall minimise and, where possible, delay until necessary the clearing of riparian vegetation at Six Mile Creek.	This measure will assist in minimising fragmentation and edge effect impacts to the TEC and associated habitat.	Clearing undertaken immediately prior to construction commencing	Maintain corridors of Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
Implement specific no-go zones for clearing as documented in the design drawings. Specific limits around habitat areas are documented in the design drawings and contract documentation for implementation by the contractor. The locations of exclusion zone fencing for Six Mile Creek are shown on the General Arrangement drawings for protection of TEC areas. No vegetation clearing or works will be carried out within the Exclusion Zone.	This measure will assist in avoiding impacts to adjacent TEC habitat	No clearing outside the specified, pre-approved boundaries	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Release of hold point to allow clearing to occur and weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
The maximum additional width for clearing and grubbing beyond the permanent works area is 1 m (apart from identified Exclusion Zones)	This measure will assist in avoiding impacts to TEC habitat and buffer zones	No clearing outside the specified, pre-approved boundaries	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Release of hold point to allow clearing to occur and weekly inspections. As per	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
unless otherwise noted in the contract documents. No clearing or works beyond the defined Project extent may proceed without approval from the Administrator and the TMR Environmental Officer (hold point). Up to 3 m additional clearing and grubbing widths may apply to the foundations of retaining structures and the toe of embankments. Additional clearing may be done to facilitate ESC in accordance with the approved Overarching ESC Plan. Where disturbance occurs to the natural surface beyond the clearing limits specified, these shall be reinstated in accordance with the contract documentation.					interference with its recovery
Construction of piers within the vicinity of the banks of Six Mile Creek bridge shall only commence when sufficient dry weather is forecast for the construction period to minimise the likelihood of increase sediment runoff and damage to the surrounding sensitive environment.	Assist in reducing impacts to Six Mile Creek and the TEC.	Erosion and sediment control is installed and maintained prior to and during clearing and construction	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
Any construction activities including stockpiling and access tracks shall be undertaken in accordance with AS4970-2009 Protection of	This measure will assist in avoiding impacts to adjacent TEC habitat	No clearing outside the specified, pre-approved boundaries	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Release of hold point to allow clearing to occur and weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
trees on development sites, including the following: • **Determine the tree protection zone where works are in proximity to retained vegetation;** • **Install 'no entry' fencing around the tree protection zone;** • **Where encroachment into the tree protection zone is unavoidable, apply the principles of Appendix D of AS4970-209 to determine any additional compensatory buffer.**					interference with its recovery
Effective control methods specifically for cats claw creeper will be implemented prior to, during and post-construction, specified in weed management plan.	This mitigation measure will assist in minimising impacts from weeds to the TEC and associated habitat.	Reduce and control the impact of weeds within the TEC	Maintain adjacent Lowland Rainforest of Subtropical Australia habitat	Weekly inspections	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
POST-CONSTRUCTION PHASE					
Progressive rehabilitation will be implemented to minimise the duration of soil exposure and the area of exposure at any given instant (in accordance with the Soil Management Plan and Contractor's Overarching and Progressive Erosion and Sediment Control Plans). Rehabilitation areas shall be weed free prior to the commencement of ground	Assist in reducing impacts to Six Mile Creek and the TEC.	Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction	Maintain corridors of and adjacent Lowland Rainforest of Subtropical Australia habitat	Revegetation works, audits and maintenance in accordance with MRTS 16 (refer Appendix B).	Reduced fragmentation and interference with recovery of the TEC

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
preparation such as topsoil spreading and laying of geofabric (biodegradable jute matting).					
Rehabilitation and revegetation will be undertaken over all areas to be developed. All disturbed areas outside the permanent works areas and on suitable batter slopes will be topsoiled and hydromulched, as a minimum.	This mitigation measure will assist in minimising fragmentation and edge effect impacts to the TEC and associated habitat.	Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction	Maintain corridors of and adjacent Lowland Rainforest of Subtropical Australia habitat	Revegetation works, audits and maintenance in accordance with MRTS 16 (refer Appendix B).	Reduced fragmentation and interference with recovery of the TEC
Revegetation will be undertaken in riparian areas above the channel banks and in shaded areas under and within 10 m of the bridges. Species for revegetation will include groundcover, shrub and tree species that are consistent with the locally occurring remnant vegetation communities and that of the TEC wherever suitable. At least 6 characteristic flora species from Appendix A of the listing advice for the TEC have been proposed for revegetation along the banks of Six Mile Creek.	This mitigation measure will assist in minimising fragmentation and edge effect impacts to the TEC and associated habitat.	Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction	Maintain corridors of and adjacent Lowland Rainforest of Subtropical Australia habitat	Revegetation works, audits and maintenance in accordance with MRTS 16 (refer Appendix B).	Reduced fragmentation and interference with recovery of the TEC
Monitoring of rehabilitation and revegetation areas shall be undertaken for a minimum of 90 days and will include inspections of plant stock, ground treatments, soil	Assist in reducing impacts to Six Mile Creek and the TEC.	Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction	Maintain corridors of and adjacent Lowland Rainforest of Subtropical Australia habitat	Monthly inspection program. Revegetation works, audits and maintenance in accordance with MRTS 16 (refer Appendix B).	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
loss/erosion, mulch levels and weed growth.					
Corrective actions and adaptive management will include: • **Weed control if greater than 20% weed cover or presence of declared weeds** • **Damaged vegetation will be reinstated with the same species, and be of comparative sized stock to conduct like for like replacement** • **Repair fencing as required and review adequacy of fencing if damage to rehabilitation areas occurs** • **Install ESC devices if evidence of erosion causing degradation of rehabilitation areas** • **Inspect rehabilitation areas after rainfall event greater than 10 mm in a 24 hr period and implement remedial works as required.**	Assist in reducing impacts to Six Mile Creek and the TEC.	Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction	Maintain corridors of and adjacent Lowland Rainforest of Subtropical Australia habitat	Monthly inspection program. Revegetation works, audits and maintenance in accordance with MRTS 16 (refer Appendix B).	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery
The following criteria will be used to determine completion of the monitoring period: • **Rehabilitation areas will be monitored for a minimum of 12 months**	Assist in reducing impacts to Six Mile Creek and the TEC.	Disturbed areas are stabilised and rehabilitated sequentially and immediately following construction	Maintain corridors of and adjacent Lowland Rainforest of Subtropical Australia habitat	Monthly inspection program. Revegetation works, audits and maintenance in accordance with MRTS 16 (refer Appendix B).	Reduced adverse impacts to TEC and 50 m buffer area extent, reduced interference with its recovery

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
• **Minimum of 50% foliage projective cover achieved across the site** • **No declared weeds within the site** • **No signs of public access to the site impacting the rehabilitation area.**					

2.4.2 Black-breasted Button-quail

Specific avoidance and mitigation measures for the protection of the black-breasted button-quail and its habitat, in addition to those outlined in Section 2.3 of this report, are provided in Table 5.

The following **key performance criteria** have been considered in the development of the avoidance and mitigation measures:

- No vegetation clearing outside the specified, pre-approved boundaries in Woondum State Forest, which is known to support habitat for the black-breasted button-quail.
- Vegetation clearance to be preceded by targeted pre-clearance searches for the black-breasted button-quail and their relocation as appropriate.
- No injury or death of black-breasted button-quail.
- No increase in level of weed and pest infestation within black-breasted button-quail habitat as a result of construction activities.
- Maintain black-breasted button-quail habitat connectivity between the eastern and western sides of the Project through the placement of a fauna connectivity structure at Ch 137000 km and underneath Six Mile Creek bridge (BR03) at Ch 137500 km.

Habitat connectivity between the western and eastern side of the Project has been a key consideration in protecting the existing black-breasted button-quail population, in particular to ensure that isolation of the population within the western habitat does not occur and fauna access is not severed to the east. The location of the fauna connectivity structure has been determined based on known habitat on either side of the Project, species records, designed landscape topography and the location of drainage lines. As a result, a fauna connectivity structure has been included in the design at Ch 137000 km and additional fauna passage will be provided underneath Six Mile Creek bridge at Ch 137500 km. McGregor (2016) undertook a long-term study into the use and therefore effectiveness of fauna connectivity structures at Compton Road in Brisbane, Queensland. The outcomes of this study found that fauna connectivity structures including overpasses and underpasses are utilised by a variety of fauna assemblages.

Many fauna die as a result of attempting to cross roads, as evidenced by road kill, therefore the inclusion of fauna connectivity structures, in addition to fauna exclusion fencing to funnel fauna toward the structure and strategic revegetation planting will improve fauna connectivity in the immediate area, reduce the risk or mortality and potentially improve gene flow across the Project corridor. Strategic revegetation treatments have been developed, both for the approaches of the fauna connectivity structure and along the riparian corridor of Six Mile Creek including specific species for planting underneath the bridge structure itself. McGregor (2016) determined that the establishment of local native vegetation that reflected the natural bushland community nearby to the fauna connectivity structure almost certainly contributes to the overall success (i.e. use) of a fauna connectivity structure.

The following are the environmental outcomes to be achieved by the avoidance and mitigation measures for the black-breasted button-quail potentially impacted by the Project:

- Protect and manage existing populations.
- Maintain or improve the extent, condition (quality) and connectivity of black-breasted button-quail habitat.
- Reduce the impacts of introduced predators and competitors.

These outcomes have been nominated with consideration of the recovery objectives listed in the National Recovery Plan for the Black-breasted Button-quail (Mathieson and Smith, 2009), the Approved Conservation Advice for *Turnix melanogaster* (black-breasted button-quail) (TSSC, 2015), the onsite habitat characteristics and the potential impacts of the Project.

Table 5 Avoidance and Mitigation Measures - Black-breasted button-quail

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
DESIGN PHASE					
A Species Management Program – High Risk has been developed (and approved by the Department of Environment and Heritage Protection (EHP)) for the black-breasted button-quail listed as vulnerable under the State's NC Act, where an active breeding place has been confirmed. The Species Management Program includes an Impact Management Plan and Breeding Place Register as a minimum. Measures required by the program are included in the contract documentation.	The implementation of the Impact Management Plan includes the requirement for a targeted monitoring program for the species within Woondum State Forest and vegetation polygon at Keefton Road. This mitigation measure will contribute to the localised knowledge of the species that may lead to the determination of the presence of the species, capture variations in habitat condition and threats throughout the construction period, informing performance evaluation of management measures and assisting in mitigating impacts to black-breasted button-quail and their breeding places/habitat.	No injury or death of black-breasted button-quail	Protect and manage existing populations. The Impact Management Plan requires that the monitoring results of the targeted monitoring program be forwarded to the Department of Environment and Science for inclusion on their threatened fauna records. This outcome aligns with the Specific Objective 1 of the recovery objectives for the species which aims to collate in a database existing black-breasted button quail site data.	Audit of pre-clearance and clearance measures to be undertaken in accordance with the approved Species Management Program.	Reduced impacts of modifying, destroying, removing or isolating habitat to the extent the species is likely to decline, due to process of identifying and relocating any nests
Incorporation of a fauna connectivity structure within Woondum State Forest (Ch 137100 m) to maintain habitat connectivity on the eastern and western sides of the Project. Fauna passage has	This measure will maintain fauna passage between the eastern and western sides of the Project within Woondum State forest.	Maintain black-breasted button-quail habitat connectivity between the eastern and western sides of the Project, as evidenced by	Maintain or improve the extent, condition (quality) and connectivity of black-breasted button-quail habitat. This outcome aligns with the Specific	Design to be audited prior to construction commencing and implementation to be audited during construction and post-construction.	Reduced impacts of modifying, destroying, removing or isolating habitat to the extent the species is likely to decline, due to

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
been designed with specific consideration of black-breasted button-quail movement requirements, such as dry passage and adequate shelter from predators.	Inclusion of a fauna connectivity structure, in addition to fauna exclusion fencing to funnel fauna toward the structure, revegetation planting will enable fauna connectivity in the immediate area, reduce the risk or mortality and potentially improve gene flow across the highway.	monitoring the use of the fauna connectivity structure.	Objective 3 of the recovery objectives for the species which aims to improve habitat linkages across public land.		maintaining safe movements
Strategic planting adjacent to targeted fauna connectivity structures will occur to improve and maintain habitat connectivity for the black-breasted button-quail, wherever possible. Specifically, low shrubs will be considered in the planting list for revegetation adjacent to the proposed fauna connectivity structure at Woondum State Forest.	Landscaping will improve the approaches to the fauna connectivity structure by including shelter and refuge for the black-breasted button-quail and provide habitat continuity. This measure will encourage the use of the constructed fauna connectivity structures as the entrance will appear more natural encouraging use.	Evidence of successful cover is achieved through strategic planting. Maintain black-breasted button-quail habitat connectivity between the eastern and western sides of the Project	Maintain or improve the extent, condition (quality) and connectivity of black-breasted button-quail habitat. This outcome aligns with the Specific Objective 3 of the recovery objectives for the species which aims to improve habitat linkages across public land.	Revegetation and landscaping will be specified in contract documentation (MRTS16) and audited regularly to ensure establishment of plants and successful cover	Reduced impacts of modifying, destroying, removing or isolating habitat to the extent the species is likely to decline, due to maintaining safe movements
CONSTRUCTION PHASE					
Fauna monitoring by a terrestrial fauna specialist will be undertaken pre- and during construction within and adjacent to suitable habitat for the black-breasted button-quail, as detailed in the Impact Management Plan of the Species	This measure will assist in reducing impacts to individuals during construction works in the vicinity of known habitat	No injury or death of black-breasted button-quail. Vegetation clearance to be preceded by targeted pre-clearance searches for the black-breasted button-quail and their	Protect and manage existing populations	Daily during clearing and in accordance with the approved high-risk species management program. Fauna specialist will submit a post-clearing report detailing fauna	Reduced impacts of modifying, destroying, removing or isolating habitat to the extent the species is likely to decline, due to preventing deaths

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
Management Program – high risk.		relocation as appropriate.		interactions and any incidences.	
Undertake regular maintenance and inspections of fauna exclusion fencing, fauna connectivity structure and successful growth of revegetation.	This measure will assist in avoiding fauna mortality from roads and predators, while also measuring the success of established cover of revegetation on fauna connectivity approaches and along the riparian corridor of Six Mile Creek.	Fauna fencing to be maintained at all times. Establishment of revegetated areas.	Protect and manage existing populations	Inspections of fauna exclusion fencing to be undertaken at least 6-monthly during and post-construction and vegetation or fence maintenance to be undertaken as required following inspections. Six-monthly monitoring of revegetated areas until evidence of successful cover is achieved adjacent to fauna connectivity structures and riparian corridor of Six Mile Creek.	Reduced impacts of modifying, destroying, removing or isolating habitat to the extent the species is likely to decline, due to preventing deaths and maintaining safe movements

2.4.3 Koala

Specific avoidance and mitigation measures for the protection of the koala and its habitat, in addition to those outlined in Section 2.3 of this report, are provided in Table 6.

The following **key performance criteria** have been considered in the development of the avoidance and mitigation measures:

- Maintain or improve safe koala movement in areas of frequent detection of koala
- No vegetation clearing outside the specified, pre-approved boundaries which is known to support habitat for the koala
- No injury or death of the koala
- No increase in level of weed and pest infestation within koala habitat as a result of construction activities.

The following are the environmental outcomes to be achieved by the avoidance and mitigation measures for the koala potentially impacted by the Project:

- Conserve koalas in their existing habitats.
- Maintain corridors and connective habitat that allow movement of koalas between large areas of habitat.
- Reduce the impacts of introduced predators.

These outcomes have been nominated with consideration of the recovery objectives listed in the Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC, 2008), the Commonwealth Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (TSSC, 2012), the EPBC Act referral guidelines for the vulnerable koala (DEE, 2014), the onsite habitat characteristics and the potential impacts of the Project.

Table 6 Avoidance and Mitigation Measures - Koala

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
DESIGN PHASE					
Inclusion of fauna fencing (koala exclusion fencing) along retained bushland habitat and on either side of nominated fauna connectivity structures, including both fauna underpasses and bridges. Fauna exclusion fencing will be erected along the majority of the Project alignment on both east and west sides. Fauna fencing (koala exclusion fencing) will be installed in accordance with Road and Traffic Authority (NSW's) Standard Drawing and include the following specifications: • **Galvanised wire 50 chain-link fence, with additional 0.5 m overhang "floppy top" (outward of road formation).** • **3 m buffer free of vegetation (excluding grasses) on habitat side of the fence.**	Fauna fencing is referenced in TMR's Fauna Sensitive Road Design Manual Volume 2: Preferred Practises as an effective management measure to avoid vehicle collisions with fauna on linear infrastructure. Exclusion fencing is rated highly effective in the EPBC Act referral guidelines for the vulnerable koala (DEE, 2014) to prevent dog attack and vehicle strike.	No injury or death of the koala. Maintain or improve safe koala movement in areas of frequent detection of koala.	Conserve koalas in their existing habitats. Maintain corridors and connective habitat that allow movement of koalas between large areas of habitat.	Design to be audited prior to construction commencing and implementation to be audited during construction and post-construction.	Reduced impacts of interfering substantially with the recovery of the species, due to preventing vehicle strike and dog attack and maintaining safe movements
Incorporation of four dedicated fauna connectivity structures and 10 bridge structures (eight over water, two over roads). Fauna connectivity structure locations have been selected based on known populations of fauna being present, including koala populations. Each fauna connectivity structure has been sized to accommodate koalas (i.e. 3m x 3m for culverts) and will incorporate fauna furniture and refuge poles specific for koalas. Structures	This measure will assist in avoiding fauna collisions and mortality from the operation phase by enabling koalas safe passage along connected habitat adjacent to roads and waterways. Placing fauna connectivity	No injury or death of the koala. Maintain or improve safe koala movement in areas of frequent detection of koala.	Conserve koalas in their existing habitats. Maintain corridors and connective habitat that allow movement of koalas between large areas of habitat.	Design to be audited prior to construction commencing and implementation to be audited during construction and post-construction.	Reduced impacts of interfering substantially with the recovery of the species, due to maintaining safe movements

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
have been designed with consideration of TMR's Fauna Sensitive Road Design Manual, species profile information and site data.	structures in areas of high koala populations, as well as maintaining and restoring suitable habitat on either side of the structures, will encourage use by koalas.				
Incorporation of revegetation under bridges over waterways where disturbance has occurred. Vegetation to be planted under bridges will incorporate shade tolerant species, with height restrictions, and species based on the pre-clearance RE. The native vegetation cover will provide refuge for koalas when moving through riparian vegetation under the bridges.	By incorporating revegetation into the areas where clearing was undertaken for the construction phase, fauna habitat connectivity will be increased due to the allowance for species (in particular koalas) to navigate between areas safely.	Maintain or improve safe koala movement in areas of frequent detection of koala.	Maintain corridors and connective habitat that allow movement of koalas between areas of habitat.	Specifications in contract documentation (MRTS16) will be audited for compliance	Reduced impacts of interfering substantially with the recovery of the species, due to maintaining safe movements
CONSTRUCTION PHASE					
No-go zones (Exclusion Zones) will be marked on construction drawings where earthworks are not required on the approaches to fauna connectivity structures (10-15 m wide). This will maintain adjacent habitat connectivity to the access point of the structures. This will be specified in contract documentation.	This measure is effective in restricting habitat disturbance to only that required for construction.	No vegetation clearing outside the specified, pre-approved boundaries. Maintain or improve safe koala movement in areas of frequent detection of koala.	Maintain corridors and connective habitat that allows movement of koalas between areas of habitat.	Daily and weekly inspections of no-go zones	Reduced impacts of adversely impacting habitat critical to the survival
POST-CONSTRUCTION PHASE					

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
Rehabilitation and revegetation of cleared areas (beyond the permanent works) will be undertaken progressively and will include planting of tube stock within dedicated areas (such as riparian corridors) including several species considered to be koala habitat trees as tube stock (*Eucalyptus tereticornis, Corymbia intermedia, Lophostemon suaveolens* and *Melaleuca saligna*, where available). Revegetated areas will be monitored monthly until establishment.	Revegetation including koala habitat trees along fauna connectivity corridors will restore some of the available habitat cleared and fragmented by the Project.	Maintain or improve safe koala movement in areas of frequent detection of koala.	Maintain corridors and connective habitat that allows movement of koalas between areas of habitat.	Monthly monitoring and maintenance of rehabilitated and revegetated areas until establishment is complete. Monthly reporting.	Reduced impacts of adversely impacting habitat critical to the survival
Undertake regular maintenance and inspections of fauna exclusion fencing and fauna underpasses, to preserve or restore the effectiveness of fauna fencing.	Maintenance of fauna fencing is required as per Chapter 5 of TMR's *Fauna Sensitive Road Design manual Volume 2: Preferred Practises.* Exclusion fencing is rated highly effective in the EPBC Act referral guidelines for the vulnerable koala to prevent dog attack and vehicle strike.	Fauna fencing to be maintained at all times.	Conserve koalas in their existing habitats. Maintain corridors and connective habitat that allows movement of koalas between areas of habitat.	Monitoring of fencing and dedicated fauna connectivity structures will occur 6-monthly during and post-construction.	Reduced impacts of interfering substantially with the recovery of the species, due to minimising vehicle strike and dog attack and maintaining safe movements

2.4.4 Macrozamia pauli-guilielmi

Specific avoidance and mitigation measures for the protection of the *M. pauli-guilielmi* in addition to those outlined in Section 2.3 of this report are provided in Table 7.

The following **key performance criteria** have been considered in the development of the avoidance and mitigation measures:

- Maintain or improve *M. pauli-guilielmi* habitat
- Reduce flora clearing outside the specified, pre-approved boundaries where *M. pauli-guilielmi* is known to occur
- Avoid fragmentation and disruption to breeding cycle via the implementation of a Translocation Management Plan (refer Appendix C for a copy of the plan)

The following are the environmental outcomes to be achieved by the avoidance and mitigation measures for *M. pauli-guilielmi* individuals and habitat potentially impacted by the Project:

- Achieve a net gain in the numbers of the species in suitable habitat
- Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population
- Effectively account for and manage the risks of the translocation not succeeding.

These outcomes have been nominated with consideration of the recovery objectives listed in the *National Multi-species Recovery Plan for Cycads* (Queensland Herbarium, 2007), the Translocation Management Plan, the onsite habitat characteristics and the potential impacts of the Project. These outcomes align with the specific objectives of the Translocation Management Plan.

A Translocation Management Plan has been developed based on the following consultation and reviews:

- Review of the National Guidelines for the Translocation of Threatened Plants in Australia (Vallee et al., 2004), a Translocation Protocol for Cycads in Queensland (Forster, 2004), and the National Multi-species Recovery Plan for Cycads (Queensland Herbarium, 2007)
- A review of two approved translocation plans previously developed for the translocation of *M. pauli-guilielmi* as conditions of approval under the EPBC Act, namely AECOM (2011) and OPUS (2012)
- The results of monitoring the translocation success of a previous translocation of *M. pauli-guilielmi*, and recommendations for translocation and monitoring provided therein, as reported in Vegetation Matters (2013, 2015)
- Consultation and advice received from Dr Paul Forster, Principal Botanist at the Queensland Herbarium and lead author of the national cycad recovery plan.

The specific objectives of the Translocation Management Plan is to:

- Achieve a net gain in the numbers of the species in suitable habitat in the wild
- Improve the long-term protection and viability of the species in the wild
- Effectively account for and manage the risks of the translocation not succeeding
- Provide a management framework that is efficient, effective, timely, transparent, scientifically robust and reasonable, with outcomes that can be readily measured, monitored and audited.

The large, swollen underground stem of adult plants provides a substantial store of water and nutrients for the plants. This provides a buffer for plants to withstand the temporary loss of leaves and photosynthetic potential and regrow the fine root system following uprooting during translocation. For this reason, *Macrozamia* species are resilient to translocation and generally recover well, particularly if minimal damage to the underground stem occurs. This storage feature also allows plants to readily establish following relocation, with *M. pauli-guilielmi* having been successfully transplanted by TMR on several occasions. Of particular relevance is a project where 143 adult *M. pauli-guilielmi* individuals were successfully translocated by TMR in 2012 at a site adjacent to the nearby Maryborough-Cooloola Road for the Maryborough-Cooloola Coast Road project (EPBC Approval 2012/6297). Vegetation Matters undertook final translocation monitoring

in 2014 and reported that approximately 88 percent of translocated plants remained alive after a period of two years (Vegetation Matters 2015). Monitoring found that 17 individuals (12 percent) did not sprout a new leaf or cone, suggesting that they had died; however, the survival of these plants was compromised to some extent by many plants being in poor health and translocated at a suboptimal time (Vegetation Matters 2015). The loss of 17 individuals was reportedly compensated by the emergence of seedlings from seed spread at the time of the translocation, resulting in an overall net gain of plants (+ 10 plants) at the site after a period of two years (Vegetation Matters 2015).

Given that *M. pauli-guilielmi* has been successfully translocated within the local area, the expected success of the proposed translocation is high.

Table 7 Avoidance and Mitigation Measures – *Macrozamia pauli-guilielmi*

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
DESIGN PHASE					
A Translocation Management Plan has been prepared to remove all *M. pauli-guilielmi* plants from the Project area to a nominated suitable site outside the Project area to mitigate impacts to the species. The Translocation Management Plan includes details on the maintenance requirements for translocated plants and monitoring and reporting requirements. The Translocation Management Plan includes provisions for the planting of seeds within the recipient site which will assist in maintaining the current number of individuals translocated. Propagation from collected seeds will be undertaken to replace any mortality of translocated plants at a ratio of 4:1. Indirectly impacted plants will also be relocated so as not to further fragment the existing subpopulation. The plan has been reviewed by the Queensland Herbarium.	This measure will effectively avoid and mitigate impacts to the local species population through translocation of directly and indirectly impacted plants (as well as ungerminated seeds) and through propagation from collected seeds to replace any plants that do not survive the translocation process. This species is known to have a high success of translocation.	Avoid fragmentation and disruption to breeding cycle via the implementation of the Translocation Management Plan	Achieve a net gain in the numbers of the species in suitable habitat. Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population. Effectively account for and manage the risks of the translocation not succeeding.	In accordance with the approved Translocation Management Plan	Reduced impacts of fragmentation of an existing population and of disrupting the breeding cycle of the population
Requirements for the translocation will be implemented by the translocation contractor in accordance with the Translocation Management Plan prior to the Project construction commencing. The Translocation Management Plan will be implemented prior to the spring flush of new growth and the development of reproductive material. In this regard, the translocation of the species will not impact upon the breeding cycle of the sub-populations.	This measure will effectively avoid and mitigate impacts to the local species population through translocation of directly and indirectly impacted plants (as well as ungerminated seeds) and through propagation from collected seeds to replace any plants that do not survive the translocation process. This species is known to have a high success of translocation.	Avoid fragmentation and disruption to the breeding cycle via the implementation of the Translocation Management Plan	Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population. Effectively account for and manage the risks of the translocation not succeeding.	In accordance with the approved Translocation Management Plan	Reduced impacts of disrupting the breeding cycle of the population

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
CONSTRUCTION PHASE					
An appointed Contractor will be required to implement TMR's Translocation Management Plan for *M. pauli-guilielmi* prior to vegetation clearing in the vicinity of the location of the known plants. All known individuals of *M. pauli-guilielmi* are to be removed from the Project area and established within the translocation recipient site.	This measure has been developed to mitigate impacts to *M. pauli-guilielmi* and will be undertaken prior to the Project commencing with effective monitoring, maintenance and adaptive management strategies to be implemented in accordance with proven protocols and procedures.	Avoid fragmentation and disruption to breeding cycle via the implementation of the Translocation Management Plan	Achieve a net gain in the numbers of the species in suitable habitat. Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population.	Monitoring, maintenance and adaptive management strategies will be undertaken in accordance with TMR's Translocation Management Plan over a period of 5 years following translocation, and that will record and report on the success of the translocation.	Reduced impacts of fragmentation of an existing population and of disrupting the breeding cycle of the population
Requirements for protecting habitat and individuals to be retained in the vicinity of the Project construction areas included in contract documentation for implementation by the Construction Contractor, including no-go zones, weed management and revegetation specifications wil be required to be met.	This measure will avoid unnecessary impacts to known habitats to be retained adjacent to the Project. Recording and reporting of any incidences of non-compliance allows for identification of potential adaptive management strategies.	Reduce flora clearing outside the specified, pre-approved boundaries	Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population	A register of wildlife incidents (flora mortality) will be established and maintained for the construction of the Project. Monthly reporting of the location and nature of the incident.	Reduced impacts of adversely affecting habitat critical to the survival of the species
Pre-clearance procedures will include a flora survey by suitably qualified persons within the Project construction areas in the vicinity of the known sub-populations in order to identify any additional seedlings or adult plants present and potentially	This measure has been developed to manage impacts to *M. pauli-guilielmi*.	Avoid fragmentation and disruption to breeding cycle via the implementation of the Translocation Management Plan	Achieve a net gain in the numbers of the species in suitable habitat.	In accordance with TMR's Translocation Management Plan	Reduced impacts of disrupting the breeding cycle of the population

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
impacted. Where additional *M. pauli-guilielmi* are found within the Project area during the construction phase, the Construction Contractor will be required to notify the Contract Administrator and the management, mitigation measures and relocation strategies within the TMR's Translocation Management Plan are to be enacted.			Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population.		
Post translocation monitoring and maintenance of *M. pauli-guilielmi* and adaptive management measures. Formal monitoring events on the *M. paul-guilielmi* individuals translocated will be undertaken twice each year during the first two years, in early summer (October to November) to assess the health of plants following the spring flush of new growth, and in autumn (May), to assess the extent of seed production and to manually disperse any ripe seed. Opportunistic monitoring of the health of translocated individuals and the presence of any degrading factors will be undertaken every two weeks for the first six months, in conjunction with the watering program.	This measure will assist in ensuring the viability of the translocated individuals.	Avoid fragmentation and disruption to breeding cycle via the implementation of the Translocation Management Plan. Maintain or improve *M. pauli-guilielmi* habitat.	Achieve a net gain in the numbers of the species in suitable habitat. Effectively account for and manage the risks of the translocation not succeeding.	In accordance with the approved Translocation Management Plan	Reduced impacts of disrupting the breeding cycle of the population
A nominated Contractor will undertake opportunistic monitoring of the health of *M. pauli-guilielmi* individuals present in the vicinity of the Project construction areas and the presence of any degrading factors will be recorded and reported in order to identify appropriate adaptive management strategies. **A monitoring program will monitor the health of the individuals during the construction phase of the Project, with**	This measure will assist in avoiding impacts to individuals remaining in the vicinity of the Project.	Maintain or improve *M. pauli-guilielmi* habitat	Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population.	Compliance with monitoring program to be audited in accordance with contract documentation.	Reduced impacts of adversely affecting habitat critical to the survival of the species

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
adaptive management strategies to be developed in the event that individuals within the sub-population display decreased health. In the event that the individuals are likely to suffer mortality, all individuals will be translocated to the translocation site.					
Revegetation activities to be undertaken in and around suitable *M. pauli-guilielmi* habitat will include species and planting methods that will restore the habitat characteristics for that species.	This measure will assist in restoring habitat value for the species where it is required to be disturbed for construction but able to be revegetated.	Maintain or improve *M. pauli-guilielmi* habitat	Improve or maintain the protection and viability of the local *M. pauli-guilielmi* population	Monitoring, maintenance and auditing in accordance with the contract documentation (MRTS16).	Reduced impacts of adversely affecting habitat critical to the survival of the species

2.4.5 Aquatic Species

DEE considers that the following aquatic species may be impacted by the Project due to water pollution, sedimentation and erosion:

- Mary River cod (*Maccullochella mariensis*)
- Australian lungfish (*Neoceratodus forsteri*)
- Mary River turtle (*Elusor macrurus*)
- White-throated snapping turtle (*Elseya albagula*)

Specific avoidance and mitigation measures for the protection of the aquatic species and their habitat in addition to those outlined in Section 2.3 of this report are provided in Table 8.

The following **key performance criteria** have been considered in the development of the avoidance and mitigation measures:

- Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans
- Exclusion zones are established and maintained throughout construction in areas of potential habitat
- Water quality monitoring is undertaken throughout the construction phase and corrective actions taken if necessary
- Instream woody debris is maintained during and post-construction in areas of potential habitat
- No instream structures that would restrict movement to be placed within the low-flow channel in areas of potential habitat
- Spills are contained and immediately cleaned up in the vicinity of waterways
- No aquatic weeds are introduced or spread to new areas
- Aquatic fauna specialist onsite during pre-clearance, dewatering and pile boring activities
- Revegetation activities commence progressively and immediately following works

The following are the environmental outcomes to be achieved by the avoidance and mitigation measures for the listed threatened aquatic species potentially impacted by the Project:

- No direct loss of habitat for listed aquatic species.
- No loss of native aquatic fauna due to construction activities.
- No indirect loss of habitat due to water quality degradation.

These outcomes have been nominated with consideration of the recovery objectives and priority actions listed in the Mary River Cod Research and Recovery Plan (Simpson and Jackson, 1996), Approved Conservation Advice documents for Australian lungfish (DotE, 2014), White-throated snapping turtle (DotE, 2014) and Mary River Turtle (DEWHA, 2008), the onsite habitat characteristics and the potential impacts of the Project.

Table 8 Avoidance and Mitigation Measures – Aquatic species

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
DESIGN PHASE					
Requirement for Construction Contractor to design, install and maintain all erosion and sediment controls in accordance with MRTS52 – Erosion and Sediment Control. This specification provides principles, design standards and quality requirements to be achieved on TMR projects, and includes a number of hold points and approvals required by the Contract Administrator, which prevents the construction progressing until the environmental checks have been completed to performance criteria acceptable to TMR. The specification also includes specific design requirements for all erosion and sediment controls to be installed on the Project.	This will assist in minimising indirect impacts on waterways (i.e. Six Mile Creek, Deep Creek and Curra Creek) by reducing sediment loss as well as associated water quality impacts. Furthermore, this mitigation measure will reduce impacts on the waterways through inclusion of management measures for vegetation clearing and general environmental management.	Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans	No indirect loss of habitat due to water quality degradation	Weekly inspections Monthly audits by independent auditor	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
Incorporation of eight bridge structures over waterways including Six Mile Creek, Deep Creek and Curra Creek rather than culverts to allow for the movement of fish upstream and downstream of the Project area. The incorporation of bridges over these waterways will assist in avoiding direct impacts on breeding/nesting habitat for the Mary River Cod, Mary River Turtle and the white-throated snapping turtle while also avoiding a direct loss of	Fauna connectivity structures are referenced in TMR's *Fauna Sensitive Road Design Manual Volume 2: Preferred Practises* as an effective management measure to maintain habitat connectivity and minimise impacts on existing populations and	No instream structures that would restrict movement to be placed within the low-flow channel in areas of potential habitat.	No direct loss of habitat for listed aquatic species.	Design and construction progressively audited against the Design Report and TMR's *Fauna Sensitive Road Design Manual Volume 2: Preferred Practises*.	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
potential habitat for aquatic MNES by spanning the low flow channel of each waterway.	fauna individuals moving across linear infrastructure. Bridges are considered by Fisheries Queensland to maintain fish passage and not constitute a waterway barrier when designed in a particular way.				
Progressive design review (including construction methods employed) for the construction of the bridge over Six Mile Creek has occurred during the Detailed Design phase due to the environmental sensitivity of this waterway. The final design of the bridge includes a main span of 46.4m in length made continuous using long super T-girders to span the low flow channel and lower sections of the bed and banks of the waterway. The design review included: • **Individual span widths have been rationalised** • **Raising deck level by 770 mm to take account of critical 1% AEP design storm event and climate change.** • **Increase in spacing between northbound and southbound bridge structures to 1360 mm to allow for increase in natural light.** • **Consideration of specific construction methodologies such as pile structure, timing of construction**	This will assist in preventing impacts on the waterway and associated riparian vegetation, and allow the area underneath the bridges to be utilised by the aquatic species.	No instream structures that would restrict movement to be placed within the low-flow channel in areas of potential habitat. Exclusion zones are established and maintained throughout construction in areas of potential habitat. Instream woody debris is maintained during and post-construction in areas of potential habitat.	No direct loss of habitat for listed aquatic species	Inspections by site supervisors during construction	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat, or fragment an existing population into two or more populations

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
program, use of launching truss, use of scaffolding and steel casings. **Bridge superstructure will be installed using either a launching truss or false work platform or existing banks or embankments rather than the installation from the bed and banks of the waterway.**					
Dual bridges proposed over major waterways have been separated to allow natural light to filter between the two structures, in order to increase the use of the underpass by fauna.	Bridges are able to act as fauna connectivity structures by allowing fauna to move underneath each bridge as referenced in TMR's *Fauna Sensitive Road Design Manual Volume 2: Preferred Practises*. Insufficient light under a bridge is noted in the aforementioned guidelines as a inefficiency of underpasses and therefore by allowing light to penetrate through to the existing ground surface, the use of these structures as an underpass increases	No instream structures that would restrict movement to be placed within the low-flow channel in areas of potential habitat.	No direct loss of habitat for listed aquatic species	Design and construction progressively audited against the Design Report and TMR's *Fauna Sensitive Road Design Manual Volume 2: Preferred Practises*.	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat, or fragment an existing population into two or more populations
Nomination of specific construction methodologies for the bridge construction in the contract documentation	Review and planning of construction methods at the design phase will assist in reducing impacts to the waterways	Construction to be undertaken in accordance with contract documents	No direct loss of habitat for listed aquatic species	In accordance with the contract documentation	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat, or fragment an

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
					existing population into two or more populations
Specific construction methods for the construction of the Six Mile Creek Bridge have been included in the contract documentation developed for the Project and includes items such as: • **Bank stabilisation to occur during dry periods and prior to the commencement of piling** • **Requirement for no temporary waterway crossings to be constructed over Six Mile Creek** • **All temporary earthworks should be adequately stabilised as early as possible to reduce the likelihood of significant erosion during large flow events** • **The construction and stabilisation of piers within the bed and banks of the waterway should only commence when sufficient dry weather is forecast for the period required for construction to minimise the likelihood of increased sediment runoff.** • **All earthworks associated with access tracks and piling pads required to support the structure over Six Mile Creek are likely to be located below the level of the regional AEP 1% event, and should be stabilised using suitable geofabric and large, clean rock**	Review and planning of construction methods at the design phase will assist in reducing impacts to Six Mile Creek, which has been identified as habitat critical to the survival of the Mary River cod.	Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans. No instream structures that would restrict movement to be placed within the low-flow channel in areas of potential habitat. Exclusion zones are established and maintained throughout construction in areas of potential habitat.	No direct loss of habitat for listed aquatic species. No indirect loss of habitat due to water quality degradation.	Design and construction progressively audited against the Design Report and TMR's *Fauna Sensitive Road Design Manual Volume 2: Preferred Practises*.	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
• **Short term construction related works including crane pads to be constructed once instream erosion and sediment controls are installed (i.e. sediment bunds etc.)** • **Nomination of timeframes for construction of bridge structure** **Nomination of specific treatments for instream stream works and bank stability works on either bank of Six Mile Creek**					
Location of ancillary activities, additional workspaces and haul routes are to be placed in previously cleared areas, where possible, as specified in the contract documentation.	This will minimise the vegetation clearing required for the Project and reduce impacts to aquatic habitat through retention of riparian vegetation and protection of water quality.	Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans. Exclusion zones are established and maintained throughout construction in areas of potential habitat.	No indirect loss of habitat due to water quality degradation.	In accordance with the contract documentation (MRTS51 Environmental Management).	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
Spill containment devices have been incorporated on structures over Six Mile Creek, Deep Creek and Curra Creek to trap oils and fuels and prevent them from entering these waterways.	This will assist in minimising indirect impacts to aquatic MNES and their habitat through a reduction in water quality impacts.	Spills are contained and immediately cleaned up in the vicinity of waterways	No indirect loss of habitat due to water quality degradation.	In accordance with the contract documentation (MRTS51 Environmental Management).) and Contractor's EMP(C).	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
Inclusion of bio-retention systems (as permanent water quality improvement devices) adjacent to each major waterway crossing (including Six Mile	This will filter out pollutants before stormwater enters the waterway.	Spills are contained and immediately cleaned up in the vicinity of waterways.	No indirect loss of habitat due to water quality degradation.	In accordance with contract documentation (MRTS51	Reduced impacts that would modify, destroy, remove, isolate

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
Creek, Deep Creek and Curra Creek) to filter out pollutants prior to entry into the waterways during operation of the Project.		Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans.		Environmental Management and MRTS52 Erosion and Sediment Control) and ESCP.	or decrease the availability or quality of habitat
Baseline water quality monitoring of major waterways intersected by the Project is/has been undertaken for two periods of six months to gain an appreciation of baseline flow characteristics and response to rainfall events.	This will assist in providing site-specific background water quality objectives to allow planning of performance criteria and effective monitoring for works that enable protection of the existing waterway characteristics and therefore maintain aquatic habitat conditions.	Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans. Water quality monitoring is undertaken throughout the construction phase and corrective actions taken if necessary.	No indirect loss of habitat due to water quality degradation.	Weekly and after specific rainfall events	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
CONSTRUCTION PHASE					
The Construction Contractor will be required to undertake instream, bank stability works and works within the bed and banks of Six Mile Creek, Deep Creek and Curra Creek during dry periods and periods of low flow.	Planning works instream and on banks for dry and low flow periods will assist in reducing impacts to and degradation of water quality and aquatic habitat	Erosion and sediment control measures are implemented according to the contract documentation and ESCPs.	No indirect loss of habitat due to water quality degradation.	In accordance with contract documentation (MRTS51 Environmental Management)	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
Construction noise and vibration impacts on the Mary River cod, Mary River turtle and White-throated snapping turtle can be avoided by	Bored piles with a screw-in casing significantly reduce the amount of noise and	Aquatic fauna specialist onsite during pre-clearance,	No loss of native aquatic fauna due to construction activities	In accordance with the contract documentation and	Reduced impacts that would modify, destroy, remove, isolate

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
using bored piles on all bridge structures rather than driven piles.	vibration within the waterway when compared to driven piles.	dewatering and pile boring activities		Contractor's EMP(C).	or decrease the availability or quality of habitat
Suitable erosion and sediment control devices to be installed in adjacent and upstream waterways prior to works commencing. The following will occur in relation to erosion and sediment controls, as a minimum: • **Erosion and sediment controls to be installed in accordance with the IECA Best Practise Erosion and Sediment Control Manual and will be approved by the contract administrator** • **Early installation of sediment basins** • **Early installations of permanent drainage works, where possible** **Monthly independent audits of erosion and sediment controls, with auditing report submitted to the contract administrator and TMR**	This will assist in preventing water quality and aquatic habitat degradation through minimising release of sediment and other contaminants to waterways as a result of the works.	Erosion and sediment control measures are implemented according to the contract documentation and ESCPs.	No indirect loss of habitat due to water quality degradation.	Weekly inspections. Monthly independent audits of erosion and sediment controls, with auditing report submitted to the contract administrator and TMR.	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
Requirements for upstream and downstream water quality conditions to be monitored through visual and *in situ* recordings during the construction phase.	Planning of appropriate and regular water quality monitoring will allow for early detection and corrective actions to be set in place if any impact to water quality is identified.	Water quality monitoring is undertaken throughout the construction phase and corrective actions taken if necessary.	No indirect loss of habitat due to water quality degradation.	Water quality data submitted monthly to Contract Administrator	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
Inclusion of water quality performance criteria in the contract documentation to be achieved prior to release from onsite sediment basins.	This will assist in preventing water quality and aquatic habitat degradation through minimising release of	Erosion and sediment control measures are implemented according to the	No indirect loss of habitat due to water quality degradation.	Water quality data submitted monthly to Contract Administrator	Reduced impacts that would modify, destroy, remove, isolate or decrease the

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
	sediment and other contaminants to waterways as a result of the works.	contract documentation and ESCPs.			availability or quality of habitat
Where flow is present, the Construction Contractor will be required to maintain flow of waterways during construction of temporary diversions, temporary waterway crossings or appropriately sized bunds.	This will assist in maintaining aquatic habitat characteristics and fauna movement through the waterway.	No instream structures that would restrict movement to be placed within the low-flow channel in areas of potential habitat.	No direct loss of habitat for listed aquatic species.	Weekly inspections	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat, or fragment an existing population into two or more populations
Where appropriate, external catchment drainage lines will be diverted around disturbed areas via cross drains and drainage channels.	This will assist in preventing impacts to aquatic habitat adjacent to the works and reducing potential for water quality degradation from additional water flow through the site.	Erosion and sediment control measures are implemented according to the contract documentation and ESCPs.	No indirect loss of habitat due to water quality degradation.	Weekly inspections	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat, or fragment an existing population into two or more populations
An aquatic fauna specialist is required to undertake pre-clearance surveys prior to any dewatering activities (including those related to dams, waterways, waterway diversions etc.) to identify whether any breeding places or individuals are present within the disturbance area.	This will avoid harm to individual MNES present within water features requiring dewatering within the Project area and allow these species to be relocated.	Aquatic fauna specialist onsite during pre-clearance, dewatering and pile boring activities	No loss of native aquatic fauna due to construction activities	The aquatic fauna specialist will prepare and submit a post-dewatering report within the Construction Contractors monthly report submitted to the Construction	Reduced impacts of disrupting the breeding cycle of a population, or interfering with the recovery of a species

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
				Administrator to keep records of any aquatic MNES that have been moved from the Project area.	
All dewatering activities are to be supervised by an aquatic fauna specialist appointed by the Construction Contractor, who must have demonstrated experience in the capture and relocation of aquatic MNES. The aquatic fauna specialist must hold all relevant permits including a current General Fisheries Permit, a Rehabilitation Permit and an Animal Ethics Permit. Water is not to be extracted from Six Mile Creek, Deep Creek, Curra Creek or any waterways mapped under the DAF Queensland's GIS layer.	This will avoid harm to individual MNES present within water features requiring dewatering within the Project area and allow these species to be relocated.	Aquatic fauna specialist onsite during pre-clearance, dewatering and pile boring activities	No loss of native aquatic fauna due to construction activities	The aquatic fauna specialist will prepare and submit a post-dewatering report within the Construction Contractors monthly report submitted to the Construction Administrator to keep records of any aquatic MNES that have been moved from the Project area.	Reduced impacts of disrupting the breeding cycle of a population, or interfering with the recovery of a species
As part of the Overarching and Progressive ESCPs and the EMP(C), that will be developed for the Project, measures will be implemented to store potential pollutants offsite and/or in bunded storage areas. Spill kits and MSDS for all chemicals used onsite will be maintained to minimise the potential for oil/fuel leaks. All machinery will be refuelled and maintained at least 30m from watercourses or drainage lines.	This will assist in minimising indirect impacts to aquatic MNES and their habitat through minimisation of potential spills which could lead to habitat degradation.	Spills are contained and immediately cleaned up in the vicinity of waterways. Erosion and sediment control measures are implemented according to the contract documentation and required ESC Plans.	No indirect loss of habitat due to water quality degradation.	Weekly inspections	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat
The EMP(C) will include a requirement to restrict the use of herbicides and growth retardants to control vegetation, as well as fire retardants and	This will assist in minimising indirect impacts to aquatic MNES and their habitat	Erosion and sediment control measures are implemented	No indirect loss of habitat due to water quality degradation.	Weekly inspections	Reduced impacts that would modify, destroy, remove, isolate

Avoidance / mitigation measure	RFI Clause 2.3 Effectiveness of avoidance / mitigation measure	RFI Clause 2.4 (a) Performance criteria	RFI Clause 2.4 (b) Environmental outcomes	RFI Clause 2.4 (c) Audit activity & frequency	RFI Clause 2.5 Residual impact
insecticides over and adjacent to dams, drainage lines and waterways within the potential area due to the potential indirect impacts on MNES and other threatened fauna.	through a reduction in water quality and habitat degradation.	according to the contract documentation and required ESC Plans.			or decrease the availability or quality of habitat
Vegetation clearing of riparian vegetation at Six Mile Creek, Deep Creek and Curra Creek shall be minimised where possible and delayed until necessary.	This will assist in minimising soil erosion and sedimentation of waterways thereby protecting water quality and ultimately MNES and their habitat.	Erosion and sediment control measures are implemented according to the contract documentation and ESCPs	No indirect loss of habitat due to water quality degradation.	Weekly inspections	Reduced impacts that would modify, destroy, remove, isolate or decrease the availability or quality of habitat

3. RFI Clause 3 – Offsets

3.1 Updated Impact Areas

The MNES Significant Impact Assessment report prepared as part of the EPBC Act referral identified that the Project has the potential to have a significant impact on the following MNES:

- Lowland Rainforest of Subtropical Australia TEC
- *Turnix melanogaster* (black-breasted button-quail) – vulnerable under EPBC Act and NC Act
- *Phascolarctos cinereus* (koala) – vulnerable under EPBC Act and Queensland NC Act

In addition, while translocation of both directly and indirectly impacted individuals will occur prior to the impact, it is understood that the DEE may require an offset for direct impacts to the *M. pauli-guilielmi* in the form of propagation and planting, listed as endangered under the EPBC Act and NC Act. The impact of the Project on *M. pauli-guilielmi* is quantified as the total number of adult plants and seedlings that will be subject to direct impacts and that are therefore to be translocated (215 individual plants).

Since the submission of the referral the detailed design of the Project has been further refined and the impact areas have been reduced as outlined in Table 9.

Table 9 MNES Updated Impact Areas

Species	Impact Area- Referral Stage	Impact Area – Preliminary Documentation Stage
Lowland Rainforest of Subtropical Australia TEC	0.82 ha of TEC	0.79 ha of TEC
Black-breasted button-quail	8.14 ha of habitat critical to the survival	8.08 ha of habitat critical to the survival
Koala	138.44 ha of habitat critical to the survival	135.83 ha of habitat critical to the survival
M. pauli-guilielmi	215 individual *M. pauli-guilielmi* plants (directly impacted)	215 individual *M. pauli-guilielmi* plants (directly impacted)

Details of the assumptions made and the offset strategy for each of the MNES are provided in the following sections.

3.1.1 TEC Buffer Area Impacts

In accordance with the listing advice for the Lowland Rainforest of Subtropical Australia TEC (TSSC, 2011), a buffer zone that extends 50 m beyond the trunks of the outermost trees in the patch is defined to assist in the preservation of the patch. It is considered that 50 m is the maximum likely height of a tree in the community and will encompass an area large enough to protect the root zone of the edge trees. The buffer zone is also considered to help protect the community from spraydrift (fertiliser, pesticide or herbicide sprayed on adjacent land) and other threats. As per the listing advice, the purpose of the buffer zone is to protect and manage the patch and to help avoid potential significant impacts to the community.

The MNES Significant Impact Assessment report described the additional clearing of the 50 m buffer area of the TEC as being a direct loss (a total of 5.19 ha, being 4.67 ha along Six Mile Creek and 0.52 ha at Woondum State Forest). Some parts of the buffer have been previously cleared by others and are occupied by active land uses and therefore provide limited protection to the TEC. Vegetated buffer areas within 50 m of the TEC that provide buffer protection and could be potentially cleared total 4.31 ha.

Due to the proposed bridge structure at Six Mile Creek and positioning of the bridge piers so as to avoid disturbance of the northern bank through the use of sheet piles, some areas of TEC along the northern bank will be able to be avoided. There is an Exclusion Zone (shown on design drawings and required to be retained through the contract documentation) along both banks of the Six Mile Creek bridge crossing (between the pier locations).

The potential clearing of 4.31 ha of vegetated TEC buffer area is a maximum extent of disturbance, with the actual extent of clearing and disturbance likely to be less than that. The following limits apply to clearing and grubbing works (as per the Project's contract documentation):

- The maximum additional width for clearing and grubbing is 1 m (beyond the permanent works) unless noted otherwise (excluding any areas indicated on the Drawings as an Exclusion Zone)
- A maximum additional 2 m along watercourses for culvert inlet and outlet works
- Maximum 2 m beyond earthworks limit for construction of private entrances
- Clearing for construction accesses as approved by the Administrator
- Clearing for fauna fencing
- Nominal 2 m wide strip for fencing (other than fauna fencing)
- Clearing 3 m beyond the foundations of retaining structures
- Clearing 3 m beyond the toe of rockfill or earth embankments
- Clearing to facilitate erosion and sediment controls in accordance with the approved Overarching ESC Plan

All areas beyond the permanent works that have been cleared or disturbed will be rehabilitated and revegetated to some extent, therefore, re-establishing a buffer protection zone to the TEC and avoiding any permanent residual loss of the TEC buffer zone areas as they will be progressively re-established with vegetation post-construction. Proposed revegetation treatments in the vicinity of the TEC areas include:

- Topsoil and hydromulch application using a native grass seed mix on batter slopes or turf in and around open, catch and embankment drains
- Tube stock of a mixture of native groundcover, shrub and tree species for riparian rehabilitation areas above channel banks (at a density of approximately 80 plants/25 m^2)
- Tube stock of a mixture of native groundcover, shrub and tree species for shaded areas under the bridge and within 10 m of bridge structure (at a density of approximately 80 plants/25 m^2)

Where disturbance occurs to the natural surface beyond the specified clearing limits, the disturbed areas shall be reinstated (as per contract documentation and the above treatments). The rehabilitation and revegetation of these impacted TEC and 50 m buffer areas is further detailed in Section 2.4.1 as part of the avoidance and mitigation measures.

The progressive rehabilitation and revegetation of cleared buffer areas, weekly inspections and monthly monitoring, and weed management measures will help maintain the extent of the TEC to be retained within the Project area and remaining adjacent the Project area, reduce the fragmentation impacts and limit the interference with the recovery of the TEC. Therefore indirect, permanent and/or long-term impacts to the remaining TEC from removal of buffer areas are considered unlikely to occur.

3.2 Assumptions - Offsets Assessment Guide

A direct land-based offset has been prepared for the MNES in accordance with the DEE Offsets Assessment Guide. The Offsets Assessment Guide requires the proponent to establish a number of criteria to assess the

impact and offset sites including site condition, site context and species stoking rate distribution. Details of each of these for the Project are outlined below.

3.2.1 Habitat Quality Scoring

According to the document *How to use the Offsets Assessment Guide* (DEE, 2012), the quality score for an area of habitat or an area of a community is a measure of how well a particular site supports a particular threatened species or TEC and contributes to its ongoing viability. In order to provide inputs relevant to the EPBC Act offsets calculator, the site assessment data can be used to determine a habitat quality score (0-10), being a combination or average of scores for site condition, site context and species stocking rate.

These components can be weighted differently depending on the ecological requirements of the impacted species or TEC; however scores have not been weighted due to insufficient baseline knowledge of specific ecological requirements and interactions for the impacted species or community within the local area as well as the broader landscape. It is noted that habitat quality needs to be assessed consistently on both the impact and offset sites and this method has been aimed at being replicated for the relevant MNES impacted sites.

The method for fauna species habitat assessment within the Queensland EHP's Guide to determining terrestrial habitat quality (version 1.2 April 2017) was used as a basis for habitat quality assessments in order to provide an overall habitat quality score for each assessment unit and target species. In this guideline, the habitat quality score (0-10) is a result of combining site condition, site context and species habitat index scores. The species habitat index score is only used when assessing the ability of a site to support a flora or fauna species of conservation significance (i.e. not an ecological community).

Overall, the guidelines used to undertake this assessment include:

- How to use the Offsets assessment guide (DEE, 2012)
- Matters of National Environmental Significance: Significant impact guidelines 1.1 (DEE, 2013)
- EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DEE, 2014)
- Guide to determining terrestrial habitat quality. A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (EHP, 2017)

The following habitat quality scoring method was not applied to *M. pauli-guilielmi* as the proposed offset of individuals does not require a habitat quality score to be derived.

3.2.1.1 Site Condition

This component is the condition of a site in relation to the ecological requirements of a threatened species or ecological community, including considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features.

Previous and current desktop and site data has been used to provide overall site condition scores for impact and potential offset sites as described in Section 3.3 for each MNES.

A score out of 10 was attributed for site condition for each assessment unit (both impact and offset sites), for MNES with habitat values present for that assessment unit.

Table 10 Site Condition Score Categories

Overall Score	Site Condition Description	Rapid vegetation condition score (1-6) (Keighery)	Species habitat index score (1-10)	ERM koala habitat type (1-4)
9-10	Suitable habitat* present. Remnant vegetation present. No evidence of weeds, logging, grazing, cultivation or bushfire impacts.	2: Excellent - Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	High (9-10)	4: Remnant (more frequent koalas)
7-8	Suitable habitat* present. Remnant vegetation present. Evidence of weeds, logging, grazing, cultivation or bushfire impacts.	3: Very Good - Vegetation structure altered, obvious signs of disturbance to vegetation structure caused by repeat fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Moderate-High (7-8)	3: Remnant (less frequent koalas)
5-6	Suitable habitat* present as regrowth or disturbed remnant. Evidence of weeds, logging, grazing, cultivation or bushfire impacts.	4: Good - Vegetation structure significantly altered by obvious signs of multiple disturbances.	Moderate (5-6)	2: Regrowth habitat (has food trees)
3-4	Some suitable habitat* present as regrowth vegetation. No koala primary food trees. Evidence of weeds, logging grazing, cultivation or bushfire impacts.	5: Degraded - Basic vegetation structure severely impacted by disturbance.	Poor-Moderate (3-4)	1: Unsuitable habitat
1-2	Little or no suitable habitat*. No koala primary food trees. Evidence of weeds, logging, grazing, cultivation or bushfire impacts.	6: Completely Degraded - The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.	Poor (1-2)	1: Unsuitable habitat

* Suitable habitat descriptions for target species/communities:

– Koala – Primary food trees present (*Eucalyptus, Corymbia, Angophora* and *Lophostemon* spp.), remnant vegetation consistent with REs 12.3.11, 12.9-10.4, 12.11.3, 12.11.5e, 12.11.14, 12.11.16

- Black-breasted button-quail – Semi-evergreen vine-thicket or rainforest with vine understorey habitat present, or surrounding eucalypt woodland with lantana understorey, remnant vegetation consistent with REs 12.11.3 or 12.11.14
- TEC – remnant vegetation consistent with REs 12.3.1 or 12.11.10 (also typically associated with REs 12.5.13, 12.8.3, 12.8.4, 12.8.13, 12.11.1, 12.12.1 and 12.12.16)

3.2.1.2 Site Context

This component is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species or community, including considerations such as movement patterns of the species, threats on or near the site, connectivity to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species or community (DEE, 2012).

The method within the Queensland EHP's Guide to determining terrestrial habitat quality (version 1.2 April 2017) was used as a basis for determining site context scoring method. This method involved a desktop-based assessment (using GIS analysis) that considered total remnant patch size, connectedness (proportion, as a percentage, of a site's boundary that is connected to remnant vegetation), context (percentage of remnant vegetation within a 1 km buffer), and proximity to mapped State, bioregional, regional or sub-regional corridors (terrestrial or riparian).

Scores were allocated based on the guide shown in Table 11 (relevant to fragmented bioregions only). These scores may be the same for different species or communities where their habitat overlaps.

The score for each site was converted to a score out of 10 as per the following equation: (**Sum of site context scores (measured) / Maximum site context score (26)) x 10 = Site Context Score out of 10**

A score out of 10 was attributed for the site context for each assessment unit (both impact and offset sites).

Table 11 Site Context Scoring Sheet Guide (based on EHP, 2017)

Attribute	Scoring Categories					
Size of Patch	**Score**	0	2	5	7	10
	Description	<5 ha	5-25 ha	26-100 ha	101-200 ha	>200 ha
Connectedness	**Score**	0	2	4	5	
	Description	0-10 %	10-<50 %	50-75 %	>75 % or >500 ha	
Context	**Score**	0	2	4	5	
	Description	<10 % remnant	>10-30 % remnant	>30-75 % remnant	>75 % remnant	
Ecological Corridors	**Score**	0	4	6		
	Description	Not within a corridor	Sharing a common boundary	Within a corridor (whole or part)		

3.2.1.3 Species Stocking Rate

This component is the usage and/or density of a species at a particular site, including the presence of the species (confirmed or modelled) or TEC, density of the species, and role of the site population in relation to the overall species population (DEE, 2012).

This score was determined using the confirmed or apparent (based on previous surveys and habitat mapping) presence of the species or TEC on-site and whether that site population would be considered to be critical to the survival of the species or TEC.

Species stocking rates were attributed as a score out of 10 for each assessment unit (both impact and offset sites) for the relevant MNES considered to be present or have habitat values present.

3.2.1.3.1 Koala

For koala, the utilisation rate derived from recent or previous surveys (spot assessment technique (SAT) or koala detection dog surveys) can be a basis for a species stocking rate score (based on Phillips and Callaghan, 2011), as outlined in Table 12. These are based on the koala activity category of East Coast (low), which generally has a naturally occurring low density population. Philips and Callaghan (2011) state that koala densities for the east coast, low density category are arbitrarily defined at less than or equal to 0.1 koalas/ha. Within this low density category, low use activity is less than 3.33% utilisation, medium (normal) use is between 3.33% and 12.59% utilisation, and high use is greater than 12.59% utilisation.

Koala habitat mapping undertaken by Gympie Regional Council (GRC) for the area was also referred to where species records were lacking. All bushland habitat was considered to be high value, while the remaining was considered to be low value habitat.

The potential for sites to be assessed as habitat critical to the survival of the koala has also been included as an indication of the role of the site population with regard to the overall species population. Within areas previously surveyed and mapped by ERM, habitat critical to the survival of the koala has been derived from koala habitat categories 3 and 4 (remnant habitat with less frequent detection of koalas and remnant habitat with more frequent detection of koalas, respectively). Where that mapping does not extend to the offset sites, or where there was insufficient survey data for an assessment unit, the habitat assessment tool in the EPBC Act referral guidelines for the vulnerable koala (DEE, 2014) can be used to determine habitat critical to the survival of the koala.

The koala habitat assessment tool was not used as the sole category for scoring habitat quality (as the referral guideline indicates is possible), due to the linear nature of the Project and resulting complexity within and between the impact and offset sites, and the variation in available desktop and survey data.

Table 12 Koala Stocking Rate Score Categories

Score	Koala stocking rate
1	No faecal pellets or direct sighting recorded, only low value habitat present Not or unlikely to be habitat critical to survival
2	No faecal pellets or direct sighting recorded, however mapped as high value habitat Marginal habitat critical to survival (e.g. koala habitat present however low connectivity, high existing threats and/or low recovery value)
3	Low use (less than 3.33% utilisation) Marginal habitat critical to survival (e.g. koala habitat/evidence present however low connectivity, high existing threats and/or low recovery value)
4	Low use (less than 3.33% utilisation) Likely to be habitat critical to survival
5	Medium use (3.33-7.96% utilisation) Marginal habitat critical to survival (e.g. koala habitat/evidence present however low connectivity, high existing threats and/or low recovery value)

Score	Koala stocking rate
6	Medium use (3.33-7.96% utilisation) Likely to be habitat critical to survival
7	Medium use (7.96-12.59% utilisation) Marginal habitat critical to survival (e.g. koala habitat/evidence present however low connectivity, high existing threats and/or low recovery value)
8	Medium use (7.96-12.59% utilisation) Likely to be habitat critical to survival
9	High use (12.59-22.52% utilisation) Likely to be habitat critical to survival
10	High use (greater than 22.52% utilisation) Likely to be habitat critical to survival

3.2.1.3.2 Black-breasted Button-quail

For black-breasted button-quail, there is limited information available as to natural abundance or density of individuals within habitat. Home ranges have been estimated to be between 1.9 and 6.2 ha in undisturbed native forest and hoop pine plantations (Smith et al., 1998; Lees and Smith, 2000). Females have been reported to hold territory against other females of approximately 1.5 ha, and individuals have been recorded singly, in pairs or small groups of 4 to 5 (Hughes and Hughes, 1991).

Due to the lack of information about existing populations, the number of categories for species stocking rate scores was reduced in order to more readily convey the limited information available (refer to Table 13). Species stocking rate was based on evidence of platelets present and the number of locations observed, as well as the habitat extent (above or below the estimated home range), connectivity to other habitat, and potential to be critical to the survival of the species.

Habitat critical to the survival of this species includes:

- Vine thickets and rainforest vegetation types that are periodically water-stressed (semi-evergreen vine thicket, low microphyll vine forest, Araucarian microphyll vine forest, Araucarian notophyll vine forest and *Brachychiton* scrubs)
- Low thickets or woodlands with a dense understorey but little ground cover, typically dominated by *Acacia spp*.
- In littoral situations, dry vine scrubs, acacia thickets and areas densely covered in shrubs, particularly midgen berry

The species is known to occur in patches of dense lantana understorey, particularly when associated with the above suitable vegetation types; therefore areas of lantana thicket present within suitable habitat in the Project area are considered to represent habitat critical to the survival of the species of a lower quality.

The local population is not considered to be an important population or subpopulation, in accordance with the National recovery plan for the black-breasted button-quail *Turnix melanogaster* (Mathieson and Smith, 2009), as described in the MNES Significant Impact Assessment Report (GHD, 2017).

Table 13 Black-breasted Button-quail Stocking Rate Score Categories

Score	Black-breasted button-quail stocking rate
1-2	No platelets or direct sightings recorded, only low value habitat present Not or unlikely to be habitat critical to survival
3-4	No platelets or direct sightings recorded, high value habitat present Area of habitat less than 1 ha, isolated from other habitat areas Not or unlikely to be habitat critical to survival
5-6	Platelets present and/or direct sightings recorded at one location or in connected habitat Area of habitat less than 2 ha, connected to other habitat areas Potentially habitat critical to survival
7-8	Platelets present at multiple locations Area of habitat greater than 2 ha Likely to be habitat critical to survival
9-10	Platelets present at multiple locations Area of habitat greater than 5 ha Likely to be habitat critical to survival

3.2.1.3.3 Lowland Rainforest of Subtropical Australia TEC

The Lowland Rainforest of Subtropical Australia TEC typically has high species richness of rainforest species (more than 30 native woody species from Appendix A of the listing advice (TSSC, 2011)). The species stocking rate score categories (refer to Table 14) have been applied to this TEC based on woody species richness that forms part of the condition thresholds in the listing advice (including characteristic native woody species in Appendix A and persistent mature trees in Appendix B).

Very degraded or modified patches are not protected as the listed TEC, however such patches may still retain important natural values and have the potential to be rehabilitated in order to meet the condition thresholds; therefore these patches should not be excluded from recovery or other management actions (TSSC, 2011).

As stated in the listing advice, patches that are larger, more species rich and less disturbed are likely to provide greater biodiversity value (TSSC, 2011).

Habitat critical to the survival of an ecological community is described in the Significant Impact Guidelines (DEE, 2013) as areas that are necessary:

- for activities such as dispersal
- for the long-term maintenance of the TEC (including the maintenance of species essential to the survival of the TEC, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development or
- for the reintroduction of populations or recovery of the TEC.

Table 14 Lowland Rainforest TEC Stocking Rate Score Categories

Score	Lowland Rainforest TEC stocking rate
1	Non-remnant patch[#] Less than 30 native woody species (Appendix A*) Greater than 50% of vegetation is non-native
2	Non-remnant patch[#] Greater than 30 native woody species (Appendix A*) Greater than 50% of vegetation is non-native
3	Non-remnant patch[#] Greater than 30 native woody species (Appendix A*) Greater than 50% of vegetation is native
4	Some residual/mature trees present[#] (Appendix B*) Greater than 30 native woody species (Appendix A*) Greater than 50% of vegetation is non-native
5	Some residual/mature trees present[#] (Appendix B*) Greater than 30 native woody species (Appendix A*) Greater than 50% of vegetation is native
6	Remnant with persistent residual/mature trees[#] (Appendix B*) Between 30 and 40 native woody species (Appendix A*) Between 50% and 70% of vegetation is native
7	Remnant with persistent residual/mature trees[#] (Appendix B*) Between 30 and 40 native woody species (Appendix A*) Greater than 70% of vegetation is native
8	Remnant with persistent residual/mature trees[#] (Appendix B*) Greater than 40 native woody species (Appendix A*) Greater than 70% of vegetation is native
9	Remnant with persistent residual/mature trees[#] (Appendix B*) Greater than 50 native woody species (Appendix A*) Greater than 70% of vegetation is native
10	Remnant with persistent residual/mature trees[#] (Appendix B*) Greater than 60 native woody species (Appendix A*) Greater than 70% of vegetation is native

* Of the listing advice

[#] Non-remnant patch = little or no mature/large trees; Some residual/mature trees = some mature trees present but not necessarily original/pre-clearing; Persistent residual/mature trees = many (but not all) pre-date clearing

3.2.1.4 Final Habitat Quality Score

To obtain a final habitat quality score for each MNES, each site (both impact and offset) was weighted according to its size (hectares) and all weighted scores were added to determine the overall habitat quality score for the impact sites and offset sites (score out of 10).

3.2.2 MNES Impact Areas

The impact areas for the black-breasted button quail, koala and TEC have been divided into assessment units. A description of each of the impact area assessment units is provided for each species and TEC in Section 3 of this report. The total impact for each species and TEC following the assessment is provided in Table 15.

Table 15 MNES Impact Areas

Species	Impact Area – Preliminary Documentation Stage	Size weighted habitat quality score	Total quantum of impact (following input to offset calculator)
Lowland Rainforest of Subtropical Australia TEC	0.79 ha of TEC	8.2	0.63 ha
Black-breasted button-quail	8.08 ha	8.5	7.27 ha
Koala	135.83 ha	7.5	108.66 ha
M. pauli-guilielmi	10 adult *M. pauli-guilielmi* plants (12% expected maximum mortality of 76 adult plants to be translocated)	NA	10 adult plants

3.2.3 Selection of Offset Sites

TMR identified a number of potential offset provision sites for each of MNES which included a total of 19 land parcels as being owned (or to be acquired) by TMR for the Project. TMR also consulted with Gympie Regional Council (GRC) and an additional 25 land parcels owned by GRC were identified as being potentially available for offset provisions.

3.2.3.1 Desktop Assessment

A desktop assessment was undertaken for the potential TMR and GRC-owned land parcels that may be used as offset sites. The desktop assessment included reference to the following databases and mapping:

- EHP's WildNet Database of species previous records
- Atlas of Living Australia (ALA, 2016) species records
- Department of Natural Resources and Mines (DNRM) Regional Ecosystem and Essential Habitat mapping (and Regional Ecosystem Description Database)
- DEE Species Profile and Threats (SPRAT) database species descriptions and listing advice

- GRC mapping of koala records, habitat and wildlife corridors
- Project mapping of target species' habitat and ecological communities
- DNRM watercourse (drainage) mapping
- DNRM detailed surface geology and soils mapping
- Aerial photography

The following characteristics were identified on each land parcel and used as a basis for targeting field assessments:

- Land parcel tenure and size (area of TMR-owned or GRC-owned land available for offset site and/or transfer to reserve tenure)
- Landscape context and connectivity of TMR parcels to existing State Forest (or other reserve) land
- Type and amount of pre-clearance, mapped and previously ground-truthed (where relevant) regional ecosystems (REs)
- Type of landform, geology and soils present (as relevant to species and communities)
- Presence of waterways
- Potential habitat for conservation significant species including koala, black-breasted button-quail and M. pauli-guilielmi (including previous records from available datasets and mapped essential habitat)
- Potential occurrence of the Lowland Rainforest of Subtropical TEC (based on previous survey records and RE mapping).

Of the initial 19 TMR-owned land parcels, there were 10 lots (or parts of lots) identified as warranting further investigation and field assessments. Of the initial 25 GRC-owned land parcels, there were seven lots (or parts of lots) identified as warranting further investigation and field assessments. The key characteristics used to deem potential sites inadequate at the desktop stage (and therefore not requiring further assessment or field investigation for the purposes of offsets) included:

- Small and insufficient land areas of properties
- Close proximity to roads, urban or rural residential properties and other developed areas, which limit the potential to protect species and habitats from disturbance by human and associated interference
- Extent of fragmentation and lack of connectivity with biodiversity corridors or larger areas of intact remnant habitat vegetation.

The 17 land parcels identified for further field assessment are described in Table 16.

Table 16 Description of potential offset land parcels assessed

Lot on plan	Location / Approx. Chainage	Total parcel size (ha)	Tenure	Ownership
1 on RP35055	Ch 135300 - 136200	58.3	FH	TMR
2 on RP891751	Ch 136200 - 136700	38	FH	TMR

Lot on plan	Location / Approx. Chainage	Total parcel size (ha)	Tenure	Ownership
983 on FTY1488	Woondum State Forest Ch 136700 - 137500	452	State Forest	EHP
1 on MPH23904	Ch 146200	6.09	FH	GRC
1 on MPH5670	Ch 146600	2.02	FH	GRC
2 on MPH14193	Ch 146800	7.32	FH	GRC
19 on RP226325	Ch 146200 - 147100	45.8	FH	GRC
700 on FTY1491	Curra State Forest Ch 151200 - 157375	4830	State Forest	EHP
1 on MPH7125	Ch 153800 - 154300	12.58	FH	TMR
1 on MPH6454	Ch 153800 - 154500	32.37	FH	TMR
4 on MPH23906	Ch 157375 - 157650	15.67	FH	TMR
1 on MPH23906	Ch 157650 - 158150	32.32	FH	TMR
2 on MPH23906	NE of Lot 1 (above)	20.22	FH	TMR
3 on MPH23906	N of Lot 1 (above)	22.99	FH	TMR
878 on MCH1061	Ch 158150 - 159650	198.09	FH	TMR
889 on CP864404	Ch 159650 - 160700	97.12	FH	TMR
14 on MCH5065	Anderleigh Rd, Anderleigh	147.01	RE	GRC
2117 on M37108	Antimony Rd, Neerdie	31.75	FH	GRC
126 on MCH4743	Anderleigh Rd, Neerdie	8.04	RE	GRC

3.2.3.2 Field Assessment

A number of field assessments have been previously undertaken for the Project, including:

- Baseline ecological assessment (BAAM, 2015)
- Terrestrial flora surveys (BAAM, 2016)
- Terrestrial fauna surveys (ERM, 2016)
- Koala surveys (USC, 2016)
- Protected plant flora survey (GHD, 2016)
- Additional TEC assessments (GHD, 2016)

Specific field assessments of the offset sites were undertaken from 27-29 April 2017 and on 2 August 2017 on TMR-owned lots and 10-12 July 2017 on GRC-owned lots. Field assessments were generally limited to areas outside of the Project survey area. The offset sites are shown in Figure 1 (along with results of Project surveys for the relevant MNES).

An assessment unit was established in each mapped RE within each land parcel (based on the EHP RE mapping (version 8) and cross-checked using the field verified RE mapping undertaken by BAAM (2015) for the Project where the mapping layers adjoin or overlap each other).

The following activities were undertaken during the field assessments:

- Description of the vegetation communities and identification of RE types using Quaternary vegetation assessments in accordance with the Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner *et al*., 2017)
- Rapid vegetation condition assessment based on the vegetation condition scale developed by Keighery (1994) (as described in the Literature Review: Vegetation Condition Assessment, Monitoring and Evaluation (DEC, 2008)). The scale refers to the degree of change in the structure, density and species present in native vegetation communities, in relation to undisturbed 'pristine' native vegetation of the same type, and has been widely used in rapid assessment techniques of vegetation condition, particularly in Western Australia
- High level habitat assessments for *M. pauli-guilielmi*, koala and the black-breasted button-quail on proposed offset sites based on habitat preference to determine habitat suitability. This assessment used species habitat index scoring guides adapted from the *Guide to determining terrestrial habitat quality* (EHP, 2017) and tailored for the above targeted species, including assessment of:
  - threats to species
  - quality and availability of food and foraging habitat
  - quality and availability of shelter
  - species mobility capacity
- Targeted searches within potential habitat for evidence of koala including Spot Assessment Technique searches (in accordance with Phillips and Callaghan, 2011) and black-breasted button-quail feeding platelet searches (where evidence observed GPS locations were recorded)
- Targeted searches within potential habitat for *M. pauli-guilielmi* (where individuals were identified, GPS locations were recorded as well as details on landscape, community and plant conditions)
- Targeted searches for the Lowland Rainforest of Subtropical Australia TEC within potential habitat areas (where potential areas of TEC were observed, assessments were undertaken to determine whether the community meets the EPBC Act threshold criteria in terms of condition and species characteristics)
- Recording of additional site characteristics such as:
  - existing disturbances/impacts

- weed cover and type
- presence of waterways
- erosion risk (based on stability of banks)
- site constraints (e.g. access, terrain).

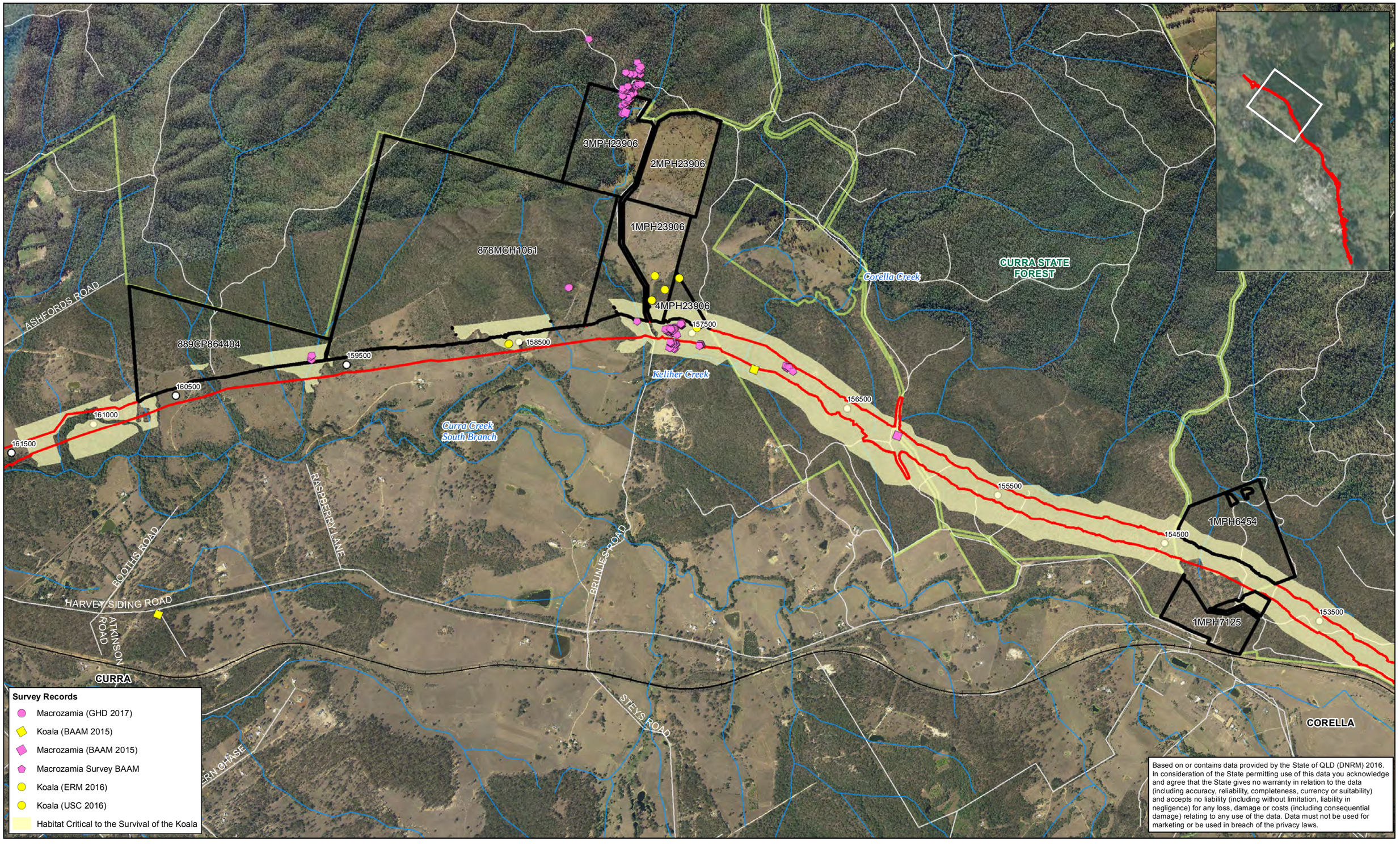
Rapid assessment forms used (including vegetation condition scale and species habitat index scoring guides) are provided in Appendix D.

3.2.3.3 Risk of Loss Assessment

In identifying the risk of loss % without the offset, a likelihood scoring guide was developed in accordance with the document EPBC Act *How to use the offset assessment guide* and is provided in Table 17. The risk of loss assessment considered the relevant pressures with the potential to influence the risk of the offset sites being cleared in the future for rural residential, agricultural or industrial activities, new infrastructure, or an intensification of existing land uses consistent with surrounding areas. Some of these clearing pressures would not necessarily trigger protections of MNES and their habitat under legislation.

Table 17 Risk of Loss Likelihood Ratings

Likelihood	Description
Highly likely	Is expected to occur in most circumstances (e.g. 90%)
Likely	Will probably occur during the 20 year period (e.g. 75%)
Possible	Might occur during the 20 year period (e.g. 50%)
Unlikely	Could occur but considered unlikely or doubtful (e.g. 25%)
Rare	May occur in exceptional circumstances (e.g. 10%)



Paper Size A3

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- 1km Chainage
- Railway
- Highway
- Street/Local Road
- Watercourses
- Road/Track
- Offset Sites
- State Forest
- Project Footprint

Department of Transport and Main Roads

Bruce Highway Cooroy to Curra
(Section D: Woodnum to Curra)

Job Number	41-29914
Revision	1
Date	02 May 2018

Offset Sites Locality Plan

Figure 1
Page 1 of 3

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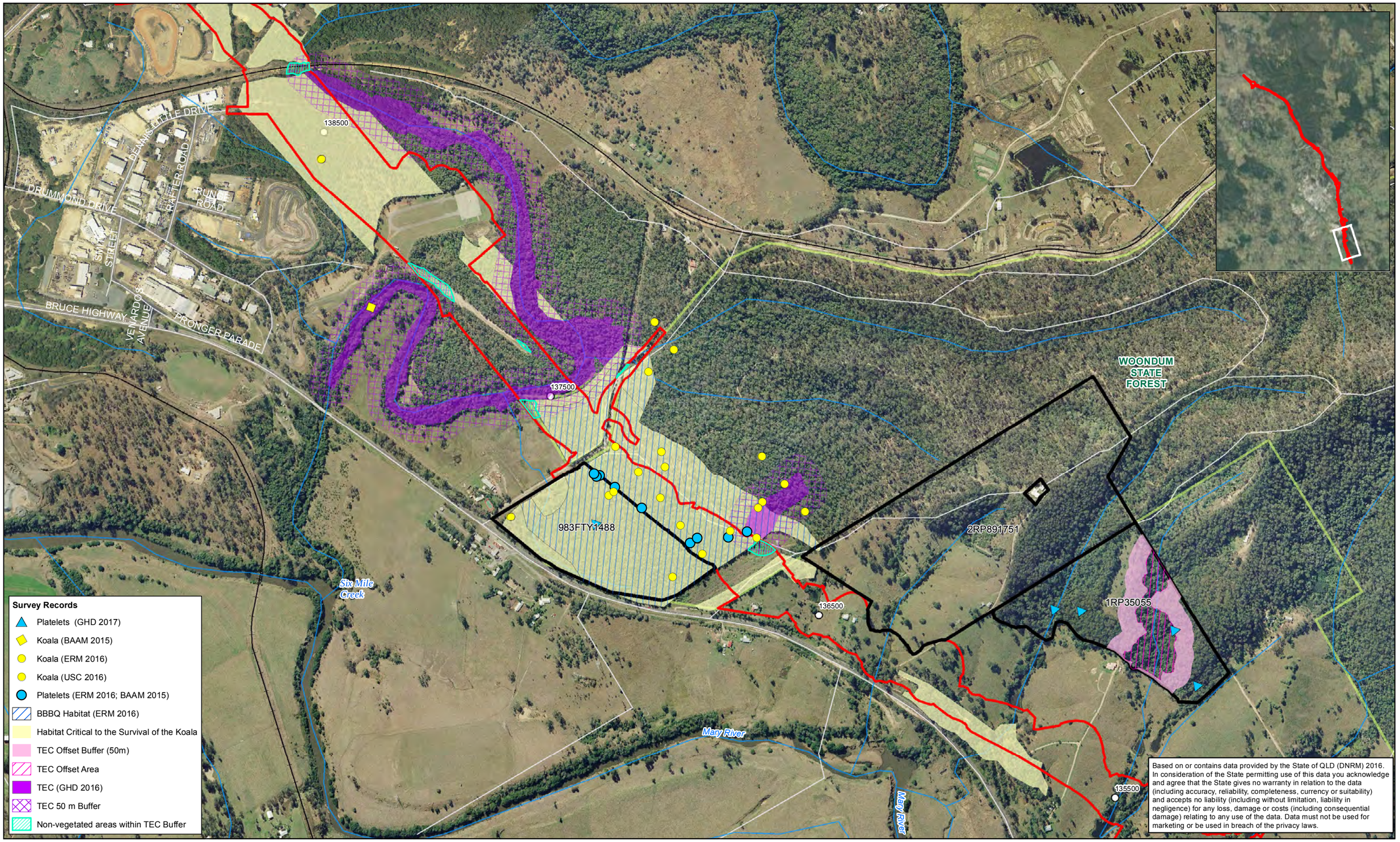
Data source: DNRM: Watercourse (2010), RE v8 (2016), Rail (2014), Roads (2016), Towns (2015), Protected Areas (2014); TMR: Imagery, Survey Area, Chainage, Areas Assessed (2016). GHD: Project Area (December 2016), Survey Site (2017), Koala Habitat (2017). Created by:mstanley

6 Innovation Parkway Birtinya QLD 4575 Australia **T** 61 7 5413 8100 **F** 61 7 5413 8199 **E** bta01mail@ghd.com **W** www.ghd.com



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Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- 1km Chainage
- Railway
- Highway
- Local Connector Road
- Street/Local Road
- Watercourses
- Road/Track
- Offset Sites
- State Forest
- Project Footprint

Department of Transport and Main Roads
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Offset Sites Locality Plan

Figure 1
Page 2 of 3

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Data source: DNRM: Watercourse (2010), RE v8 (2016), Rail (2014), Roads (2016), Towns (2015), Protected Areas (2014); TMR: Imagery, Survey Area, Chainage, Areas Assessed (2016). GHD: Project Area (December 2016), Survey Site (2017), Koala Habitat (2017). Created by:mstanley

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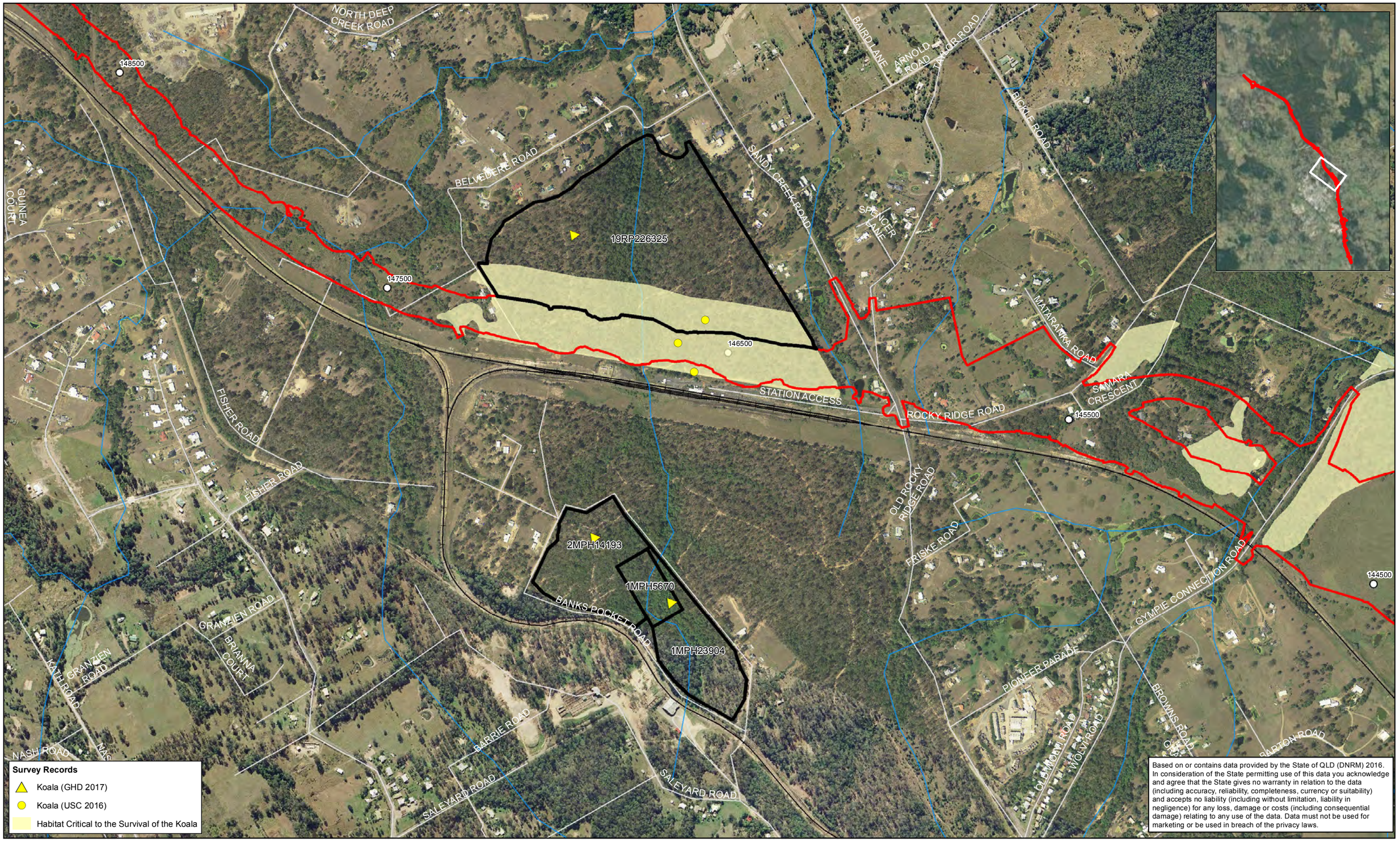

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Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- 1km Chainage
- Railway
- Secondary Road
- Local Connector Road
- Street/Local Road
- Watercourses
- Road/Track
- Project Footprint
- Offset Sites

Department of Transport and Main Roads
Bruce Highway Cooroy to Curra
(Section D: Woodnum to Curra)

Job Number 41-29914
Revision 1
Date 02 May 2018

Offset Sites Locality Plan

Figure 1
Page 3 of 3

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6 Innovation Parkway Birtinya QLD 4575 Australia T 61 7 5413 8100 F 61 7 5413 8199 E bta01mail@ghd.com W www.ghd.com

Data source: DNRM: Watercourse (2010), RE v8 (2016), Rail (2014), Roads (2016), Towns (2015), Protected Areas (2014); TMR: Imagery, Survey Area, Chainage, Areas Assessed (2016). GHD: Project Area (December 2016), Survey Site (2017), Koala Habitat (2017). Created by:mstanley

3.3 Offset Strategy

TMR has considered the offset requirements for the potential residual impacts to the above MNES in terms of a direct land-based offset in the first instance. Suitable offset sites have been identified through the offset assessment guide process described in Section 3.2. The sites are mainly land parcels currently owned by TMR and containing suitable habitat characteristics for the MNES to be impacted. Further details of and proposed offset strategies are provided for each MNES below.

In addition to direct land based offsets, TMR has also developed a number of indirect offsets to compensate for impacts to the MNES as a result of the Project. The indirect offsets for each species have been developed in consultation with a number of stakeholders including Gympie Regional Council, Mary River Catchment Co-ordinating Committee (MRCCC), Gympie Koala Action Group (GKAG) and Landcare. Details of the results of the offset assessment and direct and indirect offset proposals, including management requirements, costs and outcomes in accordance with Clause 3.3 of the RFI are provided below for each MNES.

3.3.1 TEC

A direct land based offset is proposed to compensate for impacts to the TEC. The proposed offset site is formally described as Lot 1 on RP 35055 and currently contains approximately 2.72 ha of Lowland Rainforest of Subtropical Australia habitat known to be present on-site (assessed through field surveys as meeting the condition thresholds and criteria for the TEC). It is also proposed to secure and manage an additional 3.8 ha of vegetated buffer within this same property in order to further protect the existing TEC.

3.3.1.1 Results of Offset Assessment Guide

3.3.1.1.1 Desktop

A summary of habitat characteristics of Lowland Rainforest of Subtropical Australia TEC as determined by the desktop assessment is provided in Table 18 below.

Table 18 Summary of TEC Habitat Characteristics

Target Species / Community	Key Habitat Characteristics	Summary of Desktop Results
Lowland Rainforest of Subtropical Australia TEC	Tall closed forest vegetation community that is closely associated with a number of REs, including RE 12.3.1 and 12.11.10 that are known to occur in the region (also 12.5.13, 12.8.3, 12.8.4, 12.8.13, 12.11.1, 12.12.1 and 12.12.16)	Woondum State Forest has previously identified area of TEC and nearby TMR Lots 2 on RP891751 and 1 on RP35055 contain areas mapped as RE 12.11.10, suitable for supporting the Lowland Rainforest of Subtropical Australia TEC.

3.3.1.1.2 Field Results

A description of the results of the field surveys of the impact and offset area assessment units are provided in Table 19 and Table 20 respectively.

Table 19 Description of Lowland Rainforest TEC Impact Area

Impact AU	Area impacted (ha)	Site description	RE present	TEC present	TEC evidence	HCSS	Threats	Disturbances/weeds	Connectivity
3	0.79	Southern patch: Lot 983FTY1488 (Woondum SF), Six Mile Creek riparian zone, Lot 100SP295964 and a corner of Lot 250M37161; Northern patch: Lot 104SP295968, Lot 105SP295969 and a small area in the railway corridor Lot 100CP907156	12.3.1	Yes - riparian zone containing closed forest of Lowland Rainforest of Subtropical Australia TEC	Meets key diagnostic and condition thresholds, 45 species from Appendix A of listing advice	Yes	Increased weed invasion, isolated and narrow linear patch along Six Mile Creek, 50m buffer zone not consistently vegetated	Highly impacted by cat's claw creeper, lantana also present	Narrow linear connectivity of vegetation along Six Mile Creek
Total	**0.79**								

Table 20 Description of Lowland Rainforest TEC Offset Sites

Offset AU	Area available (ha)	Site description	RE present	TEC present	TEC evidence	HCSS	Threats	Disturbances/weeds	Connectivity
4	2.72	Lot 1RP35055 (patch on eastern boundary)	12.11.10	Yes - lowland rainforest TEC present (Araucarian vine forest)	Meets key diagnostic and condition thresholds, 41 species from Appendix A of listing advice	Yes	Edge effects, weed invasion, disturbances within 50 m buffer zone (high weed densities including lantana)	Logging track, low weed cover (lantana), ephemeral drainage line with low erosion risk (moderately stable), difficult to access	Some connectivity to Woondum SF via vegetated freehold property (Gympie Cooloola Pet Resort)
3a	1.89	Lot 1RP35055 (patch on eastern boundary)	12.11.5e	TEC 50 m buffer	NA	No	Edge effects, weed invasion	Past logging, higher weed cover (lantana)	Some connectivity to Woondum SF via vegetated freehold property
5a	1.91	Lot 1RP35055 (patch on eastern boundary)	12.11.3	TEC 50 m buffer	NA	No	Edge effects, weed invasion	Past logging, cleared track	Some connectivity to Woondum SF via vegetated freehold property
Total	**6.52**								

3.3.1.1.3 Habitat Quality Scoring

A summary of the habitat quality scoring for the TEC impact and offset areas is provided in Table 21 and Table 22 below respectively.

Table 21 Lowland Rainforest TEC Impact Area Habitat Quality Scoring

Impact Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
3	0.79	Southern patch: Lot 983FTY1488 (Woondum SF), Six Mile Creek riparian zone, Lot 100SP295964 and a corner of Lot 250M37161; Northern patch: Lot 104SP295968, Lot 105SP295969 and a small area in the railway corridor Lot 100CP90715	7	9.6	8	8.2	1.00	8.2
Total	**0.79**							**8.2**

Table 22 Lowland Rainforest TEC Offset site habitat quality scoring

Offset Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
4	2.72	Lot 1RP35055 (patch on eastern boundary)	8	7.3	8	7.8	0.42	3.2
3a	1.89	Lot 1RP35055 (patch on eastern boundary)	6	7.3	1	4.8	0.29	1.4
5a	1.91	Lot 1RP35055 (patch on eastern boundary)	6	6.9	1	4.6	0.29	1.4
Total	**6.52**							**6.0**

3.3.1.1.4 Direct Offset Assessment Guide

Table 23 provides the descriptions and justification of inputs to the offset assessment guide calculator for the TEC. A copy of the offset assessment guide is provided in Appendix E.

Table 23 Lowland Rainforest TEC Offset Calculator Guide

Components	Description of Input	Calculator Input
IMPACT CALCULATOR		
Area of community	0.79 ha of TEC habitat with a quality score of 8.2 (rounded down to 8 in the calculator) to be impacted	Total quantum of impact (adjusted) = 0.63
OFFSET CALCULATOR		
Risk-related time horizon (max. 20 years)	A maximum 20 year period has been applied as the land will be legally secured	20 years
Time until ecological benefit	A 3 year period has been applied as there is existing TEC habitat value at this site and additional protection and management measures proposed through weed control, fencing and monitoring for additional disturbances to be managed (both within the TEC and the 50 m vegetated buffer area.	3 years
Start area (hectares)	6.52 ha in total for TMR-owned lot	6.52 ha
Start quality (scale of 0-10)	A total weighted habitat quality score of 6 has been derived for the TEC and 50 m buffer areas within the vegetated areas of the TMR-owned lot. The existing TEC was assessed as having good condition and high diversity, with some connectivity to other potential habitat areas.	6
Risk of loss (%) without offset	If the offset site is not legally secured then it is at risk of being sold and potentially cleared for industrial, agricultural or rural residential purposes, consistent with surrounding land uses and the local town planning intent for the site. Additional disturbances are likely to occur without the offset site and 50 m vegetated buffer areas being protected and managed due to increasing pressures from surrounding land uses, fragmentation, edge effects and pest flora. There are pressures on the land that would not necessarily trigger an approval process resulting in protection of the TEC, thereby not result in an offsets requirement for future impacts. The lot is freehold and zoned Industry Investigation Area under the Gympie Regional Council Planning Scheme 2013. There are a number of accepted development purposes for the Industry zoning, which do not trigger assessment under the planning scheme and therefore do not necessarily require an approval. Risk of loss was considered to not be higher than 50% due to the existing protections afforded under the EPBC Act and *Vegetation Management Act 1999* (VM Act) regarding the mapped regulated vegetation, therefore making the offset area unlikely to be able to be clear-felled for one particular development in the future.	50 %

Components	Description of Input	Calculator Input
	Risk of loss was considered to not be lower than 50% because of the existing and surrounding land uses that would be continued and likely intensified (without the need for an approval) if the offset proposal does not proceed. The risk of loss assessment is described further below.	
Future quality without offset (scale of 0-10)	Without protection, the habitat quality is considered likely to decrease due to increasing disturbances through increased public and stock/domestic animal access, clearing, fragmentation, weed infestation, edge effects.	5
Risk of loss (%) with offset	The site will be legally secured therefore will not be lost.	0 %
Future quality with offset (scale of 0-10)	The site will be legally secured, therefore the habitat quality will not be at risk of future clearing or major disturbances. The additional protection of 50 m vegetated buffer areas will assist in the protection and management of the TEC. The key threats to this TEC include vegetation clearance, impacts associated with fragmentation of remnants, and weeds, therefore these threats within the offset area will be significantly reduced or prevented. With the removal of disturbing factors such as human activities and weed infestations and monitoring and management of any additional disturbances, the condition and species stocking rate (i.e. flora species diversity) will be able to increase, thereby increasing the habitat quality score. Additional measures to supplement land-based offsets for the TEC include the mapping and targeted control of the invasive weed cat's claw creeper and other site rehabilitation, such as supplementary replanting the buffer area around the TEC with appropriate lowland rainforest species. An offset area management plan will be prepared for the offset site.	8
Confidence in result	There is a high degree of confidence in this assessment due to repeated survey efforts covering large areas of the impact and offset sites that have provided comprehensive data on habitat quality and species diversity. Assessment methods are consistent and undertaken at representative locations. Impact extents are clearly defined and offsets will be in place prior to any construction impacts occurring.	90 %

Risk of Loss Assessment

The offset area is on a freehold lot currently zoned Industry Investigation under the local government planning scheme (Gympie Regional Council Planning Scheme 2013) with no existing land clearing covenants. An assessment of the potential pressures considered likely to contribute to the risk of loss of the existing TEC was undertaken, should the offset site not be legally secured. This assessment included a likelihood of occurrence assessment, which considered the following factors that were found to increase the risk of loss of the offset area (without the offset in place):

- A number of accepted development purposes for the Industry Investigation zone, which do not trigger assessment under the planning scheme, including animal husbandry/keeping, cropping, dwelling house,

emergency services, roadside stall, rural industry (including storage, processing and packaging of products from a rural use), utility installation and wholesale nursery. The strategic outcome for the Industry Investigation areas at Kybong are to preserve land for longer term employment purposes, dependent upon detailed planning and the completion of the Bruce Highway upgrade. **HIGHLY LIKELY**

- Mapped Least Concern Regional Ecosystem on freehold land has a number of exemptions (i.e. no assessment required) for clearing under the Vegetation Management Act (VM Act) and Planning Regulation, including for urban purposes (e.g. industrial, recreational, residential, sporting, commercial), forestry, to maintain infrastructure, to source construction timber, to establish necessary built infrastructure less than 2 ha or a fence or road up to 10 m wide, or clearing under an accepted development vegetation clearing code. The lower status of the vegetation and lack of other mapped matters of State significance (other than regulated vegetation intersecting a watercourse) mean that the requirement for offsets are not necessarily triggered for assessable activities over this land. **HIGHLY LIKELY**
- Being a freehold property containing native hardwood forest (identified as RE 12.11.3) and rainforest (RE 12.11.10), a landholder can undertake an ongoing native forestry practice in accordance with the 'Managing a native forest practice' accepted development vegetation clearing code made under the VM Act without further approval assessment being triggered. **POSSIBLE**
- Although the local government planning scheme limits the lot size to 100 ha minimum in this zoning, there are lots subdivided down to less than 2 ha size within the same zoning surrounding the offset site (less than 1 km from the offset lot). Some of these lots contain very little remaining vegetation. Encroaching residential and industrial development and land use will increase the threats to this habitat area. **HIGHLY LIKELY**
- There were previously mineral exploration permits over the site (historically and as recently as 2016), which indicates that future resource exploration permits could be granted and potentially allow exploration activities on or adjacent the offset area. **POSSIBLE**

Result

The result of the Offsets Assessment Guide indicates that:

- Based on a total impact area of 0.79 ha with a habitat quality score of 8 (adjusted area of 0.63 ha)
- Based on a legally secured offset site of 6.52 ha with a current and expected future habitat quality of 6 and 8 respectively, and
- Assuming that the offset site was not legally secured the risk of averting the loss of the site is 50% and the quality of the land will decrease to a habitat quality score of 5

the proposed offset site provides a **213.96%** direct offset.

3.3.1.2 Details of Direct Offset

The details of the direct offset strategy for the TEC are summarised below in Table 24.

Table 24 Direct Offset Strategy - TEC

Aspect	Description
Type of offset	Direct offset
Location	Lot 1RP35055 (patch on eastern boundary)

Aspect	Description
Suitability and values	Suitable Lowland Rainforest of Subtropical Australia habitat known to be present on-site (assessed through field surveys as meeting the condition thresholds and criteria for the TEC). Approximately 2.72 ha of TEC is present that was given a habitat quality score of 7.8. An additional 50 m vegetated buffer will be secured and managed on-site as part of the offset, being additional 3.8 ha given an average habitat quality score of 4.7. **Therefore the total area to be secured as an offset is 6.52 ha with an overall habitat quality score of 6.**
Land tenure	Freehold, owned by TMR
Method of securing	Land portions containing habitat values (for this and other MNES) will be converted to State Forest tenure, managed by the Department of National Parks, Sport and Racing, and protected from clearing or future logging under the Forestry Act. Should the land conversion not be successfully agreed to between Departments, TMR will provide legal protection over the land parcels to prevent clearing from occurring. Protection will either be in the form of a covenant or Nature Refuge and will be determined following consultation with the Department of National Parks, Sport and Racing. TMR will notify DEE once confirmation is received and which method of securing is proposed.
Management	The offset will be managed by Department of National Parks, Sport and Racing under the Foresty Act (or by TMR or a nominated entity as required through legally securing the offset area). An Offset Management Plan will be prepared that outlines the management of the offset area and will include actions, timing, reporting, corrective actions and responsibilities for the following activities to be undertaken: • Annual monitoring of the TEC habitat to assess any changes to condition or extent, including evidence of species recruitment, presence and abundance of weed species, evidence of plant pathogens, and other evidence of degradation such as eroding land. • Exclusion of any domestic/stock animals and public access from the TEC and 50 m buffer areas through installation, repair and maintenance of fencing bordering cleared or developed areas. • Monitoring and management of known weed infestations (previously identified as cat's claw creeper, lantana and passionflower) in accordance with a weed management protocol to maintain or improve the habitat quality. This will be undertaken both within the TEC and within the 50 m buffer zones either side. Weed control will be undertaken initially within the offset site through appropriate techniques (potentially a combination of biological, physical and chemical methods, depending on the species and extent of infestations) and then monitored annually with maintenance/eradication of new infestations undertaken as necessary.
Estimated cost	$150,000
Outcomes	The outcomes proposed to be achieved for the duration of the offset for the TEC are: • Maintain or improve Lowland Rainforest of Subtropical Australia habitat • Restore or maintain corridors of Lowland Rainforest of Subtropical Australia habitat These outcomes were based on priority objectives within the below listed conservation advice and threat abatement plan documents.

Aspect	Description
Risks	Risks associated with achieving the outcomes include: • Other development adjacent to the offset area causing degradation of the water quality of the creek intersecting the TEC habitat, or introducing weeds or feral animals/livestock to the area, thereby having an impact on the TEC habitat area • Weed infestations that are not controlled may impact the habitat quality and condition of the TEC • If plant pathogens are introduced, they may be difficult to eradicate or prevent from spreading between individual plants and species • Extreme weather events cause damage to the habitat within the offset area, therefore reducing the habitat quality and condition of the TEC
Measurability of outcome	The Offset Management Plan will include monitoring schedules and recording requirements for habitat conditions, evidence of weeds and evidence of threats such as feral animals/livestock or pathogens/disease. Specific performance and management measures and reporting will be included in the Offset Management Plan (see Management Measures below). The maintenance or improvement of TEC habitat can be measured using the criteria and condition thresholds as per the listing advice for the TEC and can be compared with the baseline data from the offset assessment. The restoration and maintenance of corridors of habitat can be measured by assessing adjacent 50 m buffer areas for recruitment and changes in extent, as well as through the outcomes of the indirect offset weed management described in Table 25 below.
Baseline data	These outcomes are derived from baseline data collected during field surveys, compared against key diagnostic criteria and condition thresholds that relate to vegetation community structure, species diversity, remnant status, patch size, canopy cover and percentage of weed cover. Additional data such as recruitment of native species within the TEC and within the 50 m buffer can be used to demonstrate regeneration and increases in extent. Evidence of disturbance or degradation will also be used to compare the baseline data with the offset area. This baseline data will be relied upon to monitor and assess the habitat quality and condition and any changes, improvement or threats to the offset area. The Offset Management Plan will detail the monitoring and reporting schedule and methods.
Conservation gains	Conservation gains to be achieved by these outcomes include • Protection of an otherwise unprotected area where the TEC occurs • Maintenance and improvement of an existing TEC patch • Maintaining connectivity of the TEC habitat with large areas of remnant vegetation community within Woondum State Forest, which will reduce the potential for threats to impact the TEC • Active monitoring and management of threats • Engaging in weed management strategies along Six Mile Creek (through the indirect offsets proposal in Table 25 below) that actively protect the TEC present in the vicinity of the Project from the introduction or spread of weeds (the management of which aids in the overall recovery of the TEC).

Aspect	Description
Consistent with conservation advice	These outcomes have been nominated with consideration of the priority actions listed in the conservation advice for the TEC (TSSC, 2011), the onsite habitat characteristics and the potential impacts of the Project. The *Threat abatement plan for disease in natural ecosystems caused by* Phytophthora cinnamomi (Commonwealth of Australia, 2014) has also been considered. No recovery plan has been published for this TEC. The key threats to this TEC include vegetation clearance, impacts associated with fragmentation of remnants, and weeds. Weeds compete with native species for space, light, water and nutrients, as well as suppress and out-compete mid-storey and canopy trees (TSSC, 2011). Accessibility to the TEC can result in impacts from invasion by pest species, rubbish dumping, trampling, garden escapes, firewood collection, impacts from vehicles, the creation of informal trails and arson (TSSC, 2011). Priority recovery and threat abatement actions listed in the conservation advice for the TEC that this offset provision is consistent with include: • Protect and conserve remaining areas • Maintain and reconnect wildlife corridors or linkages • Investigate formal conservation arrangements or inclusion in reserve tenure • Monitor the progress of recovery through condition assessments and effective adaptive management actions • Implement appropriate management regimes to maintain biodiversity • Include buffer zones between the ecological community and development zones
Audit	The Offset Management Plan will include an auditing schedule that assesses the performance of the monitoring and management strategies in achieving the outcomes.
Assessment of level of control	If TMR is not the owner, TMR will ensure an agreement is in place for the implementation of monitoring and maintenance in accordance with the Offset Management Plan.
Management measures	Monitoring: • One monitoring event will be undertaken prior to the offset commencing in order to establish the monitoring locations and provide an initial baseline for the monitoring program within the offset site. Monitoring data will then be collected annually from the time the offset area is legally secured, and thereafter for a minimum of 5 years. • Provisions for additional monitoring and adaptive management will be included in the Offset Management Plan in the case that the milestones or performance indicators have not been achieved by the end of the minimum 5 year term. Milestones: • At 3 years after the start of the offset, major weed infestations have been eradicated and no additional disturbances to the TEC have been observed. • At 5 years after the start of the offset, the habitat has been maintained or improved and no increase in threats have occurred. Performance indicators: • Species diversity is maintained or increased. • Evidence of recruitment is present within the TEC and the 50 m buffer area. • Threats that have been identified have not spread or increased.

Aspect	Description
	Further details of monitoring, adaptive management/corrective actions, record keeping, publication and reporting procedures will be included in the Offset Management Plan.

3.3.1.3 Details of Indirect Offset

The results of the surveys of the TEC along Six Mile Creek (refer Appendix F of the referral) have reported that at intermittent locations the TEC has been observed to be impacted by the declared pest species *Macfadyena unguis-cati* (cat's claw creeper) as illustrated in Figure 2.

Figure 2 TEC impacted by *Macfadyena unguis-cati* (cat's claw creeper) along Six Mile Creek

Weed infestation is documented in the *Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia* (TSSC, 2011) as a current threat to the TEC. TMR has undertaken consultation with MRCCC and GRC as to the extent of the weed infestation along Six Mile Creek. Initial mapping completed by MRCCC has indicated that there are cat's claw creeper infestations located along Six Mile Creek downstream of the Project area at Six Mile Creek rest area and upstream near Tandur Road, as well as at Woondum and other isolated pockets between the up- and downstream extents. A cat's claw creeper control program has been developed with GRC and MRCCC as outlined below in Table 25. This work will be undertaken in collaboration with Noosa and Gympie Landcare groups who both have recent experience in undertaking successful cat's claw creeper control programs within the region.

TMR have received approval from the Department of Infrastructure and Regional Development to allocate funds for this program ahead of construction funding being announced in order to commence the works early and achieve a conservation gain as soon as reasonably practical. In this regard it is anticipated that the control program will commence in Spring 2018.

Table 25 Cat's Claw Creeper Control program

Aspect	Description
Type of offset	Indirect
Program	Cat's claw control program using a mixture of biological and physical control methods between nominated up and down stream project extents defined as Tandur Road and Six Mile Creek Rest Area respectively.
Management	The program will be managed as follows:

Aspect	Description
	• MRCCC and GRC – identify land parcels to undertake the control and develop a program of works • TMR, MRCCC and GRC consult with relevant land owners to gain permission to undertake the works on their properties. • GRC – co-ordinate control program on GRC and state-owned land in collaboration with Gympie and Noosa Landcare as relevant • MRCCC - co-ordinate control program on all remaining land parcels in collaboration with Gympie and Noosa Landcare as relevant
Cost	$190,000 for the first 5 years with the option to review and continue for a further five years at an estimated $150,000 (at 2017 costs)
Reporting	MRCCC and GRC will provide TMR with the following: • Program of works and methodology within three months of project award • Annual report documenting outcomes of the control program.
Outcome	Control of cat's claw creeper between the upstream extent of works at Tandur Road and the downstream extent at Six Mile Creek rest area. Management of the infestation at Woondum will also be a key component of this work.
Risks	• There are insufficient funds to control the spread of cat's claw creeper. • Additional infestations are identified within the up and downstream extents. • Sufficient biological controls are unable to be resourced for the works. • Insufficient resources are unable to be employed for the works. • Private land owners are unwilling to co-operate with the project team.
Measurability of outcome	Control of spread of cat's claw creeper between the nominated up and down stream project extents.
Baseline data	Field mapping of the extent of cat's claw creeper infestation between the up and down stream extents is being undertaken by MRCCC in collaboration with GRC.
Conservation gains	Reduce cat's claw creeper infestation to enable the preservation of the TEC at this location.
Consistent with conservation advice	These outcomes have been nominated with consideration of the priority actions listed in the conservation advice for the TEC (TSSC, 2011), including: • Maintain and reconnect wildlife corridors or linkages • Monitor the progress of recovery through improved mapping, estimates of extent and effective adaptive management actions • Implement appropriate management regimes to maintain biodiversity • Develop and implement best practice standards for management • Promote community programs that assist with the conservation.

Aspect	Description
Audit	TMR will be in regular consultation with GRC and MRCCC with regard to the progress of the cat's claw creeper control program.
Assessment of level of control	TMR will be in control of the overall delivery and expenditure of the program and will undertake regular consultation with GRC and MRCCC with regard to the on-ground implementation, weed management actions, records, and reporting. Day to day management of the program will be the responsibility of MRCCC and GRC.
Management measures	Weed management strategies will be prepared in accordance with relevant pest management plans or other standard practices, as appropriate for the onsite habitat, proximity to waterways, access points, and with targeting cat's claw creeper. Monitoring of the effectiveness of the control program will be undertaken throughout the duration of the program, including effectiveness of varied control measures and any impacts or degradation of surrounding habitat values. Adaptive management strategies will be developed and implemented where disturbance or degradation of the surrounding environment occurs as a result of the program. All actions will be recorded and reported annually. TMR will document the progress of the program to DEE in each annual compliance report.

3.3.2 Black-breasted button-quail

3.3.2.1 Results of Offset Assessment Guide

3.3.2.1.1 Desktop

A summary of habitat characteristics of the black-breasted button-quail is provided in Table 26 below.

Table 26 Summary of Black-breasted Button-quail Habitat Characteristics

Target Species / Community	Key Habitat Characteristics	Summary of Desktop Results
Black-breasted button-quail	Habitat consists of structurally complex vegetation communities in fragments of microphyll and notophyll vine forest, thickets and coastal scrubs, but can occur in habitat suitable for koala. For example, semi-evergreen vine thicket, some rainforest communities and some littoral vegetation types such as the following REs: 12.2.2, 12.2.3, 12.8.13, 12.8.21, 12.8.22, 12.8.23, 12.9-10.6, 12.9-10.15, 12.11.13, 12.12.18 and 12.12.26	No sites are mapped as supporting RE specifically for the black-breasted button-quail though it is noted that this species can occur in habitat suitable for koala. Some RE descriptions list the black-breasted button-quail as being a potential threatened fauna species within that habitat (i.e. RE 12.3.11). There are known occurrences of black-breasted button-quail in proximity to Woondum State Forest in RE 12.11.3/12.11.14.

3.3.2.1.2 Field Results

A description of the results of the field surveys of the impact and offset area assessment units are provided in Table 27 and Table 28 respectively.

Table 27 Description of Black-breasted Button-quail Impact Areas

Impact AU	Area impacted (ha)	Site description	RE present	BBBQ habitat	BBBQ evidence	HCSS	Threats	Disturbances/weeds	Connectivity
1	5.63	Lot 983FTY1488 (Woondum SF)	12.11.3	Yes - semi-evergreen vine thicket and surrounding eucalypt woodland with lantana understorey	Platelets (BAAM 2015; ERM 2016) - 9 locations total	Yes	Future logging of State Forest, close to existing Bruce Highway, possible predation by cats, wild dogs etc	Lantana understorey (however providing habitat value), generally low other weed cover, distant noise from highway	Connected to large contiguous patch of Woondum SF and surrounding properties
2	2.45	Lot 983FTY1488 (Woondum SF), 2 small areas within Keefton Road reserve	12.11.3	Yes - semi-evergreen vine thicket and surrounding eucalypt woodland with lantana understorey	Connected to records of platelets (BAAM 2015; ERM 2016) - separated by Keefton Rd	Yes	Future logging of State Forest, close to existing Bruce Highway, possible predation by cats, wild dogs etc	Lantana understorey (however providing habitat value), generally low other weed cover (cat's claw prevalent along nearby Six Mile Creek, distant noise from highway	Connected to large contiguous patch of Woondum SF, riparian vegetation along Six Mile Creek, and surrounding properties
Total	**8.08**								

Table 28 Description of Black-breasted Button-quail Offset Areas

Offset AU	Area available (ha)	Site description	RE present	BBBQ habitat	BBBQ evidence	HCSS	Threats	Disturbances/weeds	Connectivity
2	0.71	Lot 1RP35055	12.11.3	Yes - eucalypt open forest with vine forest and lantana understorey	Platelets (GHD 2017)	Yes	Edge effects, possible predation by cats, wild dogs etc	Weeds (dense lantana, cats claw creeper and passionflower), edge effects	Some connectivity to Woondum SF via vegetated freehold property (Gympie Cooloola Pet Resort)
4	2.72	Lot 1RP35055	12.11.10	Yes - lowland rainforest TEC present (Araucarian vine forest)	Platelets (GHD 2017)	Yes	Edge effects, possible predation by cats, wild dogs etc	Logging track, low weed cover (lantana), ephemeral drainage line with low erosion risk (moderately stable), difficult to access	Some connectivity to Woondum SF via vegetated freehold property (Gympie Cooloola Pet Resort)
5	5.16	Lot 1RP35055	12.11.3	Yes - eucalypt open forest with vine forest understorey	Platelets (GHD 2017)	Yes	Edge effects, possible predation by cats, wild dogs etc	Adjoins patches with weeds, logging, some erosion	Some connectivity to Woondum SF via vegetated freehold properties (Lot 2RP891751 and Gympie Cooloola Pet Resort)
30	2.04	Lot 1RP35055	12.11.10	Yes - eucalypt open forest with some vine forest (not rainforest or TEC)	Platelets (GHD 2017)	Yes	Edge effects, possible predation by cats, wild dogs etc	Logging, dense weed cover (lantana, cat's claw), waterway with channel erosion (stable due to rocks)	Some connectivity to Woondum SF via vegetated freehold properties (Lot 2RP891751 and Gympie Cooloola Pet Resort)

Offset AU	Area available (ha)	Site description	RE present	BBBQ habitat	BBBQ evidence	HCSS	Threats	Disturbances/weeds	Connectivity
32	0.68	Lot 2RP891751	12.11.3	Potential	Same vegetation community as recorded platelets	Potential	Possible predation by cats, wild dogs etc	Adjoins patches with weeds, logging, some erosion	Directly connected to Woondum SF
33	1.16	Lot 2RP891751	12.11.10	Potential	Same vegetation community as recorded platelets	Potential	Edge effects, possible predation by cats, wild dogs etc	Logging, dense weed cover (lantana, cat's claw), waterway with channel erosion (stable due to rocks)	Directly connected to Woondum SF
27	10.68	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	12.11.3	Yes - eucalypt open forest with rainforest elements in understorey)	Platelets (BAAM 2015; ERM 2016; GHD 2017)	Yes	Future logging of State Forest, close to existing Bruce Highway, possible predation by cats, wild dogs etc	Logging, low weed cover (lantana, Brazilian nightshade, cadaghi), no waterway, no erosion	Currently connected to Woondum SF, however will be isolated by road alignment. Fauna underpass proposed.
Total	**23.15**								

3.3.2.1.3 Habitat Quality Scoring

A summary of the habitat quality scoring for the black-breasted button quail impact and offset areas is provided in Table 29 and Table 30 below respectively.

Table 29 Black-breasted Button-quail Impact Area Habitat Quality Scoring

Impact Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
1	5.63	Lot 983FTY1488 (Woondum SF)	8	9.6	9	8.9	0.7	6.2
2	2.45	Lot 983FTY1488 (Woondum SF), 2 small areas within Keefton Road reserve	8	9.2	6	7.7	0.3	2.3
Total	**8.08**							**8.5**

Table 30 Black-breasted Button-quail Offset Site Habitat Quality Scoring

Offset Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
2	0.71	Lot 1RP35055	8	7.3	6	7.1	0.03	0.2
4	2.72	Lot 1RP35055	8	7.3	7	7.4	0.12	0.9
5	5.16	Lot 1RP35055	7	6.9	8	7.3	0.22	1.6
30	2.04	Lot 1RP35055	8	7.3	7	7.4	0.09	0.7
32	0.68	Lot 2RP891751	7	7.3	5	6.4	0.03	0.2
33	1.16	Lot 2RP891751	8	7.3	5	6.4	0.05	0.3
27	10.68	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	8	7.3	5	8.1	0.46	3.7
Total	**23.15**							**7.6**

3.3.2.1.4 Direct Offset Assessment Guide

Table 31 provides the descriptions and justification of inputs to the offset assessment guide calculator for the black-breasted button-quail. A copy of the offset assessment guide is provided in Appendix E.

Table 31 Black-breasted Button-quail Offset Calculator Guide

Components	Description of Input	Calculator Input
IMPACT CALCULATOR		
Area of habitat	8.08 ha of black-breasted button-quail habitat with a habitat quality score of 8.5 (rounded up to 9 in calculator) to be impacted	Total quantum of impact (adjusted) = 7.27 ha
OFFSET CALCULATOR		
Time over which loss is averted (max. 20 years)	A 20 year period has been applied as the land will be legally secured	20 years
Time until ecological benefit	A 3 year period has been applied as there is existing black-breasted button-quail habitat value at this site, proposed quarterly pest animal control program targeting cats, foxes, wild dogs and pigs within approximately 5 km of the offset site for a period of three years, and additional protection and management measures proposed through weed control, fencing, monitoring and maintenance of fauna connectivity structures for usage, and monitoring for additional disturbances to be managed.	3 years
Start area (hectares)	23.15 ha in total for TMR-owned lots and revocated State Forest land	23.15 ha
Start quality (scale of 0-10)	A total weighted habitat quality score of 7.6 has been derived for TMR-owned lots. The majority of assessment units considered to contain habitat critical to the survival of the black-breasted button-quail with generally high scores for each habitat quality component.	7.6 (rounded up to 8 in calculator)
Risk of loss (%) without offset	If the offset sites are not legally secured they are at risk of being sold and potentially cleared for agricultural, industrial, commercial forestry or rural residential purposes, consistent with surrounding land uses and the town planning intents for the freehold sites. Additional disturbances are likely to occur without the offset site being protected due to increasing pressures from surrounding land uses, fragmentation, edge effects, pest flora and pest fauna such as wild dogs that are known to occur. There are pressures on the land that would not necessarily trigger an approval process resulting in protection of the black-breasted button-quail habitat, thereby not result in an offsets requirement for future impacts. The parcels of land are currently State Forest (to be revocated due to severance by the Project from remaining Woondum State Forest areas) zoned Environmental Management and freehold zoned Rural and Industry Investigation Area. There are a number of accepted development purposes for these zoned areas, which do not	50 %

Components	Description of Input	Calculator Input
	trigger assessment under the planning scheme and therefore do not necessarily require an approval. Risk of loss was considered to not be higher than 50% due to the existing protections afforded under the EPBC Act, *Nature Conservation Act 1999* (NC Act) and VM Act regarding the mapped regulated vegetation and wildlife habitat, therefore making the offset area unlikely to be able to be clear-felled for one particular development in the future. Risk of loss was considered to not be lower than 50% because of the existing and surrounding land uses that would be continued and likely intensified (without the need for an approval) if the offset proposal does not proceed. The risk of loss assessment is described further below.	
Future quality without offset (scale of 0-10)	Without protection, the habitat quality is considered likely to decrease due to increasing disturbances through public and stock/domestic animal access, feral animal predation, clearing, fragmentation, weed infestation, edge effects.	7
Risk of loss (%) with offset	The site will be legally secured therefore will not be lost.	0 %
Future quality with offset (scale of 0-10)	The site will be legally secured, therefore the habitat quality will not be at risk of future clearing or major disturbances. Due to connectivity to large areas of potential habitat, the ability for black-breasted button-quail to move into and through offset sites and the removal of disturbing factors such as cattle grazing and human activities and added protection against injury or mortality through exclusion fencing along the road corridors and feral animal control programs, the condition and species stocking rate will be able to increase. This will in turn increase the habitat quality of the offset sites overall. Fauna passage will be provided between the fragmented part of Woondum State Forest to maintain connectivity to the large areas of adjacent habitat. Additional measures to supplement land-based offsets for black-breasted button-quail include a quarterly pest animal control program targeting cats, foxes, wild dogs and pigs within approximately 5 km of the offset site for a period of three years.	9
Confidence in result	There is a high degree of confidence in this assessment due to repeated survey efforts over several years and covering large areas of the impact and offset sites that have provided comprehensive data on habitat quality and values for species. Assessment methods are consistent and undertaken at representative locations. Impact extents are clearly defined and offsets will be secured and monitored prior to any construction impacts occurring.	90 %

Risk of Loss Assessment

The offset sites include two freehold lots currently zoned Industry Investigation and Rural under the local government planning scheme (Gympie Regional Council Planning Scheme 2013) with no existing land clearing covenants. The third portion is currently State Forest tenure that is zoned as Environmental Management under the planning scheme, however will be severed by the Project and likely converted to a different tenure.

An assessment of the potential pressures considered likely to contribute to the risk of loss of the existing black-breasted button-quail habitat was undertaken, should the offset site not be legally secured. This assessment included a likelihood of occurrence assessment, which considered the following factors that were found to increase the risk of loss of the offset area (without the offset in place):

- A number of accepted development purposes for the Rural and Industry Investigation zone, which do not trigger assessment under the planning scheme, including animal husbandry/keeping, cropping, dwelling house, emergency services, roadside stall, rural industry (including storage, processing and packaging of products from a rural use), tourist attraction, utility installation and wholesale nursery. A utility installation can occur in the Environmental Management zone without further assessment triggered under the planning scheme. **HIGHLY LIKELY**
- Mapped Least Concern Regional Ecosystem on freehold land has a number of exemptions (i.e. no assessment required) for clearing under the VM Act and Planning Regulation, including for urban purposes (e.g. industrial, recreational, residential, sporting, commercial), forestry, to maintain infrastructure, to source construction timber, to establish necessary built infrastructure less than 2 ha or a fence or road up to 10 m wide, or clearing under an accepted development vegetation clearing code (such as clearing for necessary property infrastructure in a rural area). The lower status of the vegetation and lack of other mapped matters of State significance (other than regulated vegetation intersecting a watercourse) mean that the requirement for offsets are not necessarily triggered for assessable activities over this land. **HIGHLY LIKELY**
- The freehold properties contain native hardwood forest (identified as RE 12.11.3 and 12.11.5) and rainforest (RE 12.11.10), within which a landholder can undertake an ongoing native forestry practice in accordance with the 'Managing a native forest practice' accepted development vegetation clearing code made under the VM Act without further approval assessment being triggered. **POSSIBLE**
- Although the local government planning scheme limits the lot size to 100 ha minimum in the Industry and Rural zoning, there are lots subdivided down to less than 2 ha size within the same zoning surrounding the offset site (less than 1 km from the offset lot). Some of these lots contain very little remaining vegetation. Encroaching residential and industrial development and land use will increase the threats to this habitat area. **HIGHLY LIKELY**
- There were previously mineral exploration permits over the sites (historically and as recently as 2016), which indicates that future resource exploration permits could be granted and potentially allow exploration activities on or adjacent the offset area. **POSSIBLE**
- Without the revocated parcel of State Forest being secured as an offset site, this may be sold and subject to a change in tenure which could allow for certain developments, encroachments or other human activities to occur that could cause the site to not be able to support the black-breasted button-quail. **POSSIBLE**

Result

The result of the Offsets Assessment Guide indicates that:

- Based on a total impact area of 8.08 ha with a habitat quality score of 9 (adjusted area of 7.27 ha)
- Based on a legally secured offset site of 23.15 ha with a current and expected future habitat quality of 8 and 9 respectively, and

- Assuming that the offset site was not legally secured the risk of averting the loss of the site is 50% and the quality of the land will decrease to a habitat quality score of 7

the proposed offset site provides a 152.36% direct offset.

3.3.2.2 Details of Direct Offset

Details of the direct offset strategy for the black-breasted button-quail are provided in Table 32.

Table 32 Direct Offset Strategy – Black-breasted Button-quail

Aspect	Description
Type of offset	Direct offset
Location	Lot 1RP35055 (habitat on eastern boundary) Lot 2RP891751 (habitat on eastern boundary) Lot 983FTY1488 (Woondum State Forest portion severed west of alignment)
Suitability and values	Suitable black-breasted button-quail habitat known to be present on-site (assessed through field surveys of habitat characteristics and evidence of feeding platelets observed). Approximately 23.15 ha of black-breasted button-quail habitat given a habitat quality score of 7.6.
Land tenure	Lot 1 and 2 – Freehold, owned by TMR Lot 983 – currently State Forest, to be revocated as part of the Project.
Method of securing	Land portions containing habitat values (for this and other MNES) will be converted to State Forest tenure, managed by the Department of National Parks, Sport and Racing, and protected from clearing or future logging under the Forestry Act. Should the land conversion not be successfully agreed to between Departments, TMR will provide legal protection over the land parcels to prevent clearing from occurring. Protection will either be in the form of a covenant or Nature Refuge and will be determined following consultation with the Department of National Parks, Sport and Racing. TMR will notify DEE once confirmation is received and which method of securing is proposed.
Management	The offset will be managed by Department of National Parks, Sport and Racing under the Forestry Act (or by TMR or a nominated entity as required through legally securing the offset area). An Offset Management Plan will be prepared that outlines the management of the offset areas for the black-breasted button-quail and will include actions, timing, reporting, corrective actions and responsibilities for the following activities to be undertaken: • Annual monitoring of the black-breasted button-quail habitat to assess any changes to condition or extent, including evidence of species usage of the site (direct observations or feeding platelets), evidence of predators, and habitat condition aspects such as extent of weed infestations, eroding land, and presence of water. • Monitoring and management of weed infestations (including cat's claw creeper, Brazilian nightshade and passionflower vines) to maintain habitat extent and free movement of black-breasted button-quail through offset areas and between offset areas. • Removal of any internal fencing that restricts movements (such as barbwire fencing) within or between habitat areas.

Aspect	Description
	• Removal of human activities (such as rural residential, forestry and stock grazing) and public access. • Complete restriction of vehicle access to prevent vehicle strike. • Fauna exclusion fencing installed where the offset vegetation adjoins the existing or proposed Bruce Highway road corridor or the North Coast Railway to prevent koala strike. • Monitoring and management of the regrowth of revegetated areas within and adjacent to the fauna connectivity structures post the completion of the establishment phase (refer Section 2.4.2). • Monitoring the use of fauna connectivity structures connecting habitats and maintenance of the structures, as required, where they connect to offset parcels to promote continued use.
Estimated cost	$330,000
Outcomes	The outcomes proposed to be achieved for the duration of the offset for black-breasted button-quail are: • Protect and manage existing populations. • Maintain or improve the extent, condition (quality) and connectivity of black-breasted button-quail habitat. • Reduce the impacts of introduced predators and competitors. These outcomes were based on priority objectives within the below listed conservation advice, recovery plan and threat abatement plan documents.
Risks	Risks associated with achieving the outcomes include: • Other development in connected habitat areas having an impact on the local black-breasted button-quail population • Weed infestations that are not controlled may impact the habitat quality and condition for black-breasted button-quail • If disease or pathogens are introduced, they may be difficult to eradicate or prevent from spreading between individuals (fauna or flora) • Extreme weather events cause damage to the habitat within the offset area, therefore reducing its occupancy by black-breasted button-quail • Failure of the fauna connectivity structures to provide habitat connectivity

Aspect	Description
Measurability of outcome	The Offset Management Plan will include monitoring schedules and recording requirements for habitat conditions, on-site black-breasted button-quail usage, evidence of weeds and evidence of threats such as predators/livestock and pathogens/disease. Specific performance and management measures and reporting will be included in the Plan (see Management Measures below). Existing populations can be measured through direct observation and feeding platelet searches in accordance with the Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010). The maintenance or improvement of black-breasted button-quail habitat can be measured through field assessments of vegetation community structure and species, abundance of leaf litter, evidence of threats to habitat such as fire, weeds and predators, and evidence of habitat degradation, and can be compared with the baseline data from the Project and offset site desktop and field assessments. The reduction of impacts from predators or competitors can be measured through site assessment of evidence of predators, including species and abundance, and effectiveness of feral animal control program as detailed in Table 33 below.
Baseline data	These outcomes are derived from baseline data collected during field surveys, particularly relating to habitat characteristics and conditions, vegetation community descriptions, species presence and abundance and presence of threatening processes. Baseline data can also be sourced from local community/action groups regarding local sightings and desktop sources such as Atlas of Living Australia and Wildlife Online for historical records. Evidence of disturbance or degradation will also be used to compare the baseline data with the offset area. This baseline data will be relied upon to monitor and assess the habitat quality and condition and any changes, improvement or threats to the offset area. The Offset Management Plan will detail the monitoring and reporting schedule and methods.
Conservation gains	Conservation gains to be achieved by these outcomes include: • The maintenance and improvement of habitat quality for the species • Protection of an otherwise unprotected area where the species occurs • Obtaining more detailed information relating to the abundance of the local population • Maintaining connectivity of the habitat with large areas of remnant vegetation community within Woondum State Forest, which will reduce the potential for threats to impact the species and habitat through provided more movement opportunities and habitat available for occupancy • Active monitoring and management of threats • Engaging in weed management strategies along Six Mile Creek that actively protect the TEC present in the vicinity of the Project from the introduction or spread of weeds (the management of which aids in the overall recovery of the TEC • Engaging in strategies that actively protect the species from the introduction or spread of threats (through the indirect offsets proposal in Table 33 below), the management of which aids in the overall recovery of the species.

Aspect	Description
Conservation advice	These outcomes have been nominated with consideration of the recovery objectives listed in the National Recovery Plan for the Black-breasted Button-quail (Mathieson and Smith, 2009), the Approved Conservation Advice for *Turnix melanogaster* (black-breasted button-quail) (TSSC, 2015), the onsite habitat characteristics and the potential impacts of the Project. The Threat Abatement Plans for feral cats, feral pigs and European red fox have also been considered.
Audit	The Offset Management Plan will include an auditing schedule that assesses the performance of the monitoring and management strategies in achieving the outcomes.
Assessment of level of control	If TMR is not the owner, TMR will ensure an agreement is in place for the implementation of monitoring and maintenance in accordance with the Offset Management Plan.
Management measures	Monitoring: • One monitoring event will be undertaken prior to the offset commencing in order to establish the monitoring locations and provide an initial baseline for the monitoring program within the offset site. Monitoring data will then be collected annually from the time the offset area is legally secured, for a minimum of 5 years. • Provisions for additional monitoring and adaptive management will be included in the Offset Management Plan in the case that the milestones or performance indicators have not been achieved by the end of the minimum 5 year term. Milestones: • At 3 years after the start of the offset, feral animal predator numbers have been substantially reduced, major weed infestations have been controlled and no additional disturbances to the offset areas have been observed. • At 5 years after the start of the offset, the habitat has been maintained or improved, habitat connection is present and no increase in threats have occurred. Performance indicators: • Abundance of black-breasted button-quail population is maintained or increased. • Habitat quality is maintained within offset areas. • Maintain black-breasted button-quail habitat connectivity and safe movements between the eastern and western sides of the Project. • No increase of impacts from introduced predators or competitors. Further details of monitoring, adaptive management/corrective actions, record keeping, publication and reporting procedures will be included in the Offset Management Plan.

3.3.2.3 Details of Indirect Offset

The Significant Impact Assessment report submitted as Appendix K of the referral identified the following threats to the black-breasted button-quail:

- degradation of habitat by livestock and feral pigs (*Sus scrofa*)
- degradation and loss of habitat due to inappropriate fire regimes (i.e. high intensity or frequency)

- predation by feral animals such as feral pigs (*Sus scrofa*), cats (*Felis catus*) and foxes (*Vulpes vulpes)*

TMR recognises that the Project will result in the loss and fragmentation of habitat and whilst land is being secured as a direct offset, the department is committed to providing additional protection of the species. TMR have negotiated a pest control program in collaboration with GRC that is outlined below in Table 33.

Table 33 Black-breasted Button-quail – Feral Animal Control

Aspect	Description
Type of offset	Indirect
Program	A quarterly pest animal control program targeting cats, foxes, wild dogs and pigs within approximately 5 km of the offset site for a period of three years.
Management	The project will be managed by GRC as they have the expertise, qualifications and knowledge to best achieve the outcomes for the project.
Cost	$20,000/yr (at 2017 prices) for three years (total $60,000)
Reporting	GRC will provide TMR with the following: • Program of works and methodology within three months of project award • Annual report documenting outcomes of the pest control program.
Outcome	Reduction of feral animals
Risks	Feral animals may return after the program is complete
Measurability of outcome	Capture of feral animals within a defined radius of the offset site
Baseline data	GRC have a knowledge of feral animal activity within their council area and will survey relevant landholders as part of the preparation of their control program.
Conservation gains	Reduce predation of the black-breasted button-quail
Consistent with conservation advice	These outcomes have been nominated with consideration of the recovery objectives listed in the National Recovery Plan for the Black-breasted Button-quail (Mathieson and Smith, 2009), the Approved Conservation Advice for *Turnix melanogaster* (black-breasted button-quail) (TSSC, 2015), and the Threat Abatement Plans for feral cats, feral pigs and European red fox.
Audit	TMR will be in regular consultation with GRC with regard to the progress of the pest control program

Aspect	Description
Assessment of level of control	Pest animal control is a specialist activity that is required to be managed by appropriately qualified organisations. In this regard TMR have consulted with personnel at GRC with the expertise and experience in undertaking feral pest control within the region and have appointed them to manage the project as they have access to suitably qualified personnel to undertake the works in accordance with relevant legislation. TMR have undertaken a similar program as part of the Cooroy to Curra Section C: Traveston to Woondum project in collaboration with GRC which has developed a model that will be replicated as part of this program, including consultation with landholders, methodology of undertaking the works, frequency of controls and subsequent reporting.
Management measures	GRC will manage the day-to-day running of the program in accordance with the relevant legislation and consultation with local land owners. GRC will appoint suitably qualified personnel to undertake the works. GRC will provide a formal annual report to TMR updating the progress of the works and provide quarterly feedback at the completion of each 'control' phase. TMR will document the progress of the program to DEE in each annual compliance report.

3.3.3 Koala

3.3.3.1 Results of Offset Assessment Guide

3.3.3.1.1 Desktop

A summary of habitat characteristics for the koala is provided in Table 34 below.

Table 34 Summary of Koala Habitat Characteristics

Target Species / Community	Key Habitat Characteristics	Summary of Desktop Results
Koala	Habitat consists of remnant vegetation with *Eucalyptus, Corymbia, Angophora, Lophostemon* and/or *Melaleuca spp.* canopy trees	The majority of sites are mapped as supporting remnant vegetation that is potentially suitable for koala. Some sites contain or connect to essential habitat for koala. A number of sites are densely vegetated, with little value for replanting koala habitat. There are known occurrences of koala at or adjacent some sites (including Curra State Forest, Woondum State Forest and GRC Lot 19 RP226325).

3.3.3.1.2 Field Results

A description of the results of the field surveys of the impact area assessment units are provided in Table 35. A description of the results of the field surveys of the TMR and GRC offset area assessment units are provided in Table 36 and Table 37 respectively.

Table 35 Description of Koala Impact Areas

Impact AU	Area impacted (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/ weeds	Connectivity
4	1.84	Existing Bruce Highway road reserve and Lot 1 on RP35055	12.11.14	Yes - remnant vegetation with more frequent detection of koala or signs	None. Food trees present.	Yes	Small, isolated patch directly adjacent existing highway	Close to highway (noisy), high edge effects	Poor connectivity
5	22.43	From Woondum SF north to Noosa Rd intersection (Ch 136600-139000	12.11.3, 12.3.11, 12.11.14	Yes - remnant vegetation with more-less frequent detection of koala or signs	Faecal pellets recorded (USC 2016; ERM 2016)	Yes	Logging of State Forest, close to existing Bruce Highway, fragmented by roads and rail, rural properties and developed areas, possible predation by wild dogs etc	Lantana and cat's claw weeds prevalent in some areas, distant noise from highway	Connected to large contiguous patch of Woondum SF, riparian vegetation along Six Mile Creek, and some vegetation on surrounding properties
6	14.52	From Noosa Rd to Flood Rd (Ch 139200-140400)	12.11.3, 12.3.11, 12.11.5e	Yes - remnant vegetation with more-less frequent detection of koala or signs	Faecal pellets recorded (USC 2016; ERM 2016)	Yes	Area bounded by roads and rail, possible predation by dogs etc	Lantana and cat's claw weeds in some areas	Connected to moderate sized patch of remnant vegetation but overall surrounded by rural and industrial properties

Impact AU	Area impacted (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/ weeds	Connectivity
7	5.21	From Tin Can Bay Rd to Rocky Ridge Rd (Ch 144200-145600)	12.3.11, 12.9-10.17b	Yes - remnant vegetation with less frequent detection of koala or signs	None. Food trees present.	Yes	Area bounded by roads and rail, fragmented by rural residential properties, possible predation by dogs etc	Lantana and cat's claw weeds in some areas, also corky passionflower	Slightly connected to moderate sized patch of remnant vegetation
8	11.78	From Sandy Creek Rd to Belvedere Rd (Ch 146200-147400	12.11.5e, 12.3.11	Yes - remnant vegetation with less frequent detection of koala or signs	Faecal pellets recorded (USC 2016; GHD 2017)	Yes	Area bounded by roads and rail, fragmented by rural residential properties, possible predation by dogs etc, property used by horse-riders and tracks through for vehicles	Intermittent loud noise from gun club adjacent habitat, waterway heavily weed infested (lantana)	Moderate sized patch of remnant vegetation with value as regional ecological corridor (Gympie Regional Council mapping)
9	58.75	Southern Curra State Forest (Ch 151000-156700)	12.11.5e, 12.3.11	Yes - remnant vegetation with less frequent detection of koala or signs	None. Food trees present.	Yes	Logging of State Forest, close to railway and local roads and rural properties, possible predation by wild dogs etc	Logging, tracks through, some weeds	Large connected remnant area of Curra SF

Impact AU	Area impacted (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/ weeds	Connectivity
10	16.01	From Curra State Forest to Lot 889CP864404 (Ch 156700-160000)	12.9-10.4, 12.3.11, 12.9-10.17b	Yes - remnant vegetation with less frequent detection of koala or signs	Faecal pellets recorded (USC 2016)	Yes	Logging of State Forest, some local tracks and rural properties, possible predation by wild dogs etc	Logging, tracks, weeds	Edges of large connected remnant area partially within Curra SF, some fragmentation on freehold properties
11	5.29	From Lot 889CP864404 to Ashford Rd (Ch 160600-161800)	12.3.3d, 12.3.11	Yes - remnant vegetation with less frequent detection of koala or signs	Faecal pellets recorded (USC 2016; Jacobs 2015)	Yes	Rural properties, some local tracks, fragmented by clearing, possible predation by dogs etc	Logging, tracks, weeds	Fragmented patches of remnant
Total	**135.83**								

Table 36 Description of TMR Koala Offset Areas

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
2	0.71	Lot 1RP35055	12.11.3	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Weeds (dense lantana, cats claw creeper and passionflower), edge effects	Some connectivity to Woondum SF via vegetated freehold property (Gympie Cooloola Pet Resort)
3	2.37	Lot 1RP35055	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Logging, weeds (dense lantana, passionflower), waterways as mapped with low erosion risk	Some connectivity to Woondum SF via vegetated freehold property (Gympie Cooloola Pet Resort)
5	5.16	Lot 1RP35055	12.11.3	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Adjoins patch with logging, dense weed cover (lantana, cat's claw)	Some connectivity to Woondum SF via vegetated freehold properties (Lot 2RP891751 and Gympie Cooloola Pet Resort)

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
6	5.93	Lot 2RP891751	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Road, logging, low weed cover (passionflower), no waterway, close to rural residential (e.g. farmhouse)	Large contiguous patch, directly connected to Woondum SF
8	76.66	Lot 878MCH1061	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Local roads and logging tracks	Logging, tracks, fire, weeds (lantana, passionflower), no waterway, no signs of erosion on tracks	Large contiguous patch, directly connected to Curra SF
9	29.86	Lot 878MCH1061	12.9-10.17b /12.9-10.4	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Tracks and possible predation	Weeds (lantana, passionflower), logging, tracks, cattle, no waterways, minor erosion on tracks	Large contiguous patch, directly connected to Curra SF
10	3.62	Lot 4MPH23906	12.9-10.4	Yes - remnant eucalypt open forest	Yes - scat present (USC 2016)	Yes	Local roads and logging tracks	Logging, tracks, no waterways, sandy soils, no weeds	Large contiguous patch, directly connected to Curra SF
11	15.06	Lot 3MPH23906	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Weeds (lantana, passionflower), logging, waterway, no signs of erosion, no access tracks, steep terrain	Large contiguous patch, directly connected to Curra SF

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
12	3.33	Lot 1MPH23906	12.9-10.17b /12.9-10.4	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Weeds (lantana), logging, waterways, low erosion risk, no access tracks, steep terrain	Slightly fragmented patch
13	6.27	Lot 878MCH1061	12.3.11	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Weeds (lantana), fire, logging, rocky gully either side of waterway, no signs of erosion but steep terrain, access along firebreak	Large contiguous patch, directly connected to Curra SF
14	21.93	Lot 889CP864404	12.9-10.17b	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Weeds (lantana, exotic grasses), regrowth, grazing, logging, stock/horse trampling, no waterway, low erosion risk, no access track	Large contiguous patch, directly connected to Curra SF
21	2.33	Lot 1MPH6454	12.3.11	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Local tracks, possible predation	Weeds (lantana), waterway, erosion present	Large contiguous patch, directly connected to Curra SF
22	18.72	Lot 1MPH6454	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Local tracks, possible predation	Low weed cover (lantana), logging, no waterway, no erosion	Large contiguous patch, directly connected to Curra SF

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
25	1.16	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	12.11.14	Yes	Yes - previous record and adjoining evidence of scat (USC 2016)	Yes (score 9)	Future logging of State Forest, close to existing Bruce Highway, edge effects, possible predation by cats, wild dogs etc	Logging, moderate weed cover (lantana), waterway, no erosion risk	Currently connected to Woondum SF, however will be isolated by road alignment. Fauna underpass proposed.
26	0.66	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	12.3.11	Yes	Yes - adjoining evidence of scat (USC 2016)	Yes (score 9)	Future logging of State Forest, close to existing Bruce Highway, edge effects, possible predation by cats, wild dogs etc	Logging, low weed cover (lantana, Brazilian nightshade, cocos palm), waterway, some erosion risk	Currently connected to Woondum SF, however will be isolated by road alignment. Fauna underpass proposed.
27	10.68	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	12.11.3	Yes - eucalypt open forest with rainforest elements in understorey)	Yes - scat present (USC 2016)	Yes (score 9)	Future logging of State Forest, close to existing Bruce Highway, possible predation by cats, wild dogs etc	Logging, low weed cover (lantana, Brazilian nightshade cadaghi), no waterway, no erosion	Currently connected to Woondum SF, however will be isolated by road alignment. Fauna underpass proposed.

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
28	1.41	Lot 1MPH7125	12.8.24	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 6)	Adjacent to railway, local roads.	Roads, logging, high mortality of mature *E. Exserta*. Low weed cover *(Lantana, Passiflora suberosa*, *Eragrostis recurvata*, *Chloris gayana*). Erosion gully present on lower slopes – dispersive silty-clay topsoil.	Connected to Curra SF vegetation however will be fragmented by future highway
29	10.97	Lot 1MPH7125	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 6)	Adjacent to railway, local roads.	Roads, vehicle tracks, logging. Weed cover is low (lantana). Waterway present at top of gully. Rill erosion present on lower slopes and on track.	Connected to Curra SF vegetation however will be fragmented by future highway
30	2.04	Lot 1RP35055 (site survey AU5)	12.11.10	Yes - eucalypt open forest with some vine forest (not rainforest or TEC)	Scratches present. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Logging, dense weed cover (lantana, cat's claw), waterway with channel erosion (stable due to rocks)	Some connectivity to Woondum SF via vegetated freehold properties (Lot 2RP891751 and Gympie Cooloola Pet Resort)

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
31	0.7	Lot 1RP35055	12.11.5e	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Road, logging, low weed cover (passionflower), no waterway, close to rural residential (e.g. farmhouse)	Some connectivity to Woondum SF via vegetated freehold properties (Lot 2RP891751 and Gympie Cooloola Pet Resort)
32	0.68	Lot 2RP891751	12.11.3	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Possible predation by cats, wild dogs etc	Adjoins patch with logging, dense weed cover (lantana, cat's claw)	Large contiguous patch, directly connected to Woondum SF
33	1.16	Lot 2RP891751	12.11.10	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Possible predation by cats, wild dogs etc	Logging, dense weed cover (lantana, cat's claw), waterway with channel erosion (stable due to rocks)	Large contiguous patch, directly connected to Woondum SF
34	4.72	Lot 2RP891751	12.11.5e	Yes - remnant eucalypt open forest	Yes - adjoining evidence of scat (USC 2016)	Yes (score 8)	Possible predation by cats, wild dogs etc	Adjoins patch with road, logging, low weed cover (passionflower), close to rural residential (e.g. farmhouse)	Large contiguous patch, directly connected to Woondum SF

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
35	2.19	Lot 2RP891751	12.11.3	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Degraded remnant	Some connectivity to Woondum SF through regrowth vegetation, fragmented remnant patch
38	0.13	Lot 2RP891751	12.11.3	Yes - remnant eucalypt open forest	Yes - adjoining evidence of scat (USC 2016)	Yes (score 8)	Possible predation by cats, wild dogs etc	Adjoins Woondum SF with logging, low weed cover (lantana, Brazilian nightshade, cadaghi), no erosion	Large contiguous patch, directly connected to Woondum SF
40	2.39	Lot 1MPH23906	12.9-10.4	Yes - remnant eucalypt open forest	Yes - scat present (USC 2016)	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Adjoins patch with previous logging, tracks, no weeds, however also adjoins non-remnant areas	Adjoins large contiguous patch connected to Curra SF
41	0.88	Lot 1MPH23906	12.3.11	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Adjoins patch with weeds (lantana), logging, waterways, low erosion risk, no access tracks, steep terrain	Slightly fragmented patch
45	0.31	Lot 2MPH23906	12.11.5e/ 12.11.3a*	Yes - mapped remnant eucalypt open forest	None. Food trees present.	Yes (score 8)	Edge effects, possible predation by cats, wild dogs etc	Adjoins mostly cleared land within the lot	Adjoins large contiguous patch connected to Curra SF

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
46	0.79	Lot 3MPH23906	12.3.11	Yes - mapped remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Adjoins patch with weeds (lantana, passionflower), logging, waterway, no signs of erosion, no access tracks, steep terrain	Adjoins large contiguous patch connected to Curra SF
48	9.83	Lot 878MCH1061	12.9-10.4	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Adjoins patch with weeds (lantana, passionflower), logging, tracks, cattle, minor erosion on tracks	Large contiguous patch, directly connected to Curra SF
51	0.83	Lot 889CP864404	12.3.11	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Adjoins patch with weeds (lantana, exotic grasses), regrowth, grazing, logging, stock/horse trampling, low erosion risk, no access track	Large contiguous patch, directly connected to Curra SF

TMR Offset AU	Area available (ha)	Site description	RE present	Koala habitat	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
52	5.3	Lot 889CP864404	12.11.5e/ 12.11.3a*	Yes - remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Possible predation by cats, wild dogs etc	Adjoins patch with weeds (lantana, exotic grasses), regrowth, grazing, logging, stock/horse trampling, low erosion risk, no access track	Large contiguous patch, directly connected to Curra SF
55	0.14	Lot 889CP864404	12.3.11	Yes - mapped remnant eucalypt open forest	None. Food trees present.	Yes (score 9)	Edge effects, possible predation by cats, wild dogs etc	Unknown	Slightly fragmented patch
Total	**248.92**								

Table 37 Description of GRC Koala Offset Areas

GRC Offset AU	Area impacted (ha)	Site description	RE present	Koala present	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
1	1.5	Lot 1 MPH5670	12.3.11	Yes - alluvial remnant eucalypt open forest	Yes - scat present (GHD 2017)	Yes (score 6)	Edge effects, possible predation by cats, wild dogs etc	Weeds prevalent along drainage line, including lantana, blue billygoat, *Asparagus africanus*, cat's claw creeper, ochna, Chinese elm, camphor laurel, *Passiflora suberosa*, paspalum.	Moderate size patch with low connectivity due to railway, local roads and rural residential properties

GRC Offset AU	Area impacted (ha)	Site description	RE present	Koala present	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
2	4.96	Lot 1 MPH23904	12.11.5e	Yes - remnant eucalypt open forest	Food trees present. Previous records adjacent (GRC)	Yes (score 5)	Edge effects, possible predation by cats, wild dogs etc	Loss of canopy, fire disturbance and thinning. Low weed cover. Very minor runnelling. Small drainage line/gully downslope.	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
3	7.18	Lot 2 MPH14193	12.11.5e	Yes - remnant eucalypt open forest	Yes - scat present (GHD 2017)	Yes (score 6)	Edge effects, possible predation by cats, wild dogs etc	Evidence of tracks, fire damage and moderate logging. Low weed cover. Erosion of track on nearby slope.	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
4	14.25	Lot 19 RP226325	12.11.5e	Yes - remnant eucalypt open forest	Yes - scat present (USC 2016)	Yes (score 7)	Edge effects, possible predation by cats, wild dogs etc. Recreational horse riding through site.	Evidence of tracks, houses, logging and fire. Low weed cover. Frequent loud noise from gun range.	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
5	6.04	Lot 19 RP226325	12.3.11	Yes - alluvial remnant eucalypt open forest	Yes - adjoining evidence of scat (USC 2016)	Yes (score 7)	Edge effects, possible predation by cats, wild dogs etc. Recreational horse riding through site.	Evidence of tracks, erosion (track erosion rills), logging, grazing and weeds (lantana, cat's claw creeper, blue billygoat). Along drainage line (stream order 1).	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
6	11.93	Lot 19 RP226325	12.11.5e	Yes - remnant eucalypt open forest	Yes - scat present (GHD 2017)	Yes (score 7)	Edge effects, possible predation by cats, wild dogs etc. Recreational horse riding through site.	Evidence of logging, grazing and fire. Low erosion risk. Only a few weeds. No waterway present (upper slope of hill).	Moderate size patch with low connectivity due to railway, local roads and rural residential properties

GRC Offset AU	Area impacted (ha)	Site description	RE present	Koala present	Koala evidence	HCSS	Threats	Disturbances/weeds	Connectivity
7	0.89	Lot 1 MPH23904	12.3.11	Yes - alluvial remnant eucalypt open forest	Yes - adjoining evidence of scat GHD 2017; GRC)	Yes (score 5)	Edge effects, possible predation by cats, wild dogs etc	Weeds prevalent along drainage line	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
8	0.53	Lot 1 MPH5670	12.11.5e	Yes - remnant eucalypt open forest	Yes - adjoining evidence of scat GHD 2017; GRC)	Yes (score 6)	Edge effects, possible predation by cats, wild dogs etc	Evidence of tracks, fire damage and moderate logging. Low weed cover. Erosion of track on nearby slope.	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
9	0.09	Lot 2 MPH14193	12.3.11	Yes - alluvial remnant eucalypt open forest	Yes - adjoining evidence of scat GHD 2017; GRC)	Yes (score 6)	Edge effects, possible predation by cats, wild dogs etc	Weeds prevalent along drainage line	Moderate size patch with low connectivity due to railway, local roads and rural residential properties
Total	**47.37 ha**								

3.3.3.1.3 Habitat Quality Scoring

A summary of the habitat quality scoring for the koala impact areas is provided in Table 38. A summary of the habitat quality scoring for the koala TMR and GRC offset areas is provided in Table 39 and Table 40 below respectively.

Table 38 Koala Impact Site Habitat Quality Scoring

Impact Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
4	1.84	Existing Bruce Highway road reserve and Lot 1 on RP35055	7	3.1	2	4.0	0.01	0.1
5	22.43	From Woondum SF north to Noosa Rd intersection (Ch 136600-139000	8	9.2	10	9.1	0.17	1.5
6	14.52	From Noosa Rd to Flood Rd (Ch 139200-140400)	8	4.2	10	7.4	0.11	0.8
7	5.21	From Tin Can Bay Rd to Rocky Ridge Rd (Ch 144200-145600)	7	3.5	2	4.2	0.04	0.2
8	11.78	From Sandy Creek Rd to Belvedere Rd (Ch 146200-147400	8	4.6	9	7.2	0.09	0.6
9	58.75	Southern Curra State Forest (Ch 151000-156700)	8	9.6	4	7.2	0.43	3.1
10	16.01	From Curra State Forest to Lot 889CP864404 (Ch 156700-160000)	8	9.6	8	8.5	0.12	1.0
11	5.29	From Lot 889CP864404 to Ashford Rd (Ch 160600-161800)	8	6.2	4	6.1	0.04	0.2
Total	**135.83**							**7.5**

Table 39 Koala TMR Offset Area Habitat Quality Scoring

Offset Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
2	0.71	Lot 1RP35055	8	7.3	2	5.8	0.003	0.02
3	2.37	Lot 1RP35055	7	7.3	2	5.4	0.01	0.1
5	5.16	Lot 1RP35055	7	6.9	2	5.3	0.02	0.1
6	5.93	Lot 2RP891751	7	6.9	2	5.3	0.02	0.1
8	76.66	Lot 878MCH1061	8	9.6	2	6.5	0.31	2.0
9	29.86	Lot 878MCH1061	8	9.2	2	6.4	0.12	0.8
10	3.62	Lot 4MPH23906	9	9.6	4	7.5	0.01	0.1
11	15.06	Lot 3MPH23906	8	9.6	2	6.5	0.06	0.4
12	3.33	Lot 1MPH23906	8	9.2	2	6.4	0.01	0.1
13	6.27	Lot 878MCH1061	8	9.6	2	6.5	0.03	0.2
14	21.93	Lot 889CP864404	7	6.9	2	5.3	0.09	0.5
21	2.33	Lot 1MPH6454	8	10	2	6.7	0.01	0.1
22	18.72	Lot 1MPH6454	8	10	2	6.7	0.08	0.5
25	1.16	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	8	6.9	7	7.3	0.003	0.02
26	0.66	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	8	7.3	10	8.4	0.04	0.4
27	10.68	Lot 983FTY1488 (Woondum SF) (severed west of alignment)	8	7.3	10	8.4	0.04	0.4
28	1.41	Lot 1MPH7125	8	9.6	2	6.5	0.01	0.04
29	10.97	Lot 1MPH7125	8	9.6	2	6.5	0.04	0.3

Offset Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
30	2.04	Lot 1RP35055 (site survey AU5)	8	7.3	2	5.8	0.01	0.05
31	0.7	Lot 1RP35055	7	7.3	2	5.4	0.003	0.02
32	0.68	Lot 2RP891751	7	7.3	2	5.4	0.003	0.01
33	1.16	Lot 2RP891751	8	7.3	2	5.8	0.005	0.03
34	4.72	Lot 2RP891751	7	6.2	9	7.4	0.02	0.1
35	2.19	Lot 2RP891751	5	15	2	2.8	0.01	0.02
38	0.13	Lot 2RP891751	9	6.9	9	8.3	0.001	0.004
40	2.39	Lot 1MPH23906	8	9.2	9	8.7	0.010	0.08
41	0.88	Lot 1MPH23906	7	9.2	3	6.4	0.004	0.02
45	0.31	Lot 2MPH23906	7	9.6	2	6.2	0.001	0.01
46	0.79	Lot 3MPH23906	7	10	2	6.3	0.003	0.02
48	9.83	Lot 878MCH1061	7	9.2	2	6.1	0.039	0.24
51	0.83	Lot 889CP864404	6	7.3	2	5.1	0.003	0.002
52	5.3	Lot 889CP864404	6	7.3	2	5.1	0.021	0.11
55	0.14	Lot 889CP864404	6	6.9	2	5.0	0.001	0.003
Total	**248.92**							**6.4**

Table 40 Koala GRC offset area habitat quality scoring

Offset Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
1	1.5	Lot 1 MPH5670	8	5.4	4	5.80	0.03	0.18
2	4.96	Lot 1 MPH23904	9	5.4	2	5.47	0.10	0.57

Offset Au	Area (ha)	Site description	Site condition	Site Context	Species Stocking Rate	Combined Score	Size Weighting	Weighted Score
3	7.18	Lot 2 MPH14193	8	5.4	4	5.80	0.15	0.88
4	14.25	Lot 19 RP226325	8	4.6	7	6.53	0.30	1.97
5	6.04	Lot 19 RP226325	7	4.6	3	4.87	0.13	0.62
6	11.93	Lot 19 RP226325	8	4.2	4	5.40	0.25	1.36
7	0.89	Lot 1 MPH23904	8	5.4	4	5.80	0.02	0.11
8	0.53	Lot 1 MPH5670	8	5.4	2	5.13	0.01	0.06
9	0.09	Lot 2 MPH14193	8	5.4	4	5.80	0.002	0.01
Total								**5.8**

3.3.3.1.4 Direct Offset Assessment Guide

Table 41 provides the descriptions and justification of inputs to the offset assessment guide calculator for the koala. A copy of the offset assessment guide is provided in Appendix E.

Table 41 Koala Offset Calculator Guide

Components	Description of Input	Calculator Input
IMPACT CALCULATOR		
Area of habitat	135.8 ha of koala habitat with a habitat quality score of 7.5 (rounded up to 8 in calculator) to be impacted	Total quantum of impact (adjusted) = 108.66 ha
OFFSET CALCULATOR		
Time over which loss is averted (max. 20 years)	A 20 year period has been applied as the land will be legally secured	20 years
Time until ecological benefit	A 3 year period has been applied as there is existing koala habitat value at this site, proposed wild dog control program within approximately 5 km of the offset sites, and additional protection and management measures proposed through weed control, fencing, monitoring and	3 years

Components	Description of Input	Calculator Input
	maintenance of fauna connectivity structures for usage, and monitoring for additional disturbances to be managed.	
Start area (hectares)	248.92 ha in total for TMR-owned lots	248.92 ha
	47.37 ha in total for GRC-owned lots included in assessment	47.37 ha
	TOTAL	**296.29 ha**
Start quality (scale of 0-10)	A total weighted habitat quality score of 6.4 has been derived for TMR-owned lots. All assessment units considered to contain habitat critical to the survival of the koala with generally high site condition and context scores but varying species stocking rates.	6.4
	A total weighted habitat quality score of 5.8 has been derived for GRC-owned lots. All assessment units considered to contain habitat critical to the survival of the koala with generally high site condition but relatively low context scores and varying species stocking rates.	5.8
	COMBINED WEIGHTED SCORE	**6.3 (rounded down to 6 in the calculator)**
Risk of loss (%) without offset	If the offset sites are not legally secured they are at risk of being sold and potentially cleared for agricultural, industrial, commercial forestry or rural residential purposes, consistent with surrounding land uses and the town planning intents for some of the sites. Additional disturbances are likely to occur without the offset site being protected due to increasing pressures from surrounding land uses, fragmentation, edge effects, pest flora and pest fauna such as wild dogs that are known to occur. There are pressures on the land that would not necessarily trigger an approval process resulting in protection of the koala habitat (such as incremental, smaller clearing areas of lower habitat value), thereby not result in an offsets requirement for future impacts. The parcels of land are currently State Forest (to be revocated due to severance by the Project from remaining Woondum State Forest areas) zoned Environmental Management and freehold lots zoned Industry Investigation Area, Rural and Rural Residential. There are a number of accepted development purposes for these zones, which do not trigger assessment under the planning scheme and therefore do not necessarily require an approval. Risk of loss was considered to not be higher than 50% due to the existing protections afforded under the EPBC Act, *Nature Conservation Act 1999* (NC Act) and VM Act regarding mapped	50 %

Components	Description of Input	Calculator Input
	regulated vegetation and wildlife habitat, therefore making the offset areas that contain these characteristics unlikely to be able to be clear-felled for one particular development in the future. Risk of loss was considered to not be lower than 50% because of the existing and surrounding land uses that would be continued and likely intensified (without the need for an approval) if the offset proposal does not proceed. The risk of loss assessment is described further below.	
Future quality without offset (scale of 0-10)	Without protection, the habitat quality is considered likely to decrease due to increasing disturbances through increased public and domestic/stock access, clearing, fragmentation, increasing wild dog populations, increased urbanisation, edge effects, introduction and spread of weed infestations.	5
Risk of loss (%) with offset	The sites will be legally secured therefore will not be lost.	0 %
Future quality with offset (scale of 0-10)	The offset sites will be legally secured, therefore the habitat quality will not be at risk of future clearing or major disturbances/development. Due to increased connectivity to large areas of koala habitat, increased ability for koalas to move into and through offset sites, the removal of disturbing factors such as cattle grazing and human activities, and added protection against injury or mortality through exclusion fencing along road and rail corridors and wild dog control programs, the condition and species stocking rate will be able to increase. This will in turn increase the habitat quality of the offset sites overall. Adjacent areas of previously cleared or regrowth vegetation will be allowed to naturally regenerate in a managed way, which will provide additional koala habitat within the offset sites. Additional measures to supplement land-based offsets for koala include wild dog control for three years within a 5 km radius of the Project area and offset sites.	8
Confidence in result	There is a high degree of confidence in this assessment due to repeated survey efforts over several years and covering large areas of the impact and offset sites have provided comprehensive data on habitat quality and koala presence. Assessment methods are consistent and undertaken at representative locations. Impact extents are clearly defined and offsets will be in place prior to any construction impacts occurring.	90 %

Risk of Loss Assessment

The offset sites include a number of freehold lots currently zoned Industry Investigation, Rural Residential and Rural under the local government planning scheme (Gympie Regional Council Planning Scheme 2013) with no existing land clearing covenants. One land parcel is currently State Forest tenure that is zoned as Environmental Management under the planning scheme, however will be severed by the Project and likely converted to a different tenure.

An assessment of the potential pressures considered likely to contribute to the risk of loss of the existing koala habitat was undertaken, should the offset site not be legally secured. This assessment included a likelihood of occurrence assessment, which considered the following factors that were found to increase the risk of loss of the offset area (without the offset in place):

- Continuing use rights and grazing activities would continue to exist without the offset in place on a number of the offset sites, where there would be a likely increase in extent and intensity of agricultural activities that reduce the areas of koala habitat gradually over time without triggering the need for referral, therefore increasing the risk of loss. **HIGHLY LIKELY**
- A number of accepted development purposes for the Rural, Rural Residential and Industry Investigation zone, which do not trigger assessment under the planning scheme, including animal husbandry/keeping, cropping, dwelling house, emergency services, roadside stall, rural industry (including storage, processing and packaging of products from a rural use), tourist attraction, park, utility installation and wholesale nursery. A utility installation can occur in the Environmental Management zone without further assessment triggered under the planning scheme. **HIGHLY LIKELY**
- Areas mapped as Of Concern and Least Concern Regional Ecosystem on freehold tenured land have a number of exemptions (i.e. no assessment required) for clearing under the VM Act and Planning Regulation, including for urban purposes (e.g. industrial, recreational, residential, sporting, commercial), forestry, to maintain infrastructure, to source construction timber, to establish necessary built infrastructure less than 2 ha or a fence or road up to 10 m wide, or clearing under an accepted development vegetation clearing code (such as clearing for necessary property infrastructure in a rural area). The lower status of the vegetation and lack of other mapped matters of State significance (other than regulated vegetation intersecting a watercourse) mean that the requirement for offsets are not necessarily triggered for assessable activities over this land. **HIGHLY LIKELY**
- The majority of the freehold properties contain native hardwood forest (such as RE 12.11.3 and 12.11.5) and some with rainforest (RE 12.11.10), within which a landholder can undertake an ongoing native forestry practice in accordance with the 'Managing a native forest practice' accepted development vegetation clearing code made under the VM Act without further approval assessment being triggered. **POSSIBLE**
- Although the local government planning scheme limits the lot size to 100 ha minimum in the Industry and Rural zoning, there are lots subdivided down to less than 2 ha size within the same zoning surrounding the offset sites (less than 1 km from some of the offset lots). The Rural Residential zoned lots can be subdivided to 0.4 ha size. Some of these subdivided lots contain very little remaining vegetation. Encroaching residential and industrial development and land use will increase the threats to this habitat area. **HIGHLY LIKELY**
- There were previously mineral exploration permits over the offset sites (historically and as recently as 2016), which indicates that future resource exploration permits could be granted and potentially allow exploration activities on or adjacent the offset area. **POSSIBLE**
- Without the revocated parcel of State Forest being secured as an offset site, this may be sold and subject to a change in tenure which could allow for certain developments, encroachments or other human activities to occur that could cause the site to not be able to support the koala. **POSSIBLE**
- Should a future proposed development within one of the offset areas be assessable under the Planning Act, an offset would only be required if a significant residual impact to habitat for koalas was considered likely, which may not be the case for separate smaller developments with incremental impacts. **LIKELY**

- The offset area is outside the South East Queensland Koala Protection Area (SEQ KPA), which provides additional protection to mapped koala habitat under the Planning Act and NC Act. There is no mapped koala habitat over the sites, therefore no approval requirements relating to mapped koala habitat. A State government supported infrastructure project outside of this SEQ KPA, which is otherwise exempt from assessment against State legislation such as the VM Act, is not required to undertake a self-assessment or provide offsets for removing individual non-juvenile koala habitat trees, which could encroach on the offset areas where upgrades or new alignments to transport, electricity or utility pipeline corridors are proposed. **POSSIBLE**

Result

The result of the Offsets Assessment Guide indicates that:

- Based on a total impact area of 135.8 ha with a habitat quality score of 8
- Based on a legally secured offset site of 296.29 ha with a current habitat quality of 6, a future habitat quality of 8, and
- Assuming that the offset site was not legally secured the risk of averting the loss of the site is 50% and the quality of the land will decrease to a habitat quality score of 5

the proposed offset site provides a 130.9% direct offset.

The offset area for GRC is still being confirmed and may increase further, thereby increasing the amount of direct offset area available for the koala.

3.3.3.2 Direct Offset

The details of the direct offset strategy for the koala are provided in Table 42.

Table 42 Direct Offset Strategy – Koala

Aspect	Description
Type of offset	Direct offset
Location	Lot 1 RP35055 (habitat on eastern boundary) Lot 2 RP891751 Lot 983 FTY1488 Lot 878 MCH1061 Lot 4 MPH23906 Lot 3 MPH23906 Lot 2 MPH23906 Lot 1 MPH23906 Lot 889 CP864404 Lot 1 MPH6454 Lot 1 MPH7125 The additional sites owned by GRC to be included as part of the offset are being finalised but the following have currently been included in the assessment: Lot 19 RP226325 Lot 2 MPH14193 Lot 1 MPH5670 Lot 1 MPH23904
Suitability and values	Suitable koala habitat known to be present on-site (assessed through field surveys of habitat characteristics and faecal pellets observed). Approximately 296.29 ha of koala habitat given a habitat quality score of 6 (includes GRC lots listed above).
Land tenure	Freehold, all owned by TMR, apart from GRC owned land parcels and Lot 983 (currently State Forest, to be revocated as part of the Project).

Aspect	Description
Method of securing	Land portions containing habitat values (for this and other MNES) will be converted to State Forest tenure, managed by the Department of National Parks, Sport and Racing, and protected from clearing or future logging under the Forestry Act. Should the land conversion not be successfully agreed to between Departments, TMR will provide legal protection over the land parcels to prevent clearing from occurring .Protection will either be in the form of a covenant or Nature Refuge and will be determined following consultation with the Department of National Parks, Sport and Racing. TMR will notify DEE once confirmation is received and which method of securing is proposed. Lot 983 FTY1488 will be managed by TMR and be legally secured in the form of a covenant or Nature Refuge. GRC-owned land will be protected by Council.
Management	The offset will be managed by Department of National Parks, Sport and Racing under the Forestry Act, TMR and GRC on the applicable lots. An Offset Management Plan will be prepared that outlines the management of the offset areas for the koala and will include actions, timing, reporting, corrective actions and responsibilities for the following activities to be undertaken: • Annual monitoring of the koala habitat to assess any changes to condition or extent, including evidence of koala usage of the site (direct observations or abundance of faecal pellets using the Spot Assessment Technique as per Phillips and Callaghan (2011)), evidence of predators, plant pathogens affecting koala food trees, and habitat condition aspects such as extent of weed infestations, eroding land, and presence of water. • Monitoring and management of weed infestations to maintain free movement of koalas and regeneration of food trees. Major weed infestations will be initially identified and then progressively eradicated and/or restricted from spreading into other high quality habitat areas as needed. • Removal of any internal fencing that restricts koala movements (such as barbwire fencing) within or between habitat areas. • Removal of human activities (such as rural residential and stock grazing) and public access. • Restriction of vehicle access (to authorised vehicles only) to prevent koala strike. • Fauna exclusion fencing installed where the offset vegetation adjoins the existing or proposed Bruce Highway road corridor or the North Coast Railway to prevent koala strike. • Installation, repair and maintenance of fencing to prevent damaging or threatening livestock or domestic animal access as appropriate to maintaining koala habitat values, or unauthorised access to these habitat areas. • Monitoring and management of the regrowth of revegetated areas within and adjacent to the dedicated fauna connectivity structures post the completion of the establishment phase

Aspect	Description
	• Three years of wild dog abatement program within a 5 km radius of the Project area and including the offset sites (to be run by GRC – refer to Section 3.3.3.3 for further details).
Estimated cost	$2.6 million
Outcomes	The outcomes proposed to be achieved for the duration of the offset for koala are: • Conserve koalas in their existing habitats. • Maintain corridors and connective habitat that allow movement of koalas between large areas of habitat. • Reduce the impacts of introduced predators. These outcomes were based on priority objectives within the below listed conservation advice, recovery plan and threat abatement plan documents.
Risks	Risks associated with achieving the outcomes include: • Other development in connected habitat areas having an impact on the local koala population • Weed infestations that are not controlled may impact the habitat quality and condition for koalas • If pathogens or diseases are introduced, they may be difficult to eradicate or prevent from spreading between individuals (fauna or flora) • Extreme weather events cause damage to the habitat within the offset area, therefore reducing its use by koala
Measurability of outcome	The Offset Management Plan will include monitoring schedules and recording requirements for habitat conditions, on-site koala usage, evidence of weeds and evidence of threats such as predators or inappropriate livestock presence and pathogens/disease. Specific performance and management measures and reporting will be included in the Plan (see Management Measures below). Existing koala populations can be measured through direct observation and faecal pellet searches in accordance with the Spot Assessment Technique (Phillips and Callaghan, 2011). The maintenance of corridors or connective koala habitat can be measured through field assessments of vegetation community structure, abundance of food tree species, barriers to movement, evidence of disturbance to/degradation of habitat such as fire and weeds, and can be compared with the baseline data from the Project and offset site desktop and field assessments. The reduction of impacts from predators can be measured through site assessment of evidence of predators, including species and abundance, and effectiveness of wild dog abatement program as detailed in Table 43 below.
Baseline data	These outcomes are derived from baseline data collected during field surveys, particularly relating to habitat characteristics and conditions, vegetation community descriptions, koala utilisation rates (using Spot Assessment Technique surveys) and dominant food species for koalas. Baseline data can also be sourced from local community/action groups regarding local sightings of koalas and desktop sources such as Atlas of Living Australia and Wildlife Online for historical records. Evidence of disturbance or degradation will also be used to compare the baseline data with the offset area. This baseline data will be relied upon to monitor and assess the habitat quality and condition and any changes, improvement or threats to the offset area. The Offset Management Plan will detail the monitoring and reporting schedule and methods.

Aspect	Description
Conservation gains	Conservation gains to be achieved by these outcomes include: • The maintenance and improvement of habitat quality for the species • Protection of otherwise unprotected areas where the species occurs, occasionally in relatively high numbers • Obtaining more detailed information relating to the abundance of the local koala population • Maintaining connectivity of suitable habitat with large areas of remnant vegetation community within Woondum and Curra State Forest, which will reduce the potential for threats to impact the species and habitat through provided more movement opportunities and habitat available for occupancy • Active monitoring and management of threats • Engaging in strategies that actively protect the species from the introduction or spread of threats (through the indirect offsets proposal in Table 43 below), the management of which aids in the overall recovery of the species.
Conservation advice	These outcomes have been nominated with consideration of the recovery objectives listed in the Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC, 2008), Priority Management Actions within the Commonwealth Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (TSSC, 2012), the EPBC Act referral guidelines for the vulnerable koala (DEE, 2014), the onsite habitat characteristics and the potential impacts of the Project. The key threats to the koala (as per the DECC Recovery Plan) include habitat loss and fragmentation, habitat degradation, road kills, dog attacks, fire, logging, disease, severe weather conditions, swimming pools, and overbrowsing (leading to starvation). Priority management actions or objectives listed in the Conservation Advice DECC Recovery Plan for the koala that this offset provision is consistent with include: • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary • Formal conservation arrangements or inclusion in reserve tenure • Develop and implement options of vegetation recovery and re-connection in regions containing fragmented koala populations • Develop and implement a management plan to control the adverse impacts of predation on koalas • Conserve koalas in their existing habitat • Rehabilitate and restore koala habitat and populations • Manage overbrowsing to prevent koala starvation and ecosystem damage
Audit	The Offset Management Plan will include an auditing schedule that assesses the performance of the monitoring and management strategies in achieving the outcomes.
Assessment of level of control	If TMR is not the owner, TMR will ensure an agreement is in place for the implementation of monitoring and maintenance in accordance with the Offset Management Plan.
Management measures	Density and abundance of koala food trees is maintained or increased. Threats that have been identified have not spread or increased. Monitoring:

Aspect	Description
	• One monitoring event will be undertaken prior to the offset commencing in order to establish the monitoring locations and provide an initial baseline for the monitoring program within the offset site. Monitoring data will then be collected annually from the time the offset area is legally secured, for a minimum of 5 years. • Provisions for additional monitoring and adaptive management will be included in the Offset Management Plan in the case that the milestones or performance indicators have not been achieved by the end of the minimum 5 year term. Milestones: • At 3 years after the start of the offset, wild dog numbers have been substantially reduced, major weed infestations have been controlled and no additional disturbances to the offset areas have been observed • At 5 years after the start of the offset, the habitat has been maintained or improved and no increase in threats have occurred. Performance indicators: • Maintain or improve safe koala movement in areas of frequent detection of koala • Abundance of koala population is maintained or increased. • No increase of impacts from introduced predators. Further details of monitoring, adaptive management/corrective actions, record keeping, publication and reporting procedures will be included in the Offset Management Plan.

3.3.3.3 Indirect Offset

Predation of koalas by wild dogs is a principal threat to koalas. Following the success of the wild dog abatement program on the Bruce Highway Cooroy to Curra Section C (Woondum to Curra) project, TMR have committed to fund a program on the Section D Project and extend the duration adopted on the Section C project from one to three years. Details of the program are provided in Table 43 below.

Table 43 Koala – Wild Dog Abatement Program

Aspect	Description
Type of offset	Indirect
Program	Contribution of $80,000 per annum for three years towards GRC's wild dog abatement program within a 5 km radius of the Section D Project alignment.
Management	The project will be managed by GRC as they have the expertise, qualifications and knowledge to best achieve the outcomes for the project.
Cost	$80,000 per annum (at 2017 prices) for three years (total $240.000)
Reporting	GRC will provide TMR with the following: • Program of works and methodology within three months of project award • Annual report documenting outcomes of the pest control program.
Outcome	Reduction of wild dog numbers

Aspect	Description
Risks	Wild dogs may return after the program is complete
Measurability of outcome	Capture of wild dogs within a defined radius of the offset sites
Baseline data	GRC have a knowledge of feral animal activity within their council area and will survey relevant landholders as part of the preparation of their control program.
Conservation gains	Reduce predation of the koala
Consistent with conservation advice	These outcomes have been nominated with consideration of the recovery objectives listed in the Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC, 2008), Priority Management Actions within the Commonwealth Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (TSSC, 2012), the EPBC Act referral guidelines for the vulnerable koala (DEE, 2014), the onsite habitat characteristics and the potential impacts of the Project.
Audit	TMR will be in regular consultation with GRC with regard to the progress of the pest control program
Assessment of level of control	Pest animal control is a specialist activity that is required to be managed by appropriately qualified organisations. In this regard TMR have consulted with personnel at GRC with the expertise and experience in undertaking feral pest control within the region and have appointed them to manage the project as they have access to suitably qualified personnel to undertake the works in accordance with relevant legislation. TMR have undertaken a similar program as part of the Cooroy to Curra Section C: Traveston to Woondum project in collaboration with GRC which has developed a model that will be replicated as part of this program, including consultation with landholders, methodology of undertaking the works, frequency of controls and subsequent reporting.
Management measures	GRC will manage the day-to-day running of the program in accordance with the relevant legislation and consultation with local land owners. GRC will appoint suitably qualified personnel to undertake the works. GRC will provide a formal annual report to TMR updating the progress of the works and provide quarterly feedback at the completion of each 'control' phase. TMR will document the progress of the program to DEE in each annual compliance report.

3.3.4 Macrozamia pauli-guilielmi

3.3.4.1 Results of Offset Assessment

3.3.4.1.1 Desktop

A summary of habitat characteristics for the *M. pauli-guilielmi* is provided in Table 44 below.

Table 44 Summary of *M. pauli-guilielmi* Habitat Characteristics

Target Species / Community	Key Habitat Characteristics	Summary of Desktop Results
Macrozamia pauli-guilielmi	Habitat consists of lowland (5 – 230 m altitude) open forest or woodland (wallum) dominated by banksias or eucalypts, or in shrub land or heath land, generally on stabilised sand dunes. This may occur in RE 12.9-10.17b, 12.3.11, 12.9-10.4 and 12.11.5e that are known to occur in the region (also recorded in non-remnant areas and pine plantations)	A number of sites support regional ecosystems that support *M. pauli-guilielmi*. A number of these properties were identified as being of low value for relocating *M. pauli-guilielmi* where the property is already densely vegetated. There are known occurrences of *M. pauli-guilielmi* at or adjacent some sites (including Curra State Forest, TMR Lots 4 on MPH23906 and 889 on CP864404, and GRC Lot 14MCH5065).

3.3.4.1.2 Field Results

Targeted flora surveys undertaken in the study area over a total of 24 days (by BAAM in March and May 2015 and February 2016 (BAAM 2016) and by GHD in July 2016 (GHD 2016) and April 2017) identified three distinct and highly localised sub-populations of *M. pauli-guilielmi* in the Contract 2 portion of the study area, with a fourth sub-population confirmed 1.2 km north-east of the Project impact area. Of the four sub-populations identified, only two (sub-populations 2 and 3) will be impacted (directly and indirectly) by the Project, which are described in Table 45. The remaining two sub-populations (1 and 4) are located sufficient distance away from the Project area that they will not be impacted (directly or indirectly) by the Project.

Table 45 Description of *M. pauli-guilielmi* Impact Sites

Impacted sub-population	Plants directly impacted	Plants close to Project area (distance, m)	Habitat description
2	33 adults 84 seedlings	28 adults 25 seedlings (1 m to 50 m)	**Structure and position:** Remnant open forest, canopy height 14 to 18 m, on hill crest and north-facing and south-facing slopes between two creeks. RE 12.9-10.4 **Tree 1 layer:** *Eucalyptus racemosa* subsp. *racemosa* (dominant), with *E. acmenoides*, *Corymbia trachyphloia*, *C. intermedia* and *Angophora leiocarpa* subdominant. **Tree 2 layer:** *Acacia disparrima* (dominant) with *Alphitonia excelsa* and *Banksia integrifolia* associated. **Shrub layer:** *Lantana camara** (dominant) with scattered *B. integrifolia*, *A. disparrima*, *A. excelsa* and *Leucopogon juniperinus.* **Ground layer:** *Imperata cylindrical* (dominant) with *Lomandra multiflora*, *Hibbertia* sp., *Xanthorrhoea johnsonii* and *Gahnia aspera*. **Substrate:** Soft sand derived from sandstone, several sandstone outcrops through the sub-population. **Comments:** A few *M. pauli-guilielmi* individuals becoming overgrown by *L. camara**.
3	15 adults 83 seedlings	None	**Structure and position:** Remnant open forest, canopy height 15 to 20 m, on lower, gently sloping north-facing footslope adjacent to creek. RE 12.9-10.4 **Tree 1 layer:** *E. racemosa* subsp. *racemosa, E. propinqua, C. intermedia, A. leiocarpa*. **Tree 2 layer:** *Lophostemon suaveolens, A. disparrima*.

Impacted sub-population	Plants directly impacted	Plants close to Project area (distance, m)	Habitat description
			Shrub layer: *L. camara** (dominant), saplings of Tree 1 layer and Tree 2 layer species. **Ground layer:** *Aristida gracilipes, I. cylindrica* and *T. triandra,* with *L. multiflora, X. johnsonii* and *G. aspera*. **Substrate:** Soft sand derived from sandstone, sandstone outcrop nearby. **Comments:** A few *M. pauli-guilielmi* individuals becoming overgrown by *P. suberosa** weeds; habitat of southern end of population subject to substantial recent logging.
Total direct impact	**215**		
Total for translocation	**48 adults 167 seedlings**	**28 adults, 25 seedlings (1 m to 50 m)**	

Areas of suitable habitat for translocation of the species were identified as remnant vegetation on soils derived from sandstone (land zone 10). The occurrences of similar vegetation communities in proximity to sub-population 4 (not impacted by the Project) and the sites of impact were identified using the RE mapping (namely RE 12.9-10.17b and RE 12.9-10.4). Suitable habitat areas to the west or south of the Project were excluded from consideration due to the potential isolation of these areas by the Project. Other criteria for assessing suitability of translocation recipient sites include:

- The presence of *M. pauli-guilielmi* individuals in close proximity as an indication of habitat suitability
- On-site match of substrate, being light grey-white sandy soils
- Suitable size of the recipient site such that the required planting configuration can be achieved
- Suitable habitat is readily accessible through existing tracks.

The preferred recipient site (refer to Table 46) was surveyed in April 2017, during which a *M. pauli-guilielmi* individual in good condition was recorded within the potentially suitable habitat area. Additional individuals were also observed close to the existing access track in an August 2017 site visit with TMR and NPSR. The vegetation community was observed to be *Eucalyptus racemosa subsp. racemosa* dominant woodland (consistent with RE 12.9-10.4) with a median canopy height of 20 m with approximately 40 percent canopy cover, 20-40 percent shrub layer cover and 10 percent ground layer cover.

Table 46 Description of *M. pauli-guilielmi* Offset (Translocation) Site

Potential recipient site	Relevant features of the site	Overall suitability
Lot 878 on MCH1061 **Freehold** **Owned by TMR**	• Individuals confirmed present in close proximity to planting area • Large area of suitable habitat that could be used • Vegetation community matches the impact site, being RE 12.9-10.4 • Substrate matches the impact site, being light grey-white sandy soils • Lower slope of a hill with a southerly aspect	High (preferred)

Potential recipient site	Relevant features of the site	Overall suitability
	• Within 1 km of sub-population 4 and connected through remnant vegetation with low potential for fragmentation • Close proximity to impact site (sub-population 2) and slightly separated from Project area • Readily accessible for translocation works and monitoring along existing tracks • Planting can be undertaken along an existing but unutilised track, which will avoid unnecessary disturbance of adjacent vegetation and existing individuals	

The impact of the Project on *M. pauli-guilielmi* is quantified as the total number of adult plants and seedlings that will be subject to direct impacts and that are therefore to be translocated (215 individual plants). All potentially indirectly impacted adults and seedlings, together with any identified ungerminated seeds, shall also be salvaged and translocated with the aim of establishing a sufficient number of juvenile plants in situations where they are not subject to interference competition with adult plants.

3.3.4.1.3 Direct Offset Assessment Guide

As the translocation of 215 individuals is considered by the DEE to be a compensatory measure, the proposed direct offset is the propagation of seedlings from collected seeds that will compensate for predicted losses during the translocation process of up to 12%.

TMR have committed to offsetting adult *M. pauli-guilielmi* lost during the translocation process at a ratio of 4:1 (higher than considered necessary for this species due to the proven success of translocations and also higher than previously approved projects), and calculated at a mortality rate of 12% (higher than the typical 10% or below experienced by this species during translocation). This is over and above previous projects that have considered a mortality rate of 10% to be an acceptable loss during replacement, and which have only replaced individuals that die beyond that rate.

Maintenance and monitoring will be carried out on translocated and propagated and planted individuals for a total of 5 years, including regular watering, weed control, protection from disturbance, insecticide application and the replacement of adult plants that have died for at least the first two years after translocation. Replacement individuals will be propagated and planted within two years of the translocation occurring, and will be established, monitored and maintained for the same duration as the translocated individuals.

The result of the Offsets Assessment Guide indicates that:

- Based on a total impact of 10 adult plants
- Based on the propagation of at least 40 plants to replace 12% mortality at a ratio of 4:1 and planting within a legally secured offset site with a current value of at least 5 plants where translocation is to occur, and
- Assuming that the future value (without offset) of the site is 20 plants,

the proposed propagation and replacement of plants (potentially lost through the translocation process) provides a 175.76% direct offset.

The following table provides the descriptions and justification of inputs to the offset assessment guide calculators for *M. pauli-guilielmi.* A copy of the offset assessment guide is provided in Appendix E.

Table 47 *M. pauli-guilielmi* Offset Calculator Guide

Components	Description of Input	Calculator Input
IMPACT CALCULATOR		
Number of individuals	Number of individuals is 10 due to the potential loss of up to 12% of the 76 adult plants to be translocated. The number of plants to be translocated is based on multiple survey events within the impact area and sub-populations. The mortality rate of 12% is based on documented mortality rates for this species in the local region.	10 plants
OFFSET CALCULATOR		
Time horizon (years)	A 2 year period has been applied as the translocation and offset areas will be provided before construction commences (therefore before the impacts occur).	2 years
Start value	An estimated value of 5 has been applied for the current value at the offset site, as there are currently a few individual *M. pauli-guilielmi* plants at the offset site.	5 plants
Future value without offset	An estimated value of 20 has been applied as there may be some natural reproduction of the current individual *M. pauli-guilielmi* plants at the offset site.	20 plants
Future value with offset	A value of 40 has been applied with consideration of the following: • The translocation of 76 adult plants to be directly and indirectly impacted • A potential 12% mortality rate (considered to be conservative based on the known success of translocating this species and associated reported mortality rates) = potential loss of 10 translocated adult plants (12% of 76) • Propagation of plants from seeds collected prior to the translocation commencing to replace possible mortality of the 76 adult plants at a rate of 4:1 (considered to be a conservative replacement rate based on the known success rate of translocating this species) = 40 replacement plants (10 x 4) • Therefore future value = 40 replacement plants (not including plants existing at offset site, and successfully translocated adults, seedlings and ungerminated seeds collected from the impact site proposed to be dispersed at offset site during translocation works) This species has a high success rate for translocation and the Translocation Management Plan has been prepared in accordance with the species recovery plan and the methodology in the Translocation Management Plan reviewed by the Queensland Herbarium. The Translocation Management Plan will also be assessed for approval prior to the translocation through the State clearing permit	40 plants

Components	Description of Input	Calculator Input
	requirements. Offset site measures will also include six-month maintenance program with watering at least once per month, weed control and replacement of adult plants, and five year monitoring program. The land will be legally secured.	
Confidence in result	There is a high degree of confidence in this assessment due to repeated survey efforts over several years and the high suitability of the proposed offset site as *M. pauli-guilielmi* habitat. The offset site is highly accessible, is in close proximity to existing populations, including the populations to be impacted, and is connected to large areas of potential habitat associated with existing State Forest. Impact extents are clearly defined and offsets will be in place prior to any construction impacts occurring. Given that *M. pauli-guilielmi* has been successfully translocated within the local region and is readily propagated from seed, the expected success of the proposed translocation is high.	90 %

3.3.4.2 Direct and Indirect Offset

The impact of the Project on *M. pauli-guilielmi* is quantified as the total number of adult plants that will be subject to direct impacts and that are therefore to be translocated. All potentially indirectly impacted adults and seedlings, together with any identified ungerminated seeds, shall also be salvaged and translocated with the aim of establishing a sufficient number of juvenile plants in situations where they are not subject to interference competition with adult plants. The majority of seedlings are naturally closely associated with adult female plants, leading to the expectation that most seedlings will naturally perish due to interference competition with the adult plants; therefore the translocation of these seedlings to lower densities than at existing locations has the potential to increase the long-term number of individuals in the sub-population and its area of occupancy.

In addition, propagation of seedlings from collected seeds will be undertaken in order to compensate for any mortality of adult plants as a result of translocation given that up to 12 % mortality of adult plants can be expected to occur (if the plants are translocated at an appropriate time, otherwise mortality rates may be greater) and seedling and juvenile plants may experience relatively high mortality before reaching maturity. Therefore, to effectively account for and manage the risks of mortality of adults over the longer term as a result of the translocation, a specific objective of the offset strategy shall be to successfully propagate and establish at least four juvenile plants for every one adult that dies during the translocation monitoring period. Seed collection and propagation will commence prior to and during the translocation process, and therefore prior to the impact occurring.

Due to the evidence that seed death can be naturally high due to predation and fire, and that many seedlings are destroyed by fire, competition or predation, it is considered that the appropriate translocation and management of seeds and 167 seedlings (in addition to the 76 adults directly and indirectly impacted) will provide a greater population number at the offset site than would likely have resulted at the impact site long-term if left undisturbed. Also, as reported by Vegetation Matters (2015) during a previous translocation of this species, the loss of individuals at the site was compensated by the emergence of seedlings from seed spread at the time of the translocation, resulting in an overall net gain of plants at the site after a period of two years. Therefore it is not proposed to replace seedlings that die due to the greater potential for them to survive at the managed offset site than they would have naturally and for the greater potential for seeds to germinate to increase the population numbers.

The direct and compensatory (indirect) offset strategy details for *M. pauli-guilielmi* are provided in Table 48.

Table 48 Offset Strategy – *M. Pauli-guilielmi*

Aspect	Description
Type of offset	Direct offset (propagation and planting) and compensatory offset (translocation of impacted plants)
Location	Lot 878 MCH1061
Suitability and values	Suitable *M. pauli-guilielmi* habitat known to be present on-site (assessed through desktop assessment and field surveys for habitat characteristics matching the impact site and for confirmation of individuals present). Approximately 7 ha of suitable habitat with a proposed planting area of approximately 0.6 ha and a start value of at least 5 existing plants (shown in Translocation Management Plan (Appendix C).
Land tenure	Freehold, owned by TMR
Method of securing	Land portions containing habitat values (for this and other MNES) will be converted to State Forest tenure, managed by the Department of National Parks, Sport and Racing, and protected from clearing or future logging under the Forestry Act. Should the land conversion not be successfully agreed to between Departments, TMR will provide legal protection over the land parcel to prevent clearing from occurring. Protection will either be in the form of a covenant or Nature Refuge and will be determined following consultation with the Department of National Parks, Sport and Racing. TMR will notify DEE once confirmation is received and which method of securing is proposed.
Management	The offset will be managed by Department of National Parks, Sport and Racing under the Forestry Act (or by TMR or a nominated entity as required through legally securing the offset area). The translocation process and monitoring and maintenance program over the initial 5 years following translocation will be managed in accordance with the Translocation Management Plan (Appendix C). An Offset Management Plan will be prepared that outlines the management of the offset area and will include actions, timing, reporting, corrective actions and responsibilities for the following activities to be undertaken: • Propagated individuals will be propagated within 2 years of the translocation occurring, and will be established, monitored and maintained for the same duration as the translocated individuals in accordance with the Translocation Management Plan. • Livestock and domestic animals will be removed/excluded (using appropriate fencing) from the offset/translocation area. • Human activities or unauthorised access (pedestrian or vehicle) will be restricted from the area. • Weed management, monitoring and maintenance (including adaptive management) will be undertaken in accordance with the Translocation Management Plan.
Estimated cost	$500,000
Outcomes	The outcomes proposed to be achieved for the duration of the offset for *M. pauli-guilielmi* are: • Achieve a net gain in the numbers of the species in suitable habitat • Improve or maintain the protection and viability of the local *M. pauli-guilielmi* sub-population • Effectively account for and manage the risks of the translocation not succeeding. These outcomes were based on priority objectives within the below listed conservation advice documents.

Aspect	Description
Risks	Risks associated with achieving the outcomes include: • Limited viable seed collected in order to propagate enough plants within 2 years of translocation commencing • Other impacts reducing the number of individuals in the sub-populations prior to translocation works commencing (e.g. timber harvesting activities within Curra State Forest areas) • Disturbance to the translocation recipient (offset) site prior to any translocation works occurring that reduce the habitat value for the species and presence of individuals (e.g. bushfire, major weed infestation, feral animal/livestock invasion) • Weed infestations that are not controlled may impact the habitat quality and ability for *M. pauli-guilielmi* to regenerate and disperse • If plant pathogens are introduced, they may be difficult to eradicate or prevent from spreading between individual plants and species • Extreme weather events cause damage to the habitat within the offset area, therefore reducing the extent or condition of available suitable habitat
Measurability of outcome	The Translocation Management Plan includes monitoring schedules, milestones and hold points, maintenance requirements, adaptive management strategies and recording requirements for the translocation process and site (also see Management Measures below). The outcomes can be measured by: • Counts of individual adult plants and seedlings, number of coning individuals, and condition of plants (evidence of yellowing or dead foliage), compared with the baseline of adult plants, seedlings and ungerminated seeds translocated • Any changes to area of occupancy of plants at the site, compared to the post-translocation area of occupancy • Monitoring of disturbance and land degradation at each monitoring event, including weeds, feral animals, damage to fences
Baseline data	These outcomes are derived from baseline data collected during field surveys, particularly relating to habitat characteristics and conditions, vegetation community descriptions, species presence and abundance, evidence of recruitment/seedlings, area of occupancy, land degradation, and presence of threatening processes such as extent of weed cover. This baseline data will be relied upon to monitor and assess the habitat quality and condition and any changes, improvement or threats to the offset area. The Translocation Management Plan details the monitoring and reporting schedule and methods. Additional baseline information will be gathered prior to the translocation process commencing, at both the impact and offset sites.
Conservation gains	Conservation gains to be achieved by these outcomes include • Protection of an otherwise unprotected area where the *M. pauli-guilielmi* occurs • Maintenance and improvement of existing *M. pauli-guilielmi* sub-population and habitat • Maintaining connectivity of the *M. pauli-guilielmi* habitat with large areas of remnant vegetation community within Curra State Forest, which will reduce the potential for threats to impact the species and habitat • Active monitoring and management of threats

Aspect	Description
	• Propagation of the species to increase the total number of individuals in the sub-population
Consistent with conservation advice	These outcomes have been nominated with consideration of the recovery objectives listed in the *National Multi-species Recovery Plan for Cycads* (Queensland Herbarium, 2007), the Translocation Management Plan (Appendix C), the onsite habitat characteristics and the potential impacts of the Project. Key threats to *M. pauli-guilielmi* include habitat loss and clearing of plants, illegal removal of plants by cycad collectors (for which the potential is greater in closer proximity to roads), too-frequent fires that kill seedlings and juvenile plants, loss of individuals affecting the ability of the species to be viable into the future, and loss of critical pollinators and mycorrhizal fungi (Queensland Herbarium 2007; DEE 2018). The Translocation Management Plan was prepared with consideration of: • Review of the National Guidelines for the Translocation of Threatened Plants in Australia (Vallee et al., 2004), a Translocation Protocol for Cycads in Queensland (Forster, 2004), and the National Multi-species Recovery Plan for Cycads (Queensland Herbarium, 2007) • A review of two approved translocation plans previously developed for the translocation of *M. pauli-guilielmi* as conditions of approval under the EPBC Act, namely AECOM (2011) and OPUS (2012) • The results of monitoring the translocation success of a previous translocation of *M. pauli-guilielmi*, and recommendations for translocation and monitoring provided therein, as reported in Vegetation Matters (2013, 2015) • Consultation and advice received from Dr Paul Forster, Principal Botanist at the Queensland Herbarium and lead author of the national cycad recovery plan and the translocation protocol.
Audit	The outcomes will be audited by TMR through reporting to be submitted by the translocation contractor in accordance with the establishment and monitoring schedule within the Translocation Management Plan. TMR will prepare and submit two Translocation Performance Reports (within 3 months of completion of the translocation process and within 3 months of completion of the establishment period (2 years after translocation).
Assessment of level of control	If TMR is not the owner, TMR will ensure an agreement is in place for the implementation of monitoring and maintenance in accordance with the Offset Management Plan. TMR will appoint suitably qualified and experienced translocation contractors to undertake the works.
Management measures	Prior to translocation: • The offset (translocation) site will be surveyed in accordance with the EHP Flora Survey Guidelines – Protected Plants (EHP, 2016) prior to translocation to identify any protected plants present within 100 m of the planting area, to clearly identify them on site, and to prepare an impact management plan to ensure such plants are not disturbed during the translocation process • Weed hygiene protocol developed • Internal fencing will be removed to facilitate access and improve the planting area • Livestock will be removed/excluded from the offset/translocation area • Human activities or unauthorised access will be restricted from the area Establishment period: • Translocation will occur as per the Translocation Management Plan. Watering, weed control, opportunistic monitoring and assessment of any damage or

Aspect	Description
	disturbance will occur once every 2 weeks for seedlings and juveniles and once every four weeks for adults for first 6 months after translocation. Application of insecticide will occur if new leaf growth or leaves with greater than 25% insect damage. Monitoring period: • Monitoring will occur twice per year for 2 years and then once per year for the following 3 years (total of 5 years) in accordance with the Translocation Management Plan. Monitoring will include attributes of habitat condition and species recruitment, condition of translocated and propagated plants, and any evidence of land degradation, plant pathogens, weeds, feral animals/livestock, human activity, and damage to fences or access routes. Milestones: • At 5 years after the translocation, there is a net increase in the number of plants for the sub-population, the offset site habitat has been maintained or improved, and no increase in threats have occurred. Performance indicators: • A net gain in the numbers of *M. pauli-guilielmi* in suitable habitat • The local *M. pauli-guilielmi* sub-population is protected from future disturbance The translocation contractor will submit Translocation Report to TMR within 1 month of translocation works being completed and a Translocation Monitoring Report once per year for 5 years. Further details of responsibilities monitoring, adaptive management/corrective actions, record keeping, and reporting procedures are included in the Translocation Management Plan.

3.3.5 Compliance with EPBC Act Offset Policy

The proposed offsets have been developed in accordance with the overarching principles and aims of the EPBC Act and EPBC Act Environmental Offsets Policy (DEE, 2012), as outlined in Table 49.

Table 49 Offset Proposal Compliance with EPBC Act Environmental Offsets Policy

Offset Principles	Compliance
Suitable offsets must:	
1. deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	The proposed offset sites will be legally secured and contain suitable habitat for the target MNES that will be maintained and improved through removal of major threats (i.e. clearing, grazing livestock, pest fauna). Indirect offset measures will also be undertaken to complement the direct land-based offsets, including mapping and management of cat's claw creeper in the TEC and predator control programs for cats, foxes, wild dogs and pigs.
2. be built around direct offsets but may include other compensatory measures	The proposed offset sites achieve over 100 % of the direct offset requirements for each MNES. Additional compensatory measures are included, such as weed control within TEC habitat in the region, wild dog control within koala habitat and pest control in black-breasted button-quail habitat.

Offset Principles	Compliance
3 be in proportion to the level of statutory protection that applies to the protected matter	The offset proposal has been defined based on the EPBC Act Offsets Assessment Guide, and therefore is considered consistent with the statutory protection that applies to the MNES.
4. be of a size and scale proportionate to the residual impacts on the protected matter	The offset proposal has been defined based on the EPBC Act Offsets Assessment Guide, and therefore is considered to be of a size and scale proportionate to the residual impacts on the MNES. Additional indirect offset measures proposed will ensure that the offsets provided are effective and are a greater compensation than that required.
5. effectively account for and manage the risks of the offset not succeeding	The offset sites contain suitable habitat for the MNES, are currently either owned by TMR, or are owned and will be managed by GRC under an agreement, and will be transferred to State Forest or otherwise legally secured prior to the impacts occurring and protected from clearing, therefore there is a low risk of the offset not succeeding. The Offset Management Plan/s will detail management actions to be implemented with timeframes and performance objectives. Management measures will include maintenance of fauna passage between habitats and restriction of access and fencing, as appropriate. Weed control and invasive fauna pest control will occur in some areas. The *M. pauli-guilielmi* translocation management plan prescribes the translocation activities, maintenance and monitoring, corrective actions and reporting required.
6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The proposed offset sites are not otherwise protected or conserved (the proposed offset area that is currently State Forest will be revocated prior to the impact occurring due to the separation of this land from the remainder of the State Forest, therefore will become unprotected if not used as an offset). The Queensland Environmental Offsets Policy recognises that requirements for offsets for MNES under the EPBC Act do not need to be duplicated where the same impact and prescribed matter have been subject to assessment under the EPBC Act as a controlled action.
7. be efficient, effective, timely, transparent, scientifically robust and reasonable	The proposed offsets have used established and scientifically robust methods and will be delivered prior to the impacts occurring to the MNES. Assessments and monitoring and management programs proposed are based on documented priority management actions and species profile information, recovery plans and threat abatement plans.
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	Detailed Offset Management Plan/s will be developed for the offset sites, including management actions, timeframes and monitoring periods, and reporting mechanisms. The *M. pauli-guilielmi* translocation management plan prescribes the translocation activities, maintenance and monitoring, corrective actions and reporting required and will be subject to State approval processes prior to translocation taking place.

3.4 Offset Summary

A summary of the offset proposal for the Project is provided in Table 50.

Table 50 Offset Summary

MNES	Offset type	Description
TEC	Direct land based offset	2.72 ha of land, including weed control and monitoring
	Indirect offset	Cats claw creeper control program
BBBQ	Direct land based offset	23.15 ha of land including weed control and monitoring
	Indirect offset	Feral animal control
Koala	Direct land based offset	248.92 ha of land including weed control and monitoring
	Direct land based offset (GRC)	47.37 ha of land including weed control and monitoring
	Indirect offset	Wild dog abatement program
M. Pauili-guiliemi	Direct	Propagation of seedlings from collected seeds that will compensate for losses during the translocation process of up to 12%.

3.5 Clause 3.3 – Offset Proposal Limitations

3.5.1 Study Limitations

The following limitations were identified for this study:

- The field assessment locations and number of sites were limited by available access routes within land parcels. Results are based on sample data from the sites that were accessible and able to be surveyed within assessment units. Where available, desktop information such as previous records and habitat mapping was used to inform apparent gaps in survey data.
- Vegetation condition was assessed at a point in time and in representative locations and can change rapidly in response to events such as fire.
- Where the TMR-owned sites intersected with the BAAM 2015 field-verified RE mapping, this mapping was cross-checked with the DNRM RE version 8.0 mapping to ensure the most accurate field-verified REs were used wherever possible. Where there was a difference, this was noted or information used to supplement any information gaps if required. However due to the BAAM mapping not extending completely across the TMR-owned land, GRC-owned land or State Forest land, the DNRM RE version 8.0 mapping (supplemented by current field verification) was generally used as the base mapping.

- Some assumptions regarding species stocking rates were made where available information was lacking for species and known populations in the region and in the broader context. This was required in order to divide scores out of 10 into categories of increasing species presence and abundance.
- The habitat quality scores can only be entered as whole amounts in the offset assessment guide calculator, therefore habitat quality scores have been rounded up or down to the nearest integer accordingly.

4. Economic and Social Matters

This section provides details of the public and Indigenous stakeholder consultation activities undertaken throughout the planning phases of the Project and the outcomes.

Community consultation was undertaken during the Strategic Planning phase between 2004 and 2008 (ARUP, 2008). Meetings, newsletters, community consultative committees, focus groups and a number of public displays were used during this time to provide information to the community and encourage public comment on the proposed alignment for the highway. In July 2008, the Strategic Planning Study Recommended Corridor Report was released and in September of that year it was endorsed by the Australian Government. Community consultation during the Strategic Planning phase was a key consideration in identifying the recommended highway alignment for the Project.

Consultation during the Business Case phase focussed on directly impacted stakeholders and interested community groups such as Mary River Catchment Coordination Committee (MRCCC), Native Title Applicants, Gympie Regional Council, Queensland Rail, Energex, the Department of Natural Resources and Mines, developers with an interest in impacted land parcels and state and federal government environmental regulators. Feedback from the Department of Infrastructure and Regional Development (federal funding partner) was also a key consideration during the development of the Business Case.

Consultation during this phase, enabled TMR to:

- identify environmental risks and constraints
- obtain agreement about standards required for local road connections (with consideration of future developments and traffic movements)
- confirm current and future infrastructure requirements and locations with public utility providers and Queensland Rail
- obtain an understanding of potential impacts on properties, business operations and cultural heritage
- identify areas for further investigation as part of the Detailed Design phase of the Project.

Consultation with key stakeholders during the Business Case enabled detailed identification of risks and opportunities and improved confidence in the recommended option.

During the Detailed Design phase, consultation continued with key stakeholders including directly impacted property and business owners, Native Title Applicants, environmental interest groups including Koala Action Group Gympie and MRCCC, transport operators, emergency service providers, service authorities, local government, state and federal elected representatives, state and federal environmental regulatory bodies and the Department of Infrastructure and Regional Development. The objectives of this consultation included:

- finalisation of property resumptions to secure the corridor
- identification of environmental risks and mitigation options (impacts to waterways, flora and fauna species, noise pollution, rehabilitation and management of sensitive areas, Environment Protection and Biodiversity Conservation Act requirements)
- continuation of negotiations for the management and preservation of Cultural Heritage within the Project
- identification of options for mitigating impacts to business operations during and post construction
- finalisation of the design to incorporate feedback from key stakeholders where feasible
- development of risk management strategies for the future construction phase.

Project team representatives met with representatives from the MRCCC during the Detailed Design phase to discuss the Project and potential impacts. The MRCCC has been involved in all sections of the Bruce Highway (Cooroy to Curra) upgrade, including monitoring the water quality of the catchment of Section D and

Section C projects during the Detailed Design phases and through the construction stages of Sections A and B.

Several enquiries were received from the general public and residents within 500 metres of the highway corridor via the project freecall hotline and email address during the Detailed Design phase. The majority of enquiries related to connectivity to the local road network, delivery time-frames for the project and potential impacts to amenity (particularly noise impacts for nearby residents). Commentary from these stakeholders suggests there is an acceptance of the need for the project and an understanding of the benefits it will deliver.

Presentations were also delivered to community groups, including the Gympie and Cooloola Rotary Clubs, and the Gympie Probus Club, to provide information on the project scope, need, progress and benefits. Feedback from these stakeholders indicates there is strong support for the project within the general community.

A number of cultural heritage assessments have been undertaken in conjunction with the Kabi Kabi First Nation People. The desktop assessment, undertaken in 2015, concluded that the project and surrounding area has the potential to contain as yet unrecorded archaeological and cultural heritage sites. The cultural heritage field assessment, undertaken in 2016, identified four cultural heritage sites and a number of potential sub surface sites which required a test pitting programme. The test pitting program was undertaken over a four week period and 40 locations were sampled. At the end of the programme discussions were undertaken with the Kabi Kabi First Nation People to negotiate on further test pitting locations and monitoring areas. A number of site specific studies have been undertaken with the Kabi Kabi People for the Rocky Ridge site, which is believed to have non-tangible cultural heritage significant to members of the group. These studies included specific site surveys, geophysical studies, an ethnographic study and a recommendation for a number of targeted archaeological test pits. TMR are currently in the process of negotiating a Part 7 Cultural Heritage Management Plan (Voluntary) with the Kabi Kabi First People."

5. Principles of Ecologically Sustainable Development

Ecologically sustainable development (ESD) is defined in the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992) (the National Strategy) as *'development which aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations… to develop ways of using those environmental resources which form the basis of our economy in a way which maintains and, where possible, improves their range, variety and quality. At the same time we need to utilise those resources to develop industry and generate employment*' (Commonwealth of Australia, 1992). The National Strategy requires government departments to develop institutional arrangements to ensure that the principles and objectives of ESD are delivered.

TMR adheres to the principles of ESD through their Environment and Heritage Policy and Strategy. The strategy has been developed with consideration of the Queensland Government's priorities and community outcomes to build Queensland's economy, strengthen Queensland's communities and protect Queensland's environment and achieves these via a defined set of strategic opportunities, priorities and challenges and the following objectives and key result indicators:

- Objective 1 - Be a leader in stakeholder engagement and community and industry relations
  - Key Result Indicators:
    - Established relationships with key internal and external stakeholders
    - Main Roads environmental performance recognised and valued by stakeholders
- Objective 2 - Lead integrated road system planning across the transport sector
  - Key Result Indicators:
    - A clear, consistent and concise direction for environmental and heritage management for Main Roads
    - A strategic approach to environmental and heritage management in road system planning
- Objective 3 - Develop and deliver the roads program effectively
  - Key Result Indicators:
    - Integration of environmental and heritage management in the delivery of road programs
    - Road construction and maintenance activities do not result in unnecessary negative impacts on environmental or heritage values
    - Adequate financial resources available for environmental and heritage management
- Objective 4 - Lead the sustainable management of road corridor land
  - Key Result Indicator:
    - Environmental and heritage values within the State-controlled road network managed in a strategic and proactive manner
- Objective 5 - Provide a safe, efficient and reliable road network
  - Key Result Indicator:
    - State-controlled road and traffic operations minimise impacts on environmental and heritage values where possible
- Objective 6 - Achieve excellence through the performance of our people, systems and practices
  - Key Result Indicators:

- Main Roads environmental and heritage capability and performance is continually enhanced
- Adequate resources available for environmental and heritage management

The Project has been developed with due consideration of TMR's Environment and Heritage Policy and Strategy and objectives as outlined below:

- Strategic planning of the road alignment and continual review through each design phase has been undertaken to minimise impacts to the environmental and heritage values of the region
- Detailed environmental desktop assessments and field investigations have been undertaken throughout the lifetime of the project to inform the design and minimise impacts to environmental and heritage values.
- Regular consultation has been undertaken with stakeholders including other government departments, community groups, the local Aboriginal party and local business and private landholders as outlined in Section 4 of this report.
- The offset proposal has been prepared to achieve the most suitable environmental outcome for the impacted species by providing a land offset and funding of research into the impact of habitat fragmentation on the health of the koala and rehabilitation of viable populations in the region.
- The Project will provide economic resources to the community by the way of providing employment and use of local suppliers where possible.

Furthermore the Project has been designed to achieve the following economic, social and environmental objectives:

- Provide a roadway of sufficient standard, capacity and flexibility to meet future road user requirements
- Improve safety along the corridor for all roads users with provision of a national highway that complies with contemporary operational and design standards
- Provide an efficient roadway that enhances road network function
- Provide appropriate connectivity (free flowing) that in particular meets the needs of broader regional freight movements
- Minimise disruption through closures and delay by adhering to acceptable flood immunity standards to enhance network resilience
- Enhance the amenity and liveability of local communities and adjacent land users through design and amelioration treatments and the removal of unwanted traffic intrusions into local urban areas
- Provide enhanced local connectivity and accessibility to support social inclusion within the local community
- Provide improved capacity and efficiency of the road freight network to contribute to Queensland's continued economic growth (prosperity) in south east Queensland
- Mitigate and/or manage any negative environmental impacts along the motorway corridor.

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Vegetation Matters (2015) *Final Translocation Performance Report for* Macrozamia pauli-guilielmi *and* Acacia attenuata: *Road 166 - Maryborough-Cooloola Coast Road, Wide Bay*. Report prepared for Queensland Department of Transport and Main Roads by Vegetation Matters, 28 January 2015.

Appendix A Copy of DEE's Request for Preliminary Documentation and Further Information Request

Australian Government
Department of the Environment and Energy

EPBC Ref: 2017/7941

Mr Don Pitt
Project Director
Department of Transport and Main Roads
PO Box 183
GYMPIE QLD 4570

Dear Mr Pitt

Additional information required for preliminary documentation.
Bruce Highway, Cooroy to Curra (Section D, Woondum to Curra), east of Gympie, Queensland.

I am writing to you in relation to your proposal to upgrade and realign the existing 26 kilometre section of the Bruce Highway, including a bypass between Cooroy and Curra, east of Gympie, Queensland.

On 7 June 2017, I decided that the the project is a controlled action and that it will be assessed by preliminary documentation. Further information will be required to be able to assess the relevant impacts of the project. Details outlining the further information required are at Appendix A.

Please note that the Department considers that translocation of pineapple zamia is a compensatory measure rather than a mitigation measure. If the translocation of pineapple zamia is approved, additional compensatory measures (such as planting of propagated pineapple zamia) will be required to meet offset requirements for this species.

Details on the assessment process and the responsibilities of the proponent are set out in the enclosed fact sheet. Further information is available from the Department's website at http://www.environment.gov.au/epbc.

If you have any questions about the referral process or this decision, please contact the project manager, Justin Keast, by email to justin.keast@environment.gov.au, or telephone 02 6275 9953 and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

James Barker
Assistant Secretary
Assessments and Governance Branch
26 June 2017

Additional information required for preliminary documentation.
Bruce Highway, Cooroy to Curra (Section D, Woondum to Curra), east of Gympie, Queensland (EPBC 2017/7941).

1. General

1.1	The preliminary documentation must be contained as one document with attachments.
1.2	Please follow the structure of this information request when structuring the preliminary documentation.
1.3	Please also include a reference table within the preliminary documentation indicating where to find the information fulfilling this request.
1.4	In addressing this information request please ensure all work and conclusions: a. are evidence based; b. use scientifically robust methodologies; c. are supported by peer reviewed literature; d. are presented so as to not bias and/or obfuscate the information, or mislead the reader; and e. demonstrate consideration of relevant conservation advice, recovery plans and threat abatement plans.

2. Avoidance and Mitigation

Based on the information available in the referral, the project is likely to have a significant impact on listed threatened species and communities (section 18 & section 18A). The project includes the clearing/removal of:

a) 0.82ha of Lowland Rainforest of Subtropical Australia ecological community – critically endangered;

b) 8.14ha of habitat critical to the survival of the black-breasted button-quail (*Turnix melanogaster*) - vulnerable;

c) 138.44ha of habitat critical to the survival of the Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (*Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT)) - vulnerable; and

d) 215 individual pineapple zamia (*Macrozamia pauli-guilelmi*) - endangered.

In addition, the project may have a significant impact upon listed aquatic species due to water pollution, sedimentation and erosion. These species include:

a) Mary River cod (*Maccullochella mariensis*) – endangered;

b) Australian lungish (*Neoceratodus forsteri*) – vulnerable;

c) Mary River turtle (*Elusor macrurus*) – endangered; and

d) White-throated snapping turtle (*Elseya albaula*) – critically endangered.

2.1	Provide a description of any avoidance or mitigation measures, additional to those described in the referral, which could be adopted to reduce the impact on each of the above listed threatened species and community. Where mitigations refer to a Department of Transport and Main Roads policy, such as the *Transport and Main Roads Specifications MRTS51 – Environment Management (2017)* or the *Transport and Main Roads Specifications MRTS52 – Erosion and Sediment Control (2017),* please describe what aspects of policy will be employed in development and operation of the project to mitigate impacts to listed threatened species and communities. Relevant policy documents should be attached to the preliminary documentation.
2.2	Provide further details about pre-clearance procedures to ensure that individual koalas, black-breasted button-quail, pineapple zamia and listed aquatic species are detected and managed appropriately to minimise mortality, stress, injury or introduction of disease.
2.3	Provide an assessment of the expected or predicted effectiveness of each proposed avoidance or mitigation measures (including those in described in the referral).
2.4	If you are proposing to use a management plan/s (such as an Environment Management Plan or Sediment Erosion Plan) to provide details as to how the project will avoid or mitigate impacts to listed threatened species or communities, including clear, measurable and time specific: a. performance criteria; b. environmental outcomes to be achieved; and c. audit regime to measure the implementation and effectiveness of the plan/s. Detail all limitations of any plans prepared for the project.
2.5	If applicable, describe how the residual impacts to listed threatened species or communities have changed, from conclusions described in the referral, once the mitigation and/or avoidance measures have been considered.
2.6	Detail all limitations in the methodologies, results, technologies, information and work done to complete items 2.1 to 2.5 of this information request.

3. <u>Offsets</u>

3.1	In the event residual significant impacts upon Lowland Rainforest of Subtropical Australia ecological community, habitat critical to the survival of the koala and black-breasted button-quail, and pineapple zamia cannot be avoided or mitigated, please provide details for an offset strategy to compensate for the residual significant impact of the project. The offset strategy should include: a. The type of offsets proposed (direct/indirect); b. The location (including a geo-referenced map) and suitability of proposed direct offsets. A suitable offset site/s should contain Lowland Rainforest of

Subtropical Australia ecological community and suitable habitat for koala, black-breasted button-quail and pineapple zamia.

c. A description of values present within the offset site/s which are relevant for each listed matter for which the offset applies;

d. Current land tenure of any proposed offset and the method of securing enduring protection of the offset site and managing the offset for the life of the impact;

e. Whether the offset will be managed by the proponent or a third party. If a third party will manage the offset, how the proponent will ensure that the offset is delivered;

f. The anticipated cost to deliver the proposed offset(s); and

g. Outcomes that will be achieved for matters of national environmental significance if the offset strategy is implemented. The outcomes need to be specific, measurable and achievable, and should be based on robust baseline data. Outcomes should be developed in consideration of the *Department's Outcomes-based Conditions Policy* (2016) and *Outcomes-based Conditions Guidance* (2016), with suitable justification for considerations identified in the policy and guidance.

   Details about each proposed environmental outcome should include:

   i. The risks associated with achieving the outcome;

   ii. The measurability of the outcome, including all suitable performance measures;

   iii. Appropriate baseline data upon which the outcome has been defined and justified. The baseline data should be measured using the same framework and monitoring sites that will be utilised to monitor the offsets;

   iv. Conservation gains to be achieved by each outcome, including, positive management strategies that will:

      - avert future loss and degradation or damage to each protected matter eg. mitigating the loss of genetic variation of pineapple zamia; and/or

      - provide a net gain in environmental value to each protected matter for which the offset applies eg. reducing the risk of koala and black-breasted button-quail mortality by cars and/or feral animals;

   v. How the proposed outcomes are consistent with the relevant conservation advice,recovery plans and threat abatement plans;

   vi. Commitments to independent and periodic audits of performance towards achieving outcomes;

   vii. Assessment of the likely level of control that the proponent will have over achieving the outcome;

	viii. Discussion of the appropriateness of any surrogates for protected matter outcomes; and ix. Details of proposed management measures to achieve the outcome, including, but not limited to performance indicators, periodic milestones, proposed monitoring and adaptive management, and record keeping, publication and reporting procedures.
3.2	Provide an analysis about how the offset(s) meets the requirements in the Department's *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy October 2012. In order for the Department to consider whether any offset proposal meets the Department's Offset Policy, provide a table detailing the proposed offset's 'score' for each attribute of the *Offsets assessment guide*, an evidence-based justification for the score for each attribute, and literature references to support the evidence-based justification. If the offset involves improving habitat quality, the same methodology for measuring habitat quality must be used at both the impact and offset sites. Should the offset proposal be acceptable and the project be approved, please note that the information provided will be used in conditions to ensure that environmental outcomes are achieved.
3.3	Detail all limitations in the methodologies, results, technologies, information and work done to complete items 3.1 through 3.2 of this information request.

4. Economic and Social Matters

4.1	Provide details on the social and economic costs and/or benefits of undertaking the project, including the: a. Basis for any estimations of costs and/or benefits; b. Potential employment opportunities expected to be generated during development of the project; and c. If economic benefits and employment opportunities are in addition to what would have been expected if the action were not to take place; Details of any public or Indigenous stakeholder consultation activities, including the outcomes are also required.

5. Ecologically Sustainable Development

5.1	Provide a description of the project in relation the principles of ecologically sustainable development, as defined in section 3A of the EPBC Act.

Australian Government
Department of the Environment and Energy

EPBC Ref: 2017/7941

Mr Don Pitt
Project Director
Department of Transport and Main Roads
PO Box 183
GYMPIE QLD 4570

Dear Mr Ptitt

Draft response to further information request—Bruce Highway, Cooroy to Curra (Section D, Woondum to Curra), east of Gympie, Queensland

Thank you for your draft response of 5 December 2017 to the Department's further information request for the above proposed action. I note that payment for the associated cost recovery fee (Stage 2) was received on 3 July 2017.

The Department has reviewed the draft response and considers that it does not meet the requirements of the further information request. Further details about the information required to satisfy the request is at Attachment A.

Following submission of an updated document the Department will reassess and, if adequate, will issue a direction to publish the documentation for public comment. Please note that as the Stage 2 cost recovery fee has been paid, review of any revised document will commence on submission.

If you have any questions, please contact the project manager, Lanbin Guo, by email to lanbin.guo@environment.gov.au, or phone 02 6274 2520 and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

James Barker
Assistant Secretary
Assessments and Governance Branch

17 / 4 / 2018

Information required to satisfy the further information request

Lowland Rainforest of Subtropical Australia ecological community—critically endangered

Impacts

Up to 0.79 hectares (ha) will be directly removed and a further 5.19 ha of the buffer zone (out to 50 m) will also be cleared. Buffer zones are important for maintaining the root zones of the community and therefore the Department considers that removal of the buffer zone may indirectly impact the community. As such, please provide an assessment of the likely indirect impacts to the community as a result of the removal of the buffer zones.

Offsets

Based on the updated impact assessment, please update the residual significant impact assessment. In particular, if the removal of buffer zones is likely to increase impacts to the community then offsets may be required for the direct impact (A), the buffer zone loss (B) and the resulting indirect impacts (C), and offset liability should be calculated on the impact of A + B + C.

The Department also notes that the offsets assessment justification table indicates a risk-related time horizon of '20 years' but the calculator indicates a value of '5 years', please clarify and update offset calculation accordingly.

Black-breasted Button-quail (*Turnix melanogaster*)—vulnerable

Impacts and management measures

Up to 8.08 ha of habitat critical to the survival of the species will be removed. The proposed action has the potential to isolate the 10.89 ha of habitat critical to the survival of the species on the western side of the road if the proposed fauna passage is not successful.

Please provide further justification and evidence about the design and expected success of the proposed fauna passage and any contingency measures that would be implemented should the passage not be successful (noting a monitoring program for the passage has been proposed).

Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (*Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT))—vulnerable

Offsets

The offset calculation lists the quality score as '8' for the impact site and '7' for the offset site (future quality with offset). The EPBC Act offsets policy[1] requires the future

[1] Department of Sustainability, Environment, Water, Population and Communities (2012). *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Commonwealth of Australia, Canberra.

quality of the offset site to, at a minimum, meet the quality score of the impact site. Please clarify and update offset calculation accordingly.

Pineapple Zamia (*Macrozamia pauli-guilielmi*)—endangered

Translocation efforts

We note your subsequent advice (email of 1 March 2018) regarding why only mortality of translocated adults are proposed to be offset. This justification should be included in the updated response.

Translocation ratio

The referral indicates replacement at 8:1 and 92 adults. The body of draft response indicates replacement at 4:1 and 76 adults. The offset calculation in the draft response indicates replacement at 8:1. Please clarify the number of adults to be translocated and the replacement ratio and update offset calculation accordingly.

Offsets generally

The following comments apply to all proposed offsets provided in the draft response.

Each offset calculation uses a 'time to ecological benefit' of '0 years'. As per the EPBC Act offsets guide, the 'future quality without offset' and 'future quality with offset' should be estimated at the 'time until ecological benefit'. Where this is 0, the two future quality scores should be the same as the start quality score.

Where management activities (e.g. weed control) are proposed to improve the quality of habitat at offset sites, the 'time until ecological benefit' score should reflect when these activities are expected to realise a benefit (e.g. it may be that 5 years of weed control activities would improve the habitat quality).

In that case, the 'future quality without offset' would be the score in 5 years under a business as usual scenario (e.g. without intervention habitat quality may be on a natural downward trend) and the 'future quality with offset' would be the score at 5 years reflecting the management measures (e.g. habitat quality would likely have improved as a result of the management measures).

With regard to each proposed offset securing mechanism, please provide further information about these mechanisms and how they are applied / managed in practice. This information could be used to support the case for the 'risk of loss with offset' score used for each protected matter proposed to be offset.

Appendix B TMR Specifications - MRTS 51 and MRTS 52 and MRTS 16

Please note these are current at the time of the submission of the Preliminary Documentation report. Any subsequent updates will be provided to DEE.

Technical Specification

Transport and Main Roads Specifications MRTS16 Landscape and Revegetation Works

July 2017

Queensland Government

Technical Specification

Transport and Main Roads Specifications MRTS51 Environmental Management

July 2017

Queensland Government

Copyright

Feedback: Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Contents

1 Introduction

This Technical Specification applies to environmental management requirements applicable to Work under the Contract. Where other statutory requirements (e.g. *Environmental Protection Act* 1994) demand higher standards of environmental management, the higher standards require adoption.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS52 *Erosion and Sediment Control* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual. This Technical Specification is not intended to address environmental management related to planning and design of transport infrastructure or activities related to transport infrastructure.

2 Definition of terms

The terms in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

Additional terms used in this Technical Specification shall be as defined in Table 2.

Table 2 – Definition of terms

Term	Definition
Administering Authority	An Authority with legislative jurisdiction.
Air Blast Overpressure	Air Blast overpressure (or air blast level) is the energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave is known as the peak air overpressure, generally measured in decibels using the linear frequency-weighting. Air blast measurement and reporting shall be conducted using methodologies in accordance with the provisions of Australian Standard AS 2187.2-1993 Appendix J.
Approval	Approval means any environment or Cultural Heritage related, permit, authority, license, self-assessable code, statutory exemption with conditions, protocol or other statutory instrument with conditions.
Average Reoccurrence Interval (ARI)	The average or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration. It is implicit in this definition that the periods between exceedances are generally random.
Biosecurity Instrument Permit	An authority issued by Biosecurity Queensland under the *Biosecurity Act* 2014 for movement of a carrier of a regulated Biosecurity Matter under a biosecurity zone regulation to a place outside the zone or into an area subject of a movement control where the activity does not meet the regulatory provisions defined in the Queensland Biosecurity Manual.
Biosecurity Matter	Biosecurity matters as defined in the *Biosecurity Act* 2014 including but not limited to prohibited and restricted invasive plants (weeds) and animals.
CHMA	Cultural Heritage Management Agreement
CHMP	Cultural Heritage Management Plan
Complaint	A verbal or written complaint from a member of the pubic regarding the Works under the Contract and the impact upon their person or property.

Term	Definition
Compliance Management Plan (CMP)	A CMP is a statutory approval under TIA by the department in relation to specific legislative requirement(s) and replaces the requirement for compliance or approval under another Act provided compliance with the CMP achieved
Compliance Testing	Compliance Testing to determine whether a product, system, or action complies with the requirements of a Technical Specification, Contract or regulation or legislation or a combination of any or all.
Contaminated Sites	An area of land where any chemical substance or waste has been added as a direct or indirect result of human activity at above background level and represents, or potentially represents, an adverse health or environmental impact.
Critical Facility, Infrastructure and Utility	In relation to impacts from noise and vibration, a Critical Facility, Infrastructure or Utility is defined in accordance with the *Transport Noise Management Code of Practice*: Volume 2 Construction Noise and Vibration as: • Critical facilities include medical/health buildings, educational / research facilities, courts of law and community buildings. The latter three are only considered critical when in use. Critical facilities are usually sensitive to both construction noise and vibration. • Critical infrastructure and utilities include dams, electrical and telecommunications facilities (including railway signalling systems), oil and gas pipelines and other petrochemical installations and utilities such as water mains and sewers. Critical infrastructure and utilities are typically sensitive to construction vibration. • Other facilities, infrastructure or utilities (for example bridges) which may be deemed to be of critical importance on a project-specific basis.
Cultural Heritage	Cultural Heritage includes artefacts, sites, items, areas or places of known or potential Cultural Heritage significance (both indigenous and non-indigenous).
Cultural Heritage Personnel	Persons nominated by the Indigenous Party's including but not limited to monitors, survey staff, and elders.
DAF	Queensland Department of Agriculture and Fisheries
DEHP	Department of Environment and Heritage Protection (Queensland)
Discharge	The movement of Site stormwater: a) into a Waterway within the Site b) into a Waterway adjacent to the Site, and c) beyond the boundary of the Site where it could reasonably enter a Waterway.
EMP(C)	Environmental Management Plan (Construction)
Environment and Cultural Heritage Incident	An environment and Cultural Heritage incident is the occurrence of a reportable breach of legislation, an event that causes or has the potential to cause material or serious Environmental Harm, or unauthorised harm to Cultural Heritage. For the purpose of this Technical Specification, events listed in Clause 7.8.1 are also Environmental and Cultural Heritage Incidents.
Environmental Harm	As defined by the *Environmental Protection Act* 1994, Section 14.
Environmental Management	The protection of existing environment and Cultural Heritage from Environmental Harm associated with the Works under the Contract.

Term	Definition
Environmental Nuisance	As defined by the *Environmental Protection Act* 1994, Section 15.
Exclusion Zone	An area not to be entered by a person or machine for the duration of the Sontract or otherwise designated period of time or restricted access for authorised persons.
Indigenous Party(s)	The signatory party to the Principal's Cultural Heritage Management Agreement or Cultural Heritage Management Plan.
Limits of Clearing	The Limits of Clearing are defined as the outside boundary of areas specified within the Contract for clearing and ground disturbance, specifically: • areas for clearing and grubbing (under Clause 7.2 of MRTS04) • side tracks (Clause 3.8 of MRTS02.1) • noise barriers (Clause 8.2 of MRTS15) • fencing (Clause 11.4 of MRTS14) • borrow areas and associated access tracks (Clause 17 of MRTS04) • water point access tracks (Clause 12 of Annexure MRTS51.1) • stockpile locations (Clause 3.2 of Annexure MRTS04.1) • areas available for disposal of excess and unsuitable material on Site (Clause 6 of Annexure MRTS04.1) • marketable timber (Clause 7.2.3 of MRTS04) • clear zones (Clause 2.4 of MRTS04.1), and • other areas identified by the Principal within the Contract.
Management Measure(s)	A management measure is purpose-built structure or strategy employed by the Contractor and documented in the EMP(C) to prevent or minimise Environmental Harm or provide an environmental benefit.
Material Environmental Harm	As defined in the *Environmental Protection Act* 1994, Section 16.
Queensland Waterway for Waterway Barrier Works	The Queensland Waterway for Waterway Barrier Works is a spatial data set, which defines waterways by colour based on their risk of adverse impact from instream barriers on fish movement.
Sensitive Receiver(s) F(air quality)	As defined by the department's *Road Traffic Air Quality Manual*, Glossary, as any of the following: • a dwelling (detached and attached), reformatory institution, caravan park or retirement village • a library, child care centre, kindergarten, school, school playgrounds, college, university, museum, art gallery or other educational institution • a hotel, motel or other premises which provides accommodation for the public • a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest under the *Nature Conservation Act* 1992 • a public park or gardens that is open to the public (whether or not on payment of a fee) for use other than for sport or organised entertainment (passive recreation only).

Term	Definition
Sensitive Receptor(s) (for noise and vibration)	Defined in accordance with the *Transport Noise Code of Practice*: Volume 2 Construction Noise and Vibration as: • a dwelling (detached or attached) including house, townhouse, unit, reformatory institution, caravan park or retirement village • a library, child care centre, kindergarten, school, school playground, college, university, museum, art gallery or other educational institution, hospital, respite care facility, nursing home, aged care facility, surgery or other medical centre • a community building including a place of public worship • a court of law • a hotel, motel or other premises which provides accommodation for the public • a commercial (office) or retail facility • a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest under the *Nature Conservation Act* 1992, or • an outdoor recreational area (such as public park or gardens open to the public, whether or not on payment of a fee, for passive recreation other than for sport or organised entertainment) or a private open space.
Serious Environmental Harm	As defined in the *Environmental Protection Act* 1994, Section 17.
Significant Vegetation	Significant Vegetation is an individual plant or vegetation community, which are protected under either State or Commonwealth legislation, or have been identified under the Clause 9 of MRTS51.1 as being of significance.
Site	Means the lands and other places upon described in Item 7A of General Conditions of Contract and any other lands and places made available to the Contractor by the Principal for the purpose of the Contract.
Suitably Qualified and Experienced Person (fauna)	1. An ecological consultant with experience in conducting surveys for animal breeding places 2. A person who possesses a degree in natural science or similar with experience in conducting surveys for animal breeding places; or 3. A spotter-catcher who are holders of a DEHP rehabilitation permit issued under the NCA.
Waste	As defined by the *Environmental Protection Act*, Section 13.
Water Quality Investigation Criteria	The Water Quality Investigation Criteria outlined in Table 8.2.3.2 of this Technical Specification sets the criteria for impacts to water quality. Non-conformance with Water Quality Investigation Criteria trigger investigations as to the cause of the non-conformance and whether the non-conformance represents an Environmental Incident.
Waterway	As defined as a watercourse under the Environmental Protection Regulation 2008 and including naturally occurring surface waters as defined in the Environmental Protection Regulation 2008.
Weekly Site Inspections	Weekly Site Inspections undertaken by the Contractor's Environmental Representative or other person deemed suitable by Administrator, and are documented visual inspections of environmental Management Measures to assess presence, functionality and adequacy of measures prescribed in the EMP(C).

Term	Definition
Work under the Contract	The work which the Contractor is or may be required to execute under the Contract and includes variations, remedial work, Construction Plant and Temporary Works

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 1940	AS 1940:2004 - *The storage and handling of flammable and combustible liquids*
AS 2187.2	*Explosives – Storage and use – Use of explosives*
AS 3833	AS3833:2007 - *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers*
Contractor's Monthly Environmental Reporting Template	*MRTS51 Appendix A Contractor's Monthly Environmental Report*, Transport and Main Roads, 2016, Technical Publications
DEHP Procedural Guide – Summary Sheet	DEHP Procedural Guide, Summary Sheet – *Standard Work Method for the Assessment of the lawfulness of releases to waters from land development and construction sites in South East Queensland*
Departmental Cultural Heritage Induction	*Cultural Heritage Induction*, Transport and Main Roads, Queensland
Exemption Requirements for the taking of water without entitlement (WSS/ 2013/666)	*Exemption Requirements for the taking of water without entitlement under the Water Regulation* 2002 (WSS/ 2013/666), Department of Natural Resources and Mines, Version 3.01, 2014
IECA Best Practice Erosion and sediment Control Appendix B – Sediment Basin Design and Operation	*International Erosion and Sediment Control (Australasia), Best Practice Erosion and Sediment Control, Appendix B – Sediment Basin Design and Operation, Major Update* – December 2016
Monitoring and Sampling Manual	*Monitoring and Sampling Manual* 2009, Environmental Protection (Water) Policy 2009, (Version 2, 2010 (July 2013 edits))
MRTS01	*Introduction to Technical Specifications*
MRTS02	*Provision for Traffic*
MRTS04	*General Earthworks*
MRTS14	*Road Furniture*
MRTS16	*Landscape and Revegetation Works*
MRTS15	*Noise Fences*
MRTS28	*Contractor's Site Facilities and Camp*
MRTS50	*Specific Quality System Requirements*
MRTS52	*Erosion and Sediment Control*
MRTS96	*Management and Removal of Asbestos*

Reference	Title
National Environment Protection (Assessment of Site Contamination) Measure, 1999	*National Environment Protection (Assessment of Site Contamination) Measure,* National Environment Protection Council, 1999 (Commonwealth)
Noise Code of Practice: Volume 2	*Transport Noise Management Code of Practice*, Volume 2 – Construction Noise and Vibration, Transport and Main Roads (2016)
Road Traffic Air Quality Management Manual	*Road Traffic Air Quality Management Manual*, Transport and Main Roads, March 2016
SMP Low risk	*Transport and Main Roads Species Management Program for tampering with animal breeding places – low risk of impacts – least concern animals (excluding special least concern or colonial breeders),* issued by the Department of Environment and Heritage Protection, June 2016
TN03	TN03 *Measurement of Ground Vibrations and Airblast*, Transport and Main Roads

4 Standard test methods

Unless stated elsewhere herein, Compliance Testing shall be carried out in accordance with the relevant Australian Standard. Where no Australian Standard exists for the test, acceptable best practice methodology shall be employed based on State or Federal Administering Authority publications.

4.1 Compliance testing

Where stipulated in this Technical Specification, the Contractor is responsible for performing Compliance Testing as specified to ensure that the Environmental Management performance complies with the standards and requirements of the Contract and statutory legislation. However, the Contractor's Compliance Testing program shall be such that the frequencies and number of Compliance Tests are not less than those specified in Annexure MRTS51.1.

5 Quality system requirements

5.1 Hold Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications* and Clause 8.3 of MRTS50 *Specific Quality System Requirements*.

The Hold Points and Milestones applicable to this Technical Specification are summarised below in Table 5.1. There are no Witness Points defined.

Table 5.1 – Hold Points and Milestones

Clause	Hold Point	Witness Point	Milestone
6.1	1. EMP(C) is assessed for suitability by Administrator 2. Amendments to EMP(C) are assessed for suitability by Administrator		Submission of EMP(C) Submission of EMP(C) amendments

5.2 Non-conformances with this Specification

Non-conformances identified under this Technical Specification shall be recorded, reported and managed under the Contractor's Quality Plan. This includes Monitoring non-conformances, Compliance Testing non-conformances and non-conformances raised by Contractor or Principal's audits.

Non-conformances that are also Environmental and Cultural Heritage Incidents, shall in addition be notified, managed and reported in accordance with Clause 7.8 of this Technical Specification.

6 Environmental management

6.1 General requirements

At all times, the Contractor shall be responsible for identifying and undertaking reasonable and practicable Management Measures appropriate to the Work under the Contract, in order to:

a) avoid causing Environmental Harm, and

b) comply with legislative requirements.

6.2 Contract-specific requirements

Contract-specific requirements are given in the Annexure MRTS51.1. The Contractor shall take notice of and must comply with these requirements as well as the requirements listed in this Technical Specification.

6.3 Environmental Management Plan (Construction)

For the duration of the Contract, the Contractor shall develop, implement and maintain an Environmental Management Plan – Construction (EMP(C)) that meets the requirements of the Contract. Works under the Contract shall be completed in accordance with the most current version of the EMP(C) deemed suitable by the Administrator. The Contractor may, with the Administrator's deemed suitability, substitute environmental Management Measures included in this Technical Specification with other environmental Management Measures which achieve the same, or better, environmental outcomes. These Management Measures shall be documented in the EMP(C).

The Contractor's Environmental Management Plan (Construction) (EMP(C)) shall address:

a) administrative requirements (Clause 7 of this Technical Specification), and

b) operational requirements – identified for each environmental element (Clause 8 of this Technical Specification).

Submission of the EMP(C) shall be in accordance with the General Conditions of Contract.

The EMP(C) shall be accessible on Site at all times during Work under the Contract.

The Administrator shall be provided with an electronic copy of the most current and complete version of the EMP(C) at all times.

6.4 EMP(C) updates

The Contractor shall develop and document a process of periodically reviewing the EMP(C). The process shall focus on identifying opportunities for continual improvement of processes and practices to ensure that the EMP(C) is relevant to the Work under the Contract. The process shall address how legislative changes and Environment and Cultural Heritage Incidents corrective actions will be

addressed via an update to the EMP(C). The Contractor shall establish and implement document version control.

Updates to the EMP(C) shall be undertaken by the Contractor to address changes on Site, Works under the Contract and to address corrective actions following non-conformances or Environment and Cultural Heritage Incidents. Where undertaken, updates to the EMP(C) shall be submitted to the Administrator as part of the Contractor's Monthly Environmental Report, for deemed suitability.

7 EMP(C) Administrative requirements

7.1 Weekly Site Inspections

The Contractor's Environmental Representative shall undertake and document Weekly Site Inspections for the purpose of:

- verifying Management Measures prescribed in the EMP(C) are present, functional and adequate[1]
- observe the Site for actual or potential Environmental Harm or Environmental Nuisance
- identify maintenance requirements for implemented Management Measures, and
- verifying preparedness for adverse weather conditions where weather forecast.

The Contractor shall undertake corrective actions to rectify issues identified by the Weekly Site Inspections.

The procedure for Weekly Site Inspections shall be documented within the EMP(C). The Weekly Site Inspection records shall be made available to the Administrator within 48 hours of a request for a specific Weekly Site Inspection Report.

7.2 Notification of visits by Administering Authorities

The Contractor shall notify the Administrator of correspondence, meetings with or visits from representatives of any Administering Authority within 24 hours of the Contractor becoming aware of the event. The Administrator may nominate a representative to attend the planned meeting or visit on the Site as an observer.

7.3 Complaint management

In addition to Clause 15.6.2 of the General Conditions of Contract, the EMP(C) shall contain the Contractor's procedures for notification, investigation, and assessment for legislative triggers, management and reporting of environmental and Cultural Heritage-related complaints. The Contractor shall manage complaints in accordance with their procedure. For contracts specified as medium or high noise or vibration risk, complaints shall be managed in accordance with the *Transport Noise Code of Practice*: Volume 2 including undertaking complaint assessment where required.

7.4 Principal's surveillance and audits

The Administrator or their representative(s) may undertake inspections and audits of the EMP(C) implementation as part of the Contract Plan. The Administrator shall provide at least five business days' notice of a planned audit or inspection. The Administrator may, at their discretion, undertake

[1] Adequate refers to whether the management measures employed on Site are reasonable and practicable to manage the risk of Environmental Harm occurring as a result of the Works under the Contract.

unplanned audits in response to non-conformances, Environment or Cultural Heritage Incidents, or upon receiving complaints regarding the Site.

7.5 Environmental Monitoring

The Contractor shall undertake Monitoring as specified in this Technical Specification, in the Annexure MRTS51.1 and where required as a condition of an Approval. The EMP(C) shall contain procedure(s) for undertaking the various types of Monitoring including specific location(s), method, timing, frequency, duration, parameter to be monitored, and objective / criteria measured against.

Where Monitoring identifies a non-conforming result with the legislative or Contractual criteria or objective, this non-conformance shall be reported in the Contractor's monthly environmental reporting (Clause 7.6 of this Technical Specification) and Clause 7.8 of this Technical Specification.

7.6 Monthly environmental reporting

The Contractor shall complete and submit exception reporting to the Administrator in the form of a monthly environmental report. The monthly environmental report shall be submitted to the Administrator within five business days of the end of each month[2]. The monthly environmental report shall include exception reporting and statements actively addressing[3] but not limited to the following that occurred during the reporting month:

a) Contractor's updates to EMP(C) and Erosion and Sediment Control Plan (ESCP).

b) Weekly Site Inspections – number of inspections completed, and summary of corrective actions undertaken.

c) Monitoring Reporting – summary of Monitoring and whether non-conforming results were obtained including submission of animal breeding place registers maintained in accordance with a Species Management Program.

d) Compliance Testing reporting if applicable – summary of Compliance Testing and whether non-conforming results obtained.

e) Register of current and completed non-conformance reports, environment-related complaints and Environmental and Cultural Heritage Incidents raised by the Contractor as part of their Quality System in relation to this Technical Specification and a record of the current status.

f) Positive environmental outcomes achieved and opportunities identified by the Contractor, and

g) Where the Contractor has developed a Compliance Management Plan, Compliance Reporting under the Compliance Management Plan.

A template for the Contractor's Monthly Environmental Report is provided in Appendix A of MRTS51. The Contractor may nominate to utilise their own reporting template if deemed suitable by the Administrator.

Where exception reporting demonstrates repeated or multiple (three or more) non-conformances of the same issue, the Administrator may instruct the Contractor to undertake a review of the adequacy of Management Measures outlined in the EMP(C) and provide response back to the Administrator

[2] If laboratory test results are not available at the time of monthly reporting it shall be included in the following month's report.

[3] Actively addressing means that where there is nothing to report, the Contractor shall report "nil" rather than omission of any response.

within five business days either confirming and justifying the suitability of the existing EMP(C) or notifying of updates to the EMP(C) and the justification.

7.7 Notification and management of Environmental Incidents

The EMP(C) shall contain the Contractor's procedures for notification and management of Environmental Incidents in accordance with relevant legislation, Approval conditions and this Technical Specification.

7.7.1 Notification

The Contractor shall report to the Administering Authority in accordance with the Approval conditions and relevant legislation where a breach of Approval condition(s), reportable legislative breach, or actual or potential material or serious Environmental Harm (as defined in the *Environmental Protection Act* 1994) is identified.

In addition, the Contractor shall notify the Administrator as soon as practicable upon becoming aware of any of the following:

a) actual or potential material or serious Environmental Harm as defined in the *Environmental Protection Act* 1994

b) reportable breach of legislation

c) breach of an Approval condition(s)

d) non-conformances from Water Quality Investigation Criteria recorded during Monitoring as specified in this Technical Specification (Table 8.2.3.2)

e) injury or death of native fauna other than least concern species, potentially caused by Work under the Contract, including the occurrence of a fish kill on Site or in Waterways receiving Discharge from Site

f) tampering with a native animal breeding place(s) other than in accordance with an applicable Species Management Program

g) ground disturbance or vegetation clearing beyond the Contractual Limits of Clearing or areas otherwise deemed suitable by the Administrator

h) damage to known or potential Cultural Heritage

i) ground disturbance or vegetation clearing beyond the boundary of the Contract's Cultural Heritage Management Agreement or Plan otherwise deemed suitable by the Administrator

j) movement or relocation of Cultural Heritage without approval of the Indigenous Party(s)

k) clearing of a protected plant under State or Commonwealth legislation other than authorised under an Environmental Approval

l) identification of a new Biosecurity prohibited matter or restricted matter (Category 1 or 2) on Site or breach of a condition of a biosecurity zone, and

m) discovery of a Contaminated Site (including unexploded ordinance) or land contamination occurred on the Site during the Work under the Contract.

Unless justified otherwise and deemed suitable by the Administrator, the above events shall be reported and managed by the Contractor as Environmental Incidents under the Contract.

7.7.2 Management

The Contractor shall undertake immediate remedial actions to mitigate Environmental Harm or further impacts. Immediate response actions shall not be delayed by the need for notification to Administrator or Administrating Authority.

Once the immediate risk from the Environmental and Cultural Heritage Incident is alleviated, the Contractor shall investigate the cause of the breach and / or potential Environmental Harm, identify, and implement corrective actions as soon as practicable. The Contractor shall provide an Environment and Heritage Incident Report to the Administrator within 40 business days of the Environmental and Cultural Heritage Incident detailing:

a) the nature of the incident

b) what Management Measures were in place to prevent an incident occurring

c) probable cause of the incident, and

d) what corrective actions have been undertaken to prevent incidents reoccurring.

Form B of Appendix MRTS51 provides an Environmental and Cultural Heritage Incident Report template. The Contractor may utilise the template or utilise their own Environment and Cultural Heritage Incident Report template where the information provided is the same, where deemed suitable by the Administrator.

The Administrator may at their discretion, instruct the Contractor to make additional corrective actions.

Should the Works under the Contract result in Environmental Nuisance or Environmental Harm, the Contractor shall be responsible for remediation works to make good the Environmental Nuisance and / or Environmental Harm to the Administrating Authority and Administrator' satisfaction. Where penalties or offsets are payable for Environmental Nuisance or Environmental Harm, they will be at the Contractor's expense.

7.8 Records and registers

Environmental records are to be included in the Quality Records under the Contract. Table 7.8 of this Technical Specification identifies environmental record requirements and what records need to be submitted to the Administrator upon Practical Completion. Records and registers shall also be made available to the Administrator upon request.

Table 7.8 - Environmental Record requirements and requirements for submission to Administrator

Record Requirement	Submit to Administrator at Practical Completion
Environment and Cultural Heritage induction attendance registers	☒
Environmental and Cultural Heritage Incident reports, non-conformances and complaints register and associated corrective actions taken	☒
Weekly Site Inspection checklists and diary entries	
Monitoring results	☒
Compliance Testing results	☒

Record Requirement	Submit to Administrator at Practical Completion
Contractor environment audit reports and subsequent corrective actions taken	
Meeting minutes with Administrating Authorities and interested parties relating to the Management Measures	☒
Formal letters from Administering Authorities	☒
Biosecurity Matter certificates, Biosecurity Instrument Permits and Biosecurity management documentation	☒
Complete registers kept under Species Management Program of animal breeding place(s) tampered with and injury(s) or death(s) to native fauna	☒
Records to demonstrate and document compliance with Environmental Approvals held by Principal and Contractor	☒
Quantities of water and quarry materials extracted from non-commercial sources under the Contract by source site	☒
Electronic copy of Waste tracking records and, where required by Clause 11.2 of Annexure MRTS51.1, a completed Waste register (MRTS51 Appendix C)	☒
Cultural Heritage personnel daily timesheets	☒
Any other record identified within the Contractor's EMP(C)	
Any other record required by Annexure MRTS51.1	☒

7.9 Environmental roles and responsibilities of personnel

The Contractor's EMP(C) shall document all environmental-specific roles and responsibilities of personnel.

7.10 Selection and management of sub-contractors

The Contractor shall include a requirement to comply with the EMP(C) in all Contractual arrangements with sub-contractors.

7.11 Approvals

The Contractor shall be responsible for identifying statutory requirements and obtaining all Approvals that are required for the construction activities. The EMP(C) shall include a list of all Approvals relevant to the Contract. Details shall include:

a) name, type and reference number of Approval

b) Administering Authority

c) commencement and expiry date, and

d) conditions of Approvals.

Clause 1 of Annexure MRTS51.1 details Approvals that the Principal has obtained for the works and associated conditions and requirements. Copies of all Approvals submitted and obtained by the Contractor shall be made available to the Administrator on request.

The Contractor shall comply with the relevant conditions of Approvals obtained by the Contractor as well as those obtained by the Principal (where stipulated in Clause 1 of Annexure MRTS51.1). The

Contractor shall retain records required to demonstrate compliance with all Approvals in accordance with Clause 7.9 of this Technical Specification.

At practical completion the Contractor shall provide documentation of the successful surrender of Approvals held by the Contractor that relate to the Contract. Where surrender is not feasible, and where deemed suitable by the Administrator, the Contractor shall apply to transfer the Approvals to the Principal prior to the defects liability period concluding. The Contractor shall be responsible for providing all relevant documentation regarding the transfer to the Principal.

7.12 Site induction

Prior to commencing ground disturbing activities, the Contractor shall ensure that all staff involved in, or supervising, these activities, have attended an Environmental Site Induction. This includes, as a minimum, all Site management staff, employees and subcontractors working on activities which disturb the natural ground surface.

The Contractor shall prepare and deliver a Contract Specific Site Induction for to all persons upon entering the Site. The Contractor shall maintain a register signed by those inducted. The register shall contain but not be limited to the name of inductees, dates inducted, and the name of the induction facilitator.

A copy of the Contractor's Environmental induction shall be included in the Contractor's EMP(C). The induction shall include, but not be limited to:

a) basic roles and responsibilities for environmental management including general environmental duty and duty to notify under the *Environmental Protection Act* 1994

b) specific locations within the Site of environmental and Cultural Heritage significance or risks, including exclusions zones and details of prohibited and restricted Biosecurity Matters on Site with photos of the matter

c) the scope and conditions of Approvals applicable to the Contract

d) locations of ancillary activities deemed suitable by the Administrator (including but not limited to stockpile sites, turnaround points, construction water and material sources)

e) the Limit of Clearing and the boundary of the Cultural Heritage Management Agreement or Cultural Heritage Management Plan where applicable

f) environmental Management Measures stipulated in the Contractor's EMP(C)

g) procedures for notifying of potential Environmental and Cultural Heritage Incidents, and

h) contingency plans for unplanned events.

Cultural Heritage Induction

Prior to commencing ground disturbing activities, the Contractor shall ensure that all staff involved in, or supervising, these activities, have attended the Principal's Cultural Heritage Induction or an alternative Cultural Heritage Induction course deemed suitable by the Administrator. This includes, as a minimum, all site management staff, employees and subcontractors working on activities which disturb the natural ground surface. The Principal's Cultural Heritage Induction shall be arranged through the Administrator.

8 EMP(C) specific element requirements

8.1 General

Environmental elements included in the EMP(C) shall include, but not be limited to those defined in the following sections.

The EMP(C) shall encompass the Environmental Management of the Works under the Contract including Temporary Works and ancillary activities including sourcing water, gravel, side tracks, stockpile sites, Contractor's Site facilities and camps, and turnaround points.

The Contractor shall select Management Measures which are reasonable and practicable for the environmental impacts they are managing. A brief justification of the suitability of the Management Measures based on the risk assessed shall be provided in the EMP(C) for environmental elements.

8.2 Water quality

8.2.1 General

The Contractor shall be responsible for the management of water quality to meet Contractual and legislative requirements, and not cause Environmental Harm or Environmental Nuisance to Waterways within the Site or adjacent waterways into which the Site Discharges.

Water quality management pertaining to sediment is managed under MRTS52 *Erosion and Sediment Control*.

8.2.2 Performance requirements

The Contractor shall at all times undertake reasonable and practicable Management Measures to avoid Environmental Harm or Environmental Nuisance within the Site and to waterways into which the Site Discharges. Specifically, the Contractor shall comply with the *Environmental Protection Act* 1994, Section 440zg.

Water quality Management Measures shall be designed to achieve Discharge from Site compliant with the Water Quality Investigation Criteria (Discharge) outlined in Table 8.2.2 of this Technical Specification.

The Contractor shall develop and undertake a water quality Monitoring Plan that is reasonable and practicable in accordance with the requirements stipulated in Clause 8.2.3 of this Technical Specification.

Table 8.2.2 –Water quality investigation criteria

Contract Water Quality Risk	Parameter	Discharge	Dewatering to Land[4]	Waterway	
				Level	Change (Upstream-Downstream)
Low water quality risk	Turbidity	No visual evidence of sediment accumulating at point of Discharge.	N/A	No visible change from upstream	-
	Waste	No waste or litter visible	No waste or litter	No waste or litter	-
	Hydrocarbons tannins, paint	No visible trace	No visible trace	No visible change from upstream	-
Medium and high water quality risk	Suspended Solids	Discharges shall be < 50 mg/L TSS for a 1 yr ARI, 24 hr event[5] or equivalent turbidity as determined by laboratory analysis by correlating turbidity with the suspended solids limit. Where specified, an alternative discharge criteria identified in Annexure MRTS52.1.	N/A	< 50 mg/L TSS for a 1 yr ARI, 24 hr event[6] or equivalent turbidity as determined by laboratory analysis by correlating turbidity with the suspended solids limit	5 mg/L or 10% increase (whichever is greatest)
	pH	Stable pH reading; and General sites: 6.5 – 8.5, or Wallum/Acidic Ecosystems: 5.0 – 7.0	Stable pH reading, and General sites: 6.5 – 8.5, or Wallum/ Acidic Ecosystem: 5.0 – 7.0	General Sites: 6.5 - 8.5 Wallum/Acid ecosystems: 5.0 - 7.0	1.0 pH unit change
	Hydrocarbons tannins, paint	No visible trace	No visible trace	No visible change from upstream	-
	Waste	No Waste or litter	No Waste or litter	No Waste or litter	-
	Dissolved Oxygen (DO)	90% Saturation (lower limit)[6]	N/A	> 85% saturation for flowing waters DO > 5 mg/L	10% decrease

NOTE: For medium and high water quality risk projects, the Contractor shall ensure that water temperature (°C) is recorded for each monitoring record on the water quality monitoring spreadsheet.

8.2.2.1 Flocculation

NOTE: The use of flocculants for erosion and sediment control is prescribed in MRTS52, however the use and discharge of chemical flocculants are also a water quality consideration.

[4] Deliberate releases to land such as dewatering to land (does not apply to overland flow).
[5] Based on the DEHP Procedural Guide – Standard work method for the assessment of the lawfulness of releases to waterways from construction sites
[6] Derived from the *DEHP Queensland Water Quality Guidelines* 2009, July 2013

Where flocculation is undertaken on Site, the Contractor shall select, store, apply and monitor the use of flocculants in accordance with *IECA Best Practice Erosion and Sediment Control Appendix B – Sediment Basin Design and Operation*, Step 17 to ensure that the flocculant does not cause Environmental Harm on the surrounding land and water. If Monitoring by the Contractor or Administrator indicates Environmental Harm may be occurring, flocculation shall cease until changes are made to the flocculation process to prevent the Environmental Harm.

Management of sediment basin sludge where flocculant has been used shall be in accordance with the chemical supplier's advice and documented within the EMP(C).

8.2.2.2 Stormwater reuse

The reuse of stormwater (including stormwater captured in sediment basins) for dust suppression, roadworks or landscaping is preferred over Discharge. Where water is to be reused for landscaping it shall be compliant with Clause 7.9 of MRTS16 *Landscape and Revegetation Works* quality requirements.

Where captured stormwater is to be reused on roadworks the Contractor shall address requirements in MRTS04 *General Earthworks*.

8.2.3 Monitoring

The Contractor shall develop and undertake a water quality Monitoring Plan to verify the effective management of water quality risks from Site. Applicable Water Quality Investigation Criteria consists of three criteria: Discharge, Waterways and Land.

1. Discharge criteria – criteria applicable to stormwater flows moving into Waterways within the Site, Waterways adjacent to the Site and beyond the boundary of the Site where it could reasonably enter a Waterway such as in defined drainage lines (Discharges). Discharges criteria also applies to Discharges from sediment basin(s) prior to dewatering. Discharge criteria does not extend to overland flows.
2. Waterway(s) criteria – criteria for Waterway(s) are applicable to Waterways within a Site or receiving Waterways adjacent to Site. Purpose of the criteria is to compare water quality parameters of the Waterway upstream of the Site to downstream of the Site to identify potential water quality impacts from the Works under the Contract. The Contractor shall nominate representative locations, not more than 100 m upstream and 100 m downstream of the works on all Waterways where stormwater is Discharged.
3. Land criteria – the land criteria applies where sediment basins or other impoundment of water is purposefully dewatered over areas of land for the purpose of evaporation and infiltration. The water quality shall comply with the criteria in Table 8.2.2. Active Monitoring of land criteria will only be required where stipulated in Clause 2 of Annexure MRTS51.1 or as requested by Administrator.

Monitoring results shall be recorded on a monitoring spreadsheet and evaluated by the Contractor against the Water Quality Investigation Criteria to verify compliance. For each Monitoring result that does not conform with the Water Quality Investigation Criteria (Discharge or Waterway) the Contractor shall:

a) Report the non-conformance to the Administrator and Administering Authority in accordance with Clause 7 of this Technical Specification. Including the size of the rainfall event ARI[7], duration of the rainfall event (where applicable), the water quality parameter that exceeded the criteria and level that was recorded from within the Site and downstream of the Site.

b) Undertake an investigation in accordance with the processes outlined in DEHP's Procedural Guide, Summary Sheet[8], and

c) Develop and implement corrective actions such as improved work procedures or Management Measures to improve water quality and prevent re-occurrence of Monitoring non-conformances.

NOTE: The Monitoring non-conformance will be a Contractual non-conformance unless the Contractor can be demonstrated the following:

- For Total Suspended Solids, the rainfall event that caused Discharge was greater than the specified design event (Table 8.2.2).
- Reasonable and practicable measures were in place, functional and maintained, or
- Non-conformance was caused by factors external to site activities / practices (for example, an upstream third party polluter).

8.2.3.1 Low risk contracts - Visual Monitoring of Discharge and Waterways

For contracts specified as low water quality risk in Clause 2.1 of Annexure MRTS51.1 Monitoring of Discharges and Waterways shall consist of visual Monitoring. Discharge and Waterway Monitoring shall be undertaken by the Contractor in accordance with Table 8.2.3 of this Technical Specification unless otherwise specified in Clause 2.2 of Annexure MRTS51.1.

Table 8.2.3.1 - Water quality Monitoring locations and frequency

Monitoring	Locations	Frequency / Trigger	
		Weekly[9]	Rainfall[10] causing Discharge
Discharge	At representative locations where concentrated-flows of stormwater Discharges from Site.		✓
Waterways	At representative locations upstream and downstream of the Site on Waterways within the Site and where Discharges enter from the Site. Where possible, the upstream and downstream Monitoring location should be no more than 100 m from the Works.	✓	✓

[7] The Contractor shall use the most recently available IFD (Intensity – Frequency- Duration) data available through the Bureau of Meteorology (www.bom.gov.au). Alternatively the Contractor may utilise data from a calibrated site based rainfall intensity gauge and Bureau of Meteorology data. The rainfall event shall be expressed as Annual Recurrence Interval (ARI).
[8] NOTE The DEHP procedural Guide requirements pertaining to sediment basins shall only be applied where appropriate for medium and high risk projects.
[9] Weekly during Works where potential impact to a Waterway or Waterbody with water present (for example from earthworks, stockpiling of pre-coated aggregate, concrete curing within a Waterway, clearing and grubbing)
[10] As soon as practicable following a rainfall event causing Discharge to a Waterway or Waterbody.

Visual Monitoring will be documented in the form of spreadsheets and photographs of the Monitoring locations. Photographs must include a time and date stamp. Rainfall data from the Bureau of Meteorology may be used for any comparison with Monitoring where required.

Where Monitoring observes Discharges or Waterways to be:

a) visually contaminated

b) there is a visible accumulation of sediment or other contaminant within a Waterway at the point of Discharge, or

c) a complaint is received

the Contractor shall undertake investigations, assess whether reasonable and practicable measures are implemented, and whether corrective actions are required. The outcome of the investigation shall be recorded and reported to the Administrator in accordance with Clause 7 of this Technical Specification.

The Administrator may at their discretion, instruct the Contractor to undertake further investigations and / or undertake water quality Monitoring in accordance with Clause 8.2.3.2 of this Technical Specification.

8.2.3.2 Medium and high water quality risk contracts

For projects specified as medium or high water quality risk in Clause 2.1 of Appendix MRTS51.1, the Contractor shall be responsible for developing, undertaking and recording a Water Quality Monitoring Program as part of the EMP(C). The Contractor's Water Quality Monitoring Program shall be developed in accordance with *DEHP's Monitoring and Sampling Manual* 2009. The Contractor's Water Quality Monitoring Program shall be reasonable and practicable considering risks from Works under the Contract and the sensitivity of the receiving Waterways.

8.2.3.2.1 Site rainfall

In order to obtain accurate rainfall data, the Contractor shall install a proprietary rain gauge and / or proprietary meteorological station and keep a record of the rainfall depth (mm) of each rainfall event, and where possible duration of the rainfall event. In instances of continuous rainfall greater than 24 hours, daily records and total duration shall be recorded when the Site is still open for operation. For geographically diverse Sites where rainfall is likely to differ significantly across the site the Contractor shall install a rain gauge at locations representative of each climatic zone.

8.2.4 EMP(C) requirement for water quality

The EMP(C) shall include descriptions and / or diagrams of:

a) Waterbodies and Waterways within 50 m of the Site boundaries that the Site Discharged to.

b) List Works under the Contract(including ancillary activities and temporary works) in locations at risk of impacting water quality other than erosion and sediment control risks, including:

   i. the potential contaminants

   ii. locations of Works in relation to waterbodies and Waterways, and

   iii. flow paths to waterbodies and Waterways within and adjacent to Site.

c) Water Quality Management Measures, other than erosion and sediment controls which are addressed in the Erosion and Sediment Control Plan in accordance with MRTS52.

d) The Contractor's water quality Monitoring Plan:

   i. low risk – The plan shall nominated Monitoring locations, frequency and methodology, or

   ii. for medium and high water quality risk – The Contractor's Monitoring program in accordance with *DEHP's Monitoring and Sampling Manual* 2009 that shall document as a minimum:

   - sampling scope – objectives of sampling, spatial boundaries, duration and frequency,
   - sampling design – what , where, when and how to sample including quality control requirements, and
   - the spreadsheet template for analysis of results against Water Quality Investigation Criteria (Table 8.2.2 of this Technical Specification) and rainfall data.

e) Contingency plans for Environmental Harm to water quality.

8.3 Erosion and sedimentation

Requirements relating to Erosion and Sediment Control are contained within MRTS52 *Erosion and Sediment Control*. The Erosion and Sediment Control Plan forms part of the Environmental Management Plan (Construction) (EMP(C)).

8.4 Cultural Heritage

8.4.1 General

The Contractor shall be responsible for the management (including protection) of Indigenous and non-Indigenous Cultural Heritage within and adjacent to the Site to avoid harm to Cultural Heritage.

Contract-specific management requirements are stipulated in Clause 3.1 - 3.6 of Annexure MRTS51.1.

Where stated in Clause 3.4 of Annexure MRTS51.1, the Department has entered into an agreement with Indigenous parties for the management of Cultural Heritage located within and adjacent to the Site.

8.4.2 Performance requirements

The Contractor shall undertake Work under the Contract in compliance with the *Aboriginal Cultural Heritage Act* 2003, *Torres Strait Islander Cultural Heritage Act* 2003, and Queensland Heritage Act 1992 and the *Environmental Protection and Biodiversity Conservation Act* 1999.

The Contractor shall at all times take reasonable and practicable Management Measures to avoid harm to Cultural Heritage from Works under the Contract. Where a Cultural Heritage Management Plan (CHMP) or Cultural Heritage Management Agreement (CHMA) is specified in Clause 3 of Annexure MRTS51.1, the Contactor shall operate in accordance with the conditions.

The Contractor shall comply with the contract specific requirements in Clause 3.1 - 3.6 of Annexure MRTS51.1.

8.4.2.1 Indigenous Heritage

Where disturbance or clearing is required outside the area covered by the CHMA or CHMP, the Contractor shall notify the Administrator. Works will not commence beyond the area covered by CHMA or CHMP, until deemed suitable by the Administrator.

Where, during the Contract, items of potential Indigenous Cultural Heritage are discovered when Cultural Heritage Personnel are present, activities shall only proceeding accordance with the procedures outlined in the CHMP or CHMA. If Cultural Heritage Personnel are not present at the time of a discovery, refer to Clause 8.4.2.3 of this Technical Specification for management requirements.

8.4.2.2 Non-Indigenous heritage

The Contractor shall comply with any Approval conditions as stated in Clause 1 of Annexure MRTS51.1. Unless otherwise stated in Clause 1 of Annexure MRTS51.1, the Contractor shall obtain all Approvals required for impacting heritage listed places within and adjacent to the Site as per the applicable legislation.

8.4.2.3 Unexpected discovery/find

Where items of potential Cultural Heritage significance (Indigenous or Non-Indigenous) are discovered (and when no Cultural Heritage Personnel are present for Indigenous heritage), the Contractor will follow the Find – Stop – Notify – Manage procedure:

a) FIND: An item of potential Cultural Heritage is found.

b) STOP: All work at the Find location shall cease. The item shall not be removed or disturbed.

c) NOTIFY: The Contractor shall immediately notify the Administrator. The Administrator will promptly notify the Principal's Cultural Heritage Officer, and

d) MANAGE: Principal's Cultural Heritage Officer will arrange for the potential Cultural Heritage to be inspected and assessed for significance. Principal's Cultural Heritage Officers shall provide the temporary management recommendations. This may include securing the find by erecting an exclusion zone for a period of time and precluding access to that area. The Contractor shall notify all site personnel of the object and / or area and proposed treatment of the object and / or area as soon as possible, but prior to commencing work on the next working day.

8.4.3 Monitoring

NOTE: This section relates to Monitoring activities generally and is not exclusively related to Monitoring of Works by Cultural Heritage Personnel.

Where stipulated in Clause 3 of Annexure MRTS51.1, Monitoring is required of specific areas within the Site. Where Monitoring is required, it shall be undertaken and reported in accordance with Clause 7 of this Technical Specification.

Where stipulated in the CHMA or CHMP, Monitoring by Cultural Heritage personnel is required in addition to the Contractor's Monitoring activities. In accordance with the CHMA or CHMP, the Contractor shall be responsible for ensuring that the Cultural Heritage Personnel are on site during ground disturbance activities identified in the CHMA or CHMP. If activities requiring Monitoring by Cultural Heritage Personnel are occurring and Cultural Heritage Personnel are not present, the Contractor is to advise the Administrator immediately. The Contractor may only proceed in accordance with the conditions of the CHMP or CHMA.

Whilst on Site, the Cultural Heritage personnel(s) shall be supervised and coordinated by the Contractor. The Contractor shall ensure that the Cultural Heritage personnel are appropriately inducted, as required by Workplace Health and Safety Regulations. The Contractor shall ensure that the Cultural Heritage personnel comply with the relevant Codes of Conduct and workplace regulations

that apply to the construction site. Cultural Heritage personnel(s) shall be employed and paid by the Principal.

The Contractor's Work Supervisor shall verify and sign the Cultural Heritage personnel including monitor(s) signed and completed daily Monitoring Report and timesheet daily. (A copy of the report / timesheet proforma shall be provided by the Principal). The Contractor shall retain a copy of timesheets store and submit to the Administrator on a weekly basis.

8.4.4 EMP(C) requirements for Cultural Heritage

The EMP(C) shall include documents and / or diagrams indicating the following:

a) the Principal's Cultural Heritage Officer contact details

b) location of known Cultural Heritage significance within and adjacent to the Work Site

c) Work under the Contract likely to occur in proximity to Cultural Heritage

d) Cultural Heritage Management Measures, and

e) a Monitoring Plan for cultural heritage including Works under the Contract that Cultural Heritage Personnel are required to monitor.

8.5 Noise

8.5.1 General

The Contractor is responsible for the management of construction noise generated from Work under the Contract. The requirements of this Technical Specification do not include management of noise in relation to noise exposure within the Workplace (occupational noise). This Technical Specification does not address noise impacts on native fauna unless specified in the Annexure MRTS51.1.

In addition to the Sensitive Receptors and Critical Facilities, Infrastructure and Utilities identified by the Principal in Clause 4 of Annexure MRTS51.1, the Contractor shall be responsible for identifying Sensitive Receptors and Critical Facilities, Infrastructure and Utilities likely to be affected by construction noise through the application of the performance requirements in Clause 8.5.2.

8.5.2 Performance requirements

The Contractor shall at all times take reasonable and practicable Management Measures to avoid and mitigate Environmental Harm or Environmental Nuisance from noise associated with Work under the Contract.

The documentation, assessment and mitigation requirements are set by the Contract's noise risk level, as defined in Clause 4.1 of Annexure MRTS51.1.

For all Contracts, the Contractor shall review the Noise Management Plan or EMP(C), update and implement additional Management Measures where:

- directed by the Administrator
- in response to a justifiable complaint caused by the Work under the Contract, or
- when changes in the equipment / work method, intensity, location, duration or timing of impacts that are expected to increase noise impacts are foreseen.

8.5.2.1 Low noise risk

For Contracts specified as low noise risk in Clause 4.1 of Annexure MRTS51.1, the *Transport Noise Code of Practice:* Volume 2 is not applicable.

8.5.2.2 Medium or high noise risk

For Contracts identified in Clause 4.1 of Annexure MRTS51.1 as medium or high risk for noise, the Contractor shall comply with the *Transport Noise Code of Practice*: Volume 2. Specifically, the Contractor shall be responsible for preparing, undertaking, submitting and maintaining the following:

a) Where specified in Clause 4.3 of Annexure MRTS51.1 that the Principal has not completed a preconstruction assessment, the Contractor shall undertake a Noise Assessment Report in accordance with Section 4 of the *Noise Code of Practice*: Volume 2, to identify noise generating activities on Site, Sensitive Receptors likely to be impacted by Construction noise, and undertake assessment of likely noise impacts. The Noise Assessment Report will identify Sensitive Receptors to be included within the Noise Management Plan and shall be carried out prior to the commencement of construction. The Noise Assessment Report shall be signed off by a Registered Professional Engineer of Queensland (RPEQ) with relevant qualifications and experience, and submitted to the Administrator for deemed suitability.

   If the Principal has provided a Noise Assessment Report that considers construction noise, the Contractor shall review the Noise Assessment Report and comply with the requirements. If the Contractor cannot comply with or has differing construction methods to those documented within the existing Noise Assessment Report, then the Contractor shall advise the Administrator and prepare an update to the Noise Assessment Report.

b) Development of a stand-alone Noise Management Plan in accordance with the requirements of the *Noise Code of Practice*: Volume 2. The Noise Management Plan shall be based on the information and outcomes of the RPEQ-signed Noise Assessment Report.

c) Planned and trial Noise Assessment Report (including Monitoring) shall be undertaken by the Contractor where stipulated in the Noise Management Plan.

8.5.3 Monitoring

For medium and high noise risk Contracts, the Contractor shall undertake noise assessment (referred to as construction stage assessment in the *Noise Code of Practice*: Volume 2 where required by the Contractor's Noise Management Plan.

8.5.4 EMP(C) requirements for noise

For low noise risk contracts

The EMP(C) requirements and documentation shall be as follows:

a) location of any Sensitive Receptors and Critical Facilitates, Infrastructure and Utilities in proximity to the project

b) noise (including air blasting overpressure) generating activities, their locations, work periods [11](standard hours, non-standard hours (day / evening), nonstandard hours (night time))

[11] Work periods are as defined in the *Noise Code of Practice:* Volume 2 Table 3.1.3.

c) evaluation outcome of whether Sensitive Receptors will likely be impacted by construction noise

d) noise Management Measures to avoid or minimise noise impacts, and

e) contingency plan for Environmental Harm associated with noise impacts.

For medium or high noise risk contracts

The Contractor's Noise Management Plan shall be prepared, maintained and implemented in accordance with the *Noise Code of Practice*: Volume 2. The Noise Management Plan shall be prepared as a stand-alone document. The Noise Management Plan and supporting Noise Assessment Report will form part of the overall EMP(C).

8.6 Vibration

8.6.1 General

The Contractor is responsible for managing Work under the Contract to avoid Environmental Harm or Environmental Nuisance to Sensitive Receptors and Critical Facilities, Infrastructure or Utilities. For the purpose of this Specification potential vibration impacts are categorised in two forms:

1. Human comfort vibration management relates to managing vibration to avoid nuisance to public, residents or people utilising the area in the vicinity of the Site.
2. Building / Structural vibration management relates to managing vibration to avoid structural damage to buildings and structures within and beyond the Site. This also includes to managing impacts on building contents and surrounding utilities and services.

This Technical Specification does not address vibration impacts to native fauna unless specified in Clause 5 of Annexure MRTS51.1.

In addition to the Sensitive Receptors and Critical Facilities, Infrastructure and Utilities identified by the Principal in Clause 5 of Annexure MRTS51.1, the Contractor shall be responsible for identifying Sensitive Receptors and Critical Facilities, Infrastructure and Utilities likely to be affected by Construction vibration through the application of the performance requirements in Section 8.6.2.

8.6.2 Performance requirements

The Contractor shall at all times take reasonable and practicable Management Measures to mitigate:

1. Vibration impacts associated with Work under the Contract so as not to cause Environmental Harm and Environmental Nuisance in accordance with *Environmental Protection Act* 1994 (Human comfort Vibration), and
2. Environmental Harm to structures, premises, services and buildings within or beyond the boundary of the Site as a result of Work under the Contract. (Building / Structural Vibration).

The Contractor shall document the reasonable and practicable Management Measures either in a standalone Vibration Management Plan or the EMP(C). The Contractor shall review the Vibration Management Plan and update and implement additional Management Measures where:

a) directed by the Administrator

b) in response to a justifiable complaint caused by the Work under the Contract

c) in the event of structural / building damage caused by the Work under the Contract, or

d) when changes in the equipment/work method, intensity, location, duration or timing of impacts that are expected to increase vibration impacts are foreseen.

The performance requirements of the Contract are dependent on the vibration risk level specified in Clause 5.1 of Annexure MRTS51.1.

8.6.2.1 Vibration (building / structural)

In managing vibration effects in nearby buildings and structures, for all contacts the Contractor shall comply with the following:

a) Vibration limits given within the *Noise Code of Practice*: Volume 2 (for medium or high Vibration Risk Projects only).

b) Air Blast Overpressure and ground vibration from blasting limits given in *Environmental Protection Act* 1994 Section 440ZB[12].

c) Ground vibration values in TN03 *Measurement of Ground Vibrations and Air blast* unless otherwise set by Vibration Assessment Report, and

d) Vibration Monitoring requirements stated in Clause 5.4 of Annexure MRTS51.1.

Where the vibration criteria cannot be achieved, the Contractor shall notify the Administrator and advise the owner of the premise, building, service or structure affected of the predicted particle velocity and what reasonable and practicable Management Measures shall be employed to minimise impacts. The Administrator shall assess the application for suitability prior to the Contractor proceeding.

8.6.2.2 Low vibration risk contracts

For contracts specified as low vibration risk in Clause 5.1 of Annexure MRTS51.1, the *Noise Code of Practice:* Volume 2 is not applicable. The Contractor shall nominate reasonable and practicable Management Measures to prevent Environmental Harm and Environmental Nuisance.

8.6.2.3 Medium or high vibration risk contracts

For contracts identified in Clause 5.1 of Annexure MRTS51.1 as medium or high risk for vibration, the Contractor shall comply with the *Noise Code of Practice*: Volume 2. Specifically, the Contractor shall be responsible for undertaking, submitting to the Administrator, implementing and maintaining the following:

a) Where specified in Clause 5.2 of Annexure MRTS51.1, that the Principal has not completed a Preconstruction Assessment, the Contractor shall prepare and undertake a Vibration Assessment Report identifying Sensitive Receptors and Critical Facilities, Infrastructure and Utilities in accordance with the *Noise Code of Practice*: Volume 2. The Vibration Assessment Report will identify Sensitive Receptors to be included within the Vibration Management Plan and shall be carried out prior to the commencement of vibration-generating Works. The

[12] A person must not conduct blasting if:

(a) the air blast overpressure is more than 115dB Z Peak for four out of any five consecutive blasts, or

(b) the air blast overpressure is more than 120dB Z Peak for any blast; or (c) the ground vibration is:

(i) for vibrations of more than 35Hz-more than 25 mm a second ground vibration, peak particle velocity; or

(ii) for vibrations of no more than 35Hz-more than 10 mm a second ground vibration, peak particle velocity.

Vibration Assessment Report shall be signed off by an RPEQ with relevant qualifications and experience, as required by the *Noise Code of Practice*: Volume 2 and submitted to the Administrator for deemed suitability.

b) Where the Principal has provided a Vibration Assessment Report that considers construction Vibration, the Contractor shall review the Principal's Vibration Assessment Report and comply with the requirements. If the Contractor cannot comply with the Principal's Vibration Assessment Report, then the Contractor shall advise the Administrator and prepare an update to the Vibration Assessment Report prior to commencement of vibration-generating Works.

c) Where required by Vibration Assessment Report or Clause 5.5 of Annexure MRTS51.1, a condition survey of buildings and structures as "at risk" of damage. The condition survey shall be undertaken prior to commencing vibration generating Works. In addition, condition surveys shall be carried out on those structures and buildings listed in Clause 5.4 of Annexure MRTS51.1, prior to the commencement of Works unless the Vibration Assessment Report determines the structures / buildings are not at risk of damage. The survey shall assess the current structural and architectural condition of buildings and structures and shall record all existing cracks and other defect. Photographs shall support the condition survey. Unless stated in Clause 5.6 of Annexure MRTS51.1 a registered structural engineer (RPEQ) shall carry out the condition survey. The survey is to be carried out with the consent and in the presence of the owner or owner's representative. A copy of the condition survey shall be given to the Administrator five working days before any Works that cause vibration start.

d) A standalone Vibration Management Plan that includes details as required by the *Noise Code of Practice*: Volume 2. The Vibration Management Plan shall be based on the information and outcomes of the RPEQ signed Vibration Assessment Report.

e) Undertake post-construction condition surveys at buildings and structures subsequent to completion of the works. Post-construction condition survey reports detailing the results of the inspections shall be submitted to the Administrator following completion of the relevant activity.

f) Undertake other investigations such as building contents investigations and infrastructure, services and utility investigations as determined in the Vibration Assessment Report.

Where the Contractor's Vibration Assessment Report identifies a department's structure(s) are at risk of impact from vibration, the Contractor shall advise the Administrator. At their discretion, the Administrator may advise the Contractor of vibration criteria for the specific structure(s) potentially impacted.

8.6.3 Monitoring

Where stipulated in Clause 5.3 of Annexure MRTS51.1 or by the Contractor's Vibration Management Plan or vibration section of the EMP(C), the Contractor shall undertake assessment for vibration (human comfort) and / or Vibration (structural / building) during Works under the contract identified as having potential risk of impact.

Contract records shall include all vibration assessment results are documented, investigated and managed in accordance with the *Noise Code of Practice*: Volume 2 and Clause 7 of this Technical Specification.

8.6.4 EMP(C) requirements for vibration

For low vibration risk contracts, the EMP(C) shall include documents and / or diagrams indicating the following:

a) the type of Vibration Sensitive Receptors and Critical Facilities, Infrastructure and Utilities potentially impacted by Works under the Contract the location in relation to Site

b) location of significant Vibration and Air Blasting Overpressure generating Works within the Site

c) applicable construction vibration criteria for assessment

d) evaluation outcome of which Sensitive Receptors, structures and / or buildings will likely be impacted by construction vibration and Air Blast Overpressure and from what Works

e) vibration Management Measures and strategies to avoid or minimise Environmental Harm of vibration (human comfort) and vibration (structural / building), and

f) contingency plan for observed damage to structures (private, public or departmental-owned).

For medium or high vibration risk contracts, the Contractors Vibration Management Plan shall be prepared, maintained and implemented in accordance with the *Noise Code of Practice*: Volume 2. The Vibration Management Plan shall be prepared as a stand-alone document. The Vibration Management Plan and supporting Vibration Assessment Report will form part of the overall EMP(C).

NOTE: Where vibration and noise risk levels are both medium and high, the Assessment Report and Management Plans may be combined in accordance with the Noise Code of Practice: Volume 2.

8.7 Air quality

8.7.1 General

The Contractor shall be responsible for managing work under the Contract to avoid and minimise Environmental Harm on air quality including from dust, smoke and offensive odours and other air pollutants.

8.7.2 Performance requirements

The Contractor shall at all times take reasonable and practicable Management Measures to avoid causing Environmental Harm and Environmental Nuisance.

Where specified in Clause 6.3 of the Annexure, the Contractor shall assess and manage construction related air quality in accordance with Chapter 6 of the *Road Traffic Air Quality Management Manual*. Construction related air quality complaints shall be managed in accordance with Chapter 7 of the *Road Traffic Air Quality Management Manual*.

Burning of material shall not be permitted unless specifically allowed by Clause 6.1 of Annexure MRTS51.1. If burning is permitted, the Contractor shall:

a) obtain approval from the Administering Authority prior to burning

b) notify adjacent landowners

c) comply with additional conditions specified in Clause 6.2 of Annexure MRTS51.1, and

d) not burn regulated waste that shall create toxic or nuisance emissions.

8.7.3 Monitoring

Where stipulated in Clause 6.3 of Annexure MRTS51.1, the Contractor shall undertake air quality Monitoring. Air quality Monitoring shall be undertaken in accordance with the current Australia Standard measurement techniques. Contract records shall include all air quality Monitoring results, schedule and all instrument calibrations. Reporting of air quality Monitoring shall be in accordance with Clause 7 of this Technical Specification.

Weekly Site Inspections shall include observations of the Site for visual evidence of dust or emissions travelling beyond the boundary of the Site and evidence of dust fallout from the Works on adjacent vegetation or buildings.

8.7.4 EMP(C) requirements for air quality

The EMP(C) shall include documents and / or diagrams indicating the following:

a) Location of Air Quality Sensitive Receivers to the Site.

b) Works likely to cause Environmental Harm or Environmental Nuisance in relation to air quality and location of these works on Site (for example, blasting, excavation, crushing, screening and earth moving plant, compressors and pumps, fabrication areas, lead paint removal, workshops, concrete batching and mixing plant, and all other construction plant and equipment).

c) Prevailing wind direction and speeds (wind rose) generally expected for the Site location (available from Bureau of Meteorology).

d) Evaluation outcome of which air quality sensitive receivers will likely experience Environmental Nuisance or Environmental Harm in relation to air quality (unless Monitoring specified in Annexure MRTS51.1 this is qualitative evaluation).

e) Management Measures and strategies for mitigating Environmental Nuisance and Environmental Harm to air quality. Works that may result in air quality emissions of a substance harmful to health, shall be identified and additional specific management practices and controls prescribed.

f) Where Monitoring is stipulated in Annexure MRTS51.1 Clause 6.3, air quality Monitoring methodology, equipment used, frequency, duration, location of equipment and details of the person undertaking the Monitoring Assessment.

g) Where Air Quality Compliance Testing is stipulated in Annexure MRTS51.1 Clause 6.4, Air Quality Compliance Testing methodology, equipment used, frequency, duration, location and details of the person undertaking the Compliance Testing Assessment, and

h) Contingency Plan for observations of emissions exceeding criteria.

8.8 Acid Sulfate Soils

The Contractor shall be responsible for the management of actual or potential acid sulfate soils within the Site. The Contractor's EMP(C) shall address the requirements of MRTS04 *General Earthworks* including the requirements concerning the management of actual and potential acid sulfate soils.

8.9 Contaminated Sites

8.9.1 General

The Contractor shall be responsible for managing Work under the Contract in order to mitigate risks of Environmental Harm from Contaminated Sites within the Site (for example, contaminated soil, Waste dumps, unexploded ordnances). In addition to the requirements in this Technical Specification, the Contractor shall comply with the requirements of MRTS04 *General Earthworks* Clause 11 in relation to use of or disposal of surplus and unsuitable material and MRTS96 *Management and Removal of Asbestos*.

Known locations of Contaminated Sites are stated in Clause 7.1 of MRTS51.1 Annexure.

Where a DEHP-accepted Site Management Plan exists, this is identified in Annexure MRTS51.1 Clause 7.2.

8.9.2 Performance requirements

The Contractor shall at all times take reasonable and practicable Management Measures to manage known Contaminated Sites in order to avoid and prevent the spread of contaminants either within the Site or beyond the boundary of the Site. Management shall be in accordance with the DEHP-approved Site Management Plan where it exists. Where the contract requires disturbance of known Contaminated Sites, Management Measures will extend to the active containment and, where stipulated in Annexure MRTS51.1, treatment of contaminated material. Management must be in accordance with statutory requirements under the *Environmental Protection Act* 1994. Where disposal is required off Site, a disposal permit shall be obtained by the Contractor unless otherwise stated in Clause 1 of Annexure MRS51.1.

Where stipulated in Clause 7.3 of MRT51.1, the Contractor shall develop and implement a Contaminated Site investigation by a suitably qualified person, management and Compliance Testing Plan in accordance with *Environmental Protection Act* 1994, Chapter 7, Part 8 Contaminated Land.

If an additional Contaminated Site is identified during Work under the Contract, the Contractor shall:

a) notify the Administrator in accordance with Clause 7 of this Technical Specification

b) notify the DEHP in accordance with the requirements of the *Environment Protection Act* 1994 (for unexploded ordnances (UXO) notify Department of Defence)

c) prevent spread of contamination

d) manage the Contaminated Site in accordance with statutory requirements

e) where instructed by the Administrator, the Contractor will develop a Site Management Plan in accordance with statutory requirements, submit to Administrator for suitability, submit to DEHP for acceptance, and carry out remediation of Contaminated Site in accordance with the Site Management Plan, and

f) provide the DEHP-accepted Site Management Plan to Administrator for records.

The Principal may at their discretion elect to undertake the investigation and management of additional Contaminated Site by its own agents. The Contractor shall facilitate the investigation.

8.9.3 Monitoring

Where stipulated in Clause 7.2 of Annexure MRTS51.1, the Contractor shall develop and undertake a reasonable and practicable Monitoring Plan submitted for deemed suitability with the EMP(C).

In addition to the requirements of Clause 7 of this Technical Specification, Weekly Site Inspections shall incorporate observations for evidence of contaminates or contaminated material being transported from the Contaminated Site without appropriate management.

8.9.4 Compliance Testing

Where stipulated in Clause 7.3 of Annexure MRT51.1, the Contractor shall undertake Compliance Testing in accordance with the Contractor's (or pre-existing) Contaminated Site Management Plan and the requirements stipulated in the *National Environment Protection (Assessment of Site Contamination) Measure*, 1999. Compliance Testing shall be required of material treated for remediation as part of this Contract. The Contractor shall provide Inspection and Test Plans (ITP's) for Contaminated Site Compliance Testing as part of the Quality Plan.

8.9.5 EMP(C) requirements for Contaminated Sites

The EMP(C) shall include documents and / or diagrams indicating the following:

a) location of known Contaminated Sites and known insitu contaminants

b) Management Measures and Monitoring requirements applicable to each Contaminated Site

c) where stipulated by Clause 7.3 of Annexure MRTS51.1, the EMPC shall document the Contractor's Contaminated Site Management Plan including methods of assessment, remediation and Compliance Testing, and

d) contingency plan for the event of contaminants leaving Site or being discovered on Site.

8.10 Native fauna

8.10.1 General

The Contractor shall be responsible for managing potential Environmental Harm to native fauna, their breeding places and their habitat within the Site and adjacent to the Site.

The Contractor shall be responsible for the assessment, management and compliance of temporary Waterway Barrier Works undertaken as part of this Contract unless otherwise stipulated in Clause 1 of Annexure MRTS51.1. Principal identified Queensland Waterways for Waterway Barrier Works, as mapped by DAF[13], are identified in Clause 8.1 of Annexure MRTS51.1.

NOTE: This Technical Specification does not address permanent fauna sensitive road design requirements as these shall be included in Contract design drawings.

8.10.2 Performance requirements

The Contractor shall take reasonable and practicable Management Measures to avoid Environmental Harm and Environmental Nuisance to native fauna, and to known habitat and breeding places. Where Environmental Harm cannot be avoided, the Contractor shall comply with the provisions of both State and Commonwealth legislation pertaining to native fauna. Where impacts to native fauna, known

[13] https://www.daf.qld.gov.au/__data/assets/pdf_file/0007/75886/spatial-data-layer-user-guide-jan-13.pdf

habitat and breeding places cannot be avoided, the Contractor shall operate in accordance with legislative requirements.

Where the Principal has identified native fauna habitat, breeding places(s) these are stipulated in Clause 8.2 of Annexure MTS51.1. The Principal has obtained an Environmental Approval for Tampering with Animal Breeding Places of Least Concern Species[14] (SMP-low risk). Where the Works under the Contract will result in a requirement to tamper with a breeding place covered by the scope of the SMP-low risk, the Contractor shall be responsible for:

a) Tampering with any least concern breeding places in accordance with Table 1 of the SMP-low risk including the engagement of Suitably Qualified and Experienced Person (fauna) as required.

b) Complete the Register of Tampering with an Animal Breeding Place[15] in accordance with the department's Technical Note completing a SMP Register, to record any breeding places known to have been tampered with and whether native fauna have been injured or killed. If no animal breeding places are identified "Nil" shall be entered into the register.

   Report fauna-related Monitoring and submit the SMP Register with the Monthly Environmental Report (Clause 7 of this Technical Specification), and

c) Submit the final completed Register to Administrator at Practical Completion in accordance with Clause 7.8 of this Technical Specification.

If required by legislation, the Contractor shall obtain other necessary Approvals unless otherwise Principal-supplied in Clause 1 of Annexure MRTS51.1.

Any unauthorised death of fauna or tampering with a breeding place not in accordance with an Approval will be reported in accordance with Clause 7 of this Technical Specification.

In the event that native fauna species is injured or killed on Site, the Contractor shall undertake an investigation into the Environmental Incident and determine whether the injury / death was related to Works under the Contract and whether reasonable and practicable measures were in place and determine if corrective actions are warranted to prevent a similar incident re-occurring. The Contractor shall submit the results of their investigation in accordance with Clause 7 of this Technical Specification. The Administrator may at its discretion elect to undertake their own investigation.

Where stipulated in Clause 8.2 of Annexure MRTS51.1, the Contractor shall implement measures to facilitate the safe movement of fauna across the Site. Where temporary fencing is required in Clause 8.3 of Annexure MRTS51.1, the Contractor shall plan for fauna movement as part of the fencing installation.

8.10.2.1 Waterway barrier works

Principal-identified Queensland Waterways for Waterway Barrier Works within the Site are identified in Clause 8.4 of Annexure MRTS51.1. Where waterway barrier works Approvals (Development Approval or Self Assessable Code) apply to permanent structures, the Contractor shall undertake works in accordance with the applicable Approval. If temporary waterway barrier works are to be constructed, raised or modified as part of this Contract, the Contractor shall ensure compliance with the

[14] https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Animal-Breeding
[15] https://www.ehp.qld.gov.au/licences-permits/plants-animals/documents/fm-wl-register-animal-breeding-place.xls

Department of Agricultural and Forestry's Self-Assessable Codes for Temporary Waterway Barrier Works (WWBW02).

Where compliance with a Self Assessable Code is not practicable, the Contractor is obligated to obtain an applicable Development Approval and comply with Approval conditions.

If the Contractor requires access over or works within a waterway mapped under the Queensland Waterways for Waterway Barrier Works not within the Site, the Contractor is required to undertake an assessment of applicable fish passage requirements. The Contractor shall obtain the necessary Approvals.

The Contractor shall be responsible for completing and submitting pre and post works notifications for all waterway barrier (permanent and temporary) works under the Contract.

8.10.3 Monitoring

Contract-specific requirements for Monitoring are outlined in Clause 8.4 of Annexure MRTS51.1 or Clause 1 of Annexure MRTS51.1 under the Environmental Approval.

When operating under the SMP-low risk, the Contractor shall engage a Suitably Qualified and Experienced Person (Fauna) to undertake pre-clearing inspections of vegetation and potential breeding places and Monitor for native fauna and breeding places when undertaking Works that are known or likely to impact animal breeding places or native fauna.

The Suitably Qualified and Experienced Person (fauna) inspections are to verify the absence or presence of native fauna and breeding places and, where active breeding places exist, the absence or presence of eggs or young. The Suitably Qualified and Experienced Person (Fauna) shall advise the Contractor of the outcomes of the inspections and whether the SMP-low risk is applicable. Where SMP-low risk applies, the Contractor shall, based on the advice of the Suitably Qualified and Experienced Person (Fauna), undertake:

a) measures to avoid tampering with breeding places, death or injury to animals

b) where avoidance is not possible, engage the Suitably Qualified and Experienced Person(fauna) to undertake Management Measures to relocate and preserve breeding places and animals if appropriate

c) where avoidance and relocation not practicable, engage the Suitably Qualified and Experienced Person(fauna) to destroy breeding places and remove eggs and young for rehabilitation, and

d) as a last resort, engage the Suitably Qualified and Experienced Person (fauna) to destroy eggs, young under an appropriate Damage Mitigation Permit.

The Contractor shall record Monitoring and tampering data in the Register for tampering with animal breeding places.

8.10.4 EMP(C) requirements for native fauna

The EMP(C) shall include documents and / or diagrams indicating the following:

a) location of native fauna habitat and breeding places within the Site and relative to the Limits of Clearing

b) identification of activities that are likely to impact fauna, habitat or animal breeding places and the nature of impacts

c) identification of mapped Queensland Waterways for Waterway Barrier Works impacted by the Work under the Contract and location of any temporary Waterway Barrier Works

d) Management Measures and strategies for native fauna, breeding places, habitat and fish passage, including details of any Suitably Qualified and Experienced Person (fauna) to be utilised for fauna management

e) contingency plan including procedures for fauna rescue and release including treatment of fauna injured by Work under the Contract, and

f) contact details for emergency wildlife care shall be included on the Site's emergency contact list and within the fauna management plan.

8.11 Vegetation

8.11.1 General

NOTE: This Vegetation section of MRTS51 is for the management of potential impacts upon Significant Vegetation and to minimise the Environmental Harm of the Works under the Contract on vegetation that is to be retained. Clearing & Grubbing activities under the contract are covered in MRTS04.

The Contractor shall be responsible for managing Work under the Contract in order to avoid Environmental Harm on Significant Vegetation within the Site, minimise the disturbance area on Site, and undertake progressive vegetation clearing and rehabilitation where reasonable and practicable.

Significant Vegetation known to occur within the Site and associated management requirements are stated in Clause 9 of Annexure MRTS51.1.

Details of revegetation, ground preparation and planting media are outlined in MRTS16 *Landscaping and Revegetation Works* Specification and the Annexure MRTS16.1.

Management of vegetative waste is detailed in Clause 8.13 Waste management.

8.11.2 Performance requirements

The Contractor shall adhere to the Contractual Limits of Clearing as defined in Table 2 of this Technical Specification. The Contractor shall take reasonable and practicable Management Measures to avoid disturbance to vegetation or ground surface outside of the Limits of Clearing and to minimise disturbance areas within the Limits of Clearing where practicable. The Contractor shall install identification markers along the Limits of Clearing boundary prior to commencing vegetation clearing and ground disturbance. Identification markers shall be maintained for the duration of the Contract or at least until Works are complete in the adjacent area.

Where the Contractor identifies the requirement for additional areas of vegetation or ground to be disturbed outside the specified Limits of Clearing, the Contractor shall submit a request to the Administrator. If the Administrator deems the additional areas suitable for clearing, the Contractor shall amend the Limits of Clearing and erosion and sediment controls managing the Site before proceeding. The Contractor will be responsible for determining whether Approval(s) are required, obtaining the Approval(s) and complying with conditions. Delays incurred as a result of obtaining Approvals shall be the Contractor's responsibility.

Where Significant Vegetation is identified within the Limits of Clearing, the Contractor shall comply with Principal obtained Approvals listed in Clause 1 of Annexure MRTS51.1. If the Contractor cannot

comply with the Approval, the Contractor shall advise the Administrator and be responsible for obtaining an alternative Approval for the relevant vegetation clearing.

The Contractor shall clearly identify areas of Significant Vegetation or habitat by identification markers that are visibly different to the limits of clearing markers and deemed suitable by the Administrator. Staff will be made aware of these areas through Site Induction, training and tool box talks prior to vegetation clearing or grubbing commencing.

Any vegetation clearing beyond the Limits of Clearing or not otherwise deemed suitable by the Administrator, shall be reported to the Administrator in accordance with Clause 7 of this Technical Specification. The Contractor shall provide details on the area (metre squared), the location, a description of the vegetation cleared and other issues that might relate to the clearing (such as clearing outside the Cultural Heritage Management Agreement area).

Where disturbance has occurred beyond the Limits of Clearing, the Administrator may at their discretion, order the Contractor to stop Works which pertain to the activity where the unauthorised disturbance occurred. The Administrator will then promptly arrange for the Site to be inspected and the extent and impact of the additional clearing assessed. The Administrator may choose to declare the area an Exclusion Zone for any period of time until the Administrator is satisfied that the additional clearing has been investigated, remediated and measures have been implemented to prevent additional unauthorised clearing from reoccurring. Remediation of unauthorised cleared areas beyond the Limits of Clearing deemed suitable by the Administrator will be at the Contractor's expense.

Where the Administrator has declared an area excluded from Works, the Contractor will organise for relevant exclusion devices to be erected to ensure that access to the area by the Contractor's staff or others is prevented. The Contractor shall notify all Site personnel of the exclusion area as soon as possible, but prior to commencing work on the next working day. The Contractor will be responsible for ensuring that access to an excluded area remains restricted until informed otherwise by the Administrator.

Where Works encroach on individual trees or vegetation to be retained, ground disturbance or other Works, including material stockpiling, shall not encroach within the dripline of the tree (below canopy of tree) unless otherwise deemed suitable by the Administrator. For contracts within an urban context, the Contractor shall comply with AS4970 2009 *Protection of trees on development sites* for the protection of vegetation to be retained.

Clear zone clearing shall be undertaken in accordance with the departmental *Road Planning and Design Manual*, Supplements to Volume 3, Part 6 Roadside Design, Safety and Barriers or otherwise stated in Annexure MRTS04.1. Specifically, clearing for clear zone shall be the selective removal of infrangible vegetation.

Any other requirements are stated in Clause 9 of the Annexure MRTS51.1.

8.11.3 Monitoring

Where specified in Clause 9 of MRTS51.1, the Contractor shall undertake Monitoring of specific areas of Significant Vegetation or areas of Site as specified.

Weekly Site Inspections shall inspect and verify the adherence to the Limits of Clearing for the duration of the Contract. The Monitoring shall assess whether identification markers are present, functional and adequate, and any maintenance requirements for the markers. The Weekly Site

Inspections shall also assess whether any clearing or disturbance has occurred beyond the Limits of Clearing without Administrator deemed suitability.

8.11.4 EMP(C) requirements for vegetation management

The EMP(C) shall include documents and / or diagrams indicating the following:

a) A drawing depicting the following:

   i. location and dimensions of Contractual Limits of Clearing (as specified in Clause 8.11.1 of this Technical Specification)

   ii. limits of Contractor's intended vegetation clearing (demonstrating minimised clearing area)

   iii. restrictions to clearing in waterways (as specified in Clause 7.2.2 of MRTS04)

   iv. any areas required for clearing additional to the Contractual Limit of Clearing

   v. locations of Significant Vegetation and any specific trees identified in Clause 9 of Annexure MRTS51.1 or Annexure MRTS04.1 to be retained on Site, and

   vi. a program of clearing operations demonstrating progressive clearing stages where practicable.

b) Identification method for the Limit of Clearing and method of identifying Significant Vegetation.

c) Management Measures and strategies to minimise the area of vegetation clearing, and

d) Where required Environmental Approval for additional clearing.

8.12 Biosecurity

8.12.1 General

The Contractor shall be responsible for managing Work under the Contract in order to mitigate the spread of Biosecurity Matters.

8.12.2 Performance requirements

The Contractor shall comply with the *Biosecurity Act* 2014. The Contractor shall undertake reasonable and practicable Management Measures to mitigate Environmental Harm from prohibited and restricted Biosecurity Matters (including but not limited to invasive animals and plants) within the Site by preventing their spread into the Site, within the Site and out of the Site. The Contractor shall manage movement of Biosecurity Matter carriers across biosecurity management zone boundaries as part of Work under the Contract. Biosecurity matters known to occur within the worksite and associated management requirements are stated in Clause 10.1 - 10.3 of Annexure MRTS51.1.

The Contractor shall undertake the following:

a) Obtain biosecurity certificates certifying that all imported topsoils and mulches are free of prohibited or restricted biosecurity matters.

b) Ensure construction plant and vehicles undergo a documented cleaned down prior to entry to Site.

c) Ensure construction plant and vehicles operating in biosecurity-contaminated areas undergo a clean down in accordance with *QDAF Clean-down* procedures prior to movement out of the biosecurity-contaminated area.

d) Where specified in Clause 1 of Annexure MRTS51.1, comply with the departmental Biosecurity Instrument Permit requirements.

e) Obtain and comply with a Biosecurity Instrument Permit for applicable Work under the Contract not covered by Principal's Biosecurity Instrument Permit.

f) Where previously unidentified suspected prohibited or restricted Biosecurity Matter is identified on or adjacent to the Site, the Contractor shall isolate the infestation and implement Management Measures to prevent the spread or transmission of the Biosecurity Matter out of the identified infestation area within the Site. The Contractor shall notify the Administrator and, where applicable Biosecurity Queensland, in accordance with Clause 7 of this Technical Specification, and

g) Ensure use of pesticides is undertaken by appropriately licenced contractors and in accordance with the label including the requirements of Clause 8.1.1.2 of MRTS16 *Landscape and Revegetation* and retain records of spray activities.

Where temporary clean-down bays are used, the Contractor shall document:

- Maintenance requirements and procedures.
- Management Measures implemented to contain wastewater and restrict movement of Biosecurity Matters particularly to Waterways and drainage lines.
- Management Measures to contain biosecurity matter, sediments, oils and greases, and
- Prevention of vehicle recontamination.

8.12.3 Monitoring

Where stipulated in Clause 10.1 of Annexure MRTS51.1 or a condition of an Environmental Approval (Clause 1 of Annexure MRTS51.1), the Contractor shall undertake Monitoring of the Site for new infestations of Biosecurity Matters. The Contractor shall submit a Biosecurity Monitoring Plan as part of the EMP(C) for deemed suitability.

8.12.4 EMP(C) requirements for biosecurity

The EMP(C) shall include documents and / or diagrams indicating the following:

a) Details of the Biosecurity Matter including photo, location of Biosecurity Matter infestations, the Biosecurity Matter category and respective Management Measures.

b) Location of applicable biosecurity management zone boundaries in relation to Work under the Contract (including ancillary activities such as water source, stockpile sites, gravel sources, spoil locations).

c) Identify movement of Biosecurity Matter carriers across biosecurity zone boundaries and Biosecurity Instrument Permit details pertaining to these movements.

d) Management Measures for preventing the spread of Biosecurity Matters within Site and out of the Site.

e) Measures to exclude access to known areas of Biosecurity Matter infestation such as flagging.

f) Location of clean-down facility (if temporary clean down bay is to be constructed on Site, specify design and maintenance requirements).

g) Specific Monitoring procedures for biosecurity matters (method, timing, frequency, duration, parameter to be monitored, criteria / outcome measured against).

h) Pesticide treatment schedule addressing method of control, chemicals, locations, timing of works, and

i) Biosecurity Matter Commercial Operator's Licence.

8.13 Waste

8.13.1 General

The Contractor shall be responsible for management of Wastes generated from Work under the Contract in accordance with the *Environmental Protection Act* 1994. This shall include Wastes generated at Site Camp and facilities under MRTS28.

Where illegally dumped waste and litter is discovered during the Work under the Contract, the Principal may instruct the Contractor to undertake appropriate management, removal and disposal of Waste and litter.

8.13.2 Performance requirements

The Contractor shall adopt the Waste management hierarchy of avoidance, reuse recycling, energy recovery and disposal of wastes generated under the Contract. No Waste, including vegetative Waste, or litter shall be burnt on Site unless allowed as specified in Clause 8.7.2.

Upon completion of Works, the Contractor shall ensure that all Wastes have been removed from Site or otherwise lawfully disposed of on Site. No Waste shall be buried on Site unless deemed suitable by the Administrator and the Administering Authority.

The Contractor shall provide bins at common areas at all times. Bins shall be fitted with lids and serviced prior to being filled to capacity. During construction, the Contractor shall maintain the Site free of litter.

Vegetation waste from clearing and grubbing, that is free from Biosecurity Matter, may be used in conjunction with soil erosion and sediment measures such as brush matting or mulch or for appropriate fauna logs in accordance with Clause 7.2.5 of MRTS04. Clause 11.1 of Annexure MRTS51.1 specifies the method of management of vegetation waste from clearing and grubbing activities.

Mulch stockpiles shall be separated from drainage lines and Waterways by distance or Management Measure to inhibit Discharge. Mulch stockpiles shall be a maximum of 2.5 m in height where air temperature is < 30° and humidity < 70%. Where Site climate conditions exceed this, mulch stockpiles should be reduced to a maximum height of 1.5 m and Monitored regularly for excess leachate and heat. Where the volume of mulch generated by the Works exceeds the volume of mulch required for the Work under Contract, the Contractor shall be responsible for removal from Site and reuse of the mulch.

Where stipulated in Clause 11.2 of Annexure MRTS51.1, the Contractor shall record Wastes generated, disposed, recycled and reused by the Work under the Contract in the Waste Register provided in Appendix C of MRTS51 or an alternative template as deemed suitable by the Administrator. The Contractor shall retain copies of all documents issued in relation to Trackable

Waste[16] transportation and disposal processes. The completed Waste Management Register shall be submitted to the Administrator at Practical Completion. Further information is available in the Project Waste Reporting Guideline[17].

Where surplus or unsuitable material shall be used or disposed of off-site in accordance with Clause 11 of MRTS04 General Earthworks, the Contractor shall provide the following details to the Administrator as part of the EMP(C) or EMP(C) updates, prior to commencing the spoil activity off-site.

a) GPS coordinates of the boundary corners of the spoil location.

b) Evidence of an agreement with the landowner for receiving the spoil, the location of the spoil and the condition of the spoil.

c) Details of the materials to be spoiled off-site.

d) Deed of indemnity from the landowner for the Principal for the long term management of the spoil, and

e) Details as to the measures to be undertaken by the Contractor to ensure the spoil is stable and not posing any environmental or safety concerns in future.

8.13.3 EMP(C) requirements for Waste management

The EMP(C) shall include documents and / or diagrams indicating the following:

a) Estimates of type and quantity of Waste expected to be generated and their source. Wastes shall be categorised as per register in MRTS51 Appendix C.

b) Waste management strategies (avoidance, reuse, recycling, energy, recovery, disposal).

c) Waste containment locations.

d) All mulch stockpiles shall be identified on plans, and

e) The procedure for measuring and recording Waste generated, reused, recycled and disposed of under the Contract.

8.14 Chemicals and fuels

8.14.1 General

The Contractor shall be responsible for the management of all chemicals and fuels within the Site so as not to cause Environmental Nuisance or Environmental Harm.

8.14.2 Performance requirements

In addition to satisfying the requirements of *Environmental Protection (Water) Policy* 2009, management of hazardous substances or dangerous goods (flammable and combustible liquid storage) shall comply with AS 1940 and AS 3833, including minor storages in accordance with Section 2 of the Standards.

Where Work under the Contract shall trigger an Approval in relation to chemical storage, the Contractor shall be responsible for obtaining and complying with relevant Approval(s).

[16] Trackable waste as defined under the Schedule 2E of Environmental Protection Regulation 2008.
[17] https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Project-waste-reporting

The Contractor shall ensure spill response equipment is available on the Site for use in an emergency. Spill response equipment shall be commensurate with the Site location, topographical features, type and quantity of chemicals and fuels being stored on Site and the time of year the contract is undertaken. All Staff on Site shall be trained in the use of spill response equipment.

The Contractor shall, promptly remediate any contamination resulting from spills, leaks and Discharges to a condition similar to that existing before the contamination and to the Administrator's satisfaction.

Refuelling of machinery shall conform to the following requirements:

a) occur away from Waterways unless for tracked machinery and contingency plan Management Measures are available in the immediate area

b) fuelling activity to be supervised at all times, and

c) hoses to be fitted with a stop valve at the nozzle end.

Machinery shall be maintained to minimise the leakage of oil, fuel, hydraulic and other fluids. During the servicing of machinery, the Contractor shall use Management Measures to capture and contain oils, fuels, hydraulic and other fluids so as to minimise contamination of the servicing area.

Surface coating treatments will be undertaken in a manner that avoids or minimises release of chemical to the environment and contact with the public.

Unless otherwise stated in the contract, no pre-coating of aggregates shall be conducted on Site.

8.14.3 EMP(C) requirements for management of chemicals and fuels

The EMP(C) shall include documents and / or diagrams indicating the following:

a) list chemical and fuels stored on Site in volumes greater than 250 L, the maximum quantity to be stored at any one time, storage location

b) type and number / size of spill response equipment stored on site

c) Management Measures, including containment, for avoiding contamination or discharge to land or water from fuels and chemicals

d) details of any approvals held in relation to fuel and chemical storage or use, and

e) contingency plan in the event of a contamination or discharge.

8.15 Sourcing of construction materials (non-commercial sources)

NOTE: This clause applies to sourcing construction material from non-commercial sources and sourcing of water from non-potable water.

8.15.1 General

Construction materials such as gravel, embankment material, and water are often sourced from non-commercial sources without existing infrastructure, management procedures and Approvals.

The sourcing of construction materials from non-commercial sources[18] requires that the material source, the activity (the "take") and any associated Site activities such as clearing vegetation,

[18] Non-commercial sources are sources where either Principal or Contractor hold relevant approvals and material sourcing operations are undertaken by the Contractor or its sub-contractor.

construction of access tracks potentially including Waterway Barriers Works, be planned and managed by the Contractor to ensure operations comply with legislation and avoid causing Environmental Harm.

8.15.2 Performance requirement

Where Approvals have not been obtained by the Principal, the Contractor is responsible for identifying, assessing, obtaining Environmental Approvals for relevant material sources including construction water and gravel resources or sourcing from suitably licensed Suppliers. The materials supplied by the Contractor shall be from sources compliant with relevant environmental legislation and managed in accordance with Environmental Approval conditions.

Where specified in Clause 1 of Annexure MRTS51.1, the Principal has obtained Approvals pertaining to the material source and activity. The Contractor shall ensure that Works under the Contract are in accordance with the conditions of the Approvals, recording and documenting compliance as required by the Approval. The Contractor shall plan and undertake Management Measures in accordance with the Approval Conditions and include in the EMP(C).

The Contractor shall maintain volumetric and photographic records of material sourced and supplied under the contract from each source as well as other records required for compliance with Approvals. The records shall be reported in accordance with Clause 7 of this Technical Specification.

Progressive rehabilitation of source sites and access tracks approved by the Administrator shall be undertaken by the Contractor as sources are exhausted or supply requirements are fulfilled. Rehabilitation shall be in accordance with the relevant approvals and Technical Specifications in MRTS16 *Landscape and Revegetation Works* and the MRTS16.1 Annexure.

For all material sourcing, unless stated otherwise in Appendix MRTS51.1 the Contractor shall complete all pre-works notifications, record keeping and reporting under the applicable Approvals.

Weekly Site Inspections shall include inspection of any material sources outside of the Site in accordance with the Weekly Site Inspections specified throughout MRTS51 or otherwise stated in Approvals.

8.15.3 Monitoring

For construction water sources, the Contractor's shall undertake Monitoring of the water source to ensure compliance with the Exemption Requirements for the taking of water without entitlement (WSS/2013/666) or other applicable Approval. This shall require Monitoring of water levels in a non-flowing source against a depth gauge or suitable alternative and recording percentage (%) of full capacity. For flowing sources, Monitoring shall be of the flow rate and whether flows cease during Works under the Contract.

For construction gravel, fill and sand material sources, the Contractor shall undertake Monitoring of the material source site against Approval and EMP(C) requirements specified in Clause 12.1 of Annexure MRTS51.1. In accordance with Clause 7 of this Technical Specification, if Monitoring finds variances from the Approval criteria and conditions, this shall be raised as a Non-Conformance and further investigated.

8.15.4 EMP(C) requirements for material sourcing

The EMP(C) shall include documents and / or diagrams indicating the following:

Water sourcing

a) Key water consumption activities under the contract, the estimated volumes of water, the identified construction water source(s) and proposed volume of take, legislative requirements, applicable conditions for take and whether notification to other users has been undertaken.

b) Water efficiency strategies to be utilised under the Contract.

c) Procedures for Monitoring against requirements of any applicable Environmental Approval (exemption) (i.e. capacity level of non-flowing source).

Construction material

d) Identified gravel, fill or sand sources, distance to Site, access track requirements, stockpile areas, associated approvals and conditions, proposed volume of take and progressive rehabilitation processes.

e) Activity based management plan for extraction sites.

f) Soil Management Plan – Construction in accordance with Clause 5.2.2 of MRTS16 where applicable, and

Other

g) Other construction material requirements identified sources and Management Measures.

9 Supplementary requirements

The requirements of MRTS51 *Environmental Management* are varied by the supplementary requirements given in Clause 12 of Annexure MRTS51.1.

Technical Specification

Transport and Main Roads Specifications MRTS52 Erosion and Sediment Control

July 2017

Queensland Government

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Contents

1 Introduction

This Technical Specification applies to the control of erosion and sediment during investigation for and construction of transport infrastructure projects

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS51 *Environmental Management*, MRTS16 *Landscape and Revegetation Works* and other Technical Specifications as appropriate. This also forms part of the Principal's Specifications. This Technical Specification has not been designed to be used for marine or boating infrastructure projects.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

The Department of Transport and Main Roads encourages the early installation of permanent drainage controls for use as construction erosion and sediment controls where appropriate. Where permanent controls are to be used the relevant project drawings and Technical Specification shall take precedence over the design requirements within this Technical Specification, however the performance requirements and intent of this Technical Specification must be adhered to.

1.1 Relationship to other documentation

Where other contractual or statutory requirements applicable to the project demand higher standards of environmental management, the higher standards shall be adopted, where applicable.

This includes but is not limited to:

- Conditions of any environmental approvals or licences obtained by Principal or Contractor for this Contract
- Department of Environment and Heritage Protection (DEHP) Procedural Guide - Standard work method for the assessment of the lawfulness of releases to waters from construction sites in South East Queensland, and
- State Planning Policy and State Development Assessment Provisions July 2013.

Clause 1 of Annexure MRTS51 provides information on environmental approvals and / or licences obtained by the Principal that may have erosion and sediment control conditions. The Contractor shall be responsible for identifying and obtaining any other licences and permits that are required.

1.2 Departure from standards

This Technical Specification derives standards for erosion and sediment control from the IECA Manual. The requirements and recommendations set out in this Technical Specification should not be inferred to preclude innovative or alternative solutions that provide improved value for money or environmental outcomes that meet the intent and principles of this Technical Specification.

Where departures are proposed from either this Technical Specification, the standards established in the IECA Manual, or a higher standard prescribed under other contractual or statutory requirements (due to an approved innovation proposal or due to other restrictions) the Contractor must clearly state the departures from standards within the tender submission. This departure must have prior agreement from the Principal.

For significant departures the contractor is encouraged to use the Guided Tender Alternative method and obtain in principal agreement prior to submission of tender. All departmental Transport Infrastructure Contracts (TIC) require that deviations agreed prior to contract award are recorded within the Schedule of Deviations.

It must be noted that insufficient space within the road reserve or challenging topographic conditions is not in itself a reason for departures from the standard. With appropriate staging areas within the Works footprint can be used for temporary controls, sediment basin sizes can be reduced through the use of high efficiency sediment basins, or adjacent land can be obtained through rent or other prior agreement. The Contractor is responsible for obtaining any necessary areas. In some instances the Principal may have pre-negotiated areas for use for sediment and erosion control. Details of these areas and requirements are given in Clause 1 of Annexure MRTS52. The Contractor must be aware of and abide by the Notification of Entry requirements contained within General Conditions of Contract.

The Contractor is responsible for temporary erosion and sediment control and for ensuring that controls are adequately designed, installed, adapted, maintained and decommissioned.

1.3 Project risk

For the purposes of the management requirements required to be employed under this Technical Specification, the project is deemed to have the Erosion Risk identified in Table 1.3 unless otherwise nominated in Clause 2 of Annexure MRTS52.

Table 1.3 - Erosion risk level

Erosion Risk	Characteristics of risk level
Low	• < 2500m² disturbed surface area open at any one time OR < 10t/ha/year soil loss predicted (using RUSLE), and • Controls installed and maintained in accordance with prescriptive standard (eg Standard Drawings).
Medium	• All projects not meeting the characteristics above or below
High	Projects with two or more of the following characteristics: • Project duration > 6 months • Project working within or discharging to sensitive environment such as marine parks, wetlands or waterway • Soils with high to very high erodibility rating (ie dispersive soils) • Projects which have > 1 hectare of land exposed during months with monthly rainfall erosivity (R factor) is greater than 285 • Topography factor (LS) is greater than 2 or modal slopes on project are steeper than 15% (6.6 degrees).

While Table 1.3 above has been prepared as indicative of likely erosion risk level there are many factors that impact on the actual environmental risk. With the breadth of infrastructure projects delivered by the department – including location, duration, season, type and receiving environments – it is difficult to develop a simple table that will account for every scenario.

Departmental project managers in consultation with design consultants and environmental officers are encouraged to state the risk level that is appropriate for their project in Clause 2 of Annexure MRTS52.

Factors that should be taken into account when determining the project risk level include soil type, location and timing (rainfall volume, intensity and likelihood), landform (including the ability to install sediment basins or other erosion and sediment controls).

For projects in locations with highly seasonal rainfall, a project over a long duration may warrant different erosion risks at different times of year. This may be specified in Clause 2 of Annexure MRTS52. A date should be set for the change of risk level and a project-specific hold point be specified in the annexure that the modified ESCP shall be submitted, accepted and implemented on site prior to this designated date.

1.4 Erosion and Sediment Control Principles

The primary purpose in installing sediment and erosion controls is to not cause environmental harm nor deposit prescribed water contaminants in waterways as per the *Environmental Protection Act* 1994.

In addition appropriate erosion control can have the benefit of decreasing soil degradation hence improving asset protection and decreasing maintenance costs during and post construction.

Erosion and Sediment Control for all projects shall be designed, installed, maintained and decommissioned in accordance with the following principles:

a) Erosion and sediment controls are integrated with construction planning.

b) Effective and flexible erosion and sediment control plans are developed based on soil, weather, construction conditions and the receiving environment.

c) The extent and duration of soil exposure is minimised.

d) Water movement through the Site is controlled - in particular clean water is diverted around the Site.

e) Soil erosion is minimised.

f) Disturbed areas are promptly stabilised.

g) Sediment retention on Site is maximised.

h) Controls are maintained in proper working order at all times, and

i) The Site is monitored and erosion and sediment control practices adjusted to maintain the required performance standard.

2 Definition of terms

The terms in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

Additional terms used in this Technical Specification shall be as defined in Table 2.

Table 2 – Definition of terms

Term	Definition
AEP	Annual Exceedance Probability The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.
Appropriately qualified person (AQP)	**Appropriately qualified person(s)** is as defined by the administering authority of the *Environmental Protection Act.* The definition at time of publication of this Technical Specification relevant to temporary sediment and erosion control is: a person or persons who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature. The appropriately qualified person(s) should have, or collectively have, all the following capabilities: a) A detailed understanding of relevant sections of the following guidelines and legislation: i. *Environmental Protection Act* and Environmental Protection Regulation ii. *Environmental Protection (Water) Policy* iii. *Environment and Heritage Protection Urban Stormwater Planning Guidelines* iv. *Queensland Urban Drainage Manual* v. *IECA Best Practice Erosion and Sediment Control Manual* b) An understanding of hydrology and hydraulics, including the ability to size and determine stabilisation requirements of drainage structures and treatment devices c) An understanding of soil as it relates to revegetation and erosion. Specifically the ability to conduct an effective soil sampling program, interpret results and design management strategies to address problem soils (pH, sodic, dispersive, and saline) d) An understanding of appropriate use of the revised universal soil loss equation (RUSLE) to estimate soil loss e) An understanding of the erosion, drainage and sediment controls considered best practice in Australia, and knowledge on the correct installation, operation and maintenance of these controls. f) Ability to prepare erosion and sediment control plans of a standard that is suitable for construction g) Has experience in erosion and sediment control and a suitable environmental or engineering degree from a recognised institution.
CPESC	Certified Professional in Erosion and Sediment Control. A CPESC is an example of a person likely to be appropriately qualified.
DEHP	Department of Environment and Heritage Protection (Queensland)

Term	Definition
EMP(C)	Environmental Management Plan (Construction)
Environmental harm	As defined by the EP Act, including nuisance, serious and material environmental harm.
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
EY	Exceedances per year
IFD	Intensity Frequency Duration
Rainfall erosivity	The ability of rainfall to cause erosion. Rainfall erosivity can be determined using the formula Annual Average erosivity $R = 164.74 (1.1177)^{S} \times S^{0.64444}$ where S = 2 year ARI, 6 hour rainfall event (mm/h). The average monthly erosivity is the annual average erosivity x % rainfall that falls in that month. Alternatively rainfall erosivity risk ratings for various towns are provided in Table 4.4.4 of IECA Manual.
RUSLE	Revised Universal Soil Loss Equation (RUSLE) Predictor of erosion risk based on the estimated annual soil loss. A = R x K x LS x C x P A = annual soil loss due to erosion (t/ha/year) R = rainfall erosivity factor K = soil erodibility factor LS = topographic factor based on slope length and gradient C = cover and management factor P = erosion control practice factor Refer to IECA Manual, Appendix E for further information.
RPEQ	Registered Professional Engineer, Queensland
Type 1, Type 2 and Type 3 controls	As defined by IECA Manual 'Sediment Control Classification System' design guide

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Unless otherwise specified a reference to a statute includes its delegated legislation and a reference to a statute or delegated legislation or a provision of either includes consolidations, amendments, re-enactments and replacements.

Table 3 - Referenced documents

Reference	Title
ARR	Australian Rainfall and Runoff, Engineers Australia
DEHP Standard Work Method	Procedural Guide - Standard work method for the assessment of the lawfulness of releases to waters from construction sites in South East Queensland (Department of Environment and Heritage)
EP Act	*Environmental Protection Act* including subordinate legislation and regulations

Reference	Title
Monitoring and Sampling Manual	*Monitoring and Sampling Manual 2009*, Version 2, July 2013 (Department of Environment and Heritage Protection)
IECA Manual	*International Erosion Control Association Australiasia* "Best Practice Erosion and Sediment Control"
South East Queensland (SEQ)	As defined by Sustainable Planning Regulation or subsequent legislation. Includes areas of: Brisbane City Council Gold Coast City Council Ipswich City Council Lockyer Valley Regional Council Logan City Council Moreton Bay Regional Council Toowoomba Regional Council (part of) Redland City Council Scenic Rim Regional Council Somerset Regional Council Sunshine Coast Regional Council Noosa Shire Council
Geotechnical Design Standard	*Transport and Main Roads Geotechnical Design Standard*
MRTS03	*Drainage, Retaining Structures and Protective Treatments*
MRTS04	*General Earthworks*
MRTS16	*Landscape and Revegetation Works*
MRTS27	*Geotextiles (Separation and Filtration)*
MRTS50	*Specific Quality System Requirements*
MRTS51	*Environmental Management*
Water and Wastewater Sampling Guidelines	EPA Guidelines, Regulatory Monitoring and Testing, Water and Wastewater Sampling (South Australian Environment Protection Agency, 2007)

4 Standard test methods

Unless stated elsewhere herein, testing shall be carried out in accordance with the relevant Australian Standard. All laboratory analyses required under this Technical Specification must be carried out by a laboratory that has National Association of Testing Authorities (NATA) certification, or an equivalent certification, for such analyses.

Soil testing for erosion and sediment control should occur with consideration of, and where practicable in coordination with, the requirements of MRTS16 and MRTS04. This includes the requirements for a Soil Management Plan – Construction (SMP-C), and for topsoil, subsoil, and acid sulfate soil (pH) testing.

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points applicable to this Technical Specification are summarised in Table 5.1. There are no Witness Points or Milestones defined in this Technical Specification.

Table 5.1 – Hold Points

Clause	Hold Point	Witness Point	Milestone
6.1	1. Assessment of suitability of Erosion and Sediment Control Plan for each stage and / or section of the Works where required		
7.1	2. Installation of appropriate erosion and sediment controls in each section of the Works		

The number of hold points relating to Erosion and Sediment Control will be dependent on the risk associated with the project.

- For low risk projects there are likely to be two Hold Points on the project – the first being no Works to occur prior to the assessment of suitability of the ESCP, the second being no earthworks (other than Works necessary to install devices) until erosion and sediment control devices have been installed.
- For high risk projects there is likely to be many Hold Points throughout the project as the assessment of suitability of the plan and assessment of installation of controls shall be required for each section or stage of the Works.

6 Erosion and Sediment Control Plan

6.1 General

Before the natural surface is disturbed on a section of the Works, the Contractor shall submit an Erosion and Sediment Control Plan (ESCP) for that section.

An ESCP is required to be prepared for all areas prior to use or disturbance including auxiliary areas under the control of the contractor such as stockpile and storage areas, access and haulage tracks, temporary waterway crossing, borrow areas, compound areas and material processing areas.

Clearing and grubbing (or the use of the area for stockpiles) for that section shall not start until the ESCP for that section is assessed as suitable by the Administrator. **Hold Point 1**

For high risk projects multiple erosion and sediment control plans will be required for sections that have significant cut and fill (eg, a plan for clearing, a plan for commencement of bulk earthworks and a plan for completion of earthworks). Prior to significant changes to drainage flow or sediment treatment locations, an updated erosion and sediment control plan shall be developed and submitted by the Contractor and assessed as suitable by the Administrator. Each ESCP shall clearly detail the area and

work that it is valid for. It is acceptable to have a primary 'over-arching' ESCP supplemented by numerous progressive ESCP on a project.

Timelines for assessment of suitability of ESCP shall be as per Conditions of Contract for the assessment of EMP(C).

6.2 Plan requirements

The Erosion and Sediment Control Plan (ESCP) shall be developed in accordance with the principles in Clause 1.4 of this Technical Specification and taking into account:

- seasonal conditions
- soil types, particularly dispersive, sodic, saline soils and acid sulfate soils
- topography, particularly areas with natural, during construction or final slope > 10%
- local hydrology and drainage affecting the worksite including temporary and overland flow paths
- specific project issues including no go zones, protected flora and fauna, private property boundaries, contaminated land; and
- specific project issues and requirements listed in Clause 3 of Annexure MRTS52.

The ESCP shall consist of the following:

a) the Works and area that the plan is valid for
b) the location of major features of the Site, such as waterways, limitations of disturbance areas, property boundaries and other special features (including sensitive environments, contaminated land, dispersive soils)
c) contour lines or flow direction arrows sufficient to show direction of waterflow
d) the type and location of all erosion and sediment control measures, including but not limited to:
    i. proposed erosion control measures including soil treatment and batter stabilisation methods such as soil binders, geofabric, hydromulching and / or early revegetation
    ii. clean and dirty water drainage paths
    iii. sediment controls such as sediment basins for all areas greater than one hectare on medium and high risk sites, and Type 2 and Type 3 controls for other areas
    iv. location of nominated discharge points, and
    v. Site exit points and controls
e) the installation sequence and timing of controls including timing of installation of any permanent Works being relied upon as drainage control during construction
f) list of any deviations from IECA Manual with regard to the installation, construction and maintenance of all erosion and sediment control measures (in particular any deviation from Book 4 – Design Fact Sheets and Book 6- Standard Drawings) and justification for such deviations,
g) the response strategy for managing significant rain events, and

h) the person/s responsible for development of the ESCP including their experience and qualifications for determination by the Administrator as to whether Appropriately Qualified.

For medium risk sites the ESC Plan shall include the above (a to h) and:

i) design calculations for all drainage and sediment control measures, including sediment basins, earth banks high flow / spillways, outlet structures and drainage lines.

The administrator may also request to view the calculations for low risk sites.

For high risk sites the ESC Plan shall include the above (a to i) and:

j) the qualifications and experience of the independent verifier (refer to Clause 6.3 below) and a statement from the independent verifier that the ESCP if implemented correctly will meet the requirements of this Technical Specification; and
k) the proposed frequency and timing of independent audits (refer to Clause 9.1.2)
l) the monitoring and maintenance requirements for the project Site, erosion and sediment controls and receiving environment

The ESCP for all projects undertaken in South-East Queensland shall comply with *Procedural Guide - Standard work method for the assessment of the lawfulness of releases to waters from construction sites in South East Queensland* (Department of Environment and Heritage).

The number and complexity of the Erosion and Sediment Control Plans will vary depending on the size and complexity of the project.

For low risk projects, the above Technical Specification could be met by one Standard Drawing or diagram that includes notes on timing of installation of controls.

For high risk and large scale medium projects the ESCP is likely to consist of multiple sets of drawings for various areas, and various stages of each area. One option for major projects is for an overarching ESCP to be developed containing key methods, procedures and features which is then supplemented by numerous progressive ESCP. A report detailing assumptions and calculations for drainage, erosion and sediment controls will also be required.

Note that the response strategy for managing significant rain events may be contained within the Severe Weather Management Plan or other document.

6.3 Personnel – Plan development

The Erosion and Sediment Control Plan shall be prepared and updated by personnel who have the requisite level of training and experience outlined in Table 6.3, or as modified by Clause 5 of Annexure MRTS52.

Table 6.3 - Erosion and Sediment Control Plan – Personnel minimum requirements

Erosion Risk Level (as per clause 1.3)	Minimum requirements for plan development and verification
Low	ESCP to be prepared by a person who has undertaken environmental representative training and has at least 5 years' experience in relevant construction type (for example, roadwork construction)
Medium	• ESCP to be prepared by Appropriately Qualified Person/s (see definitions) with experience in relevant construction type (for example general road projects). • Drawings and design for any items that are Prescribed Engineering Service (PES) shall be certified by an RPEQ.
High	• ESCP to be prepared by Appropriately Qualified Person/s (see definitions) with experience in relevant construction type (for example major road projects). • Drawings and design for any items that are Prescribed Engineering Service (PES) shall be certified by an RPEQ ESCP to be reviewed and deemed suitable by an independent verifier who is an Appropriately Qualified Person.

The Contractor must submit details of the person preparing the ESCP and the verifier to the Administrator with the ESCP for determination of suitability by Administrator. The Contract may submit details prior to engagement of said person/s

6.4 Implementation and revision of plan

The Contractor shall:

a) implement the Erosion and Sediment Control Plan
b) monitor the continued effectiveness of the ESC during the contract
c) update the ESCP where necessary

The plans shall be updated in accordance with Clause 5.1 of this Technical Specification, and updated such that all major drainage paths and Type 1 sediment treatment devices are shown correctly. The updates shall be undertaken by personnel approved as suitable by the Administrator (that is, who has the requisite level of training and experience outlined in Table 6.3, or as modified by Clause 4 of Annexure MRTS52.

7 Erosion and Sediment Control Management – General requirements

7.1 Installation

As soon as practicable and prior to initial earthworks operations (clearing and grubbing) for any stage or section of the Works, the Contractor must install erosion and sediment controls (including sediment traps, catch banks and diversion drains) associated with drainage paths flowing through the Works area. The completion of these activities will be a **Hold Point 2** for any further earthworks.

Where clearing is required in order to construct or install the erosion and sediment controls this shall be discussed and approved by the Administrator.

7.2 Operation and maintenance

The Contractor shall maintain all erosion and sediment controls in effective working order including reconfiguring drainage lines as required during the construction process to ensure dirty water is directed into sediment controls at all times.

Reuse of the water collected in sediment ponds or basins for dust suppression and roadworks is preferred over release into the environment. Where water is being stored for dust suppression the required design capacity of the basins shall be available.

Sediment basins and other sediment controls shall be operated and maintained in a manner that minimises the risk of environmental harm. The design capacity of the upper settling volume shall be made available within 120 hours of the most recent rainfall event which causes runoff.

The sediment storage zone shall be maintained at all times with the accumulated sediment removed in a manner that does not allow the sediment to be conveyed into a watercourse or offsite.

Where coagulants or flocculants are used to treat stormwater, they must not cause harm to the receiving waters or environment. A jar test or streaming current detector (SCV) must be undertaken to estimate volumes of the coagulant or flocculant required and to reduce the risk of overdosing. Coagulants or flocculants containing aluminium (including alum and PAC) shall not be used when water is being discharged to an acidic environment where natural pH is less than 6.0 (such as wallum stream or wetland).

> The greatest environmental risk from coagulants / flocculants exists when overdosing has occurred. This risk can be mitigated by discharging water from sediment basin that has been flocced into a drainage channel rather than directly into a waterway. For projects using coagulants other than gypsum this practice is recommended.

7.3 Decommissioning and removal

The Contractor shall remove temporary controls when permanent measures are in place and / or Site stabilisation has occurred. This should occur prior to the end of the Defects Liability Period or the end of the Landscape and Revegetation Works Monitoring Period whichever is the later. The Contractor will not receive a Final Certificate until these temporary controls have been removed from the Site.

Any areas used for erosion and sediment control shall be rehabilitated to the satisfaction of Administrator.

8 Erosion and Sediment Control Management – Performance requirements

8.1 Performance requirements

There shall be no erosion resulting from construction practices unless there are provisions within the worksite to manage resultant sediment.

Releases from site must not cause scour at the area of discharge. Water must only be released at the discharge point nominated within the ESCP and as deemed acceptable by the Administrator. Any modification to discharge point must be agreed by the Administrator.

The Contractor's erosion and sediment controls shall be sufficient to achieve the water quality investigation criteria for Discharge, land and Waterways in accordance with Clause 8.2.2 of MRTS51 Technical Specification.

The Project Manager and / or Environmental Officer is encouraged to develop Site specific discharge criteria relevant to the receiving environment / catchment Site based on the risks to the receiving environment and Site specific information available. In particular it is recommended that Site specific criteria be developed for:

- naturally occurring acid environments and ecosystems such as wallum streams, and
- projects located in western catchments such as Murray-Darling and desert channel area.

Consideration may need to be given to the analysis of water for electrical conductivity (EC) particularly if using a coagulant or flocculant which increases EC and water being discharged into a low salinity low flow stream.

9 Administrative Requirements

The ESCP is an annexure to the EMP(C) defined in MRTS51 *Environmental Management*. Unless specified otherwise in this Technical Specification, all requirements defined in Clause 6 and 7 of MRTS51 *Environmental Management* will apply to MRTS52.

9.1 Independent Audits

In addition to MRTS51 administrative requirements, for sites determined to have a high erosion risk (assessed against the criteria of Table 1.3 of this Technical Specification and as nominated in Clause 2 of Annexure MRTS52) the Contractor shall engage an independent Appropriately Qualified Person (AQP). The AQP shall assess the compliance of ESC measures against:

- this Technical Specification
- the accepted ESCP
- ESCP principles (as defined in Section 1.4), and
- discharge limits.

The Contractor shall submit the independent review report to the Administrator with proposed and completed actions undertaken to address the identified issues not more than seven days following the audit.

Unless modified by Clause 5.1 of Annexure MRTS52 the Contractor shall allow for a minimum of three independent audits for each stage of the project – for example: one audit immediately following clearing and grubbing and one audit during cut and fill and one audit at end of major earthworks.

Management and reporting of non-conformances and incidents relating to erosion and sediment control shall be as per requirements for environmental non conformances and incidents (Clause 5.2 of MRTS51). Notification to the Administrator or the Principal does not in any way negate the requirements on the Contractor to notify DEHP, other regulatory authorities and landowners under the Environmental Protection or other Acts.

The Administrator reserves the right to seek costs against the Contractor for incidents that cause environmental harm. The costs shall correspond to the cost for additional administration of the contract (which may include investigation of the incident, internal and external reporting of incident, meetings and correspondence). The costs shall be recovered based on the hourly rate listed in Clause 6 of MRTS52 Annexure.

Transport and Main Roads may elect to nominate a greater frequency such as monthly if desired, or nominate high frequency for areas around sensitive environments.

10 Design and technical standards

10.1 Technical Standards

The Contractor shall ensure sediment and erosion controls are designed, installed and maintained in accordance with the IECA Manual (particularly Book 4 – Design Fact Sheets and Book 6 – Standard Drawings) and manufacturers specifications except as modified by design requirements in Clause 10.2 below.

Where controls will become permanent, the relevant Technical Specification shall have precedence, for example:

- MRTS03 *Drainage, Retaining Structures and Protective Treatments* shall apply for drainage controls that become permanent including sheet or strip filter drains
- MRTS16 *Landscape and Revegetation Works* shall apply for permanent revegetation (including Technical Specifications for cover crop to be included within permanent seed mixes); and
- MRTS27 *Geotextiles (Separation and Filtration)* shall apply for geotextiles that are part of the permanent Works.

10.2 Design Requirements

Controls shall be designed to have the capacity and structural strength specified in Table 10.2.

Table 10.2 - Design Requirements

Item	Disturbed area open for:		
	0 – 12 months	**12 – 24 months**	**> 24 months**
Drainage controls • Diversion drains • Channels • Batter chutes	39.3 % AEP (2 year ARI)	18.13% AEP (5 year ARI)	~ 10% AEP (10 year ARI)
Sediment Basins	80th percentile 5 day rain event Projects adjacent to sensitive receiving waters: 85th percentile, five day rain event		
Sediment basin inlet	18.13% AEP (5 year ARI)	~ 10% AEP (10 year ARI)	10% AEP (~10 year ARI)
Sediment basin – Emergency Outlet, Embankments	5% AEP (~20 year ARI)	5% AEP (~20 year ARI)	2% AEP (~50 year ARI)

10.2.1 Sediment Basin embankments

Fill materials used for the construction of sediment basin embankment shall be in accordance with Clause 14.2.6 of MRTS04. The material shall be compacted to not less than 97% in accordance with requirements stipulated in Table 15.3(b) of MRTS04. The stability requirements shall be as per Section 2 of Geotechnical Design Standard.

10.2.2 Catch drains

Triangular V drains (Type B catch drains as shown in IECA Standard Drawing CD-01: Catch Drains) shall not be installed in areas with dispersive soil.

11 Supplementary requirements

The requirements of MRTS52 *Sediment and Erosion Control* are varied by the additional requirements specified in Clause 7 of Annexure MRTS52.

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Contents

1 Introduction

This Technical Specification applies to the construction of landscape and revegetation treatments in road works.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*. Additional terms used in this Technical Specification are defined in Table 2.

Table 2 – Definition of terms

Term	Definition
> 1 on 4 Slopes	Slopes steeper than 1V on 4H.
≤ 1 on 4 Slopes	Slopes equal to or flatter than 1V on 4H.
Biosecurity Instrument Permit	An authority issued by Biosecurity Queensland under the *Biosecurity Act* 2014 for movement of a carrier of a regulation biosecurity matter under a biosecurity zone regulation to a place outside the zone or into an area subject of a movement control.
Biosecurity Matter	Biosecurity matter as defined in the *Biosecurity Act* 2014 including but not limited to invasive plants (weeds) and animals.
Broadacre	The areas beyond the toe of a fill embankment or top of a cut batter that are generally flat to gently sloping.
Clear zone	The area that commences at the edge of the trafficable lane and is available for emergency use by errant vehicles. The distance that the clear zone extends from the carriageway edge is dependent on the traffic volume, road geometry and design speed of the road. This area may consist of a shoulder, parking bays, a recoverable slope or a clear run-out area. Refer to the Department's *Road Landscape Manual – Safety* chapter.
Contained areas	Medians, separators; and planting beds bordered by hard constructed garden edging.
DEHP	Department of Environment and Heritage Protection
Dolomite	Agricultural dolomite (calcium magnesium carbonate $CaMg(CO_3)_2$).
Gypsum	Agricultural gypsum (calcium sulfate $CaSO_4 2H_2O$).
High profile areas	Off road areas, highly visible to the public including: a) pedestrian areas and shared paths b) transport stations c) areas fronting residential property, and d) key entries, gateways and intersections.
Lime	Agricultural lime (calcium carbonate $CaCO_3$).

Term	Definition
Pesticide	A pesticide is the collective term for herbicides, insecticides and fungicides.
Potable water	Water of a quality suitable for drinking.
Propagules	The reproductive parts of plants including seeds, stolons, roots, corms, bulbs and stems.
Recycled water	Appropriately treated effluent or storm water meeting standards in this Technical Specification.
Representative soil sample	A representative soil sample is a sample that is representative of a single soil type and a single soil layer.
Seed germination / viability tests	Tests that indicate the live / viable seed percentages in a sample of seeds.
Seed purity test	A test that shows the percentages of pure seed, inert matter and other seed species in a sample of seeds.
Sight visibility zone	An area calculated to provide the driver with adequate time to observe the road layout and react and stop if necessary, before entering a potential conflict zone. Refer to the Department's *Road Landscape Manual* – Safety chapter.
Soil	For the purposes of this Technical Specification, soil is considered to be in two distinct layers: a) topsoil, and b) subsoil.
Stripped site topsoil	Non-ameliorated Site topsoil stripped and stockpiled after the clearing and grubbing process.
Subsoil	For the purposes of this Technical Specification, subsoil is considered: a) the soil below the topsoil layer b) the outer face / surface of a cut or fill embankment (subgrade), or c) the exposed soil in areas that have been stripped of topsoil in broadacre areas.
Topsoil	For the purposes of this Technical Specification, topsoil refers to: a) surface soil that contain organic material b) screened and ameliorated site topsoil that complies with Form D of Appendix MRTS16, or c) imported topsoil that complies with Form C of Appendix MRTS16.
Vegetation Treatment	Turfing, Seeding or Planting.
Weeds	Plants which include declared plants, environmental weeds and the wrong plant in the wrong place or non-specified species. Plants that are known to impact negatively on the vigour and sustainability of the specified species.

3 Referenced documents

3.1 Material and practices

Table 3.1 lists documents referenced in this Technical Specification.

Table 3.1 – Referenced documents

Reference	Title
	Biosecurity Act (2014) and Biosecurity Regulation (2016)
	*Chemical Usage (Agricultural and Veterinary) Control Ac*t (1988)
	*Agricultural Chemicals Distribution Control A*ct (1966)
	Land Protection (Pest and Stock Route Management) Act 2002
	Land Protection (Pest and Stock Route Management) Regulation 2003
	Queensland Water Recycling Guidelines (EPA 2005)
	Recycled Water Management Plan and Validation Guidelines (DEWS 2008)
	Guide to Workplace use of Non-potable Water Including Recycled Waters (DIER 2007)
-	Transport and Main Roads *Materials Testing Manual*
-	*Soil Chemical Methods : Australasia* – Rayment & Lyons, CSIRO 2011
AS 1289.3.8.1	*Methods of testing soils for engineering purposes - Soil classification tests - Dispersion - Determination of Emerson class number of a soil*
AS 2303	*Tree Stock for Landscape Use*
AS 2439.1	*Perforated plastics drainage and effluent pipe and fittings Perforated drainage pipe and associated fittings*
AS 3896	*Waters - Examination for Legionella spp. including Legionella pneumophia*
AS 4276.7	*Water microbiology - Escherichia coli and thermotolerant coliforms - Membrane filtration method*
AS 4373	Pruning of Amenity Trees
AS 4419	Soils for landscaping and garden use
AS 4454	*Compost, soil conditioners and mulches*
AS 4964	*Method for the qualitative identification of asbestos in bulk samples*
AS 5013.24.2	*Microbiology of food and animal feeding stuffs – Horizontal method for the detection and enumeration of Listeria monocytogenes - Enumeration method*
AS/NZ 1319:1994	*Safety Signs for the Occupational Environment*
MRTS01	*Introduction to Technical Specifications*
MRTS04	*General Earthworks*
MRTS21	*Bituminous Emulsion*
MRTS27	*Geotextiles (Separation and Filtration)*
MRTS50	*Specific Quality System Requirements*
MRTS51	*Environmental Management*
MRTS70	*Concrete*

Reference	Title
MRTS228	*Electrical Switchboards*
MRTS256	*Power Cables*
RLM	*Road Landscape Manual* (Transport and Main Roads)

3.2 Standard drawings

Table 3.2 lists standard drawings referenced in this Technical Specification.

Table 3.2 – Standard drawings

Standard Drawing Number	Title
1643	*Vegetation Ground Works - Planting Container Stock Kerbed Medians and Separators*
1644	*Vegetation Ground Works - Hardstand Abutments to Vegetation Works*
1647	*Vegetation Works - Matting*
1650	*Vegetation Works - Turfing*
1651	*Vegetation Works - Seeding*
1653	*Vegetation Works - Planting Container Stock < 25 L Container*
1654	*Vegetation Works - Planting Container Stock > 25 L Container*

4 Standard test methods

4.1 Test methods

Testing of all work shall be undertaken in accordance with Clause 4 of MRTS01 *Introduction to Technical Specifications*.

The standard test methods listed in Table 4.1 shall be used in this Technical Specification.

Table 4.1 – Test methods

Material	Test Method
Site Topsoil	*Form C of Appendix MRTS16*
Imported Topsoil	*Form C of Appendix MRTS16*
Manufactured Site Topsoil	*Form D of Appendix MRTS16*
Subsoil	*Form E of Appendix MRTS16*
Drainage Basin Soil	*Form F of Appendix MRTS16*
Organic Soil Conditioner	AS 4454 and *Form G of Appendix MRTS16*
Non-potable Water	*Form I of Appendix MRTS16*
Imported Mulch	AS 4454

Soil test methods have been developed by the department specifically for Queensland soils to ensure:

- topsoil is capable of supporting pasture grasses and native vegetation, and
- subsoil is capable of supporting plant growth and to identify and manage dispersive / sodic / saline soil risks.

The test forms are based primarily on components of AS 4419 *Soils for landscaping and garden use*, and *Soil Chemical Methods: Australasia*. The number of test parameters and parameter requirements have been reduced relevant to naturally occurring soils and their use in road building projects.

The Topsoil Testing form is relevant to naturally occurring topsoils and their reuse in road building projects.

The Manufactured Site Topsoil Compliance Testing form is relevant to stripped site topsoils which have undergone amelioration processes, and is based on testing those parameters affected by the amelioration process (including agricultural lime, dolomite, gypsum and / or organic soil conditioner).

The Subsoil Testing form is relevant to subsoils and their use in road building projects where present as either as insitu materials or reconstructed in bulk earthworks. It has been developed to identify and manage erosion / dispersion / sodicity risks and other critical chemical properties to ensure the outer layer of subsoil is capable of supporting plant growth.

The Drainage Basin Soil Testing form has been developed to ensure basin material is a suitable construction material and capable of supporting plant growth.

The Organic Soil Conditioner Testing form has been developed to ensure material will not cause health issues to workers or the general public. The Nitrogen Drawdown Index (NDI) parameter is tested to ensure material has reached maturity levels and is not detrimental to soil or vegetation establishment. Electrical conductivity is limited to ensure material does not inhibit seed germination and plant development.

The Non-potable Water Testing and Assessment Report form has been developed to ensure material will not cause health issues to workers or the general public. The requirements also ensure the chemical properties do not have a detrimental effect on soil or vegetation establishment.

4.2 Testing laboratory standards

Laboratory testing required as part of this technical specification shall be carried out by a laboratory accredited by the National Association of Testing Authorities (NATA).

Laboratories that typically test for the engineering or geotechnical characteristics of soils are often not equipped or experienced in carrying out the soil test methods required for testing topsoil and subsoil. It is recommended Australasian Soil and Plant Analysis Council (ASPAC) certified laboratories be used to ensure correct test methods are undertaken.

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications* and Clause 8.3 of MRTS50 *Specific Quality System Requirements*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.2.1	1. Submission of a Soil Management Plan – Construction and assessment of suitability		Submission of a Soil Management Plan – Construction
5.2.2	2. Submission of Non-Potable Water Plan and applicable permits, and assessment of suitability		
5.3.1	3. Submission of a Seed Supply Proposal and assessment of suitability		
5.3.2	4. Submission of a Seed Harvesting Proposal and assessment of suitability		
5.3.3	5. Submission of a Plant Supply Proposal and assessment of suitability		
5.3.3.1		1. Nursery inspection of container stock	
5.3.4	6. Submission of a Plant Harvesting Proposal and assessment of suitability		
8.2.1	7. Manufactured site topsoil is in accordance with Form D of MRTS16 Appendix		
8.3		2. Weed treatment prior to other ground preparation operations	
8.4.1.1	8. Spreading of amelioration agents on subsoil		
8.4.1.2		3. Ripping of subsoil	
8.4.1.3		4. Cultivation of subsoil	
8.4.1.4		5. Roughening of subsoil	
8.4.2.1		6. Installation of topsoil	
8.5.3.1		7. Plant delivery	
8.5.3.2		8. Plant delivery	

Clause	Hold Point	Witness Point	Milestone
8.5.1	9. Sample installation of hydraulically applied seeding operations		
8.5.1	10. Inspection and verification of seeding materials and quantities		
8.5.3.3	11. Inspection of plant setting-out prior to planting.		
8.6.2.1	12. Submission of an irrigation system design.		
8.6.2.2	13. Commissioning and testing of the irrigation system.		
9.1			Issue of the Certificate of Commencement of the Establishment Period
9.1.1.7	14. Interim evaluation of treatments to determine if it is on track to meet the completion criteria		
9.1.2			Issue of the Certificate of Completion of the Establishment Period
9.2			Issue of the Certificate of Commencement of the Monitoring Period
9.2.2			Issue of the Certificate of Completion of the Monitoring Period

5.2 Plans to be included in the Contract Plan

5.2.1 Soil Management Plan – Construction

The Soil Management Plan – Construction shall be:

a) prepared in accordance with Form A of Appendix MRTS16

b) submitted as part of the Environmental Management Plan – Construction and prior to clearing and grubbing, and stripping of topsoil operations. **Milestone**

c) regularly updated and re-submitted when subsoil and topsoil testing occurs, and

d) assessed for suitability by the Administrator, prior to carrying out the implementation of the above operations and activities. **Hold Point 1**

The initial submission prior to clearing and grubbing, and stripping of topsoil requires at a minimum *Section 1 – Topsoil volumes assessment* and *Section 2 – Integrated soil management activities* to be completed to identify topsoil material requirements and demonstrate soil related activities are considered and addressed at the commencement of the project.

Where a soil management plan from the planning and design phases of the project is provided by the Principal, it shall be specified in Clause 1.1 of the Annexure MRTS16.1. Where a soil management plan is provided by the Principal, the Contractor shall prepare a Soil Management Plan – Construction and validate soil material requirements.

The intent of the Soil Management Plan – Construction is to:

- provide an understanding of project soil volumetric issues including total topsoil required for revegetation works, available stripped site soil, site soil shortfalls and requirements for imported topsoils, consideration of revegetation treatment type options
- identify and understand soil characteristics, deficiencies and associated risks
- determine amelioration types and rates
- ensure the appropriate management of soil throughout construction
- reduce the short and long term risk of erosion, vegetation failure and associated rework, and
- provide a Quality System to document soil material and construction related activities.

5.2.2 Non-Potable Water Management Plan (dam, creek, river and bore water)

Where a Contractor proposes to water vegetation works with non-potable water (dam, creek, river and bore water), they shall:

a) obtain the necessary permits and approvals for the use of water from proposed water source, and

b) submit a Non-Potable Water Management Plan in accordance with *Form H of Appendix MRTS16*.

The Non-Potable Water Management Plan shall be assessed for suitability by the Administrator, prior to use. **Hold Point 2**

This Clause excludes recycled water; recycled water shall be in accordance with Clause 7.7.1

5.3 Proposals

5.3.1 Seed Supply Proposal

The Contractor shall initially submit a Seed Supply Proposal for a determination as to its suitability by the Administrator, within 30 days of the date of Possession of Site or as specified in the Contract. **Hold Point 3** For projects with a long duration, updates shall be provided as seed availability and quality may vary over time.

The Seed Supply Proposal shall include:

a) seed supplier(s) details

b) Clause 3.2.2 or 3.2.3 of the Annexure MRTS16.1 with:

   i. seed species, application rates

   ii. adjusted application rates, where seed purity and germination / viability percentages are less than 95% purity and 80% germination / viability, and

iii. total required seed for each species / seed mix.

c) seed pre-treatment requirements for hard cased native seeds in accordance with Clause 7.4.9.2, and seed pre-treatments such as inoculation, coating or anticide in accordance with Clause 3.2.1 of the Annexure MRTS16.1, or as shown on the drawings

d) seed test certificates, in accordance with Clause 8.1.4

e) the timing and management of seed procurement in particular large volumes of species and or species diversity, and

f) proposed substitute species where seed species are unavailable.

Where seed supply is proposed to be supplied or supplemented by harvesting seed from site, a Seed Harvesting Proposal shall be prepared in accordance with Clause 5.3.2.

The Seed Supply Proposal is a management tool to:

- promote the timely supply of seed species and quantities, reducing the need for substitutes
- where substitute species are unavoidable, allow the Administrator to review and assess for suitability substitute and additional species
- allow the Administrator to confirm the species to be supplied and application rates meet the requirements of the Contract, and
- allow the Administrator to confirm seed pre-treatment requirements for hard cased native seeds are nominated.

5.3.2 Seed Harvesting Proposal

Where seed harvesting is to occur, the Contractor shall submit a Seed Harvesting Proposal for a determination as to its suitability by the Administrator, prior to harvesting seeds. **Hold Point 4**

The Seed Harvesting Proposal shall:

a) be prepared by a seed collector / merchant / specialist, and

b) be included as an annexure to the Seed Supply Proposal.

The Contractor shall obtain all relevant permits prior to harvesting, in accordance with DEHP requirements and MRTS51.

The Contractor shall collect, manage and store seed in accordance with the *Flora Bank Model Code of Practice and associated Guidelines*.

Collected seed shall be tested in accordance with Clause 8.1.4.

The Seed Harvesting Proposal shall include:

a) species to be harvested and their location

b) timing / season of harvesting for each species

c) seed harvester details / licences / permits

d) method of harvesting

e) method of storage and care

f) location for storage, and

g) seed test certificates.

5.3.3 Plant Supply Proposal

The Contractor shall submit a Plant Supply Proposal for a determination as to its suitability within 30 days of the date of Possession of Site or as specified in the Contract. **Hold Point 5**

The Plant Supply Proposal shall include:

a) plant nursery(s) details

b) the plant species, planting densities and quantities in accordance with Clause 3.4.1 of the Annexure MRTS16.1, or as shown on the drawings

c) the timing and management of plant procurement, in particular large volumes of species, container stock ≥ 25 L and specified stock required for critical and specialised functional roles (median headlight screening, noise wall screening, rehabilitation of environmental areas)

d) proposed substitute species where specified plant species are unavailable

e) inspection report forms and documentation in accordance with AS2303 *Tree Stock for Landscape Use*, for all tree stock in containers ≥ 25 L and ex-ground stock

f) proposed plant delivery program, including method of transport

g) installation methodology and work method statements for container stock > 100 L, and

h) dates for joint inspections at the nursery in accordance with Clause 5.3.3.1.

Where plant supply is proposed to be supplied or supplemented by harvesting plant material from Site, a Plant Harvesting Proposal shall be prepared in accordance with Clause 5.3.4

The Plant Supply Proposal is a management tool to:

- promote the timely procurement and supply of the specified container stock, reducing project delays or the need for substitutes. Large volumes of plants are typically contract grown and sufficient lead time is required to allow this process.
- allow the Administrator to confirm the species and quantities to be supplied meet the requirements of the Contract, and
- where substitute species are unavoidable, allow the Administrator to review and assess for suitability substitute species to determine their suitability.

5.3.3.1 Nursery inspections

Joint nursery inspections are required:

a) prior to the delivery of plants to Site

b) within sixty days of the Administrator deeming the Plant Supply Proposal suitable, and

c) every sixty days where the growing period is greater than sixty days.

The Contractor shall give a minimum 5 days' notice of joint inspections at nurseries. **Witness Point 1**

Plant root inspection shall:

a) not exceed 2% of the total of each species, or

b) not exceed two containers if less than 100.

If samples inspected are found to be defective, the entire species represented by the defective samples may be rejected. All plants rendered unsuitable as a result of an inspection will be rejected and considered as samples on which payment cannot be claimed.

5.3.4 Plant Harvesting Proposal

Where plant harvesting is to occur, the Contractor shall submit a Plant Harvesting Proposal for a determination as to its suitability prior to harvesting plants. **Hold Point 6**

The Plant Harvesting Proposal shall be:

a) prepared by a revegetation or horticultural specialist, and

b) included as an annexure to the Plant Supply Proposal.

The Contractor shall obtain all relevant permits prior to harvesting, in accordance with DEHP requirements and MRTS51.

The Plant Harvesting Proposal shall include:

a) species to be harvested and their location

b) harvester details / licences / permits

c) method of harvesting and transport to storage facility

d) method of storage and care

e) location (on-site or nursery) for storage

f) any specific installation requirements, and

g) any specific maintenance and monitoring requirements under the permit.

5.4 Quality system supplementary requirements

Quality system supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Clause 1.1 of the Annexure MRTS16.1.

6 General requirements

6.1 Landscape Representative

Where required in the General Conditions of Contract Appendix A, the Contractor shall employ a suitably qualified and experienced personnel as Landscape Representative(s).

Except where modified by the General Conditions of Contract Appendix A, the Landscape Representative(s) shall:

a) have a minimum five years of experience in supervising or carrying out large scale landscape and rehabilitation / revegetation projects, with demonstrated experience in:

   i. managing a program of landscape and revegetation works

ii. soil management as it relates to revegetation and erosion control, and

iii. design, implementation and establishment of works.

b) be engaged prior to clearing and grubbing, to have an active role in:

i. clearing and grubbing

ii. identification of topsoil suitable for stripping / stockpiling

iii. manufacture and storage of topsoil

iv. manufacture and storage of mulch

v. seed and plant procurement / harvesting

c) be available on Site when landscape and revegetation activities are being carried out, the Landscape Representative(s) does not necessarily need to be on Site full time, but shall be on Site when landscape and revegetation activities are being carried out

d) be available during the establishment and monitoring periods, until the end of the Date of Final Completion

e) assist in the development of the Contractor's Plans in accordance with Clause 5.2, and Proposals in accordance with Clause 5.3

f) ensure that the landscape and revegetation treatments are implemented in accordance with the design and this Technical Specification

g) prepare electronic (daily or as required by installation program) diaries including photographic evidence of the activities involved in each lot for uploading into the QA database. Supplementary evidentiary support documents such as supplier certifications of materials maybe uploaded separately into the QA database or associated management plans, and

h) ensure that the landscape and revegetation treatments established and monitored to meet the completion criteria of Clause 9.1.2 and Clause 9.2.2.

Nominating a Landscape Representative(s) on large and / or complex projects can save project funds by reducing failures and associated rework, providing a more robust landscape for the Department at handover. Landscape and revegetation activities are unique to other road building activities as they involve the use of living materials (plant material) that require establishment so as to successfully reach their intended function.

Landscape Representative(s) should be engaged early in the project life to ensure adequate planning and co-ordination with civil works programme and to undertake material procurement in accordance with the project Proposals of Clause 5.3

The Landscape Representative should not be confused with the Environmental Representative as they have distinctly separate qualifications, skills and experience.

6.2 Soil Assessor accreditation

The Contractor shall have sampling, assessment and interpretation of soil test results carried out by a:

a) Certified Professional Soil Scientist (CPSS), or

b) soil scientist or agronomist with:

   i. educational qualifications relating to soil science, and

   ii. at least ten years relevant experience in soil assessment and management.

It is important soil sampling, assessment, interpretation and recommendations are provided by appropriately qualified and experienced specialists. Incorrect interpretation and recommendations can lead to additional costs, project delays and / or rework.

6.3 General requirements supplementary requirements

General requirements supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Clause 2.1 of the Annexure MRTS16.1.

7 Materials

The material requirements used throughout this Technical Specification are given below.

Materials imported to Site shall be free of prohibited or restricted biosecurity matter.

The Contractor shall store materials to ensure no deterioration or contamination occurs, including the potential for environmental harm.

7.1 Soil

For the purposes of this Technical Specification, soil is considered to have two distinct layers:

a) Subsoil:

   i. the soil below the topsoil layer

   ii. the outer face / surface of a cut or fill embankment (subgrade), and

   iii. the exposed soil in broadacre areas that have been stripped of topsoil.

b) Topsoil:

   i. manufactured from site topsoil, and

   ii. imported topsoil.

Soil shall be free of contaminants harmful to plant growth.

7.1.1 Subsoil

Subsoil shall:

a) be sampled and tested, in accordance with Clause 8.1.1, and

b) be ameliorated, in accordance with the recommendations of the *Soil Management Plan – Construction*.

7.1.2 Topsoil

Topsoil shall be:

a) Site topsoil in accordance with Clause 7.1.2.1, or

b) imported topsoil in accordance with Clause 7.1.2.2.

Where practicable, Site topsoil shall be prioritised over imported topsoil.

7.1.2.1 Site topsoil

Site topsoil shall be:

a) topsoil stripped during clearing and grubbing operations, in accordance with MRTS04 *General Earthworks*, or topsoil in areas that have not been stripped

b) sampled and tested in accordance with Clause 8.1.2, and

c) manufactured in accordance with Clause 8.2.1.

When it is intended to use site topsoil, ensure the relevant clauses of Annexure MRTS04.1 *General Earthworks* is completed to promote the provision of adequate quantities of suitable material. Where insufficient quantities are available, additional imported materials may be required.

7.1.2.2 Imported topsoil

Imported topsoil shall:

a) be sampled and tested:

i. in accordance with Clause 8.1.2, and

ii. no later than six months before delivery to Site

b) be certified free prohibited or restricted biosecurity matter.

The Contractor shall provide quality assurance documentation from the supplier to demonstrate the imported topsoil is in accordance with the requirements of this Clause, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the Soil Management Plan – Construction.

7.1.2.3 Backfill soil material

Backfill soil material, used in planting holes deeper than 300 mm, shall be ameliorated subsoil excavated from the planting hole.

7.2 Soil amelioration agents

Soil amelioration agents may include:

a) agricultural lime

b) agricultural gypsum

c) agricultural dolomite

d) fertiliser

e) organic soil conditioner

f) microbial inoculants

g) soil wetting agents, and

h) water holding agents.

7.2.1 Agricultural lime, agricultural dolomite and agricultural gypsum

Agricultural lime, agricultural dolomite and agricultural gypsum shall not be in a liquid form.

Agricultural lime shall be naturally occurring limestone (calcium carbonate $CaCO_3$).

Agricultural dolomite shall be naturally occurring dolomite (calcium magnesium carbonate $CaMg(CO_3)_2$).

Agricultural lime and agricultural dolomite shall meet the following parameter requirements:

a) have a neutralising value (NV) of 90 or above, determined using the Test Method 19A1 from the *Soil Chemical Methods: Australasia* (2011) by Rayment and Lyons

b) have a pH value of 8.5 +/- 0.5, determined using the test method in accordance with Clause 5.5 of AS 4419, and

c) have a particle size distribution of:

   i. 100% by weight to pass a 5 mm sieve

   ii. 95% by weight to pass a 3.5 mm sieve, and

   iii. 40% by weight to pass a 0.15 mm sieve.

Agricultural gypsum shall be naturally occurring grade 1 gypsum (calcium sulfate $CaSO_4 2H_2O$). Crushed plaster board is not permitted.

Agricultural gypsum shall meet the following parameter requirements:

a) a minimum 80% of gypsum

b) a moisture content of < 20%

c) have sodium content < 0.8%

d) have a total content (x-ray fluorescence test) of:

   i. 20% calcium (Ca)

   ii. 15% sulphur (S), and

   iii. < 2% sodium chloride (NaCl).

e) if manufactured – have a total content of heavy metals:

   i. < 0.001% cadmium (Cd), and

   ii. < 0.01% lead (Pb).

f) have a particle size distribution of:

   i. 100% by weight to pass a 6 mm sieve

   ii. 80% by weight to pass a 4 mm sieve, and

   iii. 50% by weight to pass a 2 mm sieve.

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this Clause, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the *Soil Management Plan – Construction*.

7.2.2 Fertiliser

Fertiliser shall be delivered to the project in bags or containers, each labelled in accordance the Queensland Agricultural Standards Regulation 1997.

Planting treatments shall be fertilised with controlled / slow release fertilisers.

Seeding and turf treatments shall be fertilised with a combination of soluble and controlled / slow release fertilisers.

Controlled / slow release fertilisers:

- provide nutrients to plants over a longer period of time compared to uncontrolled release fertilisers
- are cost effective by reducing the requirement for additional fertilising, and
- have a reduced risk of nutrient deficient related failures in planting treatments.

Soluble fertilisers:

- provide immediate but relatively short supply of nutrients
- are water soluble and highly leachable, with potential for translocating into water bodies or adjacent vegetation treatments and potentially causing potential harm, and
- have a higher risk of nutrient deficient related vegetation failures if not reapplied during vegetation development.

The N:P:K:S rates are intended to:

- address nutrient requirements for each vegetation treatment type, and
- allow flexibility to address soil nutrient deficiencies identified in the *Soil Management Plan – Construction*.

7.2.3 Organic soil conditioner

Organic soil conditioner shall comply with:

a) AS 4454 Clause 3.1.1.1 (d) mature compost

b) AS 4454 Clause 3.1.1.2 (a) soil conditioner, and

c) Form G of Appendix MRTS16.

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this Clause, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the *Soil Management Plan – Construction*.

7.2.4 Microbial inoculants

Biological growth stimulants shall:

a) not be toxic to plant growth

b) improve soil structure

c) stimulate seed germination

d) improve overall plant health and development, and

e) increase root mass and nutrient uptake.

Microbial inoculants shall comprise of one or more of the following:

a) beneficial bacteria / microbes, and / or

b) beneficial fungi / mycorrhizal fungi.

Where humic acid / humates are proposed for use, they must be combined with beneficial bacteria.

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this Clause, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the *Soil Management Plan – Construction*.

7.2.5 Soil wetting and water holding agents

7.2.5.1 Soil wetting agents

Soil wetting agents (surfactants) shall:

a) have a life of at least three months from the time of application

b) reduce soil water repellence / hydrophobicity

c) reduce surface tension of soil particles

d) increase water penetration to soil, and

e) be free from matter toxic to plant growth.

7.2.5.2 Water holding agents

Water holding agents shall:

a) have a life of at least six months from the time of installation

b) hold water equal to at least 200 times their own mass

c) be hydrated / activated prior to installation, and

d) be free from matter toxic to plant growth.

Water holding agents shall be incorporated into the topsoil or installed in individual planting holes.

7.3 Pesticides

Pesticides shall:

a) be registered for use on roadsides and rights of way under the *Chemical Usage* (Agricultural and Veterinary) *Control Act* 1988, and

b) be registered for treatment of weeds by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

7.3.1 Knock-down herbicides

Knock-down herbicides shall be a broad spectrum, non-residual, glyphosate based herbicide that has been specifically manufactured for low aquatic toxicity.

7.3.2 Target herbicides

Target herbicides shall be used exclusively for the eradication of the target plant species. The type of herbicide and target vegetation to be controlled shall be specified in Clause 3.1.1 of the Annexure MRTS16.1.

7.3.3 Insecticides

Insecticides shall treat target insect species infesting vegetation works.

7.3.4 Fungicides

Fungicides shall treat target diseases infesting vegetation works.

7.4 Seeding

7.4.1 Drill seeding

Drill seeding treatment:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) seed (Clause 7.4.9)

f) fertiliser (Clause 7.4.10), and

g) water (Clause 7.7).

7.4.2 Broadcast Seeding

Broadcast seeding treatment:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) seed (Clause 7.4.9)

f) dry coarse sand or sawdust

g) fertiliser (Clause 7.4.10), and

h) water (Clause 7.7).

7.4.3 Hydromulch - Standard

Standard hydromulch treatment:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the Soil Management Plan – Construction (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) seed (Clause 7.4.9)

f) fibre (Clause 7.4.3.1)

g) binder (Clause 7.4.3.2)

h) fertiliser (Clause 7.4.10), and

i) water (Clause 7.7).

7.4.3.1 Fibre

Fibres shall be free from matter toxic to plant growth, prohibited or restricted biosecurity matter, plant propagules, soil, rubbish, seed germination inhibitors and other deleterious materials. Fibre shall be in accordance with AS4454 Test Method I and Test Method M.

Fibre shall disperse into a uniform slurry when mixed with water.

Fibres shall have a mixture of fine material and longer fibres to promote interlocking and erosion control and provide a suitable environment for seed germination.

Fibre shall be supplied in bales covered with UV stabilised and weather resistant plastic, with a maximum moisture content of 15%. Fibre rates specified within respective construction clauses of this Specification are dry weight, with moisture content no greater than 15%.

Fibres shall be combined with a marker / tracer dye. Dye may be either pre-packaged with the fibre or included with the binder.

Fibres may be any of the following or combination of these fibres.

a) Sugar cane

Sugar cane fibre shall:

i. be predominantly sugar cane tops, and

ii. mechanically processed

b) Wood

Wood fibre shall:

i. be defibrated or other suitable fiberising process, and

ii. mechanically and thermally processed.

c) Straw

Straw fibre shall:

i. be crop residue

ii. be predominantly stalk material, and

iii. mechanically and thermally processed.

d) Paper

Paper fibre shall:

i. be manufactured from hammer-milling or other suitable fiberising process, and

ii. be combined with other fibres, and be no greater than 25% of the total fibre weight used.

e) Coir

Coir fibre shall:

i. be a fine / peat grade product, suitable for use in seed raising, and

ii. be combined with other fibres, and be no greater than 25% of the total fibre weight used.

7.4.3.2 Binder

Standard hydromulch binder shall:

a) have a minimum two month functional longevity

b) be free from:

i. matter toxic to plant growth / seed germination

ii. plant propagules

iii. soil

iv. rubbish, and

v. other deleterious materials.

c) be manufactured for use in hydromulch or similar seeding applications

d) be readily dispersible

e) be highly soluble / hydro-colloidal

f) display a delayed development of viscosity before setting, and

g) be applied in accordance with manufacturer's specification.

Binders may be pre-packaged with fibre.

7.4.4 Hydromulch - Bonded Fibre Matrix

Bonded fibre matrix is a hydraulically applied mix of fibres and binder. Bonded fibre matrix products shall be proprietary products that have been tested to meet Table 7.4.4, or other suitable independent testing method deemed suitable. The Contractor shall provide quality assurance documentation from

the supplier to demonstrate material is in accordance with Table 7.4.4, prior to delivery to Site. Bonded fibre matrix treatment:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) seed (Clause 7.4.9)

f) fibre (Clause 7.4.4.1)

g) binder(Clause 7.4.4.2)

h) fertiliser (Clause 7.4.10), and

i) water (Clause 7.7).

Table 7.4.4 – Bonded Fibre Matrix Performance Standards

Property	Test Method	Tested Value
Functional longevity [1]	Observation	6 months
Minimum application rate	Observation	5000 kg/ha (500g/m^2)
Minimum application wet thickness	Observation	5 mm
Typical maximum slope gradient	Observation	≤ 1:2
Maximum uninterrupted slope length	Observation	20
Maximum C-Factor [2] (1:3 test)	ASTM 6459, or other suitable independent testing deemed suitable	0.05
Minimum vegetation establishment [3]	ASTM D7322, or other suitable independent testing deemed suitable	≥ 300%
Cure time	Observation	4 – 24 hour

[1] A manufacturer's estimated time period, based on field observations, that a product can be anticipated to provide effective erosion control.

[2] "C" Factor calculated as ratio of soil loss from a slope with the applied product, to a ratio of soil loss from an unprotected control slope.

[3] Calculated, as outlined in ASTM D7322, as a percentage by dividing the plant mass per area of the applied product plot by the plant mass per area of the untreated control plot.

7.4.4.1 Fibre

Fibres shall be free from matter toxic to plant growth, prohibited or restricted biosecurity matter, plant propagules, soil, rubbish, seed germination inhibitors and other deleterious materials. Fibre shall be in accordance with AS4454 Test Method I and Test Method M.

Fibre shall disperse into a uniform slurry when mixed with water.

Fibres shall have a mixture of fine material and longer fibres to promote interlocking and erosion control and provide a suitable environment for seed germination.

Fibre shall be supplied in bales covered with UV stabilised and weather resistant plastic, with a maximum moisture content of 15%. Fibre rates specified within respective construction clauses of this Specification are dry weight, with moisture content no greater than 15%.

Fibres shall be combined with a marker / tracer dye. Dye may be either pre-packaged with the fibre or included with the binder.

Fibres may be any of the following or combination of these fibres.

a) Sugar cane

Sugar cane fibre shall:

i. be predominantly sugar cane tops, and

ii. mechanically processed

b) Wood

Wood fibre shall:

i. be defibrated or other suitable fiberising process, and

ii. mechanically and thermally processed.

c) Straw

Straw fibre shall:

i. be crop residue

ii. be predominantly stalk material, and

iii. mechanically and thermally processed.

d) Paper

Paper fibre shall:

i. be manufactured from hammer-milling or other suitable fiberising process, and

ii. be combined with other fibres and be no greater than 25% of the total fibre weight used.

e) Coir

Coir fibre shall:

i. be a fine / peat grade product, suitable for use in seed raising, and

ii. be combined with other fibres and be no greater than 25% of the total fibre weight used.

7.4.4.2 Binder

Bonded fibre matrix binder shall:

a) have a minimum six months functional longevity

b) be non-re-wettable

c) be crosslinked hydro-colloidal

d) be free from:

   i. matter toxic to plant growth / seed germination

   ii. plant propagules

   iii. soil

   iv. rubbish, and

   v. other deleterious materials.

e) be readily dispersible

f) be highly soluble

g) display a delayed development of viscosity before setting, and

h) be applied in accordance with manufacturer's specification.

Binders may be pre-packaged with fibre.

Where binder is supplied / packaged separately from fibre, the manufacturer of the proprietary product(s), must provide certification the supplied materials and quantity / ratio is in accordance with the tested product, to meet the requirements of Table 7.4.4.

7.4.5 Hydro-compost

Hydro-compost is a hydraulically applied mix of compost, fibres and binder. The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the following compost, fibres and binder requirements, prior to delivery to Site.

Hydro-compost treatment:

a) topsoil (Clause 7.1.2) Note - Where a site topsoil is tested in accordance with Form C of Appendix MRTS16 and has less than 3% organic matter, Hydro-compost may be used to address organic matter requirements of the topsoil in lieu of ameliorating the stockpiled topsoil with organic soil conditioner.

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) topsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

d) compost be a minimum 60% of the total product and shall comply with, or an approved equivalent of, the following:

   i. AS 4454 Clause 3.1.1.1 (d) mature compost

   ii. AS 4454 Clause 3.1.1.2 (a) soil conditioner, and

   iii. Form G of Appendix MRTS16.

e) soil microbial inoculants (Clause 7.2.4)

f) soil wetting agent (Clause 7.2.5.1)

g) seed (Clause 7.4.9)

h) fibre (Clause 7.4.4.1)

i) binder (Clause 7.4.4.2)

j) fertiliser (Clause 7.4.10), and

k) water (Clause 7.7).

7.4.6 Straw Mulching

Straw mulching treatment:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) seed (Clause 7.4.9)

f) dry coarse sand or sawdust, if broadcast seeding

g) straw mulching fibre (Clause 7.4.6.1)

h) bituminous emulsion binder (Clause 7.4.6.2)

i) fertiliser (Clause 7.4.10), and

j) water (Clause 7.7).

7.4.6.1 Fibre

Straw mulch shall:

a) be crop residue

b) be predominantly stalk material, and

c) be free from matter toxic to plant growth, plant propagules, soil, rubbish, and other deleterious materials.

Fibre rates specified within respective construction clauses of this Specification are dry weight, with moisture content no greater than 15%.

7.4.6.2 Binder

Bituminous binder shall:

a) be slow setting anionic bituminous emulsion (ASS) in accordance with the requirements of MRTS21 *Bituminous Emulsion*

b) be free from petroleum solvent or other components toxic to plant growth

c) be readily dispersible, and

d) display a delayed development of viscosity before setting.

Bituminous binder shall be further diluted 50 / 50 with water.

Application rates specified in Clause 8.5.1.6 is a diluted 50 / 50 rate.

7.4.7 Organic Blanket

Organics blanket treatment:

a) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

b) soil microbial inoculants (Clause 7.2.4)

c) soil wetting agent (Clause 7.2.5.1)

d) seed (Clause 7.4.9)

e) binder (Clause 7.4.7.1)

f) fertiliser (Clause 7.4.10)

g) water (Clause 7.7), and

h) mulch and soil conditioner materials compliant with

   i. AS 4454 Clause 3.1.1.1 (d) mature compost

   ii. Form G of Appendix MRTS16, and

   iii. mulch particle size distribution of

< 75 mm	100%
> 16 mm	10-20%
5 - 16 mm	30 – 50%, and
< 5 mm	30 – 50%.

7.4.7.1 Binder

Standard hydromulch binder shall:

a) have a minimum two month functional longevity

b) be free from:

   i. matter toxic to plant growth

   ii. plant propagules

   iii. soil

   iv. rubbish, and

   v. other deleterious materials.

c) be manufactured for use in hydromulch or similar seeding applications

d) be readily dispersible

e) be highly soluble / hydro-colloidal

f) display a delayed development of viscosity before setting, and

g) be applied in accordance with manufacturer's specification.

7.4.8 Seeded mesh lined drain

Seeded mesh lined drain treatment:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) seed (Clause 7.4.9)

f) organic mesh (Clause 7.4.8.1)

g) bituminous emulsion binder (Clause 7.4.8.2)

h) fertiliser (Clause 7.4.10), and

i) water (Clause 7.7)

7.4.8.1 Organic Mesh

Mesh used with seeding operations shall:

a) be an open jute or coir mesh material suitable for seeding operations

b) protect topsoil and seeding from water and wind erosion

c) be made from 100% biodegradable fabric

d) allow the exchange of air and water, and

e) not contain matter toxic to plant growth.

Fixing pins used to secure mesh shall be a minimum 30 x 200 mm steel U-pins.

The type of organic mesh shall be as specified in Clause 3.2.4 of the Annexure MRTS16.1.

> Jute mesh has an approximate life of 3 - 6 months in a drainage structure.
>
> Coir mesh has an approximate life of 6 – 18 months in a drainage structure.

7.4.8.2 Binder

Bituminous binder shall:

a) be slow setting anionic bituminous emulsion in accordance with the requirements of MRTS21 *Bituminous Emulsion*

b) be free from petroleum solvent or other components toxic to plant growth

c) be readily dispersible

d) be highly soluble, and

e) display a delayed development of viscosity before setting.

Bituminous binder shall be further diluted 50 / 50 with water.

Application rates specified in Clause 8.5.1.8 is a diluted 50 / 50 rate.

7.4.9 Seeds

Grass seed shall be in accordance with Clause 7.4.9.1.

Woodland / forest seed shall be in accordance with Clause 7.4.9.2.

Seeds shall be tested in accordance with Clause 8.1.4.

Minimum seed application rates are based on a seed purity of 95% and germination / viability of 80%. Where purity and germination / viability test certificates indicate seed lots are outside these parameters, the contractor shall adjust the application rate of the species to meet the minimum requirements. Where purity and germination / viability is low, consideration should be given to seeking an alternate supply or using a substitute species with higher purity and germination / viability.

Seed pre-treatments such as inoculation, coating or anticide in accordance with Clause 3.2.1 of the Annexure MRTS16.1, or as shown on the drawings.

Seed shall be supplied in containers or bags at a size suitable for use per load by the seeding contractor (will vary depending on type of seeding and equipment used), or by area (for example, per 500 m^2).

Seed shall be supplied in sealed containers or bags labelled with:

a) Project identification

b) Lot / bag number

c) mix name

d) species and quantities of each species

e) total bag weight, and

f) date.

The seed supplier shall provide certification of the supplied seed per lot / bag number, including the individual species and weight per bag to demonstrate material is in accordance with the requirements of this Clause and the Seed Supply Proposal, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the *Seed Supply Proposal*.

Where seed species are unavailable the Contractor shall submit a proposal to substitute species, in accordance with the Seed Supply Proposal. Substitute species shall be suitable to the site conditions and be suitable for use in areas with applicable design constraints (clear zone, sight visibility and other vegetation setbacks and clearances)

Where seed species and application rates are specified in Clause 3.2.2 or Clause 3.2.3 of the Annexure MRTS16.1 or shown on the drawings, the Contractor:

a) shall regard the seed mix and application rates as the required minimum, and

b) may increase the seed species and / or application rates to ensure Clause 9.1.2 and / or Clause 9.2.2 completion criteria is achieved.

It is recommended experienced agronomists, revegetation specialist and seed suppliers are consulted to develop seed mixes that are well suited to Site specific conditions, particular geographic regions and climatic zones of Queensland.

In developing seed mixes, consideration should be given to the adjoining landholder requirements (for example environmentally sensitive areas such State Forests / National Parks or pastoral / agricultural land) and minimising potential impacts.

A mixture of perennial grasses is required to reduce the risk of not achieving a suitable outcome. Perennial grass species selection should prioritise species:

- commonly found in the area, particularly turf or pasture areas
- suitable for the soil type and annual rainfall of the site / treatment area, and
- that are commercially available and cost effective.

It is important to note that some native grass species may not be suitable for seeding due to:

- lower germination and establishment rates
- shape / morphology relative to mechanical applicators
- an inability to compete with exotic grass species (included in the seed mix or in sites adjoining the Site), and
- availability.

7.4.9.1 Grass seed

Grass seed mix application rates shall be:

a) in accordance with Table 7.4.9.1

b) specified in Clause 3.2.2 of the Annexure MRTS16.1and / or shown on the drawings

c) included in the Seed Supply Proposal, and

d) based on a minimum 95% purity and 80% germination / viability.

Perennial grass species shall:

a) be perennial species

b) not exceed a mature height of 700 mm, and

c) be commonly found in the region.

Seeds shall be tested in accordance with Clause 8.1.4. The Contractor shall use the purity and germination / viability test certificates to adjust the application rates to achieve the minimum purity and germination / viability requirements.

Table 7.4.9.1 – Grass seed mix application rate

Time of Year	Description	Total Application Rate kg / ha
Perennial Species		
All	Cynodon dactylon (Green Couch) – Hulled	10
	Cynodon dactylon (Green Couch) – Un-Hulled	10
	Mix of three additional perennial grass species*	15
Cover Crop Species		
Apr - Aug	50% Annual Rye and 50% Annual Millet	10
Sep - Mar	100% Annual Millet	

Perennial grass species, shall contain a minimum 50% by weight of species existing within or adjoining the Site.

* Urban Areas (High profile areas, as per Table 2 – Definition of Terms) – a default mix of Cynodon dactylon 20 kg / ha hulled, 20 kg / ha unhulled and 10 kg / ha cover crop shall be used.

A mixture of perennial grasses is required to reduce the risk of not achieving a suitable outcome. Perennial grass species selection should prioritise species:

- commonly found in the area, particularly turf or pasture areas
- suitable for the soil type and annual rainfall of the site / treatment area,
- that are commercially available and cost effective, and
- are suitable to exposed, full sun conditions.

It is important to note that some native grass species may not be suitable for seeding due to:

- lower germination and establishment rates
- shape / morphology relative to mechanical applicators
- an inability to compete with exotic grass species (included in the seed mix or in sites adjoining the Site), and
- availability.

7.4.9.2 Woodland / forest seed

Woodland / forest seed mix application rates shall be:

a) in accordance with Table 7.4.9.2

b) specified in Clause 3.2.3 of the Annexure MRTS16.1 and / or shown on the drawings

c) included in the Seed Supply Proposal, and

d) based on a minimum 95% purity and 80% germination / viability.

Woodland / forest species shall:

a) be endemic to the region

b) be species with a mature height and width greater than 1.2 m

c) not include groundcover species, and

d) not include vine or climbing species.

Grass species shall be in accordance with Clause 7.4.9.1

Hard cased woodland / forest species seed shall be pre-treated by the supplier, by scarification of the seed case, unless otherwise specified in Seed Supply Proposal, and

Seeds shall be tested in accordance with Clause 8.1.4. The Contractor shall use the purity and germination / viability test certificates to adjust the application rates to achieve the minimum purity and germination / viability requirements.

Table 7.4.9.2 – Woodland / forest seed mix application rate

Time of Year	Description	Total Application Rate kg / ha
Native Woodland / Forest Species		
All	Mix of a minimum of three Acacia species*	5
	Mix of a minimum of three tree species*	2
	Mix of a minimum of three shrub species	1
Perennial Grass Species		
All	Cynodon dactylon (Green Couch) - Hulled	10
	Cynodon dactylon (Green Couch) – Un-Hulled	10
	Mix of three perennial species	15
Cover Crop Species		
Sep - Mar	100% Annual Millet	10
Apr - Aug	50% Annual Rye and 50% Annual Millet	

Woodland / Forest Species and Perennial grass species shall contain a minimum 50% by weight of species existing within or adjoining the Site.

* Where woodland / forest seed mix is proposed within road design constraint areas (clear zone and other vegetation setbacks and clearances), shrub species shall be used.

The intent of the woodland / forest species mix is to establish pioneer plant species to stabilise the site and provide a framework for natural successional processes to occur. The grass species provide the initial stabilisation of the Site, reducing runoff, increasing water absorption and improving soil biological systems. The acacia species are pioneer species which, over several years, assist in further stabilising the Site and developing soil conditions conducive to allowing subsequent succession with climax species.

7.4.10 Seeding fertilisers

Fertiliser shall:

a) be in accordance with Clause 7.2.2

b) be in accordance with Table 7.4.10, and

c) be in accordance with the *Soil Management Plan – Construction*.

Fertiliser shall be applied in the N:P:K:S rates in Table 7.4.10, unless specified otherwise in the *Soil Management Plan – Construction*.

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this Clause, prior to delivery to site. The documentation shall be incorporated as an Appendix to the *Soil Management Plan – Construction*.

Table 7.4.10 – Seeding Fertiliser N:P:K:S Rates

	Soluble	**Controlled / Slow Release**
N	20 – 40 kg / ha	10 – 15 kg / ha
P	10 - 40 kg / ha	
K	20 - 80 kg / ha	
S	5 – 30 kg / ha	
Trace elements	As required	

An example fertiliser NPKS analysis of 10:10:20:6 applied at 100 kg / ha delivers approximately the following quantities of NPKS.

N – 10 kg/ha

P – 10 kg/ha

K – 20 kg/ha

S – 6 kg/ha

Accordingly, a minimum 200 kg / ha of the example fertiliser would need to be applied to meet the minimum NPKS rates.

7.5 Turfing

7.5.1 Turfing treatment material

Turfing treatment materials:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) turf (Clause 7.5.2)

f) fertiliser (Clause 7.5.3), and

g) water (Clause 7.7).

7.5.2 Turf

Turf shall:

a) have a minimum 30 mm depth of sod

b) be in a healthy condition

c) be free from prohibited or restricted biosecurity matter, pests, diseases and matter toxic to plant growth

d) show signs of active growth, and

e) be true to the form of the specified species.

A-grade turf shall consist of a minimum 95% of the specified turf species.

B-grade turf shall consist of a minimum 80% of the specified turf species.

Turf species, turf grade and roll width shall be specified in Clause 3.3.1 of the Annexure MRTS16.1.

The Contractor must provide Turf Certification of the species.

A-grade turf must be used in high profile urban areas such as:

- pedestrian areas and shared paths
- transport stations, and
- areas fronting residential property.

B-grade turf is suitable for all other areas other than high profile urban areas as noted above.

7.5.3 Turf fertiliser

Fertiliser shall:

a) be in accordance with Clause 7.2.2

b) be in accordance with Table 7.5.3, and

c) be in accordance with the *Soil Management Plan – Construction.*

Fertiliser shall be applied in the N:P:K:S rates in Table 7.5.3, unless specified otherwise in the *Soil Management Plan – Construction.*

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this Clause, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the. *Soil Management Plan – Construction.*

Table 7.5.3 – Turf Fertiliser N:P:K:S Rates

	Soluble	**Controlled / Slow Release**
N	20 – 40 kg / ha	10 – 15 kg / ha
P	10 – 40 kg / ha	
K	20 – 80 kg / ha	
S	5 – 30 kg / ha	
Trace elements	As required	

An example fertiliser NPKS analysis of 10:10:20:6 applied at 100 kg / ha delivers approximately the following quantities of NPKS.

N – 10 kg/ha

P – 10 kg/ha

K – 20 kg/ha

S – 6 kg/ha

Accordingly, a minimum 200 kg / ha of the example fertiliser would need to be applied to meet the minimum NPKS rates.

7.6 Planting

7.6.1 Planting treatment materials

Planting treatment materials:

a) topsoil (Clause 7.1.2)

b) subsoil ameliorants (gypsum, lime, dolomite) where required by the *Soil Management Plan – Construction* (Clause 7.2.1)

c) soil microbial inoculants, where specified in Clause 3.6 of the Annexure MRTS16.1(Clause 7.2.4)

d) soil wetting agent (Clause 7.2.5.1)

e) water holding agents, where specified in Clause 3.6 of the Annexure MRTS16.1 (Clause 7.2.5.2)

f) containerised plants and ex-ground stock (Clause 7.6.2)

g) mulch (Clause 7.6.3)

h) organic matting, where specified (Clause 7.6.4)

i) stakes and guys (Clause 7.6.5)

j) subsoil drain, where required, (Clause 7.6.6)

k) fertiliser (Clause 7.6.7), and

l) water (Clause 7.7).

7.6.2 Containerised plants and ex-ground stock

Plants may be obtained from:

a) nurseries, and / or

b) harvested plant material from Site.

Nurseries shall be members of *Nursery and Garden Industry Australia / Queensland*.

Plant container sizes include:

a) < 25 L container stock:

   i. Viro tube (macrophytes only)

   ii. Full native tube (50 x 50 x 130)

   iii. 140 mm

   iv. 200 mm, and

   v. 300 mm.

b) ≥ 25 L container stock:

   i. 25 L

   ii. 45 L

   iii. 100 L

   iv. 200 L

   v. 400 L, and

   vi. ex-ground stock.

Plant material shall:

a) be acclimatised to the conditions of the Site – by sun hardening and reducing watering

b) be of a size appropriate to the container size

c) be in a healthy condition free from weeds, pests and diseases

d) be free of prohibited or restricted biosecurity matter

e) not be showing signs of nutrient or water deficiency, heat stress, notable pest damage or other physical damages

f) be showing signs of active growth relative to season and true to form of the species

g) have a healthy root system and not be pot bound

h) be clearly and correctly labelled according to botanical name

i) have water resistant labels and tied securely to a minimum one species per tray, and

j) be delivered to site in fully enclosed trucks (container stock < 200 L).

Trees shall have a single, healthy, undamaged leading stem unless otherwise specified.

Trees shall be in accordance with AS2303 *Tree Stock for Landscape Use*.

Plant species, quantities, container sizes, mature heights and widths; and planting densities shall be specified in Clause 3.4.1 of the Annexure MRTS16.1 and shown on the drawings.

7.6.3 Mulch

Mulch shall be:

a) Site manufactured mulch, or

b) imported mulch.

7.6.3.1 Site manufactured mulch

Site manufactured mulch shall:

a) be manufactured from vegetation material set aside during clearing and grubbing operations in accordance with MRTS04 *General Earthworks*

b) be free from contaminants, rubbish and deleterious material

c) be free from weeds, including prohibited or restricted biosecurity matter, and

d) be manufactured in accordance with Clause 8.2.2.

Where vegetation exists on site and it is intended to use it to produce site manufactured mulch for use in permanent landscape works or temporary erosion and sediment control works, ensure the retention of adequate quantities of suitable material is nominated in the Annexure MRTS04.1 *General Earthworks*.

7.6.3.2 Imported mulch

Imported mulch shall:

a) comply with the requirements of AS 4454, Clause 3.1.1.1 (c) composted product

b) be free from contaminants, rubbish and deleterious material, and

c) be certified free from weeds, including prohibited or restricted biosecurity matter.

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this clause, prior to delivery to Site.

Mulch type and size shall be as specified in Clause 3.4.2 of the Annexure MRTS16.1.

7.6.4 Organic matting

Organic matting used with container planting operations shall:

a) be a high density material suitable for container planting operations

b) be made from 100% biodegradable fabric

c) minimise weed growth

d) reduce soil moisture loss

e) protect topsoil from water and wind erosion

f) allow the exchange of air and water, and

g) not contain matter toxic to plant growth.

Organic matting used with container planting operations in drainage structures shall be capable of withstanding design water velocities until vegetation is established.

Jute or coir mesh may be used to secure mulch on 1:2 scopes.

Fixing pins used to secure matting shall be a minimum 30 x 200 mm steel U-pins.

The type of organic matting shall be as specified in Clause 3.4.3 of the Annexure MRTS16.1

7.6.5 Stakes and guys

Stakes and guying shall be in accordance with Table 7.6.5.

Table 7.6.5 – Stakes and guys

Description	Container	Ties	Number of Stakes
600 x 10 mm diameter bamboo	Tube – 200 mm stock (marker for supplementary planting in seeded areas only)	-	1
1500 x 25 x 25 mm hardwood	25 – 45 L (tree species only)	✓	2
1800 x 50 x 50 mm hardwood	100 L stock (tree species only)	✓	
Guys*	≥ 200 L and ex-ground	-	4

*Guys shall be a proprietary underground tree guying system, installed in accordance with a manufacturer's recommendations.

7.6.6 Subsoil drain

Subsoil drains shall:

a) have a 100 mm perforated drainage pipe with textile sleeve compliant with AS 2439.1

b) have backfill material consisting of a single-sized aggregate of 20 mm or 10 mm particle size, with a maximum of 5% passing the AS 0.15 mm sieve, and

c) have a geotextile surround compliant with Clause 6 of MRTS27 *Geotextiles (Separation and Filtration)*.

7.6.7 Planting fertilisers

Fertilisers shall:

a) be in accordance with Clause 7.2.2

b) be controlled / slow release, minimum 6 months

c) applied in accordance with the manufacturer's application rate, and

d) have an N:P:K analysis within the following ranges, unless specified otherwise in the *Soil Management Plan – Construction*:

   i. N: 7 – 22

   ii. P: 1 – 6

   iii. K: 2 – 10

The Contractor shall provide quality assurance documentation from the supplier to demonstrate material is in accordance with the requirements of this clause, prior to delivery to Site. The documentation shall be incorporated as an Appendix to the *Soil Management Plan – Construction*.

7.7 Water

Water used for vegetation works shall be:

a) potable water, or

b) recycled water, in accordance with Clause 7.7.1, or

c) non-potable water (dam, creek, river and bore water) in accordance with Clause 7.7.2.

7.7.1 Recycled water

Recycled water used for vegetation works shall:

a) contain no substances toxic to plant growth

b) have a pH between 6 and 8.5 (inclusive)

c) have a total soluble salts concentration less than 1000 mg / L, and

d) be Class A or A+ only, in accordance with the *Queensland Water Recycling Guidelines (EPA 2005)*

e) be sourced from a supplier with a Recycled Water Management Plan prepared in accordance with the *Recycled Water Management Plan and Validation Guidelines (DEWS 2008)*

f) be managed and handled in accordance with the *Guide to Workplace use of Non-potable Water Including Recycled Waters (DIER 2007)*, and

g) have relevant signage erected in accordance with the AS/NZ 1319:1994 – *Safety Signs for the Occupational Environment*.

7.7.2 Non-potable water (dam, creek, river and bore water)

Non-potable water (excluding recycled water) used for vegetation works shall:

a) contain no substances toxic to plant growth

b) have a pH between 6 and 8.5 (inclusive)

c) have a total soluble salts concentration less than 1000 mg / L, and

d) be sampled and tested in accordance with Clause 8.1.3

e) be managed and applied, in accordance with the *Form H of MRTS16 Appendix*, and

f) have relevant signage erected in accordance with the AS/NZ 1319:1994 – *Safety Signs for the Occupational Environment*.

Water from sediment basins shall not be used for irrigating landscape and revegetation treatments.

Sediment basins are typically required to be flocculated and discharged within 5 days of a rain event. This timeframe does not allow for adequate testing. There is a high risk of water being toxic to vegetation where over flocculation occurs with salt and metal based flocculants.

7.8 Planting bed edging

7.8.1 Concrete planting bed edging

Concrete planting bed edging shall:

a) be 150 x 150 mm

b) be Class N25/10 concrete, in accordance with MRTS70 *Concrete*

c) have expansion joints installed at regular intervals not exceeding 20 m

d) have contraction joints between expansion joints at regular intervals not exceeding 5 m and / or at changes of curvature, and

e) be installed on subgrade compacted in accordance with the requirements of Clause 15 of MRTS04 *General Earthworks*.

Concrete testing not required.

7.9 Irrigation system

Irrigation system materials shall:

a) comply with relevant Australian Standards, and

b) meet the requirements of the applicable Local Government.

Materials used for electrical cabling and fittings shall comply with the requirements of MRTS228 *Electrical Switchboards* and MRTS256 *Power Cables*.

Specific irrigation design type and requirements shall be specified in Clause 3.5 of the Annexure MRTS16.1.

7.10 Material supplementary requirements

Material supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Clause 3.6 of the Annexure MRTS16.1.

8 Construction

The extent and types of vegetation treatments shall be installed as shown on the drawings, or as specified elsewhere in the Contract.

8.1 Sampling and testing

8.1.1 Subsoil sampling and testing

8.1.1.1 Subsoil sampling

Sampling shall be conducted by a soil scientist with qualifications in accordance with Clause 6.2. Where an accredited soil scientist is unavailable in a remote location, soil sampling will be carried out under the direction of the Administrator.

Sampling for each test shall comply with the following requirements:

a) be representative of the subsoil type and not include different subsoil types or topsoil layers

b) be in accordance with Table 8.1.1.1

c) be composed of a composite of 10 sub-samples representative of the subsoil lot (top 200 mm final trimmed cut batter face or bench, final trim fill batter face, final trimmed broadacre areas beyond the batter)

d) be approximately 1 kg

e) be placed in clean, sealable, durable plastic bags clearly labelled with:

   i. Project name

   ii. Job / Contract number

   iii. Sample date

   iv. Sample Location, including GPS or chainage reference

   v. Sample material layer / type, and

   vi. Lot / sub-lot identification.

f) be submitted to a laboratory for testing with a copy of the relevant testing Form, in accordance with Clause 8.1.1.2.

Table 8.1.1.1 – Subsoil sampling requirements

Subsoil	Sampling Frequency
Subsoil	One test per subsoil type
Drainage Basin	One test per subsoil type / 1 test per drainage basin

Consider undertaking field testing (for example, pH, EC and dispersion/slaking) to validate representative sampling.

Consideration should be given to increasing sampling and frequencies, as benefits include:

- reduced risk of anomalies or errors made during the sampling process
- greater certainty of results and recommendations, minimising the risk of poor outcomes
- reduced risk of inadequate amelioration recommendations for stockpiled topsoil, resulting in non-compliant results during compliance testing, required rework and further testing, and
- a relatively small increase in sampling / testing costs compared with the high costs and program delay of rework operations.

8.1.1.2 Subsoil testing

Testing shall be in accordance with Table 8.1.1.2.

Table 8.1.1.2 – Subsoil testing requirements

Soil Testing	Set of Tests Required
Subsoil	*Form E of MRTS16 Appendix*
Drainage Basin	*Form F of MRTS16 Appendix*

A Soil Assessment Report shall be:

a) prepared for each sample

b) prepared by a soil scientist with accreditations in accordance with Clause 6.2

c) in accordance with *Form B of MRTS16 Appendix*

d) used to develop the *Soil Management Plan – Construction*, and

e) incorporated as an Appendix to the *Soil Management Plan – Construction*.

Guidance on amelioration strategies, rates and targets are provided in *Form B of MRTS16 Appendix*.

8.1.2 Topsoil sampling and testing

8.1.2.1 Topsoil sampling

Sampling shall be conducted by a soil scientist with qualifications in accordance with Clause 6.2. Where an accredited soil scientist is unavailable in a remote location, soil sampling will be carried out under the direction of the Administrator.

Sampling for each test shall comply with the following requirements:

a) be representative of the topsoil type and not include different soil types or layers

b) be in accordance with Table 8.1.2.1

c) where sampling stockpiles, sub-samples shall be sampled from various locations, 0.5 m within the stockpile

d) be composed of a composite of 10 sub-samples representative of the topsoil

e) be approximately 3.0 kg

f) be placed in clean, sealable, durable plastic bags clearly labelled with:

   i. Project name

   ii. Job / Contract number

   iii. Sample date

   iv. Sample Location, including GPS or chainage reference

   v. Sample material layer / type, and

   vi. Lot / sub-lot identification.

g) be submitted to a laboratory for testing with a copy of the relevant testing Form, in accordance with Clause 8.1.2.2.

Compliance sampling of manufactured site soil should ideally be tested between one and four weeks after manufacture.

Table 8.1.2.1 – Topsoil sampling requirements

Topsoil	Sampling Frequency
Insitu Topsoil	1 per 2500 m² with a minimum of 1 test per topsoil type
Site Stockpiled Topsoil	2 per 500 m³ with a minimum of 1 test per topsoil type
Manufactured Site Topsoil Compliance Testing	2 per 500 m³ with a minimum of 1 test per topsoil type
Imported Topsoil	1 per 500 m³ with a minimum of 1 test per manufactured batch

Allow sufficient time for soil sampling, testing assessment reporting to minimise delays in the construction program.

Consider sampling and testing site topsoil prior to stripping, for efficient and effective incorporation of ameliorants during the stripping process.

A soil sample should not contain any large particles whereas the sampled stockpile may; the soil sample would comply relevant to this requirement but not the stockpiled soil in general, therefore observation of the stockpiled soil is necessary.

Consideration should be given to increasing sampling and frequencies, as benefits include:

- reduced risk of anomalies or errors made during the sampling process
- greater certainty of results and recommendations, minimising the risk of poor outcomes
- reduced risk of inadequate amelioration recommendations for stockpiled topsoil, resulting in non-compliant results during compliance testing, required rework and further testing, and
- a relatively small increase in sampling / testing costs compared with the high costs and program delay of rework operations.

8.1.2.2 Topsoil testing

Testing shall be in accordance with Table 8.1.2.2.

Table 8.1.2.2 – Topsoil testing requirements

Topsoil	Set of Tests Required
Site Topsoil	*Form C of MRTS16 Appendix*
Manufactured Site Topsoil Compliance Testing	*Form D of MRTS16 Appendix*
Imported Topsoil	*Form C of MRTS16 Appendix*

A Soil Assessment Report shall be:

a) prepared for each sample

b) prepared by a soil scientist with accreditations in accordance with Clause 6.2

c) in accordance with *Form B of MRTS16 Appendix*

d) used to develop the *Soil Management Plan – Construction*, and

e) incorporated as an Appendix to the *Soil Management Plan – Construction*.

Guidance on amelioration strategies, rates and targets are provided in *Form B of MRTS16 Appendix*.

8.1.3 Non-potable water (dam, creek, river and bore water) sampling and testing

8.1.3.1 Non-potable water sampling

Sampling location and frequency shall be in accordance with Table 8.1.3.1.

Table 8.1.3.1 – Non-potable water sampling

Type	Sample Location	Sampling Frequency
Dams	Away from the edge 500 mm below the surface. If it is not possible, sample close to where the pump draws water, or at the first outlet along the supply line.	When water levels fluctuate, or when water quality visually changes
Creeks or Rivers	From the main flow where water movement is constant. Do not sample where there is little or no flow.	When water levels / flow rates fluctuate, or when water quality visually changes
Bores	Before sampling, allow the water to flow for sufficient time to remove standing water in pipes.	When water quality visually changes, or when an odour occurs

Sampling for each test shall comply with the following requirements:

a) be approximately 1 L

b) contain no air spaces in the bottle

c) be placed in a clean, sealable, durable plastic bottle clearly labelled with

   i. Project name

   ii. Job / Contract number

   iii. Sample date

   iv. Sample Location, including GPS or chainage reference

   v. Sample material layer / type, and

   vi. Lot / sub-lot identification.

d) be submitted to a laboratory for testing with a copy of the *Form I of MRTS16 Appendix*, in accordance with Clause 8.1.3.2.

8.1.3.2 Non-potable water testing

A Non-Potable Water Testing and Assessment Report shall be:

a) prepared for each sample tested

b) in accordance with *Form I of MRTS16 Appendix*

c) used to develop the *Non-potable Water Management Plan*, and

d) incorporated as an Appendix to the *Non-potable Water Management Plan*.

8.1.4 Seed Testing

Seeds shall be tested to determine:

a) purity percentage, and

b) germination / viability percentage.

A certificate for each species shall be included in the Appendix of the Seed Supply Proposal, and include the following:

a) species of the seed

b) purity percentage

c) germination / viability percentage, and

d) pre-treatments or coatings that have been applied to the seed.

Grass seed purity and germination / viability certificates shall be no older than 6 months old.

Tree and shrub seed purity and germination / viability certificates shall be no older than 1 year old.

Projects with a long duration require seed testing to be conducted regularly to ensure the minimum certificate ages are within the required timeframes.

8.2 Site manufactured materials

8.2.1 Manufacture of site topsoil

Site topsoil shall be manufactured in accordance with the *Soil Management Plan – Construction* by:

a) ameliorating topsoil with amelioration agents, and

b) screening, or similar operation, to achieve particle size requirements and / or to incorporate amelioration agents.

Note - fertilisers and wetting agents shall be applied during the installation of the vegetation works treatments.

Where not in accordance with *Form D of MRTS16 Appendix*, manufactured site topsoil shall have additional amelioration and testing until compliance is achieved. Manufactured site topsoil shall be in accordance with *Form D of MRTS16 Appendix* prior to being used. **Hold Point 7**

Where manufactured topsoil is to be stockpiled greater than two weeks, it shall be suitably stabilised by either seeding with a cover crop or applying a polymer based soil binder.

Consideration should be given to testing topsoils prior to stripping to identify the most suitable topsoils and stripping depths. This may also allow for application of ameliorants to the topsoil surface prior to stripping. This is an efficient method to incorporate the ameliorants during the stripping process.

Where site constraints do not allow for stockpiling of stripped site topsoil, it may be more cost effective to use a topsoil free vegetation treatment such as organics blanket seeding in lieu of importing and spreading topsoil.

8.2.2 Manufacture of site mulch

Site mulch shall be produced from material set aside during clearing and grubbing operations as specified in Annexure MRTS04.1 *General Earthworks*. Material must not contain prohibited or restricted biosecurity species.

Mulch shall be manufactured by:

a) double tub grinding vegetation to produce a fine material, with a maximum dimension of 75 mm

b) stockpiling material to a maximum height of 2 m, and

c) initially watering the stockpile so the entire stockpile is moist.

Mulch stockpiles shall:

a) not be located near water bodies or concentrate drainage flows or timber structures

b) not be located within the drip line of retained trees, and

c) be maintained weed free; weeds which appear shall be treated immediately.

8.2.3 Harvesting of site vegetation material

8.2.3.1 Harvesting of site seed material

Seeds shall be harvested and stored for in accordance with the *Seed Harvesting Proposal*.

8.2.3.2 Harvesting of site plant material

Plant material shall be harvested, stored and cared for in accordance with the *Plant Harvesting Proposal*.

8.3 Weed control

Prior to the commencement of ground preparation operations, the area shall be in a weed free condition. **Witness Point 2**

All prohibited and restricted Biosecurity Matters shall be addressed as per MRTS51 *Environmental Management* and the EMP-C.

Weed control methods include:

a) mechanical application of herbicide using boom spray or high volume power applicator

b) manual application of herbicide from knapsack or similar applicator, or

c) manual methods, including removal and disposal of weeds.

Application devices shall be calibrated to deliver prescribed rates of product in accordance with the manufacturer's instructions.

Where a herbicide is required to be applied to hazardous areas, as defined by the *Agricultural Chemicals Distribution Control Act (1966)*, the Contractor shall obtain and submit a distribution permit to the Administrator.

Handling and application of herbicides shall:

a) only be carried by a licensed contractor who possess qualifications and licences relevant to the products being applied

b) be in accordance with the *Agricultural Chemicals Distribution Control Act (1966)*

c) be in accordance with permit instructions under the *Chemical Usage (Agricultural and Veterinary) Control Act (1988)*

d) be in accordance with the manufacturer's instructions, and

e) be applied with biodegradable, non-toxic tracer dye to highlight areas sprayed.

The Contractor shall maintain records of spray activities.

Where herbicides are prohibited from use, weeds shall be removed by hand and disposed off site in accordance with Clause 11 of MRTS04 *General Earthworks* and relevant bio-security requirements.

Manual methods of weed control, weed removal and target vegetation shall be specified in Clause 3.1.2 of the Annexure MRTS16.1.

8.4 Ground preparation works

Ground preparation work operations include:

a) subsoil operations, and

b) topsoil operations.

8.4.1 Subsoil operations

Subsoil operations include:

a) sampling and testing, in accordance with Clause 8.1.1

b) spreading amelioration agents on subsoil, in accordance with Clause 8.4.1.1

c) ripping, in accordance with Clause 8.4.1.2

d) cultivation, in accordance with Clause 8.4.1.3, and

e) roughening, in accordance with Clause 8.4.1.4.

8.4.1.1 Spreading of amelioration agents on subsoil

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Ground preparation operations shall occur immediately after the application of amelioration agents.

The actual type and quantity of amelioration agent to be applied is determined through testing the subsoil and completing the relevant sections in the Soil Assessment Report and Soil Management Plan – Construction.

8.4.1.2 Ripping

Ripping shall be used in areas to be vegetated with slopes ≤ 1 on 4 where soil has been compacted. For example, decommissioned site compounds and building pads, parking areas, stockpile areas, roads and haul routes, and general areas compacted by construction works.

Ripping shall:

a) be a minimum 300 mm depth, with rip lines at 500 mm maximum spacing

b) be to just below the depth of the compacted layer

c) incorporate amelioration agents into the subsoil

d) occur when soils are dry enough to shatter compacted subsoil sufficiently to allow subsequent cultivation operation

e) be parallel to the contour

f) not invert soil layers, and

g) be followed with the spreading of amelioration agents **Witness Point 3**

h) be followed with the cultivation operation, in accordance with Clause 8.4.1.3, to produce a finely tilled planting bed.

Ripping shall not occur within the drip line of vegetation to be retained, or within 300 mm of paths, kerbs, road furniture or structures.

8.4.1.3 Cultivation

Cultivation shall be used in areas to be vegetated with slope ≤ 1 on 4.

Cultivation shall occur immediately after the application of amelioration agents. **Witness Point 4**

Cultivation shall:

a) be a minimum 150 mm depth

b) incorporate amelioration agents into the subsoil

c) occur when soils are dry enough to break up the surface of the subsoil to produce a finely tilled planting bed, and

d) be parallel to the contour.

All stone, rubble and other deleterious material greater than 40 mm that is brought to the surface in areas to be mown / slashed in the future shall be removed.

Cultivation shall not occur within the drip line of vegetation to be retained, or within 300 mm of paths, kerbs, road furniture or structures. Hand cultivation is required in these locations.

8.4.1.4 Roughening

Roughening shall be used in areas to be vegetated with slope > 1 on 4.

Roughening shall occur immediately after the application of amelioration agents. **Witness Point 5**

Roughening shall:

a) be approximately 50 mm depth

b) incorporate amelioration agents into the subsoil

c) occur when soils are dry enough to roughen / break up / crumb the surface, and

d) be parallel to the contour and form keys in the subsoil to prevent subsequent material slipping down the face of the slope

8.4.2 Topsoil operations

Topsoil work operations include:

a) sampling and testing, in accordance with Clause 8.1.2

b) manufacture of topsoil, in accordance with Clause 8.2.1

c) importation of topsoil, and

d) installation of topsoil, in accordance with Clause 8.4.2.1.

Allow sufficient time for soil sampling, testing assessment reporting; and amelioration and screening operations to minimise delays in the construction program.

Where topsoil is scheduled in the plans and allowance should be made for manufacturing site topsoil and / or for the importation of topsoil. Generally, the department prioritises the use of site won materials; however when there is a shortfall, or when it is not feasible to ameliorate or where site storage constraints apply, importation of topsoil may be required. Alternatively the use of an alternate treatment such as organic blanket which does not require topsoil, may be considered.

8.4.2.1 Installation of topsoil

Topsoil shall be installed within three days of the subsoil operations.

Topsoil shall be spread to the depths described in the relevant vegetation works operation, and allow for settlement after installation.

The Contractor shall give at least three days notice before installation of topsoil. **Witness Point 6**

8.5 Vegetation works

Vegetation work operations include:

a) seeding

b) turfing, and

c) planting.

8.5.1 Seeding

Seeding operations include:

a) drill seeding

b) broadcast seeding

c) hydromulch - standard

d) hydromulch - bonded fibre matrix

e) hydro-compost

f) straw mulching, and

g) organics blanket.

Do not apply seeding during rain or where the soil is too wet for machinery.

The Contractor shall prepare a sample installation to provide an agreed quality control for further installations **Hold Point 9**

All seeds, wetting agents, binders, fibre and fertilisers are to be bought to site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10**

Sample installation shall form part of the final project. A sample area shall be prepared for each distinct area / and or seed mix. A sample area shall remain valid as a sample area for a maximum fourteen days (growth of cover crop / grass will change the appearance of a sample area).

The Contractor and Administrator shall:

a) determine the volume of fibre the tank can apply (volume varies with tank / pump and fibre / binder used) to determine a suitably sized sample area (minimum 100 m²)

b) clearly mark out the extent of the sample area

c) verify quanitites to be loaded into the tank / machinery

d) apply the seeding to the sample area in accordance with the relevant seeding clause. Ensure the minimum fibre depth is achieved (depth achieved will vary with fibre type / product and the roughness of the surface; the rougher the surface, the more fibre required to achieve the minimum depths).

e) where required, increase the fibre rate in order to achieve the minimum depth coverage based on the typical roughness / finish of the surface.

8.5.1.1 Drill seeding

Drill seeding shall be in accordance with Table 8.5.1.1.

Table 8.5.1.1 - Drill seeding

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering
≤ 1 on 4	1651	1*	Ripping* 300 mm Cultivation 150 mm	75 mm	10 L /m²
> 1 on 4	Not suitable for drill seeding machinery				

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents.
Witness Point 3, 4 or 5

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Drill seeding shall be installed within two days from the completion of the topsoil operation.

All seed, wetting agents and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10**

Drill seeding shall be installed:

a) parallel to the contour

b) by drilling seed and fertiliser into the topsoil, ensuring the seed is covered by topsoil, and

c) by watering, on the day of installation, with a solution of water and wetting agent, until the topsoil layer is moist. Watering shall be applied in multiple applications to ensure surface erosion does not occur.

8.5.1.2 Broadcast seeding

Broadcast seeding shall be in accordance with Table 8.5.1.2.

Table 8.5.1.2 – Broadcast seeding

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering
≤ 1 on 4	1651	1*	Ripping* 300 mm Cultivation 150 mm	75 mm	10 L /m²
> 1 on 4	1651	2	Roughening 50 mm		

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents.
Witness Point 3, 4 or 5

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Broadcast seeding shall be installed within two days from the completion of the topsoil operation.

All seed, wetting agents and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10**

Broadcast seeding shall be installed:

a) by blending a broadcast mixture of seed, fertiliser and a bulking agent such as dry, sharp sand or sawdust

b) by broadcasting the blended mixture on the topsoil

c) by lightly working the topsoil surface parallel to the contour by harrowing, raking, tracking or chain dragging, to ensure seeds are covered with topsoil, and

d) by watering, on the day of installation, with a solution of water and wetting agent until the topsoil layer is moist. Watering shall be applied in multiple applications to ensure surface erosion does not occur.

8.5.1.3 Hydromulch – Standard

Standard hydromulch shall be in accordance with Table 8.5.1.3.

Table 8.5.1.3 – Standard Hydromulch

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering	Minimum Fibre	Minimum Finished Fibre Depth
≤ 1 on 4	1651	1*	Ripping* 300 mm Cultivation 150 mm	75 mm	NA	4000 kg/ha	4 mm
> 1 on 4	1651	2	Roughening 50 mm				

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Sample areas shall be installed in accordance with Clause 8.5.1 **Hold Point 9**

All seeds, wetting agents, binders, fibre and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10** Note, some proprietary products are packaged with pre-blended fibre, binder and wetting agents, which is suitable.

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Standard hydromulch shall be installed within two days from the completion of the topsoil operation.

Standard hydromulch shall be installed:

a) by moistening the topsoil layer with a solution of water and wetting agent

b) by applying the hydromulch slurry in an indirect, dispersed spray pattern, from opposing directions during each pass, to achieve a complete coverage and a uniform finish. Best results are obtained when applied at a range of angles from the toe of the slope and the top of the slope. In scenarios where this in not practicable because access is restricted, apply in a forward and then backward manner as the area is traversed

c) by applying the hydromulch slurry in a minimum two pass process as follows:

   i. the first pass shall consist of a slurry of water, 1000 kg/ha of fibre, binder, fertiliser and 90% of the seed mix. The first pass shall become tacky (not dry) before subsequent passes are applied, and

   ii. the subsequent passes shall consist of a slurry of water, balance of the fibre required, binder and 10% of the seed mix.

d) with no soil visible after installation and a minimum finished fibre depth of 4 mm to be achieved at any location, and

e) with no initial watering on the day of installation to allow the binder to set.

A minimum two pass process is required to ensure seed is in contact with the topsoil and is covered by mulch, reducing its exposure to the elements and predation by insects and birds.

8.5.1.4 Hydromulch - Bonded Fibre Matrix

Bonded fibre matrix shall be in accordance with Table 8.5.1.4.

Table 8.5.1.4 – Bonded Fibre Matrix

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering	Minimum Fibre	Minimum Finished Fibre Depth
≤ 1 on 4	1651	1*	Ripping* 300 mm Cultivation 150 mm	75 mm	NA	5000 kg/ha	5 mm
> 1 on 4	1651	2	Roughening 50 mm				

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Regular sample areas shall be installed in accordance with Clause 8.5.1. **Hold Point 9**

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Bonded fibre matrix shall be installed within two days from the completion of the topsoil operation.

All seeds, wetting agents, binders, fibre and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10** Note, some proprietary products are packaged with pre-blended fibre, binder and wetting agents, which is suitable.

Bonded fibre matrix shall be installed:

a) by moistening the topsoil layer with a solution of water and wetting agent

b) by applying the bonded fibre matrix slurry in an indirect, dispersed spray pattern, from opposing directions during each pass, to achieve a complete coverage and a uniform finish. Best results are obtained when applied at a range of angles from the toe of the slope and the top of the slope. In scenarios where this in not practicable because access is restricted, apply in a forward and then backward manner as the area is traversed

c) by applying the bonded fibre matrix slurry in a minimum two pass process as follows:

   i. the first pass shall consist of a slurry of water, 1000 kg/ha of fibre, binder, fertiliser and 90% of the seed mix. The first pass shall become tacky (not dry) before subsequent passes are applied, and

   ii. the subsequent passes shall consist of a slurry of water, balance of the fibre required, binder and balance of the seed mix.

d) with no soil visible after installation and a minimum finished fibre depth of 5mm to be achieved at any location, and

e) with no initial watering on the day of installation to allow the binder to set.

A minimum two pass process is required to ensure seed is in contact with the topsoil and is covered by mulch, reducing its exposure to the elements and predation by insects and birds.

8.5.1.5 Hydro-compost

Hydro-compost shall be in accordance with Table 8.5.1.5.

Table 8.5.1.5 – Hydro-compost

Slope	Standard Drawing	Detail	Subsoil Operation		Topsoil Depth	Initial Watering	Minimum Finished Fibre Depth
≤ 1 on 4	1651	3*	Ripping* Cultivation	300 mm 150 mm	75 mm**	NA	10 mm
> 1 on 4	1651	4	Roughening	50 mm			

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Regular sample areas shall be installed in accordance with Clause 8.5.1. **Hold Point 9**

Where a site topsoil is tested in accordance with *Form C of Appendix MRTS16* and has less than 3% organic matter, Hydro-compost may be used to address organic matter requirements of the topsoil in lieu of ameliorating the stockpiled topsoil with organic soil conditioner.

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Hydro-compost shall be installed within two days from the completion of the topsoil operation.

All seeds, wetting agents, binders, fibre and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10** Note, some proprietary products are packaged with pre-blended compost, fibre, binder and wetting agents, which is suitable.

Hydro-compost shall be installed:

a) by moistening the topsoil layer with a solution of water and wetting agent

b) by hydraulically applying the hydro-compost slurry in an indirect, dispersed spray pattern, from opposing directions during each pass, to achieve a complete coverage and a uniform finish. Best results are obtained when applied at a range of angles from the toe of the slope and the top of the slope. In scenarios where this in not practicable because access is restricted, apply in a forward and then backward manner as the area is traversed

c) by applying the hydro-compost slurry in a minimum two pass process as follows:

   i. the first pass shall consist of a slurry of water, compost / fibre, binder, seed and fertiliser. The first pass shall become tacky (not dry) before subsequent passes are applied, and

   ii. the subsequent passes shall consist of a slurry of water, balance of the compost / fibre required, seed, binder, and fertiliser.

d) with no soil visible after installation and a minimum finished fibre depth of 10mm to be achieved at any location, and

e) with no initial watering on the day of installation to allow the binder to set.

8.5.1.6 Straw mulching

Straw mulching shall be in accordance with Table 8.5.1.6.

Table 8.5.1.6 – Straw mulching

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering	Fibre	Bitumen Emulsion	Minimum Finished Fibre Depth
≤ 1 on 4	1651	1*	Ripping* 300 mm Cultivation 150 mm	75 mm	10 L/m²	5000 kg/ha	20000 L / ha	25 mm
> 1 on 4	1651	2	Roughening 50 mm					

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Regular sample areas shall be installed in accordance with Clause 8.5.1. **Hold Point 9**

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Seeding shall be installed within two days from the completion of the topsoil operations. All seeds, wetting agents, binders, fibre and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10**

Straw mulch seeding shall be installed:

a) by installing seed as per drill seeding Clause 8.5.1.1, or broadcast seeding Clause 8.5.1.2, including the initial watering

b) by covering the finished drill / broadcast seeding with a mixture of straw and bituminous emulsion. Straw shall be spread with a purpose made blower. The emulsion may be incorporated into the airstream of the blower, or sprayed over the straw as a separate operation immediately after the application of straw

c) with no soil visible after installation and a minimum finished fibre depth of 25 mm to be achieved at any location, and

d) with no initial watering after the application of the straw mulch to allow the bituminous emulsion to set.

8.5.1.7 Organics blanket

Organic blanket shall be in accordance with Table 8.5.1.7.

Table 8.5.1.7 – Organics blanket

Slope	Standard Drawing	Detail	Subsoil Operation	Initial Watering	Organics Blanket Depth
≤ 1 on 4	1651	5*	Ripping* 300 mm Cultivation 150 mm	5 L/m²	40 mm
> 1 on 4	1651	6	Roughening 50 mm		

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Regular sample areas shall be installed in accordance with Clause 8.5.1. **Hold Point 9**

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Organics blanket shall be installed within two days from the completion of the subsoil operations. All seeds, wetting agents, binders and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10**

Organics blanket shall be installed:

a) by spreading the organic blanket with a pneumatic blower, with binder and seed mixed into the blanket as it is being installed

b) with no soil visible after installation and a minimum finished fibre depth of 40 mm to be achieved at any location, and

c) by watering, on the day of installation, with a solution of water and wetting agent, until the topsoil layer is moist. Watering shall be applied in multiple applications to ensure surface erosion does not occur.

8.5.1.8 Mesh lined drain

Mesh lined drain shall be in accordance with Table 8.5.1.8.

Table 8.5.1.8 – Mesh lined drain

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering	Bitumen Emulsion
All	1647	3	Roughening 50 mm	75 mm	10 L/m²	20000 L/ha

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Regular sample areas shall be installed in accordance with Clause 8.5.1. **Hold Point 9**

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Seeding shall be installed within two days from the completion of the topsoil operations. All seeds, wetting agents, binders, fibre and fertilisers shall be brought on site in separately labelled containers and mixed on-site to allow verification of materials and quantities. **Hold Point 10**

Mesh lined drains shall be installed:

a) by installing seeding as per Clause 8.5.1.1 – Clause 8.5.1.7

b) by covering the finished seeding treatment with jute or coir mesh. Mesh shall be pulled taut and secured with pins in accordance with the manufacturers requirements, with the following exclusion – mesh to be secured with pinning only; securing ends of mesh using trenches is not permitted

c) by spraying mesh with a bituminous emulsion, and

d) with no watering after the application of the mesh to allow the bituminous emulsion to set.

8.5.2 Turfing

Turfing shall be in accordance with Table 8.5.2.

Table 8.5.2 – Turfing

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Initial Watering
≤ 1 on 4	1650	1*	Ripping* 300 mm Cultivation 150 mm	75 mm	25 L /m²
> 1 on 4	1650	2	Roughening 50 mm		

*Ripping only required where soils are compacted. For example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

Amelioration agents, where specified in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the specified rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents.
Witness Point 3, 4 or 5

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth. **Witness Point 6**

Turf shall be installed within two days from the completion of the topsoil operations.

Turf shall be delivered within one day of cutting, and installed within two days of cutting.

Turf shall be installed:

a) by spreading fertiliser over the topsoil and raking the surface smooth

b) to the prepared surface that has been moistened with a solution of water and wetting agent

c) on the day turf is delivered to site

d) by laying rolls parallel to the contour, in a staggered brick pattern, and

e) by watering, within 2 hours of installation, with a solution of water and wetting agent until the topsoil layer is moist. Watering shall be applied in multiple applications to ensure surface erosion does not occur.

Turf in high profile areas shall be top-dressed to ensure there are no gaps between rolls and to correct any uneven areas. Top-dressing shall be washed and graded sand specifically produced for the horticultural industry.

8.5.3 Planting

8.5.3.1 Planting Containers < 25 L

Planting of containers < 25 L shall be in accordance with Table 8.5.3.1

Table 8.5.3.1 –Planting < 25 L Containers

Slope	Standard Drawing	Detail	Subsoil Operation	Topsoil Depth	Mulch Depth	Alternate Surface Treatment	Initial Watering
Planting Contained Areas							
≤ 1 on 4	1653	1*	Ripping* 300 mm Cultivation 150 mm	300 mm	100 mm	-	10 L / m²
Planting Contained Areas – Median and Separators**							
≤ 1 on 4	1643	1	Ripping 300 mm Cultivation 150 mm	300 mm	100 mm	-	10 L / m²
Planting Broadacre Areas							
≤ 1 on 4	1653	2*	Ripping* 300 mm Cultivation 150 mm	150 mm	100 mm	-	10 L / m²
Planting Slopes > 1 on 4							
> 1 on 4	1653	3	Roughening 50 mm	75 mm	100 mm	-	10 L / m²
> 1 on 4	1653	4		Per hole			
Planting in Seeding Areas							
≤ 1 on 4	1653	5*	Ripping* 300 mm Cultivation 150 mm	75 mm	-	Seeding	10 L / m²
> 1 on 4	1653	6	Roughening 50 mm				
Planting in Matting							
Drains	1647	1	Roughening 50 mm	75 mm	-	Matting	10 L / m²
> 1 on 4	1647	2	Roughening 50 mm	75 mm	100 mm	Mesh	10 L / m²

*Ripping only required where soils are compacted, for example, decommissioned site compounds, building pads, parking areas, stockpile areas, roads and haul routes.

**In medians, separators or contained areas within pavements, subsoil drainage shall be installed in accordance with Standard Drawing 1643.

Amelioration agents, where required in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface at the required rates prior to subsoil operations. **Hold Point 8**

Subsoil operations shall occur immediately after the application of amelioration agents. **Witness Point 3, 4 or 5**

Topsoil shall be installed within three days from the completion of the subsoil operations. Topsoil shall be spread to the required depth over the prepared surface. Topsoil shall be moistened with a solution of water and wetting agent. **Witness Point 6**

Mulch shall be installed within one day from the completion of the topsoil operations. Mulch shall be spread to the required depth over the prepared surface.

Plants shall be installed within five days from the completion of the mulch operations.

Plants shall be installed within two days of delivery to site. The Contractor shall give two days notice prior to delivery of plants to allow inspection of the plants. **Witness Point 7**

Prior to installing plants, plants shall be set out in accordance with Clause 8.5.3.3. **Hold Point 11**

Plants shall be:

a) thoroughly watered 1-2 hours prior to planting

b) installed with controlled / slow release fertiliser, placed in each planting hole

c) installed with water holding agents, where specified

d) staked, where required, and

e) watered, on the day of installation, with a solution of water and wetting agent until the topsoil layer is moist. Watering shall be applied in multiple applications to ensure surface erosion does not occur.

Topsoil per planting hole – should only be used in small areas given the high labour costs associated with incorporating topsoil to individual planting holes.

Jute or coir mesh may be used to secure mulch on steep batters.

8.5.3.2 Planting Containers ≥ 25 L

Plants ≥ 25 L shall be installed in accordance with Table 8.5.3.2

Table 8.5.3.2 – Planting ≥ 25 L Containers

Slope	Standard Drawing	Detail	Subsoil Operation	Backfill Soil Per Hole	Topsoil Depth	Mulch Depth	Initial Watering
Planting Mulch Areas**							
≤ 1 on 4	1654	1	Ripping base of hole 200 mm and Roughening side of hole	Varies with container size - Remaining depth of hole	300 mm	150 mm	20 L per plant
Planting Grass Areas**							
≤ 1 on 4	1654	2	Ripping base of hole 200 mm and Roughening side of hole	Varies with container size - Remaining depth of hole	300 mm	150 mm	20 L / per plant

Slope	Standard Drawing	Detail	Subsoil Operation	Backfill Soil Per Hole	Topsoil Depth	Mulch Depth	Initial Watering
Planting Slopes > 1 on 4 – Free Draining Soils							
> 1 on 4	1654	3	Ripping base of hole 200 mm and Roughening side of hole	Varies with container size - Remaining depth of hole	300 mm	150 mm	20 L / per plant
Planting Slopes > 1 on 4 – Poor Draining Soils							
> 1 on 4	1654	4	Ripping base of hole 200 mm and Roughening side of hole	Varies with container size - Remaining depth of hole	300 mm	150 mm	20 L / per plant
Planting in Contained Areas							
-	1643	2	Ripping base of hole 200 mm and Roughening side of hole	Varies with container size - Remaining depth of hole	300 mm	100 mm	20 L / per plant

**In medians, separators or contained areas within pavements, subsoil drainage shall be installed in accordance with Standard Drawing 1643.

Prior to installing plants, plants shall be set out in accordance with Clause 8.5.3.3. **Hold Point 11**

The planting hole shall be excavated and the base of the hole ripped and the sides of the hole roughened in accordance with Table 8.5.3.2. **Witness Point 3 or 5**

Amelioration agents, where required in the *Soil Management Plan – Construction*, shall be spread over the subsoil surface and sides of holes at the required rates prior to subsoil operations. **Hold Point 8**

Plants shall be installed within two days of delivery to site. The Contractor shall give two days notice prior to delivery of plants to allow inspection of the plants. **Witness Point 7**

The plant, backfill material, topsoil shall be installed within one day from the completion of the planting hole. **Witness Point 6**

Planting shall be:

a) thoroughly watered 1-2 hours prior to planting

b) installed with controlled / slow release fertiliser, placed in each planting hole

c) installed with water holding agents, where specified

d) staked or guyed

e) installed with mulch, and

f) watered, on the day of installation, with a solution of water and wetting agent until the topsoil layer is moist. Watering shall be applied in multiple applications to ensure surface erosion does not occur.

8.5.3.3 Setting-out of plants

Prior to setting-out plants the Contractor shall determine locations and extent of the following elements:

a) services

b) services easements

c) road furniture

d) lighting

e) road signs

f) structures

g) clear zones, and

h) sight visibility zones.

The Contractor shall:

a) set out plants in the locations as shown on the drawings

b) adjust locations, as required, in accordance with vegetation setback and clearance table and notes:

c) as shown on the Drawings, or

d) in accordance with the *Road Landscape Manual – Appendix 4*, where not shown on the Drawings.

e) allow the inspection of plant set out in accordance with Clause 8 of MRTS01 *Introduction to Technical Specifications*. **Hold Point 11**

8.6 Hardscape works

Hardscape work operations include:

a) planting bed edging, and

b) irrigation.

8.6.1 Concrete planting bed edging

Concrete planting bed edging shall:

a) be 150 x 150 mm

b) have expansion joints installed at regular intervals not exceeding 20 m

c) have contraction joints between expansion joints at regular intervals not exceeding 5 m and / or at changes of curvature, and

d) be installed on subgrade compacted in accordance with the requirements of Clause 15 of MRTS04 *General Earthworks*.

8.6.2 Irrigation system

Permanent irrigation systems shall:

a) only be provided where specified in the Contract

b) provide a functioning sprinkler and / or drip irrigation system that delivers a quantity of water sufficient to maintain plant health and growth that is suitable to the Region, and

c) meet the requirements of the applicable Local Government.

8.6.2.1 Irrigation System Design

Prior to installation, the proposed design shall be submitted for a determination as to its suitability. **Hold Point 12**

Design of the irrigation system shall:

a) be in accordance with Clause 8.6.2

b) be carried out by a suitably qualified, certified landscape and turf irrigation designer

c) have 240V electrical components designed by an electrical engineer, and

d) be certified by the consultant organisation which carried out the design.

Documents produced shall include:

a) schematic drawings of the irrigation system showing:

   i. the number and sequence of watering stations

   ii. the locations of:

      - water filters
      - water isolation valves
      - irrigation controller, and
      - electrical isolation equipment

b) detailed drawings of the irrigation system showing:

   i. all pipe installations

   ii. conduits

   iii. sprinkler or dripper emitters

   iv. manual or automatic valve details

   v. backflow prevention devices

   vi. water filters

   vii. rain gauge / weather station / rain sensor

   viii. controllers

   ix. protection boxes and cabinets

   x. electrical connections, and

   xi. water supply connections.

c) a schedule showing the rates of application of all water outlet devices

d) installation specifications

e) a commissioning schedule and checklist

f) a statement of the design warranty, and

g) a comprehensive operating manual, including a parts list which sets out the description and suppliers of all components.

8.6.2.2 Supply, installation and commissioning

The irrigation system shall be installed:

a) in accordance with the approved design

b) in accordance with relevant Australian Standard listed in, but not limited to, Table 3.1, and

c) by a suitably qualified, certified irrigation contractor.

All electrical installations shall be installed by a registered electrical contractor as defined under the *Electricity Act 1994*.

The Contractor shall commission and test the irrigation system, at current local government supply pressure or design operating pressure respectively for a minimum period of 30 minutes, prior to covering. **Hold Point 13**

The Contractor shall provide training to the Principal's nominated representatives in the set up and operation of the irrigation system.

8.6.2.3 Warranties, Manuals and As Constructed Drawings

The Contractor shall provide:

a) construction and installation warranties

b) three hard copies of a comprehensive operating manual, including a parts list which sets out the description and suppliers of all components

c) three hard copies (A3 format) of the As-Constructed Drawings and specifications, and

d) three copies of an editable, electronic format copy of the As-Constructed Drawings and specification.

8.7 Construction supplementary requirements

Construction supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Clause 3.6 of the MRTS16.1 Annexure.

9 Establishment and monitoring

Vegetation works maintenance consists of two distinct periods:

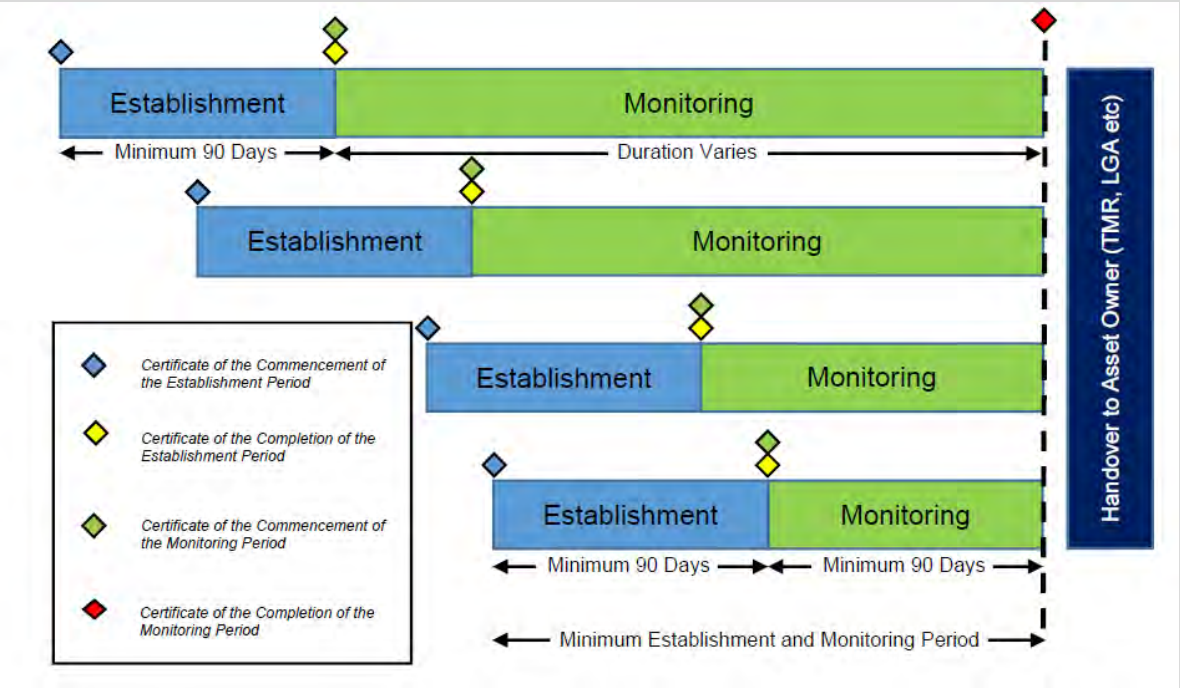
a) the Establishment Period, and

b) the Monitoring Period.

Contracts with native seeding and / or container stock treatments shall undertake an Establishment Period and Monitoring Period.

Contracts consisting of only grass seeding and / or turfing treatments may omit the Monitoring Period. Omission of the Monitoring Period shall be specified as per Clause 9.2.

Vegetation works maintenance is required for a lot or series of lots within a Contract. All vegetation work Monitoring Periods are required to be completed and to satisfy the completion criteria before the specified end date of the Defects Liability Period.



Where a lot's Monitoring Period finishes outside the Defects Liability Period, the creation of a Separable Portion may be required to be negotiated with the Contractor.

9.1 Establishment Period

The Establishment Period shall commence when the installation of treatments is deemed compliant and a *Certificate of Commencement of the Establishment Period* has been issued by the Administrator. **Milestone**

Where the Contractor has installed works in a series of lots, the Administrator shall issue a *Certificate of Commencement of the Establishment Period* for each lot. The Establishment Period shall:

a) be evaluated at four weeks (interim evaluation), in accordance with Clause 9.1.1.6 to determine if it is on track for meeting the completion criteria

b) be a minimum duration of ninety days from the date of *Certificate of Commencement of the Establishment Works*, and

c) where completion criteria has not been achieved, continue beyond the minimum ninety day until vegetation treatments meet the completion criteria of Clause 9.1.2.

9.1.1 Establishment Period operations

The Contractor shall care for the installed vegetation treatments to ensure their long term sustainability and to meet the completion criteria of Clause 9.1.2.

Establishment Period operations include:

a) watering

b) fertilising

c) weed control

d) pest and disease control

e) protection of vegetation works

f) interim evaluation

g) repair or re-installation of treatments

h) mowing, slashing and brush cutting

i) pruning

j) selective removal of non-complying plants

k) topping up of mulch, and

l) monthly program and inspection reporting.

9.1.1.1 Watering

During the Establishment Period watering shall:

a) be 'misted' or conducted in a manner that does not cause damage, run-off or subsequent erosion or displacement of treated areas

b) not spray onto, flow across or pond on paved areas including roadways, bikeways and footpaths, and

c) be in accordance with the minimum watering schedule and watering rates of Table 9.1.1.1(a) and Table 9.1.1.1(b), unless otherwise specified in Clause 4.1 of the Annexure MRTS16.1.

Watering must be applied in sufficient quantities and regularity to ensure:

a) soil moisture is maintained

b) germination of seedling occurs

c) emergence and establishment of seedlings, and

d) maintain and encourage deep rooting, and

e) the completion criteria of Clause 9.1.2 is achieved.

Table 9.1.1.1(a) – Minimum watering schedule – Establishment Period

Vegetation Treatment	% of watering rate in Table 9.1.1.1(b)	Frequency of watering days		
		Week 1, 2 and 3	Week 4 and 5	Remainder of Establishment Period
Seeding				
Drill Seeding*	100%	Daily	Every second day	As required to meet the completion criteria.
Broadcast Seeding*	100%	Daily	Every second day	
Hydromulch – Standard*	75%	Daily	Every second day	
Hydromulch – BFM*	75%	Daily	Every second day	
Hydro – compost*	75%	Daily	Every second day	
Straw mulching*	50%	Daily	Every second day	
Organic Blanket*	50%	Daily	Every second day	
Seed mesh lined drain*	75%	Daily	Every second day	
Turfing				
Turf	75%	Daily	Every second day	As required to meet the completion criteria.
Planting				
Mass Plantings – of container stock	100%	Every second day		As required to meet the completion criteria.
25 L – 45 L	200%	Every second day		
100 L – 200 L	300%	Every second day		
≥ 400 L	400%	Every second day		
The minimum relevant watering L/m² rate, as per Table 9.1.1.1(b) shall be applied. *Prior to the development of cover crop in seeding areas, apply the required minimum L/m² rate in two separate passes to minimise the risk of erosion. It is recommended, where practicable, watering occur in the morning or evening to increase infiltration and minimise evaporation.				

Table 9.1.1.1(b) – Watering rate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AVG Oct - Mar	AVG Apr - Sep
SEQ Districts	11	11	11	9	8	8	8	9	10	11	13	13	**12**	**10**
Mackay Whitsunday, Fitzroy and Wide Bay Districts	13	12	11	10	9	9	9	10	11	13	15	13	**13**	**10**
Far North and Northern Districts	13	12	12	11	10	10	10	11	12	15	16	14	**14**	**11**
Central Queensland and South West Districts	14	14	11	11	9	9	9	9	11	13	15	14	**14**	**10**
North West Districts	16	16	15	13	11	11	11	13	15	16	18	16	**16**	**12**

The rates in Table 9.1.1.1(b) are based on average daily pan evaporation rates + 5L to ensure water moisture is maintained consistent in the soil. The additional daily 5L/m² accounts for inefficiencies in the watering process.

Prior to the development of cover crop in seeding areas, apply the required minimum L/m² rate in two separate passes to minimise the risk of erosion.

Watering rates or frequency should be increased during periods of wind, drought and / or where soils have low moisture retaining characteristics.

Regular checks of soil moisture shall be undertaken to determine if watering rates require adjustment due to site, soil or seasonal conditions.

Table 9.1.1.1(b) is based on historic data from the Bureau of Meteorology and shall be used to adjust application rates and quantity allowances.

Prioritise early morning or night watering to lessen evaporation.

Temporary irrigation systems can be highly effective and efficient in delivering watering requirements, compared to watering with water trucks with cannons.

Below is a worked example for calculating water quantity requirements for a hydromulch seeding (75%) operation in summer in SEQ (avg 12L/m²), based on an area of 1 hectare.

Week 1 – 3 12 L x 75% x 21 days x 10,000 m² = 1,890,000 L = 1890 kilolitres / ha

Week 4 – 5 12 L x 75% x 7 days x 10,000 m² = 630,000 L = 630 kilolitres / ha

Week 6 – 12 As required to meet completion criteria – varies with treatment and conditions

The above worked example is based on no rain events occurring within the 90 day Establishment Period. Depending on the location and season, natural rainfall events may reduce the required watering frequency. Where soil moisture is naturally maintained, watering frequency may be reduced.

Temporary irrigation system

Where the Contractor proposes to use a temporary irrigation system for Establishment Period watering purposes, the temporary irrigation system shall:

a) be designed and installed as such to deliver the quantities of water and frequency of watering in accordance with Clause 9.1.1.1

b) be conducted in a manner that does not cause damage or subsequent erosion or displacement of treated areas

c) not spray onto, flow across or pond on paved areas including roadways, bikeways and footpaths or active construction areas, and

d) be removed at the end of the maintenance period.

Depending on the scale of the project, temporary irrigation can significantly reduce the costs associated with watering, particularly where traffic control is required to apply water. Temporary irrigation is also highly effective at delivering required water levels and can be readily adjusted to cater for drier and wetter conditions.

Temporary irrigation should be set up outside of exclusion zones such that it can be accessed during daylight hours for repairs.

9.1.1.2 Establishment Period Fertilising

Seeding, turfing and planting treatments shall be fertilised at 6 weeks in accordance with Table 9.1.1.2, then as required, to ensure plant health and to achieve the completion criteria.

Table 9.1.1.2 – Establishment Period Fertilising Rates

	N	P	K	S	Trace Elements
Seeding	10 - 30 kg/ha	1 - 10 kg/ha	10 - 40 kg/ha	5 -15 kg/ha	As required
Turf	10 - 20 kg/ha	1 - 10 kg/ha	10 - 40 kg/ha	5 -15 kg/ha	As required
Planting	As required				

9.1.1.3 Weed control

Vegetation treatments shall be maintained in a weed free condition.

Handling and application of herbicides shall be in accordance with Clause 8.3.

Where vegetation treatments are poisoned due to overspray, the Contractor shall replace the vegetation treatment with the originally specified treatment.

Restricted, prohibited and invasive species shall be managed in accordance with MRTS51 and associated *Biosecurity Act 2014*.

9.1.1.4 Pest and disease control

Vegetation treatments shall be maintained in a pest and disease free condition.

Handling and application of pesticides shall be in accordance with Clause 8.3.

Restricted, prohibited and invasive species shall be managed in accordance with MRTS51 and associated *Biosecurity Act 2014*.

9.1.1.5 Protection of vegetation works

During the Establishment Period the Contractor shall install appropriate temporary measures, relative to the context and season, to protect installed works from surface water flows caused by watering and typical seasonal rainfall events. These measures must cater for the catchment area and not cause ponding on the pavement nor contribute to hydroplaning. These measures must be removed at the completion of the end of the Establishment Period.

9.1.1.6 Interim evaluation

After four weeks from installation, treatments shall be evaluated against the following criteria to determine if it is on track to meet the completion criteria. **Hold Point 14**

Repair or reinstate the area within seven days of issues being identified.

Seeding treatments

Seeding treatments shall have an even strike of cover crop.

Turfing treatments

Turfing treatments shall have a healthy grass cover and show signs of growth.

Container and ex-ground stock treatments

Throughout the Establishment Period container stock that dies shall be replaced, within seven days of being identified, with the same species and container size as originally specified.

9.1.1.7 Repair or re-installation of treatments

The Contractor shall repair / re-install failed or damaged treatments.

Where subsoil or topsoil is eroded, the Contractor shall repair and re-ameliorate the subsoil, re-apply topsoil to the affected area and reinstall the vegetation treatment.

Prior to re-installation, the Contractor shall investigate the failed treatment to determine the cause of poor performance or failure.

> The most common cause of vegetation failure, presuming the subsoil and topsoil have been adequately ameliorated, is through a lack of water and / or a lack of nutrients.
>
> If treatments are performing poorly, increased / modified watering rates and additional fertilising should be considered before complete re-installation of treatments.
>
> Where watering rates are adjusted and re-fertilising does not rectify the situation, the Quality Systems should be checked by the Administrator, prior to re-installing works.

9.1.1.8 Mowing, slashing and brush cutting

Slashing and brush cutting shall:

a) be in accordance with Table 9.1.1.8

b) be evenly windrowed or dispersed over the area, and

c) shall not disperse clippings into mulched planting beds.

Table 9.1.1.8 – Mowing, slashing and brush cutting schedule – Establishment Period

Vegetation Treatment (as shown in the Drawings)	Mow	Intervention Level	Average Finished Height
High Profile Areas			
Turfed Areas	1st and consecutive	50 mm	30 mm
Grass Seeded Areas (Couch or other turf species)	1st	200 mm	50 mm
	2nd	75 mm	40 mm
	3rd and consecutive	50 mm	30 mm
All Other Areas			
Turfed and Grass Seeded Areas	1st	200 mm	100 mm
	2nd and consecutive	300 mm	100 mm
Woodland / forest seeded areas	NA		

9.1.1.9 Pruning

Pruning shall:

a) be used to remove damaged, diseased or pest infested parts of plants

b) be used to formatively prune trees to clean lower sections of trunks, to allow the tree to develop appropriate form relative to pedestrian and sight visibility requirements, and

c) be in accordance with AS 4373 *Pruning of Amenity Trees*.

Care shall be taken to avoid placement of prunings in a manner that may be hazardous to public safety. Placement of prunings in clear zones, sight visibility zones and pedestrian areas is prohibited.

Pest or disease infested prunings shall be disposed off site in accordance with Clause 11 of MRTS04 *General Earthworks*.

9.1.1.10 Selective removal of non-complying vegetation

Potentially non-complying tree and shrub vegetation shall be removed in areas including:

a) sight visibility zones

b) clear zones

c) CCTV sight visibility zones

d) vegetation setbacks

e) below overhead services or structures

f) above underground services, and

g) service easements.

9.1.1.11 Topping up of mulch

Thirty days before the completion of the Establishment Period, mulched treatments shall be topped up with mulch to achieve the originally specified depths.

9.1.1.12 Monthly program and inspection report

A report shall be submitted to the Administrator every month, within seven days of the inspection.

The report shall include:

a) monthly program of maintenance works

b) dates of maintenance visits and inspections

c) maintenance works undertaken

d) maintenance works in progress

e) watering application dates and volumes

f) failed or failing vegetation treatments, their general locations on marked up plans, and suspected cause of failure

g) repair or re-installation of failed treatments

h) weeds identified and method of treatment

i) issues identified during inspections and actions required to remedy these, and

j) damage to vegetation caused by vandalism or theft of vegetation.

All vandalism and theft claims shall be supported by photographic evidence and / or police report.

9.1.2 Establishment Period completion criteria

The Establishment Period shall be completed when the lot has met the following completion criteria:

a) the area is weed free in accordance with Clause 9.1.1.3

b) seeding treatments meet the completion criteria of Clause 9.1.2.1

c) turfing treatments meet the completion criteria of Clause 9.1.2.2,

d) planting treatments meet the completion criteria of Clause 9.1.2.3, and

e) the lot has been established for a minimum 90 day duration.

At the completion of the Establishment Period a *Certificate of Completion of the Establishment Period* shall be issued by the Administrator. **Milestone**

9.1.2.1 Seeding treatments

Seeding treatments:

a) have a uniform cover of perennial and cover crop grasses over a minimum 90% of the area

b) have a minimum perennial cover of 30%

c) show no signs of nutrient deficiency

d) show no signs of water deficiency

e) have no rills or sheet erosion

f) have no bare areas > 1 m², and

g) grass seeded areas shall be mowed / slashed at a height in accordance with Clause 9.1.1.8.

9.1.2.2 Turfing treatments

Turfing treatments:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) shall be top dressed and contain no uneven jointing in pedestrian areas

d) have a healthy root system that has penetrated into the ground so that the turf cannot be easily lifted, and

e) are mowed / slashed at a height in accordance with Clause 9.1.1.8.

9.1.2.3 Planting treatments

Planting treatments:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) show no signs of pests or disease

d) are established and well formed, showing evidence of growth

e) have a healthy root system that has penetrated into the ground so that the plant cannot be easily lifted out of the ground

f) tree trunks shall be vertical

g) tree rootball cannot be tilted

h) where required ties shall be repaired, and

i) have a mulch depth in accordance with Clause 9.1.1.11.

9.2 Monitoring Period

The Monitoring Period shall commence with the issuing of the *Certificate of Commencement of the Monitoring Period* by the Administrator, following the completion of the Establishment Period.
Milestone

Where the Contractor has installed works in a series of lots, the Administer shall issue a *Certificate of Commencement of the Monitoring Period* for each lot.

All Monitoring Period lots must be handed over to the Authority in a single package at the completion of the Monitoring Period.

The Monitoring Period for each Lot shall:

a) be a minimum duration of 90 days, unless otherwise specified in Clause 4.2 of the Annexure MRTS16.1, from the date of *Certificate of the Commencement of the Monitoring Period*, and

b) continue until all vegetation treatments / Lots meet the completion criteria of Clause 9.2.2.

Where a lot's Monitoring Period finishes outside the Defects Liability Period, the creation of a Separable Portion may be required to be negotiated with the Contractor.

Where native seed mixes are installed in Autumn and Winter consideration should be given to increasing the minimum Monitoring Period until the end of Summer to ensure seeding has been successful. It is suggested to increase the Monitoring Period to the end of the wet season in this instance.

Where container stock has been installed, consideration should be given to increasing the Monitoring Period to ensure plants are mature enough to out-compete weeds beyond handover. It is suggested to increase the Monitoring Period to 180 days or greater.

For projects with Defects Liability Periods greater than 180 days it is suggested the Monitoring Period finish in line with the Defects Liability Period.

9.2.1 Monitoring Period operations

The Contractor shall care for the installed vegetation treatments to ensure their long term sustainability and to meet the completion criteria of Clause 9.2.2.

Monitoring Period operations include:

a) watering

b) fertilising

c) weed control

d) pest and disease control

e) repair or re-installation of failed treatments

f) mowing, slashing and brush cutting

g) pruning

h) selective removal of non-complying plants

i) topping up of mulch, and

j) monthly program and inspection reporting.

9.2.1.1 Watering

During the Monitoring Period watering shall:

a) be undertaken as required to achieve the completion criteria

b) be conducted in a manner that does not cause damage, run-off or subsequent erosion or displacement of treated areas, and

c) not spray onto, flow across or pond on paved areas including roadways, bikeways and footpaths or active construction areas.

Specific watering requirements may be nominated in Clause 4.1 of the Annexure MRTS16.1.

Watering should be undertaken to ensure soil moisture is maintained to promote plant health and to achieve the completion criteria. During periods of wind, drought and / or where soils have low moisture retaining characteristics, watering may be required. During periods of high rainfall, watering is not required.

Consideration should be given to potential costs, particularly on large projects, where multiple lots are installed and are monitored for durations longer than the minimum monitoring period nominated in the Contract.

9.2.1.2 Fertilising

Seeding, turfing and planting treatments shall be fertilised, as required, to ensure plant health and to achieve the completion criteria.

One month before the completion of the Monitoring Period, all container stock treatments shall be fertilised with an all-purpose controlled / slow release fertiliser, in accordance with manufacturers' specifications.

9.2.1.3 Weed control

Vegetation treatments shall be maintained in a weed free condition.

Handling and application of herbicides shall be in accordance with Clause 8.3.

Where vegetation treatments are poisoned due to overspray, the Contractor shall replace the vegetation treatment with the originally specified treatment.

Restricted, prohibited and invasive species shall be managed in accordance with MRTS51 and associated *Biosecurity Act 2014*.

9.2.1.4 Pest and disease control

Vegetation treatments shall be maintained in a pest and disease free condition.

Handling and application of pesticides shall be in accordance with Clause 8.3.

Restricted, prohibited and invasive species shall be managed in accordance with MRTS51 and associated *Biosecurity Act 2014*.

9.2.1.5 Protection of vegetation works

During the Monitoring Period the Contractor shall install appropriate temporary measures, relative to the context and season, to protect installed works from surface water flows caused by typical seasonal rainfall events.

These measures must cater for the catchment area and not cause ponding on the pavement nor contribute to hydroplaning.

These measures must be removed thirty days prior to the completion of the end of the Monitoring Period.

9.2.1.6 Not Used

9.2.1.7 Repair or re-installation of treatments

The Contractor shall repair / re-install failed or damaged treatments.

Where subsoil or topsoil is eroded, the Contractor shall repair and re-ameliorate the subsoil, re-apply topsoil to the affected area and reinstall the vegetation treatment.

Prior to re-installation, the Contractor shall investigate the failed treatment to determine the cause of poor performance or failure.

Throughout the Monitoring Period container stock that dies shall be replaced, within seven days of being identified, with the same species and container size as originally specified.

> The most common cause of vegetation treatment failure, presuming the subsoil and topsoil have been adequately ameliorated, is through a lack of water and / or a lack of nutrients.
>
> If treatments are performing poorly, increased /modified watering rates and additional fertilising should be considered before complete re-installation of treatments.

9.2.1.8 Mowing, slashing and brush cutting

Mowing, slashing and brush cutting shall:

a) be in accordance with Table 9.2.1.8

b) be evenly windrowed or dispersed over the area, and

c) shall not disperse clippings into mulched planting beds.

Do not mow or slash in native woodland / forest seeded areas.

Table 9.2.1.8 – Mowing, slashing and brush cutting schedule – Monitoring Period

Location	Intervention Level	Average Finished Height
Turf / High Profile Areas / Pedestrian Areas	50 mm	30 mm
Roadside grass verge areas, grass drains, and grass sight visibility areas	300 mm	100 mm

9.2.1.9 Pruning

Pruning shall:

a) be used to remove damaged, diseased or pest infested parts of plants

b) be used to formatively prune trees to clean lower sections of trunks, to allow the tree to develop appropriate form relative to pedestrian and sight visibility requirements, and

c) be in accordance with AS 4373 *Pruning of Amenity Trees*.

Care shall be taken to avoid placement of prunings in a manner that may be hazardous to public safety. Placement of prunings in clear zones, sight visibility zones and pedestrian areas is prohibited.

Pest or disease infested prunings shall be disposed off site in accordance with Clause 11 of MRTS04 *General Earthworks*.

9.2.1.10 Selective removal of non-complying vegetation

Potentially non-complying tree and shrub vegetation shall be removed in areas including:

a) sight visibility zones

b) clear zones

c) CCTV sight visibility zones

d) vegetation setbacks

e) below overhead services or structures

f) above underground services, and

g) service easements.

9.2.1.11 Topping up of mulch

Thirty days before the completion of the Monitoring Period, mulched treatments shall be topped up with mulch to achieve the originally specified depths.

9.2.1.12 Monthly program and inspection report

A report shall be submitted to the Administrator every month, within seven days of the inspection.

The report shall include:

a) monthly program of maintenance works

b) dates of maintenance visits and inspections

c) maintenance works undertaken

d) maintenance works in progress

e) watering application dates and volumes

f) failed or failing vegetation treatments, their general locations on marked up on plans, and suspected cause of failure

g) repair or re-installation of failed treatments

h) weeds identified and method of treatment

i) issues identified during inspections and actions required to remedy these, and

j) damage to vegetation caused by vandalism or theft of vegetation.

All vandalism and theft claims shall be supported by photographic evidence and / or police report.

9.2.2 Monitoring Period completion criteria

The Monitoring Period shall be completed when the lot has met the following completion criteria:

a) the area is weed free in accordance with Clause 9.2.1.3

b) seeding treatments meet the criteria of Clause 9.2.2.1

c) turfing treatments meet the criteria of Clause 9.2.2.2

d) planting treatments meet the criteria of Clause 9.2.2.3, and

e) the lot has been monitored for a minimum 90 day duration, or as otherwise specified in Clause 4.1 of the Annexure MRTS16.1 or the Contract.

Upon successful completion of the Monitoring Period the *Certificate of Completion of the Monitoring Period* shall be issued by the Administrator. **Milestone**

9.2.2.1 Seeding treatments

Seeding treatments shall:

a) have evidence of healthy growth

b) show no signs of nutrient deficiency

c) contain no bare areas > 1 m², and

d) contain no rills or sheet erosion.

Grassing treatments shall:

a) have 90% perennial grass coverage, and

b) roadside grass verge areas, grass drains, and grass sight visibility areas are mowed / slashed at a height in accordance with Table 9.2.1.8.

Woodland / forest treatments:

a) have 90% perennial grass coverage, and

b) contain native seed strike throughout the treatment area, or

c) where the Monitoring Period has been extended to 365 days or greater, have tree or shrub strike of nominally one plant per 16 m² (nominally 4 m centres).

Where high concentrations of shrubs and trees seedlings stricke and shade out grass species, lower percentage of perennial grass coverage is suitable. The intent of the coverage is to provide slope / surface stability.

9.2.2.2 Turfing treatments

Turfing treatments shall:

a) show no signs of nutrient deficiency

b) contain no uneven surfaces or jointing in pedestrian areas

c) have a healthy root system that has penetrated into the ground so that the turf cannot be easily lifted, and

d) are mowed / slashed at a height in accordance with Table 9.2.1.8.

9.2.2.3 Planting treatments

Planting treatments shall:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) show no signs of pests or disease

d) are established and well formed, showing evidence of growth typical of the species

e) tree rootball cannot be tilted

f) be formatively pruned in pedestrian areas, high profile areas or where directed, in accordance with Clause 9.2.1.9

g) have all stakes and ties removed, and

h) have a mulch depth in accordance with Clause 9.2.1.11.

9.3 Establishment and monitoring supplementary requirements

Establishment and monitoring supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Clause 4.4 of the Annexure MRTS16.1.

Appendix C Translocation Management Plan

Bruce Highway - Cooroy to Curra (Section D: Woondum to Curra)

Macrozamia pauli-guilielmi Translocation Management Plan

November 2017

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1. Introduction

1.1 Project description

The Bruce Highway (Cooroy to Curra) project involves a 62 kilometre (km) upgrade and realignment of the Bruce Highway between Cooroy and Curra, including a bypass of Gympie, South-East Queensland. Section D of the project comprises the construction of 26 km of four-lane dual carriageway from Woondum Road to Curra, including a bypass of Gympie. Section D of the project (the Project) comprises two stages, namely Contract 1 (Woondum Interchange to Sandy Creek Road) and Contract 2 (Sandy Creek Road to Curra Interchange).

The study area for the Project is the area selected for the purposes of conducting flora and fauna surveys, and includes the extent of the cut and fill batters provided in the concept design for the highway as at January 2015, plus a buffer of approximately 200 metres (m) on either side. The study area was not moved following slight modifications to the design after January 2015. Consequently, the width of the buffer varies along the length of the alignment and may be 50 m or less in some places. The Project area is the likely impact area associated with the construction of the Project and takes into account the potential areas for site offices, drainage structures, access tracks, erosion and sediment control devices, and borrow/spoil areas. The Project impact area has been refined during the Detailed Design phase and is based on the following:

- The toe of embankments plus 25 m will be cleared of vegetation to provide adequate room for haul routes, light vehicle access, drainage structures, stockpiles and temporary and permanent sediment basins.
- The top of cuttings plus 15 m will be cleared of vegetation to provide adequate room for drainage structures and light vehicle access tracks.
- Where cuttings are required to be laid back to gain more material, or spoil areas required to dispose of material, additional areas within the footprint has been provided.
- Proposed site office locations as identified in the constructability review.

1.2 *Macrozamia pauli-guilielmi* plants impacted by the Project

Targeted flora surveys undertaken in the study area over a total of 24 days (by BAAM in March and May 2015 and February 2016 (BAAM 2016) and by GHD in July 2016 (GHD 2016) and April 2017) identified three distinct and highly localised sub-populations of *Macrozamia pauli-guilielmi* (pineapple zamia) in the Contract 2 portion of the study area, with a fourth sub-population confirmed 1.2 km north-east of the Project impact area. *Macrozamia pauli-guilielmi* is a species of cycad that is listed as endangered under both the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Queensland *Nature Conservation Act 1992* (NC Act). The locations of these sub-populations are mapped in Figure 1, and details of the sub-population sizes and supporting habitats are summarised in Table 1.

The three sub-populations within the study area all occur on soft, sandy soils derived from sandstone (land zone 10), in three Regional Ecosystems (REs) described below and in Table 1 (shown on Figure 1):

- RE 12.9-10.4 (*Eucalyptus racemosa subsp. racemosa* woodland on sedimentary rocks)
- RE 12.9-10.17b (*Corymbia citriodora subsp. variegata* mixed open forest to woodland on sedimentary rocks)
- RE 12.3.11 (*Eucalyptus tereticornis* +/- *Eucalyptus siderophloia*, *Corymbia intermedia* open forest on alluvial plains usually near coast).

A further sub-population (sub-population 4) was confirmed at the site of historical specimen records (from 1997 and 2011) located 1.2 km north-east of the Project impact area (Figure 1, Table 1). Sub-population 4 occurs on a different substrate (land zone 11) to the other sub-populations, in RE 12.11.5e (*Corymbia citriodora* subsp. *variegata* open forest on metamorphics +/- interbedded volcanics).

Table 1 Details of *Macrozamia pauli-guilielmi* sub-populations in proximity to the study area

	Sub-population size	RE	Habitat description
1	16 adults, 2 seedlings	12.9-10.17b	**Structure and position:** Remnant open forest, canopy height 19 m, on lower, south-facing footslope adjacent to creek. **Tree 1 layer:** *Corymbia citriodora* (dominant), *Eucalyptus acmenoides, E. longirostrata, E. siderophloia*. **Tree 2 layer:** *Lophostemon confertus, E. acmenoides, E. longirostrata, E. siderophloia*. **Shrub layer:** *Lantana camara** (dominant), *L. confertus, Jagera pseudorhus*. **Ground layer:** *Megathyrsus maximus*, Passiflora suberosa*, *Themeda triandra*. **Substrate:** Soft sand derived from sandstone, sandstone outcrop nearby. **Comments:** *M. pauli-guilielmi* individuals becoming overgrown by *L. camara** and *P. suberosa** weeds.
2	61 adults, at least 109 seedlings	12.9-10.4	**Structure and position:** Remnant open forest, canopy height 14 to 18 m, on hill crest and north-facing and south-facing slopes between two creeks. **Tree 1 layer:** *Eucalyptus racemosa* subsp. *racemosa* (dominant), with *E. acmenoides*, *Corymbia trachyphloia*, *C. intermedia* and *Angophora leiocarpa* subdominant. **Tree 2 layer:** *Acacia disparrima* (dominant) with *Alphitonia excelsa* and *Banksia integrifolia* associated. **Shrub layer:** *Lantana camara** (dominant) with scattered *B. integrifolia*, *A. disparrima*, *A. excelsa* and *Leucopogon juniperinus.* **Ground layer:** *Imperata cylindrical* (dominant) with *Lomandra multiflora*, *Hibbertia* sp., *Xanthorrhoea johnsonii* and *Gahnia aspera*. **Substrate:** Soft sand derived from sandstone, several sandstone outcrops through the sub-population. **Comments:** A few *M. pauli-guilielmi* individuals becoming overgrown by *L. camara**.
3	15 adults, 83 seedlings	12.9-10.4	**Structure and position:** Remnant open forest, canopy height 15 to 20 m, on lower, gently sloping north-facing footslope adjacent to creek. **Tree 1 layer:** *E. racemosa* subsp. *racemosa, E. propinqua, C. intermedia, A. leiocarpa*. **Tree 2 layer:** *Lophostemon suaveolens, A. disparrima*. **Shrub layer:** *L. camara** (dominant), saplings of Tree 1 layer and Tree 2 layer species. **Ground layer:** *Aristida gracilipes, I. cylindrica* and *T. triandra,* with *L. multiflora, X. johnsonii* and *G. aspera*. **Substrate:** Soft sand derived from sandstone, sandstone outcrop nearby. **Comments:** A few *M. pauli-guilielmi* individuals becoming overgrown by *P. suberosa** weeds; habitat of southern end of population subject to substantial recent logging.
4	At least 98 adults, abundant seedlings	12.11.5e	**Structure and position:** Remnant open forest, canopy height 15 to 20 m, on moderate to steeply-sloping, south-facing hillslope adjacent to creek. **Tree 1 layer:** *Corymbia intermedia, C. citriodora, E. acmenoides, E. propinqua*.

	Sub-population size	RE	Habitat description
	(outside study area)		**Tree 2 layer:** *L. confertus* (dominant), *Acacia maidenii.* **Shrub layer:** *L. camara**, *L. confertus* (dominant). **Ground layer:** *Themeda triandra, Cymbopogon refractus, P. suberosa**. **Substrate:** Shallow, loamy, gravelly soils derived from metasediments. **Comments:** A large, dispersed population that may extend further east of the portion surveyed; a few *M. pauli-guilielmi* individuals on the western edge of the sub-population becoming overgrown by *L. camara** weeds.

Note: Asterisk (*) indicates non-native species (i.e. species that are introduced to Queensland)

The presence of seedlings in all sub-populations suggests that individual plants from all sub-populations have reproduced successfully in the recent past, including the relatively small sub-population 1 that is comprised of 16 adult individuals. Nearly all seedlings were found growing within 20 cm of the bases of female plants. Sub-populations 1 to 3 represent sub-populations not previously known to occur, whereas sub-population 4 is a previously described sub-population (Queensland Herbarium 2007). All four sub-populations, together with other sub-populations that may occur undetected in the local region, are likely to form a meta-population. A plant meta-population is a set of local populations that interact via movement of genetic material between populations (Hanski and Gilpin, 1991). The movement of genetic material among *M. pauli-guilielmi* sub-populations is achieved through transfer of pollen by the mobile insect pollinators.

Based on the proposed Project area, a total of 215 *M. pauli-guilielmi* individuals (48 adult and 167 seedlings) will be directly impacted by Contract 2 of the Project (Table 2). These directly impacted individuals are located within sub-populations 2 and 3. Plants directly impacted by the Project are required to be translocated to mitigate a negative impact of the Project on the species.

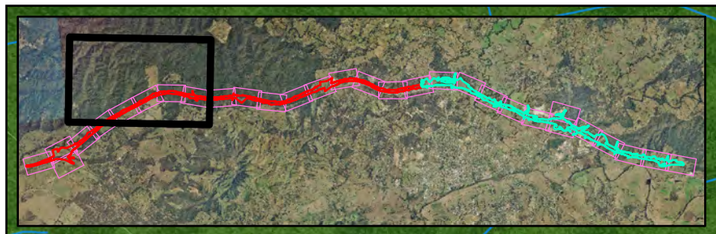
A further 28 adults and 25 seedlings within sub-population 2 may be indirectly impacted due to their close proximity to the proposed Project area and/or as a result of population fragmentation by the Project. Due to the indirect impacts of habitat fragmentation and the removal of plants from a portion of sub-population 2, it is recommended that all indirectly impacted plants from sub-population 2 also be translocated. This will maintain the size of the sub-population.

While there are individuals located within 30 m of the Project area in sub-population 1 (Table 2), with consideration of the separation distance between sub-population 1 and the proposed works, as well as the fact that sub-population size will not be reduced as there are no direct impacts to this sub-population, no translocation of sub-population 1 is proposed.

In total, 76 adult plants and approximately 192 seedlings will be subject to translocation, assuming no mortality of plants in the interim. The majority of seedlings are closely associated with adult female plants, leading to the expectation that most seedlings will naturally perish due to interference competition with the adult plants; therefore the translocation of these seedlings to lower densities than at existing locations has the potential to increase the long-term number of individuals in the sub-population and its area of occupancy.

Table 2 Summary of *Macrozamia pauli-guilielmi* plants within the Project area (direct impact) or close to the Project area

Sub-population	Plants directly impacted	Plants close to Project area (distance, m)
1	None	16 adults, 2 seedlings (10 m to 30 m)
2	33 adults, 84 seedlings	28 adults, 25 seedlings (1 m to 50 m)
3	15 adults, 83 seedlings	None
4	None	None
Total	48 adults, 167 seedlings	44 adults, 27 seedlings
Total for translocation	**48 adults, 167 seedlings**	**28 adults, 25 seedlings (1 m to 50 m)**



700FTY1491

BRADYS ROAD

700FTY1491

Sub-population 4

CURRA STATE FOREST

3MPH23906

2MPH23906

700FTY1491

1MPH14173

1MPH23906

700FTY1491

700FTY1491

Sub-population 2

Sub-population 3

12.9-10.4

12.3.11

12.9-10.4

1MPH23906

156500

12.9-10.4

12.11.5e

155500

878MCH1061

4MPH23906

12.9-10.4

158500

1MPH6120

1MPH5393

1MPH23630

98MCH191

BRUNNES ROAD

700FTY1491

Sub-population 1

1MPH14134

159500

108MCH1009

97MCH191

12.9-10.17b

12.3.11

878MCH1061

1RP197351

1RP84730

2SP237592

SIDING ROAD

889CP864404

2RP197351

4RP85

ASHFORDS ROAD

1717M37818

12.9-10.17b

2MPH34753

3MPH34753

6SP233571

3RP216838

1MPH23534

1:15,000 @A3

0 100 200 400 600 800

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- 1 km Chainage
- Macrozamia (BAAM 2015)
- Macrozamia ALA Record
- Macrozamia (BAAM 2016)
- Macrozamia (GHD 2017)
- Street/Local Road
- Watercourses
- Cadastre
- Contract 2

Field Verified RE (BAAM 2015)

- 12.11.5e
- 12.3.11
- 12.9-10.17b
- 12.9-10.4
- Protected Areas
- Survey Area

Department of Transport and Main Roads
Bruce Highway Cooroy to Curra
(Section D: Woondum to Curra)

Job Number	41-29914
Revision	0
Date	21 Aug 2017

Locations of Macrozamia pauli-guilielmi sub-populations

Figure 1

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Data source: TMR: BAAM Flora Survey Data (2015) (2016), Survey Area (2015), Chainage (2016), Field Verified RE (2015), Imagery (2015); DNRM: Cadastre (2015), Protected Areas (2015), Waterways (2010). GHD: Project Area (2016). Created by: sc

6 Innovation Parkway Birtinya QLD 4575 Australia **T** 61 7 5413 8100 **F** 61 7 5413 8199 **E** bta01mail@ghd.com **W** www.ghd.com

1.3 Legislation and permit requirements

1.3.1 Commonwealth legislation

Macrozamia pauli-guilielmi is listed as endangered under the EPBC Act, and is therefore a matter of national environmental significance. Under the EPBC Act, an action requires approval from the minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. A national recovery plan provides guidance for the management of *M. pauli-guilielmi* and other endangered cycad species in northern Australia (Queensland Herbarium 2007). Recovery action 4.6.1 of this plan recommends that individual plants under immediate threat should be translocated to suitable habitat in the vicinity of nearby larger populations. The Commonwealth Department of the Environment and Energy (DEE) (2016) recommends that any translocation project for *M. pauli-guilielmi* should follow the general guidelines for translocation as given by Vallee *et al*. (2004). The *EPBC Act Policy Statement on the Translocation of Listed Threatened Species – Assessment under Chapter 4 of the EPBC Act* provides information relevant to considering a translocation proposal in connection with a referral under the EPBC Act. This Policy Statement recommends that a salvage translocation proposal should:

- Consider the proportion of reproductively mature individuals proposed to be removed, the species' reproductive cycle and rate, the security of new and existing populations and the potential impacts of the translocation, including impacts on the recipient site
- Effectively account for and manage the risks of the translocation not succeeding
- Provide a high degree of certainty that a particular translocation attempt will be successful in its effectiveness in contributing to the long-term conservation of the species, where success may be characterised by:
  - the individuals involved are of measurable value to the long term conservation of the species
  - the post-translocation outcome is of measurable value to the long term conservation of the species
  - this value is likely to be retained for 50 or 100 years without management input (i.e. the risk that this value will diminish without active management is very low), and
- Accord with any plans for the conservation of the species, meets the requirements of State or Territory and national guidelines for translocation, and takes account of the requirements of any applicable State or Territory legislation.

The Policy Statement also suggests that a translocation proposal would not usually be made a condition of approval, or form any part of a mitigation or compensation arrangement until it can be confirmed that the translocation is consistent with State and Territory law, and is generally supported by the relevant state or territory conservation agency.

1.3.2 State legislation

Macrozamia pauli-guilielmi is listed as endangered under the NC Act. Under amendments to the protected plants regulatory framework under the NC Act and regulations that commenced on 31 March 2014, the taking of a protected plant other than in a protected area can only be done under a protected plant clearing permit or an exemption under a regulation.

Clearing, growing, harvesting and trading of protected plants in Queensland is regulated by the *Nature Conservation (Wildlife Management) Regulation 2006*. Under the *Nature Conservation (Wildlife Management) Regulation 2006*, any plant listed as endangered, vulnerable or near threatened (EVNT) under the NC Act is taken to have been directly impacted if it is proposed to be cleared, and indirectly impacted if clearing is proposed to occur within 100 m of that plant. Where direct or indirect impacts are unavoidable, impacts must be managed using a suite of mitigation measures to facilitate a 'no net loss of EVNT plants'. Management of impacts must be detailed in an Impact Management Plan, developed in accordance with the assessment guideline. The Impact Management Plan should include expert advice (e.g. a suitably qualified person or the Queensland Herbarium) that validates the claim that management of an impact to a species

should have a high chance of success to facilitate 'no net loss of EVNT plants'. The clearing permit application must be submitted no later than 12 months after the completion of the flora survey that was undertaken for the report. If a permit is granted, the applicant must then notify the department when the clearing is started. This Translocation Management Plan will accompany the Impact Management Plan.

An environmental offset may be required as a condition of approval where, following consideration of avoidance and mitigation measures, the activity is likely to result in a significant residual impact on prescribed environmental matters, including species listed as EVNT under the NC Act. The Queensland Environmental Offsets Policy (Version 1.1) clarifies how environmental offsets across Queensland's terrestrial and aquatic ecosystems should be delivered. The policy is a statutory instrument, given effect through section 12 of the *Environmental Offsets Act 2014* and prescribed under the Environmental Offsets Regulation 2014. The Environmental Offsets Policy nominates an offset ratio of four new plants for every one plant impacted, which has been adopted as a conservative approach for this species. Therefore, this ratio of 4:1 has been applied to the propagation of new seedlings from collected seeds in order to compensate for mortality of translocated plants.

To avoid duplication of offset conditions between jurisdictions, State and local governments can only impose an offset condition in relation to a prescribed activity, if the same, or substantially the same impact and the same, or substantially the same matter has not been subject to assessment under the EPBC Act. As the impact of the Project on *M. pauli-guilielmi* will be subject to assessment under the EPBC Act, the imposition of an offset by the State government is not expected to occur.

As a listed threatened species under the NC Act, the taking of *M. pauli-guilielmi* seeds for the purposes of propagation must be undertaken in accordance with a protected plant growing licence issued by the Department of Environment and Heritage Protection (EHP) and in accordance with the EHP's Code of Practice for the Taking and Use of Protected Plants.

1.4 Aims and objectives

This Translocation Management Plan aims to describe a strategy to compensate for the residual adverse impacts of the Project on *M. pauli-guilielmi* by translocating plants likely to be directly and indirectly impacted by the Project to a suitable recipient site. This translocation program will deliver an overall conservation outcome that improves or maintains the long-term protection and viability of *M. pauli-guilielmi*.

The specific objectives of the Translocation Management Plan are to:

- Achieve a net gain in the numbers of the species in suitable habitat in the wild
- Improve the long-term protection and viability of the species in the wild
- Effectively account for and manage the risks of the translocation not succeeding
- Provide a management framework that is efficient, effective, timely, transparent, scientifically robust and reasonable, with outcomes that can be readily measured, monitored and audited.

The cumulative direct and indirect impact of the Project on *M. pauli-guilielmi* is quantified as the total number of adult plants that will be subject to direct and indirect impacts and that are therefore to be translocated. All potentially impacted seedlings together with any identified ungerminated seeds shall be salvaged and translocated with the aim of establishing a sufficient number of juvenile plants in situations where they are not subject to interference competition with adult plants. In addition, propagation of seedlings from collected seeds will be undertaken in order to compensate for any mortality of adult plants as a result of translocation given that up to 12 percent mortality of adult plants can be expected to occur (if the plants are translocated at an appropriate time, otherwise mortality rates may be greater) and seedling and juvenile plants may experience relatively high mortality before reaching maturity. Therefore, to effectively account for and manage the risks of mortality of adults over the longer term as a result of the translocation, a specific objective of the Translocation Management Plan shall be to successfully propagate and establish at least four juvenile plants for every one adult that dies during the translocation monitoring period.

To achieve the objectives of the Translocation Management Plan, the translocation program involves the following steps, discussed in more detail in Sections 4 to 7:

- Selection and preparation of a suitable translocation site
- Translocation of adult and seedling plants and ungerminated seeds from areas proposed to be impacted to the translocation site
- Maintenance of translocated plants until they have become sufficiently established
- Monitoring of the health of translocated plants and the success of the translocation program

1.5 Consultation and review

This Translocation Management Plan is based on a draft document prepared by BAAM (2016). To develop a Translocation Management Plan that is scientifically robust, preparation of this Translocation Management Plan has been informed by:

- Review of the national guidelines for the translocation of threatened plants in Australia (Vallee *et al*. 2004), a translocation protocol for cycads in Queensland (Forster 2004), and the national multi-species recovery plan for cycads (Queensland Herbarium 2007)
- A review of two approved translocation plans previously developed for the translocation of *M. pauli-guilielmi* as conditions of approval under the EPBC Act, namely AECOM (2011) and OPUS (2012)
- The results of monitoring the translocation success of a previous translocation of *M. pauli-guilielmi*, and recommendations for translocation and monitoring provided therein, as reported in Vegetation Matters (2013, 2015)
- Consultation and advice received from Dr Paul Forster, Principal Botanist at the Queensland Herbarium and lead author of the national cycad recovery plan

2. Profile of Macrozamia pauli-guilielmi

2.1 Status

M. pauli-guilielmi is listed as endangered under the EPBC Act and NC Act.

2.2 Description

M. pauli-guilielmi is a small cycad with a swollen, underground, non-branching trunk that is not visible from the surface and grows to 25 cm long and 20 cm diameter with one to three parsnip like roots. Mature plants have between two and eight erect leaves that emerge from the soil to a length of 30 to 80 cm (Photo 1). The leaf stems are strongly spirally twisted and have narrow, pale green leaflets (Photo 2). The species is dioecious, having separate male and female plants.

Female plants produce erect oval cones that are 9 to 14 cm long and resemble small pineapples (Photo 3), with a collection of large seeds that are 17 to 25 mm long and 13 to 20 mm wide that change colour from green to red or orange when ripe (Photos 6 and 7). Male plants produce cones that are 8 to 14 cm long (Photo 4) (Queensland Herbarium 2007, DotE 2016).

2.3 Distribution, habitat and population

M. pauli-guilielmi is endemic to south-east Queensland where it is only found in the Wide Bay district between the Isis River in the north, and Wolvi in the south, from the coast and Fraser Island inland to Mt Woocoo and the Gympie district (Queensland Herbarium 2007, ALA 2016). *M. pauli-guilielmi* grows in lowland (5 to 230 m altitude) open forest or woodland dominated by banksias or eucalypts (wallum), or in shrub land or heath land, generally on sandy and loamy soils, including stabilised sand dunes. It does not have a preferred aspect. Like other *Macrozamia* species, *M. pauli-guilielmi* grows in clusters or groves that derive ecological benefit from existing as high-density, spatially discrete populations (Hall and Walter 2013). There are 27 known populations totalling at least 13,131 adult individuals, and ranging in population size from single plants to up to 3,600 individuals. A large majority of individuals occur in just four populations, the only populations considered to be viable in the long-term.

M. pauli-guilielmi is thought to be genetically impoverished and therefore all populations are important for maintaining genetic diversity (Queensland Herbarium 2007, DotE 2016). There are no lifespan or age-at-maturity estimates for *M. pauli-guilielmi*, but other *Macrozamia* species can live to between 120 and 1,500 years, and while other cycads can take 2 to 30 years to reach maturity, age to maturity in *M. pauli-guilielmi* is relatively short in cultivation (DotE 2016) and is thought to be approximately 25 years in the wild (P. Forster, personal communication).

2.4 Ecology

M. pauli-guilielmi has a symbiotic relationship with blue-green algae within specialised coralloid roots that grow upwards. The algae grow in some of the cells of these roots and 'fix' nitrogen from the atmosphere, making this available to the cycad. While cycads are also known to have a mutualistic relationship with vesicular arbuscular mycorrhizal (VAM) fungi that penetrate the roots of the cycad and facilitate the uptake of mineral nutrients and water from the soil, there is no specific information on this association in relation to *M. pauli-guilielmi* (DotE 2016). While definitive information is limited, *M. pauli-guilielmi* is thought to be pollinated by a species of tiny, weevil-like beetle (*Tranes* sp.) (Forster *et al*. 2004) that is likely to be attracted to cones by volatile odours emitted by the cones at night (Terry *et al*. 2004). *Macrozamia pauli-guilielmi* individuals are highly variable in their annual seed production as females produce cones only every 4 to 6 years (Jones 1993).

Synchronous cone production (masting) often follows fire, with a small percentage of individuals coning in the first year following the fire, and a high percentage of individuals coning in the second year. The seeds ripen in April and May, and the viability of seeds is thought not to persist beyond 6 to 12 months (Queensland Herbarium 2007; DotE 2016). In the related *M. lucida*, partially buried seeds germinate at a significantly higher rate than those on the soil surface or those buried completely (Snow and Walter 2007). The large, heavy and colourful seeds of *Macrozamia* species (see Photos 6 and 7) are thought to be adaptations to dispersal by large vertebrates (megafauna), most of which went extinct over 10,000 years ago. Consequently, seed dispersal is very limited in *Macrozamia* species, but animals such as Brush-tailed Possum (*Trichosurus vulpecula*) and Bush Rats (*Rattus fuscipes*) may infrequently move seeds up to 5 to 24 m from the parent plant (Burbidge *et al*. 1982, Snow and Walter 2007, Hall and Walter 2013). Because of restricted dispersal, most seeds germinate very close to maternal female plants (Photo 5), and most seedlings that remain in the vicinity of adult plants perish before they reach maturity (Hall and Walter 2013, Borsboom *et al.* 2015). Adult plants resprout after fire, but seedlings and unburied seeds are usually killed by fire.

2.5 Threats and mitigation

Key threats to *M. pauli-guilielmi* include habitat loss and clearing of plants, illegal removal of plants by cycad collectors (for which the potential is greater in closer proximity to roads), too-frequent fires that kill seedlings and juvenile plants, loss of individuals affecting the ability of the species to be viable into the future, and loss of critical pollinators and mycorrhizal fungi (Queensland Herbarium 2007, DotE 2016).

2.6 Translocation success

The large, swollen underground stem of adult plants provides a substantial store of water and nutrients for the plants. This provides a buffer for plants to withstand the temporary loss of leaves and photosynthetic potential and regrow the fine root system following uprooting during translocation. For this reason, *Macrozamia* species are resilient to translocation and generally recover well, particularly if minimal damage to the underground stem occurs. This storage feature also allows plants to readily establish following relocation, with *M. pauli-guilielmi* having been successfully transplanted by TMR on several occasions. Of particular relevance is a project where 143 adult *M. pauli-guilielmi* individuals were successfully translocated by TMR in 2012 at a site adjacent to the nearby Maryborough-Cooloola Road for the Maryborough-Cooloola Coast Road project (EPBC Approval 2012/6297). Vegetation Matters undertook final translocation monitoring in 2014 and reported that approximately 88 percent of translocated plants remained alive after a period of two years (Vegetation Matters 2015). Monitoring found that 17 individuals (12 percent) did not sprout a new leaf or cone, suggesting that they had died; however, the survival of these plants was compromised to some extent by many plants being in poor health and translocated at a suboptimal time (Vegetation Matters 2015). The loss of 17 individuals was reportedly compensated by the emergence of seedlings from seed spread at the time of the translocation, resulting in an overall net gain of plants (+ 10 plants) at the site after a period of two years (Vegetation Matters 2015).

Given that *M. pauli-guilielmi* has been successfully translocated within the local area, the expected success of the proposed translocation is high.

Photo 1. *M. pauli-guilielmi* female plant with erect leaves and a green cone.

Photo 2. *M. pauli-guilielmi* spirally twisted leaf stem.

Photo 3. *M. pauli-guilielmi* female cone not yet ripe in early March.

Photo 4. *M. pauli-guilielmi* male plant with old, open cone in March.

Photo 5. Cluster of *M. pauli-guilielmi* seedlings near the base of a female plant.

Photo 6. Female cone with ripe seeds in early May.

Photo 7. Large ripe seeds of *M. pauli-guilielmi*.

3. Responsibilities and schedule

3.1 Department of Transport and Main Roads

The Department of Transport and Main Roads (TMR) is the Proponent for the Project and will be responsible for obtaining and ensuring compliance with all Project approval conditions. TMR shall be responsible for:

- Ensuring all necessary Commonwealth and State permits and approvals are obtained prior to commencement of works at the subject site
- Ensuring all Contractors comply with all conditions of necessary permits and approvals relating to the works, including the requirements of this *M. pauli-guilielmi* Translocation Management Plan
- Engaging suitably qualified persons (i.e. the Translocation Contractor) to undertake the translocation works and to conduct ongoing monitoring and maintenance of the translocation works for the duration of the proposed five-year maintenance period
- Ensuring adequate resources are available for implementing the translocation process and requirements of this *M. pauli-guilielmi* Translocation Management Plan
- Providing notifications to DEE and EHP as specified in approval and permit conditions, which are to be confirmed
- Submitting Translocation Monitoring Reports to DEE and EHP as specified in approval and permit conditions, which are to be confirmed
- Maintaining accurate records of all activities associated with or relevant to the conditions of approval, including implementation of the *M. pauli-guilielmi* Translocation Management Plan, and providing these records to DEE and EHP as specified in approval and permit conditions, which are to be confirmed
- Identifying and obtaining a legally secured area, as detailed in Section 4
- Securing the long-term protection (i.e. for the duration of the impact) of the translocated *M. pauli-guilielmi* population at the recipient site

3.2 Translocation contractor

A Translocation Contractor shall be engaged by TMR to undertake all translocation works required by this Translocation Management Plan. The Translocation Contractor shall be responsible for:

- Undertaking the translocation, maintenance and monitoring in accordance with this Translocation Management Plan and any associated conditions of the EHP Clearing Permit
- Preparing the recipient site to receive the translocated plants
- Carrying out translocation of all impacted plants to the designated recipient site
- Carrying out the maintenance activities and any necessary corrective actions required for adaptive management during the maintenance period
- Preparing Translocation Monitoring Reports for submission to TMR

It is recommended that a suitably qualified person that has previous experience with the translocation of *Macrozamia* species be involved in supervising the translocation, and that the operator of the excavator or backhoe be experienced in landscaping works.

3.3 Schedule

An indicative schedule for the implementation of this Translocation Management Plan is summarised in Table 3, with details of the scheduled activities provided in the subsequent sections.

Table 3 Indicative schedule for implementation of the Translocation Management Plan

Activity	Scheduled timing and frequency	Quality management+
Recipient site identification	April 2017 - Completed	
Collection of seeds for propagation	September 2017 ongoing until enough seed is collected	Milestone
Propagation of seeds in nursery	1-2 years immediately following collection of seeds	
Protected plant survey of impact site and recipient site	Within 12 months prior to impact	Milestone
Preparation and submission of flora survey report and associated plans	At least 40 business days prior to impact	Milestone
Legally secure the recipient site	Prior to impact	HOLD POINT
Development of weed hygiene protocol	Prior to impact	Witness point
Protected plant clearing permit and associated plans approved	Prior to impact	HOLD POINT
Recipient site preparation (remove internal fencing, weed control, prepare planting area)	Immediately prior to translocation (no more than four weeks prior)	Witness point
Locate, identify and mark all plants to be translocated (postpone translocation if recent fire damage)	Immediately prior to translocation	Witness point
COMMENCEMENT OF ESTABLISHMENT PERIOD		Milestone
Translocation of adult plants, seedlings and ungerminated seeds	At time of translocation	Witness point
Submit Translocation Report to TMR	One month after translocation works completed	Witness point
Maintenance watering (all plants and seeds), opportunistic monitoring, weed control (manually or spot-spray), assess any damage or disturbance	Once every two weeks for seedlings and juveniles and once every four weeks for adults, for the first six months after translocations	
Application of insecticide	If new leaf growth or leaves with greater than 25 percent insect damage	
COMPLETION OF ESTABLISHMENT PERIOD		HOLD POINT
COMMENCEMENT OF MONITORING PERIOD		Milestone
Monitoring (weed control, assessment of disturbances, record of new seedlings)	Twice per year for two years, then once per year for following three years	
Submit Translocation Monitoring Report to TMR	Once per year for five years	Witness point
COMPLETION OF MONITORING PERIOD		HOLD POINT

+ Quality management triggers

Hold point: an identified point past which the Contractor shall not proceed without a direction from TMR

Witness point: an identified point where an activity is nominated to be observed by TMR

Milestone: a point which marks the start or completion of an activity

4. Translocation site

4.1 Translocation site selection

The national multi-species recovery plan for cycads (Queensland Herbarium 2007) recommends that selection of a suitable recipient site for translocated *M. pauli-guilielmi* should be guided by a requirement to supplement existing populations in proximity to, but outside of, proposed impact areas. One such population (sub-population 4 in Figure 1) occurs approximately 1.2 km north-east of the closest Project impact site. However, this sub-population occurs on a different substrate type, namely gravelly soils derived from metasediments (land zone 11) to the sub-populations that are to be translocated, which are growing in soft sands derived from sandstone (land zone 10). As translocation of plants between different substrate types may present a risk to the survival of translocated plants, the recipient site should have the same land zone as the impact sites. Therefore, areas of suitable habitat for the species were identified as remnant vegetation on soils derived from sandstone (land zone 10). The occurrences of similar vegetation communities in proximity to sub-population 4 and the sites of impact were mapped on the basis of Queensland Government RE mapping (namely RE 12.9-10.17b and RE 12.9-10.4). This process identified three patches of RE to the north or east of the Project area and within 1 to 2.2 km of sub-population 4 (shown as Suitable Offset Habitat on Figure 2). Suitable habitat areas to the west or south of the Project were excluded from consideration due to the potential isolation of these areas by the Project.

Other criteria for assessing suitability of recipient sites include:

- The presence of *M. pauli-guilielmi* individuals in close proximity as an indication of habitat suitability
- On-site match of substrate, being light grey-white sandy soils
- The size of the recipient site is to be such that the planting configuration described in Section 5.5 can be achieved
- Suitable habitat is readily accessible through existing tracks.

Four potential recipient sites have been identified through the desktop and site assessment process. The suitability of each of the potential recipient sites is described in Table 4. These sites are shown on Figure 2.

Table 4 Descriptions of potential recipient sites

Potential recipient site	Relevant features of the site	Overall suitability
Lot 878 on MCH1061 **Freehold** **Owned by TMR**	• Individuals confirmed present in close proximity to planting area • Large area of suitable habitat that could be used • Vegetation community matches the impact site, being RE 12.9-10.4 • Substrate matches the impact site, being light grey-white sandy soils • Lower slope of a hill with a southerly aspect • Within 1 km of sub-population 4 and connected through remnant vegetation with low potential for fragmentation • Close proximity to impact site (sub-population 2) and slightly separated from Project area • Readily accessible for translocation works and monitoring along existing tracks	High (preferred)

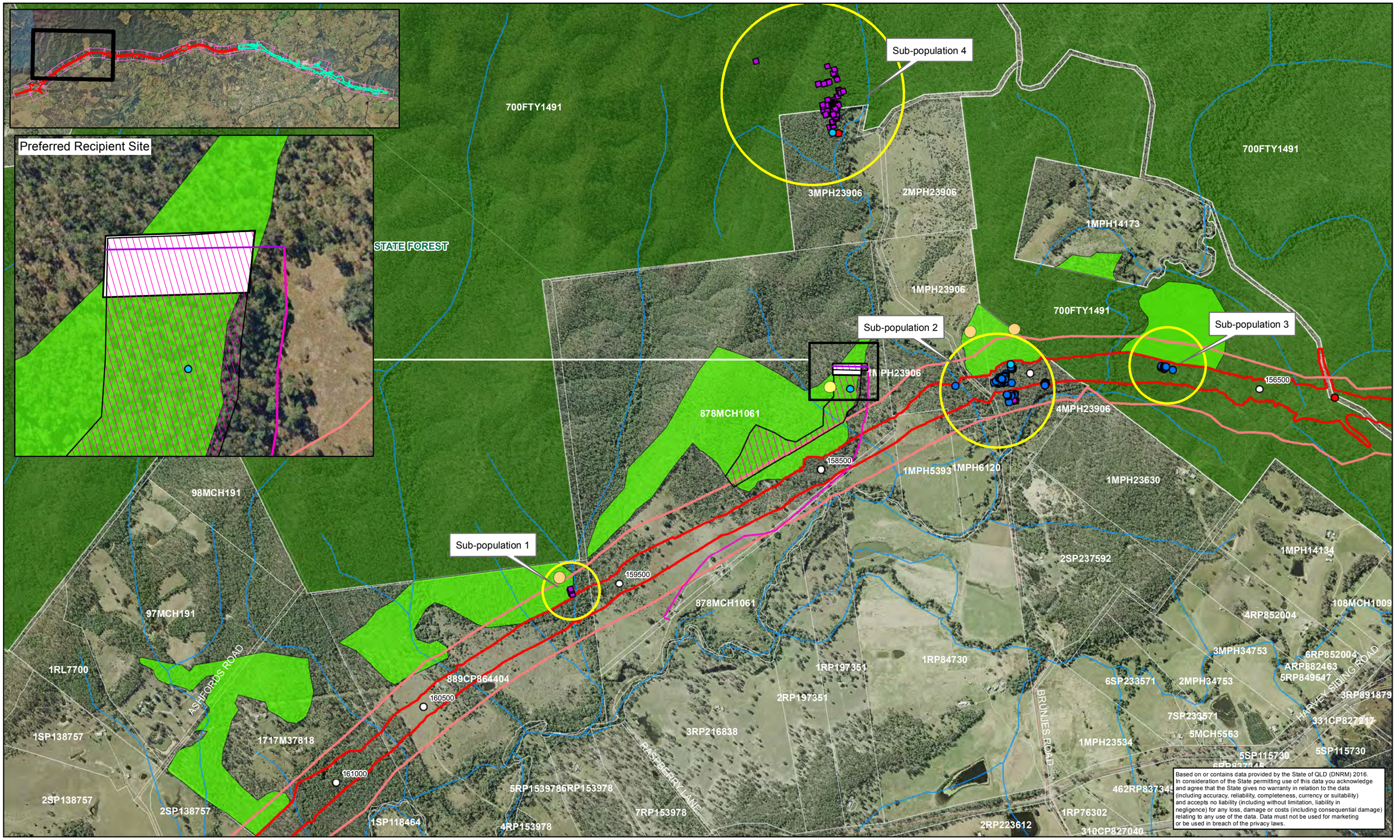
Potential recipient site	Relevant features of the site	Overall suitability
	• Planting can be undertaken along an existing but unutilised track, which will avoid unnecessary disturbance of adjacent vegetation and existing individuals	
Lot 889 on CP864404 **Freehold** **Owned by TMR**	• Individuals confirmed present in close proximity (sub-population 1) • Large area of suitable habitat that could be used • Land zone and sandy substrate matches impact sites however vegetation community does not feature *E. racemosa* subsp. *racemosa* • Greater than 2 km from sub-population 4 although still connected through remnant vegetation with some potential for fragmentation through logging activities in Curra State Forest • Greater than 1.8 km from impact site (sub-population 2) and close proximity to Project area • Poor access to suitable habitat from existing tracks or cleared land to the south-west • Habitat within remnant vegetation that would disturb existing native vegetation through access, site preparation and planting activities	Moderate (suboptimal)
Lot 1 on MPH23906 **Freehold** **Owned by TMR**	• Individuals confirmed present within Project area approximately 200 m to south, however not observed on-site • Smaller area of suitable habitat that could be used • Vegetation community matches the impact site, being RE 12.9-10.4 • Land zone matches impact site, however substrate is lacking light sandy soils (steep rocky slope) • Approximately 1 km from sub-population 4, however not well connected through remnant vegetation and with higher potential for fragmentation and edge effects • Close proximity to impact site (sub-population 2) and slightly separated from Project area • Poor access as adjacent road reserve unformed and steep terrain • Habitat within remnant vegetation that would disturb existing native vegetation through access, site preparation and planting activities	Low
Lot 4 on MPH23906 **Freehold** **Owned by TMR**	• Individuals confirmed present within Project area approximately 150 m to south, however not observed on-site • Smaller area of suitable habitat that could be used	Low

Potential recipient site	Relevant features of the site	Overall suitability
	• Land zone and substrate matches impact site, however vegetation community does not feature *E. racemosa* subsp. *racemosa* • Within 1.2 km from sub-population 4 however not well connected through remnant vegetation and with higher potential for fragmentation and edge effects through logging activities in Curra State Forest • Close proximity to impact site (sub-population 2) and slightly separated from Project area • Readily accessible for translocation works and monitoring along existing track • Habitat within remnant vegetation that would disturb existing native vegetation through access, site preparation and planting activities	

The preferred recipient site (Lot 878 on MCH1061) was surveyed in April 2017, during which a *M. pauli-guilielmi* individual in good condition was recorded within the potentially suitable habitat area (shown on Figure 2). Additional individuals were also observed close to the existing access track in an August 2017 site visit with TMR and NPWS. The vegetation community was observed to be *Eucalyptus racemosa* subsp. *racemosa* dominant woodland (consistent with RE 12.9-10.4) with a median canopy height of 20 m with approximately 40 percent canopy cover, 20-40 percent shrub layer cover and 10 percent ground layer cover. This site is currently owned by TMR, with negotiations currently being undertaken with stakeholders to determine the future land tenure, land use and protection status of the proposed site and the property in its entirety.

The indicative planting area and existing access track for the preferred recipient site is shown on Figure 2. Photos of the existing access track at the preferred recipient site are provided in Plate 1. There is an existing internal fence along one side of the track that would be removed prior to site preparation works.

Plate 1 Photos of preferred recipient site



1:15,000 @A3

0 100 200 400 600 800

Metres

Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

LEGEND

- 1 km Chainage
- Macrozamia (GHD 2017)
- Macrozamia ALA Record
- Macrozamia (BAAM 2016)
- Macrozamia (BAAM 2015)
- Potential recipient site
- Preferred recipient site
- Proposed access route
- Track for planting access
- Watercourses
- Street/Local Road
- Planting area
- Optimal Macrozamia translocation habitat
- Survey Area
- Suitable Offset Habitat
- Protected Areas
- Cadastre
- Project Area
- Contract 2

Department of Transport and Main Roads
Bruce Highway Cooroy to Curra
(Section D: Woondum to Curra)

Suitable translocation habitat adjacent to project area

Job Number	41-29914
Revision	0
Date	17 Oct 2017

Figure 2

\\ghdnet\ghd\AU\Brisbane\Projects\41\30594\GIS\Maps\Working\41_29914_3046_TranslocationMgmtPlan_Fig02_A3_Rev0.mxd

Data source: TMR: BAAM Flora Survey data (2015) (2016), Survey Area (2015), Chainage (2015), Imagery (2015); DNRM: Cadastre (2015), Protected Areas (2015), Waterways (2010). GHD: Project Area (2016), Suitable Offset Habitat (2017). Created by: sc

6 Innovation Parkway Birtinya QLD 4575 Australia T 61 7 5413 8100 F 61 7 5413 8199 E bta01mail@ghd.com W www.ghd.com

5. Translocation of plants

Translocation methods will be generally in accordance with Paul Forster's A translocation protocol for cycads in Queensland (2004). The process and site-specific requirements are further detailed below.

5.1 Protected plant surveys

The removal of plants from the impact sites and the preparation of the recipient site for the *M. pauli-guilielmi* individual translocations is likely to require the disturbance of native vegetation (including protected plants to be translocated) within high risk areas on the protected flora survey trigger area map. Protected plants are prescribed by the *Nature Conservation (Wildlife Management) Regulation 2006*. A survey for protected plant species shall be undertaken in accordance with the *Flora Survey Guidelines – Protected Plants* (EHP 2016) prior to translocation from the impact sites and prior to preparing the recipient site. This will identify whether any EVNT species (including other individuals of *M. pauli-guilielmi)* occur within 100 m of the disturbance footprints. This species can be detected at any time of year; however cones must be present in order to determine sex, which is thought to occur every 4-6 years and is therefore difficult to predict for timing of surveys. It is considered unlikely that other EVNT species will be present within the proposed clearing impact areas (due to extensive surveys and knowledge of the Project survey area).

The proposed removal of plants for the project and as part of the translocation works at the impact sites will require a protected plant clearing permit application to be submitted and approved, with an associated flora survey report, impact management plan and translocation management plan.

Due to the known presence of *M. pauli-guilielmi* individuals at the preferred recipient site, and the site preparation activities required within the planting area, it is likely that the protected plant clearing permit will need to incorporate the disturbance of a minor amount of native vegetation at the recipient site as well. Existing protected plants will be clearly marked on-site and site access, preparation and planting activities will be undertaken in a manner so as not to disturb these individuals. The planting along the existing access track at the preferred recipient site avoids major disturbance to surrounding vegetation. Results of the protected plant flora survey will provide further information for siting translocation activities and individual plantings.

5.2 Marking of plants to be translocated

The detailed survey results of BAAM (2016), which recorded the GPS coordinates of all *M. pauli-guilielmi* plants in the study area together with a count of the number of adult plants and seedlings associated with each record, shall be used to locate, identify and mark with labels all plants proposed to be translocated prior to any works commencing. Records shall be kept confirming the number of adult and seedling plants removed for translocation and their identifying numbers/labels. Each adult plant shall be marked on one side with a fluorescent spray-paint to deter poaching and to enable each plant to be replanted with a similar north-south orientation to its site of origin.

5.3 Translocation timing

The optimal time for translocation is before a new leaf flush, which generally occurs in the spring before the onset of the wet season. Translocation success is also enhanced if translocation occurs during the cooler autumn and winter months. Should a fire burn the habitat of the plants to be translocated prior to their translocation, the translocation shall still take place if the positions of the adult plants can still be accurately determined on the basis of residual foliage or markers. However, if all foliage is consumed by the fire, translocation shall be postponed to allow for resprouting leaves to reach maturity following the fire.

5.4 Weed hygiene

To manage the risk of weed introduction on the long-term health and viability of translocated plants, a strict weed hygiene protocol will be implemented for the translocation and monitoring phases. The impact sites and recipient site have similar weed populations, with *Lantana camara** (lantana) and *Passiflora suberosa** (corky passionflower) posing the greatest risk to the long-term health of translocated plants in remnant vegetation in the landscape. While there is little risk of transferring new weeds between impact sites and the recipient site, grazing paddocks in the broader landscape are infested with a variety of weeds, including *Sporobolus pyramidalis** (giant rat's tail grass) and *Sporobolus fertilis** (giant Parramatta grass). Therefore, there is a risk that vehicles travelling through open paddocks while accessing and leaving sites may pick up and spread propagules of these weeds.

The weed hygiene protocol shall include the following controls, as a minimum:

- All vehicles and machinery are to undergo a thorough weed washdown and inspection at an appropriate washdown facility before commencing work on site, to prevent the potential introduction and spread of weeds within the impacted sites and the recipient site.
- When travelling between impact sites and the recipient site, all vehicles and machinery shall keep to graded roads as far as possible and avoid travelling through areas infested with *S. pyramidalis** or *S. fertilis**, or shall undergo a thorough weed washdown and inspection before accessing impact or recipient sites after travelling through grassy paddocks.
- Training and inductions shall be provided for contractors and workers about the importance of weed hygiene, including a briefing on weed issues in the local landscape and appropriate hygiene measures.

5.5 Recipient site preparation

The term 'planting area' refers to the total extent of translocation works at the recipient site (shown on Figure 2). The planting area (indicatively shown on Figure 2 as being approximately 0.6 ha) has been selected to be:

- Sufficiently large to accommodate all translocated plants (making allowance for a minimum 2 m spacing between all plantings and 2 m buffer to existing trees and saplings, however of a size that will allow for much greater spacing and future planting of propagated seedlings)
- Along an existing, unutilised access track to facilitate access for translocation and maintenance
- In an area of deeper soils without surface rock to facilitate the digging of holes for plants, and
- In an area without a dense grass sward and with limited existing weed cover.

No native trees or shrubs shall need to be removed to accommodate the translocated plants or to carry out the necessary translocation works, however damage to native groundcover vegetation is likely to be required within the planting area. The translocation shall have no negative impact on any other conservation significant species listed under the EPBC Act or NC Act.

The presence of an existing, unutilised access track through the centre of the planting area for a length of approximately 150 m from the access point to the south will allow for ease of access for planting, monitoring and maintenance. It is proposed to plant along the existing track and within the vegetated buffers either side of the track up to a width of approximately 50 m. The area (being approximately 0.6 ha including the access track) will provide plant spacings of between 15-20 m^2, which will vary depending on the numbers of ungerminated seeds collected, existing trees and shrubs to be avoided, and propagated individuals to be planted. This planting area can be expanded if deemed necessary following the protected plant survey in order to provide adequate spacing between translocated and existing protected plants and to adjacent trees and shrubs. Internal fencing through this area will be removed prior to undertaking site preparation works.

The initial preparation of the recipient site shall involve the control of all weeds that have potential to impact on the health of *M. pauli-guilielmi* plants, particularly *L. camara** and *P. suberosa** weeds. Weeds shall be

controlled through hand removal and/or spot spraying with appropriate herbicides to establish a weed-free area within a 20 m radius of the full extent of the recipient planting area. Any necessary weed control activities shall be completed less than 4 weeks prior to translocation works commencing and shall preferably be undertaken using manual methods to minimise potential impacts on native plants in the planting area.

Immediately prior to translocation, planting holes shall be dug at the recipient site by hand or using an excavator or backhoe. To minimise damage to neighbouring tree root systems, avoid interference competition and allow space for natural recruitment of seedlings between adult plants, the planting holes shall be spaced 2 to 3 m apart in a loose grid pattern, but no closer than 2 m from any living tree or sapling. Soil surrounding the holes shall be loosened and the holes shall not be much deeper than the root system of the plants being transplanted.

5.6 Translocation methods

Prior to the start of translocation works, a work strategy will be discussed and clearly communicated to all members of the translocation team. This will allow the locations of all marked plants to be understood and identify a strategy for sequential digging up of plants in order to prevent any accidental damage by vehicles and machinery to plants not yet translocated.

The following shall be recorded at the time of the translocation:

- The date of translocation (start to finish)
- The name of the person/s responsible
- The GPS coordinate (and waypoint number) and age (adult/juvenile/seedling) of each translocated plant, including a unique identifier number for each translocated plant
- The number of leaves and foliage condition (living/dead, new/old, insect/vertebrate damage as percentage of leaf removed) for each plant, and any evidence of existing disturbance to plants (such as fire)
- Evidence of coning, and if so, whether male or female
- The number of ripe seeds collected and manually dispersed (with record of locations dispersed within (e.g. an area marked by GPS coordinates)
- Photographs before and after planting at the recipient site.

5.6.1 Translocation of adult plants

Large adult *M. pauli-guilielmi* plants can be successfully transplanted using the following methods:

- The area around each individual shall first be cleared of ground-cover and rocks by hand or with machinery, taking care to first identify the positions of any seedlings associated with adult plants (refer to Section 5.6.2 for translocation methods for seedlings) and to collect any loose seeds on the soil surface (refer to Section 5.6.3 for translocation methods for seeds)
- All excess or badly damaged leaf fronds shall be trimmed back to where the rachis is attached to the stems
- An anti-transpirant (e.g. Envy®) shall be sprayed onto the residual foliage of each plant to reduce water loss from transpiration
- The soil around each individual shall be loosened using a trenching pattern (either by hand or with the assistance of an excavator or backhoe), taking care not to damage any associated seedlings, the coralloid root system or the underground stem of the adult plant that can be up to 20 cm in diameter, and searching for and collecting any buried seeds at the same time (due to the sandy soil characteristics, a greater amount of material may need to be removed with the plant)

- Each individual adult plant may be extracted with the assistance of a small excavator or backhoe bucket, however further handling and soil removal should be undertaken by hand wherever possible to avoid damage and minimise loss of coralline root clusters, taking care to retain as much soil and organic matter around the root ball as possible, although this will be difficult given the nature of the soft, sandy soil and presence of rock outcrops at the impact sites
- Any damaged roots shall be trimmed with secateurs and a fungicide powder (e.g. Banrot® 400WP) applied to the damaged surfaces
- The rootball and roots shall be wrapped with hessian sacking (sewing the hessian closed if necessary to secure the root ball and soil for transport to the translocation site), and, if considered necessary, sprayed with water so that the root ball remains moist while the plant is awaiting replanting; alternatively, plants removed with limited soil around the root ball may be transported upright in 20 litre buckets backfilled with in situ soil
- The plants shall be kept shaded and transported to the translocation site as soon as possible from the time the plant is excavated, taking care to avoid bruising of plant stems. Heavy plants shall be loaded using a soft sling that is slung on a backhoe or excavator bucket and packed appropriately
- Just prior to planting, the hessian shall be removed and any further damaged roots shall be trimmed and a fungicide powder applied
- Plants shall be lowered gently and positioned vertically in the new holes, taking care to maintain the north-south orientation from the old locality, and back-filled using topsoil removed during the digging of the hole
- The foliage shall be sprayed for a second time with an anti-transpirant
- Each plant shall be watered thoroughly with 10 to 20 litres of water, including 5 to 9 litres of a systemic fungicide applied around each rootball
- The locations of all translocated plants shall be recorded via hand-held GPS together with their health at planting and age.

5.6.2 Translocation of seedlings

The translocation process for the many small seedlings currently associated with adult female plants shall be undertaken slightly differently from that of the adult plants, and shall use the following methods:

- Any seedlings associated with adult plants shall be carefully extracted by hand from the loose soil surrounding adult plants to avoid damage to the stem and roots, and then placed vertically in a potting bag, one seedling per bag, and the bag back-filled with soil dug from the original plant location
- Each potted seedling shall be watered with sufficient water to saturate the soil in the potting bag and placed in a shaded area until transported to the recipient site and their foliage shall be sprayed with an anti-transpirant
- Seedlings shall be planted out once the adult plants have been planted, around the perimeter of the adult planting area and/or in gaps between adult plants, selecting areas of limited grass and shrub cover to minimise the risk of mortality from fire
- Planting holes shall be dug by hand and ground cover vegetation trimmed within a 1 m radius of the planting holes
- Seedlings shall be gently lowered into the hole, positioned vertically and back-filled using topsoil removed during the digging of the hole
- Each seedling shall be watered thoroughly with at least 10 litres of water.

5.6.3 Translocation of seeds

A previous translocation of *M. pauli-guilielmi* for the Maryborough-Cooloola Coast Road documented that many ungerminated seeds could be found in the surface soil layer (A-horizon) associated with adult female plants, and that translocation and planting of these seeds at the recipient site promoted the establishment of new seedlings (Vegetation Matters 2015). To facilitate a net conservation benefit for the species, seeds shall be translocated using the following methods:

- During the initial clearing of vegetation from around adult female plants (identified from cones, the remains of cone stems or the presence of seedlings around the base of the plant), any seeds on the soil surface shall be collected
- During the extraction of adult female plants, the surface soil layer shall be carefully searched for older seeds that may be shallowly buried in soft sand, and similarly collected
- The viability of all collected seeds shall be tested by immersing them in a bucket of water; all seeds that float shall be discarded and all seeds that sink shall be planted
- Once all adult plants and seedlings have been translocated, any partially germinated seeds shall be planted among planted seedlings (and watered together with the seedlings) and all viable ungerminated seeds shall be planted in a specially demarcated area at the perimeter of the recipient site, with this area selected to have a relatively sparse groundcover to reduce the potential impact of competition interference from other plants.
- Each seed will be pressed into the surface of the soil in suitable micro-sites with a slight depression and sparse surrounding vegetation to promote germination and seedling survival. It is important to lightly cover them with the substrate/humus so that the seed is barely visible, which has been found to be successful with direct seeding of these types of macrozamias (P Forster, personal communication, November 2017).
- Ungerminated seeds shall not be watered during the six-month maintenance period unless monitoring during the maintenance period identifies that seeds have germinated, where after they shall be watered liberally during each maintenance watering event thereafter.

During each autumn monitoring event (see under Section 7.1) during the five-year monitoring period post-translocation, any ripe seeds that have fallen from female fruiting cones shall be collected and manually dispersed around the perimeter of the recipient site planting area to facilitate the longer-term expansion of the area of occupancy of *M. pauli-guilielmi* at the recipient site. This manual dispersal shall involve pressing each seed into the surface of the soil (but not covering it) in a suitable micro-site with a slight depression and sparse surrounding vegetation to promote germination and seedling survival. Seeds dispersed by this technique shall be allowed to germinate and grow naturally, and shall not be subject to supplementary watering.

6. Maintenance of translocated plants

To facilitate the establishment of translocated plants, maintenance watering should occur for six months following translocation. The recommended frequency of maintenance watering is at least once per month for adult plants and once every two weeks for seedlings and juveniles. Therefore, for the first six months following translocation, seedlings and juveniles shall be watered once every two weeks and adults once every 4 weeks (or as appropriate depending on the timing and quantity of rainfall during the maintenance period) with approximately 10 litres of water for seedlings and 10 to 20 litres of water for adults.

At the first signs of the spring growth flush during the maintenance period, the fresh foliage of each plant shall be watered and sprayed thoroughly with a systemic insecticide (e.g. Crown® or Confidor®) to avert insect attack. These systemic insecticides should be applied at a high concentration (e.g. 5 ml Crown® per 9 litres; 10 ml Confidor® per 9 litres). However, plants developing cones should not be sprayed.

A weed free zone (minimum radius 20 m of the planting area together with the perimeter area within which seeds are to be dispersed) shall be maintained for the duration of the six-month maintenance period by hand weeding and/or spot spraying with appropriate herbicides.

A record shall be kept of the date of each maintenance visit, whether any disturbance or damage to translocated plants was evident and whether any weed control or insect herbivore control activities were undertaken.

7. Monitoring and reporting

7.1 Monitoring

Monitoring is required to assess the success of translocation and monitor the health of the translocated plants and the condition of the translocation site to allow for timely and effective adaptive management should the monitoring detect emerging risks to translocation success. A recommendation that emerged from the monitoring of the Maryborough-Cooloola Coast Road *M. pauli-guilielmi* translocation was that the monitoring of translocation success be extended for an additional three annual monitoring events beyond the initial two years of monitoring, as the two-year period was considered too short to adequately assess longer-term survival (Vegetation Matters 2013).

Opportunistic monitoring of the health of translocated individuals and the presence of any degrading factors should be undertaken every two weeks for the first six months, in conjunction with the watering program. Any issues observed during the maintenance watering period will be recorded and actioned (e.g. additional weed control undertaken, additional watering, application of pesticide or other).

Formal monitoring events shall be undertaken twice each year during the first two years, in early summer (October to November) to assess the health of plants following the spring flush of new growth, and in autumn (April to May), to assess the extent of seed production and to manually disperse any ripe seed. The timing of the early summer survey should be flexible in relation to rainfall, which may affect the timing of the spring growth flush that tends to occur in response to the first substantial rainfall in spring. After the first two years, monitoring shall be undertaken once per year in autumn (April/May) for the next three years. The following parameters shall be recorded (on a field sheet developed for the project) during each monitoring event:

- The date of monitoring
- The name of the person undertaking the monitoring
- The GPS point number and age (adult/seedling) for each translocated plant, including a unique identifier number for each translocated plant
- The number of leaves and foliage condition (living/dead, new/old, insect/vertebrate damage as percentage of leaf removed) for each plant, and any evidence of disturbance to plants
- Evidence of coning, and if so, whether male or female
- The locations and number of any new seedlings
- The number of ripe seeds collected and manually dispersed
- Whether any weed control activities were undertaken
- Any adaptive management actions undertaken (see Table 5 below)

A weed free zone (minimum radius 20 m of the planting area together with the perimeter area within which seeds are to be dispersed) shall be maintained for the duration of the five year monitoring period by hand weeding and/or spot spraying with appropriate herbicides (as a component of the monitoring event) whenever declared and environmental weeds are detected during monitoring.

7.2 Adaptive management triggers and corrective actions

To facilitate adaptive management, management triggers and associated corrective actions are detailed in Table 5. These management actions will be recorded as part of the monitoring event field sheet records.

Table 5 Adaptive management framework for translocation monitoring

Management trigger	Assessment frequency	Corrective action
Presence of damage from feral animals (e.g. pigs)	Every 2 weeks in first 6 months, twice per year in the first 2 years, once per year in the following 3 years	Develop and implement appropriate control measures
Presence of declared and environmental weeds within 20 m of the planting area	Twice per year in the first 2 years, once per year in the following 3 years	Conduct weed removal and control using appropriate methods
Insect herbivory has removed greater than 25% of fresh leaf of any plant	Every 2 weeks in first 6 months, and after the spring growth flush in the following year	Spray the foliage of all plants with a systemic insecticide (e.g. Crown® or Confidor®) to avert insect attack
Vegetation growth within a 1 m radius of seedling and juvenile plants causing an increase in fuel loads around plants sensitive to fire	Every 2 weeks in first 6 months, twice per year in the first 2 years, once per year in the following 3 years	Remove vegetation fuels within a 1 m radius of seedling and juvenile plants through hand removal, brush cutting or use of appropriate herbicides
Evidence of plants dug up and removed by poachers	Every 2 weeks in first 6 months, twice per year in the first 2 years, once per year in the following 3 years	Reassess access controls and implement better controls on public access and assess need to replace plants removed
Mortality or loss of adult plants translocated to the recipient site	Twice per year in the first 2 years, once per year in the following 3 years	Develop and implement a program to collect seed from existing population prior to translocation occurring in order to propagate and plant the seedlings back into existing populations at a ratio of four seedlings established per adult plant lost to increase the size of existing populations

7.3 Reporting

Table 6 below summarises the reporting schedule for the Translocation Contractor during the translocation, maintenance and monitoring phases of the translocation process. The schedule for TMR reporting to DEE and EHP shall be confirmed to achieve compliance with approvals and permit conditions.

Table 6 Reporting schedule for the Translocation Contractor

Report type	Frequency and timing
Translocation report that details the timing and outcomes of the translocation, together with a summary of the health and number of adult, juvenile and seedling plants and ungerminated seeds translocated	Within one month of the completion of translocation works
Translocation monitoring report that reports on the results of translocation monitoring and translocation success to date	Once each year for five years, submitted within one month of the early summer (October-November) monitoring event in the first two years, and within one month of the annual (May) monitoring event in the subsequent three years

8. Risk management

8.1 Translocation timing

An important factor affecting the survival of translocated plants in previous translocations has been the timing of translocation; plants suffer greater mortality if they are not translocated during the cooler autumn or winter months prior to the spring flush of new foliage (Vegetation Matters 2013). The most common factor that constrains translocation timing is a Project construction deadline resulting from insufficient allowance being made during the planning stage for the approvals and permitting process in relation to Project deadlines and optimal translocation timing. This risk is being managed proactively for the current Project through the timely development of this Translocation Management Plan as part of a staged approvals and permitting process to achieve translocation in a timely manner.

8.2 Long-term active management

The long-term active management of recipient sites i.e. beyond the period of maintenance and monitoring outlined in a typical translocation management plan can be problematic to manage, audit and enforce. The risk that this presents for the long-term success of translocation, particularly the risk of long-term weed impacts can be minimised by selecting a recipient site in a relatively large tract of mature, remnant vegetation that has minimal baseline levels of weed infestation. Potential drawbacks can be competition with other plants and the risk of fire that may kill seedling plants, but these can be managed through the critical maintenance and monitoring period by planting at least 2 m from established trees and saplings and trimming surrounding grass and other potential fuels within a 1 m radius of translocated seedling plants during the maintenance period.

8.3 Long-term protection and viability

To maximise the long-term protection of the translocated plants, the receiving site will be required to be secured from future clearing. This can be achieved by the following mechanisms:

- An environmental offset protection area under section 30 of the *Environmental Offsets Act 2014*
- A voluntary declaration over the site under the *Vegetation Management Act 1999* which allows landholders to voluntarily protect native vegetation (not currently protected from clearing) for a range of purposes
- An area declared as an area of high nature conservation value under section 19F of the *Vegetation Management Act 1999*
- Declared as a nature refuge under section 46 of the NC Act
- Declared as a protected area under section 29(1) of the NC Act
- Secured as a statutory covenant for environmental purposes under the *Land Act 1994* or *Land Title Act 1994*

Mechanisms to legally secure these areas are prescribed under the relevant legislation.

The mechanism to be adopted to legally secure the recipient site for translocated *M. pauli-guilielmi* individuals shall be confirmed following negotiations with relevant stakeholders.

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Appendix D Rapid Condition Assessment Form

Rapid condition/suitability assessment form – Assessment unit:……. GPS WPt:……..

Photos (N,S,E W)	RE
Vegetation condition score (Kieghery)	
Impacts	
Weed cover and type	
Lowland rainforest present	
Waterways present	
Erosion risk	
Translocation constraints (Access, terrain)	

Quaternary Site Form

Location

Site:		**Recorder:**		**Day/Date:**	
Project:					
Locality:					
Coordinates:	Zone	E	N	**Datum:**	

Vegetation structure

Median height of EDL is to be measured
Cover density is to be estimated
D = touching-overlap <0; M = touching-slight separation 0-0.25; S = clearly separated 0.25-1; V = well separated 1-20

Stratum	Median height	Height interval	Est. cover density (% cover)
E		-	
T1		-	
T2		-	
T3		-	
S1		-	
S2		-	
G		-	

Structural formation (including height):

Ecologically dominant layer:

Land form element# (40 m radius):

Land form pattern# (300 m radius):

Soil and geology:

Slope and aspect:

Plant species

Record relative (numerical) dominance for each stratum;
d – dominant; ***c*** – codominant; ***s*** – subdominant; ***a*** – associated
* = exotic; ^{2} = class 2 declared weed; ^{3} = class 3 declared weed

Str.	Rel. dom.	Scientific Name

Condition Scale	Description
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback , logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Habitat index scoring guide (BBBQ) – Assessment Unit:

Threats to spp • Habitat loss and fragmentation (timber-harvesting, other forestry-related practices, agriculture, infrastructure construction and urban development) • Habitat degradation by cattle and feral pigs • Weed levels • frequent fires or lack of protection from fires • Predation by feral animals	Score	1		7	15
	Description	High threat level (i.e. likely to result in death, irreversible damage)		Moderate threat level	Low threat level (i.e. likely to survive)
Quality and availability of food and foraging habitat • Vegetation structure (vine thickets, rainforest or low thickets or woodlands with a dense understorey but little ground cover) • Connectivity • Weed levels	Score	1		5	10
	Description	Poor		Moderate	High (minimal thinning)
Quality and availability of shelter • Vegetation structure (vine thickets, rainforest or low thickets or woodlands with a dense understorey but little ground cover) • Litter cover and depth (3-10 cm) • Other microhabitat features (woody debris, hollow logs)	Score	1		5	10
	Description	Poor		Moderate	High
Species mobility capacity • Barriers to movement (roads, rail, etc)	Score	1	4	7	10
	Description	Severely restricted (76–100% reduction)	Highly restricted (51–75% reduction)	Moderately restricted (26–50% reduction)	Minor restriction (0–25% reduction

Additional notes:

Habitat index scoring guide (koala) - Assessment Unit:

Threats to spp • Habitat loss and fragmentation (timber-harvesting, other forestry-related practices, agriculture, infrastructure construction and urban development) • Mortality from dog attacks and vehicle strikes • Disease	Score	1		7	15
	Description	High threat level (i.e. likely to result in death, irreversible damage)		Moderate threat level	Low threat level (i.e. likely to survive)
Quality and availability of food and foraging habitat • Vegetation composition	Score	1		5	10
	Description	Poor		Moderate (1 species of known koala food tree present)	High (2 or more known koala food tree species)
Quality and availability of shelter • Vegetation structure (forest or woodland) • Connectivity	Score	1		5	10
	Description	Poor		Moderate	High
Species mobility capacity • Barriers to movement (roads, rail, non-vegetated areas etc)	Score	1	4	7	10
	Description	Severely restricted (76–100% reduction)	Highly restricted (51–75% reduction)	Moderately restricted (26–50% reduction)	Minor restriction (0–25% reduction

Additional notes:

Habitat index scoring guide (Marsdenia coronata) - Assessment Unit:

Threats to spp • Habitat loss and fragmentation (timber-harvesting, other forestry-related practices, agriculture, infrastructure construction and urban development) • Cattle • Weed invasion	Score	1	7	15
	Description	High threat level (i.e. likely to result in death, irreversible damage)	Moderate threat level	Low threat level (i.e. likely to survive)
Vegetation structure • Rainforest or open eucalypt forest and woodlands with shrub layer • sparse grass cover levels recorded at local occurrences	Score	1	5	10
	Description	Poor	Moderate	High
Associated species • Eucalyptus fibrosa, E. carnea, Corymbia citriodora), C. henryi, E. acmenoides and E. propinqua , C. intermedia	Score	1	5	10
	Description	Poor	Moderate	High
Landform suitability • hillslopes and ridge tops at altitudes of 40–780 m above sea level, also on rocky outcrops along clifflines • sandstone or stony soils - well drained, shallow, vary in texture from sandy, gravelly sand, loam to clay loam	Score	1	5	10
	Description	Poor	Moderate	High

Additional notes:

Habitat index scoring guide (MPG) - Assessment Unit:

Threats to spp • Habitat loss and fragmentation (timber-harvesting, other forestry-related practices, agriculture, infrastructure construction and urban development) • Predation and trampling • Weed invasion • Fire • Harvesting • Disease	Score	1	7	15
	Description	High threat level (i.e. likely to result in death, irreversible damage)	Moderate threat level	Low threat level (i.e. likely to survive)
Vegetation structure • Lowland open forest or woodland	Score	1	5	10
	Description	Poor	Moderate	High
Associated species • Banksias or eucalypts (A. leiocarpa Leptospermum species; E. racemosa; A. leiocarpa, C. intermedia, E. pilularis, E. microcorys, L. confertus, various rainforest elements; C. citriodora subsp. variegata, and E. fibrosa).	Score	1	5	10
	Description	Poor	Moderate	High
Landform suitability • Stabilised sand dunes • Mid-slope position of landzone 9-10	Score	1	5	10
	Description	Poor	Moderate	High

Additional notes (e.g. proximity to existing populations):

Appendix E Offset Assessment Guides

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Black-breasted button-quail
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Black-breasted button-quail habitat	**Area**	8.08	Hectares	Field and desktop assessments, species profiles and population data
			Quality	**9**	Scale 0-10	
			Total quantum of impact	7.27	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	7.27	Adjusted hectares	Land-based offsets of existing habitat for species	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	23.15	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	0%	11.58	90%	10.42	10.01	11.08	152.36%	Yes	
									Future area without offset (adjusted hectares)	11.6	**Future area with offset (adjusted hectares)**	23.2								
					Time until ecological benefit	3	**Start quality (scale of 0-10)**	**8**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**9**	2.00	90%	1.80	1.79				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	7.272	11.08	152.36%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Phascolarctos cinereus
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Koala habitat critical to survival	**Area**	135.8	Hectares	Field and desktop assessments, species profiles and population information
			Quality	**8**	Scale 0-10	
			Total quantum of impact	108.66	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	108.66	Adjusted hectares	Land-based offsets of existing koala habitat	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	296.29	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	0%	148.15	90%	133.33	128.11	142.25	130.90%	Yes	
									Future area without offset (adjusted hectares)	148.1	**Future area with offset (adjusted hectares)**	296.3								
					Time until ecological benefit	3	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**5**	**Future quality with offset (scale of 0-10)**	**8**	3.00	90%	2.70	2.68				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	108.664	142.25	130.90%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Macrozamia pauli-guilielmi
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	Yes	Macrozamia pauli-guilielmi	10		Count	Potential loss of 12% of 76 adult individuals translocated

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	Yes	10	Count	Replacement of lost individuals through propagation and planting at a ratio of 4:1	2		5		20		40		20	90%	18.00	17.58	175.76%	Yes		Desktop assessments, field surveys, translocation management plan

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	10	17.58	175.76%	**Yes**	$0.00	N/A	$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Lowland rainforest of subtropical
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	**6.8%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes	Lowland rainforest of subtropical Australia TEC	**Area**	0.79	Hectares	Surveys and desktop assessments, TEC listing advice and condition thresholds
			Quality	**8**	Scale 0-10	
			Total quantum of impact	0.63	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality	**0**		
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																					
Area of community	Yes	0.63	Adjusted hectares	Land-based offset of existing Lowland rainforest TEC	**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	6.52	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	0%	3.26	90%	2.93	0.79	1.35	213.96%	Yes		
									Future area without offset (adjusted hectares)	3.3	**Future area with offset (adjusted hectares)**	6.5									
					Time until ecological benefit	3	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**5**	**Future quality with offset (scale of 0-10)**	**8**	3.00	90%	2.70	2.22					
Threatened species habitat																					
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**										
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0									
					Time until ecological benefit		**Start quality (scale of 0-10)**	**0**	**Future quality without offset (scale of 0-10)**	**0**	**Future quality with offset (scale of 0-10)**	**0**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Threatened species																					
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	0.632	1.35	213.96%	**Yes**	$0.00	N/A	$0.00
					$0.00	**$0.00**	**$0.00**