



Environmental Authority Amendment Application Supporting Report

P-EA-100658735 and P-PRCP-100669070_V1

Centurion Coal Mining Pty Ltd.

Moranbah, Queensland 4744

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Centurion Coal Mining Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Executive Summary

Centurion Coal Mining Pty Ltd has recently secured the rights to further explore resources under a portion of Mining Lease (ML) 1790 and ML 70495 located immediately adjacent to and directly north of the Centurion Coal Mine, an existing underground longwall mine located on ML 6949.

As a result, Centurion Coal Mining Pty Ltd proposes to undertake exploration activities which consist of a pilot coal seam gas (CSG) exploration and extraction programme (the Project) within ML 1790. Exploration and evaluation of CSG requires the implementation of a network of 13 vertical and 10 lateral wells, extending from the ground surface down to the Goonyella Middle coal seam. These wells will be connected to flare kits and be supported by other surface infrastructure for CSG processing, monitoring, and control.

To obtain authorisation for the Project activities, an amendment to the Environmental Authority (EA) P-EA-100658735 and Progressive Rehabilitation and Closure Plan (PRCP) P-PRCP-100669070_V1 is required. The proposed changes include:

- EA P-EA-100658735:
 - Condition 15 Schedule A.
 - Condition 7 Schedule F.
 - Condition 9 Schedule F.
 - Condition 22 Schedule F.
- PRCP P-PRCP-100669070_V1:
 - Section B - Figure 1.
 - Section C – (RA1) Rehabilitation area 1

Assessments air quality, greenhouse gas, noise and vibration, terrestrial ecology, aquatic ecology, groundwater, surface water, and waste management were undertaken to determine impacts. The impacts resulting from Project activities along with mitigation measures are presented in this Supporting Report.

Risk assessments have determined that the proposed Project activities pose a low risk of causing environmental harm/ nuisance beyond that authorised by the EA. This is attributed to the scale and location of the Project activities, and that these activities can be managed under the monitoring and compliance requirements of the existing EA and Centurion Coal Mine management practices that will be applied to the Project to minimise and/or prevent unauthorised harm to Environmental Values from the Project.

Based on the outcomes of the assessments undertaken, Centurion Coal Mining Pty Ltd consider that the approvals pathway is commensurate to a minor EA Amendment process.



Table of Contents

Basis of Report	i
Executive Summary	ii
Acronyms and Abbreviations	ix
1.0 Introduction	1
1.1 Objective of this Environmental Authority Amendment	1
1.2 Project Background	1
1.3 Project Objectives	1
1.4 Report Structure	2
2.0 Legislative Context	3
2.1 Mineral Resources Act 1989	3
2.2 Environmental Protection Act 1994	3
2.2.1 Amendment Threshold	4
2.2.2 Standard Criteria	5
2.2.3 Environmentally Relevant Activities	8
2.2.4 Environmental Protection (Air) Policy 2019	8
2.2.5 Environmental Protection (Noise) Policy 2019	8
2.2.6 Environmental Protection (Water and Wetland Biodiversity) Act 2019	9
2.3 Environment Protection and Biodiversity Conservation Act 1999	9
2.4 Water Act 2000	10
2.5 Regional Planning Interests Act 2014	10
3.0 Activities Subject of this EA Amendment	11
3.1 Location of the Project	11
3.2 Access Tracks	13
3.3 Coal Seam Gas Exploration	13
3.3.1 Drill Pad	13
3.3.2 Vertical Wells	14
3.3.3 Lateral Wells	14
3.3.4 Exploration Method	15
3.4 Water	18
3.5 Power	18
3.6 Amenities	18
3.7 Equipment	19
3.8 Workforce and Working Hours	20
3.9 Hours of Operation	20



3.10	Rehabilitation and Closure	20
3.11	Project Schedule	23
4.0	Proposed EA and PRCP Amendments	24
4.1	Environmental Authority	24
4.1.1	Condition 15 Schedule A	24
4.1.2	Condition 7 Schedule F	25
4.1.3	Condition 9 Schedule F	25
4.1.4	Condition 22 Schedule F	26
4.2	Progressive Rehabilitation and Closure Plan	28
4.2.1	Section B – Final site design and reference maps	28
4.2.2	Section C – Post-mining land uses	28
5.0	Assessment Methodology	30
5.1	Terminology	30
5.2	Methodology to Identify Environmental Impacts	30
5.2.1	Terrestrial and Aquatic Ecology	31
5.2.2	Groundwater Assessment	31
5.3	Risk Assessment Methodology	31
6.0	Environmental Assessments	33
6.1	Air Quality	34
6.1.1	Existing Environmental Values	34
6.1.2	Potential Impacts	39
6.1.3	Management Practices	40
6.1.4	Risk Assessment	41
6.2	Greenhouse Gas	42
6.2.1	Existing Environmental Values	42
6.2.2	Potential Impacts	45
6.2.3	Management Practices	47
6.2.4	Risk Assessment	47
6.3	Noise and Vibration	49
6.3.1	Existing Environment	49
6.3.2	Potential Impacts	52
6.3.3	Management Practices	58
6.3.4	Risk Assessment	58
6.4	Land Resources	59
6.4.1	Existing Environmental Values	59
6.4.2	Potential Impacts	70



6.4.3	Management Practices.....	72
6.4.4	Risk Assessment.....	72
6.5	Terrestrial Ecology	75
6.5.1	Existing Environmental Values	75
6.5.2	Summary of MSES.....	92
6.5.3	Potential Impacts.....	95
6.5.4	Management Practices.....	98
6.5.5	Risk Assessment.....	100
6.6	Aquatic Ecology	102
6.6.1	Existing Environmental Values	102
6.6.2	Summary of MSES.....	103
6.6.3	Potential Impacts.....	104
6.6.4	Management Practices.....	104
6.6.5	Risk Assessment.....	105
6.7	Groundwater	105
6.7.1	Existing Environmental Values	106
6.7.2	Proposed Activities.....	119
6.7.3	Prediction of Impacts.....	119
6.7.4	Risk Assessment.....	127
6.7.5	Limitations.....	132
6.8	Surface Water	133
6.8.1	Existing Environmental Values	133
6.8.2	Potential Impacts.....	136
6.8.3	Management Practices.....	136
6.8.4	Risk Assessment.....	136
6.9	Waste.....	138
6.9.1	Existing Environmental Values	138
6.9.2	Potential Impacts.....	138
6.9.3	Management Practices.....	143
6.9.4	Risk Assessment.....	144
7.0	Conclusion	146
8.0	References.....	147



Tables in Text

Table 1.1	Report structure	2
Table 2.1	Summary of minor EA amendment threshold criteria (Section 223)	4
Table 2.2	Assessment of standard criteria	5
Table 3.1	Drill pad disturbance area	13
Table 3.2	Equipment requirements	19
Table 4.1	EA P-EA-100658735 Condition A15.....	24
Table 4.2	EA P-EA-100658735 Condition F7.....	25
Table 4.3	EA P-EA-100658735 Condition F9.....	25
Table 4.4	EA P-EA-100658735 Condition F22.....	26
Table 4.5	PRCP P-PRCP-100669070_V1 Section B – Figure 1	28
Table 4.6	PRCP P-PRCP-100669070_V1 Section C – (RA1) Rehabilitation area 1.....	28
Table 5.1	Likelihood level	31
Table 5.2	Consequence rating	31
Table 5.3	Risk matrix	32
Table 5.4	Descriptions of risk rating	32
Table 6.1	Environmental values not subject to potential impacts	33
Table 6.2	Receptors Surrounding the Project	34
Table 6.3	Ambient Air Quality Objectives.....	36
Table 6.4	Estimates of background levels of pollutants.....	38
Table 6.5	Air quality risk assessment.....	41
Table 6.6	Rainfall and temperature climate statistics based on data obtained from the BoM MWTP monitoring station (1972-2012).....	42
Table 6.7	National Greenhouse Accounts Emission Factors (Scope 1).....	45
Table 6.8	Summary of GHG Emissions.....	47
Table 6.9	Greenhouse gas risk assessment	48
Table 6.10	Receptors Surrounding the Project	49
Table 6.11	Baseline noise monitoring results summary	51
Table 6.12	Modelled meteorological conditions	52
Table 6.13	Modelled scenarios and equipment SWL data – A-weighted.....	53
Table 6.14	Predicted worst-case new access track and drill pad construction noise levels.....	54
Table 6.15	Predicted worst-case CSG exploration drilling noise levels	56
Table 6.16	Predicted worst-case CSG well operational noise levels	57



Table 6.17	Noise and vibration risk assessment	58
Table 6.18	Surface geology lithological summary	59
Table 6.19	Soil order chemical properties summary	64
Table 6.20	Queensland suitability classes	67
Table 6.21	Land resources risk assessment	73
Table 6.22	Ground-truthed REs within the Project Area.....	75
Table 6.23	MSES regulated vegetation within the Project Area	94
Table 6.24	MSES protected wildlife habitat within the Project Area	95
Table 6.25	Direct impacts to remnant and mature regrowth REs within the Project Area ..	96
Table 6.26	Direct impacts to threatened flora and fauna habitat within the Project Area ...	96
Table 6.27	Groundwater Section 126A	105
Table 6.28	Hydraulic conductivity estimates from field testing	110
Table 6.29	Pumping stress periods used in model.....	122
Table 6.30	Model aquifer layering and hydraulic parameters	123
Table 6.31	Sensitivity analysis of interburden vertical conductivity.....	127
Table 6.32	Likelihood Categories.....	128
Table 6.33	Consequence Categories.....	128
Table 6.34	Risk Ranking Matrix	129
Table 6.35	Risk assessment summary	130
Table 6.36	Suttor River at Eaglefield: flow volume summary (ML)	134
Table 6.37	Surface water risk assessment	137
Table 6.38	Waste types anticipated from Project activities.....	139
Table 6.39	Waste risk assessment	144

Figures in Text

Figure 3.1	Project location	12
Figure 3.2	Proposed project layout	16
Figure 3.3	Proposed final site design	22
Figure 6.1	Location of sensitive air receptors.....	35
Figure 6.2	Location of DESI Moranbah Monitoring Stations.....	37
Figure 6.3	Location of assessed receptors.....	50
Figure 6.4	Surface geology	61
Figure 6.5	Atlas of Australian Soils	62
Figure 6.6	ASC of Project Areas (SKM, 2012)	65
Figure 6.7	ASC of Project Areas (DNRME and DES 2024)	66



Figure 6.8	Grazing land class suitability	68
Figure 6.9	Cropping land class suitability	69
Figure 6.10	Ground-truthed regional ecosystems	77
Figure 6.11	Threatened ecological communities	78
Figure 6.12	Dichanthium Queenslandicum records and habitat	80
Figure 6.13	<i>Digitaria porrecta</i> records and habitat	81
Figure 6.14	Koala records and habitat	85
Figure 6.15	Short-beaked echidna records and habitat.....	86
Figure 6.16	Squatter pigeon (southern) records and habitat	87
Figure 6.17	White-throated needletail habitat.....	88
Figure 6.18	Fork-tailed swift habitat	90
Figure 6.19	Oriental cuckoo habitat	91
Figure 6.21	Vertical well depth.....	107
Figure 6.22	Surface geology and monitoring network	111
Figure 6.23	Permian coal measures groundwater contours	114
Figure 6.24	Groundwater dependent ecosystem mapping and private bores.....	117
Figure 6.25	Predicted drawdown in coal seam.....	126
Figure 6.26	Regional drainage.....	135

Appendices

Appendix A Terrestrial Ecology and Aquatic Ecology Methodology to Identify Environmental Impacts

Appendix B MSES significant residual impact assessments

Appendix C Greenhouse Gas Abatement Plan



Acronyms and Abbreviations

ALD	Assessment level decision
AUSRIVAS	Australian River Assessment System
BAR	Bioacoustic records
CCM	Centurion Coal Mine
CEC	Cation exchange capacity
CH ₄	Methane
CONCAWE	The Conservation of Clean Air and Water Europe
CSG	Coal seam gas
dBa	Decibels A
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEHP	Department of the Environment and Heritage Protection
DES	Department of Environment and Science
DESI	Department of Environment, Science and Innovation
DEWHA	Department of the Environment, Water, Heritage and the Arts
DNRM	Department of Natural Resource Management
DNRME	Department of Natural Resources, Mines and Energy
DoR	Department of Resources
DotE	Department of the Environment
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
DSITI	Department of Science, Information Technology and Innovation
EA	Environmental authority
EIS	Environmental Impact Statement
EO Act	<i>Environmental Offsets Act 2014</i>
EO Regulation	Environmental Offsets Regulation 2014
EP Act	<i>Environmental Protection Act 1994</i>
EP Regulation	Environment Protection Regulation 2019
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EPP	Environmental Protection Policy
ERA	Environmentally Relevant Activities
ERC	Estimated Rehabilitation Cost
E2M	E2M Consulting Pty Ltd
GDE	Groundwater-dependent ecosystem
GHG	Greenhouse gas
GHG Act	<i>Greenhouse Gas Storage Act 2009</i>
GM	Goonyella Middle
ha	Hectares
HDPE	High density poly ethylene
Hydrobiology	Hydrobiology Pty Ltd
Hz	Hertz
ID	Identification
IESC	Independent Expert Scientific Committee
ISO	International Organisation for Standardisation
kL	kilolitre



km	kilometers
kpa	kilopascals
kV	kilovolt
L	litre
LIKT	Locally important koala tree
m	meters
mm	millimeters
mbGL	meters below ground level
MMC	Model Mining Conditions Guideline
MDL	Mineral development lease
ML	Mega litres
ML	Mining lease
MNES	Matters of national environmental significance
MR Act	<i>Mineral Resources Act 1989</i>
MSES	Matters of state environmental significance
NA	Not applicable
NC Act	<i>Nature Conservation Act 1992</i>
NEPM	National Environment Protection Measures
PET	Plecoptera, Ephemeroptera, and Trichoptera macroinvertebrates
PM	Particulate matter
PNC	EcoAccess Planning for Noise Control guideline
PPV	Peak particle velocity
PRCP	Progressive Rehabilitation and Closure Plan
RBL	Rating background levels
RE	Regional Ecosystem
RIDA	Regional Interests Development Approval
RPI Act	<i>Regional Planning Interests Act 2014</i>
SCADA	Supervisory Control and Data Acquisition
SEVT	Semi-evergreen vine thicket
SIGNAL	Stream Invertebrate Grade Number - Average Level
SIS	Surface-to-inseam
SLR	SLR Consulting Australia
SO	Stream order
SRI	Significant Residual Impact
SWL	Sound power level
SWL	Standing water level
t	tonnes
TEC	Threatened ecological communities
TEP	Transitional Environment Programs
TSP	Total suspended particulates
TSSC	Threatened Species Scientific Committee
VM Act	<i>Vegetation Management Act 1999</i>
W	Watts



1.0 Introduction

This section presents the background, objectives, and structure of this supporting report.

1.1 Objective of this Environmental Authority Amendment

Centurion Coal Mining Pty Ltd (a subsidiary of Peabody Energy Australia PCI PTY LTD) is seeking authorisation to undertake exploration activities which consist of a pilot coal seam gas (CSG) exploration and extraction programme on Mining Lease (ML) 1790.

To obtain authorisation for these activities, an amendment to the Environmental Authority (EA) P-EA-100658735 and Progressive Rehabilitation and Closure Plan (PRCP) P - PRCP - 100669070_V1 is required.

This report has been prepared to support an amendment to P-EA-100658735 and P- PRCP - 100669070_V1 under Section 226A of the *Environmental Protection Act 1994* (EP Act).

1.2 Project Background

Centurion Coal Mining Pty Ltd has recently secured the rights to further explore resources under a portion of ML 1790 and ML 70495 located immediately adjacent to and directly north of the Centurion Coal Mine (CCM), an existing underground longwall mine located on ML 6949.

As a result, Centurion Coal Mining Pty Ltd proposes to undertake the Project exploration activities on ML 1790. The activities and infrastructure associated with the pilot CSG exploration and extraction programme are the subject of this EA and PRCP Amendment and are henceforth referred to as 'the Project'.

1.3 Project Objectives

The objectives of the Project are:

- **Resource identification and characterisation:** Determine the presence, quantity, and quality of CSG within the Goonyella Middle (GM) coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity). As the exploration wells are brought online, the water and gas production are monitored and measured to determine the drawdown characteristics of the water and CSG within the GM coal seam.
- **Feasibility assessment:** There had been no historical testing on ML1790 to measure CSG drainage performance. This Project is required to understand more about the characteristics of the GM coal seam and the contained gas. This is required to develop management plans for the safe, environmentally conscience and economic extraction of CSG and coal from the ML1790. The drilling and sampling of the resource, and data gathering from the exploration works enables resource and groundwater models to be built and verified. From this the technical and economic analysis can be based on more reliable information to assess the feasibility of extracting the resource.
- **Impact and risk assessment:** Monitor and evaluate potential impacts associated with CSG exploration and extraction on environmental values (EVs); and refine mitigation measures to ensure the safety and success of the Project.



- **Regulatory compliance:** Ensure that exploration activities comply with, or exceed, local, state, and commonwealth regulations.

1.4 Report Structure

This Report is structured as shown in **Table 1.1**.

Table 1.1 Report structure

Chapter	Content
Chapter 1: Introduction (this chapter)	Objectives of the EA Amendment Application Supporting Report, project background, project objectives, and report structure.
Chapter 2: Legislation Context	Key legislation, policies and guidelines to this project.
Chapter 3: Activities Subject to this EA Amendment	Design information on each phase of the Project to inform the impact assessment process. Includes the project justification and alternatives assessment.
Chapter 4: Proposed EA Amendments	Conditions of EA P-EA-100658735 and PRCP P-PRCP-100669070_V1 that require amendment.
Chapter 5: Assessment Methodology	A description of the environmental assessment process and approach taken to determining the significance of impacts and appropriate mitigation.
Chapters 6: Environmental Assessment	An assessment of the Project's environmental impacts on air quality, greenhouse gases (GHG), noise and vibration, land resources, terrestrial ecology, aquatic ecology, surface water and groundwater resources, and waste management. Includes a description of relevant legislation, policies and guidelines adopted for this assessment, a description of baseline characteristics, identified mitigation measures to reduce or avoid significant impacts, and a summary of the residual (post-mitigation) effects.
Chapter 7: Conclusion	A summary of the EA Amendment Application Supporting Report findings.
Chapter 8: Reference	-



2.0 Legislative Context

This section summarises the key State and Commonwealth legislation, policies, and guidelines applicable to the Project.

2.1 Mineral Resources Act 1989

The Mineral Resources Act 1989 (MR Act) is administered by the Department of Resources (DoR) and provides for “the assessment, development and utilisation of mineral resources to the maximum extent practicable consistent with sound economic and land use management”.

The principal objectives of the MR Act are to:

- Encourage and facilitate prospecting and exploring for and mining of minerals.
- Enhance knowledge of the mineral resources of the State.
- Minimise land use conflict with respect to prospecting, exploring and mining.
- Encourage environmental responsibility in prospecting, exploring and mining.
- Ensure an appropriate financial return to the State from mining.
- Provide an administrative framework to expedite and regulate prospecting and exploring for and mining of minerals.
- Encourage responsible land care management in prospecting, exploring and mining.

The MR Act provides for the granting, conditioning and management of mining tenements, prospecting permits, exploration permits, mineral development licences, mining leases and mining claims.

A ML (with surface rights) under the MR Act is required to permit the conduct of mining and associated activities within the ML. The Project footprint is located within ML 1790, which authorise surface rights to access minerals and gaseous hydrocarbons in the Project Area.

2.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994 (EP Act)* was established “to protect Queensland’s environment, while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends”.

Resource activities carried out on mining tenure are approved via the grant of an EA under Chapter 5 of the EP Act. When deciding whether to grant or refuse an application for an EA or an amendment to an EA or deciding on the conditions of the EA, the Department of Environment, Science and Innovation (DESI), the administering authority, must consider certain matters set out in the EP Act.

The EP Act utilises several mechanisms to achieve its objectives. These include:

- EA assessment processes, including where applicable, an Environmental Impact Statement (EIS) process for resource projects.
- Licensing or approving all Environmentally Relevant Activities (ERAs).
- Major and minor EA Amendment provisions to EAs.
- Allowing for improvement through Transitional Environment Programs (TEPs).
- Issuing Environmental Protection Policies (EPPs).



- Regulating contaminated land.
- Creating a general environmental duty.

An EA Amendment is required where there is a proposed change to the nature and extent of authorised activities on an associated ML(s) and/or the conditions of the EA need to be amended. For the Project to proceed, an amendment to the existing EA Conditions is required.

2.2.1 Amendment Threshold

A minor amendment for an EA under Section 223 of the EP Act “means an amendment that is for an environmental authority a condition conversion; or a minor amendment (threshold)”. An assessment of the proposed EA Amendment for the Project against the minor amendment (threshold) criteria (as outlined in Section 223 of the EP Act) is presented in **Table 2.1**.

Table 2.1 Summary of minor EA amendment threshold criteria (Section 223)

Minor EA Amendment Threshold Criteria	This EA Amendment Application
The proposed amendment:	
a) is not a change to a condition identified in the authority as a standard condition, other than – i. a change that is a condition conversion. ii. a change that is not a condition conversion but that replaces a standard condition of the authority with a standard condition for the environmentally relevant activity to which the authority relates. iii. a change that will not result in a change to the impact of the relevant activity on an EV.	The Project is not a change to a standard condition.
b) does not significantly increase the level of environmental harm caused by the relevant activity	The Project does not significantly increase the level of environmental harm, as demonstrated under Section 6.0 .
c) does not change any rehabilitation objectives stated in the authority in a way likely to result in significantly different impacts on EVs than the impacts previously permitted under the authority	The Project does not result in any changes to the current rehabilitation objectives that would result in a significant impact on EV, as demonstrated under Section 6.0 .
d) does not significantly increase the scale or intensity of the relevant activity	The Project does not significantly increase the intensity of the relevant activities, as demonstrated under Section 6.0 .
e) does not relate to a new relevant resource tenure for the authority that is— i. a new mining lease ii. a new petroleum lease iii. new geothermal lease under the Geothermal Energy Act iv. a new GHG injection and storage lease under the GHG storage Act	The Project does not relate to a new resource tenure for the EA.



Minor EA Amendment Threshold Criteria	This EA Amendment Application
f) involves an addition to the surface area for the relevant activity of no more than 10% of the existing area	The Project will not change the existing surface area for the relevant activities by more than 10%, as demonstrated under Section 3.0 and Section 6.0 .
g) for an environmental authority for a petroleum activity— i. involves constructing a new pipeline that does not exceed 150km ii. involves extending an existing pipeline so that the extension does not exceed 10% of the existing length of the pipeline	Not Applicable.
h) if the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—seeks, in the amendment application under section 224, an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit.	The Project will adhere to the standard conditions for the relevant authority.

This assessment demonstrates that the proposed EA Amendment is not a major amendment, and it therefore should be considered a minor EA amendment for the purposes of the EP Act.

2.2.1.1 Assessment Level Decision

Within 10 business days after receiving an EA Amendment Application, DESI must make an Assessment Level Decision (ALD). The ALD process will determine whether the amendment application is a minor or major amendment (with or without an EIS).

2.2.1.2 Public Interest and Notification

Centurion Coal Mining Pty Ltd considers that the Project does not represent a significant impact to EVs to that currently approved under the EA P-EA-100658735. It is therefore reasonably considered unlikely that the Project (and accompanying EA amendment) will trigger minimal, if any, public interest.

2.2.2 Standard Criteria

The Standard Criteria, as defined in Schedule 4 of the EP Act, has been considered to assist in assessing the significance of the proposed amendment and to assist the DESI in the assessment of the proposed application as a minor amendment in accordance with Section 241 of the EP Act. Centurion Coal Mining Pty Ltd assessment against the Standard Criteria is outlined in Table 2.2.

Table 2.2 Assessment of standard criteria

EP Act Reference	Legislation Requirement	How Requirement is Addressed
Standard criteria (a)	The following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment—	(i) Peabody has evaluated the risk of potential environmental impact in line with the precautionary principle. These evaluations have formed the development of suitable environmental



EP Act Reference	Legislation Requirement	How Requirement is Addressed
	(i) the precautionary principle; (ii) intergenerational equity; (iii) conservation of biological diversity and ecological integrity	avoidance and mitigation measures, detailed in each Environmental Assessment provided in Section 6.0 for the technical disciplines. Peabody possesses the necessary technical expertise, financial backing, and resources to implement and sustain the suggested environmental mitigation measures for the Project. (ii) The Project will balance economic benefit with minimal environmental disturbance, beneficial infrastructure construction, and post-mining land use planning. It emphasises maintaining environmental value, reducing impact, and using existing infrastructure where possible. Intergenerational equity is addressed through long-term land use planning, community impact consideration, and environmental monitoring and mitigation measures. (iii) The Project will retain remnant vegetation, use existing infrastructure to limit clearing, and plan progressive rehabilitation. Mitigation measures include preserving riparian zones, minimising clearing, managing weeds, and rehabilitating with native species.
Standard criteria (b)	Any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development.	It is expected that the Project will be consistent with the Isaac Regional Planning Scheme Version 1.1, July 2024. Relevant standards include those set out under the <i>National Environment Protection Council (Queensland) Act 1994</i>. National Environment Protection Measures (NEPMs) outline national objectives for protecting and managing aspects of the environment. These NEPMs have been considered during the environmental assessment stage for the Project. The following EPPs are relevant to the Project and discussed in Section 2.2.4, 2.2.5, and 2.2.6.
Standard criteria (d)	Any relevant environmental impact study, assessment or report.	Peabody has conducted environmental assessments commensurate with a minor EA Amendment Application under the EP Act. These assessments have prioritised key factors such as air quality, GHG, noise and vibration, surface water and groundwater resources, terrestrial and aquatic ecology, GDEs, and waste management i.e., critical matters. They comprehensively address current environmental values, potential



EP Act Reference	Legislation Requirement	How Requirement is Addressed
		impacts, and strategies for avoiding, managing, mitigating, and rehabilitating these impacts.
Standard criteria (e)	The character, resilience and values of the receiving environment.	The ML 1790 and ML 70495 are situated amongst a coal mining region in the Bowen Basin where resource extraction, agriculture and livestock grazing are the predominant, co-existent land uses. The Project is located on an area that has been subject to previous drilling and exploration activities. As a result, the landscape has been highly modified. An assessment of environmental characteristics was conducted (Section 6.0) as part of this amendment application.
Standard criteria (f)	All submissions made by the applicant and submitters.	The Project and associated environmental studies will constitute Peabody's submission in support of the EA Amendment Application. Peabody will undertake an appropriate level of formal and non-formal key stakeholder consultation during the EA Amendment process in line with Peabody's existing stakeholder engagement principles and process. Peabody will respond to complaints and concerns from the public during the Project should they arise.
Standard criteria (g)	The best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows— (i) an environmental authority (ii) a transitional environmental program (iii) an environmental protection order (iv) a disposal permit (v) a development approval	P-EA-100658735 sets out suitable environmental management practice for the proposed activities and is not the subject of: (ii) a transitional environmental program (iii) an environmental protection order (iv) a disposal permit, or (v) a development approval.
Standard criteria (h)	The financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument	Approval of this EA Amendment will require an amendment to the current estimated rehabilitation cost (ERC) decision. This will be addressed following approval of the amendment application.
Standard criteria (i)	The public interest	Issues of community interest and concern will be addressed during the EA Amendment process. Peabody will continue to engage with the relevant key stakeholders in relation to the Project as an extension of its existing stakeholder engagement program. In addition, the Project does not represent a significant impact to EVs that is currently approved under the EA P-EA-100658735. It



EP Act Reference	Legislation Requirement	How Requirement is Addressed
		is therefore reasonably considered unlikely that the Project (and accompanying EA amendment) would trigger minimal, if any, public interest.
Standard criteria (j)	Any relevant site management plan	The existing CCM environmental management plans will be updated accordingly, stating the management strategies to prevent or minimise the potential for environmental harm from the Project. They will also set out a framework to manage environmental obligations set out in the EA.
Standard criteria (k)	Any relevant integrated environmental management system or proposed integrated environmental management system	The Project will operate in accordance with the existing CCM Environmental Management Framework and other related documentation.

2.2.3 Environmentally Relevant Activities

ERAs described under the *Environment Protection Regulation 2019* (Qld) (EP Regulation) and authorised to take place on ML 1790 and ML 70495 will continue to be undertaken under EA (P-EA-100658735).

The Project will not require the authorisation of any additional ERAs.

2.2.4 Environmental Protection (Air) Policy 2019

The purpose of the *Environmental Protection (Air) Policy 2019* (EPP(Air)) is to achieve the relevant objectives of the EP Act by:

- Identifying EVs to be enhanced or protected.
- Stating indicators and air quality objectives for enhancing or protecting the EVs.
- Providing a framework for making consistent, equitable and informed decisions about the air environment.

This EA Amendment outlines an air quality assessment in **Section 1.1**, inclusive of a summary of management and mitigation measures and risk assessment of impacts to the air shed and sensitive receptors.

2.2.5 Environmental Protection (Noise) Policy 2019

The purpose of the *Environmental Protection (Noise) Policy 2019* (EPP(Noise)) is to achieve the relevant objectives of the EP Act by:

- Identifying EVs to be enhanced or protected.
- Stating acoustic quality objectives for enhancing or protecting the EVs.
- Providing a framework for making consistent, equitable and informed decisions about the acoustic environment.

This EA Amendment outlines the noise and vibration assessment in **Section 0**, inclusive of a summary of management and mitigation measures and risk assessment of potential impacts to sensitive receptors.



2.2.6 Environmental Protection (Water and Wetland Biodiversity) Act 2019

The purpose of the *Environmental Protection (Water and Wetland Biodiversity) Act 2019* (EPP(WWB)) is to achieve the relevant objectives of the EP Act by:

- Identifying EVs for waters and wetlands.
- Identifying management goals for waters.
- Stating water quality guidelines and water quality objectives to enhance or protect the environment.
- Providing a framework for making consistent, equitable and informed decisions about waters.
- Monitoring and reporting on the condition of water.

This EA Amendment outlines the surface and groundwater assessment in **Section 6.7** and **Section 1.1**, inclusive of a summary of management practices and risk assessment of impacts to the relevant EVs.

2.3 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas. The EPBC Act identifies nine Matters of National Environmental Significance (MNES) categories:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).
- A water resource, in relation to coal seam gas development and large coal mining development.

An assessment and approval under the EPBC Act is required for any activity that has, or is likely to have, a significant impact on an MNES. Such an activity is deemed to be a 'controlled action'. It is an offence to undertake a 'controlled action' without the approval of the Commonwealth Environment Minister.

The Project is not anticipated to require approval under EPBC Act; refer to **Section 6.5** and **Appendix B** for further details. However, Centurion Coal Mining Pty Ltd is currently preparing a self-assessment to determine whether there are potential impacts to MNES. Should the self-assessment determine there is a significant impact on MNES, Centurion Coal Mining Pty Ltd will submit a referral to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) accordingly.



2.4 Water Act 2000

The *Water Act 2000* (Water Act) provides for the management of waters and watercourses and the construction, control and management of works that affect watercourses. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

Centurion Coal Mining Pty Ltd exercises underground water rights on ML 1790 and ML 70495 in accordance with the requirements of the Water Act.

Section 227AA of the EP Act describes the circumstances in which additional information on the exercise of underground water rights must be provided for an EA amendment application. Additional information must be provided where:

- The application relates to a site-specific EA for a resource project or activity that includes a resource tenure that is a mineral development licence, mining lease or petroleum lease.
- The proposed amendment involves changes to the exercise of underground water rights.

Section 227AA requires that an applicant must provide the information required by section 126A of the EP Act. Section 1.1.4 of the DESI Guideline ESR/2016/3275 '*Requirements for site-specific and amendment applications – underground water rights*' provides guidance on when information on the exercise of underground water rights is required. Amendment applications only need to include information relating to the changes to the proposed exercise of underground water rights which will occur, or are predicted to occur as a result of the proposed amendment to the EA.

The activities proposed as part of this EA amendment are partially located within the Highland Groundwater Underground Water Area. The Water Regulation 2016 outlines that the Highland Groundwater Underground Water Area does not require water entitlement, water permit or seasonal water assignment notice for stock or domestic purposes or a prescribed activity.

2.5 Regional Planning Interests Act 2014

The *Regional Planning Interests Act 2014* (RPI Act) regulates impacts from resource and other regulated activities on identified areas of regional interest. The RPI Act restricts the carrying out of resource activities in 'areas of regional interest' where the activity is not exempt from the provisions of the RPI Act, or a regional interests development approval (RIDA) has not been granted. The 'areas of regional interest' managed under the RPI Act are Priority Living Areas, Priority Agricultural Areas, Strategic Environmental Areas and Strategic Cropping Areas.

Under the RPI Act, approximately 153 ha of Strategic Cropping Land has been mapped within the Project Area. A compliance certificate (No. SCLRD2013/000151) has been issued for ML1790, ML4752, MLA70443, MLA70495 on 6 November 2013.



3.0 Activities Subject of this EA Amendment

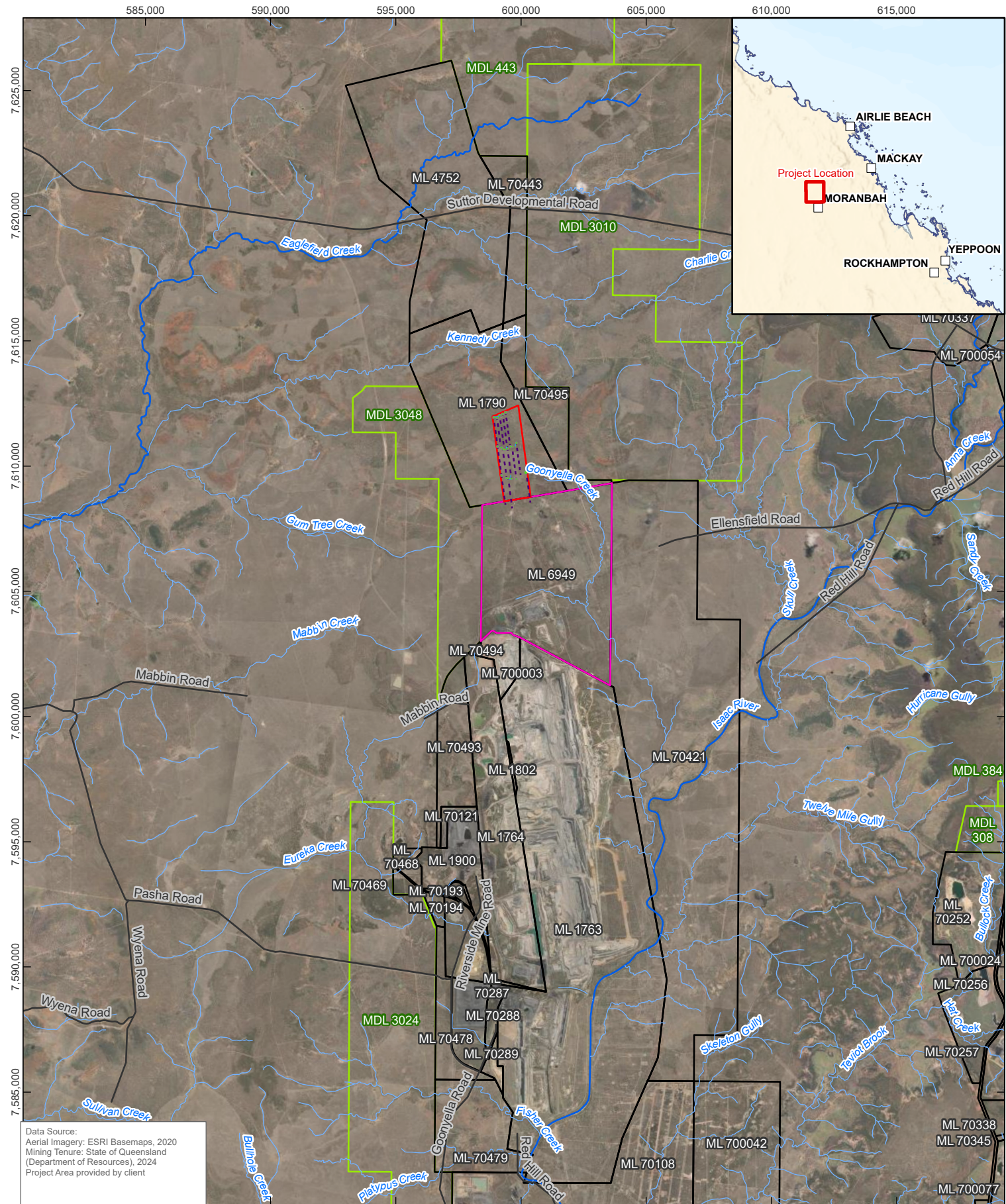
This section provides a description of the activities subject of this EA Amendment. **Section 4.0** provides details on the necessary amendments to the EA.

3.1 Location of the Project

The Project is located approximately 40 km north of Moranbah and is accessed from Moranbah via the Goonyella Road, the Red Hill Road and the North Goonyella Mine Access Road. Mackay is located approximately 140 km (and approximately 188 km by road), to the east and is accessed via the Peak Downs Highway, the Suttor Developmental Road, the Red Hill Road and the North Goonyella Mine Access Road.

The Project is located immediately adjacent to, and north of, the CCM (**Figure 3.1**).





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.040594.00001
Date Drawn: 11-Sep-2024
Drawn by: RB

LEGEND

- Road
- Lateral Well Length
- Project Area
- Drill Pad
- Centurion Coal Mine
- Access Track
- Mining Lease
- Mineral Development Licence

EA AMENDMENT P-EA-100658735

PROJECT LOCATION



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3.1

3.2 Access Tracks

A network of access tracks for light and heavy vehicles is present across ML 1790 and connects to the existing road network (i.e. North Goonyella Mine Access Road) (**Figure 3.1**) due to existing and historical activities within ML 1790. The existing access tracks will be used as much as possible to connect the proposed drill pads and minimise requirements for additional surface disturbance.

Where new access tracks are required due to the location of the drill pads, these will be constructed to allow for light and heavy vehicles. The new access tracks will be 5 m wide and will extend a cumulative 0.31 km, typically in an East-West direction (**Figure 3.2**).

The access tracks will be constructed as follows:

- Survey and demarcation of access track alignment and clearing boundaries.
- Removal of vegetation.
- Removal and stockpile of topsoil and unsuitable sub-soils.
- Preparation of access track base with sub-base material.
- Installation of traffic control infrastructure such as signage.

A 30 kL water cart will operate for dust suppression across working and trafficable areas. The access tracks will be maintained to ensure the safety of site personnel and to facilitate the effective transportation of equipment and personnel.

3.3 Coal Seam Gas Exploration

The program for exploration and evaluation of CSG has been designed as a network of gas extraction wells, extending from the ground surface down to the GM coal seam with lateral in-seam drainage to maximise the coverage of data acquisition from the exploration program. These wells will be supported by surface infrastructure for CSG processing, monitoring, and control.

Vertical wells are drilled from the surface directly downwards. The lateral wells are drilled near vertically from the surface and are then deviated through a tight radius bend to intercept the target coal seam parallel to the bedding planes (**Image 3.1**). The lateral wells are then directionally drilled through the GM coal seam to intercept its corresponding vertical well. The vertical wells are used for collecting and conveying the CSG and associated water to the surface from within the lateral well that passes through the GM coal seam.

3.3.1 Drill Pad

Each CSG well will be constructed and operated from within the boundaries of a drill pad. A total of nineteen (19) drill pads are proposed for the vertical and lateral wells. **Table 3.1** presents details of the drill pad disturbance area and **Figure 3.2** illustrates their locations.

Table 3.1 Drill pad disturbance area

Drill pads	No	Dimensions (m)	Disturbance area (ha)
Drill pad	19	80 X 80 m	12.65
Less existing approved disturbance			(0.85)
Total new disturbance			11.80



Drill pad construction methodology will be as follows:

- Permit to Disturb is required prior to any vegetation or groundcover removal.
- Survey and demarcation of access track alignment and clearing boundaries.
- Removal of vegetation.
- Removal and stockpile of topsoil and unsuitable sub-soils.
- Construction and installation of water management infrastructure, such as sumps, bunds and water tanks.
- Delivery and spread of gravel to ensure drill pad allows for all-weather access.

Figure 3.2 illustrates the proposed layout of vertical and lateral wells across the drill pads. Some drill pads will be dual propose and accommodate both vertical and lateral wells within them.

3.3.2 Vertical Wells

A total of thirteen (13) vertical wells will be drilled (**Figure 3.2**). Following development of the drill pads, construction methodology for the vertical wells is as follows:

- The initial step involves drilling a pilot hole (known as spudding). A larger diameter hole (12 ¾" diameter) is then drilled to a shallow depth (24 m) and a steel casing is installed to prevent the well from collapsing. The hole is then drilled to the target GM coal seam depth (290 - 570 m). Drilling fluid (mud) is used to lubricate the bit, control pressure, and carry cuttings to the surface. The cuttings will then be collected at the surface, where they will be disposed of in line with the CCM waste management procedure.
- Casing (such as steel, fibre glass or high-density polyethylene (HDPE)) is run into the hole to the total depth and cemented in place to prevent groundwater and gas from moving outside of the well and between geological layers. Perforations are made in the casing at the coal seam level to allow gas to flow into the well.
- The well is completed with necessary equipment for gas extraction. Initial production tests are conducted to evaluate the well's performance.
- During the extraction evaluation operation, the CSG from the vertical well will be connected via a low-pressure pipeline to a candle stick flare kit located within the disturbance footprint of the drill pad. The flare will enable combustion of all extracted methane gas to minimise the emission intensity of the evaluation operation.

3.3.3 Lateral Wells

Ten (10) lateral wells will be drilled into the GM coal seam (**Figure 3.2**). Following development of the drill pads, construction methodology for the lateral wells follows the same methodology as for vertical wells:

- A vertical section is drilled to a depth above the target GM coal seam (290 - 570m). Then, using directional drilling techniques, the wellbore is gradually deviated from the vertical to horizontal, forming a curve. This requires specialized downhole motors and tools. Once the curve is horizontal, it is drilled along the coal seam (1000-1900 m) for a specified distance to connect with the vertical well. The horizontal well maximizes exposure to the coal seam, enhancing gas recovery and the spatial extent of data acquisition.



- Casing (such as steel, fibre glass or HDPE) (7 7/8" diameter) is run into the well and cemented to isolate the gas-producing zones. Perforations are made in the casing at the coal seam level to allow gas to flow into the well.
- The horizontal well is completed with equipment designed for gas production, including perforating the casing along the horizontal section.

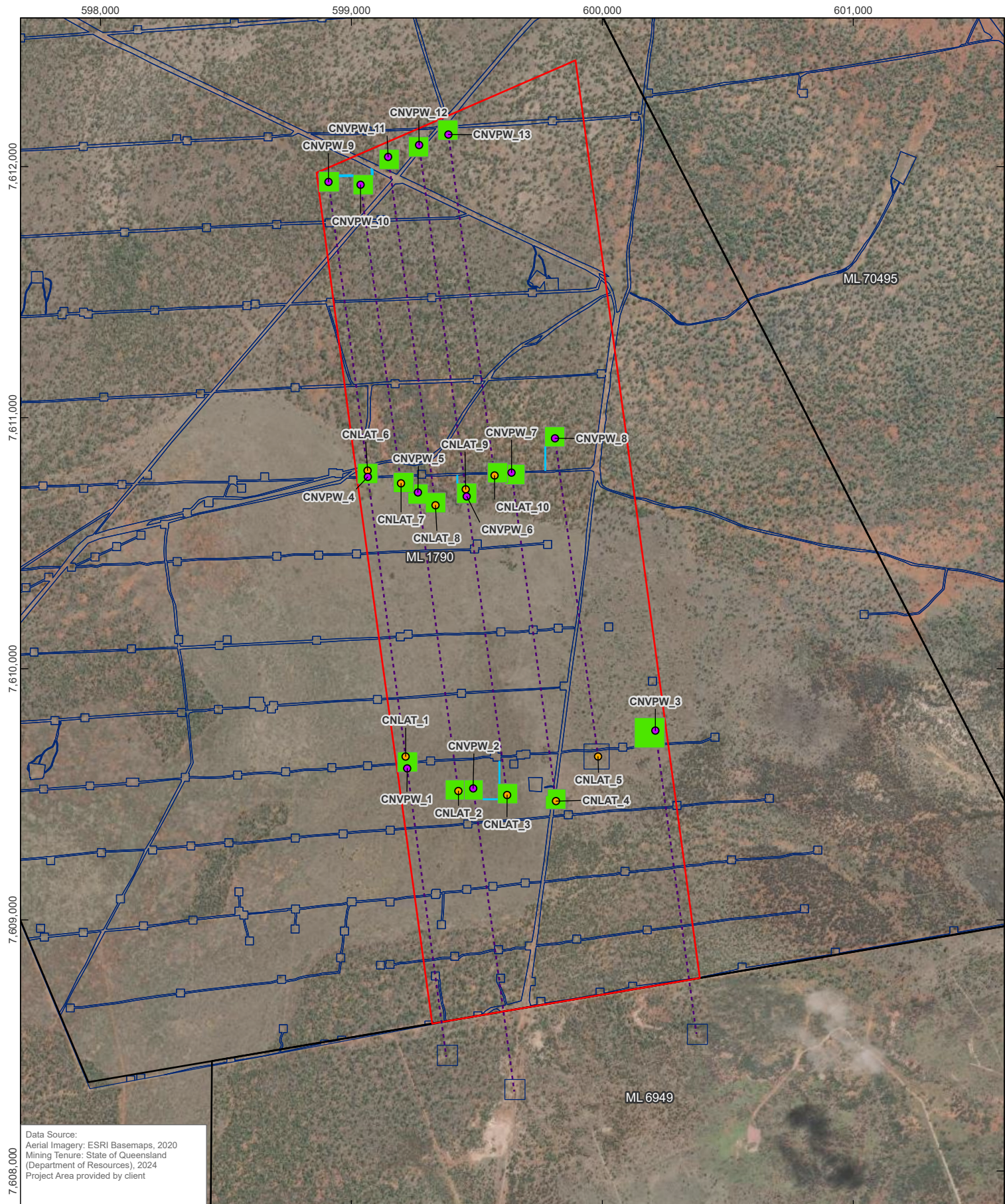
3.3.4 Exploration Method

Following drilling of the vertical and lateral wells and installation of the necessary extraction and monitoring equipment, CSG will be extracted as follows:

- Water in the GM coal seam (formation water) will be removed, reducing the pressure in the coal seam (~40 kpa/day). Pumps located at the base of the vertical wells, are operated to bring water to the surface.
- It is anticipated that depressurising of the coal seam will take up to 90 days. The water will pass through the well head to storage tanks and be carted off and added to the CCM mine water management system.
- The reduction in pressure within the coal seam allows CSG to be desorbed from the coal. The CSG will migrate through the coal's natural fractures (cleats) through the perforations made in the casing and into the well.
- The desorbed CSG will flow up the well to the surface, where it will be separated from any remaining water. The CSG will pass through a steel pipe before being flared. It is anticipated that the CSG will comprise >99% methane (CH₄) and will be flared 24 hours per day. Data logging will take place to record the amount of CSG produced from the wells. It is anticipated that CSG will be produced at a rate of 500 l/sec.
- Water and gas monitoring data collected during the evaluation will enable the development of decline curves which will better inform the gas-in-place, geological and hydrogeological models for the resource.

Image 3.1 and **Image 3.2** present examples of CSG well schematics.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:20,000 at A4

Project Number: 620.040594.00001

Date Drawn: 09-Sep-2024

Drawn by: RB

LEGEND

- Project Area
- Mining Lease
- Existing Approved Disturbance

- Lateral Well
- Vertical Well
- Lateral Well Length
- Drill Pad
- Access Track

EA AMENDMENT P-EA-100658735

PROPOSED PROJECT LAYOUT



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FIGURE 3.2

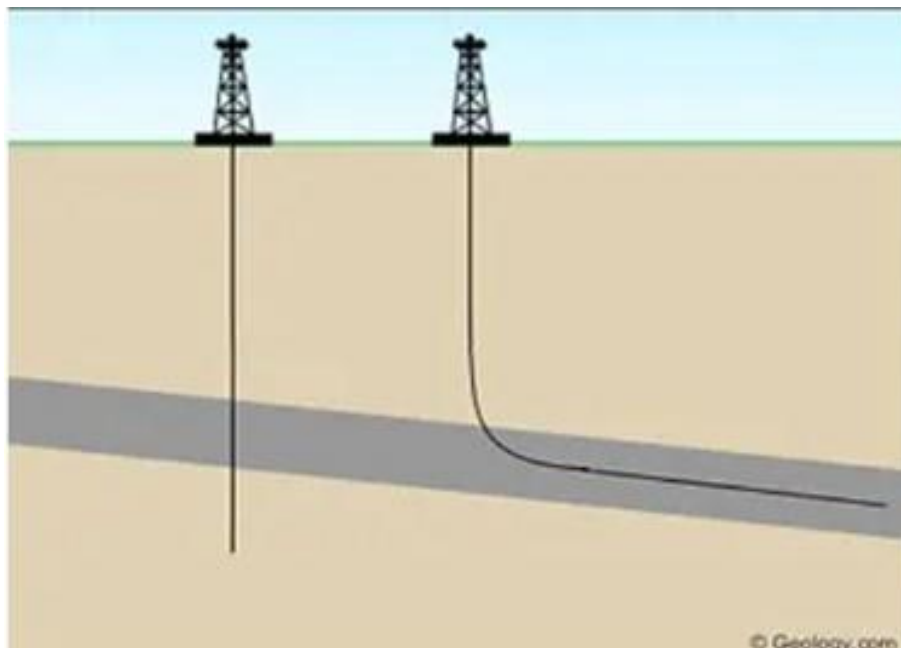


Image 3.1 Schematic of vertical and lateral wells



Image 3.2 Example of drill pad arrangement



3.4 Water

Construction water requirements will be supplied via water truck to the drill pad and well locations. Approximately 5,000 kL of water sourced from the CCM raw water dam is anticipated to be required for construction of the 19 drill pads and drilling of the 23 wells.

Water collected from the wells during operations will be pumped to holding tanks located on the relevant drill pads. Each holding tank is designed to hold a capacity of 20 kL of water / sufficient for one day of pumping during initial depressurising of the target coal seam. It is expected that water collected from the wells following depressurisation will reduce. From the holding tank, the water will be collected by a water truck and taken to CCM where it will be treated and integrated into the CCM mine water management system.

3.5 Power

The Project electricity requirements are for the drill pumps and well pumps. It is proposed that on-site generators are used to provide electricity for vertical drill pads. One 60 kV diesel generator is required per vertical drill pad, a total of thirteen (13) generators are required.

High-voltage connection to the electricity network will not be required.

3.6 Amenities

Typical drill pad site layouts are shown in **Image 3.3** and **Image 3.4**. The drill pad sites will include a mobile office and workshop which will be relocated as drilling progresses.

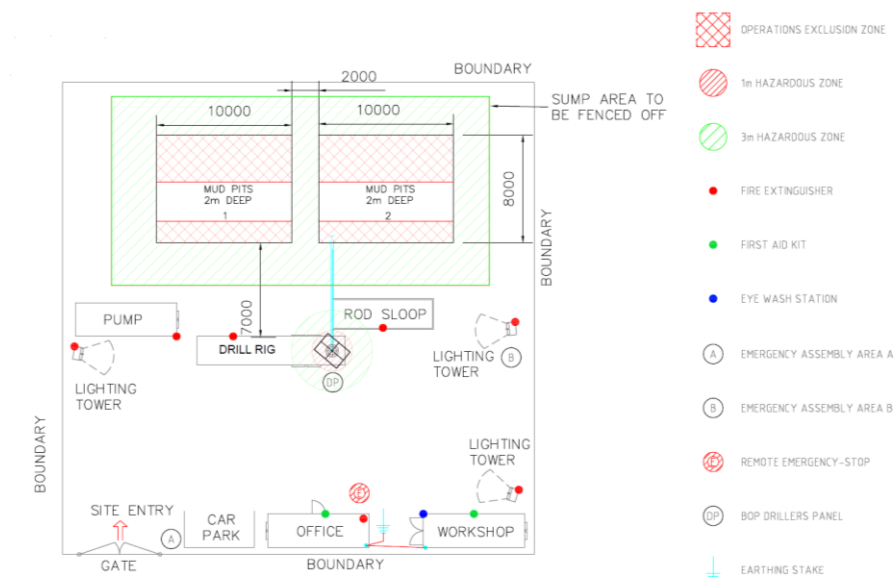


Image 3.3 Example of vertical well drill pad layout and amenities



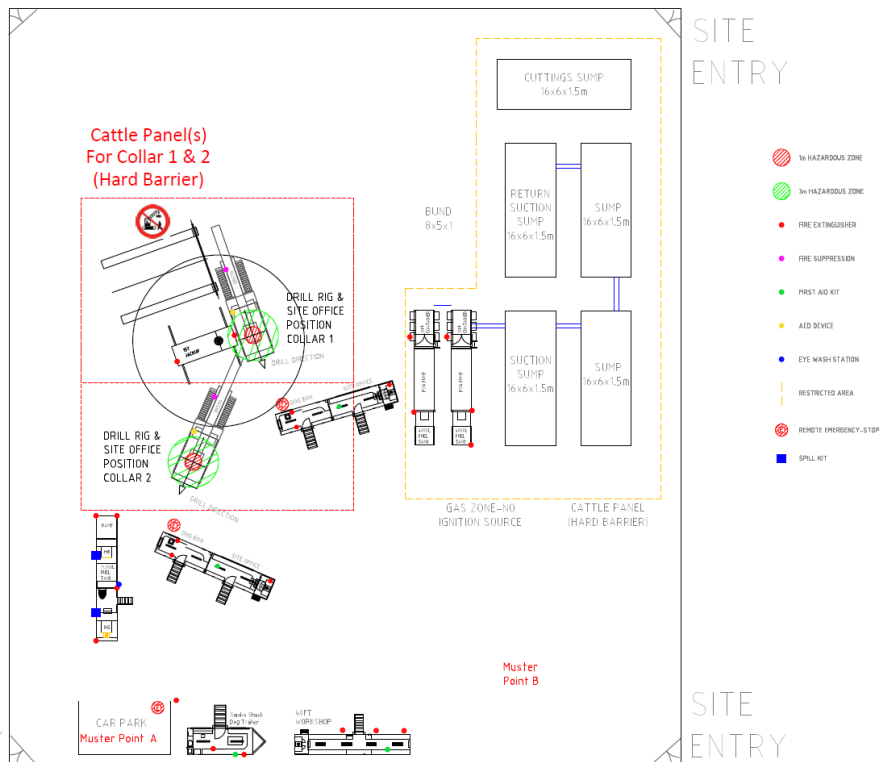


Image 3.4 example of lateral well drill pad layout and amenities

3.7 Equipment

Table 3.2 outlines the earth moving and drilling equipment (currently being utilised at the CCM) that will be used in the construction, maintenance and operation of the access tracks, drill pads and wells.

Table 3.2 Equipment requirements

Equipment Description
Earth moving
Dozer such as the Caterpillar D8T for primary excavation surface of drill pads and access tracks
Grader, such as Caterpillar Grader 150
Truck, such as Caterpillar 745 Articulated Truck
Vibratory soil compactor, such as Caterpillar Roller 256B
Vegetation slasher
Water
30kL water truck to provide construction water requirements and collect extracted well water
Power
60kV diesel generator to provide power to well and pump infrastructure
Drill rigs
1 SIS drill rig and 1 vertical drill rig



Equipment Description
Wellhead equipment
Wellhead assemblies to control the pressure and flow of CSG to the surface
Valves and fittings to control and direct the flow of CSG to the surface
Flares and venting systems for controlled burning of CSG
Pumps
Water pumps to remove water from the coal seam
Gas pumps for extracting CSG from the well
Mud pumps and systems for drilling fluid circulation
Gas Separation and processing equipment
Separators to separate CSG from water and other impurities
Measurement and monitoring devices
Flow meters to measure the amount of CSG being extracted
Pressure gauges to monitor pressure levels in the well
Gas analysers to analyse the composition and quality of the CSG
Safety and environmental control equipment
Blowout preventers (BOPs) to prevent uncontrolled release of CSG
Monitoring systems for detecting gas leaks and monitoring environmental compliance
Control and automation systems
SCADA systems for remote monitoring and control of gas production
Automation software for optimising gas extraction and processing

3.8 Workforce and Working Hours

Staffing has been estimated at 14 personnel during the construction of the Project. Construction staff will work a 12 -hour day / night shift 7 days / 7 nights roster.

During operation, the CSG drainage will be flared 24 hours per day. Staffing has been estimated at 2 personnel working 12-hour day / night shift 7 days / 7 nights roster (commencing 6:00am or 6:00pm).

Staff will transfer from CCM to the Project, and it is not envisaged that additional staff will be required.

The existing Centurion Village will provide accommodation for the Project workforce during the construction and operation phase. No additional worker accommodation will be required.

3.9 Hours of Operation

It is anticipated that the Project will operate 24 hours per day.

3.10 Rehabilitation and Closure

In accordance with the P-PRCP-100669070_V1, land will be rehabilitated to a stable condition which is defined as land that is:

- Safe and structurally stable.



- No environmental harm being caused by anything on or in the land.
- Can sustain a post-mining land use.

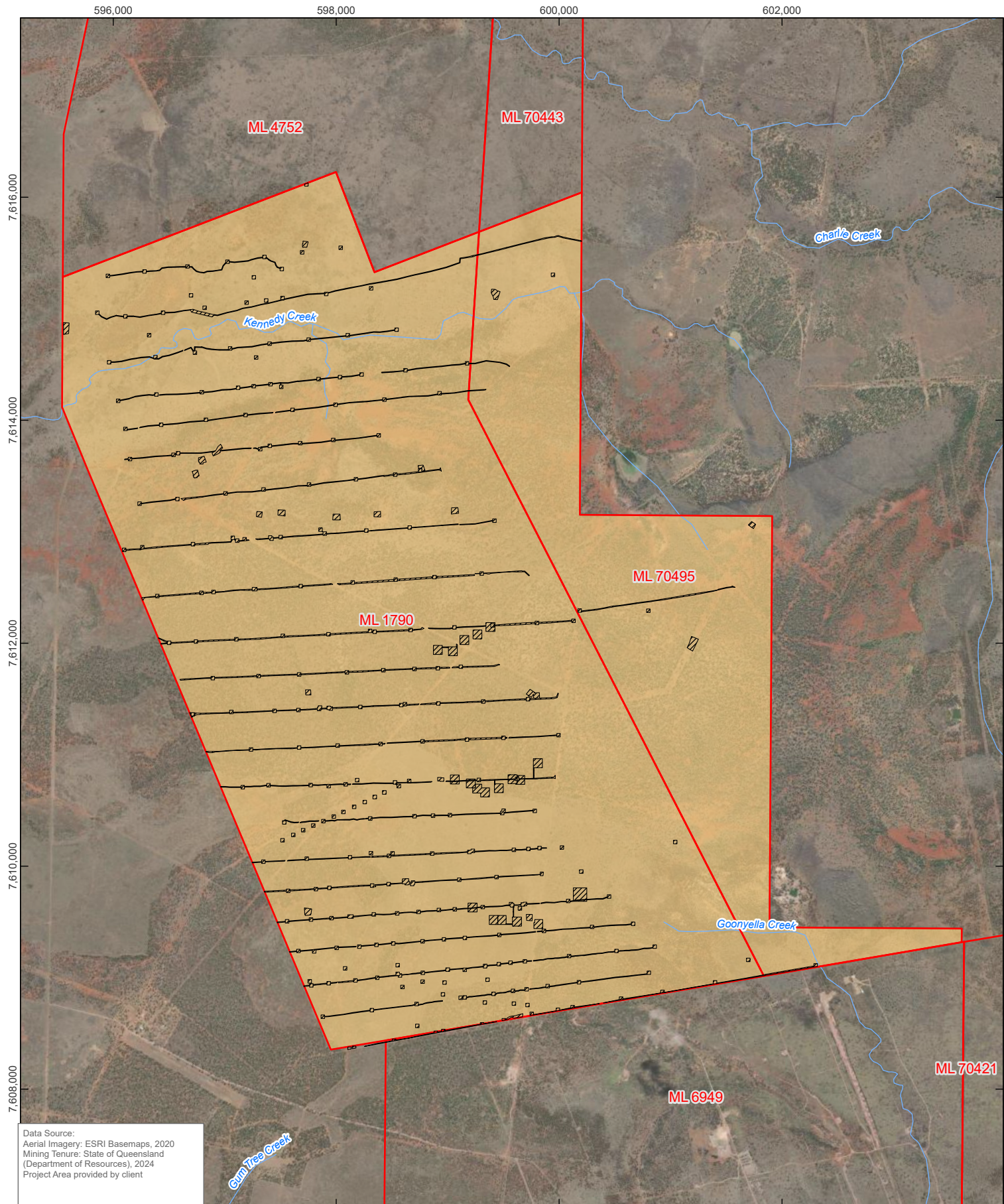
The access tracks and drill pads will be rehabilitated through the following methodologies:

- Windrows and drains will be pushed and deep ripped.
- Topsoil placement, amelioration and seeding with pasture grasses and trees.
- Where the access tracks and drill pads cross a watercourse, or there is an increased risk of sedimentation, rock armour will be applied.

The extent of rehabilitation activities will be subject to agreement with landholders who may choose to retain infrastructure deemed beneficial.

Figure 3.3 presents the proposed final site design to be included in the amended PRCP.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

 0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:45,000 at A4

Project Number: 620.040594.00001

Date Drawn: 09-Sep-2024

Drawn by: RB

LEGEND

-  Watercourse
-  Mining Lease
-  Maximum Disturbance Footprint
-  PMLU - Grazing

EA AMENDMENT P-EA-100658735

PROPOSED FINAL SITE DESIGN



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3.3

3.11 Project Schedule

One Surface to in-seam (SIS) drill rig will be used to drill the vertical and lateral wells. Vertical wells will be drilled first (approximately 10 days per well) followed by the connecting lateral wells (approximately 20 days per well). Once the wells have been drilled, the surface infrastructure will be installed (approximately 15 days per vertical well). It is anticipated that it may take up to 90 days to depressurise the wells followed by up to 18 months of gas flow.

To summarise, Project activities are:

- Clearing 12 ha of vegetation for drill pads (11.80 ha) and access tracks (0.20 ha).
- Developing 0.31 km of 5 m wide access track.
- Drilling, installing and operating thirteen (13) vertical wells and ten (10) lateral wells across 19 drill pads.
- Extracting the groundwater and CSG from the target GM coal seam.
- Closure and rehabilitation of the wells.



4.0 Proposed EA and PRCP Amendments

The following section details the conditions of EA P-EA-100658735 and PRCP P-PRCP-100669070_V1 that require amendment.

4.1 Environmental Authority

This section presents the proposed amendments to the following conditions:

- Condition 15 Schedule A.
- Condition 7 Schedule F.
- Condition 9 Schedule F.
- Condition 22 Schedule F.

4.1.1 Condition 15 Schedule A

Table 4.1 details the existing conditions of A15 and the proposed changes subject of this EA amendment.

Table 4.1 EA P-EA-100658735 Condition A15

Existing Condition				
The only mining activities to be carried out under this EA are the mining activities defined within the parameters of Table 1 (Mining Activities) and identified in Figure 1 attached to this EA.				
Proposed Condition				
No change to wording of condition. Table 1 and Figure 1 referenced in the condition is to be amended.				
Change				
Table 1 will be updated and replaced by				
Mine Domain	Mine Feature Domain	Location (GDA94)	Maximum Disturbance Area	Constraints
Exploration activities	Drill holes and pads	As per Figure 3.2	1400 metres squared per drill pad	Total disturbed area must not exceed 1.4 ha
			6400 metres squared per drill pad	Total disturbed area must not exceed 11.80 ha
	Historic holes and pads	As per Figure 3.2	3000 metres squared per drill pad	Quantity: 310 drill holes
Ancillary infrastructure	Roads and tracks	As per Figure 3.2		Scale and intensity

Figure 1 in EA P-EA-100658735 will be updated and replaced by Figure 3.2 of this report.



Existing Condition
Figure 3.2 reflects the following changes to the location and extent of activities for the Project outlined in Section 3 of this report. - Clearing 12 ha of vegetation for drill pads (11.80 ha) and 0.31 km of access tracks (0.20 ha). - Drilling, installing and operating thirteen (13) vertical wells and ten (10) lateral wells across 19 drill pads. - Closure and rehabilitation of the wells.
Justification
The proposed amendment ensures that the variation in activities aligns with the approved disturbance and activities outlined in Table 1 (Mining Activities) and Figure 1. The amendment incorporates the Project activities to determine the presence, quantity, and quality of CSG within the GM coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity).

4.1.2 Condition 7 Schedule F

Table 4.2 details the existing conditions of F7 and the proposed changes subject of this EA amendment.

Table 4.2 EA P-EA-100658735 Condition F7

Existing Condition
Exploration activities undertaken must be consistent with Figures 1 to 4 attached to this environmental authority.
Proposed Condition
No change to wording of condition. Figure 1 to 4 referenced in the condition is to be amended.
Change
Figure 1 to Figure 4 in EA P-EA-100658735 will be updated and replaced by Figure 3.1, Figure 3.2, Figure 6.10 through Figure 6.19 of this report. These figures illustrate the location of exploration and mineral development activities, mining leases, and proposed extent of impacts to Matters of State Environmental Significant (MSES) regulated vegetation and protected wildlife habitat.
Justification
The proposed amendment ensures that any necessary expansions or modifications to the exploration activities, as depicted in the updated figures, are within the scope of the EA.

4.1.3 Condition 9 Schedule F

Table 4.3 details the existing conditions of F9 and the proposed changes subject of this EA amendment.

Table 4.3 EA P-EA-100658735 Condition F9

Existing Condition
The operational area of individual drill sites must not exceed 1,400 square metres.
Proposed Condition
The operational area of individual drill sites must not exceed 6,400 square metres.
Change



Existing Condition
Condition F9 would be updated to refer to the drill pads in which the Project activities can be performed. Figure 1 in EA P-EA-100658735 will be updated and replaced by Figure 3.2 of this report. This figure illustrates the location of exploration and mineral development activities.
Justification
The proposed amendment ensures that the variation in activities aligns with the approved disturbance and activities outlined in Table 1 (Mining Activities) and Figures 1 to 4 . The amendment incorporates the Project activities to determine the presence, quantity, and quality of CSG within the GM coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity).

4.1.4 Condition 22 Schedule F

Table 4.4 details the existing conditions of F22 and the proposed changes subject of this EA amendment.

Table 4.4 EA P-EA-100658735 Condition F22

Existing Condition			
Impacts to matters of State environmental significant (MSES) as a result of carrying out exploration activities must only occur to the maximum extent stated in Table F1 – Authorised residual impacts to MSES’ and consistent with general exploration activities depicted in Figure 3 ‘Authorised impacts to MSES Regulated Vegetation’ and Figure 4 ‘Authorised impacts to MSES Protected Wildlife Habitat’.			
Proposed Condition			
No change to wording of condition. Table F1, Figure 3 and Figure 4 referenced in the condition is to be amended.			
Change			
Table F1 in EA P-EA-100658735 will be updated and replaced by:			
Prescribed Environmental Matters – Matter Of State Environmental Significance (MSES)	Location Of Impact	Offset Requirements Under Environmental Offsets Act 2014	Maximum Extent Of Impact (Ha)
Regulated vegetation – Endangered or Of Concern Regional Ecosystem			
Grassland Regional Ecosystem (11.8.11)	In accordance with Figure 6.10.	No	1.81
Sparse Regional Ecosystem (11.3.4, 11.4.2)	N/A	No	0
Dense / Mid Dense Regional Ecosystem (11.3.1, 11.9.5)	N/A	No	0
Regulated Vegetation – Located in the defined distance from the defining banks of a watercourse			



Existing Condition			
Grassland Regional Ecosystem (11.8.11)	N/A	No	0
Sparse Regional Ecosystem (11.3.4, 11.4.2)	N/A	No	0
Dense / Mid Dense Regional Ecosystem (11.3.1, 11.9.5)	N/A	No	0
Protected Wildlife Habitat – Essential habitat for an endangered or vulnerable animal or plant			
Dichanthium queenslandicum (King Blue Grass)	In accordance with Figure 6.10.	No	1.81
Protected Wildlife Habitat – A habitat for endangered or vulnerable wildlife or Special Least Concern animal			
Squatter Pigeon	In accordance with Figure 6.16	No	7.41
Grey Falcon	N/A	No	1.50
Fork Tailed Swift	In accordance with Figure 6.18	No	1.50
Koala	In accordance with Figure 6.14	No	7.15
Greater Glider	N/A	No	0.88
Short Beaked Echidna	In accordance with Figure 6.15	No	7.95
Ornamental Snake	N/A	No	6.54
Figure 3 and Figure 4 in EA P-EA-100658735 will be updated and replaced by Figure 6.10 through Figure 6.19 of this report. These figures illustrate the proposed extent of impacts to MSES regulated vegetation and protected wildlife habitat.			
Justification			
The completion of terrestrial and aquatic ecology field surveys across the Study Area have allowed for a more refined understanding of the categorisation of vegetation communities, presence of flora and fauna, and extent of habitat for these flora and fauna species. As such, the assessment of impacts to MSES from the Project are based on contemporary, ground-truthed ecological data. During the design stages of the Project, terrestrial and aquatic ecological values were considered and avoided where feasible and practical. This included the use of previously disturbed areas where possible, prioritised location of disturbance in non-remnant areas of vegetation affording limited habitat value, avoidance of TECs where possible, and where remnant vegetation was required for			



Existing Condition
clearing those area classified as No concern at present under the VM Act were prioritised over Of concern and Endangered REs. Though the Project will result in the direct clearing of habitat for MSES flora and fauna species, this amount comprises less than 1% of habitat for each species as mapped within the broader Study Area. In addition, the implementation of mitigation measures will further minimise potential impacts to the species. As such, an assessment against the SRI Guideline determined the Project is unlikely to result in a significant residual impact on any MSES (Refer to Appendix B).

4.2 Progressive Rehabilitation and Closure Plan

This section presents the proposed amendments to the following conditions:

- Section B – Figure 1
- Section C – (RA1) Rehabilitation area 1

4.2.1 Section B – Final site design and reference maps

Table 4.5 details the existing conditions of Section B – Final site design and reference maps and the proposed changes subject of this PRCP amendment.

Table 4.5 PRCP P-PRCP-100669070_V1 Section B – Figure 1

Existing Condition
Section B of the PRCP contains the final site design plans in Figure 1 .
Proposed Condition
No change to wording of condition. Figure 1 referenced in the PRCP is to be amended.
Change
Figure 1 in PRCP P-PRCP-100669070_V1 will be updated and replaced by Figure 3.3 of this report. Figure 3.3 reflects the following changes to the location and extent of activities for the Project activities.
• Clearing 12 ha of vegetation for drill pads (11.80 ha) and access tracks (0.20 ha) • Developing 0.31 km of 5 m wide access tracks • Drilling, installing and operating thirteen (13) vertical wells and ten (10) lateral wells across 19 drill pads, and • Closure and rehabilitation of the wells.
Justification
The amendment incorporates the Project activities to determine the presence, quantity, and quality of CSG within the GM coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity).

4.2.2 Section C – Post-mining land uses

Table 4.6 details the existing conditions of Section C – (RA1) Rehabilitation area 1 and the proposed changes subject of this PRCP amendment.

Table 4.6 PRCP P-PRCP-100669070_V1 Section C – (RA1) Rehabilitation area 1



Existing Condition						
Rehabilitation of the site must be undertaken as per Section C of PRCP P-PRCP-100669070_V1. Currently, 133 ha of the site is to be rehabilitated, with rehabilitation milestones to be reached within the timeframes indicated in the schedule below.						
Proposed Condition						
No change to wording of condition. Section C – Post-mining land use, (RA1) Rehabilitation area 1 referenced in the PRCP is to be amended.						
Change						
Post-mining land uses (PMLU)						
Rehabilitation area			RA1			
Relevant activities			Exploration - drilling and associated tracks			
Total rehabilitation area size (ha)			145			
Commencement of fire milestone : RM1			10/12/2021			
PMLU			Cattle grazing			
Date area is available	10/12/2021	10/12/2028				
Cumulative area available	19	145				
Milestone completed by	10/12/2026	10/12/2031	10/12/2036	10/12/2041	10/12/2046	
Milestone Reference	Cumulative area achieved (ha)					
RM1	19	145				
RM2	19	145				
RM3	19	145				
RM4	19	145				
RM5	19	145				
RM6			19	145		
RM7				19	145	
Justification						
Total rehabilitation area size in (RA1) Rehabilitation area 1 of PRCP P-PRCP-100669070_V1 is proposed to increase from 133 ha to 145 ha. The 145 ha reflects the additional 12 ha of disturbance involved with the aforementioned clearing of vegetation for drill pads (11.80 ha) and access tracks (0.20 ha) associated with the Project activities.						



5.0 Assessment Methodology

This section outlines the methodology used to assess the potential impacts the Project has on relevant EVs.

The following methodology was taken when assessing the impacts to the EVs:

- Characterisation of EVs.
- Identification of any potential relevant environmental impacts.
- Outline existing management practices.
- Risk assessment of potential impacts.

5.1 Terminology

In the context of this Report, the following terminology are used to define the spatial and operational parameters of the Project:

- **Project:** Refers to the planned development which is the subject of this Report. A project usually involves construction, operation, or changes to land use, that requires regulatory approval and has the potential to cause environmental impacts. A project includes all stages of its lifecycle, from design to construction, operation, and rehabilitation and closure.
- **Project Area:** The Project Area refers to the physical boundaries of the land, water resources, or other resources that will be directly affected by the proposed Project. This includes the location where construction, operations, and any other project-related activities will take place.
- **Study Area:** The Study Area is the broader geographic region that is considered through the impact assessment process. It includes the Project Area and surrounding areas that may be indirectly affected by the Project. The boundaries of the Study Area are often determined by the nature of the Project's potential impacts on EVs.
- **Project Activities:** Project activities encompass all actions or operations associated with the Project during construction, operation and rehabilitation that may have a direct or indirect impact on the environment. These activities are assessed to determine the impacts on EVs.
- **Disturbance Area:** The disturbance area refers to the specific portion of the Project or Study Area where physical or ecological disturbance will occur as a result of the Project Activities. It is usually a subset of the Project Area but might extend beyond it due to indirect impacts.

5.2 Methodology to Identify Environmental Impacts

To identify the potential impacts to the EVs desktop assessments were conducted. The nature of the Project Activities and the location of the Project resulted in further investigation into the potential impacts associated with ecology and groundwater. The specific methodology for the assessments of these EVs are detailed in the following sections.

Section 6.0 provides the results of such assessments.



5.2.1 Terrestrial and Aquatic Ecology

Refer to **Appendix A** for details of the terrestrial and aquatic ecology methodology, respectively.

5.2.2 Groundwater Assessment

Refer to **Section 6.7** of the groundwater methodology.

5.3 Risk Assessment Methodology

The EVs were assessed using an adapted version of the Risk Assessment Education Resource (Mining Safety and Health Advisory Committee 2023). This guideline was developed for conducting effective risk assessments and was designed in accordance with *ISO 31000:2018 – Risk Management*.

A likelihood and consequence rating were assigned to each potential impact, which resulted in an overall, risk rating. **Table 5.1** details the likelihood descriptors and **Table 5.2** outlines the level of consequence. The combination of likelihood and consequence resulted in a risk matrix (**Table 5.3**). A description of each risk rating is provided in **Table 5.4**.

Table 5.1 Likelihood level

Likelihood Level	Description
Almost certain (5)	Could occur several times a year Could be expected to occur during a project >80% likely to occur
Likely (4)	Could occur within one year Could easily occur during a project 60% - 80% likely to occur
Possible (3)	Could occur in a one to two-year period Occurred in a small number of projects 30% - 60% likely to occur
Unlikely (2)	Could occur in a two to five-year timeframe Known to have happened within the industry 5% - 30% likely to occur
Rare (1)	Could occur in more than five years' time Has not occurred but could Less than 5% likely to occur

Table 5.2 Consequence rating

Consequence	Description
Major (5)	Destruction of important habitat, species, or natural environment Significant impact to sensitive receptors Regulatory significant
High (4)	Extensive and measurable medium-term impact on habitat, species, or natural environment Extensive impact to sensitive receptors



Consequence	Description
Medium (3)	Localised medium-term impact on habitat, species, or natural environment Localised medium-term impact to sensitive receptors
Low (2)	Localised short-term impact on habitat, species, or natural environment Localised short-term impact on sensitive receptors
Minor (1)	Little to no discernible impact on habitat, species, or natural environment Little to no impact on sensitive receptors

Table 5.3 Risk matrix

Likelihood	Consequence				
	Minor (1)	Low (2)	Medium (3)	High (4)	Major (5)
Almost certain (5)	Medium	Significant	Significant	High	High
Likely (4)	Medium	Medium	Significant	High	High
Possible (3)	Low	Medium	Significant	Significant	High
Unlikely (2)	Low	Low	Medium	Significant	Significant
Rare (1)	Low	Low	Medium	Medium	Significant

Table 5.4 Descriptions of risk rating

Risk Level	Risk Measures
High	Immediate action required Identify and implement controls to manage risks Highest level of management needs to be involved
Significant	Immediate action required Identify and implement controls to manage risks Senior site management should be involved
Medium	Implement controls to manage risks Responsibility must be defined
Low	Implement controls as required Manage by routine processes



6.0 Environmental Assessments

The following sections provide the environmental assessments for:

- Section 1.1: Air quality.
- Section 6.2: Greenhouse gas.
- Section 6.3: Noise and vibration.
- Section 6.4: Land resources.
- Section 6.5: Terrestrial ecology.
- Section 6.6: Aquatic ecology.
- Section 6.7: Groundwater.
- Section 1.1: Surface water.
- Section 1.1: Waste.

The EVs for which no new or varied impacts are anticipated as a function of the Project activities are summarised in **Table 6.1**.

Table 6.1 Environmental values not subject to potential impacts

EV	Risk to EV	Details
Social	Not subject to potential impacts. No changes are predicted.	The Project activities will not change existing potential impacts. Any potential, relevant impacts to EVs will continue to be managed via current protocols and management plans.
Geochemistry	Not subject to potential impacts. No changes are predicted.	The Project activities will not change existing potential impacts. Any potential, relevant impacts to EVs will continue to be managed via current protocols and management plans.



6.1 Air Quality

This section presents the assessment of Project related air quality impacts to sensitive receptors.

6.1.1 Existing Environmental Values

6.1.1.1 Sensitive Receptor Locations

Potential sensitive receptors surrounding the Project Area are presented in **Table 6.2** and **Figure 6.1**. Sensitive receptors have been identified through desktop review of historical information (e.g. EIS, EA amendments etc) and an analysis of available aerial photographic images.

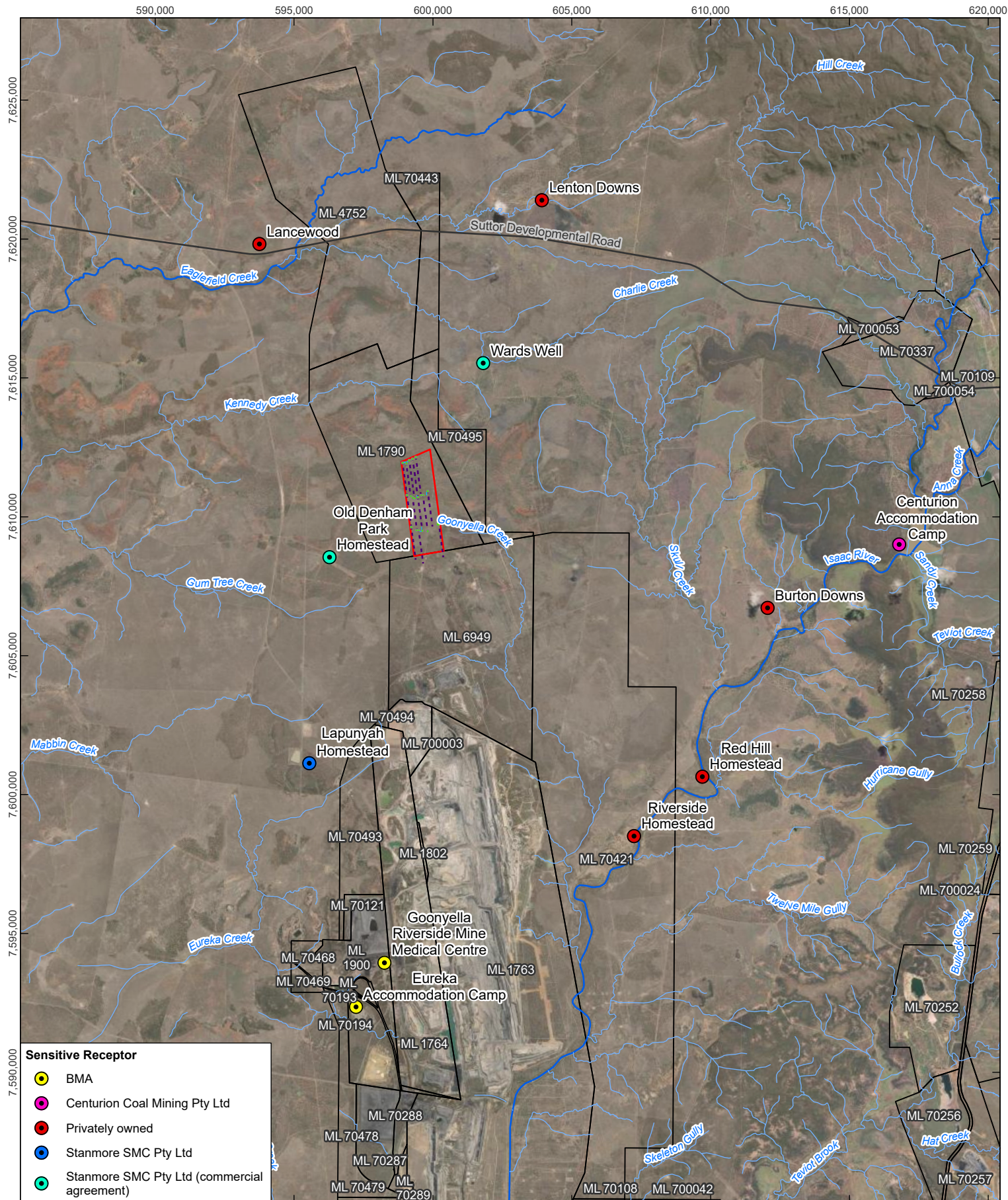
It is noted that the nearest privately owned receptor is Lancewood which is located approximately 9.4 km to the nearest drill pad. The closest receptor is Old Denham Park Homestead (3.1 km) which is owned by Stanmore SMC Pty Ltd and with which there is an agreement in place.

Table 6.2 Receptors Surrounding the Project

ID	Receptor Name	Easting (m)	Northing (m)	Approximate Distance to Closest Drill Pad (km)	Ownership/Agreement Status
1	Old Denham Park Homestead	596275	7608546	3.1	Stanmore SMC Pty Ltd (commercial agreement)
2	Wards Well	601809	7615534	4.1	Stanmore SMC Pty Ltd (commercial agreement)
3	Lancewood	593750	7619821	9.4	Privately owned
4	Lenton Downs	603922	7621398	10.2	Privately owned
5	Centurion Accommodation Camp	616790	7609005	16.5	Centurion Coal Mining Pty Ltd
6	Burton Downs	612051	7606721	12.2	Privately owned
7	Red Hill Homestead	609702	7600644	13.0	Privately owned
8	Riverside Homestead	607241	7598505	13.2	Privately owned
9	Goonyella Riverside Mine Medical Centre	598253	7593944	15.5	BMA
10	Eureka Accommodation Camp	597230	7592356	17.2	BMA
11	Lapunyah Homestead	595547	7601128	9.2	Stanmore SMC Pty Ltd

Note 1: GDA 2020 MGA Zone 55 projection.





Sensitive Receptor

- BMA
- Centurion Coal Mining Pty Ltd
- Privately owned
- Stanmore SMC Pty Ltd
- Stanmore SMC Pty Ltd (commercial agreement)

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:180,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

- Major Road
- Major Watercourse
- Minor Watercourse
- Project Area
- Mining Lease
- Lateral Well Length
- Drill Pad
- Access Track

EA AMENDMENT P-EA-100658735

LOCATION OF SENSITIVE RECEPTORS



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6.1

6.1.1.2 Air Quality Objectives

A summary of the Queensland EPP (Air) ambient air quality objectives that are relevant to the Project is provided in **Table 6.3**.

The pollutants are associated with the mechanical generation of dust (i.e. total suspended particulates (TSP), particulate matter with an aerodynamic diameter less than 10 microns (PM₁₀), and dust deposition) and the combustion of diesel fuels (particulate matter with an aerodynamic diameter less than 2.5 microns (PM_{2.5}), carbon monoxide, and nitrogen dioxide).

Table 6.3 Ambient Air Quality Objectives

Pollutant	Environmental Value	Averaging Period	Objectives	Allowable exceedances	Source
Carbon monoxide	Health and wellbeing	8 hours	11,000 µg/m ³	1 day each year	QLD EPP(Air)
Nitrogen dioxide	Health and wellbeing	1 hour	250 µg/m ³	1 day each year	QLD EPP(Air)
		1 year	62 µg/m ³	None	QLD EPP(Air)
	Health and diversity of ecosystems	1 year	33 µg/m ³	None	QLD EPP(Air)
PM ₁₀	Health and wellbeing	24 hour	50 µg/m ³	None	QLD EPP(Air)
		Annual	25 µg/m ³	None	QLD EPP(Air)
PM _{2.5}	Health and wellbeing	24 hour	25 µg/m ³	None	QLD EPP(Air)
		Annual	8 µg/m ³	None	QLD EPP(Air)
TSP	Health and wellbeing	Annual	90 µg/m ³	None	QLD EPP(Air)
Dust deposition	Nuisance	30 day	120 mg/m ² /day	None	QLD DESI

6.1.1.3 Air Quality Environment

The nearest ambient air monitoring stations operated by the DESI are the DESI Moranbah (Utah Drive) and DESI Moranbah (Cunningham Way) located approximately 40 km to the south-southeast of the Project (**Figure 6.2**).

The DESI monitoring station on Utah Drive has been in operation since 2011 with the Cunningham Way station operational since 2020. Both of the DESI stations record levels of PM₁₀ and PM_{2.5} as well as meteorological parameters such as wind speed and wind direction.

The DESI Moranbah monitoring stations are potentially influenced by a number of open cut mining operations within the airshed. When developing estimates of background levels of dust, it has been assumed that air quality recorded at the DESI Moranbah (Utah Drive) monitoring station is sufficiently representative of those in the vicinity of the Project.



Pollutant gases included in the Queensland EPP (Air) such as carbon monoxide or nitrogen dioxide, that are associated with the combustion of diesel fuel, are not recorded at either of the two DESI Moranbah ambient air monitoring stations.

Thus estimates of background levels of these pollutants were based on data sets from other DESI operated monitoring stations.

Carbon monoxide and nitrogen dioxide are recorded at locations that are more representative of the urban and/or industrialised airshed as opposed to an airshed dominated by the influence of mining or mine-related operations and thus estimates developed from these data sets may over-estimate background pollutant levels in the vicinity of the Project.

A summary of estimates of background levels of pollutants is provided in **Table 6.4** with additional notes in relation to the data sets, included in the table.

Background estimates suggest that in general background ambient air quality is well below the relevant objective with the exception of the annual averages of PM₁₀ (96% of objective) and PM_{2.5} (85% of objective).

These high levels of dust as well as the frequently recorded exceedances of the 24 hour average concentration of PM₁₀ and PM_{2.5} at the DESI Moranbah monitoring stations, highlights the dusty background environment within the airshed that includes the Project.

Table 6.4 Estimates of background levels of pollutants

Pollutant	Environmental Value	Averaging Period	Objectives	Background Estimate	Percentage of Objective	Source
Carbon monoxide	Health and wellbeing	8 hours	11,000 µg/m ³	370 µg/m ³	3%	QLD ⁽⁴⁾
Nitrogen dioxide	Health and wellbeing	1 hour	250 µg/m ³	60.4 µg/m ³	24%	QLD ⁽⁵⁾
		1 year	62 µg/m ³	14.5 µg/m ³	23%	QLD ⁽⁵⁾
	Health and diversity of ecosystems	1 year	33 µg/m ³	14.5 µg/m ³	44%	QLD ⁽⁵⁾
PM ₁₀	Health and wellbeing	24 hour	50 µg/m ³	24.4 µg/m ³	49%	DESI ⁽²⁾
		Annual	25 µg/m ³	23.8 µg/m ³	96%	DESI ⁽²⁾
PM _{2.5}	Health and wellbeing	24 hour	25 µg/m ³	7.6 µg/m ³	30%	DESI ⁽²⁾
		Annual	8 µg/m ³	6.8 µg/m ³	85%	DESI ⁽²⁾
TSP	Health and wellbeing	Annual	90 µg/m ³	47.6 µg/m ³	53%	DESI ^(2,3)
Dust deposition	Nuisance	30 day	120 mg/m ² /day	47 mg/m ² /day	39%	AQMP ⁽¹⁾ (CMJV)
Notes:						
(1) AQMP (CMJV) – Air Quality Management Plan: Coppabella-Moorvale Joint Venture – Draft, dated 13 March 2023						
(2) DESI – Based on 2023 data from the DESI Moranbah (Utah Drive) monitoring station. Estimates for the 24 hour averages are conservatively based on the 90 th percentile of the data set. A total of five days exceeded the EPP(Air) objective of 50 for the 24 hour average concentration of PM ₁₀ . Four PM _{2.5} EPP(Air) exceedances days were recorded.						
(3) TSP is not collected at the DESI Moranbah monitoring stations. The estimate for the annual average is based on the assumption that 50% of TSP is in the form of PM ₁₀ .						



Pollutant	Environmental Value	Averaging Period	Objectives	Background Estimate	Percentage of Objective	Source
(4) QLD – Queensland Government’s Queensland air monitoring 2023 National Environment Protection (Ambient Air Quality) Measure. Estimate based on the maximum 90 th percentile 8 hour average concentration from the Boyne Island monitoring station over the period 2010 through 2023. Note that concentrations of carbon monoxide are only reported for the Boyne Island and Woolloongabba monitoring stations in 2023. Carbon monoxide ceased to be measured at the North Toowoomba monitoring station in 2010.						
(5) QLD – Queensland Government’s Queensland air monitoring 2023 National Environment Protection (Ambient Air Quality) Measure. Estimate based on the maximum 90 th percentile 1 hour average or annual average concentration of nitrogen dioxide from the South Gladstone monitoring station over the period 2010 through 2023.						

6.1.2 Potential Impacts

The following subsections detail the potential air quality impacts as a result of the Project activities described in **Section 3.0**.

A risk-based assessment of these potential impacts is detailed in **Table 6.5**

6.1.2.1 Construction of Access Tracks

Based on information provided in **Section 3.2**, the establishment of new access tracks to will involve the clearing of vegetation and the stockpiling of topsoil and sub-soils for the access track. Compacting of the access track will be undertaken using a roller. Gravel will be delivered by truck to the access track and spread using a grader to ensure all-weather access.

As a series of access tracks already exist across ML 1790, the construction of new access tracks will be limited to a disturbance footprint of approximately 0.20 ha.

The construction of the access tracks has the potential to create emissions of mechanically generated dust as well as emissions of particulates and gases through the combustion of diesel fuel by the dozer, grader, roller and trucks.

The construction of the access track is anticipated to be associated with a minimal risk of air quality impacts at receptor locations due to the significant distance to the nearest receptor.

6.1.2.2 Construction of Drill Pads

Based on information provided in **Section 3.3**, a total of 19 drill pads will be developed as part of the Project. The total combined footprint of all pads in areas that are not covered by existing disturbance approvals is 11.8 ha.

A dozer will be used to remove and stockpile topsoil and sub-soils from each of the pads. Compacting of the pad will be undertaken using a roller. Gravel will be delivered by truck to the drill pad and spread using a grader to ensure all-weather access. It is estimated that each drill pad will take 2-3 days to construct.

The construction of the drill pads has the potential to create emissions of mechanically generated dust as well as emissions of particulates and gases through the combustion of diesel fuel by the dozer, grader, roller and trucks.

The construction of the drill pads is anticipated to be associated with a minimal risk of air quality impacts at receptor locations due to the significant distance to the nearest receptor.

6.1.2.3 Drilling of Vertical and Lateral Wells

Based on information provided in **Section 3.3**, the 13 vertical wells will require approximately 10 days of drilling time. Lateral wells will each take approximately 20 days. One well will be



drilled at a time, thus cumulatively approximately 330 days of drilling will be required to complete the network.

Although the drilling of the wells is unlikely to generate significant levels of larger scale dust (i.e. TSP or PM₁₀) emissions of particulate (PM_{2.5}) and gases (e.g. carbon monoxide and oxides of nitrogen) will be associated with the combustion of diesel fuel by the drill rig.

As a single drill rig will be used at any one time, the risk of impacts due to emissions of particulate and gases associated with the combustion of diesel fuel are anticipated to be minimal at receptor locations due to the significant distance to the nearest receptor.

6.1.2.4 Vertical and Lateral Well Operation

Flaring

Based on information provided in **Section 3.3**, CSG will be extracted at a rate of approximately 500 l/sec per well or approximately 1,800 cubic metres per hour of CSG per well. It is anticipated that the destruction efficiency of the candlestick flare will be in excess of 95%.

The risk of adverse impacts associated with emission of pollutant gases included in the EPP (Air) due to the flaring of the CSG is anticipated to be minimal at receptor locations due to the significant distance to the nearest receptor.

Generators

As noted in **Section 3.5**, electricity will be required to operate the drill pumps and the well pumps.

A total of thirteen 60 kV diesel generators will be co-located with the vertical wells.

The risk of adverse impacts associated with emission of pollutant gases included in the EPP(Air) due to the combustion of diesel fuel is anticipated to be minimal at receptor locations due to the significant distance to the nearest receptor.

6.1.2.5 Closure and Rehabilitation

The risk of air quality impacts will reduce as the need for diesel fuel decreases.

The reduction in the disturbance footprint associated with rehabilitation will lead to a reduction in the risk of air quality impacts associated with the generation of dust either by the movement of equipment and/or wind generated dust during adverse conditions.

6.1.3 Management Practices

will be managed. Mitigation and management practices to reduce the potential impacts to the sensitive receptors as a result of the Project Activities include:

- Watering of unsealed areas whenever visible dust is being generated.
- Reducing speed limits.
- Minimising clearing of vegetation.
- Seeding of stockpiled material where appropriate.
- Utilising cleaner burning generators.
- Optimising engine performance based on emissions outcomes.
- Operating plant and equipment (including flares) in an emission's optimal manner.



- Monitoring meteorological conditions and pro-actively watering unsealed areas and stockpiles prior to and during, adverse meteorological conditions.

6.1.4 Risk Assessment

The potential air quality impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.5**.

The risk of air quality impacts is Low.

Table 6.5 Air quality risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Impact of emissions of dust and/or pollutants due to combustion of diesel at sensitive receptor locations during construction of access track and drill pads	Unlikely (2)	Low (2)	Low	Short duration of drill pad construction activities (i.e. 2-3 days each). Watering of disturbance areas will provide effective mitigation of dust. Significant distance to nearest receptor (i.e. greater than 3 km)
Impact of emissions of pollutants due to combustion of diesel at sensitive receptor locations during drilling	Unlikely (2)	Low (2)	Low	Drilling activities at each drill pad ranges from 10 to 30 days per pad. Significant distance to nearest receptor (i.e. greater than 3 km)
Impact of emissions of pollutants due to combustion of CSG at sensitive receptor locations during flaring	Unlikely (2)	Low (2)	Low	Flares distributed over a number of drill pads. High destruction efficiency of flares. Significant distance to nearest receptor (i.e. greater than 3 km)
Impact of emissions of pollutants due to combustion of diesel in generators during dewatering and CSG extraction	Unlikely (2)	Low (2)	Low	Individual generators distributed over a number of drill pads. Significant distance to nearest receptor (i.e. greater than 3 km)



6.2 Greenhouse Gas

This section presents the assessment of Project related GHG emissions.

6.2.1 Existing Environmental Values

6.2.1.1 Climate and Meteorology

The Project is located in the sub-tropical region of Central Queensland and is characterised by hot, moist summers and dry winters.

The nearest monitoring station is located at the Moranbah Water Treatment Plant (MWTP), approximately 38 km south of the Project. The MWTP was operated by the Bureau of Meteorology for the period of 1972 to 2012.

Table 6.6 presents a summary of the long term monthly averaged data for:

- Daily maximum temperature
- Daily minimum temperate, and
- Rainfall, of particular note is the seasonal variability in rainfall totals with the majority of the rain occurring during the summer months of December, January and February.

Table 6.6 Rainfall and temperature climate statistics based on data obtained from the BoM MWTP monitoring station (1972-2012)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	33.9	33.1	32.2	29.6	26.5	23.7	23.6	25.5	29.3	32.3	33.1	33.9	29.7
Mean minimum temperature (°C)	21.9	21.8	20.2	17.6	14.2	11.1	9.8	11.1	14.1	17.6	19.4	21.1	16.7
Mean rainfall (mm)	103.8	100.7	55.4	36.4	34.5	22.1	18	25	9.1	35.7	69.3	103.9	613

Long term wind roses for 09:00 and 15:00 provide in Image 6.1 and Image 6.2 respectively, highlight the general light to moderate winds and predominately easterly and south-easterly winds experienced at this location.



Rose of Wind direction versus Wind speed in km/h (10 Jan 1986 to 26 Mar 2012)

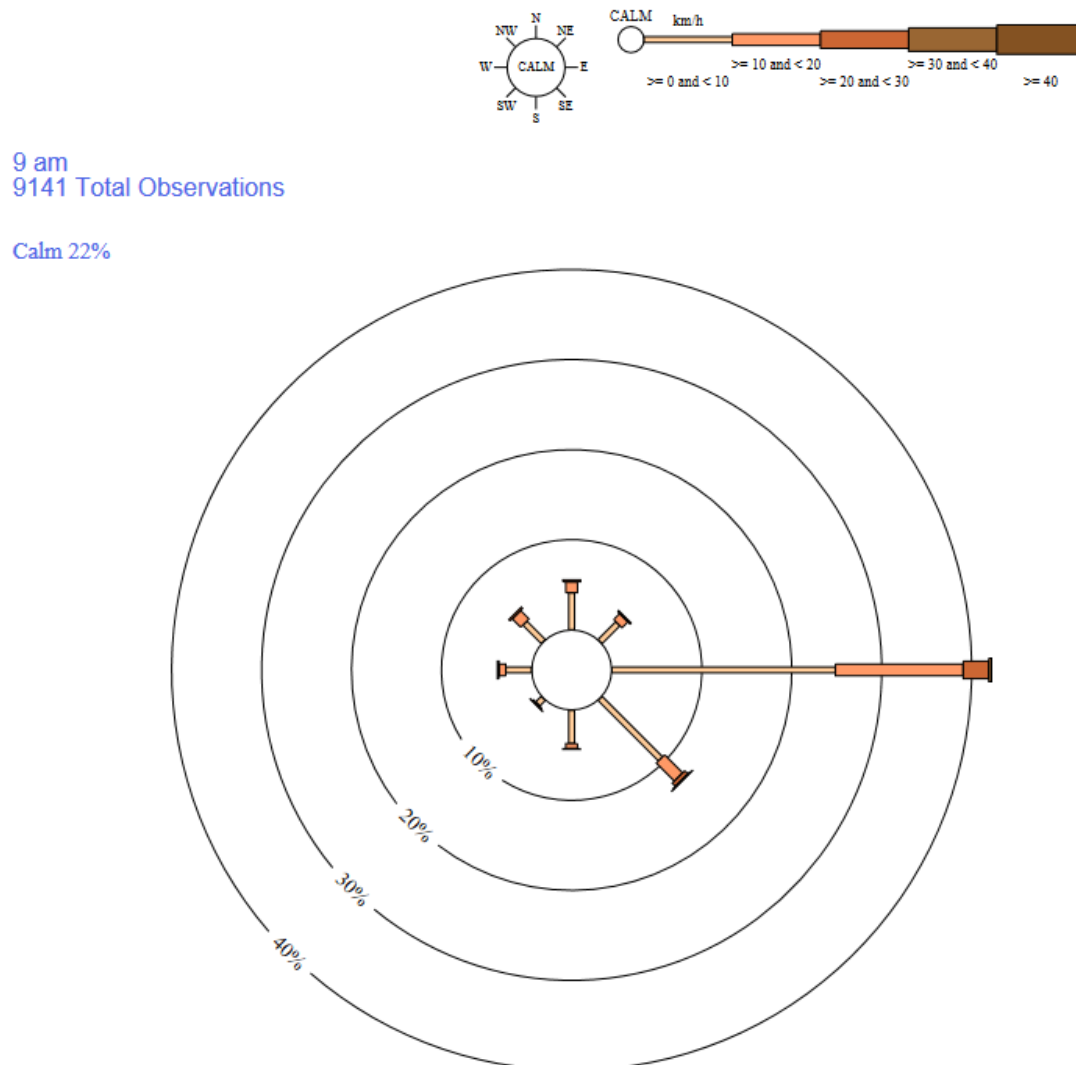
Custom times selected, refer to attached note for details

MORANBAH WATER TREATMENT PLANT

Site No: 034038 • Opened Jan 1972 • Closed Apr 2012 • Latitude: -21.9947° • Longitude: 148.0308° • Elevation 260m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



9 am
9141 Total Observations

Calm 22%

Image 6.1: Wind Rose based on data obtained at 09:00 at the MWTP (1986-2012)
(Source: BoM website
http://www.bom.gov.au/climate/averages/tables/cw_034038.shtml)



Rose of Wind direction versus Wind speed in km/h (10 Jan 1986 to 26 Mar 2012)

Custom times selected, refer to attached note for details

MORANBAH WATER TREATMENT PLANT

Site No: 034038 • Opened Jan 1972 • Closed Apr 2012 • Latitude: -21.9947° • Longitude: 148.0308° • Elevation 260m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.

3 pm
8922 Total Observations

Calm 16%

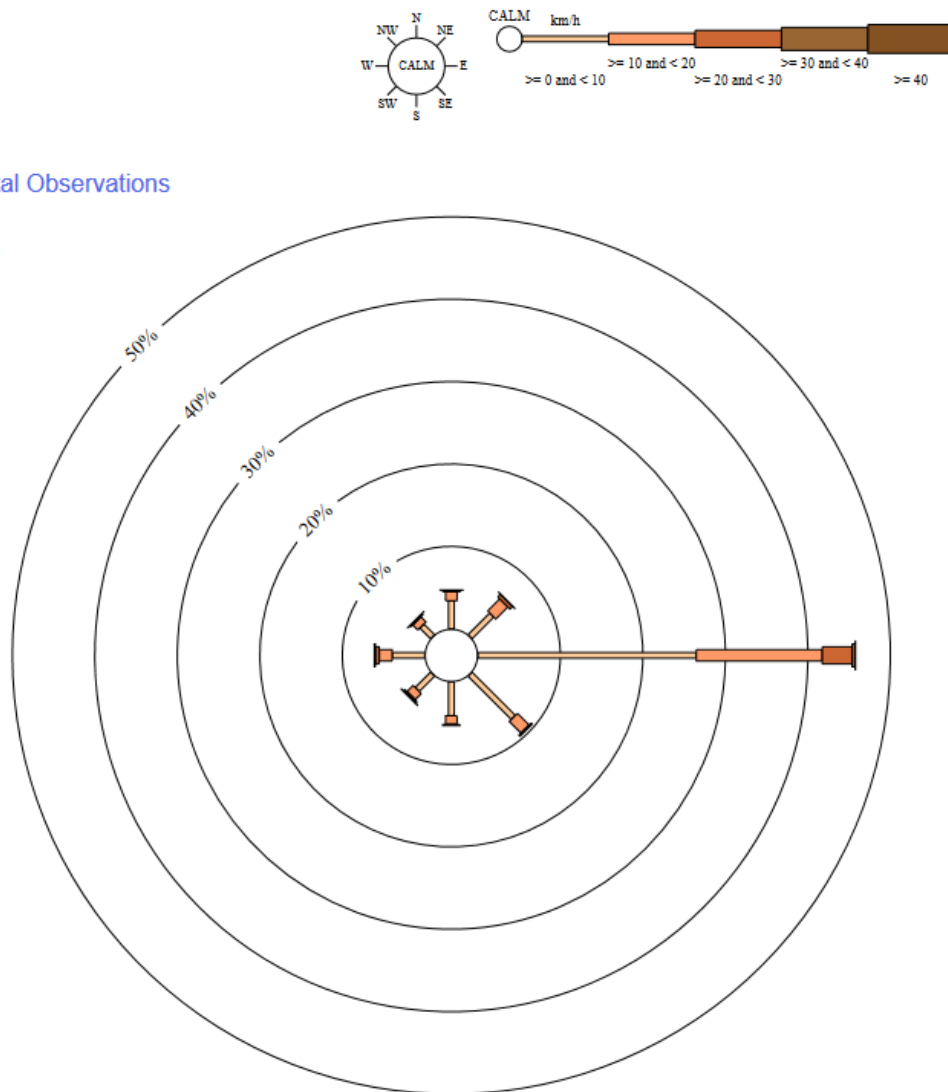


Image 6.2: Wind Rose based on data obtained at 15:00 at the MWTP (1986-2012)
(Source: BoM website
http://www.bom.gov.au/climate/averages/tables/cw_034038.shtml)

6.2.1.2 Greenhouse Gas Inventory

The 'National Greenhouse and Energy Reporting Act 2007' (NGER Act) provides a framework for the annual reporting of corporate greenhouse gas (GHG) emissions, energy consumption and production.



DCCEEWs 'Australian National Greenhouse Accounts Factors' (NGA Factors 2023) provides a methodology by which corporations estimate GHG emissions associated with their activities, including:

- GHG emissions are reported in units of carbon dioxide equivalent or CO₂-e
- GHG sources are classified as being either 'direct' or 'indirect'.
 - Direct emission sources (or Scope 1) are produced from sources within the boundary of an organisation and as a result of that organisation's activities
 - Indirect emissions are generated as a consequence of an organisation's activity, but which are physically produced by the activities of another organisation. There are two classes of indirect emissions: electricity (Scope 2) and other sources (Scope 3).
- It is noted that the NGER Act requires the reporting of Scope 1 and Scope 2 emissions, however the reporting of Scope 3 emissions is voluntary.

The focus of this GHG assessment is Scope 1 emissions. Scope 2 emissions are excluded as the Project electricity requirements will be locally generated using diesel generators and not consumed from the national grid. Further the Project will not produce a product, therefore there are no downstream Scope 3 emissions and upstream Scope 3 emissions have not been considered.

Table 6.7 presents the scope 1 NGA Factors considered in this assessment.

Table 6.7 National Greenhouse Accounts Emission Factors (Scope 1)

Emission Source	Energy Content ⁽³⁾	Emission Factor	Units ⁽²⁾	Source
Coal seam methane that is captured for combustion	0.0377 GJ/m ³	51.63	kg CO ₂ -e/GJ	NGA ⁽¹⁾
Combustion of diesel fuel	38.6 GJ/kL	70.20	kg CO ₂ -e/GJ	NGA ⁽¹⁾
Note: (1) NGA – Australian Government's Department of Climate Change, Energy, the Environment and Water's National Greenhouse Accounts Factors (2023) (2) kg CO ₂ -e/GJ – kilograms (KG) of carbon dioxide equivalent (CO ₂ -e) per gigajoule (GJ) (3) (a) GJ/m ³ – gigajoule (GJ) per cubic metre (m ³) (3) (b) GJ/kL – gigajoule (GJ) per kilolitre (kL)				

6.2.2 Potential Impacts

The following subsections detail the potential GHG impacts as a result of the activities described in **Section 3**. A risk-based assessment of these potential impacts is detailed in **Table 6.5** and a GHG Abatement Plan is presented in **Appendix C**.

6.2.2.1 Construction of Drill Pads and Access Tracks

Based on information provided in **Section 3.2**, a total of 19 drill pads (11.80 ha) and 0.2 ha of access tracks will be developed as part of the Project. Combustion of diesel fuel will be associated with activities undertaken by the dozer, articulated truck, roller and grader during the construction of the drill pads and access tracks.



Based on the NGA Factors provided in **Table 6.7** and estimates of diesel fuel usage, between 170 to 260 tonnes of CO₂-e emissions is estimated to be associated with the combustion of diesel fuel during the construction of the drill pads and access tracks.

6.2.2.2 Establishment of Vertical and Lateral Wells

Based on information provided in **Section 3.3**, the 13 vertical well will require approximately 10 days of drilling time. Lateral wells will each taking approximately 20 days. Thus in total, approximately 330 days of drilling will be undertaken to complete drilling of the network of vertical and lateral wells.

Based on the NGA Factors provided in **Table 6.7** and a drill rig diesel fuel consumption range of 75 to 110 litres per hour, approximately 1,600 to 2,400 tonnes of CO₂-e emissions is estimated to be associated with the drilling of the network of vertical and lateral wells.

6.2.2.3 Vertical and Lateral Wells Operation

Flaring

Based on information provided in **Section 3.3**, each of the 13 vertical wells will produce CSG at a rate of approximately 500 l/sec per well.

The flaring of CSG, as opposed the release of CSG directly to the atmosphere, has the benefit of significantly reducing the global warming potential (GWP) of the released gases into the atmosphere from that of (approximately 100%) methane with a GWP of 28 to that of carbon dioxide with a GWP of 1.

Based on the NGA Factors provided in **Table 6.7** and assuming that the CSG is flared for a period of 1½ and 2 years with all wells producing CSG at a rate of 500 l/sec for the duration, between 700,000 to 800,000 tonnes of CO₂-e emissions is estimated to be generated due to flaring over the life of the Project.

Generators

As noted in **Section 3.5**, electricity will be required to operate the drill pumps and the well pumps. A total of thirteen 60 kV diesel generators will be co-located with the vertical wells.

Based on the NGA Factors provided in **Table 6.7** and assuming that all diesel generators will operate for a period of 2 years at a diesel fuel consumption rate of between 8 to 14 litres per hour, between 5,000 to 8,700 tonnes of CO₂-e emissions are estimated to be associated with the operation of the generators over the life of the Project.

6.2.2.4 Summary of GHG Emission Estimates

Table 6.8 provides a summary of estimated Scope 1 GHG emissions over the life of the Project, highlighting the flaring of CSG as the primary source of emissions. It is noted that CSG flaring will occur primarily during Year 2 of the Project.

It is also noted that it has conservatively been assumed that the CSG flow rate of 500 l/s will be sustained across all thirteen vertical wells throughout a 1½ to 2-year period. In practice, CSG flow rates will be both spatially and temporally variable.



Table 6.8 Summary of GHG Emissions

Project Phase	Source	Tonnes of CO2-e	Percentage of Total
Construction	Combustion of diesel in equipment during drill pad and access track construction	170 - 260	0.02 - 0.03
Construction	Combustion of diesel in drill rig during construction of vertical and lateral wells	1,600 - 2,400	0.23 - 0.30
Operation	Combustion of diesel in generators during operation of vertical and lateral wells	5,000 – 8,700	0.71 – 1.07
Operation	Flaring of CSG	700,00 – 800,000	98.6 – 99.0
Total		706,770 – 811,360	

6.2.2.5 Comparison with Australian Emissions

The latest Australian GHG emissions inventory (2021-2022) provided in the DCCEEW 'National Inventory Report 2022' (DCCEEW, 2024) indicates Australia's total GHG emissions (including land use, land use change and forestry activities) was 432.6 million tonnes (Mt) of CO2-e.

Most of the Project CO2-e emissions occur over the 2-year period associated with the flaring of CSG. The summary of emissions provided in **Table 6.8** suggests an annual Project-related contribution to GHG emissions in the range of approximately 0.35 Mt and 0.4 Mt of CO2-e per year. This represents between 0.08% and 0.09% of Australia's 2022 GHG emissions. Queensland's contribution to the 2022 national inventory was estimated to be 124.1 Mt of CO2-e. The Project's contribution represents 0.28% to 0.33% of Queensland's 2022 emissions.

6.2.3 Management Practices

The potential impacts will be managed through current practices. These methods are used to mitigate impacts of GHG emission, and include:

- Monitoring of diesel use
- Operating plant and equipment so as to minimise fuel usage
- Minimising the risk of fugitive emissions of CSG, and
- Ensuring flares are operating optimally.

6.2.4 Risk Assessment

The potential GHG impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.5**. The risk of greenhouse gas impacts is considered low.



Table 6.9 Greenhouse gas risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Fugitive emissions of GHG associated with the Project will contribute to climate change	Possible (3)	Minor (1)	Low	Although any contribution to GHG emissions may contribute to climate change in theory, it is unlikely that the scale of the contribution of fugitive emissions of GHG from the Project would result in a material change in climate outcomes. Nonetheless, all practicable strategies to reduce the risk of fugitive emissions of CSG throughout the life of the Project should be implemented.



6.3 Noise and Vibration

This section presents the assessment of Project related noise and vibration impacts to sensitive receptors.

6.3.1 Existing Environment

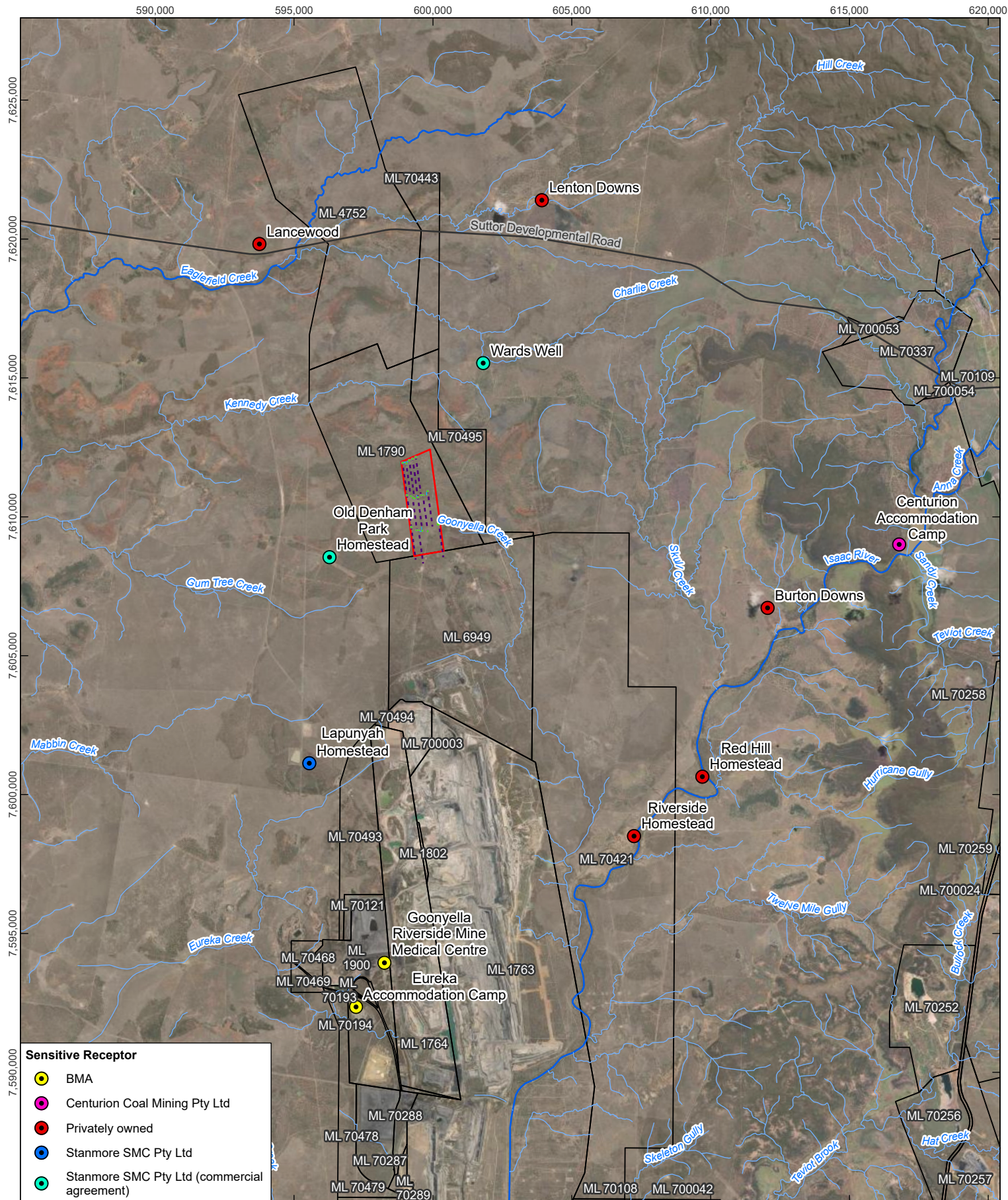
6.3.1.1 Sensitive Receptors

Potential sensitive receptors surrounding the Project Area, are presented in **Table 6.10** and **Figure 6.3**. Sensitive receptors have been identified through a desktop review of historical information (e.g. EIS, EA amendments, etc) and an analysis of available aerial photographic images.

Table 6.10 Receptors Surrounding the Project

ID	Receptor Name	Easting (m) ¹	Northing (m) ¹	Approximate Distance to Closest Drill Pad (km)	Ownership/Agreement Status
1	Old Denham Park Homestead	596275	7608546	3.1	Stanmore SMC Pty Ltd (commercial agreement)
2	Wards Well	601809	7615534	4.1	Stanmore SMC Pty Ltd (commercial agreement)
3	Lancewood	593750	7619821	9.4	Privately owned
4	Lenton Downs	603922	7621398	10.2	Privately owned
5	Centurion Accommodation Camp	616790	7609005	16.5	Centurion Coal Mining Pty Ltd
6	Burton Downs	612051	7606721	12.2	Privately owned
7	Red Hill Homestead	609702	7600644	13.0	Privately owned
8	Riverside Homestead	607241	7598505	13.2	Privately owned
9	Goonyella Riverside Mine Medical Centre	598253	7593944	15.5	BMA
10	Eureka Accommodation Camp	597230	7592356	17.2	BMA
11	Lapunyah Homestead	595547	7601128	9.2	Stanmore SMC Pty Ltd
Note 1: GDA 2020 MGA Zone 55 projection.					





Sensitive Receptor

- BMA
- Centurion Coal Mining Pty Ltd
- Privately owned
- Stanmore SMC Pty Ltd
- Stanmore SMC Pty Ltd (commercial agreement)

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:180,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

LEGEND

- Major Road
- Major Watercourse
- Minor Watercourse
- ▭ Project Area
- ▭ Mining Lease
- Lateral Well Length
- ▭ Drill Pad
- ▭ Access Track

EA AMENDMENT P-EA-100658735

LOCATION OF SENSITIVE RECEPTORS



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6.3

6.3.1.2 Acoustic Environment

Historical noise monitoring results obtained from measurements completed by SLR have been used to inform the assessment criteria for the Project. The baseline noise levels are summarised in **Table 6.11** and have been conservatively applied to the assessment.

All items of acoustic instrumentation employed during the noise monitoring were set to A-weighted and 'Fast' response in accordance with the relevant Australian Standards and DESI's *Noise Measurement Manual* (EPA 2020). All items of acoustic instrumentation employed during the noise measurement surveys were designed to comply with AS/NZS IEC 61672.1-2019 *Electroacoustics-Sound level meters-Specifications* and carried current manufacturer calibration certificates.

Table 6.11 Baseline noise monitoring results summary

Monitoring Location	Description	Rating Background Level (dBA)		
		Day (7 am – 6 pm)	Evening (6 pm – 10 pm)	Night (10 pm – 7 am)
(ID 1) Old Denham Park Homestead	Noise logger located in south-eastern corner of front yard, approximately 15 m from the homestead	28	25	25
(ID 6) Burton Downs Homestead	Noise logger located in centre of front yard, approximately 100 m from the homestead (between homestead and working shed, next to fruit garden)	25	24	24
(ID 8) Riverside Homestead	Noise logger located in north-eastern corner of tennis court, approximately 40 m from the homestead	30	23	23
(ID 10) Eureka Accommodation Camp	Noise logger located ~200 m from Eureka Creek & ~500 m from Riverside Mine Road	36	39	36
(ID 11) Lapunyah Homestead	Noise logger located in south-eastern corner of front yard, approximately 20 m from the homestead	26	30	28

The following is noted from the existing baseline noise monitoring data:

- Excluding the Eureka Camp, Rating Background Levels (RBL) ranged from 25 dBA to 30 dBA during the daytime, and 23 dBA to 30 dBA during both the evening and night-time.
- The observed noise levels were typical of a rural environment with natural noise sources, such as birds, light wind in trees, insects, as well as mining noise contributions associated with the Goonyella Riverside Mine complex and CCM.
- RBLs at the Eureka Village ranged between 36 dBA to 39 dBA during the daytime, evening and night-time. The ambient noise environment at this location was largely controlled by local (i.e. camp-related) vehicle movements, mechanical plant noise from within the camp and noise from Goonyella Riverside Mine.

Of the above, the observation most relevant to this study is that background noise levels (in the context of the existing EA) were shown to be 30 dBA or lower during the day, evening and night-time assessment periods. This is expected to also be the case at other sensitive receptor locations listed in **Table 6.17**.



6.3.2 Potential Impacts

The following subsections detail the noise and vibration assessment methodology and potential impacts resulting from the activities described in **Section 3.0**.

6.3.2.1 Assessment Methodology

Modelling Parameters and Assumptions

A SoundPLAN (Version 8.2) computer noise model was developed to predict project noise levels at potentially impacted receptors. SoundPLAN is a computer model software package enabling calculation of environmental noise by combining a digitised ground map (topography), the location and acoustic sound power levels of potentially critical noise sources on site and the location of receivers for assessment purposes.

The Conservation of Clean Air and Water Europe (CONCAWE¹) industrial prediction algorithm has been used to model predicted noise levels from the Project. The statistical accuracy of environmental noise predictions using CONCAWE was investigated by Marsh (Applied Acoustics 15 – 1982). Marsh concluded that CONCAWE was accurate to ± 2 dBA in any one octave band between 63 hertz (Hz) and 4 kHz and ± 1 dBA overall.

In relation to the modelling of atmospheric conditions, DESI's *EcoAccess Planning for Noise Control* (PNC) guideline (retracted and currently undergoing review by DESI), provides guidance with respect to applying default atmospheric conditions for the assessment of mining operations. The default weather parameters recommended by the PNC guideline are summarised in **Table 6.12** and have been applied to the assessment of noise impacts from the Project.

Table 6.12 Modelled meteorological conditions

Parameter	Neutral Weather	Adverse Weather
Temperature	10oC	10oC
Humidity	70%	90%
Pasqual stability class	D	F (representative of temperature inversion)
Wind speed	0 m/s	2 m/s

Noise and Vibration Modelling Scenarios

The following provides an overview of the noise and vibration modelling completed to inform the assessment of the potential for noise and vibration impacts from the Project:

- New access track and drill pad construction:
 - The pre-drilling stage involving the development of the new access tracks and drill pads has been modelled based on the combined fleet of construction equipment listed in **Table 6.13** operating simultaneously. Noise from the new access tracks and drill pad construction activities have been modelled individually at every proposed access track and drill pad site with the highest (i.e. worst-case) noise level predicted at each receptor assessed against the noise criteria.

¹ Report no. 4/81 the propagation of noise from petroleum and petrochemical complexes to neighbouring communities



- Vibration modelling and assessment has been carried out for the 12t vibratory roller required for soil compaction as part of the earthmoving fleet.
- Drilling of vertical and lateral wells:
 - The modelling of well drilling noise has been conservatively based on the lateral well rig setup (spread) for all Project wells (i.e. both vertical and lateral wells), noting noise emission from the drilling of vertical wells will potentially be lower, given the smaller rig spread. Noise from the SIS drill rig have been modelled individually at every proposed drill site with the highest (i.e. worst-case) noise level predicted at each receptor assessed against the noise criteria. The modelled sound power level (SWL) data is summarised in **Table 6.13**.
 - No discernible sources of vibration are anticipated during this stage of the Project.
- Vertical and lateral well operation:
 - Modelling of worst-case operational noise from the Project has been based on the plant listed in **Table 6.13** all operating simultaneously at all proposed well sites. As can be seen by the significant difference in source SWLs, noise emission levels associated with this stage of the Project will be dominated by the vertical flare.
 - No discernible sources of vibration are anticipated during this stage of the Project.

Table 6.13 Modelled scenarios and equipment SWL data – A-weighted

Plant Item	Octave Band Centre Frequency (Hz)								Total SWL	Source Height
	63	125	250	500	1k	2k	4k	8k		
New access track and drill pad construction (note: fleet consists of one (1) of each item)										
Slasher	83	103	105	110	112	104	102	92	115	2.0 m
Dozer D8T	84	93	97	105	101	100	98	90	108	2.5 m
Vibratory roller (12t)	97	102	95	100	102	101	98	93	108	2.0 m
Water truck (30 kL)	84	90	95	100	100	99	95	85	106	2.5 m
Grader CAT 150	94	100	106	103	109	106	102	90	113	3.0 m
Well drilling (note: only one (1) rig proposed for well drilling)										
SIS drill rig	105	109	111	117	122	119	111	102	125	3.0 m
Well operation (note: well operational plant modelled at each well pad; other plant will also be required however the below represents the acoustically significant plant items required for the Project)										
Flare (500 L/sec)	95	106	113	118	116	115	111	108	123	6.0 m



Plant Item	Octave Band Centre Frequency (Hz)								Total SWL	Source Height
	63	125	250	500	1k	2k	4k	8k		
Well pumps	89	84	88	91	96	98	92	81	102	2.0 m
Generator 60kV diesel	78	85	86	83	85	85	79	65	92	1.5 m

6.3.2.2 New Access Tracks and Well Pad Development

Construction Noise

The predicted new access track and drill pad construction noise levels, under neutral and adverse weather conditions, are summarised in **Table 6.14**.

Construction of the new access tracks and drill pads is anticipated to occur during the hours of 6:00 am to 6:00 pm daily. As such, the EA noise limits for both the daytime period (i.e. 7:00 am to 6:00 pm) and night-time period (i.e. 6:00 am to 7:00 am) have been included for reference in **Table 6.14**.

Table 6.14 Predicted worst-case new access track and drill pad construction noise levels

Receptor	EA Noise Limit LA10,adj,10mins (dBA)		Predicted Construction Noise Level LA10,adj,10min (dBA)	
	6:00 am to 7:00 am	7:00 am to 6:00 pm	Adverse Weather	Neutral Weather
1 - Old Denham Park Homestead ¹	N/A	N/A	31	26
2 - Wards Well ¹	N/A	N/A	27	21
3 - Lancewood	33	35	14	<10
4 - Lenton Downs	33	35	13	<10
5 - Centurion Accommodation Camp	N/A	N/A	<10	<10
6 - Burton Downs	33	35	11	<10
7 - Red Hill Homestead	33	35	10	<10
8 - Riverside Homestead	33	35	10	<10
9 - Goonyella Riverside Mine Medical Centre ²	33	35	<10	<10
10 - Eureka Accommodation Camp ²	33	35	<10	<10
11 - Lapunyah Homestead ¹	33	35	15	<10
Note: Greyed cells indicate the receptor is either owned by CCM or a commercial agreement exists (i.e. non-sensitive receptors). Note 1: Receptor owned and operated by Stanmore SMC Pty Ltd. Note 2: Receptor owned and operated by BMA.				



From the noise modelling results presented in **Table 6.14**, the following is noted:

- Worst-case new access track and drill pad construction noise levels are predicted to comply with the EA noise limits at all sensitive receptors.
- The highest predicted noise level was 31 dBA LA10,adj,10mins at the Old Denham Park Homestead, which is noted to be owned by Stanmore SMC Pty Ltd with a commercial agreement in place between CCM and Stanmore.
- The highest predicted noise level at a privately-owned sensitive receptor was 14 dBA LA10,adj,10mins at Lancewood.

Construction Vibration

The current EA does not prescribe vibration limits, nor does it provide guidance in relation to the prevention of vibration impacts from activities occurring on ML 1790. Consequently, the potential for vibration impacts associated with the operation of the 12t vibratory roller (required as part of the earthworks fleet) has been assessed against the following criterion:

- Human comfort peak particle velocity (PPV) vibration limit of 5 mm/s, based on guidance from DESI's *Model Mining Conditions* Guideline (MMC).

It is noted the above criterion specifically refers to ground vibration from blasting, however it is considered that the vibration limits are relevant to the assessment of vibration from the Project vibratory compaction works, particularly given the temporary and short-term nature of these works. Notwithstanding this, vibration offset buffer distances to comply with the threshold of human perception (i.e. <0.15 mm/s²) have also been calculated and assessed for the Project.

Prediction of PPV vibration levels from the 12t roller has been based on the following methodology:

- Vibratory compaction – BS 5228-2:2009 Evaluation and measurement for vibration in buildings - Part 2 (plus 2014 Amendment), specifically Table E.1 'Empirical predictors for groundborne vibration arising from mechanized construction works'.

Vibratory compaction PPV vibration levels were calculated using the empirical formulae shown in **Image 6.3**.

Operation	Prediction question	Scaling factors (and probability of predicted value being exceeded)	Parameter range
Vibratory compaction (steady state)	$v_{res} = k_s \sqrt{n_d} \left[\frac{A}{x + L_d} \right]^{1.5}$	$k_s = 75$ (50%) $k_s = 143$ (33.3%) $k_s = 276$ (5%)	$1 \leq n_d \leq 2$ $0.4 \leq A \leq 1.72$ mm $2 \leq x \leq 110$ m
Vibratory compaction (start up and run down)	$v_{res} = k_t \sqrt{n_d} \left[\frac{A^{1.5}}{(x + L_d)^{1.3}} \right]$	$k_t = 65$ (50%) $k_t = 106$ (33.3%) $k_t = 177$ (5%)	$0.75 \leq L_d \leq 2.2$ m

Image 6.3 Empirical predictors for groundborne vibration from construction works

Source: Table E.1, Vibratory rolling – BS 5228-2:2009 Evaluation and measurement for vibration in buildings - Part 2 (plus 2014 Amendment)

² British Standard BS 5228-2:2009, *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*, states "Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV range of 0.14 mm/s to 0.3 mm/s".



Based on the formulae presented in **Image 6.3**, vibration offset buffer distances for the 12t roller have been calculated to inform the assessment:

- Approximately 30 m to comply with the 5 mm/s human comfort vibration limit.
- Approximately 480 m to be below the threshold of human perception (i.e. <0.15 mm/s).

Based on the above vibration offset buffer distances and the receptor to drill pad distances in Table 6.10 (i.e. 9.4 km to 13.2 km for privately-owned sensitive receptors), the risk of vibration-related impacts is negligible for any sensitive receptor during the vibratory compaction works.

6.3.2.3 Vertical and Lateral Well Drilling

The predicted vertical and lateral well drilling noise levels, under neutral and adverse weather conditions, are summarised in **Table 6.15** and are assessed against the daytime and night-time period noise limits.

Table 6.15 Predicted worst-case CSG exploration drilling noise levels

Receptor	EA Noise Limit LA10,adj,10mins (dBA)		Predicted Drilling Noise Level LA10,adj,10min (dBA)	
	6:00 am to 7:00 am	7:00 am to 6:00 pm	Adverse Weather	Neutral Weather
1 - Old Denham Park Homestead ¹	N/A	N/A	37	31
2 - Wards Well ¹	N/A	N/A	32	26
3 - Lancewood	33	35	17	10
4 - Lenton Downs	33	35	16	<10
5 - Centurion Accommodation Camp	N/A	N/A	<10	<10
6 - Burton Downs	33	35	13	<10
7 - Red Hill Homestead	33	35	12	<10
8 - Riverside Homestead	33	35	12	<10
9 - Goonyella Riverside Mine Medical Centre ²	33	35	11	<10
10 - Eureka Accommodation Camp ²	33	35	<10	<10
11 - Lapunyah Homestead ¹	33	35	17	10
Note: Greyed cells indicate the receptor is either owned by CCM or a commercial agreement exists (i.e. non-sensitive receptors). Note 1: Receptor owned and operated by Stanmore SMC Pty Ltd. Note 2: Receptor owned and operated by BMA.				

The noise prediction modelling results shown in **Table 6.14** and **Table 6.15** indicate the following:



- Worst-case drilling noise levels are predicted to comply with the EA noise limits at all sensitive receptors.
- The highest predicted noise level at a privately-owned sensitive receptor was 17 dBA LA10,adj,10mins at Lancewood.

6.3.2.4 Vertical and Lateral Well Operation

The predicted vertical and lateral well operational noise levels under neutral and adverse weather conditions, are summarised in **Table 6.16** and are assessed against the daytime and night-time period noise limits.

Table 6.16 Predicted worst-case CSG well operational noise levels

Receptor	EA Noise Limit LA10,adj,10mins (dBA)		Predicted CSG Well Noise Level LA10,adj,10min (dBA)	
	6:00 am to 7:00 am	7:00 am to 6:00 pm	Adverse Weather	Neutral Weather
1 - Old Denham Park Homestead 1	N/A	N/A	46	40
2 - Wards Well 1	N/A	N/A	41	34
3 - Lancewood	33	35	28	20
4 - Lenton Downs	33	35	26	19
5 - Centurion Accommodation Camp	N/A	N/A	<10	<10
6 - Burton Downs	33	35	24	17
7 - Red Hill Homestead	33	35	23	16
8 - Riverside Homestead	33	35	23	15
9 - Goonyella Riverside Mine Medical Centre 2	33	35	22	14
10 - Eureka Accommodation Camp 2	33	35	19	12
11 - Lapunyah Homestead 1	33	35	29	21
Note: Greyed cells indicate the receptor is either owned by Centurion Mine or a commercial agreement exists (i.e. non-sensitive receptors). Note 1: Receptor owned and operated by Stanmore SMC Pty Ltd. Note 2: Receptor owned and operated by BMA.				

The noise prediction modelling results shown in **Table 6.16** the following is noted:

- Worst-case CSG well operational noise levels are predicted to comply with the EA noise limits at all sensitive receptors.
- The highest predicted noise level at a privately-owned sensitive receptor was 28 dBA LA10,adj,10mins at Lancewood. The 6 m high vertical flares are the dominant source of noise during this stage of the Project.



6.3.3 Management Practices

The assessment of the potential for noise and vibration impacts to sensitive receptors has indicated that impacts would likely be avoided without the need for specific mitigation and management measures. Nonetheless, it is recommended that the following good practice measures are applied during the Project to assist with the control of noise and vibration levels:

- Use of the quietest available equipment to complete the earthworks, drilling and CSG flaring works.
- All plant and equipment should be operated in accordance with the manufacturer's instruction and regularly maintained in order to minimise noise emission levels.
- Lining pipe racks with rubber to dampen the metal-on-metal impact.
- Equipment should be shut down when not in use.
- Broadband "buzzer", not tonal "beeper", reversing alarms should be utilised on all mobile plant.

6.3.4 Risk Assessment

The potential noise and vibration impacts were assessed to provide an overall risk rating, which are presented in **Table 6.17**. The risk-based assessment has determined that noise and vibration impact to sensitive receptors surrounding the Project are low due to the scale and location of the Project activities.

Table 6.17 Noise and vibration risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Noise disturbance at sensitive receptors during new access track and drill pad construction works	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm
Vibration disturbance at sensitive receptors during vibratory compaction associated with new access track and drill pad construction works	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm
Noise disturbance at sensitive receptors during CSG exploration drilling works	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm
Noise disturbance at sensitive receptors during CSG flaring operations	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm



6.4 Land Resources

This section presents the assessment of Project related land resource impacts to environmental values.

6.4.1 Existing Environmental Values

6.4.1.1 Surface Geology

The Project is located within the Nogoa-Belyando region, which comprises of gently undulating Tertiary land surface that was depositional over extensive lowland areas (SKM 2012). **Table 6.18** translates lithologies (Department of Resources 2023) within the Project area, as illustrated in **Figure 6.4**.

Table 6.18 Surface geology lithological summary

Map Symbol	Legend	Lithological Summary	Age
TQr\>Pwt	TQr\>QLD>Fort Cooper Coal Measures (TQr\>Pwt)	Older residual soils, colluvium (ferruginous soils)	Late Tertiary - Quaternary
Pwt	Fort Cooper Coal Measures (Pwt)	Lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff, tuffaceous (cherty) mudstone	Late Permian
TQr\>Pb	TQr\>QLD>Back Creek Group (TQr\>Pb)	Older residual soils, colluvium (ferruginous)	Late Tertiary - Quaternary
TQa	TQa-(TQa)	Locally red-brown mottled, poorly consolidated sand, silt, clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected)	Late Tertiary - Quaternary
TQr>Tu	TQr-QLD>Suttor Formation (TQr>Tu)	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)	Late Tertiary - Quaternary
TQr>Tb	TQr-QLD>Tb-(TQr>Tb)	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)	Late Tertiary - Quaternary
TQr\>	TQr\>-(TQr\>)	Older residual soils, colluvium (ferruginous)	Late Tertiary - Quaternary
Tb	Tb-(Tb)	Mostly olivine basalt flows and some plugs; some areas of nephelinite, basanite etc	Tertiary

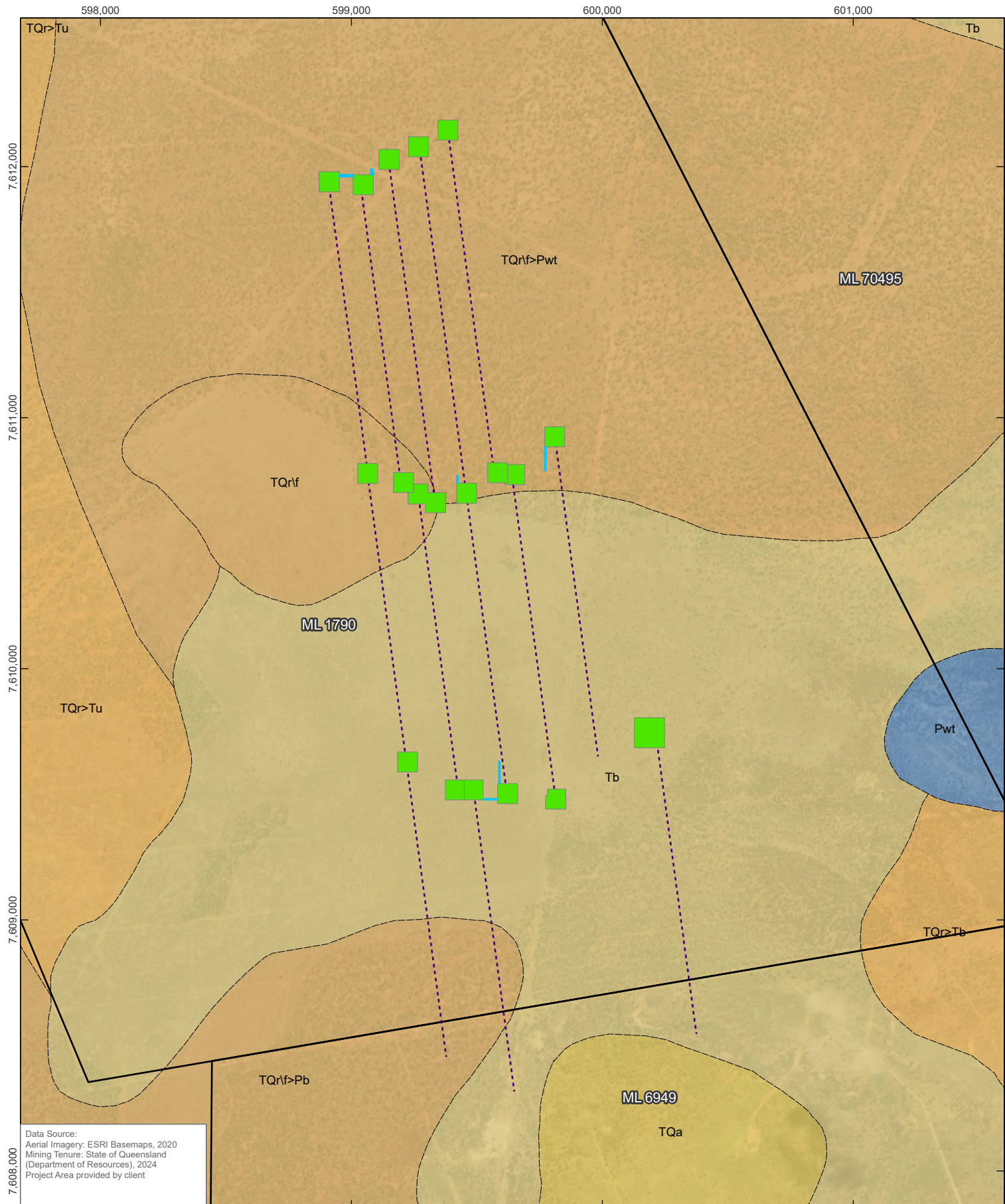


6.4.1.2 Soil Mapping Units

Within the disturbances areas of the Project, only one soil mapping unit (**Figure 6.4**) is identified utilising the Queensland Government Department of Resources (2018) database. It uses The Atlas of Australian Soils compiled by during the 1960's period to create a standardised Australian national description of soils.

The disturbance area is dominated by the unit My28 (**Figure 6.5**) and is described as gently undulating lands with broad ridge crests and low rises. Dominant soils are loamy or occasionally sandy red earths.





 0 0.3 0.5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:20,000 at A4
Project Number: 620.040594.00001
Date Drawn: 10-Sep-2024
Drawn by: RB

LEGEND

-  Lateral Well Length
-  Drill Pad
-  Access Track
-  Mining Lease

Surface Geology

-  Geological boundary approximate
-  Fort Cooper Coal Measures (Pwt)
-  TQa-QLD (TQa)
-  TQr-QLD>Suttor Formation (TQr>Tu)
-  TQr-QLD>Tb-QLD (TQr>Tb)
-  TQr<f>-QLD (TQr<f>)
-  TQr<f>-QLD>Back Creek Group (TQr<f>>Pb)
-  TQr<f>-QLD>Fort Cooper Coal Measures (TQr<f>>Pwt)
-  Tb-QLD (Tb)

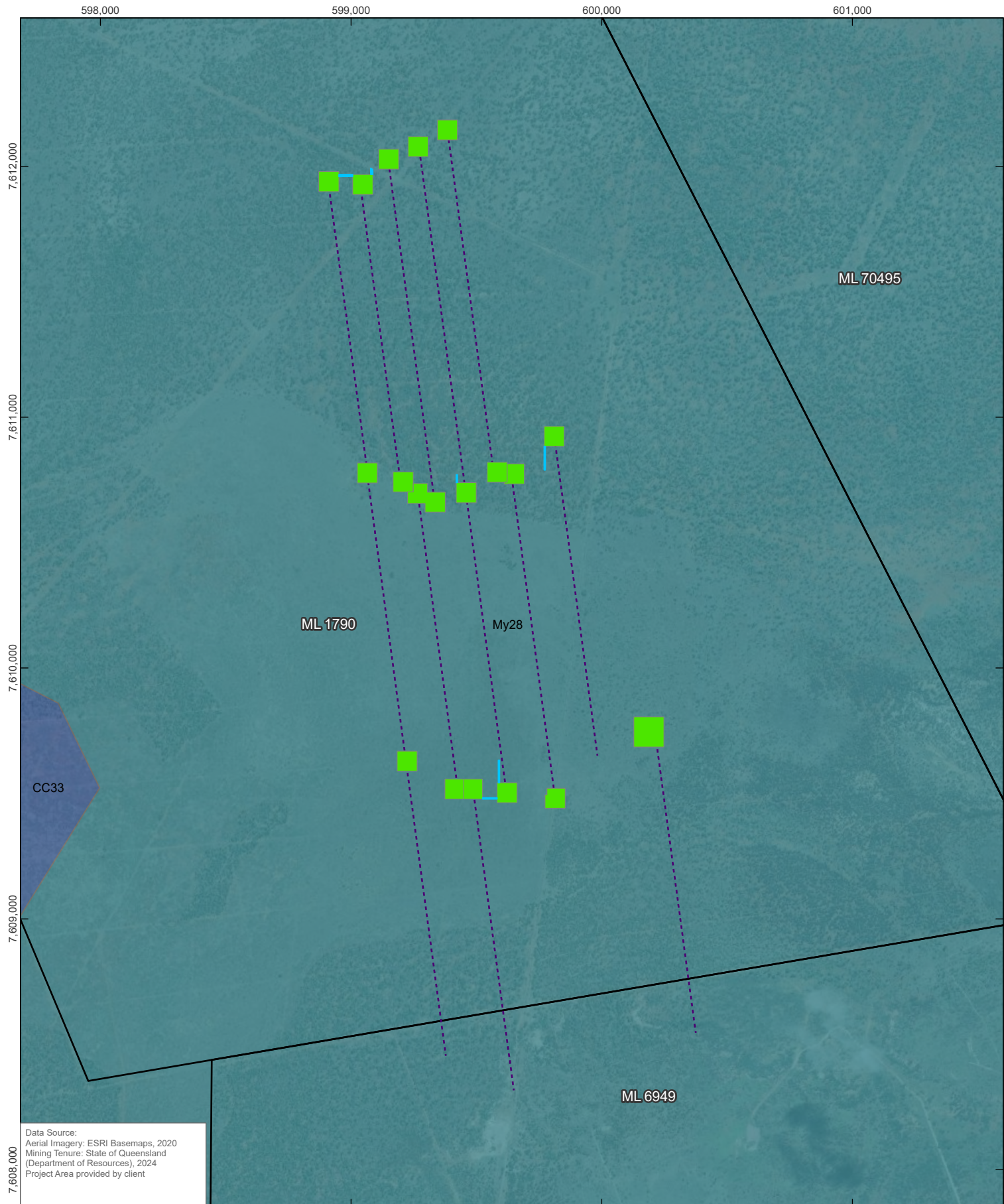
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SURFACE GEOLOGY



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FIGURE 6.4



Data Source:
 Aerial Imagery: ESRI Basemaps, 2020
 Mining Tenure: State of Queensland
 (Department of Resources), 2024
 Project Area provided by client

	0 0.3 0.5 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	620.040594.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

LEGEND

-  Lateral Well Length
-  Drill Pad
-  Access Track
-  Mining Lease

Atlas of Australian Soils

Map Unit

-  CC33
-  My28

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ATLAS OF AUSTRALIAN SOILS



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FIGURE 6.5

6.4.1.3 Soil Orders

Soil units for most of the Project Area was mapped by (2012) as part of the *Wards Well: Soil Survey*. completed detailed soil descriptions at 98 locations and 384 observation sites. A section of the disturbance area to the south of the Project Area was not classified by SKM (**Figure 6.6**). The broad scale regional soil mapping (DNRME and DES 2024) was accessed to determine the soil order (**Figure 6.7**). The major soil orders present on site are Vertosol, Dermosol and Kandosol. The dominant properties of each soil order are provided below.

Vertosol

The soil profile is predominantly clayey, with the surface soil typically consisting of light clay containing over 35% clay content. The subsoil varies from light to medium or heavy clay. Due to the characteristics of the clay minerals, these soils undergo significant shrinkage and swelling during wetting and drying cycles. When dry, they develop noticeable cracks that usually extend to the soil surface (VRO 2021).

On-site (SKM 2012), the observed Vertosols have a well-developed structure and high clay content, with most being utilized for grazing in the region. These cracking clays typically range from very dark brown to dark greyish black, consisting of medium to heavy clays. They are moderately to well-drained, generally alkaline, and become increasingly alkaline with depth.

Further observations include:

- Overall good fertility.
- Sodicity and salinity increase below 300 mm, restricting plant rooting depth and plant-available water capacity (PAWC) with probability of soils becoming epihypersodic³.
- Desirable pH levels.
- High levels of nitrates, phosphorus and metals.
- Well-structured surface soil (high organic matter and calcium relative to magnesium), though it may become dispersive below 300 mm.

Dermosol

Dermosols are characterized by a strong texture transition between the A and B horizons and are not uniformly calcareous. They feature moderately to strongly structured B2 horizons, which are typically clayey and contain less than 5% free iron oxides. In arid regions, Dermosols are commonly found on low-angle pediments with sparse shrublands.

Within the mining lease (SKM, 2012), Dermosols have been observed to have the following properties:

- Overall low fertility (low levels of phosphorus and nitrogen).
- Sodicity and dispersiveness increase below 200 mm.
- pH at desirable levels.

³ Extremely high levels of exchangeable sodium within the upper part of the soil profile. Soil with very high exchangeable sodium percentage (ESP), typically in the range of 15% or more, which is considered detrimental to soil health.



- Poor surface soil structure (low organic matter and apedal) with dispersiveness below 200 mm; other tested Dermosols showed dispersiveness below 700 mm.

Kandosol

Kandosols are non-texture contrast soils (with little or gradual increase in clay content with depth) that have massive (i.e. weakly to non-structured) subsoils (B horizons). They are found mainly in the upland areas, often in association with Dermosols, Chromosols and Kurosols. These soils can vary from stony hardsetting soils to deeper friable soils. Some may almost be texture contrast and have a bleached subsurface (A2) horizon (VRO 2021).

Kandosols are often found in conjunction with ferricrete deposits, within level to gently undulating plains. Their parent material usually consists of quartz-rich sedimentary rock. They are often greater than 3m deep and clay rich. The Kandosols within the Project area have been observed with the following (SKM 2012):

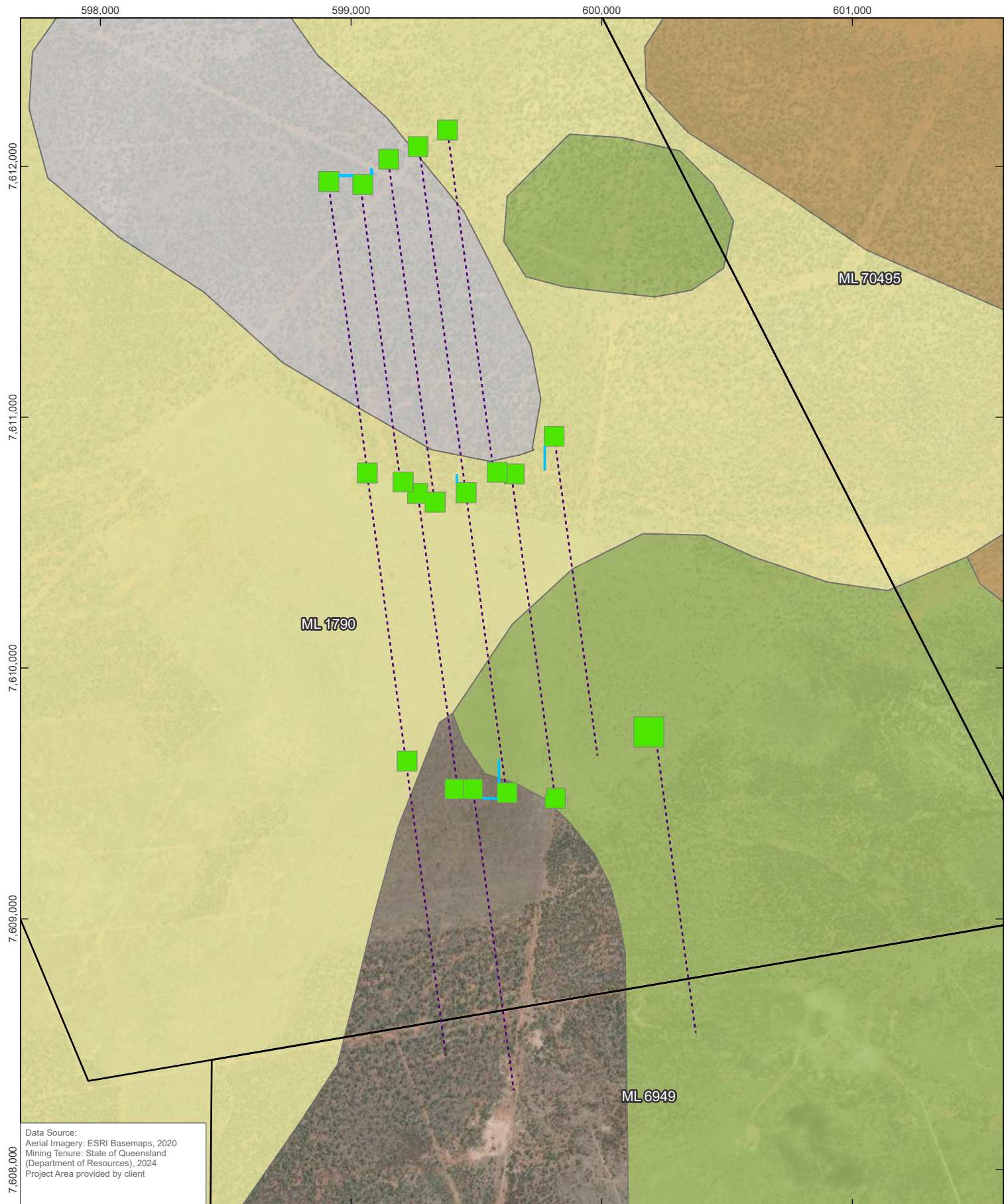
- pH is within desirable range.
- Good soil structure.
- Moderate overall fertility (high levels of nitrogen, adequate phosphorus and metals, low sulphate at surface and low to moderate cation exchange capacity (CEC)).

A summary of chemical properties (**Table 6.19**) of these soil orders have been extracted from Wards Well Mine (BHP, 2021). Further details of each soil order are presented in the following sections.

Table 6.19 Soil order chemical properties summary

Parameter	Unit	Vertosol	Dermosol	Kandosol
pH1:5 water	N/A	7.8 - 8.6	7.2 - 7.8	6.7 – 7.5
Electrical conductivity (1:5 water)	dS/m	0.1 - 0.66	0.025 - 0.15	0.014 – 0.034
Plant available water content	mm	125 - 450	100 - >125	>125
Organic carbon	%	5.1	1.4	3.6
Cation exchange capacity	cmol/kg	57 - 72.4	8.1 - 20.3	17.4 – 31
Exchangeable sodium percentage	%	0 - 12	5 – 11	0 – 5
Calcium to magnesium ratio	N/A	1.1 - 2.1	0.8 – 1.2	1.2 – 1.7
Productivity	-	Predominate soil type in the region. Soil properties sufficient to support grasses and native trees	Suitable for rehabilitation for cattle grazing on flat to gentle slopes	Suitable for rehabilitation of steeper slopes due to good soil structure





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:20,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

--- Lateral Well Length

■ Drill Pad

— Access Track

□ Mining Lease

Australian Soil Classification (SKM, 2012)

■ Dermosol

■ Kandasols

■ Sodosol

■ Vertosol

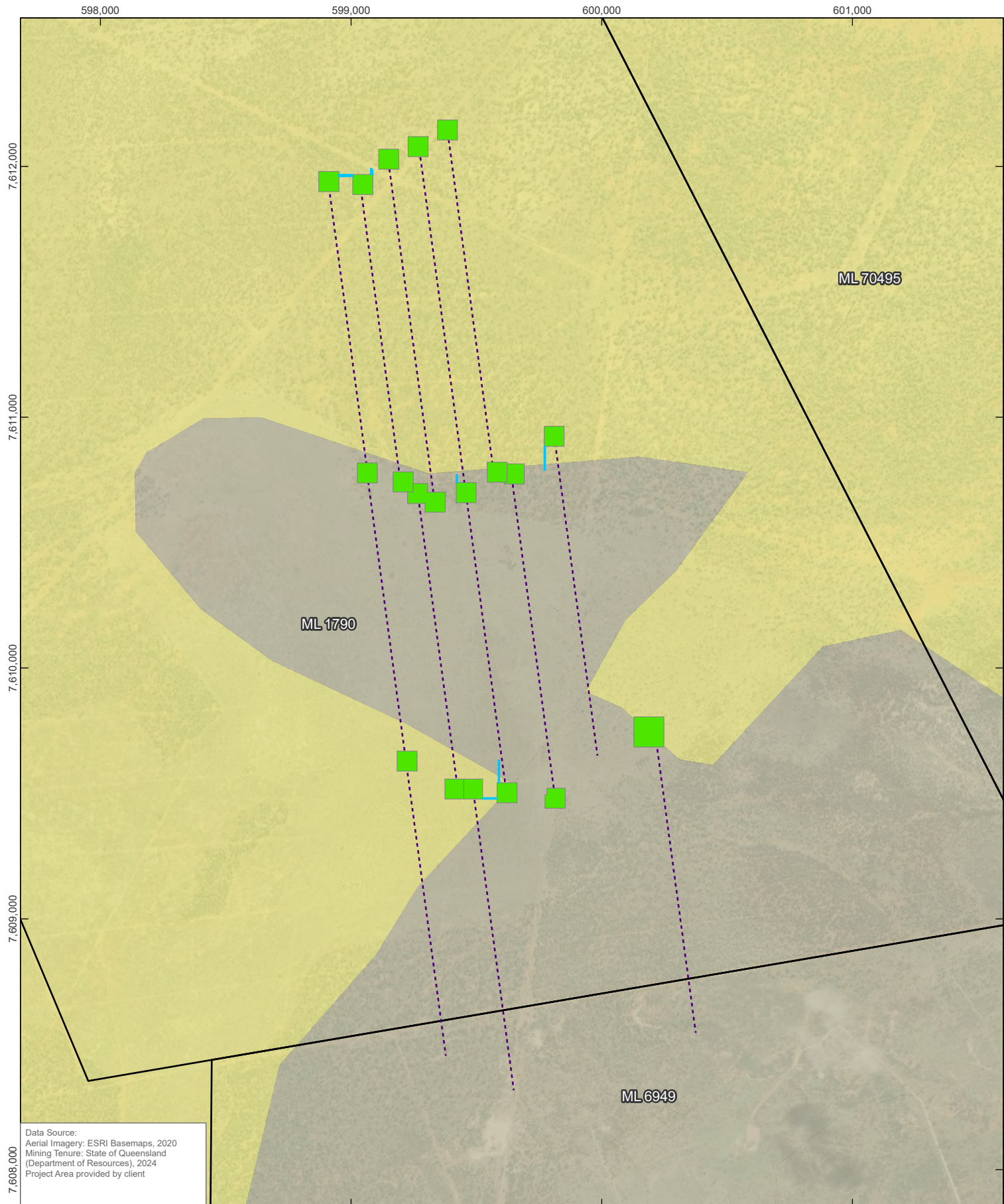
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AUSTRALIAN SOIL CLASSIFICATION OF PROJECT AREAS (SKM, 2012)



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FIGURE 6.6



 0 0.3 0.5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:20,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

LEGEND

-  Lateral Well Length
-  Drill Pad
-  Access Track
-  Mining Lease

Australian Soil Classification (DNRME and DES, 2024)

-  Kandosol
-  Vertosol

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**AUSTRALIAN SOIL
CLASSIFICATION OF PROJECT
AREAS (DNRME AND DES, 2024)**



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FIGURE 6.7

6.4.1.4 Land Use

Most of the Project Area is currently utilised for cattle grazing on buffel and native grasses, which were in good condition during the survey completed by (2012). The vegetation in the area includes natural bush consisting of Poplar Box, Bloodwood, Ironbark, Acacia, Wattle and Brigalow species. The environmental values of terrestrial ecology and vegetation are described in further detail in **Section 6.5** and **Section 6.6**.

6.4.1.5 Land Suitability

Five land suitability classes are defined for use in Queensland, with land suitability decreasing progressively from Class 1 to Class 5 (**Table 6.24**). These classes are used to describe an area of land in terms of suitability for a particular land use which allows optimum, sustainable production with current technology while minimising degradation to the land resource in the short, medium or long-term (Queensland Government 2013). Land suitability deals with land specific uses, which in this case are grazing and cropping.

An overall suitability class for each land use is then determined for each mapping unit on a scale of 1 to 5. This is usually determined by the most severe suitability subclass that applies in that particular mapping unit.

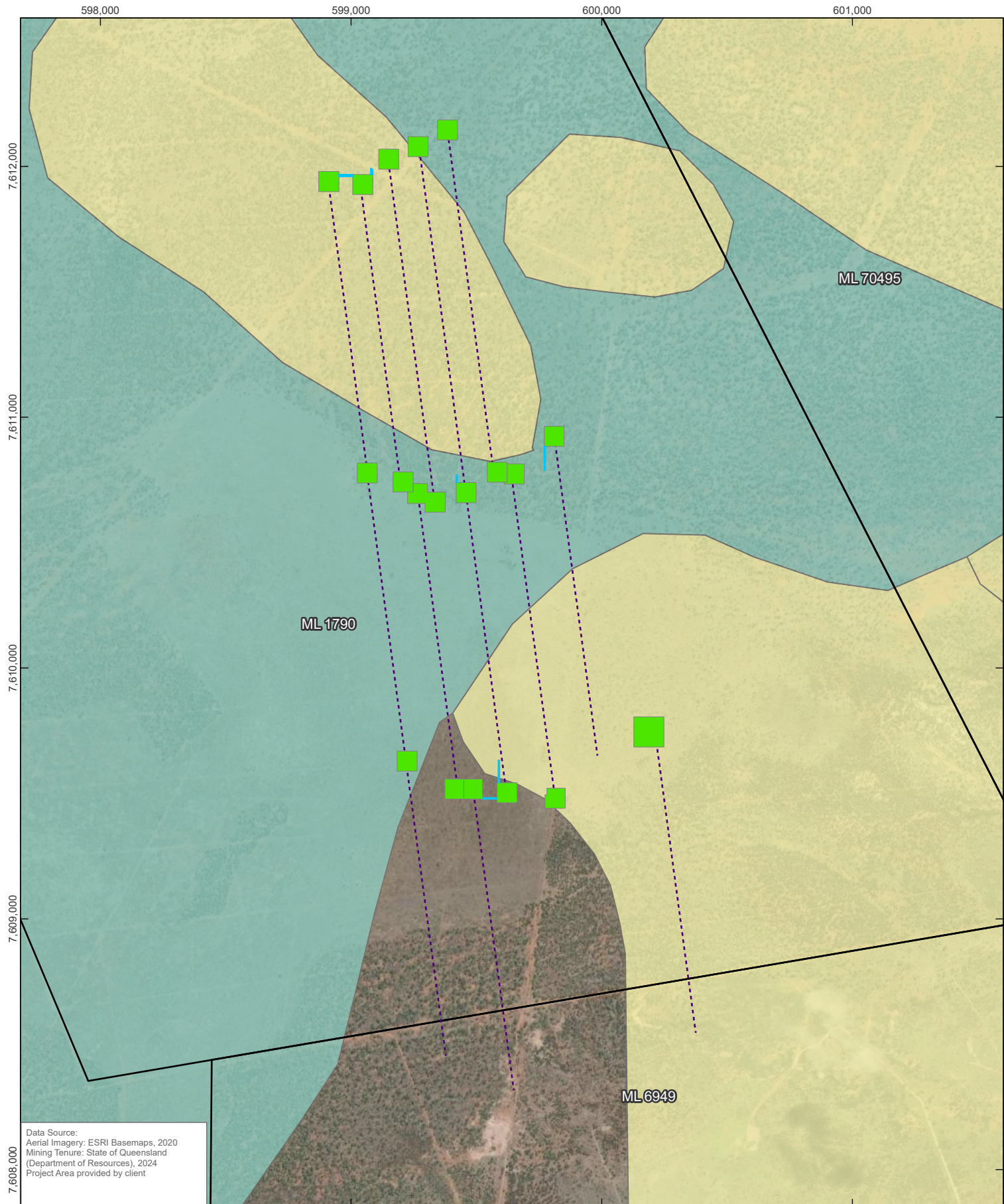
Land suitability for the Project Area was classified by (2012) using the Department of Minerals and Energy (1995) *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland* (1995) and the grazing and cropping guidelines in Shields and Williams (1991) *Land Resource Survey and Evaluation of the Kilcummin Area, Queensland*.

Vertosol and Dermosol were Class 3 for grazing and Class 4 for cropping and Kandosol Class 2 for grazing and Class 3 for cropping (**Figure 6.8** and **Figure 6.9**). The soil survey did not evaluate the full Project Area. The area between the Kandosols and Dermosols in the southern extend of the Project Area was not evaluated. Following a conservative approach, it is assumed that this area is classified as the higher of the two land suitability classes between which it is located.

Table 6.20 Queensland suitability classes

Class	Description
1	Highly productive land requiring only simple management practices to maintain economic production.
2	Land with limitations that either constrain production or require more than the simple management practices of class 1 land to maintain economic production.
3	Land with limitations that either further constrain production or require more than those management practices of class 2 land to maintain economic production.
4	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics or technology.
5	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:20,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

--- Lateral Well Length

■ Drill Pad

— Access Track

□ Mining Lease

Land Suitable for Grazing

■ 2 - Suitable grazing land with minor limitations (Kandosols)

■ 3 - Suitable grazing land with moderate limitations (Dermosols, Sodosols, Vertosols)

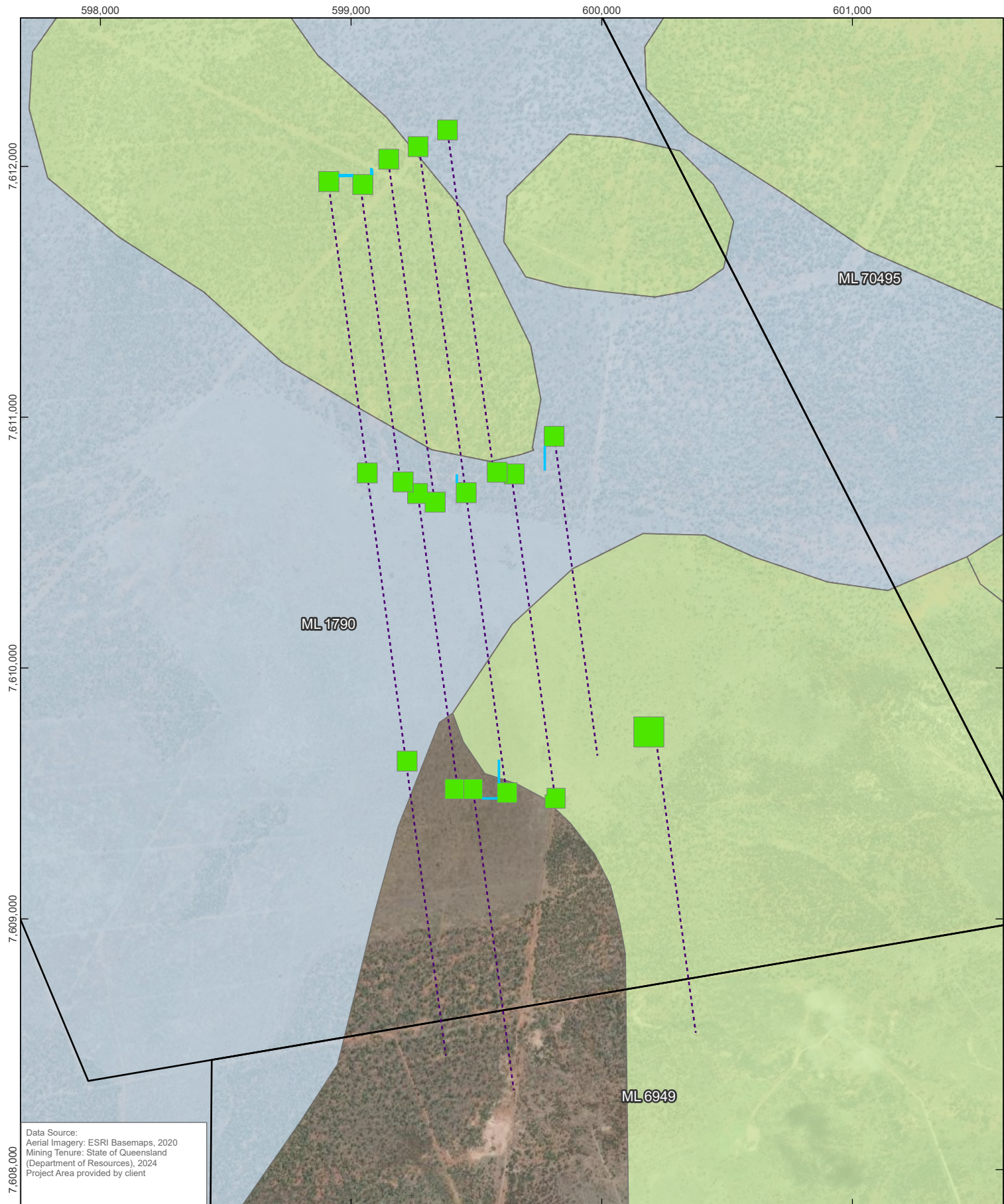
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**GRAZING LAND CLASS
SUITABILITY**



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FIGURE 6.8



Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:20,000 at A4
Project Number: 620.040594.00001
Date Drawn: 10-Sep-2024
Drawn by: RB

LEGEND

- Lateral Well Length
- Drill Pad
- Access Track
- Mining Lease

Land Suitable for Cropping

- 3 - Cropping land with moderate limitations (Kandasols)
- 4 - Marginal cropping land (Dermosols, Sodosols, Vertosols)

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**CROPPING LAND CLASS
SUITABILITY**



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FIGURE 6.9

6.4.1.6 Regional Interest Areas

This desktop strategic cropping land (SCL) assessment has been prepared generally in accordance with the requirements of the following relevant strategic land use planning documents:

- Regional Planning Interests Act 2014 (Act) (DSDMIP 2014).
- Regional Planning Interests Regulation 2014 (Regulation) (DSDMIP 2014).
- Act Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land (State of Queensland, 2014) (Guideline) (State of Queensland 2014).

The Act commenced in 2014 and replaced the repealed Act. The Act is designed to manage the impact of resource activities and other regulated activities on areas of the State that contribute, or are likely to contribute, to Queensland's economic, social and environmental prosperity. The relevant aspects of the Act, as with regard to this report, are as follows:

- The Act incorporates the current zonal criteria and on-ground guideline for assessing whether a property (or part of a property) is SCL.
- The Act does not allow the mapping of an Area of Regional Interest (ARI) to be challenged by proponents or third parties. However, through the process of a Regional Impact Development Approval (RIDA) application this will in essence determine if land is or not according to the Assessment Criteria contained in the Guideline. These criteria detailed are generally equivalent to those in the repealed Act.

The Project is located within the Western Cropping Zone. Four of the proposed drill pads and wells are located on trigger mapped SCL.

Resource activities that were the subject of a Protection Decision or Compliance Certificate do not need to obtain another approval in relation to for the approved activities.

The Strategic Cropping Land Standard conditions code for resource activities contains the standard conditions that were applied to certain resource activities that were triggered for assessment under the *Strategic Cropping Land Act 2011*. A compliance certificate was issued in November 2013 for ML1790 (Application Reference SCLRD2013/000151).

6.4.2 Potential Impacts

The following subsections detail the potential land and soil impacts as a result of the Project activities described in **Section 3.0**.

A risk-based assessment of these potential impacts are detailed in **Table 6.21** and determined that land resource and soil impacts are low due to the scale and location of the Project activities.

The Project consists of activities relevant to Condition 15 Schedule A, Condition 7 Schedule F, and Condition 22 Schedule F in P-EA-100658735. Key activities which may have an impact on the land resource and soil include:

- New access tracks (5 metres wide) totalling 0.31 km in length will be slashed to allow vehicle access. This will result in approximately 0.20 ha of ground disturbance.
- Construction of 19 drill pads, each 80 x 80 metres in size, will disturb a total of 12.65 ha. This includes 11.8 ha of new disturbance and 0.82 ha of previously approved disturbance.



- Construction of water management features such as holding ponds and bunds on the drill pads.
- The development of 13 vertical wells and 10 lateral wells requires clearing and preparing the drill pad areas.
- Placement of mobile offices, workshops, and other temporary facilities at the drill pad sites will involve localised ground preparation and disturbance.

These areas will involve vegetation removal, topsoil stockpiling and surface preparation for construction and operation activities.

6.4.2.1 Construction

The construction phase involves land disturbance, including site preparation, access track and drill pad clearance and the installation of infrastructure such as vertical and lateral wells. During this phase, soil compaction, erosion and loss of topsoil are primary concerns.

Impacts associated with the construction phase include:

- Increased erosion resulting from ground disturbance, vegetation clearance, alteration of natural drainage and flow concentration due to construction activities that disturbs the ground.
- Exposure of sodic and saline subsoils from soil profile inversion during ground disturbance.
- Deposition of eroded material downslope or downstream.
- Soil compaction from spoil placement or access tracks and laydown areas, potentially affecting long term cropping and grazing productivity.

6.4.2.2 Operation

During the operational phase, the risk to land resource and soil includes:

- Soil contamination from chemical spills, leaks from gas wells and improper management of wastewater.
- Increased erosion and deposition of eroded material downslope/downstream resulting from alteration of natural runoff regimes.
- Presence of heavy machinery can also result in soil compaction, reducing soil porosity and water infiltration, which may affect both the soil's biological activity and agricultural potential.

6.4.2.3 Closure and Rehabilitation

The closure and rehabilitation phase are focused on restoring the soil and ecosystem after Project activities cease. During this phase, the main goal is to address any damage caused by de-compacting soils, re-establishing vegetation and ensuring proper drainage systems are in place to prevent erosion. Risks associated with this phase include:

- Increased erosion resulting from ground disturbance and vegetation clearance.
- Soil not meeting requirements for post development land use.
- Insufficient topsoil to reinstate vegetation.



6.4.3 Management Practices

The potential impacts will be managed through current practices. The following general mitigation measures are to be implemented by the Project to minimise the extent and severity of land disturbance and constraints on rehabilitation, thus minimising risks that could result in environmental impacts:

- Clearing will occur within the area approved via the Permit to Disturb process.
- Minimise land disturbance with the smallest practical area of land being disturbed in the shortest practicable time.
- Erosion and sediment control measures will be implemented prior to any clearing activities where required.
- Establish clear delineation of disturbance boundary limits of works prior to commencement of clearing and soil stripping.
- Disturbance to be undertaken in consideration of water flows that could affect land resources during early construction activities.
- Topsoil will be stripped prior to construction and direct re-spread is the preferred method to minimise topsoil handling and reduce damage to soil structure and propagules.
- Strip soil according to designated profile depths, subject to further field investigations during stripping.
- Stripped and salvaged soil will be re-used within a short period of time in areas where rehabilitation immediately follows installation of infrastructure.
- Topsoil that is not directly re-spread will be stockpiled for re-use in rehabilitation.
- Surface of soil stockpiles to be left in as coarsely structured condition as possible to promote infiltration and minimise erosion until vegetation is established or suitable erosion controls have been applied.
- Appropriate surface water management measures will be implemented.
- Monitoring and maintenance of rehabilitation until post-mining land use criteria and relinquishment have been achieved.
- Appropriate storage and management of hydrocarbons and hazardous materials to prevent contamination of land e.g. bunding.

6.4.4 Risk Assessment

The potential land and soil impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.21**

The risk of land resource impacts is low. Any realised impacts will be low in comparison to the existing operations undertaken on ML1790.



Table 6.21 Land resources risk assessment

Stage	Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Construction	Increased erosion resulting from ground disturbance, vegetation clearance, alteration of natural drainage and flow concentration	Unlikely	Minor	Low	Erosion control measures such as drainage and sediment control will be implemented where required. Minimizing land disturbance and controlling water flow will reduce the risk of erosion.
Construction	Exposure of sodic and saline subsoils from soil profile inversion	Unlikely	Minor	Low	Topsoil stripping and controlled soil stockpiling will reduce the likelihood of exposure to sodic and saline subsoils.
Construction	Deposition of eroded material downslope or downstream	Unlikely	Minor	Low	Erosion control measures will be implemented where required to mitigate the deposition of eroded materials downslope.
Construction	Soil compaction from spoil placement or access tracks and laydown areas, potentially affecting long-term cropping and grazing productivity	Possible	Minor	Low	Limiting vehicle access and using designated tracks will reduce soil compaction. Compacted areas will be rehabilitated post-construction to restore productivity.
Operation	Soil contamination from chemical spills, leaks from gas wells, and improper management of wastewater	Unlikely	Minor	Low	Proper storage, bunding, and management of hydrocarbons and chemicals will minimize the risk of contamination.
Operation	Increased erosion and deposition of eroded material downslope/downstream resulting from alteration of natural runoff regime	Unlikely	Minor	Low	During operations, water from wells will be collected in water tanks located on drill pads to prevent erosion during operations.
Operation	Presence of heavy machinery can result in soil compaction, reducing soil porosity and water infiltration, affecting biological activity and agricultural potential	Possible	Minor	Low	Regular visual monitoring of compacted areas and decompaction during rehabilitation will help mitigate the impacts of machinery.



Stage	Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Closure and Rehabilitation	Increased erosion resulting from ground disturbance and vegetation clearance	Unlikely	Minor	Low	The re-establishment of vegetation and implementation of erosion control measures during closure will reduce erosion risks.
Closure and Rehabilitation	Soil not meeting requirements for post-development land use	Unlikely	Minor	Low	Rehabilitation will focus on restoring soil structure and quality to meet post-development land use requirements.
Closure and Rehabilitation	Insufficient topsoil to reinstate vegetation	Unlikely	Medium	Medium	Topsoil will be carefully stockpiled and re-used in rehabilitation, ensuring adequate supply for vegetation regrowth.



6.5 Terrestrial Ecology

This section presents the assessment of Project related terrestrial ecology impacts to environmental values.

6.5.1 Existing Environmental Values

The following subsections detail the existing EVs within the Project Area (see **Figure 3.2**) based on terrestrial ecological surveys undertaken to date. It also details the MSES impacted by the Project based on these findings.

6.5.1.1 Regional Ecosystems

A total of approximately 7.74 ha of remnant vegetation and 0.23 ha of mature regrowth were ground-truthed within the Project Area. A summary of REs and their associated vegetation condition and area is provided in Table 6.22 and depicted in **Figure 6.10**.

REs recorded within the Project Area comprised:

- 7.74 ha of remnant vegetation.
- 0.23 ha of mature regrowth vegetation.
- 4.89 ha of non-remnant vegetation comprising non-remnant young woody regrowth vegetation.

Table 6.22 Ground-truthed REs within the Project Area

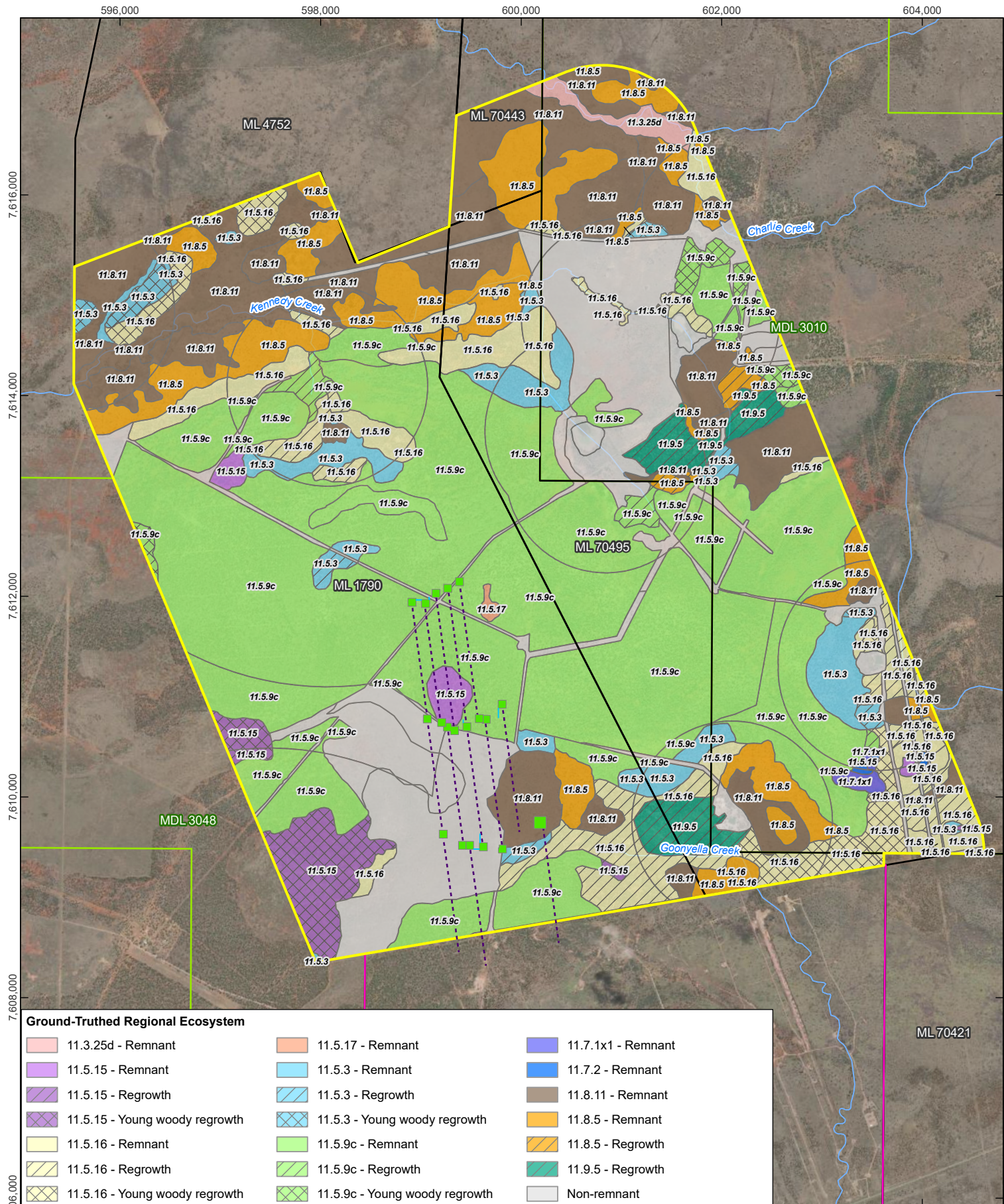
RE	RE description	RE type	Biodiversity status	VM Act class	Broad Vegetation Group	Area within Project Area (ha)
11.5.3	<i>Eucalyptus brownii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Mature regrowth	No concern at present	Least concern	17a	0.23
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland. Occurs on Cainozoic sandplains formed on plateaus and broad crests of hills and ranges. Soils are generally deep red earths.	Remnant	No concern at present	Least concern	18b	5.75
		Non-remnant: young woody regrowth	NA	NA	NA	4.89
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces	Remnant	Endangered	Least concern	7a	0.46
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks.	Remnant	Of concern	Of concern	30b	1.53

6.5.1.2 Threatened Ecological Communities

The Project Area intersects with 0.46 ha of the SEVT TEC. This TEC is mapped in association with a patch of remnant RE 11.5.15 which showed characteristic floristic and minimum structure requirements to be considered as the RE (**Figure 6.10**).

The Brigalow TEC and Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin TEC were identified as present within the Study Area, however neither are located within the Project Area.





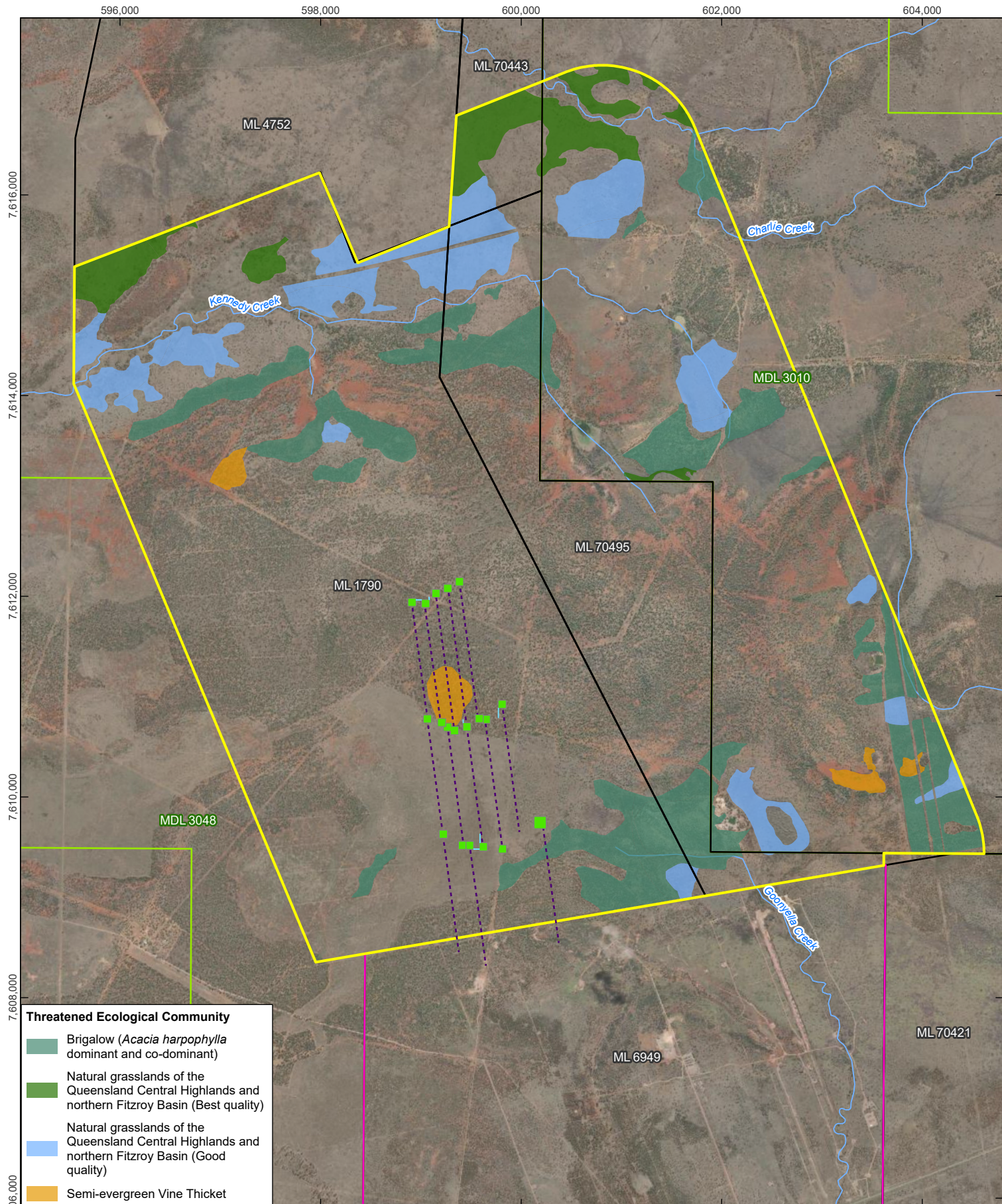
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**GROUND-TRUTHED
REGIONAL ECOSYSTEMS**

FIGURE 6.10



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Threatened Ecological Community

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Best quality)
- Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Good quality)
- Semi-evergreen Vine Thicket

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

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THREATENED ECOLOGICAL COMMUNITIES



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FIGURE 6.11

6.5.1.3 Threatened Flora

The likelihood of occurrence assessment identified two threatened flora species that are known to occur within the Study Area. Given the presence of mapped habitat within the Project Area, these species are also considered known to occur within the Project Area. The species include:

- *Dichanthium queenslandicum* – Endangered under the EPBC Act and Nature Conservation Act 1992 (NC Act).
- *Digitaria porrecta* – Near Threatened under the NC Act.

Dichanthium Queenslandicum

There are no records for *D. queenslandicum* within the Project Area, however, 1,800 tussocks of this species were identified within the northern part of the Study Area in association with areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance.

Preferred habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance (RE 11.8.11 and 11.8.5) where records of *D. queenslandicum* were present within the Study Area.

The Project Area intercepts with 1.53 ha of preferred habitat for the species in RE 11.8.11 as shown in **Figure 6.12**.

Digitaria Porrecta

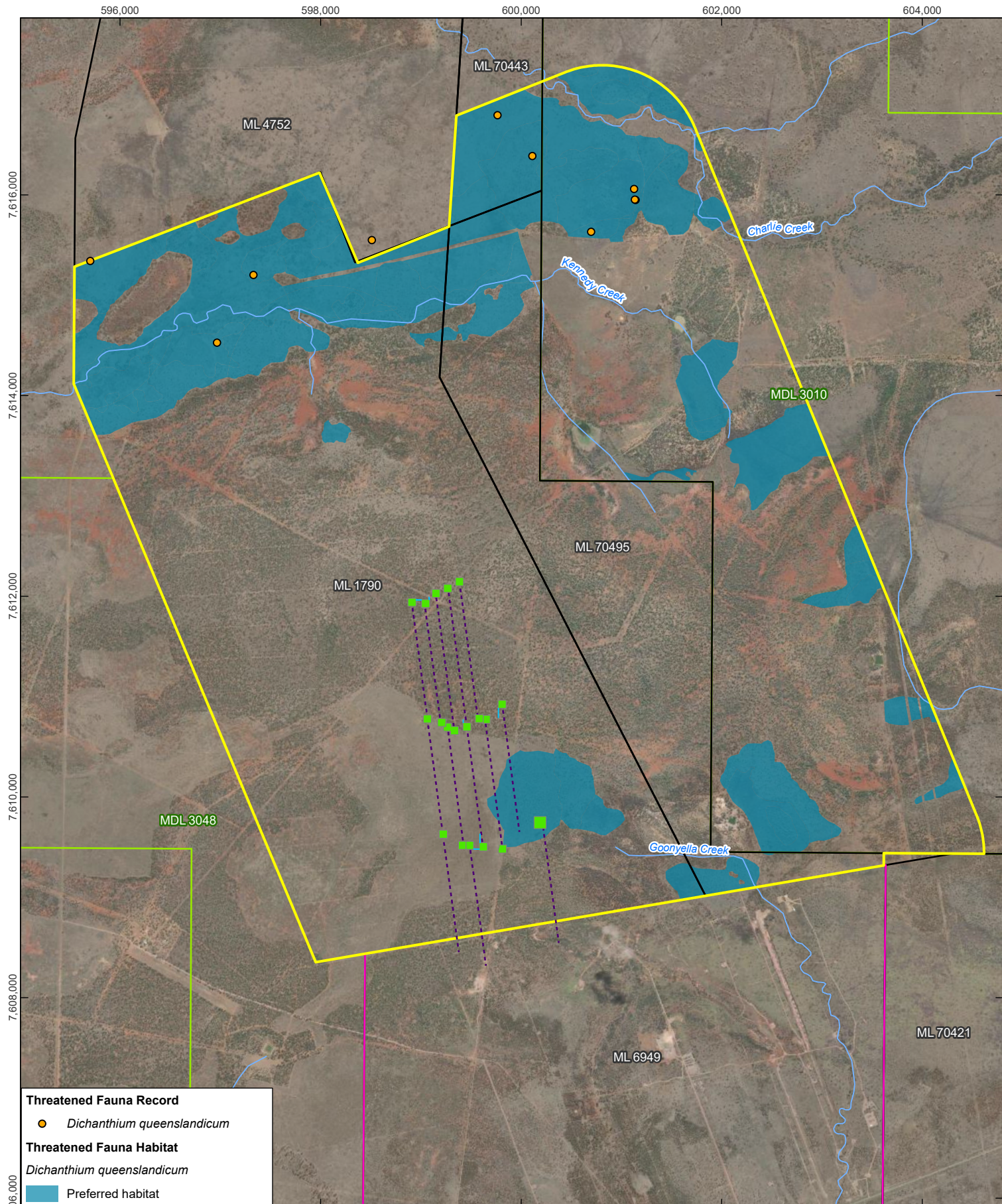
There are no records for *D. porrecta* within the Project Area, however, 71 tussocks were identified within the northern and central eastern part of the Study Area in associations with areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance.

Preferred habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance (RE 11.8.11 and 11.8.5) where records of *D. porrecta* were present within the Study Area.

The Project Area intercepts with 1.53 ha of preferred habitat for the species in RE 11.8.11 as shown in **Figure 6.13**.





Threatened Fauna Record

● *Dichanthium queenslandicum*

Threatened Fauna Habitat

Dichanthium queenslandicum

Preferred habitat

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

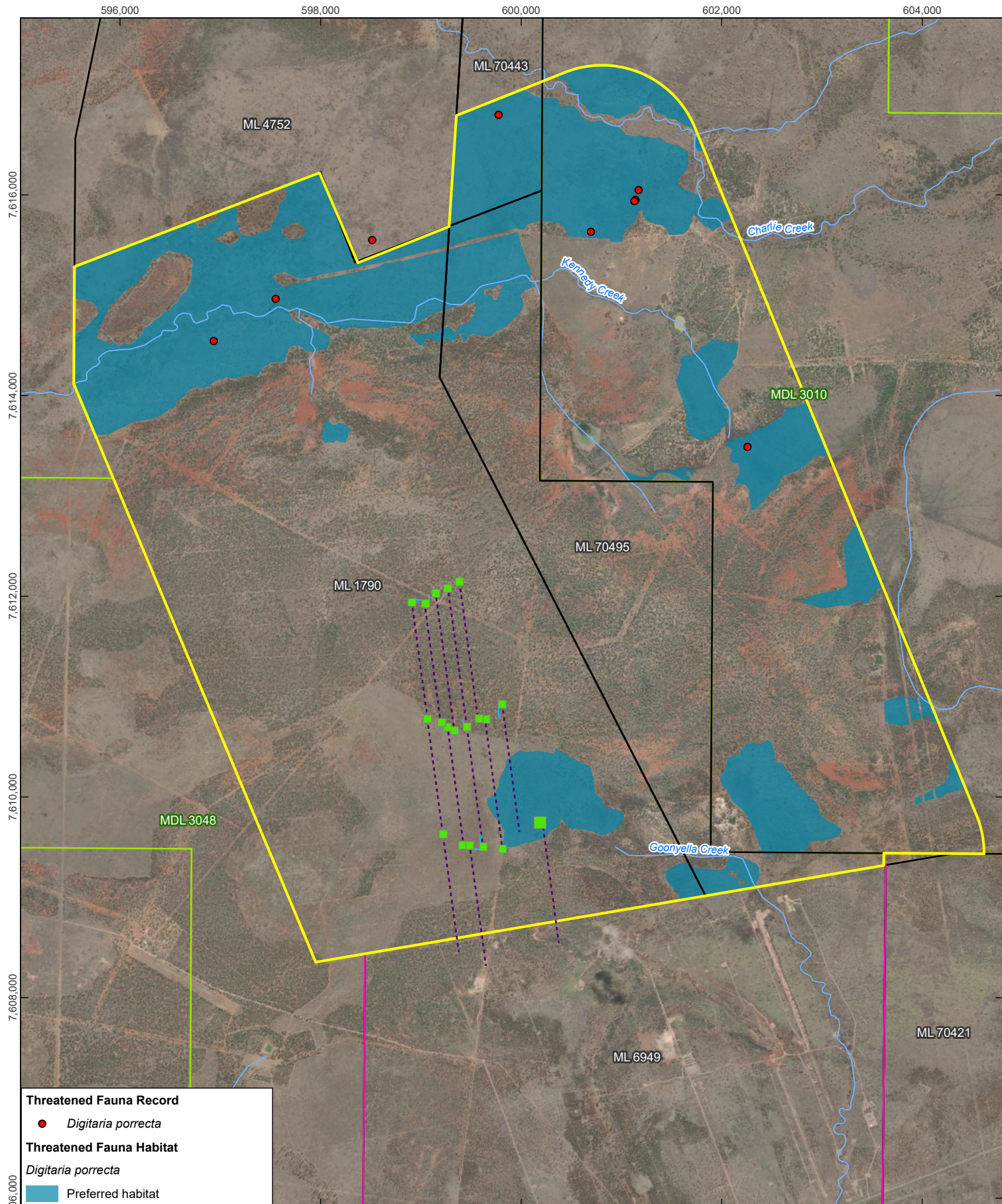
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**DICHANTHIUM
QUEENSLANDICUM
RECORDS AND HABITAT**



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FIGURE 6.12



EA AMENDMENT P-EA-100658735

DIGITARIA PORRECTA
RECORDS AND HABITAT



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6.13

6.5.1.4 Pest Flora

Three weed species listed as Weeds of National Environmental Significance (WoNS) or restricted matters under the Queensland *Biosecurity Act 2014* (Biosecurity Act) were recorded within the Study Area and are therefore considered likely to also be present within the Project Area. These weed species include:

- *Harrisia martinii* (harrisia cactus) – Category 3 under the Biosecurity Act and WoNS.
- *Opuntia tomentosa* (velvet tree pear) – Category 3 under the Biosecurity Act and WoNS.
- *Parthenium hysterophorus* (parthenium) – Category 3 under the Biosecurity Act and WoNS.

The cactus-like species (*Harrisia martinii* and *Opuntia tomentosa*) were scattered across remnant and regrowth woodland vegetation types. Parthenium was in high abundance in wet areas.

6.5.1.5 Threatened Fauna

The likelihood of occurrence assessment identified two threatened fauna species and one conservation significant species that are known to occur within the Study Area. Given the presence of mapped habitat within the Project Area, these species are also considered known to occur within the Project Area. The species include:

- Koala (*Phascolarctos cinereus*) – Endangered under the EPBC Act and NC Act.
- Short-beaked echidna (*Tachyglossus aculeatus*) – Special least concern under the NC Act.
- Squatter pigeon (southern) (*Geophaps scripta scripta*) – Vulnerable under the EPBC Act and the NC Act.

An additional threatened fauna species was assessed as likely to occur within the Study Area and Project Area, including:

- White-throated needletail (*Hirundapus caudacutus*) – Vulnerable under the EPBC Act and the NC Act.

The Australian painted snipe (*Rostratula australis*) (Endangered under the EPBC Act and NC Act) was assessed as likely to occur within the Study Area, however, given that the Project Area does not contain mapped habitat for the species it is considered unlikely to occur within the Project Area and is not detailed further here.

Koala

There are no records for koala within the Project Area, however, individuals were identified from two BAR locations within the central western and central parts of the Study Area. The closest of these records is within 330 m of the Project Area. All records were in areas of *Eucalyptus crebra* woodland and *Eucalyptus brownii* woodland (RE 11.5.9c).

Koala habitat within the Study Area has been mapped as either preferred, suitable or marginal habitat, with guidance from *A review of koala habitat assessment criteria and methods* (Youngentob et al., 2021).

- Preferred habitat mapped for the species within the Study Area includes:



- Areas of remnant riparian eucalypt woodland RE 11.3.25d with locally important koala trees (LIKTs) present with high moisture content (*E. tereticornis* and *E. camaldulensis*) and connectivity to other areas of preferred habitat.

Suitable habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant and mature regrowth eucalypt woodland REs 11.5.3, 11.5.9c, 11.8.5 and 11.5.17 providing abundant LIKTs (*E. brownii*, *E. crebra* and *E. tereticornis*) where koalas were recorded within the Study Area.
- Marginal habitat mapped for the species within the Study Area includes:
- Areas of remnant and regrowth brigalow dominated communities RE 11.5.16 and 11.9.5 providing few LIKTs (*E. cambageana*) and ancillary habitat trees (*A. harpophylla*) that provide limited feeding resources but may facilitate dispersal to other areas of suitable and preferred habitat.

The Project Area intercepts with 5.98 ha of suitable habitat for the species in remnant RE 11.5.9c and mature regrowth RE 11.5.3 as shown in **Figure 6.10**.

Short-beaked Echidna

There are no records for short-beaked echidna within the Project Area, however, one individual was identified with the central part of the Study Area. This record is within 490 m of the Project Area. This record was recorded in remnant *Eucalyptus crebra* woodland (RE 11.5.9c). Scats attributable to the species were also recorded in multiple locations in remnant vegetation within the Study Area.

Short-beaked echidna habitat within the Study Area has been mapped as either suitable or marginal habitat.

Suitable habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant and mature regrowth woodland REs providing habitat features such as large woody debris, shrubby areas and logs suitable for short-beaked echidna.

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of grasslands and young woody regrowth vegetation providing limited habitat features such as large woody debris, shrubby areas and logs suitable for short-beaked echidna and provides dispersal habitat between areas of preferred habitat.

The Project Area intercepts with:

- 6.45 ha of suitable habitat for the species in remnant REs 11.5.9c and 11.5.15 and mature regrowth RE 11.5.3.
- 1.53 ha of marginal habitat for the species in remnant RE 11.8.11 as shown in **Figure 6.15**.

There are no records of the squatter pigeon (southern) within the Project Area, however, a total of 65 squatter pigeon (southern) individuals were recorded across the Study Area. The closest of these records (comprising 2 individuals) is within 170 m of the Project Area. Records were in proximity to dams where there were trees nearby to disperse into when startled. Wooded areas with tree cover had lower levels of grass productivity with mid-dense



to sparse ground cover. These areas are likely to be more suitable for squatter pigeon (southern) foraging habitat.

Squatter pigeon (southern) habitat within the Study Area has been mapped as either preferred, suitable or marginal habitat with guidance from the DCCEEW species profile (DotE, 2022).

Preferred habitat mapped for the species within the Study Area includes:

- Areas within 1 km of permanent water source suitable for breeding, that are areas of remnant and mature regrowth eucalypt woodland REs suitable for foraging.

Suitable habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas within 3 km of permanent water source that are areas of remnant and mature regrowth eucalypt woodland REs suitable for foraging.

Marginal habitat mapped for the species within the Study Area includes:

- Dispersal habitat which includes non-remnant areas within 3km of a permanent water source.
- The Project Area intercepts with 5.98 ha of suitable habitat for the species in remnant RE 11.5.9c and mature regrowth RE 11.5.3 as shown in Figure 6.16.

White-throated Needletail

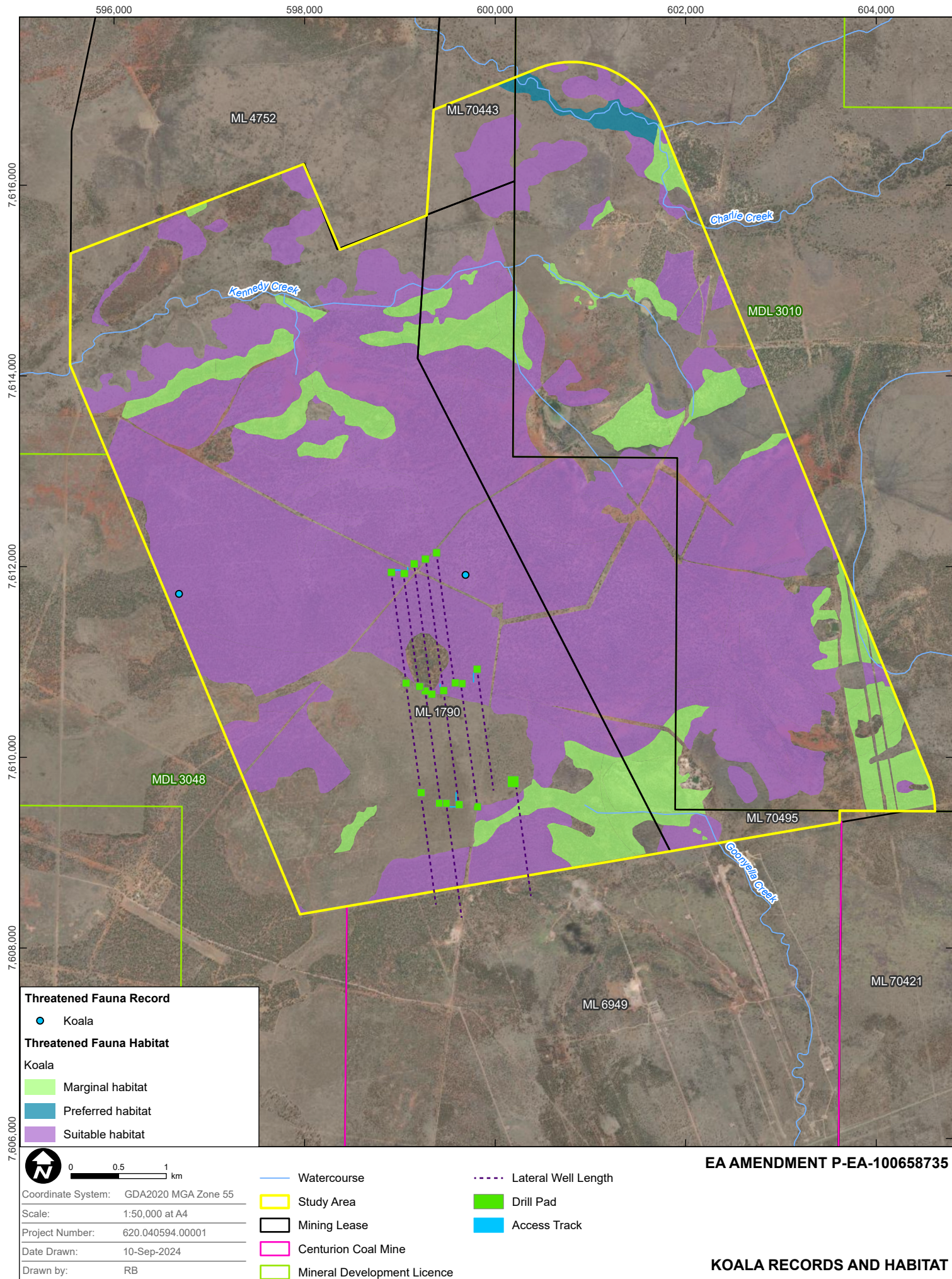
White-throated needletail was not detected during the field surveys, however, has been previously recorded nearby (approximately 20 km) the Study Area (ALA, 2024) and is considered likely to occur. Suitable habitat for the species includes a broad range of vegetation communities that support feeding resources in which they fly in the airspace above. No areas of emergent trees with hollows in woodlands or tall trees at the edges of clearing were observed within the Study Area.

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- All areas that provide aerial space above suitable for foraging.

The Project Area intercepts with 12.86 ha of marginal habitat for the species comprising all aerial space above the Project Area as shown in Figure 6.17.





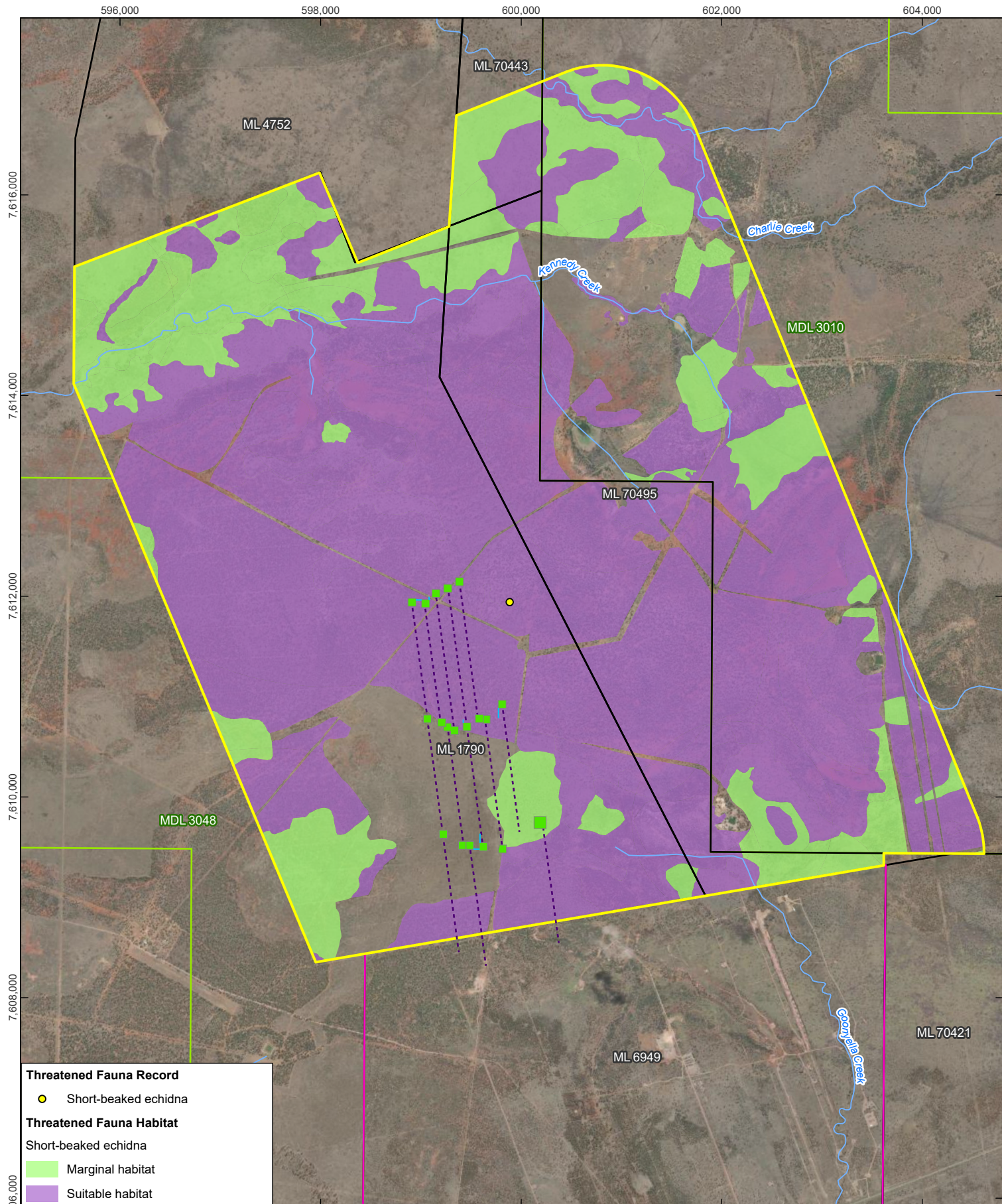
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KOALA RECORDS AND HABITAT



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FIGURE 6.14



Threatened Fauna Record

- Short-beaked echidna

Threatened Fauna Habitat

Short-beaked echidna

- Marginal habitat
- Suitable habitat

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

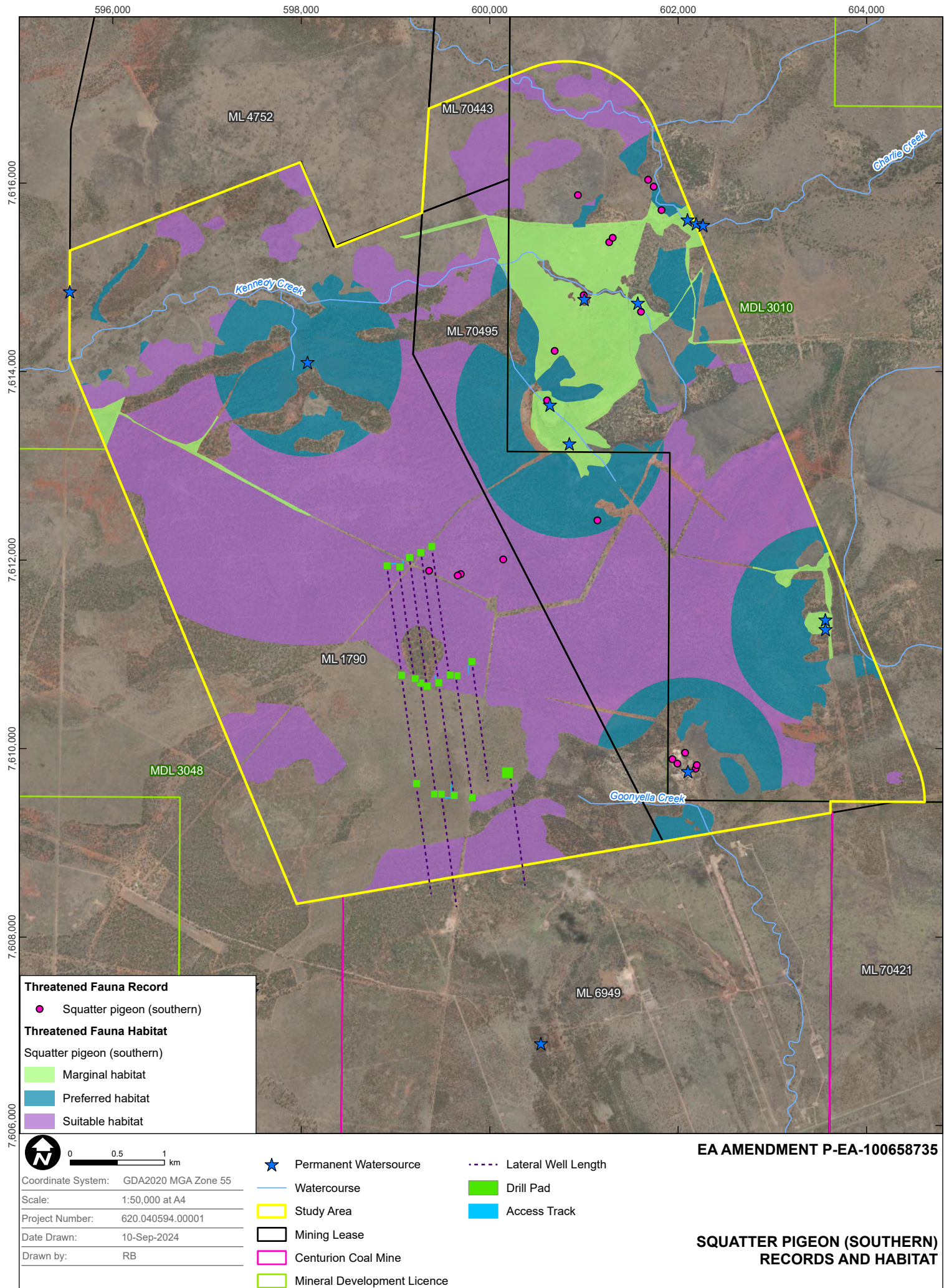
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SHORT-BEAKED ECHIDNA
RECORDS AND HABITAT



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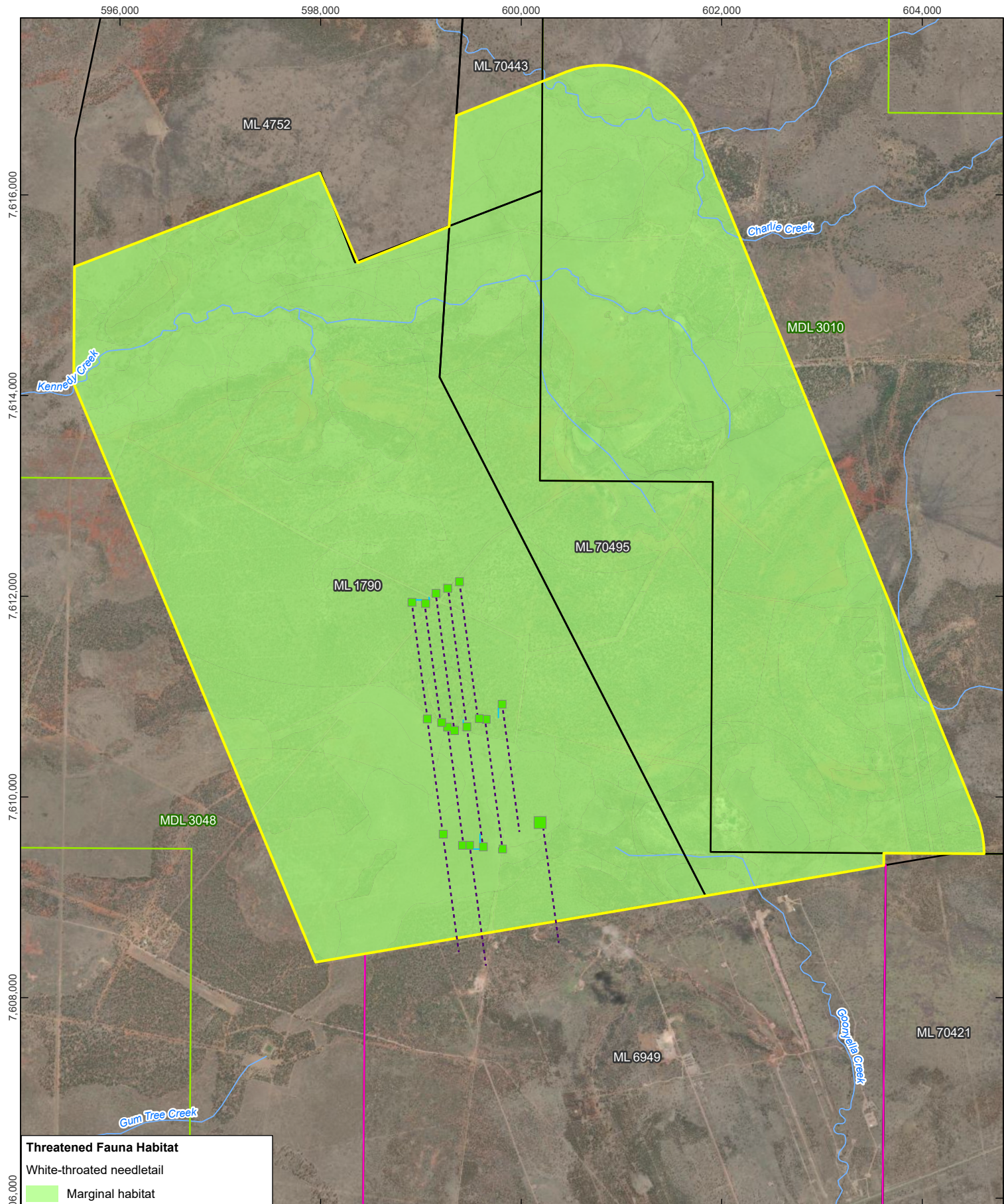
FIGURE 6.15



EA AMENDMENT P-EA-100658735

SQUATTER PIGEON (SOUTHERN) RECORDS AND HABITAT

FIGURE 6.16



Threatened Fauna Habitat
 White-throated needletail
 Marginal habitat

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

Watercourse
 Study Area
 Mining Lease
 Centurion Coal Mine
 Mineral Development Licence
 Lateral Well Length
 Drill Pad
 Access Track

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**WHITE-THROATED NEEDLETAIL
 HABITAT**



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FIGURE 6.17

6.5.1.6 Migratory Fauna

The likelihood of occurrence assessment identified two migratory fauna species that are likely to occur within the Study Area and Project Area, including:

- Fork-tailed swift (*Apus pacificus*) – Migratory under the EPBC Act and Special least concern under the NC Act.
- Oriental cuckoo (*Cuculus optatus*) - Migratory under the EPBC Act and Special least concern under the NC Act.

An additional two migratory fauna species were assessed as likely to occur within the Study Area, however, given that the Project Area does not contain mapped habitat for these species they are considered unlikely to occur within the Project Area and are not detailed further here. These species include glossy ibis (*Plegadis falcinellus*) and Latham's snipe (*Gallinago hardwickii*) (Migratory under the EPBC Act and Special least concern under the NC Act).

Fork-tailed Swift

Fork-tailed swift was not detected during the field surveys, however, has been previously recorded nearby (approximately 20 km) the Study Area (ALA, 2024) and is considered likely to occur. Suitable habitat for the species include a broad range of vegetation communities that support feeding resources in which they fly in the airspace above.

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- All areas that provide aerial space above suitable for foraging.

The Project Area intercepts with 12.86 ha of marginal habitat for the species comprising all aerial space above the Project Area as shown in **Figure 6.18**.

Oriental Cuckoo

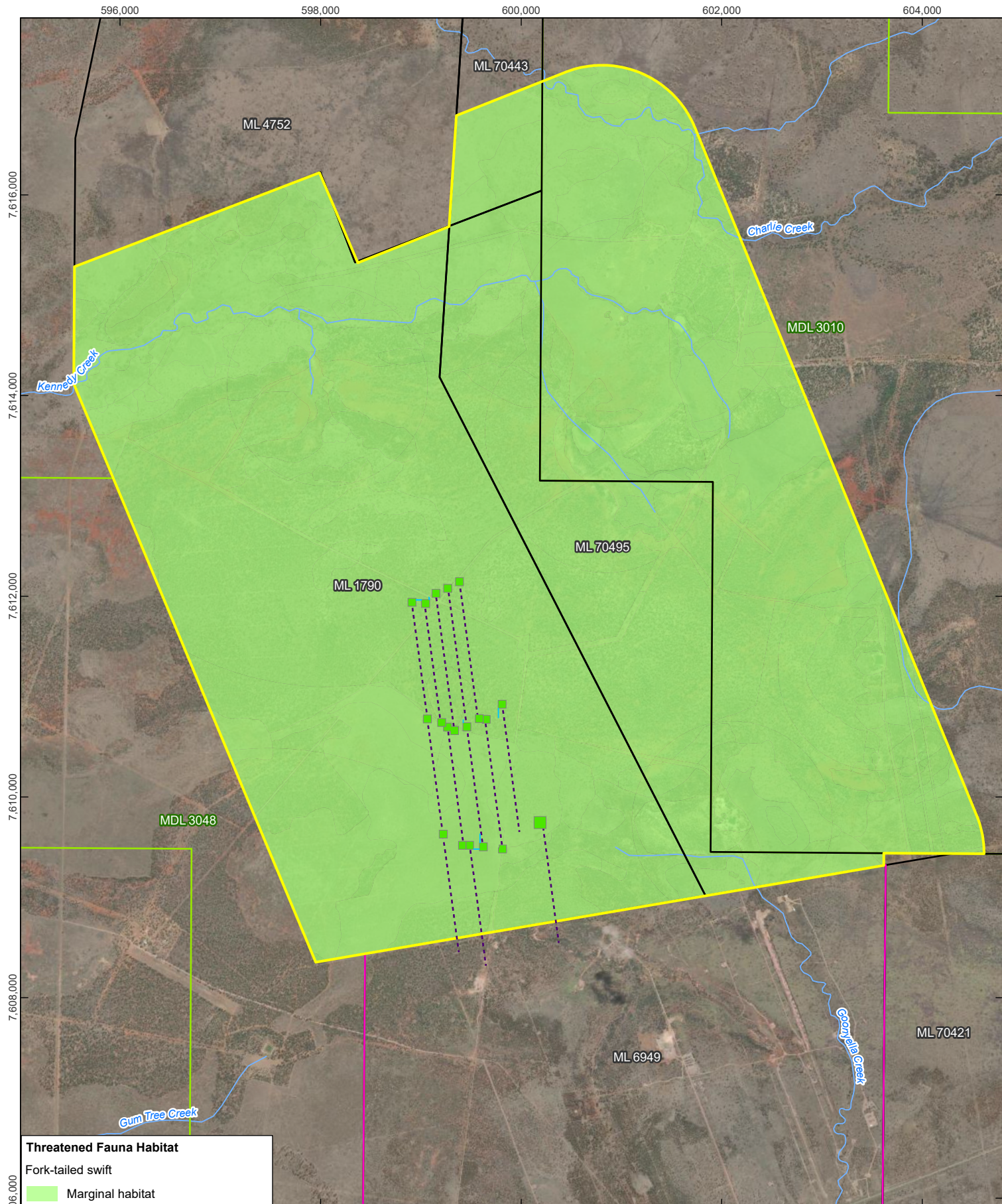
Oriental cuckoo was not detected during the field surveys, however, has been previously recorded approximately 17 to 25 km from the Study Area (BMA, 2014; ALA, 2024) and is considered likely to occur. The species does not breed in Australia. Suitable habitat for the species' only includes intermittent roosting and foraging habitat (DotE, 2015). Suitable habitat for the species includes a broad range of vegetation communities that support feeding and dispersal of the species. Therefore, oriental cuckoo habitat within the Study Area has been mapped as marginal habitat with guidance from the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DotE, 2015).

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- All areas of remnant and regrowth woodland communities that intermittently provide roosting, feeding and dispersal opportunities.

The Project Area intercepts with 6.45 ha of marginal habitat for the species in remnant RE 11.5.9c and 11.5.15 and mature regrowth RE 11.5.3 as shown in Figure 6.18.





Threatened Fauna Habitat
 Fork-tailed swift
 Marginal habitat

	0 0.5 1 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.040594.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

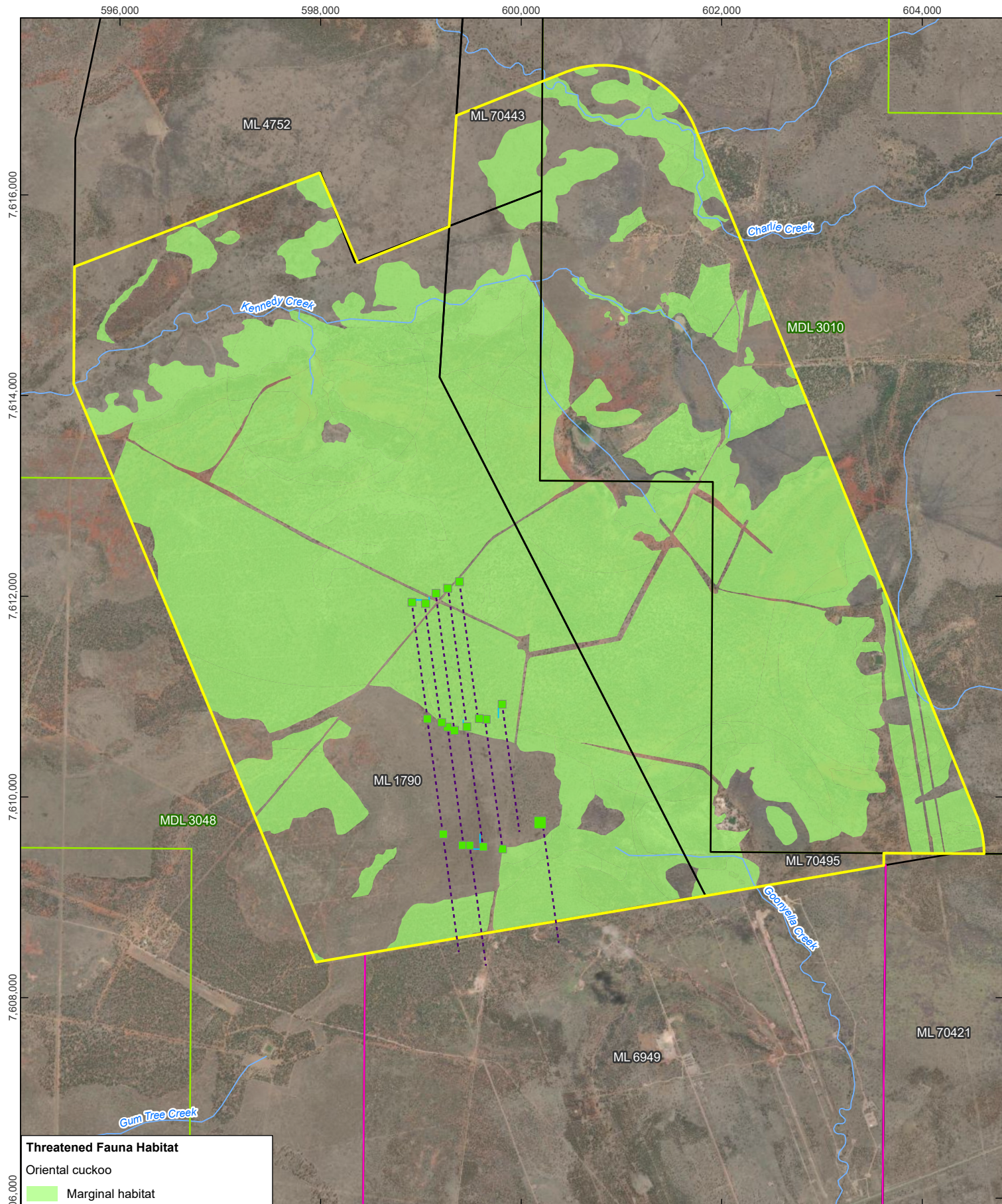
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FORK-TAILED SWIFT HABITAT



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FIGURE 6.18



Threatened Fauna Habitat

Oriental cuckoo

Marginal habitat

	0 0.5 1 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.040594.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

EA AMENDMENT P-EA-100658735

ORIENTAL CUCKOO HABITAT



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FIGURE 6.19

6.5.1.7 Pest Fauna

Five pest fauna species were recorded within the Study Area. Four of these species were listed as restricted matters under the Biosecurity Act, including:

- Cane toad (*Rhinella marina*).
- Cat (*Felis catus*) – Category 3, 4 and 6 restricted matter.
- Wild dogs (*Canis lupus*) – Category 3, 4 and 6 restricted matter.
- European rabbit (*Oryctolagus cuniculus*) – Category 3, 4, 5, and 6 restricted matter.
- Feral pig (*Sus scrofa*) – Category 3, 4, and 6 restricted matter.

Pest fauna species have varying adverse impacts on the environment. Pigs are known to contribute to habitat degradation by damaging the banks of wetlands, creek lines and gilgai, uprooting vegetation, causing soil erosion, spreading weeds and browsing/grazing native flora. Evidence of habitat degradation caused by pig rooting was observed within the Study Area including damage around gilgai as well as within SEVT vegetation.

Carnivorous pest fauna such as feral cats and dingos and opportunistic carnivores such as feral pigs, are known to directly predate native fauna. In addition, cane toads outcompete native amphibians and are toxic to animals such as ornamental snake that predate upon them.

6.5.1.8 Ecological Function

Watercourses and Wetlands

The Project Area does not intercept with any watercourses or wetland values.

Corridors and Connectivity

The Project Area does not intercept with any mapped terrestrial corridors.

Groundwater Dependent Ecosystems

The Project Area does not intercept with any ground-truthed potential terrestrial GDEs (refined during field surveys from BoM supplied mapping).

Environmentally Sensitive Areas

The Project Area does not intercept with any Category A or Category B ESAs as described in the Queensland *Environmental Protection Regulation 2019*.

Note: This was assessed utilising an RE amendment that has been submitted and approved by the Queensland Herbarium (MAR 3577) to refine vegetation mapping within the Study Area.

6.5.2 Summary of MSES

Three MSES as defined in the *Queensland Environmental Offset Regulation 2014* (EO Regulation) were identified within the Project Area, including:

- Regulated vegetation.
- Protected wildlife habitat.
- Connectivity areas.

No protected areas or legally secured offset areas are located within the Project Area.



6.5.2.1 Regulated Vegetation

MSES regulated vegetation includes *prescribed regional ecosystems* (remnant), as defined under the EO Regulation. In accordance with the EO Regulation, a prescribed regional ecosystem does not include:

- Regional Ecosystem comprising vegetation defined under Section 8 of the VM Act (i.e. grass or non-woody herbage, a grassland RE with a grassland structure, a mangrove).
- Regrowth or non-remnant vegetation.

MSES regulated vegetation includes prescribed REs that:

- Are 'endangered' (VM Act class) Res.
- Are 'of concern' (VM Act class) Res.
- Intersect with an area shown as a wetland on the vegetation management wetlands map (Wetland REs).
- Are an area of essential habitat on the essential habitat map for an animal that is critically endangered wildlife, endangered wildlife or vulnerable wildlife or a plant that is critically endangered wildlife, endangered wildlife or vulnerable wildlife.
- For a prescribed activity mentioned in Schedule 1, Item 7(e), if the ecosystem is an area of essential habitat on the essential habitat map for an animal that is near threatened wildlife or a plant that is near threatened wildlife.
- The extent the ecosystem is located within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature. In accordance with the Queensland Environmental Offset Policy (DES, 2021b), distances from the defining bank of the watercourse stream order (SO) (non-coastal Bioregion) comprised:
 - 25 m for SO 1 and 2
 - 50 m for SO 3 and 4; and
 - 100 m for SO 5 or greater.

Within the Project Area, MSES regulated vegetation was assessed utilising data from an RE amendment that has been submitted and approved by the Queensland Herbarium (MAR 3577) to refine vegetation mapping within the Study Area. A summary of MSES regulated vegetation within the Project Area is provided in **Table 6.23**.

REs located within the defined distance from the defining banks of a Vegetation Management watercourse were mapped by buffering all DoR mapped VM Act watercourses and drainage features (DoR, 2024) by a 2 m buffer to estimate the defining banks of the watercourse. The banks were then buffered by the defined distance⁴ and any E2M ground-truthed remnant REs within these defined distances were included as MSES regulated vegetation. The Project Area does not intercept regulated vegetation within the defined distance of a VM Act watercourse.

The Project Area also does not intercept with regulated vegetation that is an Endangered or Of concern RE. While the Project Area does intercept with remnant, Of concern RE 11.8.11

⁴ *defined distance*, for a RE, means a distance identified in the *Queensland Environmental Offsets Policy* as the relevant distance from the defining banks of a relevant watercourse or relevant drainage feature.



(see **Section 6.5.1.1**) this RE has a structure category / structure code of woody grassland / tussock grassland respectively and so is not classified as MSES regulated vegetation.

In accordance with the *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline* (DEHP 2014) (SRI Guideline), essential habitat included in **Table 6.23** will be assessed as part of MSES protected wildlife habitat.

Table 6.23 MSES regulated vegetation within the Project Area

MSES	Area within Project Area (ha)
Essential habitat	
Ornamental snake (<i>Denisonia maculata</i>)	6.45

6.5.2.2 Protected Wildlife Habitat

Protected wildlife habitat is defined in the EO Regulation as:

- A high-risk area on the flora survey trigger map that contains plants that are Critically endangered wildlife, Endangered wildlife or Vulnerable wildlife.
- An area that contains plants that are Critically endangered wildlife, Endangered wildlife or Vulnerable wildlife.
- A mapped koala habitat area.
- Habitat for an animal that is Critically endangered wildlife, Endangered wildlife or Vulnerable wildlife or a Special least concern animal (non-migratory).

The SRI Guideline defines habitat as ‘*the area occupied, or periodically or occasionally occupied, by any species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles*’.

The MSES protected wildlife habitat summarised in **Table 6.24** comprises those species that were identified as known or likely to occur within the Project Area. In addition, essential habitat for ornamental snake has been mapped as present by the DoR (see **Section 6.5.2.1** and **Table 6.23**) and will therefore be assessed further even though it was identified as unlikely to occur based on ecological field surveys. The following three threatened species identified as known and likely to occur within the Project Area are not considered as MSES protected wildlife habitat, for the following reasons:

- *Digitaria porrecta* – habitat mapped within the Project Area (see **Section 6.5.1.3**) but the species is listed as Near threatened under the NC Act.
- Fork-tailed swift (*Apus pacificus*) – habitat mapped within the Project Area (see **Section 6.5.1.6**) but the species is listed as Special least concern under the NC Act due to migratory status.
- Oriental cuckoo (*Cuculus optatus*) – habitat mapped within the Project Area (see **Section 6.5.1.6**) but the species is listed as Special least concern under the NC Act due to migratory status.



Table 6.24 MSES protected wildlife habitat within the Project Area

Species	NC Act status	Area within Project Area (ha)
<i>Dichanthium queenslandicum</i>	Endangered	1.53
Koala	Endangered	5.98
Short-beaked echidna	Special least concern (non-migratory)	6.45*
Squatter pigeon (southern)	Vulnerable	5.98
White-throated needletail	Vulnerable	12.86

* Dispersal habitat mapped as marginal habitat has been removed from this table due to this habitat type not being regarded as offsettable.

6.5.2.3 Connectivity Areas

Connectivity areas are defined under the EO Regulation as prescribed REs that contain remnant vegetation and an area of land that is required for ecosystem functioning. *Prescribed regional ecosystems* (remnant) as defined under the EO Regulation does not include:

- RE comprising vegetation defined under Section 8 of the VM Act (i.e. grass or non-woody herbage, a grassland RE with a grassland structure, a mangrove), or
- Regrowth or non-remnant vegetation.

MSES connectivity areas was assessed utilising an RE amendment that has been submitted and approved by the Queensland Herbarium (MAR 3577) to refine vegetation mapping within the Study Area. Within the Project Area, all ground-truthed remnant vegetation containing a prescribed RE is considered to comprise connectivity values. The Project Area contains approximately 6.51 ha of connectivity areas.

6.5.3 Potential Impacts

The following subsections detail the potential terrestrial ecology impacts as a result of the activities described in **Section 3.0**. Where multiple activities contribute to a potential impact, all relevant activities have been listed in the subsection heading.

6.5.3.1 Access Tracks and Coal Seam Gas Exploration

Native Vegetation Clearing

The Project activities will result in native vegetation clearing of approximately 12.00 ha comprising non-remnant, remnant and mature regrowth vegetation. Table 6.25 details the remnant and mature regrowth vegetation that will be cleared and shows that this is a small portion of what will be retained in surrounding areas within the Study Area. In addition, the majority of this vegetation is listed as Least concern under the VM Act with only one small area (1.53 ha) listed as Of concern. The Project Area intersects with 0.46 ha of the SEVT TEC with other areas of TEC avoided where feasible and possible.



Table 6.25 Direct impacts to remnant and mature regrowth REs within the Project Area

RE	VM Act class	Area within Study Area (ha)	Area within Project Area (ha)	Percentage impacted (%)
Remnant				
11.5.9c	Least concern	2,119.64	5.75	0.27
11.5.15	Least concern	32.02	0.46	1.44
11.8.11	Of concern	741.57	1.53	0.21
Mature regrowth				
11.5.3	Least concern	29.64	0.23	0.78

Fauna and Flora Habitat Removal

The Project activities will also result in loss of habitat for MSES threatened flora and fauna species. The extent of habitat removal is detailed in **Table 6.26**. As shown, this is a small portion of what will be retained in surrounding areas within the Study Area.

Table 6.26 Direct impacts to threatened flora and fauna habitat within the Project Area

Species	NC Act status	Area within Study Area (ha)	Area within Project Area (ha)	Percentage impacted (%)
<i>Dichanthium queenslandicum</i>	Endangered	1,163.36	1.53	0.13
Koala	Endangered	2,831.40*	5.98	0.21
Short-beaked echidna	Special least concern (non-migratory)	3,398.89*	6.45*	0.19
Squatter pigeon (southern)	Vulnerable	2,759.26*	5.98	0.22
White-throated needletail	Vulnerable	5,191.48	12.00	0.25

* Dispersal habitat mapped as marginal habitat has been removed from this table due to this habitat type not being regarded as offsetable.

Habitat Degradation and Edge Effects

Project activities and native vegetation clearing have the potential to result in indirect degradation of adjacent (edge effects) and downstream habitats. Edge effects occur where vegetation communities are subject to distinct ecotones, as may occur due to vegetation clearing, resulting in changes in vegetation/habitat composition, and quality (Laurance & Yensen, 1991). Indirect influences associated with edge effects can include exposure to weeds, noise, light, dust, reduced foraging resources and species assemblages (Laurance & Yensen, 1991). Prolonged exposure to edge effects can degrade or reduce the quality of habitat.

While the Project activities are likely to result in edge effects to some degree, it is unlikely to contribute significantly at a landscape scale given the surrounding land use of the area being largely fragmented with agricultural and mining activities.



Fauna Injury and/or Mortality

Project activities, during construction and operation, have the potential to lead to fauna injury or mortality. Vehicles and machinery can cause injury or mortality to fauna if individuals are struck. Similarly, fauna that are unable to disperse away from areas under active clearing are also particularly susceptible to injury or mortality. Other causes of injury or mortality include animals becoming trapped in excavations/trenches.

6.5.3.2 Access Tracks, Coal Seam Gas Exploration, Amenities and Hours of Operation

Noise, Light and Dust

Project activities, during construction and operation, can disrupt local fauna roosting, breeding and foraging activities as a result of increased exposure to artificial lighting, noise and vibration. Artificial lighting poses risks to fauna, as increased light allows predators to locate prey more easily. Additionally, noise and vibration can also lead to increased predation of some species, as it makes it harder for prey to detect approaching predators.

Excessive dust deposition on foliage can cause impacts to vegetation, including reducing photosynthetic processes, respiration, transpiration, health and growth rates. Potential dust impacts on vegetation are concentrated near dust sources such as access tracks, drilling locations and stockpiles as a result of construction/operation activities.

Areas of remnant vegetation adjacent to the Project may be subject to degradation from dust deposition on foliage.

6.5.3.3 Amenities

Introduction and Spread of Pests

The Project may result in an increase in the presence and abundance of feral animals through improper waste disposal and increased permanency of water sources associated with the amenities located on drill pads. These pests can result in adverse impacts to native fauna through increased habitat degradation, predation pressure and competition for resources. They can also be identified as a particular risk to the recovery of threatened fauna species. Five pest fauna species were recorded within the Study Area, including:

- Cane toad (*Rhinella marina*).
- Cat (*Felis catus*).
- Wild dogs (*Canis lupus*).
- European rabbit (*Oryctolagus cuniculus*).
- Feral pig (*Sus scrofa*).

6.5.3.4 Equipment

Introduction and Spread of Weeds

Introduced flora species disrupt ecosystems by outcompeting and replacing native species, resulting in altered ecosystem diversity and function. They can also be identified as a particular risk to the recovery of threatened fauna and flora species. Proliferation and spread of environmental weeds and pests may occur as a result of the increased movement and use of heavy machinery and vehicles as required for vegetation clearing and soil



disturbance/movement. Three weed species listed as WoNS and/or restricted matters under the Biosecurity Act were recorded within the Study Area, including:

- *Harrisia martini*.
- *Opuntia tomentosa*.
- *Parthenium hysterophorus*.

Weed seeds can be transported in contaminated landfill, and as seed and material on machinery, vehicles or personnel. Construction activities have the potential to spread or introduce weeds throughout adjacent areas, resulting in a degradation of vegetation/habitat quality and native species assemblages.

6.5.4 Management Practices

The potential impacts will be managed through current practices. The methods used to mitigate impacts to terrestrial ecology are detailed in the following subsections.

6.5.4.1 Avoidance

During the design stages of the Project, terrestrial ecological values were considered and avoided where feasible and practical. These included the following.

- The total number of drill pads and wells has been optimised to align with Project objectives while also reducing the extent of disturbance to ecological values.
- Previously disturbed access tracks and areas used in exploration have been utilised where possible. Drill pads have been positioned closer to previously disturbed areas so that limited new access tracks would need to be cleared.
- Non-remnant areas of vegetation that provide limited habitat value in the south-western areas of the Study Area were prioritised over areas of mature regrowth and remnant vegetation. Nine of the proposed wells are situated in pastureland that has previously been cleared for agricultural purposes.
- Where remnant vegetation was required to be cleared, vegetation classified as No concern at present under the VM Act was utilised in preference of Of concern and Endangered REs.
- Areas of TEC were avoided where possible.

6.5.4.2 Mitigation

Native Vegetation Clearing and Habitat Removal

To mitigate and minimise the potential impacts from native vegetation clearing and fauna habitat removal (including habitat for MNES and MSES fauna) during the construction and operational stage of the Project, the following measures should be implemented.

- Vegetation clearing extents will be kept to the minimum area necessary for access road and drill pad construction.
- Boundaries of areas to be cleared, and those not to be cleared, are to be clearly defined during clearing activities and clearly communicated to all necessary construction personnel. Where necessary, signage, flagging and/or barricade fencing may be used to demarcate areas not to be cleared.



- Pre-clearance fauna surveys are to be undertaken by a suitably experienced and qualified person to identify fauna and habitat features at direct risk from clearing activities.
- Habitat features such as large logs will be moved out of disturbance areas into adjacent areas as habitat.
- A suitably experienced and qualified person will be present during the clearing of any structures that may serve as habitat or refugia for animals.
- Directional clearing towards retained vegetation would be undertaken where practical to enable the movement of fauna into retained vegetation.
- Hollow-bearing trees providing shelter for native fauna should be felled slowly (in sections), so as to minimise the risk of injury to fauna.
- In the event a MSES fauna (such as koala) is identified within areas to be cleared, the individual is to be left to vacate the area in accordance with the legislation.
- During construction works, work areas and excavations (trenches) are to be checked regularly for fauna that may have become trapped.
- Fauna exclusion fencing will be erected around open trenches and pits >1 m depth to minimise the risk of injury to fauna.
- If trenches remain open after daily site works have been completed, fauna ramps would be put in place.

Fauna Injury and/or Mortality

To mitigate and minimise the potential for fauna injury and/or mortality during Project activities, the following measures should be implemented.

- Vehicles are to remain on designated access tracks and adhere to site rules relating to speed limits.
- Speed limits are to be clearly signposted to minimise potential fauna strike.
- Removal of roadkill should be undertaken to minimise the risk of attracting other fauna to the road corridor.
- Contingencies and procedures for the treatment of injured fauna will be implemented.
- Where installation of wire fencing is required to exclude personnel or vehicular traffic, consideration should be given to movement of fauna around and/or through such fencing. Barbed wire should not be used on the top strand of wire fences unless necessary for security.

Noise, Light and Dust

To mitigate and minimise the potential impacts from noise, light and dust during the construction and operational stage of the Project, the following measures will be implemented:

- Where artificial lighting is required, directional lighting and glare guards should be implemented to focus on work areas and minimise lighting of adjacent remnant vegetation.
- Active roads are to be regularly watered (or applied with dust suppressants) to minimise dust generation potential.



- Regular maintenance of machinery and mobile plants should be undertaken to minimise unnecessary noise.

Introduction and Spread of Pests and Weeds

To mitigate and minimise the potential for the introduction and spread of pests and weeds during Project activities, the following measures should be implemented:

- Weeds or soil removed as a result of construction activities are to be appropriately disposed of or stored separately to minimise potential spread and proliferation of weed species.
- Prior to vegetation clearing activities, a pre-clearance survey should be undertaken to identify and map infestations of WoNs and restricted matters under the Biosecurity Act to minimise spread during clearing works and the operational phase.
- Waste management measures should be identified and enacted to minimise occurrences of pest fauna.
- All vehicles, equipment and materials (e.g. landfill, soil etc.) brought to site are to be certified free of biosecurity matter and carry weed hygiene certification.
- Biosecurity monitoring will be undertaken during construction, operational and rehabilitation phases to identify and assess the risk of weed and pest occurrences within the Project.
- Pest fauna will be monitored and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land.
- Biosecurity measures will be undertaken to ensure no diseases will be spread during construction and operational phases of the Project.

Rehabilitation and Closure

Rehabilitation will be undertaken to ensure land be progressively rehabilitated to achieve completion criteria for a safe, stable and non-polluting landform able to sustain an agreed post-mining land use. This will include:

- Top-soil to be stockpiled to be utilised during rehabilitation.
- Rehabilitated areas will be of similar floristic diversity and structure to pre-disturbance.
- Any habitat features in adjacent habitat that are unoccupied may be returned to pre-disturbance locations.

6.5.5 Risk Assessment

The field surveys identified that the Project Area contains three MSES identified under the EO Act (see **Section 6.5.2**). The Queensland Government has produced the *Queensland Environmental Offsets Policy – Significant Residual Impact Guideline* (DEHP 2014) (SRI Guideline) to assist in determining if significant residual impacts associated with a Project will require offsetting. Self-assessments against the SRI Guideline are provided in Appendix A.

An assessment against the SRI Guideline determined the Project is unlikely to result in a significant residual impact on any of the three MSES. This is summarised below for each MSES.



Regulated Vegetation

In accordance with the SRI Guideline, essential habitat has been assessed as part of MSES protected wildlife habitat.

Protected Wildlife Habitat

Protected wildlife habitat was assessed in accordance with the SRI Guideline for the following five threatened species and essential habitat for one species:

- ***Dichanthium queenslandicum*** – The Project will result in the direct clearing of 1.53 ha of preferred habitat for *D. queenslandicum*. This amount comprises less than 1% of preferred habitat for the species mapped within the broader Study Area. Any individuals removed will be a small portion of the population within the habitat patch that is being disturbed and therefore, it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **Koala** – The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The Project is located outside of areas of preferred habitat for the species and given survey effort across the Study Area it is considered that koala is present at low densities in this area. Therefore, it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **Ornamental snake (comprising Essential Habitat)** – The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake. Seasonal targeted surveys for the species (comprising pitfall trapping and spotlighting) within the Study Area failed to detect the species, and no suitable habitat was identified. Therefore, the species is assessed as unlikely to occur within the Study Area and Project Area and it is considered unlikely that the Project will have a significant residual impact on the species.
- **Short-beaked echidna** – The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The species has a relatively widespread distribution across its range (Van Dyck & Strahan, 2008) and given the small portion of habitat being cleared and retained connectivity of avoided habitat within the Study Area, it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **Squatter pigeon (southern)** – The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern). This comprises less than 1% of suitable habitat for the species within the broader Study Area. The species is locally abundant within its range (DCCEE, 2024) and given the small portion of habitat being cleared and retained presence of important habitat features (i.e. permanent and seasonal waterbodies) (Squatter Pigeon Workshop, 2011), it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **White-throated needletail** – The species is a wide-ranging nomadic species that is almost exclusively aerial in Australia (DCCEE, 2024). As such, the clearing of vegetation is considered largely inconsequential to the species. Therefore, it is



considered unlikely that the Project will lead to a long-term decrease in the species population, extent of occurrence, quality of habitat or result in an invasive species or disease that may cause the species to decline. Furthermore, the Project is unlikely to interfere substantially with the recovery of the species.

Connectivity Areas

In accordance with the SRI Guideline, the Landscape Fragmentation and Connectivity Tool was used to assess the associated impacts to connectivity areas resulting from the Project. Based on the Landscape Fragmentation and Connectivity Tool, the Project will not result in a significant residual impact on MSES connectivity areas. The two tests identified:

- **Test 1:** The regional extent of core remnant areas is approximately 41.61%, resulting in a local impact threshold of 10.00%. The core remnant extent at the local scale pre-impact was calculated as 5,700.58 ha with a 0.36% change post impact. As such, Test 1 did not exceed the 10.00% threshold for change in core remnant ecosystem extent at the local scale.
- **Test 2:** One core remnant area was identified within the site pre-impact and this was retained post impact. As such the loss or fragmentation of core remnant ecosystem at the site does not result.

6.6 Aquatic Ecology

This section presents the assessment of Project related aquatic ecology impacts to environmental values.

6.6.1 Existing Environmental Values

The following subsections detail the existing EVs within the Project Area (see **Figure 3.2**) based on aquatic ecological surveys undertaken to date. It also details the MSES impacted by the Project based on these findings.

6.6.1.1 Subterranean GDEs and Stygofauna

According to state mapping, high potential GDEs are present along two of the creeks that are located within the Study Area; Kennedy Creek and Goonyella Creek. However, field surveys of these creeks identified that they were dry and did not exhibit characteristics of an ecosystem likely to be dependent on the surface expression of groundwater. Additionally, neither of these creeks intersect with the Project Area.

There are no mapped subterranean GDEs within or near (within 100 km) the Study Area. Additionally, no stygofauna were collected from bores within or immediately surrounding the Study Area, suggesting the absence of subterranean GDEs within these aquifers.

6.6.1.2 Habitat

The creeks of the Study Area are ephemeral in nature, where flow and pool habitat only occur following sufficient rainfall. Habitat condition of the creeks within the Study Area ranged from poor to fair, given that they were impacted by grazing, heavily eroded, dominated by fine sediment and affected by scouring and channelisation. The Project Area does not intercept with these creeks.

Two constructed dams in the Study Area were surveyed and likely provide a perennial source of water, though do not appear to supply water or be directly connected to surrounding creeks. The Project Area does not intercept with constructed dams.



6.6.1.3 Water Quality

Water quality was only measured in the two dams present in the Study Area and one creek when it held water in the early-wet survey. Water quality was typical for constructed dams, though some extremes were noted in pH and dissolved oxygen, owing to the high macrophyte density. High turbidity was noted in the only creek to hold water, though this is typical for an ephemeral creek. The Project Area does not intercept creeks or constructed dams.

6.6.1.4 Macroinvertebrates

Macroinvertebrate diversity indices (taxonomic richness, PET richness and SIGNAL score) were generally low, largely due to the lack of macro and microhabitat diversity within the creeks or constructed dams. The Project Area does not intercept creeks or constructed dams.

6.6.1.5 Fish and Macrocrustaceans

Fish were only caught in one dam and were typical species for the area, potentially being stocked in the past. Red claw crayfish (*Cherax quadricarinatus*) was also caught in the same dam and though native to northern Queensland, are considered non-native in the area. Freshwater inland crabs were also caught in the only creek site to hold water and provide an indication of ephemerality. The Project Area does not intercept with creeks or constructed dams.

6.6.1.6 Threatened Species

No threatened flora or fauna species were identified during the field survey. The critically endangered white-throated snapping turtle (Critically endangered under the EPBC Act and NC Act) and Fitzroy River turtle (Vulnerable under the EPBC Act and NC Act) have not been recorded in or near (within 100 km) the Study Area and suitable habitat was not identified mostly due to the lack of perennial, flowing water. The platypus (Special least concern under the NC Act) was also not caught and suitable habitat was not identified, again largely due to the lack of suitable habitat in the Study Area.

6.6.2 Summary of MSES

No MSES as defined in the EO Regulation were identified within the Project Area. More specifically, the Project Area does not intercept with the following MSES:

- Wetlands and watercourses (including High Ecological Significance wetlands and wetlands or waterways in High Ecological Value waters).
- Protected wildlife habitat (for aquatic species).
- Declared fish habitat areas under the Fisheries Act 1994.
- Protected areas.
- Legally secured offset areas.
- Watercourses as defined in the *Water Act 2000*:
 - Waterways providing for fish passage.
 - Threatened aquatic species.



6.6.3 Potential Impacts

There are no direct Project impacts to aquatic ecology considered likely to occur. As such, the following subsections detail the potential indirect aquatic ecology impacts as a result of the activities described in **Section 3.0**. Where multiple activities contribute to a potential impact, all relevant activities have been listed in the subsection heading.

6.6.3.1 Access Tracks, Coal Seam Gas Exploration and Water

Surface Water Quality

Changes in the surface water quality and quantity may impact terrestrial ecosystems downstream of the Project Area. Sedimentation and chemicals can enter downstream environments resulting from overland flow patterns (Evans, 2000). While no uncontrolled spills of water will be impacted by Project activities, some overflow may occur when rainfall exceeds the design standard (e.g. flood events).

Groundwater Drawdown

Changes to groundwater quality and quantity can have an indirect impact on ecosystems surrounding the Project Area, including ecosystems that are dependant or partially dependant on groundwater (terrestrial GDEs). The process of CSG drainage may reduce water levels in the surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown.

6.6.4 Management Practices

6.6.4.1 Avoidance

During the design stages of the Project, aquatic ecological values were considered and avoided where feasible and practical. This included the complete avoidance of MSES associated with aquatic ecology (see **Section 6.6.2**).

6.6.4.2 Mitigation

To mitigate and minimise the potential indirect impacts to surface water and groundwater during the Project activities, the following measures should be implemented.

- Erosion and sediment control monitoring should be implemented to reduce the amount of sediment laden run-off entering downstream waterways. The following general principles should apply to the erosion and sediment controls:
 - Minimise the surface disturbance areas
 - Where possible, apply local temporary erosion control measures, and
 - Intercept run-off from undisturbed areas and divert around surface disturbance areas, where required.
- Active access tracks are to be regularly watered (or applied with dust suppressants) to minimise dust generation potential.
- Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with AS1940:2004, and where practical, will be located away from any waterbodies.



- Oil spill recovery equipment will be available and located with construction crews conducting activities with the potential for significant spills.
- As soon as practical, disturbed areas will be rehabilitated to reduce the extent of exposed soils.

6.6.5 Risk Assessment

As detailed in **Section 6.6.2**, no MSES are located within the Project Area. As such, no SRIs in accordance with the SRI Guideline are considered likely to result from the Project.

6.7 Groundwater

The following section describes the hydrogeological environment, and analytical modelling undertaken to assess potential impacts on groundwater receptors resulting from the Project. The proposed location of vertical and lateral wells is presented in **Figure 6.20**.

Table 6.27 sets out where in this groundwater assessment the exercise of underground water rights for site-specific application as per Section 126A of the EP Act are considered.

Table 6.27 Groundwater Section 126A

Section 126A of the EP Act	Reference
2 (a) any proposed exercise of underground water rights during the period in which resource activities will be carried out under the relevant tenure	Refer to Section 6.7.2 for a description of the proposed activities.
(b) the areas in which underground water rights are proposed to be exercised	Refer to Section 6.7.2 for the underground water rights area.
(c) for each aquifer affected, or likely to be affected, by the exercise of underground water rights — I. a description of the aquifer; and II. an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers and surface water; and III. a description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights; and IV. the predicted quantities of water to be taken or interfered with because of the exercise of underground water rights during the period in which resource activities are carried out;	I. Refer to Section 6.7.1.1 for a description of the aquifers. II. Refer to Section 6.7.1.1 and Section 6.7.1.2 for a description of the movement and interactions of groundwater. III. Refer to Section 6.7.3 for a description of predicted water level decline. IV. Refer to Section 6.7.2 for anticipated water take.
(d) the environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values;	Refer to Section 6.7.1 and Section 6.7.4 for a description of EV impacts.
(e) any impacts on the quality of groundwater that will, or may, happen because of the exercise of underground water rights during or after the	Refer to Section 6.7.1 and Section 6.7.4 for a description of EV impacts.



Section 126A of the EP Act	Reference
period in which resource activities are carried out;	
(f) strategies for avoiding, mitigating or managing the predicted impacts on the environmental values stated for paragraph (d) or the impacts on the quality of groundwater mentioned in paragraph (e).	Refer to Section 6.7.4 for a risk assessment of predicted impacts.

6.7.1 Existing Environmental Values

6.7.1.1 Aquifers

Hydrostratigraphy

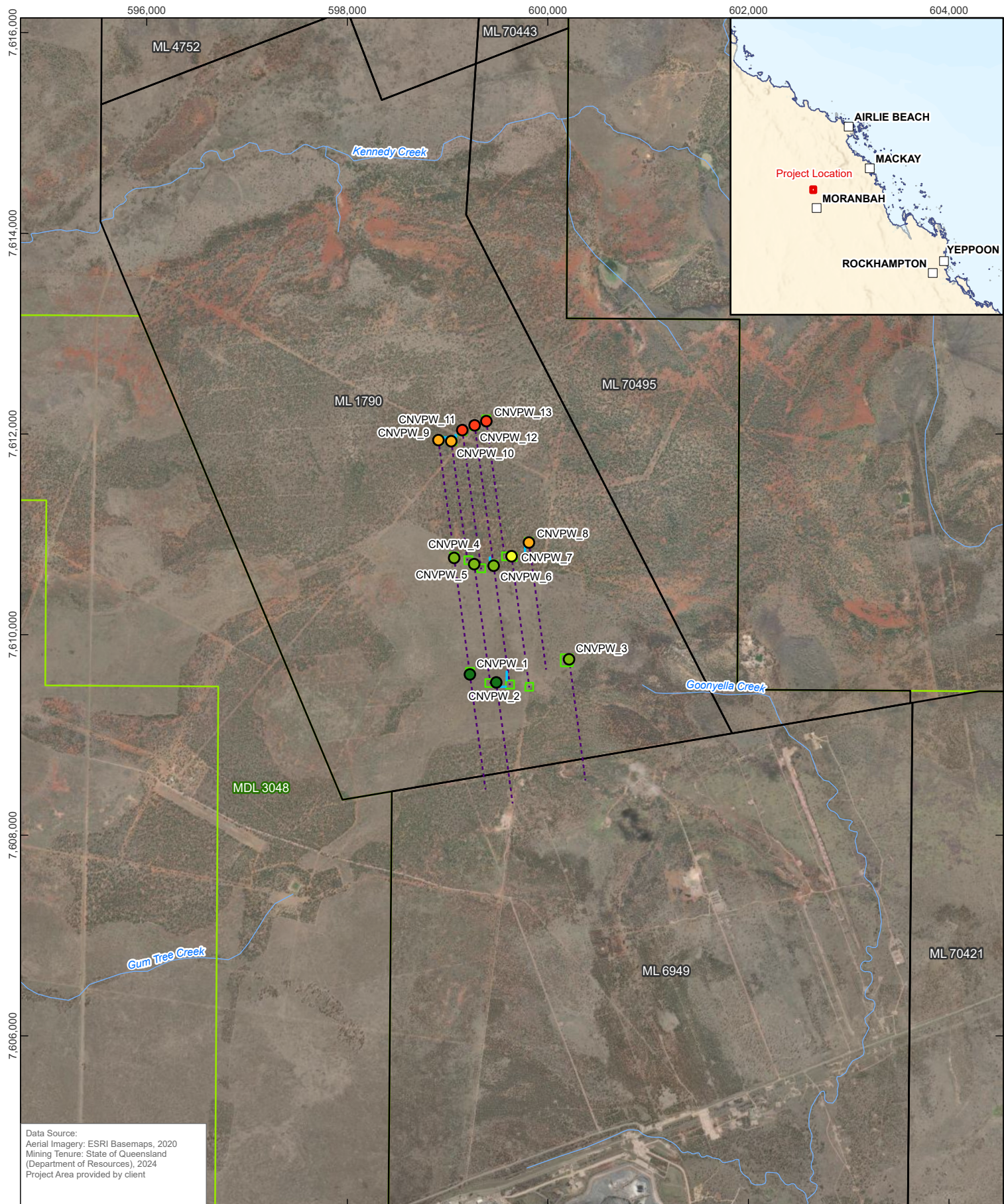
The hydrostratigraphy relevant to the Project comprises the Quaternary alluvium, Tertiary strata (basalt and sediments) and Permian strata. A conceptual cross section of the hydrogeological setting is provided in **Image 6.4** and the surface geology of the Project Area is shown in **Figure 6.21**. Solid geology (excluding Tertiary and Quaternary cover sequences) used for the representation of dip angles and formation contacts is per geology model provided by Peabody.

Quaternary Alluvium

The Quaternary alluvium forms an unconfined aquifer and includes alluvial deposits associated with local creeks. Where present, the thickness of the alluvium is likely to be highly irregular, with estimates of maximum thicknesses in the range of 15 to 25m (Golder, 2020). Groundwater flow within the alluvium (if/where saturated) will follow topographic gradients but it is considered unlikely that, where present, the alluvium forms a continuous saturated aquifer. Relative to the vertical and lateral wells, the Quaternary Alluvium is located along Kennedy Creek, approximately 7.5 kilometres (km) northwest of the Project Area.

Recharge to the Quaternary alluvium will occur via direct infiltration of rainfall and occasional creek flow/flooding during the wet season (Golder, 2020, BMC, 2021). Discharge mechanisms from the alluvium include evapotranspiration, leakage to underlying/adjacent aquifers and groundwater extraction (BMC, 2021). Previous conceptualisations have noted all creeks in the area are ephemeral. No water level data for this unit is available in the monitoring network.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:50,000 at A4
Project Number: 620.041540.00001
Date Drawn: 10-Sep-2024
Drawn by: RB



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LEGEND

- Watercourse
- Lateral Well Length
- Mining Lease
- Mineral Development Licence
- Drill Pad
- Access Track

Planned Vertical Well

Approximate Depth

- 290 - 305
- 306 - 425
- 426 - 460
- 461 - 505
- 506 - 565

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VERTICAL WELL DEPTH

FIGURE 6.20

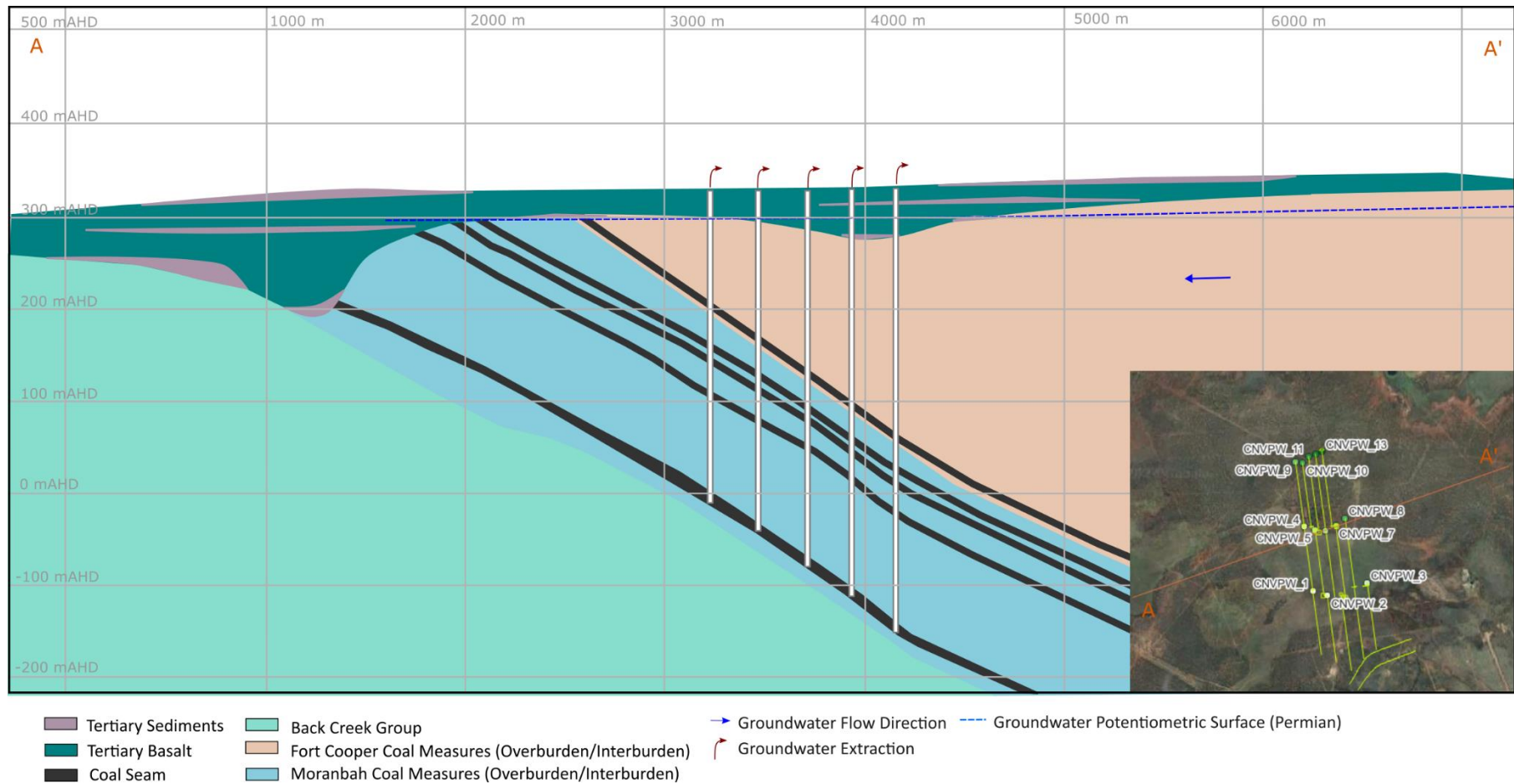


Image 6.4 Conceptual hydrogeological cross section



Tertiary

The Tertiary Strata includes thick basalt flows interbedded with sediments. The flows and sediments occupy Tertiary paleochannels in the Permian coal measures basement. These strata represent the most significant groundwater resource in the region.

Groundwater within the basalt is stored and transmitted through fractures, joints, and discontinuities within the rock mass. The aquifer is layered due to the presence of sediments and weathering horizons which develop between individual flows. Additionally, low permeability associated with massive basalt in the centre of the flows typically separate the higher permeability vesicular basalts, which develop at the top and bottom individual flows (Golder, 2017). In most areas the basalt is underlain by sediments of variable thickness, however, in some areas the basalt is directly in contact with the underlying Permian strata. These underlying sediments occasionally express as lenses of sand that may be hydrogeologically significant due to high primary porosity and hydraulic conductivity.

Golder, 2017 presents geological model data including mapping for the base of the Tertiary, basalt thickness, and the inferred thickness of Tertiary sediments underlying the basalt across ML1790 and the immediate surroundings. The basalts are thickest along the western, north-western and northern edge of ML1790 reaching thicknesses of up to 150m, including one data point at the south-western corner of ML 1790, proximal to the proposed well field.

Permian

The Permian strata comprise siltstone, sandstone, calcareous and carbonaceous shale and coal seams. The coal seams and jointed sandstone units are generally the most transmissive units within in the coal measures with water moving through the coal seams via joints and fractures. The lower permeability interburden/overburden units (siltstones and mudstones / shales) may have some fracture permeability but typically confine groundwater within the coal seams.

Recharge to the Permian will occur via downwards seepage from overlying aquifers, though faults or discontinuities and where the unit outcrops through direct rainfall infiltration or overland flow (Golder, 2020, BMC, 2021). Discharge from the Permian is expected to occur through downgradient flow, downwards seepage through structural discontinuities and groundwater extraction (including dewatering) (Golder, 2020, BMC, 2021)

Hydraulic Properties

Site specific hydraulic conductivity estimates from field testing are presented in **Table 6.28**.

Hydraulic conductivity estimates for the Quaternary alluvium indicate a range from 2 to 20 metres per day (m/day). However, this is based on testing of the Suttor Creek alluvium and regional studies and no site-specific testing has been conducted.

Hydraulic conductivity estimates from one bore in the Tertiary sediments (sandy sediments of the Suttor Formation), shows a range from 0.3 to 0.8 m/day. The silt and clay layers of this formation would be expected to have permeabilities several orders of magnitude lower. The Tertiary sediments distribution model (Silwa, 2011) indicates a varied composition and distribution of sand, clay and mixed material for these sediments.

Two long term pumping tests in the basalt (Streamline Hydro, 2012) were conducted at the northern end of ML 1790 some 8-10 km north of the proposed production well area. The hydraulic conductivity, transmissivity and storage of the Tertiary basalt is likely to vary significantly across the area.



Hydraulic conductivity estimates for the Permian interburden/overburden range from 2×10^{-6} to 0.33 m/day. Hydraulic conductivity estimates for the Permian coal seams ranged from 2×10^{-6} to 0.47 m/day, with estimates for the Goonyella seams in the range 0.003 to 0.47 m/day.

Table 6.28 Hydraulic conductivity estimates from field testing

Aquifer	K (m/day)	Test bore/area	Type	Source ¹
Alluvium	2 to 20	Regional study		Arrow (2012)
	3	Suttor Creek	-	Golder, 2005
Tertiary sediments	0.3 to 0.8	PB03	CRT	Streamline Hydro (2012)
Tertiary Basalt	0.5 to 2.4	PB01	CRT	Streamline Hydro (2012)
	0.01 to 0.4	PB02	CRT	Streamline Hydro (2012)
Permian GM Seam	0.003 to 0.034	GBMC	-	URS, 2013
	0.01	GBMC	-	Golder, 2016
Permian GL Seam	0.06 to 0.47	GBMC	-	URS, 2013
	0.01 to 0.1	GBMC	-	URS, 2013
	0.01	GBMC	-	Golder, 2016
Permian GU Seam	0.01	GBMC	-	Golder, 2016
Permian coal seams (undifferentiated)	1×10^{-6} to 0.001	Wards Well ML	packer	AGE, 2012
Permian Interburden	2×10^{-5} to 0.33	GBMC	-	URS, 2013
	2×10^{-6} to 3×10^{-5}	Red Hill	-	URS, 2013
Permian Overburden/Interburden	8×10^{-4}	GBMC	-	Golder, 2016

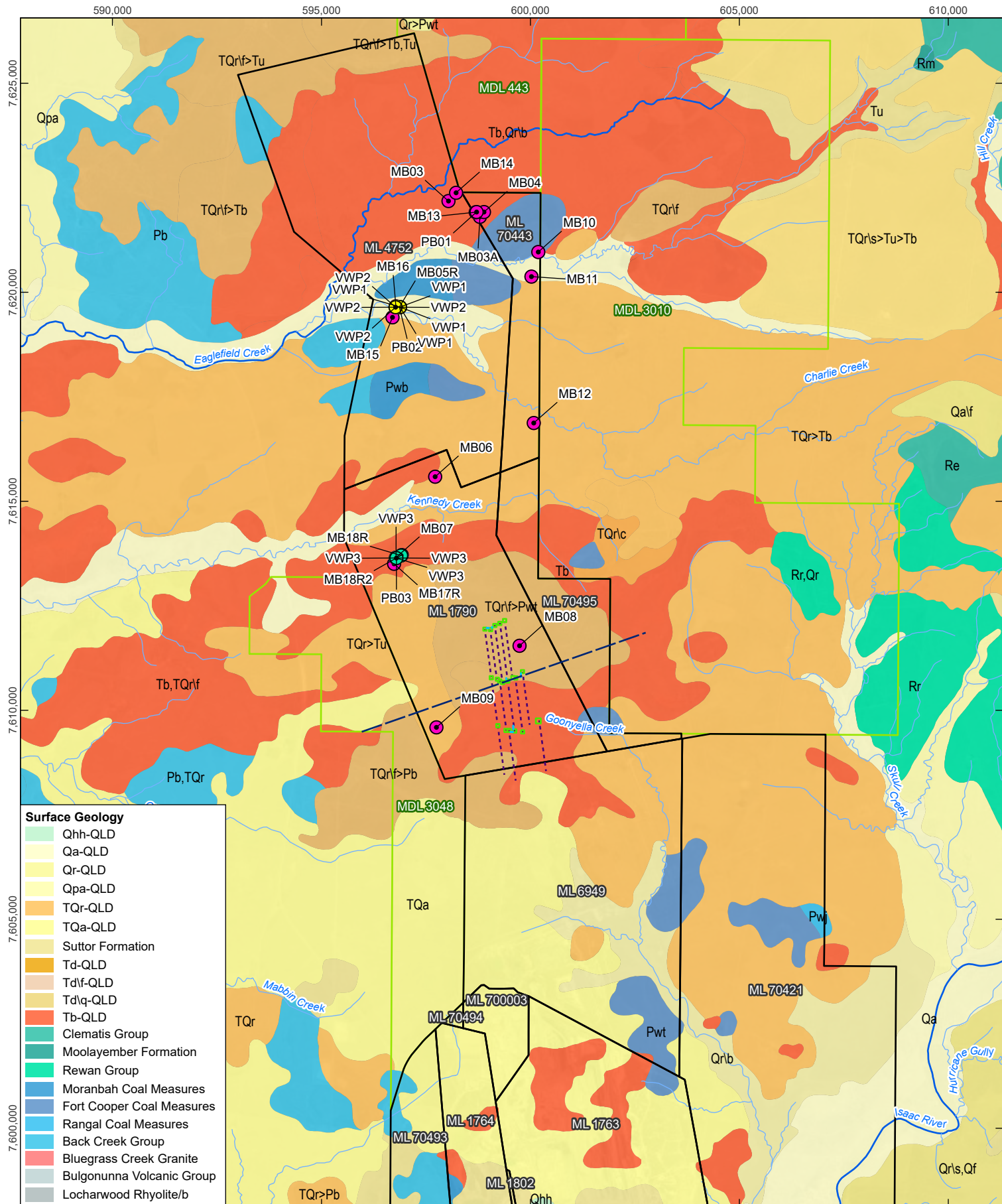
¹ as reported by Golder (2020)

- test type not reported

CRT = Constant Rate Test

GBMC = Goonyella Broad Meadow Complex





Surface Geology

- Qhh-QLD
- Qa-QLD
- Qr-QLD
- Qpa-QLD
- TQr-QLD
- TQa-QLD
- Sutor Formation
- Td-QLD
- Td/f-QLD
- Td/q-QLD
- Tb-QLD
- Clematis Group
- Moolayember Formation
- Rewan Group
- Moranbah Coal Measures
- Fort Cooper Coal Measures
- Rangal Coal Measures
- Back Creek Group
- Bluegrass Creek Granite
- Bulgonunna Volcanic Group
- Locharwood Rhyolite/b

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:120,000 at A4

Project Number: 620.041540.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

Monitoring Bore

- Basalt
- Permian (Coal)
- Permian (Interburden/Overburden)
- Tertiary Sediments
- Hydrogeological Cross Section
- Lateral Well Length

- Major Watercourse
- Minor Watercourse
- Mining Lease
- Mineral Development Licence
- Drill Pad
- Access Track

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SURFACE GEOLOGY AND MONITORING NETWORK



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FIGURE 6.21

6.7.1.2 Groundwater Conditions

This section outlines the baseline understanding of hydrogeological conditions that informs the analytical model design and impact assessment.

Water Level

Located in between CNVPW_13 and CNVPW_8, MB08 is screened in the basalt aquifer and gives the best indication of groundwater conditions in this aquifer at the production well field. **Image 6.5** shows a hydrograph MB08 with Cumulative Rainfall Departure included to assess the impact of monthly rainfall variations in the groundwater hydrographs.

Groundwater levels at MB08 very broadly reflect the long-term rainfall trend with a clear recession from the significant recharge associated with very high rainfall during the 2010-11 wet season. Based on groundwater levels at MB08, Tertiary basalt groundwater levels in the immediate footprint of the Project Area are considered likely to range between approximately ~296 and 297m AHD.

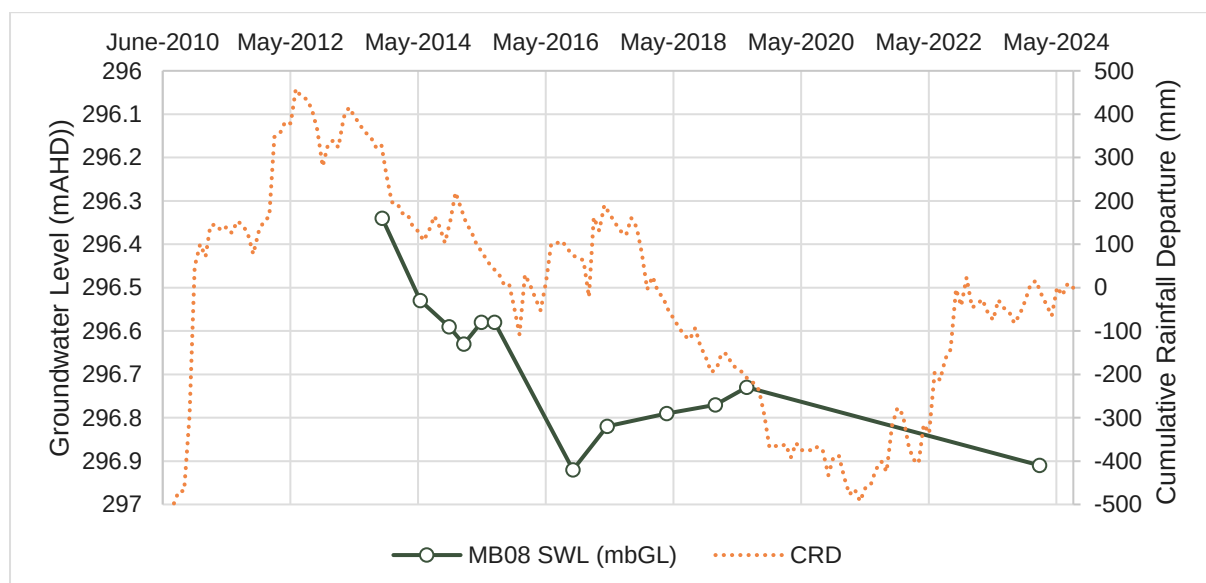


Image 6.5 Groundwater level monitoring bore MB08 hydrograph

The nearest groundwater level monitoring in the Permian coal seams is VWP03, approximately 2.7 km northwest of the proposed Project Area. Hydrograph of this data is provided in **Image 6.6**. Sensor lithology corresponds to:

- Sensor 4: Interburden
- Sensor 3: Goonyella Middle 0
- Sensor 2: Goonyella Lower 3, and
- Sensor 1: Goonyella Lower 8.

Groundwater level and flow direction in the Permian was additionally investigated by developing groundwater level contours from exploration drilling bores that were cased to below 150 metres below ground level (mbGL) i.e. reflecting groundwater conditions in the Permian (**Image 6.6**). These are considered to be low reliability water level estimates as they are likely to present as averaged piezometric level Permian strata that are exposed in the borehole (including coal and overburden). Based on these localised contours for data collected in 2011, the interpreted groundwater flow direction is to the south and west.



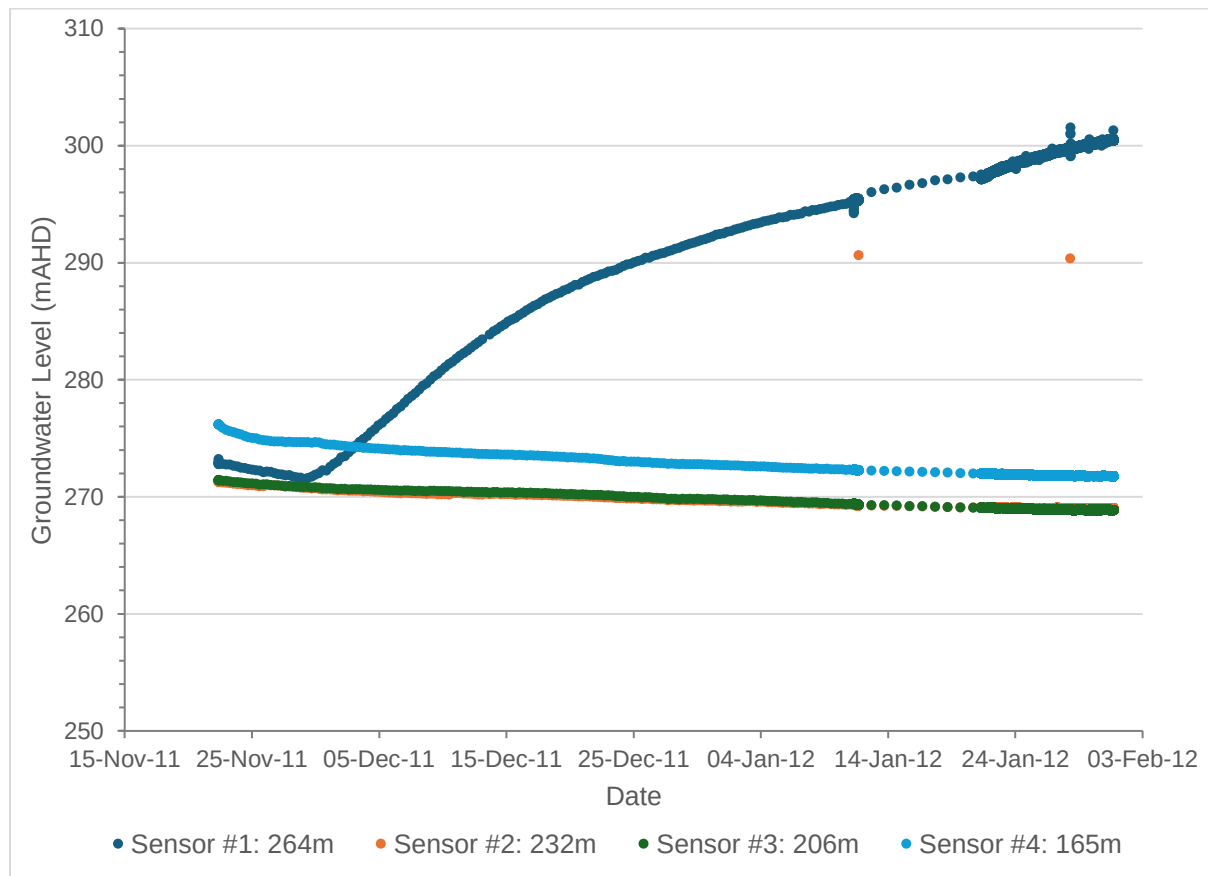


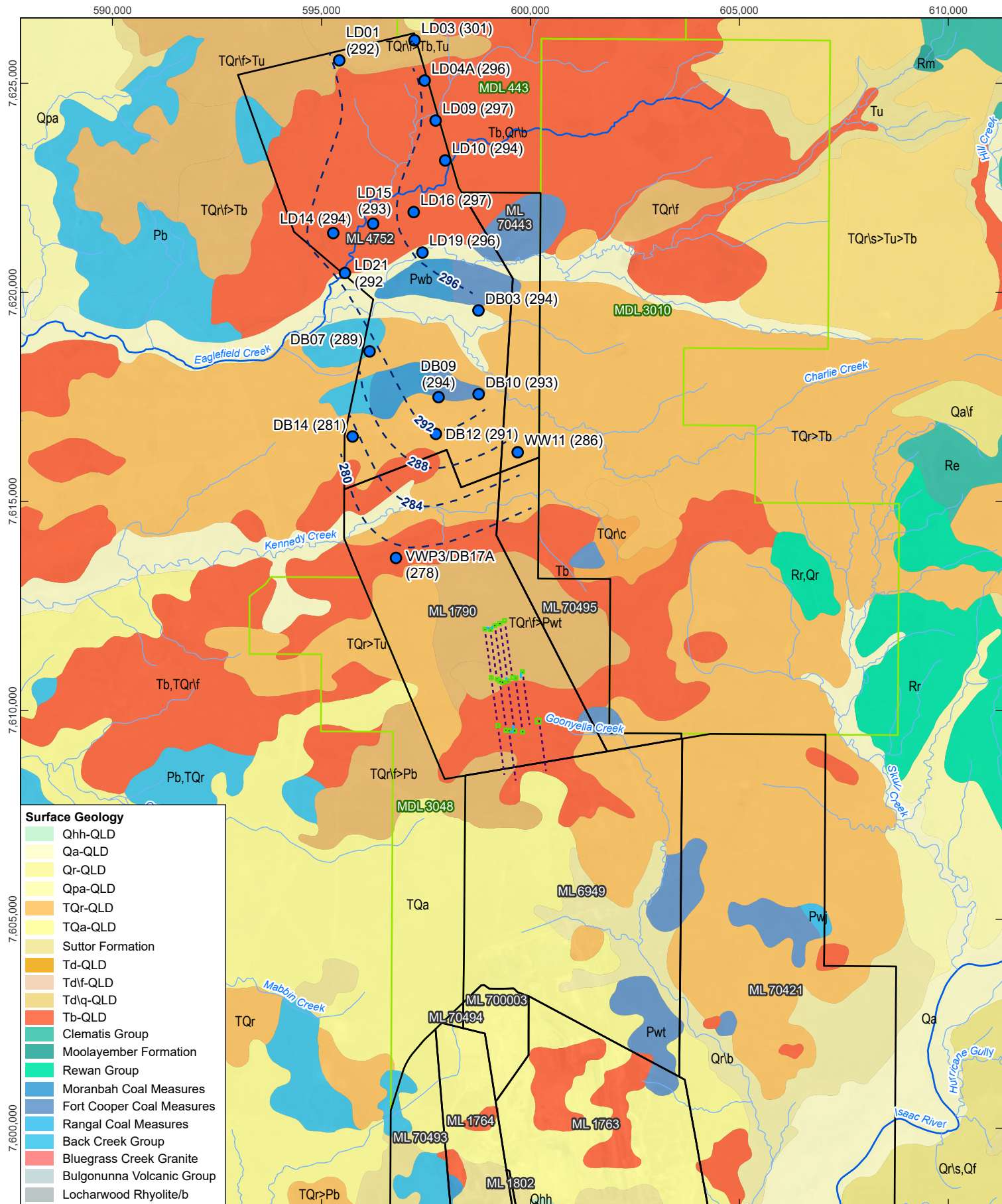
Image 6.6 VWP03 hydrograph

Water Chemistry

Groundwater quality data collected for the Project Area indicates the following:

- **Alluvium:** Variable salinity, but generally brackish to saline (up to 6,600 $\mu\text{S/cm}$, with an average of $\sim 3,700$ $\mu\text{S/cm}$), slightly alkaline pH (7.32 to 7.61) and sodium chloride dominated.
- **Basalt:** Moderate salinity, ranging from slightly brackish to saline (893 $\mu\text{S/cm}$ to 4,670 $\mu\text{S/cm}$), very slightly alkaline to moderately alkaline pH (7.16 to 8.97), and sodium chloride dominated.
- **Permian Coal Measures:** Limited data exists for monitoring bores screened within the coal measures outside of two rounds of grab samples in late 2011. Chemistry results from these sampling rounds indicated that groundwater in the coal measures is of significantly higher in salinity, and more alkaline compared to samples from the basalt and alluvium.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:120,000 at A4

Project Number: 620.041540.00001

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FIGURE 6.22

6.7.1.3 Environmental Values

Groundwater Management Areas

The south-eastern corner of ML 1790 and the southern half of the adjoining ML 70495 lie within the Isaac-Connors Rivers catchment of the Fitzroy Basin and the Isaac Connors GMA. The rest of ML 1790 to the north-west lies within the Suttor River catchment of the Burdekin Basin. The south-western area of ML 1790 which lies within the Suttor River catchment also lies within the Highlands Underground Water Area.

Groundwaters in the portion of the Project intersecting the Isaac Connors GMA are scheduled under the Queensland Environmental Protection Policy (Water and Wetland Biodiversity) 2019 (under the Environmental Protection Act 1994) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated Environmental Values (EVs) for these groundwaters are:

- Biological integrity of aquatic ecosystems – these occur where groundwater baseflow supports streams and water holes to some extent (e.g. seasonally or permanently).
- Human use EVs:
 - Suitability of water supply for irrigation – where groundwater is used to grow crops and pastures for commercial purposes.
 - Farm water supply/use – where groundwater is used to provide domestic supply and support growing domestic produce.
 - Stock watering – where groundwater is used to provide stock water.
 - Drinking water supply – where groundwater is used for potable water supply.
 - Primary recreation – where groundwater supports recreational use that involves direct contact and a high probability of being swallowed, e.g. diving, swimming, water skiing.
 - Cultural and spiritual values – where groundwater supports both indigenous and non-indigenous values, e.g. recreational fishing, heritage, ecology.

The majority of ML1790 is located within the Suttor River Catchment which is not a defined water management zone within the Burdekin Basin and no legislated EVs for groundwaters are currently defined. However, within this catchment the southwestern portion of ML 1790 lies within the Highlands Underground Water Area. The Water Act states that declared underground water areas may be subject to the following regulations:

- The taking of, or interfering with, underground water.
- The types of works for taking or interfering with underground water that are assessable development or accepted development of the Planning Act.

The Water Regulation 2016, which describes the relevant legislation surrounding declared underground water areas, states that the Highlands Underground Water Area does not require water entitlement, water permit or seasonal water assignment notice for stock or domestic purposes or a prescribed activity. Prescribed activities in the context of mining operations include:

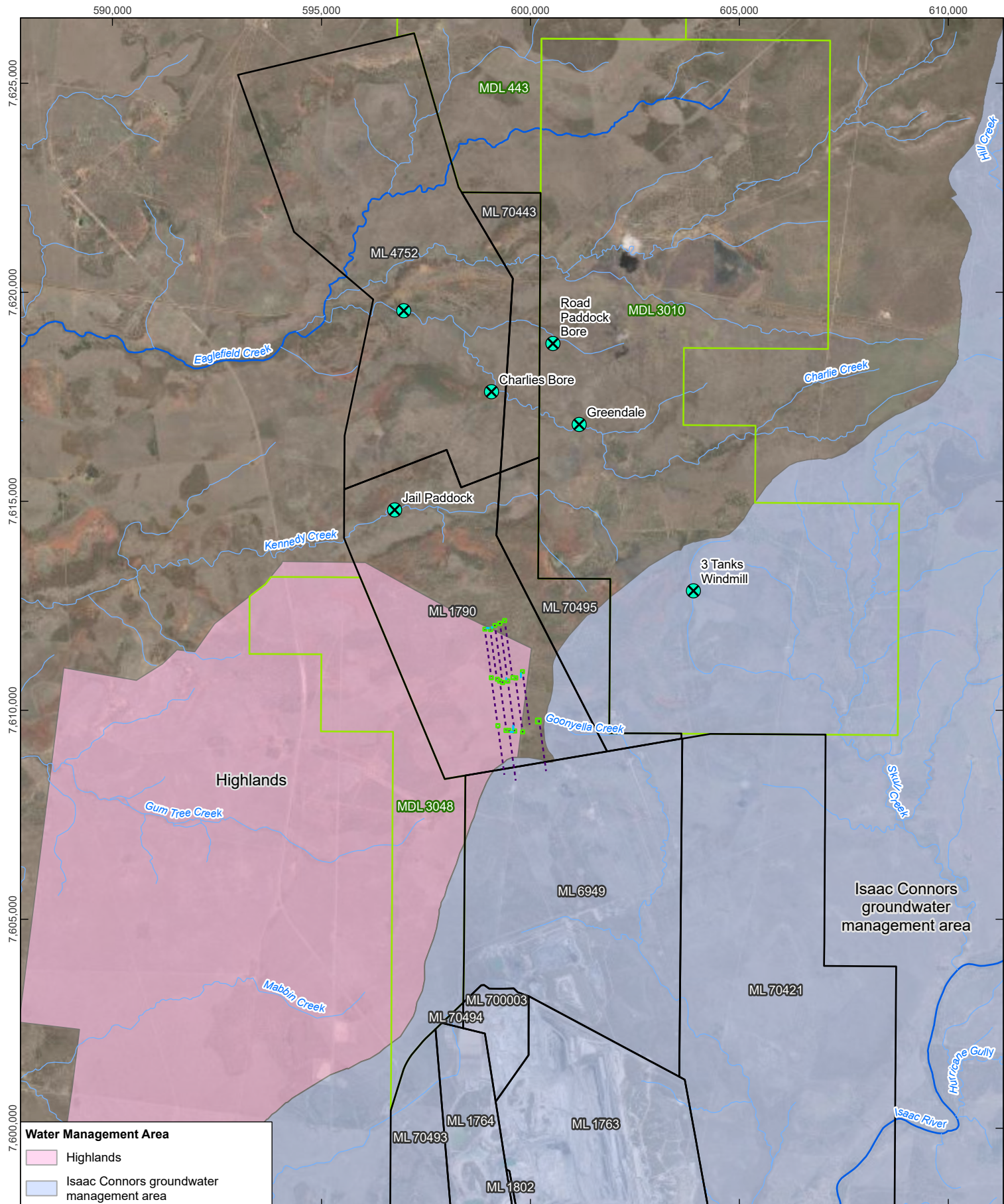
- Washing down equipment plant or vehicles.
- Supplying water for temporary camps or living quarters for staff, for example, for operating toilets, showers, kitchens, or laundries.



- Construction works, infrastructure or plant that are temporary and reasonably necessary for, or incidental to, carrying on mining under a mining lease granted under the Mineral Resources Act.
- Constructing, but not maintaining, roads with the area of a mineral development licence, or mining lease, granted under the Mineral Resources Act.
- Rehabilitation of riparian land.
- The following activities in relation to pumps, wells, or bores:
 - Constructing or drilling.
 - Proving supply.
 - Testing water quality.
 - Flushing out.

Any dewatering requirements occurring within the bounds of the Highlands Underground Water Area will be subject to obtainment of a water entitlement, water permit or seasonal water assignment notice.





Water Management Area

- Highlands
- Isaac Connors groundwater management area

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:120,000 at A4
 Project Number: 620.041540.00001
 Date Drawn: 11-Sep-2024
 Drawn by: RB

LEGEND

- Bore Census Water Supply Bore (AGE 2012)
- Major Watercourse
- Minor Watercourse
- Mining Lease
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

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WATER MANAGEMENT AREAS AND PRIVATE BORES



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FIGURE 6.23

Water Supply Bores

A search of the Queensland Government's Registered Groundwater Bore Database (GWDB) (DRDMW, 2024) was undertaken to identify registered bores within the 10 km of the Project Area. The search returned 45 bores with the following uses:

- Mine monitoring (28 bores).
- Petroleum exploration (1 bore).
- Water supply (7 bores).
- Sub-artesian monitoring (5 bores).
- Unknown use (10 bores).
- Decommissioned (1 bore).

Monitoring bores, exploration, and decommissioned or abandoned bores were excluded, which left no existing registered water supply bores within the search area. A landholder bore census was conducted for the Wards Well EIS by AGE (2012). The census included a total of 21 bores and identified six unregistered bores. The results of the survey indicated that these bores are used for stock watering. The locations of the six unregistered bores identified are included on Figure 6.23.

Groundwater Dependent Ecosystems

A groundwater dependant ecosystem (GDE) is a natural ecosystem that requires "access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services" (Richardson, S., et al., 2011).

The BoM's National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (BoM, 2017) classifies ecosystems based on the potential for dependence on groundwater through multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater dependence (indicating a strong possibility the ecosystem is interacting with groundwater).
- Moderate potential for groundwater dependence.
- Low potential for groundwater dependence (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

BoM GDE Atlas regional study mapping indicates that areas with possible high, moderate, and low potential for groundwater interaction occur in the vicinity of the Project Area (Figure 6.23). This includes "high potential" terrestrial GDEs associated with regional ecosystems on basalt within the immediate mining footprint and the riparian corridor of Kennedy Creek across the northern end of ML 1790.

Ecological field surveys (refer to Section 6.6) have identified that there are no aquatic or terrestrial GDEs present within the Study Area. There are no mapped subterranean GDEs within or near (within 100 km) the Study Area. Additionally, no stygofauna were collected from bores within or immediately surrounding the Study Area, suggesting the absence of subterranean GDEs within these aquifers.



6.7.2 Proposed Activities

Groundwater extraction will occur at the vertical and lateral wells that may have impact on groundwater levels in the area. The extraction of groundwater from the wells, located on ML 1790, is the primary activity to be assessed for potential hydrogeological impacts.

Proposed activities will include drilling of vertical and lateral wells to target the GM seam between 290 - 570 mbGL. These activities are detailed in Section 3. The summary presented below focuses on the relevant information for prediction of potential groundwater impacts.

Groundwater in the coal seam will be pumped from the wells, reducing the hydrostatic pressure in the production seam by a planned 40 kilopascals (kPa) per day, or 4 metres water head (mH₂O). Based on information provided by Peabody, it is anticipated that depressurisation of the coal seam will take up to 90 days. From the well head, the water will pass through the well head to storage tanks and ultimately be added to the CCM mine water management system.

- The reduction in hydrostatic pressure within the coal seam allows CSG to desorb from the coal matrix. The CSG will migrate through the coal's natural fractures (cleats) through the perforations made in the casing and into the well.
- The desorbed CSG will flow up the well to the surface, where it will be separated from any co-produced water. The CSG will pass through a steel pipe before being flared. Data logging will take place to record the amount of CSG produced from the wells. It is anticipated that CSG will be produced at 500 l/sec rate.
- Currently, Peabody estimates water production rates of 20 kilolitres (kL) per day over the operational life of the well.
- Report on Surface to Inseam (SIS) well performance at North Goonyella (Weisstech, 2023) demonstrates that production effectively ceased at four production locations before the 800th day online, indicating that CSG production per bore will likely be less than 800 days. As a conservative assumption, the following prediction of impact is based on well life of 800 days. Analytical model runs extended to t = 1200 days.

6.7.3 Prediction of Impacts

The following subsections detail the potential groundwater impacts as a result of the activities described in **Section 3.0**. Impacts may result from the propagation of drawdown that results from the depressurisation of the target coal seam to groundwater receptors (**Section 6.7.1.3**). The prediction of drawdown impacts has been investigated through analytical modelling of the hydrogeological environment outlined above, with conservative estimates of input parameters selected to inform the assessment of risk.

The analytical assessment of the Project activities has aimed to adopt an overly conservative approach to offset some of the limitations of the simple representation of the hydrogeological setting.

A risk-based assessment of these potential impacts is detailed in **Section 6.7.4**.

6.7.3.1 Analytical Modelling

The proposed well field was represented using MLU (Multi Layer Unsteady) (Hemker and Post, 2012), an aquifer testing software that computes drawdown within layered aquifer systems. Analytical model represented the proposed activities discussed above as:



- 13 vertical wells, and 10 lateral wells, distributed across the Project Area targeting the GM seam near the base of the Moranbah Coal Measures.
- Initial pumping period involving depressurising the coal seam by approximately 4 mH₂O per day for 90 days, followed by CSG extraction. Model results are presented below for up to 1200 days to include some recovery period representation. A conservative assumption is included that all production bores are operating simultaneously, which will increase the predicted drawdown.
- Estimated water production rate of 20 kilolitres per day (kL/day) for the life of the bores.

The detail of these inputs is discussed in subsequent sections.

Model Inputs

Model Layers

Model aquifer/aquitard layers were based on geological logs of monitoring in the Project Area (MB08 and MB09 bore logs) as well as the geological model and a conceptual understanding of the surrounding area. A thin unit representing surficial Tertiary/weathered basalt regolith was represented at the surface, comprising tertiary sediments although not a regionally significant aquifer. Below this is a basalt layer which is between 30 and 150 metres thick near the production well field. This unit is underlain by Permian overburden between 300 and 150 m thick in this area, comprising interbedded siltstone, claystone and coal seams.

The model development process included evaluating different scenarios where the thicknesses of Basalt Aquifer and Overburden Aquitard was varied between 50 and 200 metres to gauge the sensitivity of predicted impacts in the basalt to the thickness of intervening overburden. The results of this basic sensitivity analysis are outlined below. A consolidated thickness of 7 metres was used for the target coal seam.

The basal unit of the model is taken to be the Back Creek Group contact underneath target coal seams. For the purposes of simplifying the model, and as a conservative assumption, there is no vertical flow component upwards from the basal unit to the target coal seam. This is considered appropriate as the back Creek Group at this depth is not likely to be a significant groundwater contributor, and this has the effect of focusing groundwater flow within the target aquifer (and the overlying aquifer/aquitards).

Hydraulic Parameters

Hydraulic conductivities were based on test data summarised in **Section 6.7.1.1**. Permeability values provided by the client in millidarcies for nearby CSG projects were not used as this is a pressure dependant quantification of material flow capacity that is incompatible with this analytical modelling method. As displayed in **Table 6.30**, a range of vertical hydraulic conductivities between 0.001 and 0.00001 were tested, with variable aquifer thickness to assess the sensitivity interaction between the basalt aquifer and target coal seam. Horizontal conductivity for the Basalt was taken to be 2 m/day as a conservatively high point within the range of site-specific hydraulic testing for this unit. Coal seam horizontal conductivity and storativity was refined to produce the anticipated production well drawdown curve, under the pumping regime that is outlined above. This is considered an appropriately conservative value in the higher range of hydraulic testing data for this unit.

Storage values for the shallow basalt and Tertiary layers were selected based on mid-point values from pumping tests carried out at PB01, PB02 and PB03, as presented in Golder (2021). No storage values were available in the previous studies for the Permian overburden



or coal seams. Coal seam storage was selected based on re-producing planned drawdown rate with anticipated pumping volumes discussed below. Overburden storage values were aligned with the coal seam estimate as a conservative assumption, with values in the mid-point of typical range (Fitts, 2012).

Pumping Stress Periods

The pumping arrangement was modified from the design locations due to the need to represent groundwater extraction along the length of the horizontal coal seam wells. Hence, the collar positions of some vertical production wells were moved to a mid-point along the trace of the lateral well connecting to them. These new locations, (termed image bores) were used along the path of lateral wells to simulate the distributed extraction and avoid over-localisation of drawdown at the clustered vertical production well points. Note that two locations (indicated as Approved VPB in **Image 6.5**) are vertical production wells that will be drilled within existing approved disturbance area. These are included in modelling due to likely interaction between the drawdown induced at these locations and the proposed disturbance for approval.



Image 6.7 Bore locations with designed vertical production well collar locations



Pumping stress periods were defined based on:

- Communication from Peabody is that hydrostatic pressure within the bores will be reduced at 40 kilopascals per day (kPa/day), approximately 4 mH₂O (metres of water head), for 90 days.
- Estimated water make for the production well field, provided by Peabody is approximately 20 kilolitres per day (kL/day), averaged over the production life of the wells.

Observation bores positioned within 10 metres of the active vertical production wells were used to approximate an initial high water production period, as groundwater levels are lowered to the CSG production pressure. Extraction rates between 20 L/sec (1753 kL/day) and 0.2 L/sec (20 kL/day) were tested for this period, with the best re-production of planned drawdown occurring at approximately 0.58 L/sec (50 kL/day). In practice, the well then transitions to CSG production, with lower water production as piezometric pressure is maintained constant and gas flow is primary discharge from the wells. This was represented conservatively by using the average water production estimate of 20 kL per day.

Table 6.29 Pumping stress periods used in model

Stress Period	Starting Time (days)	Pumping Rate (kL/day)
1	0	50
2	90	20
3	800	0

Base Case

For the base case scenario, model layers were aligned with general geological information as described above. Hydraulic conductivity data selected, aquifer model layout and parameterisation are shown in **Table 6.30** and **Image 6.6**.



Table 6.30 Model aquifer layering and hydraulic parameters

Layer	Thickness (m)	Vertical Conductivity (m/day)	Horizontal Conductivity (m/day)	Storativity (-)	Justification Assumptions
Regolith	5	0.01	-	0.001	- Little to no regolith influence on pumping arrangement or groundwater utilisation - Hydraulic parameters per Golder (2021)
Basalt Aquifer	Range: 50 to 200 Base Case: 50	-	2.0	0.0001	- Thickness varied to test sensitivity. Thick and thin areas present on site. - Relatively high hydraulic conductivity used as conservative assumption (Golder 2021) - Middle order-of-magnitude storage value used from pumping test data (Golder 2021)
Claystone/Siltstone/Sandstone Overburden	Range: 50 to 275 Base Case: 250	Range: 1×10^{-4} to 1×10^{-6} Base Case: 1×10^{-4}	-	0.0001	- Thickness varied to test sensitivity. Thick and thin areas present on site. - Hydraulic conductivity range from Golder (2021). Sensitivity analysis applied to K_v. Base case uses upper range as conservative assumption - No storativity data from previous studies, estimate derived from literature values (Fitts, 2002)
Permian Coal Measures	7	-	Range: 3×10^{-1} to 1×10^{-6} Base Case: 1×10^{-2}	0.0005	- Hydraulic conductivity data presented per Golder (2021) - Hydraulic conductivity and storativity values refined to produce anticipated drawdown response in production wells. Correspond to upper range of reported conductivity in this unit, therefore appropriately conservative - No storativity data from previous studies
Siltstone Underburden	30	0.0		0.0	Basal unit, assumed impermeable



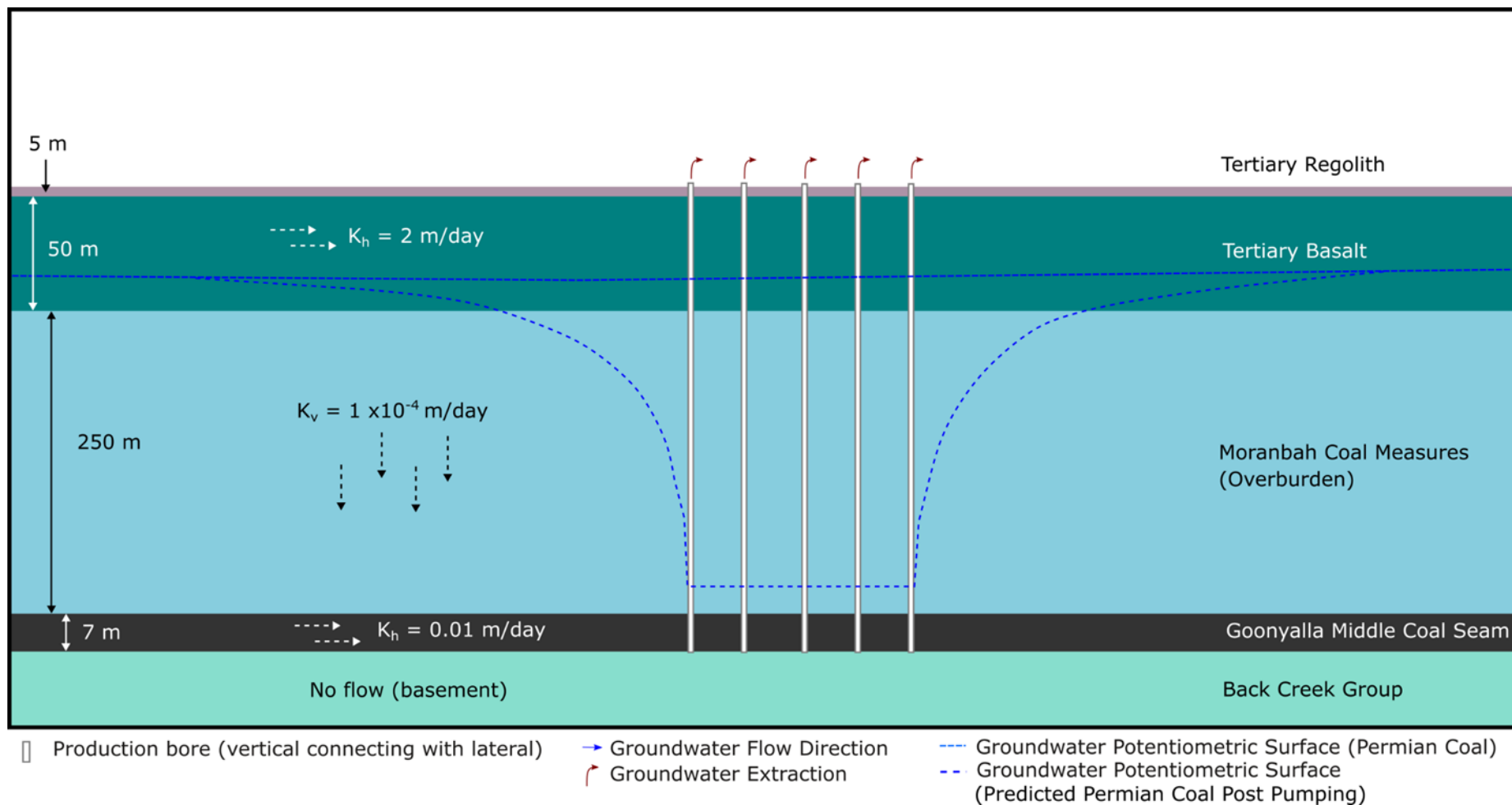


Image 6.8 Analytical model layout and base case diagram



6.7.3.2 Results

Drawdown predictions from the analytical model are presented as hydrographs in **Image 6.7** and **Image 6.8**. **Image 6.7** shows drawdown observations at CNVPW6, a centrally located vertical production well. High drawdown in initial pumping period stabilises once target drawdown has been attained. **Image 6.8** depicts water level response in the basalt adjacent to CNVPW_6, together with predicted impacts at the location of landholder bores in the overlying basalt aquifer. Predicted coal seam drawdown contours for $t = 800$ days are presented in **Figure 6.24**.

Observed drawdown in the shallow aquifer, is negligible i.e. <0.02 m. No drawdown is observed in the basalt aquifer at three of the closest potential water supply receptors. Coal seam drawdown is pronounced in the immediate area of the production bores, however horizontal drawdown propagation (**Figure 6.24**), is relatively limited, within 1 kilometre of the production well field.

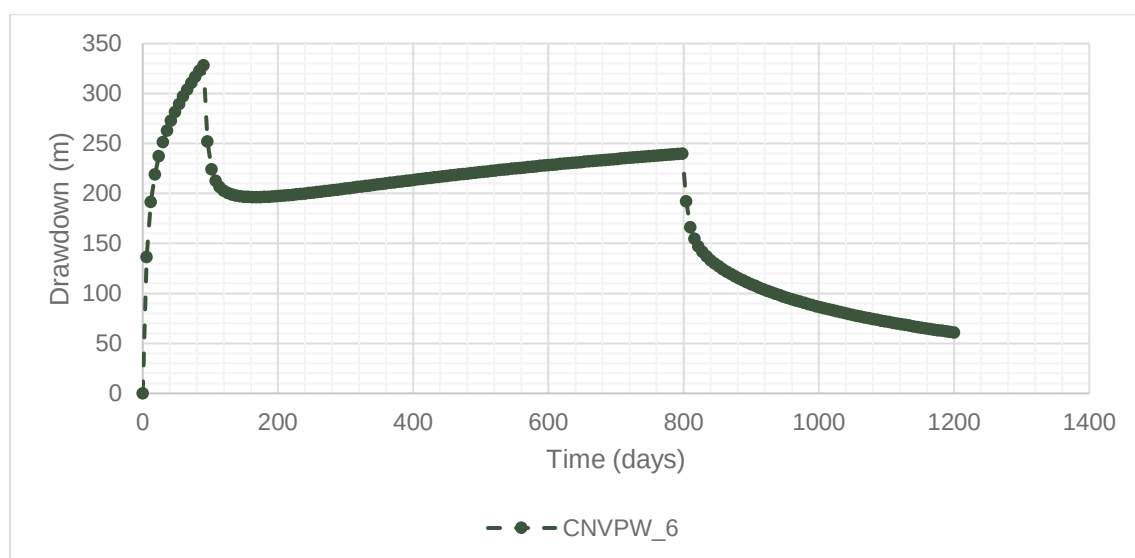


Image 6.9 Predicted drawdown in the target coal seam at the production well field

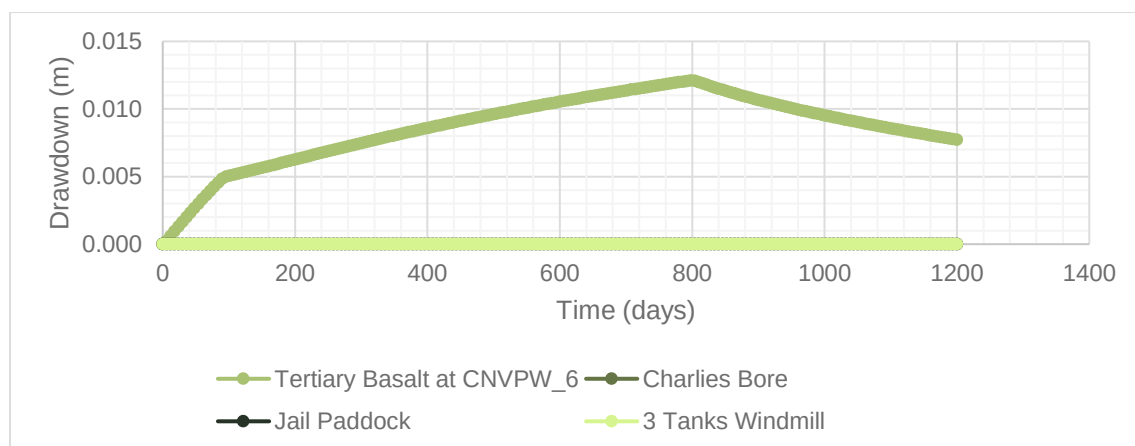
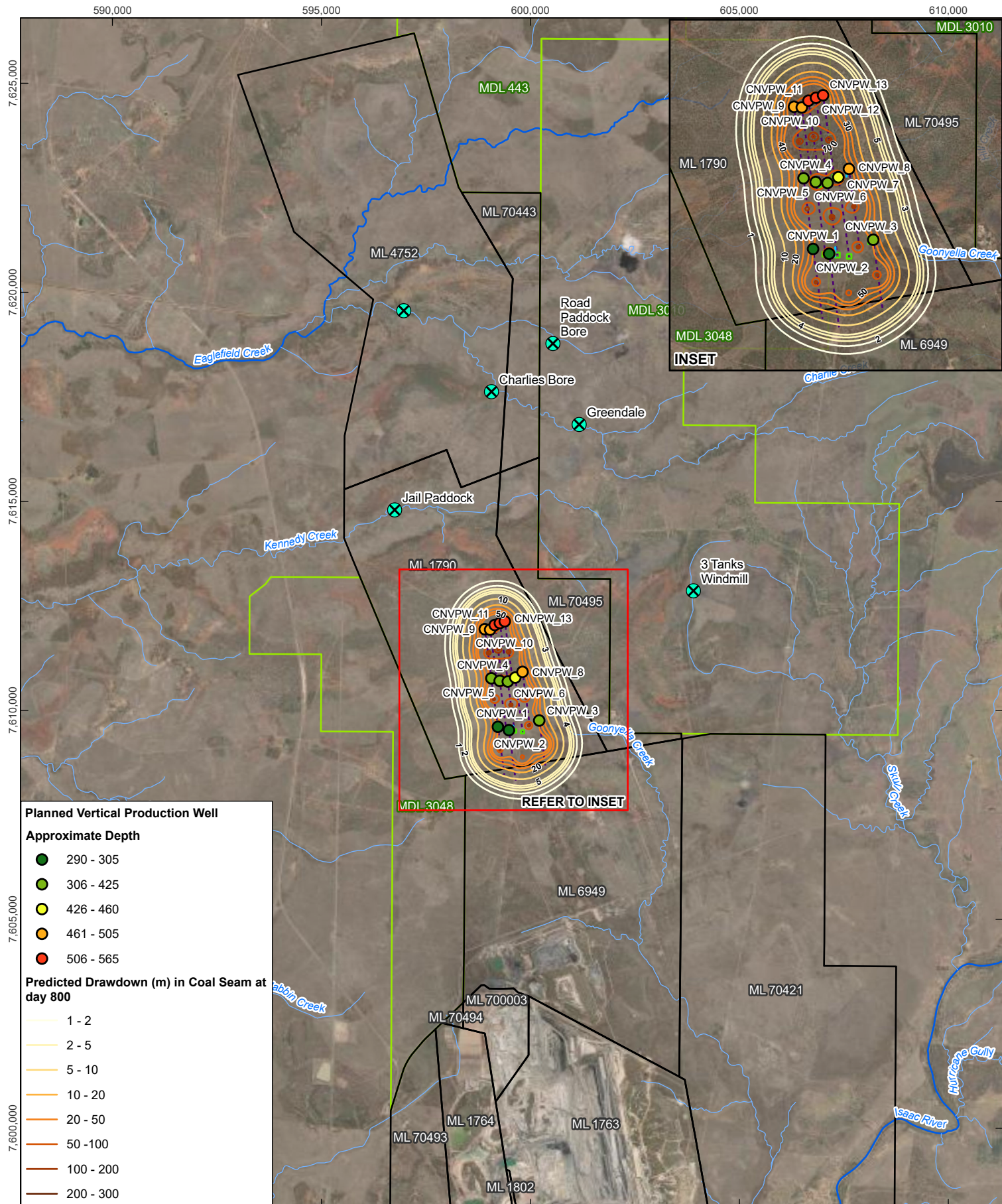


Image 6.10 Predicted drawdown in the shallow aquifer observation bores, basalt aquifer at the production well field, and nearby landholder bores





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:120,000 at A4

Project Number: 620.041540.00001

Date Drawn: 10-Sep-2024

Drawn by: RB



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FIGURE 6.24

Sensitivity Analysis

The key impact of groundwater extraction for the purposes of this assessment is the propagation of depressurisation in the target coal seam propagating into the overlying strata, specifically the basalt aquifer. Therefore, the sensitivity analysis focuses on interaction / connection between the basalt aquifer and the target coal seam. A range model inputs for the thickness and vertical hydraulic conductivity of the Permian overburden between the target coal seam and the basalt aquifer, and the thickness of the basalt aquifer, were tested. Parameter combinations and predicted drawdowns in the basalt aquifer are presented in Table 6.31. An observation point located at CNVPW_6, which is positioned at a central point in the Project Area, and observing the basalt aquifer was used to measure the predicted maximum drawdown after 1200 days of pumping. This location was selected as this is expected to be the point of maximum potential interaction, with the lowest coal seam pressures inducing leakage from the overlying layers.

Table 6.31 Sensitivity analysis of interburden vertical conductivity

	Vertical Hydraulic Conductivity of Overburden (m/day)	Basalt & Overburden Thickness (m)		
		200 / 50	150 / 100	50 / 250
Predicted Drawdown In Basalt at Production Bore Field (m)	Minimum: 1×10^{-6}	0.0009	0.0005	0.0003
	Median: 1×10^{-5}	0.008	0.004	0.002
	Maximum: 1×10^{-4}	0.026	0.023	0.017

Predicted drawdown in the overlying basalt aquifer is negligible for all scenarios. A high overburden vertical hydraulic conductivity (1×10^{-4} m/day) was selected to bring forward in the modelling process, reflecting a conservatively high value, on the upper estimates of potential vertical conductivity for the region. Basalt thickness of 50 m and overburden thickness of 250 m was selected as these represent values more in line with the geological information for the production well field, and these combine for a reasonably conservative representation of the aquifer layout based on sensitivity analysis.

6.7.4 Risk Assessment

A risk assessment has been used to summarise the potential impacts on groundwater receptors arising from the Project activities based on a consideration of likelihood and consequence of potential risks being realised. The following were considered as part of the risk assessment:

- Brief description of the potential issue in terms of source > pathway > receptor.
- Description of the potential impact.
- Potential likelihood of the risk being realised.
- Potential consequence of the impact.
- Risk rating derived from likelihood vs consequence.

Descriptions of the categories that were used to rank the likelihood and consequence of potential risks being realised are provided in **Table 6.32** and **Table 6.33** respectively.



Table 6.32 Likelihood Categories

Likelihood	Basis of Rating
Highly Likely	Expected to occur
Likely	More likely to occur than not to occur
Possible	As likely to occur as not to occur
Unlikely	More likely to not occur than to occur
Highly Unlikely	Very unlikely to occur even in the long term

Table 6.33 Consequence Categories

Rating	Environmental	Reputational / Legal & Compliance
5 Severe	Widespread environmental damage or effect (permanent; >10 years)	Formal expression of significant dissatisfaction by government Sustained campaign by one or more international NGOs resulting in physical impact on the assets or loss of ability to operate Major litigation / prosecution at Glencore corporate level
4 High	Long term impact (2 to 10 years)	Broad societal concern and criticism Negative media coverage at international level resulting in a Corporate statement within 24 hours Investigation from government and/ or international (or high-profile) NGOs Negative impact on share price Major litigation / prosecution at Department level
3 Moderate	Medium term impact (<2 years impact)	Negative media coverage at national level over more than one day Local Stakeholder action resulting in national societal scrutiny Major litigation / prosecution at Operation level
2 Low	Short term impact (<1 year)	Negative local/ regional media coverage Complaint received from an internal or external stakeholder Regulation breaches resulting in fine or litigation
1 Negligible	No lasting environmental damage or effect	Negligible media interest Regulation breaches without fine or litigation

The risk rating for each potential impact was determined by combining the likelihood and consequence of a risk being realised. The modelling predictions allow quantification of the likelihood of drawdown impacts occurring. The likelihood vs consequence risk assessment matrix is presented in **Table 6.34**.



Table 6.34 Risk Ranking Matrix

		Likelihood				
		Highly Unlikely	Unlikely	Possible	Likely	Highly Likely
Consequence	5	Moderate	Moderate	High	High	High
	4	Low	Moderate	Moderate	High	High
	3	Low	Low	Moderate	Moderate	High
	2	Insignificant	Low	Low	Moderate	Moderate
	1	Insignificant	Insignificant	Low	Low	Low

The risk assessment summary is presented in Table 6.35.

The risk of significant impacts to groundwater receptors from the proposed limited CSG development are considered to be low to negligible. Note that the conclusions discussed here are subject to the assumptions and exclusions outlined in **Section 6.7.5**.



Table 6.35 Risk assessment summary

Source	Pathway	Receptor	Potential Impact	Consequence	Likelihood	Risk
Depressurisation of the target coal seam at depth below the basalt aquifer for the purpose of CSG production	Upward propagation of drawdown from the depressurised coal seam through the overburden into the basalt aquifer	Landholder bores	Drawdown impacts at landholder bores – loss of yield	Moderate: loss of water source for landholder, reputational risk for operator.	Highly unlikely: modelling predicts no significant drawdown in the basalt at landholder bore locations.	Low
		Aquatic and terrestrial GDEs	Drawdown reaches potential terrestrial GDEs which are dependent on the saturated water table rather than shallow perched water tables. Decline in health or loss GDE	Ecological field surveys (Section 6.6) identified that terrestrial GDE are not present within the Study Area. Therefore, assessment of risk is not required.		N/A
		Watercourses	Drawdown impacts reach creek locations and reduce baseflow.	Negligible: The creeks are ephemeral and not supported by baseflow and so a reduction in basalt groundwater levels could not affect creek flows.	Highly unlikely: The local watercourses are ephemeral, flowing only in response to heavy rainfall and runoff events. There is no baseflow to the creeks and so a reduction in groundwater levels beneath isolated creek reaches can have no effect on creek flow. In addition, drawdown impacts in the basalt are considered negligible.	Negligible
Contaminant release through drilling or water storage activities	Hydraulic gradient away from disturbance activities, either in deep aquifer through	Landholder bores	Unable to use water for domestic or stock purposes	Moderate: loss of water source for landholder, reputational risk for operator.	Highly unlikely: No fracking to be conducted, therefore hydraulic gradient will be towards production well. Appropriate post-production rehabilitation and decommissioning to be taken to	Low



Source	Pathway	Receptor	Potential Impact	Consequence	Likelihood	Risk
	production bores, or shallow aquifers through surficial infiltration				mitigate long-term risk. Additionally, surface water controls are to mitigate contaminant release potential at surface.	
		Aquatic and terrestrial GDEs	Harm to water reliant ecosystems	Ecological field surveys (Section 6.6) identified that terrestrial GDE are not present within the Study Area. Therefore, assessment of risk is not required.		N/A
		Watercourses	Harm to water reliant ecosystems	Negligible: The creeks are ephemeral and not supported by baseflow and so a reduction in basalt groundwater levels could not affect creek flows	Highly unlikely: The local watercourses are ephemeral, flowing only in response to heavy rainfall and runoff events. There is no baseflow to the creeks and so a reduction in groundwater levels beneath isolated creek reaches can have no effect on creek flow. In addition, surface water controls are to mitigate contaminant release potential	Negligible



6.7.5 Limitations

The analytical modelling has adopted a conservative approach and included a sensitivity analysis to assess the outcome of high vertical conductivity in the overburden and reduced thickness of overburden in order to compensate for potential limitations.

As with an analytical model, this method is subject to simplifying assumptions (outlined in Carlson and Randall, 2012) including:

- All layers are of infinite horizontal extent.
- All aquifer layers are homogeneous and isotropic with respect to transmissivity and storativity.
- All aquitard layers are homogeneous with respect to vertical resistance and storativity.
- Darcy's law is valid, except for turbulent flow near well screen.



6.8 Surface Water

This section presents the assessment of Project related surface water impacts to environmental values.

6.8.1 Existing Environmental Values

The environmental values associated with surface water for this Project are downstream aquatic ecosystems, farm water supply, stock watering, drinking water supply, industrial use and cultural values.

Aquatic environmental values are not present in the Study Area or immediate surrounds and accordingly, there are unlikely to be any aquatic ecosystem environmental values associated the Study Area. Refer to Section 6.5 for further details on aquatic ecology.

6.8.1.1 Land Use

The predominant land use in the Study Area comprises relatively natural environments, including grazing, native vegetation (99%) and localised areas of residential homesteads and farm infrastructure.

6.8.1.2 Protected Areas

The nearest protected area is Homevale National Park which is located approximately 60 km to the east of the Project Area. This Park is not hydrologically connected to the Project Area.

6.8.1.3 Regional Drainage

The Project Area is located within the Burdekin Basin water management area with the Fitzroy Basin immediately adjacent to the southeast.

There are no mapped creek systems within the Project Area. The mapped head of Goonyella Creek, a stream order 1 watercourse, is approximately 1 km to the east of the Project Area and runs east before heading south before joining into Isaac River in the Fitzroy Basin water management area. Kennedy Creek, a stream order 2 watercourse, is approximately 2.3 km to the north of the Project Area and runs east and discharges towards the Suttor River, which is situated to the west of the Project Area in the Burdekin Basin water management area. The mapped head of Gum Tree Creek is approximately 2 km southwest of the Project Area and drains westward, again discharging towards the Suttor River, shown in **Figure 6.25**. The mapped head of Goonyella Creek, a stream order 1 watercourse, is approximately 1 km to the east of the Project Area and runs east before heading south before joining into Isaac River in the Fitzroy Basin water management area. Kennedy Creek, a stream order 2 watercourse, is approximately 2.3 km to the north of the Project Area and runs east and discharges towards the Suttor River, which is situated to the west of the Project Area in the Burdekin Basin water management area. The mapped head of Gum Tree Creek is approximately 2 km southwest of the Project Area and drains westward, again discharging towards the Suttor River, shown in **Figure 6.25**.

These creeks are ephemeral waterways, meaning that there is extreme variability in both water quality and volume as a natural part of the water system. A 'typical' year could see local waterways dry from March through to November, intermittently flowing or flooding following high intensity rainfall events between November - March, with this flow slowing and developing into pools of stagnant water that slowly dry out until the more typical dry conditions return.



Streamflow gauging stations are sparsely distributed in the region, and none are located near the Project Area. The nearest gauging station is on the Suttor River at Eaglefield (# 120304A) approximately 30 km to the northwest. Details of flow volumes at this gauging station are provided in **Table 6.36**. This data demonstrates the ephemeral nature of this river and by proxy, the nearby creek systems. The catchment area for this gauging station is approximately 1,915 km². In comparison the total drill pad area is approximately 0.12 km².

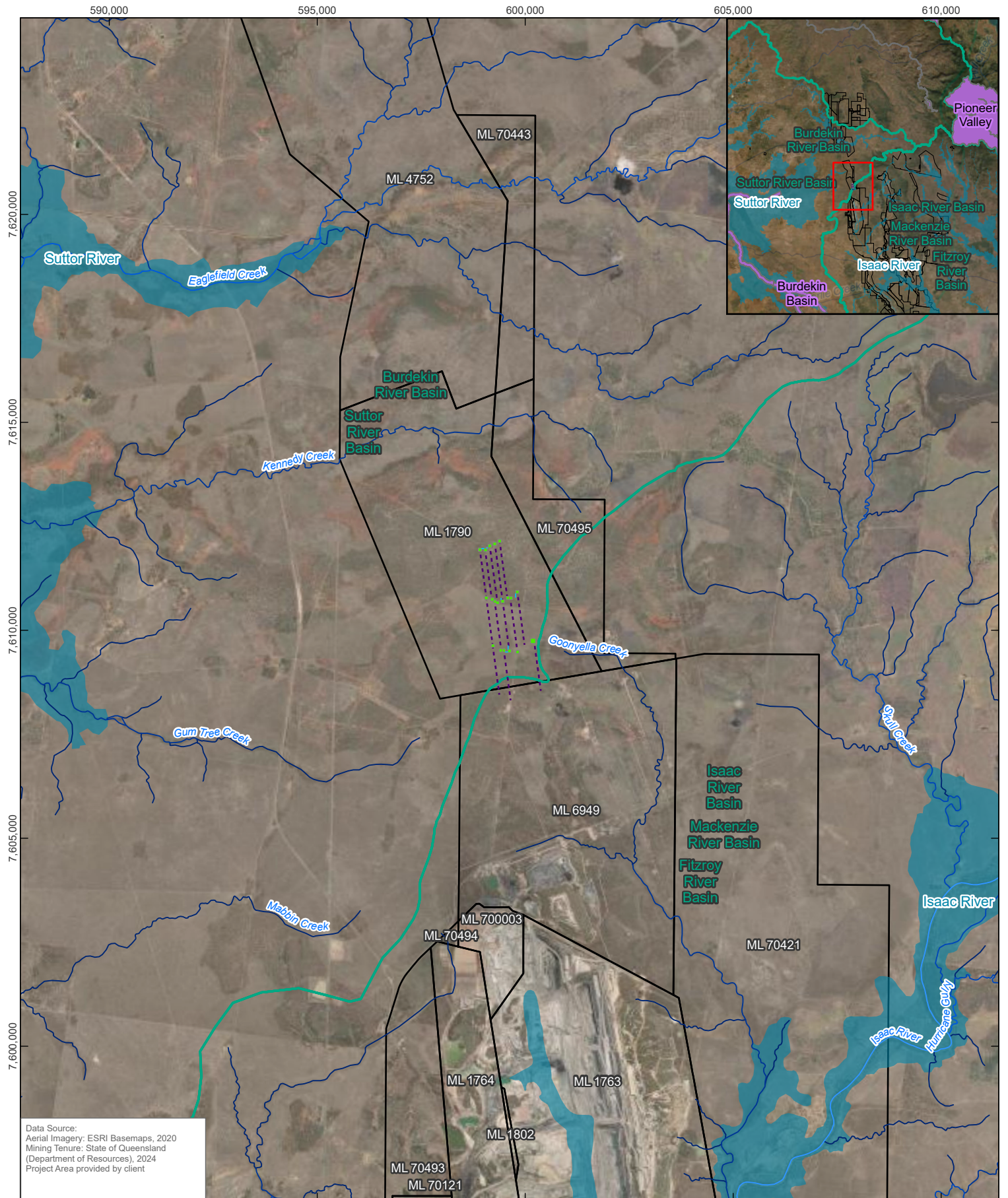
For ungauged catchments in the region, peak streamflow discharges can be estimated using empirical techniques, as recommended in Australian Rainfall and Runoff 2019.

Table 6.36 Suttor River at Eaglefield: flow volume summary (ML)

	Daily				Monthly
	Max	Min	Mean	Median	Mean
Jan	70,286	0	669	4	20,748
Feb	110,991	0	1,054	13	29,802
Mar	110,328	0	554	5	17,178
Apr	34,107	0	116	0	3,423
May	59,461	0	110	0	3,412
Jun	6,600	0	20	0	614
Jul	5,978	0	17	0	519
Aug	13,300	0	9	0	276
Sep	2,085	0	3	0	85
Oct	5,314	0	11	0	336
Nov	22,768	0	114	0	3,413
Dec	48,444	0	502	0	15,547
All months	110,991	0	263	0	7,974

<https://water-monitoring.information.qld.gov.au/>





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:120,000 at A4
Project Number:	620.040594.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

LEGEND

Stream Order

- 1
- 2
- 3
- 4
- 6

- - - Lateral Well Length
- Drill Pad
- Access Track
- Potential Flood Hazard Area
- River Basin
- Surface Water Management Area

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REGIONAL DRAINAGE



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FIGURE 6.25

6.8.2 Potential Impacts

Potential surface water impacts as a result of the activities described in Section 3 include:

- Clearing for access track and drill pads will affect runoff regimes locally.
- Surface water contamination from chemical spills, leaks from gas wells and improper management of wastewater.

A risk-based assessment of these potential impacts is detailed in Table 6.37 and determined that surface water impacts are low due to the scale and location of the proposed activities described in **Section 3.0**.

6.8.3 Management Practices

The potential impacts to the surface water resulting from Project activities outlined in **Section 3.0** will be managed through practices currently employed at CCM. The following management and mitigation measures will be implemented to minimise and/or prevent unauthorised harm to environmental values from the Project:

- Operation water management and control measures associated with potential pollutant and contaminant sources will be maintained to prevent uncontrolled discharge to surface waters. This includes:
 - Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with AS1940:2004, and where practical, will be located away from any waterbodies.
 - Provision of spill recovery equipment will be available and located with construction crews conducting activities with the potential for significant spills.
- Water extracted during operations will be contained in water tanks located on drill pads and will be trucked to CCM for treatment and integration into the mine water system.
- Erosion and sediment control monitoring should be implemented to reduce the amount of sediment laden run-off entering downstream waterways. The following general principles apply:
 - Minimise the surface disturbance areas.
 - Where possible, apply local temporary erosion control measures.
 - As soon as practical, disturbed areas will be rehabilitated to reduce the extent of exposed soils.

6.8.4 Risk Assessment

The potential surface water impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.37**.

The risk of surface water impacts is low. Any realised impacts will be low in comparison to the existing operations undertaken on ML1790.



Table 6.37 Surface water risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Sedimentation of surface waters result from erosion and surface water runoff from Project area	Possible	Minor	Low	Due to the minor scale and size of the Project activities, and the distance to the nearest creeks, this impact poses a low risk of environmental harm
Water and drilling muds contaminate surface waters	Unlikely	Low	Low	Due to the minor scale and size of the Project activities, and the distance to the nearest creeks this impact poses a low risk of environmental harm
Impact to EVs caused by contaminates	Unlikely	Low	Low	Due to the minor scale and size of the proposed activities, and the distance to the nearest creeks this impact poses a low risk of environmental harm



6.9 Waste

This section presents the assessment of Project related waste management impacts to environmental values.

6.9.1 Existing Environmental Values

EVs relevant to waste management refer to the qualities or physical characteristics of the environment that support ecological health, public amenity, safety, or are otherwise defined under a declared environmental protection policy or regulation. The identified waste management EVs for the Project include:

- Air (refer to **Section 1.1**)
- Land resources (refer to **Section 6.4**)
- Terrestrial and aquatic ecological values (refer to **Section 6.5** and **Section 6.6** respectively)
- Groundwater (refer to **Section 6.7**)
- Surface water (refer to **Section 1.1**).

6.9.2 Potential Impacts

The following subsections detail the potential waste impacts resulting from Project activities as described in **Section 3.0**. The sections below outline the Project activities that are relevant to waste generation management. **Table 6.38** outlines the waste types which are likely to be generated by Project activities.



Table 6.38 Waste types anticipated from Project activities

Type of waste	Type	Nature
General: Waste that is <u>not</u> classified as regulated waste, as set out in schedule 9 of the <i>Environmental Protection Regulation 2019</i> and must be managed according to local council regulations and can be disposed of in designated landfills or through other authorized waste management services.	Putrescible – administrative and maintenance buildings	Solid
	General waste (non-regulated) generated from Project-related activities	Solid
	Green waste (vegetation)	Solid
	Soil (uncontaminated from topsoil removal)	Solid
Recyclable: Waste that can demonstrate a higher level of use in the waste management hierarchy such as reuse, reprocessing or recycling	Paper and cardboard – administrative and maintenance buildings	Solid
	Drink containers (such as aluminium cans and plastic bottles)	Solid
	Scrap steel	Solid
Regulated: Waste listed in schedule 9 of the <i>Environmental Protection Regulation 2019</i> , requiring specific handling and disposal control defined by legislation to manage associated risks to the environment (may also be recyclable)	Hydrocarbon waste – waste oils, solvents and greases, water emulsions, oil filters, oily rags, oil interceptor sludges, and oil and grease drums	Liquid/ Solid
	Light and heavy vehicle tyres	Solid
	Batteries	Solid
	Other regulated waste (such as paint tins and aerosol cans)	Solid
	Sewage and sewage sludge	Liquid/solid
	Water from dewatering activities (produced/ formation water)	Liquid with fine particulates



Type of waste	Type	Nature
	Drill cuttings and drill fluid additives	Solid



6.9.2.1 Access Tracks

Site clearance activities for the establishment of new access tracks will comprise the removal of existing minor surface structures or material (such as boulders or fencing if present). Following removal, there will be vegetation clearing (tress, bushes, and grasses) and stripping and removal of topsoil.

Potential waste impacts associated with site clearance in the construction and rehabilitation and closure phase will include:

- Generation of organic waste which if not properly managed, may decompose on-site attracting pests or impact local ecology.
- Improper waste disposal of organic material, example by burning, can result in air pollution and increase in particulate matter emissions (refer to **Section 1.1**).
- Removal of vegetation will result in increased erosion and dust (refer to **Section 1.1** and **Section 6.4**).
- During the operation phase, minimal impacts are anticipated because clearance will occur for maintenance purposes. Potential generation of organic waste which is not properly managed may decompose on-site attracting pests or impacts local ecology.

6.9.2.2 Vertical and Lateral Well Operation

The construction and operation of the vertical and lateral wells comprise vegetation clearance, stripping and removal of topsoil (for the drill pads and wells), installation of casing, pipelines, and wellheads, which can generate waste. In addition to this, the drilling activities involve creating both vertical and lateral wells, which generate various forms of waste which may impact soil and water quality.

Potential waste impacts associated with Project activities in the **construction phase** includes:

- Generation of organic waste, if not properly managed, may decompose on-site, attracting pests and negatively impacting local ecology. Additionally, improper disposal methods, such as burning, can contribute to air pollution through the release of particulate matter and other harmful emissions (refer to Section 1.1 and Section 6.4).
- Potential for contamination of identified EVs due to improper disposal or management of generated waste, such as:
 - Sedimentation in surface waters from improper handling and management of topsoil.
 - Overflow or improper disposal of sewage from portable toilets.
 - Contamination from improper disposal drilling mud and rock cuttings or spills from cement, lubricants, and other chemicals used during well construction.
- Potential for contamination of identified EVs due to accidental spillages or improper management of equipment, such as:
 - Accidental spillages or leakages due to improper storage of chemicals or transfer of waste products.
 - Hydrocarbon leakages from unmaintained equipment.



- Increased generation of gaseous waste from vehicular movement and operation (refer to **Section 1.1**).

Potential waste impacts associated with CSG extraction activities in the **operation phase** includes:

- Potential for contamination of identified EVs due to improper disposal or management of generated waste, such as:
 - Putrescible & organic (food waste) leading to the introduction of nuisance pests and vermin.
 - Accidental overflow of sewage from administration buildings.
 - Accidental spillages or leakages due to improper storage of chemicals used for maintenance of equipment.
 - Hydrocarbon spillages or accidental leaks from equipment.

Potential contamination of water resources due to improper management of wastewater, including the risk of overflow of produced water from dewatering activities and spillage during the transfer of produced water by truck to CCM facilities.

Potential contamination of identified EVs due to improper disposal of produced water, such as uncontrolled releases.

Potential waste impacts associated with CSG extraction activities in the rehabilitation and closure phase includes:

- Dismantling of infrastructure (where required) will generate large amounts of solid wastes.
- Potential contamination of soil and water resources due to improper disposal or handling of materials, including:
 - Improper sealing of wells.
 - Residual contamination from inadequate cleaning of wells or pipelines.
 - Improper disposal of wastewater from dewatering activities.
 - Improper disposal of hazardous materials, such as fuel, oil, and cleaning chemicals used in equipment maintenance.

6.9.2.3 Power and Water

On-site diesel generators will be used for power generation. Water will be supplied via truck to drill pad locations, and water collection from the dewatering activities (from the wells) will be contained in holding tanks. Impacts related to produced water storage is provided as part of the Project activities (**Section 3.0**), other impacts are outlined below.

- The use of the diesel generator during the Project will result in waste in the form of particulate emissions affecting air quality (see **Section 1.1**).
- Operation of the generators may increase the risk of accidental spillages, or leaks of hydrocarbons (diesel), potentially contaminating identified EVs.
- There is a risk of contamination to land or surface water resources due to accidental spillages of hydrocarbon (fuels and oils) from water transportation by trucks.



6.9.2.4 Amenities

On-site amenities for workers will be located on the drill pads and will include a mobile office and workshop. Waste generation from the mobile office will include domestic solid waste, and sewage and greywater. The workshop is likely to generate hazardous waste (such as hydrocarbon materials from fuel, oils). Potential impacts associated with amenities include the following:

- Potential contamination of land and water due and increased risk of occurrence of pests and diseases due to improper handling, treatment or disposal of sewage and greywater.
- Potential contamination of identified EVs because of improper management of litter, causing windblown litter which may affect surface water quality or cause an increase pests which affect the local ecology.
- Potential contamination of surface water and land resources, and increased risk of pests due to improper storage and disposal of organic waste.
- Potential contamination due to accidental spillages, leakage of hazardous materials such as hydrocarbons fuels, oils, chemicals, detergents from the workshop operation.

A risk-based assessment of these potential impacts is detailed in **Table 6.39** and determined that waste impacts are low due to the scale and location of the Project activities.

6.9.3 Management Practices

The following principles, in preferential order, may be applied to management of waste for the Project:

- *Waste avoidance and minimisation* – includes practices that prevent or reduce the generation of waste. This can be achieved either by using products/processes that do not generate waste or products/processes, thus reducing the total volume of waste generated.
- *Waste reuse* – includes practices to re-use wastes without first substantially changing its form. Examples include recovering solvents, metals, oil and re-using them for a secondary purpose or substituting a waste for a virgin material in a production process.
- *Waste recycling* – includes treatment practices for waste that is no longer useable in its present form and using it to produce new products. This can be achieved by using products that can be recycled and then collected for storage and removal by a recycling company.
- *Waste disposal* – all waste generated as part of the Project activities must be disposed of ensuring compliance with Queensland's environmental legislation, particularly the *Environmental Protection Act 1994* and *Environmental Protection Regulation 2019* and should employ best practice approaches.

The potential impacts will be managed through current practices. These methods are used to mitigate impacts to waste, and include:

- Ensure personnel are trained and competent in waste identification, segregation, storage, and disposal activities.
- Segregate and classify all construction and operational waste for appropriate disposal according to Queensland's regulated waste guidelines.



- Implement containment measures and rapid response protocols to manage spills, preventing soil and water contamination.
- Use low-emission diesel generators and manage fuel waste, such as spent oils and filters, to minimize air and soil contamination.
- Minimize vegetation clearing to reduce green waste, overburden, and emissions from equipment use and decomposition.
- Maintain a procurement policy which encourages goods and services that reduce waste generation, substituting for more sustainable alternatives where feasible.
- Conduct routine preventative maintenance and inspections of plant equipment, wastewater containment structures, waste disposal locations, and workplaces.
- Store liquid waste (excluding CSG water and sewage) and periodically remove for disposal or recycling.
- Contained waste drilling fluids from drilling activities in properly lined storage tanks before re-use, recycling, treatment, or disposal.
- Store putrescible solid waste in covered containers to prevent odours, public health hazards, and access by fauna.

6.9.4 Risk Assessment

The potential waste impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.39**.

The risk of waste impacts is low. Any realised impacts will be low in comparison to the existing operations undertaken at CCM.

Table 6.39 Waste risk assessment

Impact	Likelihood	Consequence	Risk Rating	Justification
Contamination of surface water or land resources	Unlikely	Low	Low	Due to the small scale of the project activities and the distance away for surface water resources, this impact poses a low risk of environmental harm. Proper storage and management of regulated wastes such as hydrocarbons and chemicals will minimise the risk of contamination and result in a low risk of environmental harm.
Generation of wastes from infrastructure and maintenance	Unlikely	Low	Low	Due to the small scale and size of Project activities, in the context of proper waste management and disposal, this impact poses a low risk of environmental harm.
Generation of litter and windblown waste	Unlikely	Low	Low	Given the small scale of the Project activities and the fact that there will be a minimal staff complement the generation of litter and windblown



Impact	Likelihood	Consequence	Risk Rating	Justification
				waste poses a low risk of environmental harm.
Increased prevalence of pests and vermin due to improper management of organic waste	Rare	Low	Low	Proper handling and disposal of waste material, and routine removal of organic waste will mitigate against the occurrence of pests and vermin. Additionally, waste generated by the small staff complement will be on a smaller scale, posing low environmental risk.



7.0 Conclusion

To obtain authorisation for the proposed Project activities, an amendment to:

- EA P-EA-100658735:
 - Condition 15 Schedule A
 - Condition 7 Schedule F
 - Condition 9 Schedule F
 - Condition 22 Schedule F
- PRCP P-PRCP-100669070_V1:
 - Section B - Figure 1, and
 - Section C – (RA1) Rehabilitation area 1

Assessment of air quality, GHG, noise and vibration, terrestrial ecology, aquatic ecology, groundwater, surface water, and waste management impacts resulting from Project activities are presented in the supporting report.

Risk assessments have determined that the changes proposed pose a low risk of causing environmental harm/ nuisance beyond that authorised by the EA. This is attributed to the scale and location of the Project activities, and that these activities can be managed under the monitoring and compliance requirements of the existing EA and CCM management practices that will be applied to Project to minimise and/or prevent unauthorised harm to EVs from the Project.

Based on the outcomes of the assessments undertaken, Centurion Coal Mining Pty Ltd consider that the approvals pathway is commensurate to a minor EA Amendment process.



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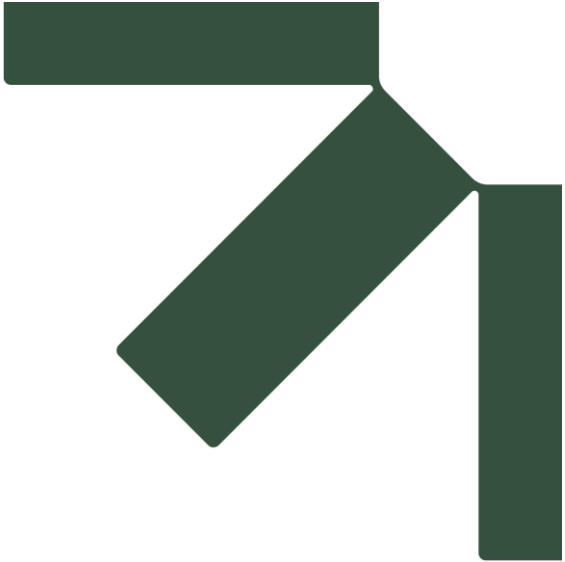
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Appendix A Terrestrial Ecology and Aquatic Ecology Methodology to Identify Environmental Impacts

**Environmental Authority Amendment Application
Supporting Report**

P-EA-100658735 and P-PRCP-100669070_V1

SLR Project No.: 620.040594

13 September 2024

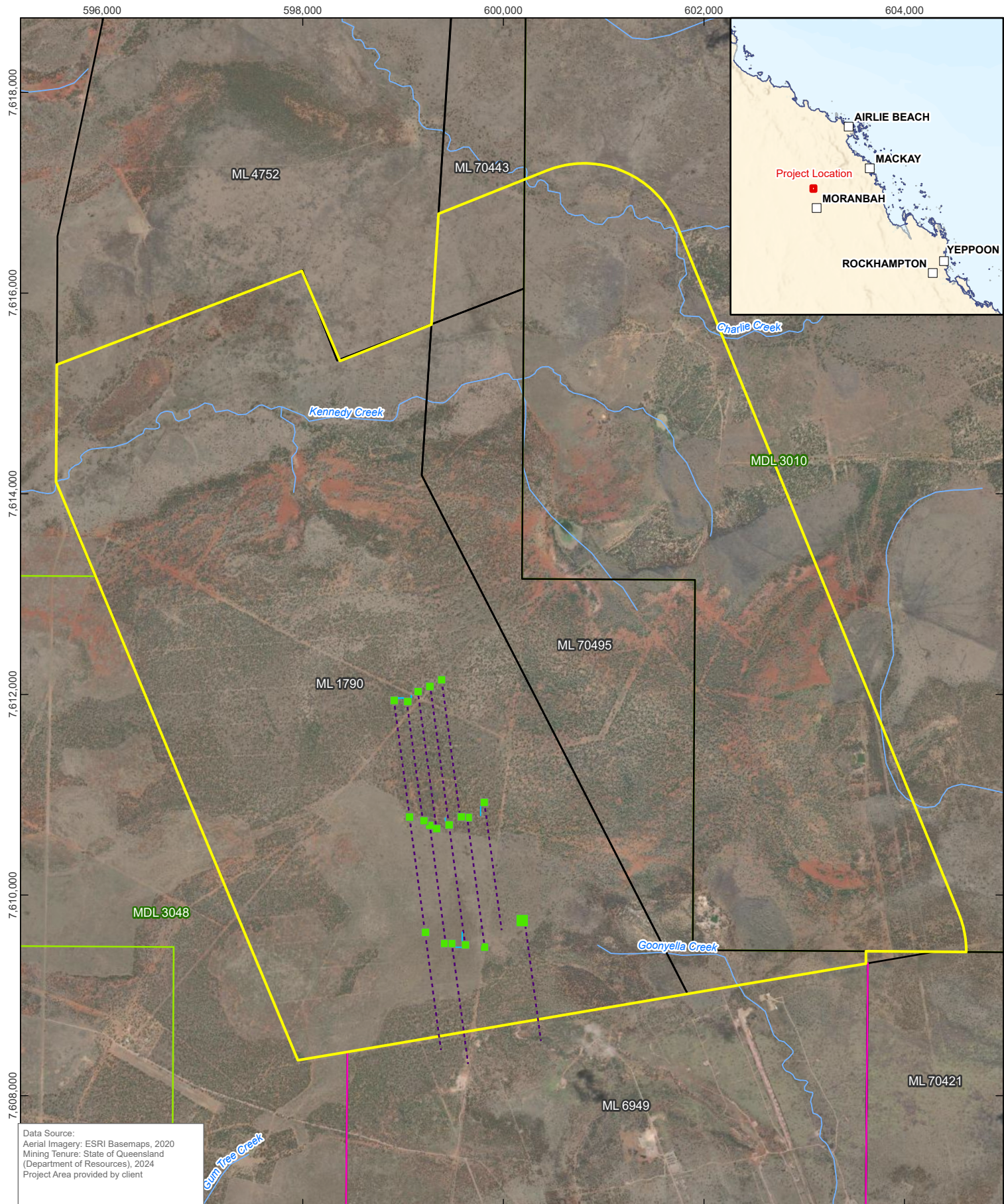
Terrestrial Ecology Methodology to Identify Environmental Impacts

Terrestrial ecological assessments were undertaken by E2M Consulting Pty Ltd (E2M) within a broader Study Area encompassing the Project Area and surrounds located within MLs 1790, 70495 and 70443 and MDL 3010 (**Table A.1**). Within the Study Area, E2M have undertaken two field surveys; comprising a:

- 'Wet season' survey undertaken in mid-February 2024, and
- 'Dry season' survey undertaken in July 2024.

These surveys aligned with the optimal timing and were undertaken during suitable survey conditions for the identification of target Matters of National Environmental Significance (MNES) and Matters of State Environmental Significance (MSES) within the Study Area.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 09-Sep-2024
 Drawn by: RB

- LEGEND**
- Watercourse
 - Study Area
 - Mining Lease
 - Centurion Coal Mine
 - Mineral Development Licence
 - Lateral Well Length
 - Drill Pad
 - Access Track

EA AMENDMENT P-EA-100658735

ECOLOGY STUDY AREA



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APPENDIX A.1

Flora Survey

Vegetation and flora surveys were undertaken to categorise vegetation groups and understand floristic diversity within the Study Area. Threatened ecological community (TEC) and threatened flora surveys were also undertaken to determine the presence of any Commonwealth and/or State listed entities within the Study Area.

Regional Ecosystems

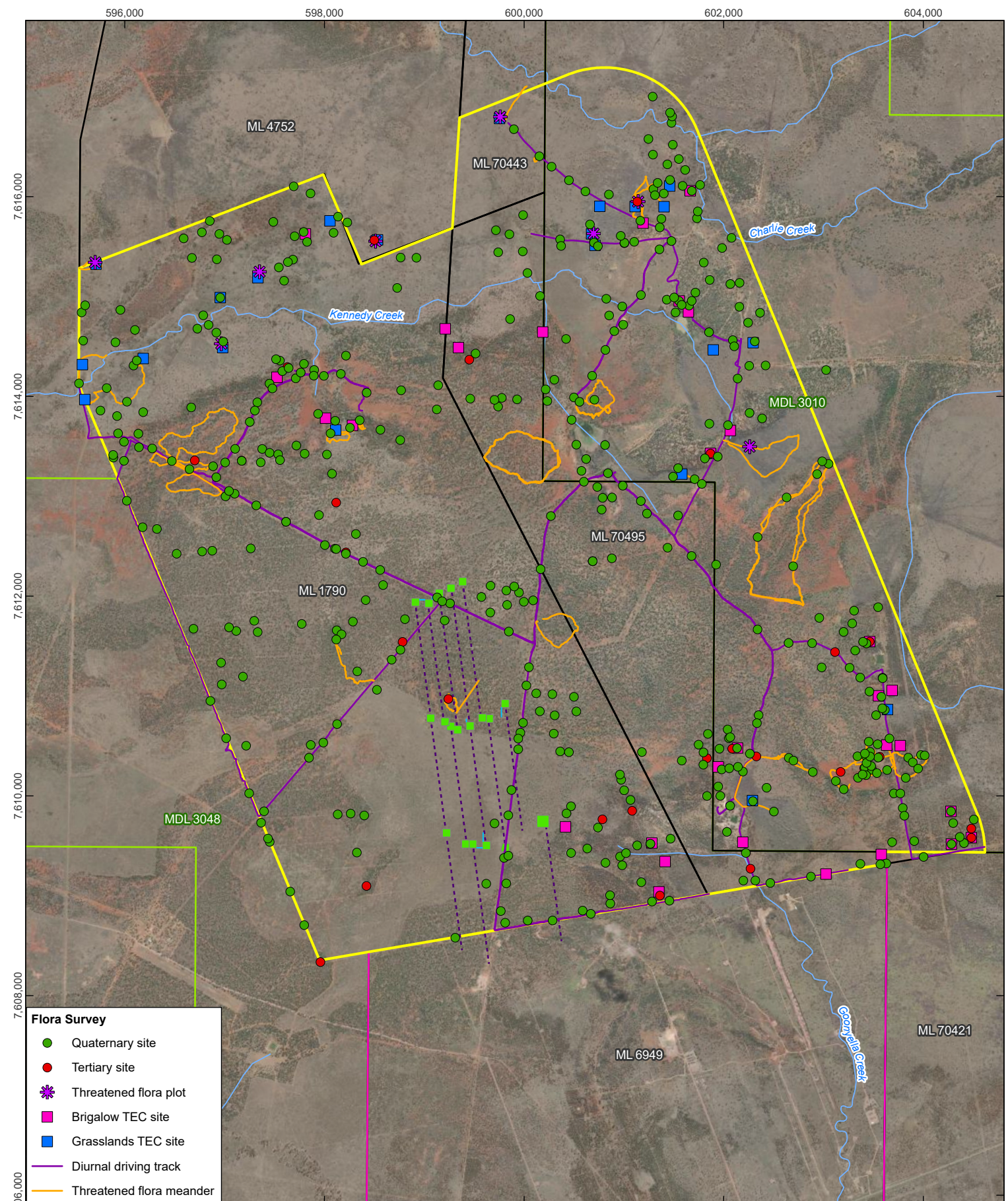
Ground-truthing and verification of vegetation community mapping within the Study Area was conducted in accordance with the methodology for surveying and mapping of regional ecosystems and vegetation communities in Queensland (Neldner et al., 2022). Tertiary and quaternary vegetation assessments were undertaken across the Study Area over the wet and dry season surveys as depicted in **Figure A.2** Tertiary assessments comprise comprehensive survey of flora species (by strata), relative abundance and overall vegetation structure, such as height and cover. Tertiary assessments are typically undertaken during wet season conditions with the emergence of annual herbs and grasses, which more accurately reflects species richness and composition. Quaternary surveys are a rapid assessment used to verify regional ecosystem (RE) based on the structure, composition and condition of the ecologically dominant layer.

Vegetation was categorised into three classes based on RE description, vegetation structure and condition. These categories comprised:

- Remnant vegetation - communities that conform with the definition under the Queensland Vegetation Management Act 1999 (VM Act) and referenced by Neldner et al. (2022). Specifically, this comprises 'vegetation, part of which forms the predominant canopy of the vegetation:
 - Covering more than 50% of the undisturbed predominant canopy
 - Averaging more than 70% of the vegetation's undisturbed height, and
 - Composed of species characteristic of the vegetation's undisturbed predominant canopy.'
- Mature regrowth – vegetation communities that have previously been cleared but meet the broad floristics and structural characteristics consistent with a particular RE. Specifically, this comprises native vegetation regrowth that is greater than 15 years old and meets either the minimum cover or the minimum height requirements to be considered remnant vegetation.
- Non-remnant vegetation – all vegetation that is not mapped as remnant vegetation. This included:
 - Young woody regrowth: vegetation that contained species composition consistent with a particular RE, but failed to meet the undisturbed height and canopy cover consistent with that of remnant vegetation, and
 - Other vegetation: communities that have been historically cleared/disturbed or heavily modified (i.e. improved pastures, weed encroachment etc).

Where benchmark strata height and cover data was unavailable for a particular RE, information provided in the Regional Ecosystem Technical Descriptions for the Brigalow Belt (DES, 2018b) and vegetation formations defined by (Specht, 1970) were used to determine remnant height thresholds.





Flora Survey

- Quaternary site
- Tertiary site
- ✱ Threatened flora plot
- Brigalow TEC site
- Grasslands TEC site
- Diurnal driving track
- Threatened flora meander

 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 09-Sep-2024
 Drawn by: RB

LEGEND

- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

EA AMENDMENT P-EA-100658735

FLORA SURVEY SITES



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APPENDIX A.2

Threatened Ecological Communities

In conjunction with tertiary and quaternary assessments, TEC assessments were undertaken to verify the presence and condition of EPBC Act listed TECs. The locations of TEC survey sites are depicted in **Table A.2**.

Specific condition criteria and characteristics used for the assessment are based on respective information provided within the listing advice published for each TEC. The following sections provide further details on the key diagnostic characteristics and condition thresholds assessed for each TEC assessed.

Brigalow (*Acacia harpophylla* dominant and co-dominant)

To determine whether a community meets the condition requirements of the Brigalow TEC (DotE, 2013), brigalow communities were assessed on whether they met the minimum thresholds pertaining to patch size and weed encroachment. Each community was also assessed on whether brigalow (*Acacia harpophylla*) was the dominant or co-dominant species within the tree layer. Using the recommendations of Butler (2007), vegetation communities of poor condition were excluded from the Brigalow TEC if they included any of the following characteristics:

- Where regrowth was less than 15 years old
- Had a patch size smaller than 0.5 ha, or
- The cover of exotic perennial plants was greater than 50%, assessed in a minimum area of 0.5 ha (100 m by 50 m).

E2M calculated the cover of exotic perennial plants for each structural layer. Exotic covers were then weighted by the percentage cover contribution of each structural layer to the RE, in accordance with published benchmarks (Queensland Herbarium, 2023), and summed.

Within Queensland, 16 REs are associated with the Brigalow TEC (DotE, 2013). Relevant Brigalow REs within the Study Area were assessed against the threshold criteria outlined in the approved conservation advice (DotE, 2013) to determine their status as the Brigalow TEC (see **Figure A.2**).

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions

The semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions TEC (SEVT TEC) is an extreme form of dry seasonal subtropical rainforest occurring on soils of high to medium fertility that is characterised by the presence of trees with microphyll size leaves, *Brachychiton* spp. in the emergent layer and thickets (TSSC, 2001).

Within the Brigalow Belt bioregion, this TEC comprises the following REs: 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8 and 11.11.18 (TSSC, 2001).

An additional RE relevant to this assessment, RE 11.7.1x1 is also considered analogous to the SEVT TEC after its addition into the Regional Ecosystem Description Database in 2002, following the listing of this TEC (DCCEEW, 2024).

Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin

The Commonwealth listing advice for the natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin (TSSC, 2009) characterises the community as containing a:

- Usually sparse or absent tree canopy (less than 10% projective crown cover)



- Shrub layer of less than 50% projected crown cover, and
- Dominance of perennial native grasses and the presence of at least three indicator native grass species outlined by the TSSC (2009b).

Within the Brigalow Belt bioregion, the Queensland Herbarium (2019) has defined the following REs as being associated with this TEC: 11.3.21, 11.4.4, 11.4.11, 11.8.11, 11.9.3, 11.9.12 and 11.11.17. Each community was assessed for whether they belong to at least one of these REs to determine whether it fits the classification of the TEC (TSSC, 2009).

Relevant REs must be a patch that is considered 'good quality' or 'best quality' to be classified as this TEC. The thresholds for defining these conditions are outlined in **Table A.1**.

Table A.1 Condition classes for the natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin TEC

Criteria	Best quality	Good quality
Patch size	At least 1 ha	At least 5 ha
Grasses	At least 4 native perennial grass species from the list of perennial native grass indicator species	At least 3 native perennial grass species from the list of perennial native grass indicator species
Tussock cover	At least 200 native grass tussocks	At least 200 native grass tussocks;
Woody shrub ¹ cover	Total projected canopy cover of shrubs is less than 30%	Total projected canopy cover of shrubs is less than 50%
Introduced species	Perennial non-woody introduced species are less than 5% of the total projected perennial plant cover	Perennial non-woody introduced species are less than 30% of the total projected perennial plant cover
¹ The shrub layer is typically absent. However, where shrubs are present, they are defined as woody plants, more than 0.5 m tall that occupy the mid vegetation layer. The upper, or tree canopy layer, also is typically absent but may comprise scattered trees to less than 10% projective crown cover.		
Sampling would be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, sites must be assessed during a good season, two months after cessation of disturbance (fire/grazing/mowing/slashing) and within two months of effective rain.		

Threatened Flora Meanders

The random meander technique (Cropper, 1993) was undertaken to survey for potential threatened flora throughout the Study Area. The technique involves traversing each habitat type that is suitable for the target species within the Study Area in a manner that maximises the coverage of habitat and potential to encounter threatened flora species. This method also allows for exploration of microhabitat features and the discovery of clumps of individuals encountered during survey. The tracks from these meander sites are depicted in **Figure A.2**.

A variation of this method has been adopted as the preferred method under the Queensland Nature Conservation Act 1992 Flora Survey Guidelines -Protected Plants (DES 2020) and Draft Survey Guidelines for Australia's Threatened Orchids (DoTE 2013). No specific Commonwealth survey guideline is currently available for other threatened flora species.

Threatened Flora Plot Surveys

Plot surveys were undertaken in accordance with the Queensland Government Flora Survey Guidelines (DES, 2020) to estimate population sizes of threatened or near threatened flora



species known to occur in the Study Area. The locations of these plots are depicted in **Figure A.2**.

Plot survey sites comprised a 50 m x 4 m plot and were undertaken when target species were first recorded in a patch. A patch being a contiguous area of habitat and homogenous vegetation. Within each plot, the number of target threatened flora species were recorded. This method was undertaken in the late wet season survey to identify population estimates across the Study Area. In the case of one of the target species, *Digitaria porrecta*, as the grass tussock ages the central portion dies and the resultant ring of plantlets eventually separate and become independent tussocks (TSSC, 2013). Since target species that were detected were not rhizomatous, separate grass tussocks were counted as individuals within the plot.

Population size (tussocks per ha) was estimated by finding the average count per plot within the habitat area and then multiplying to convert to a density per hectare. This density is based on areas of suitable habitat where the species is present.

Opportunistic Observations

Flora species, including threatened species, observed that were not recorded via other survey methods, were also collected as opportunistic observations. This included those species observed while driving or walking between survey sites.

Fauna Survey

A suite of fauna survey methods were undertaken to detect the presence of target MNES and MSES species within the Study Area, in accordance with relevant Commonwealth and State Government survey guidelines.

Habitat Assessment

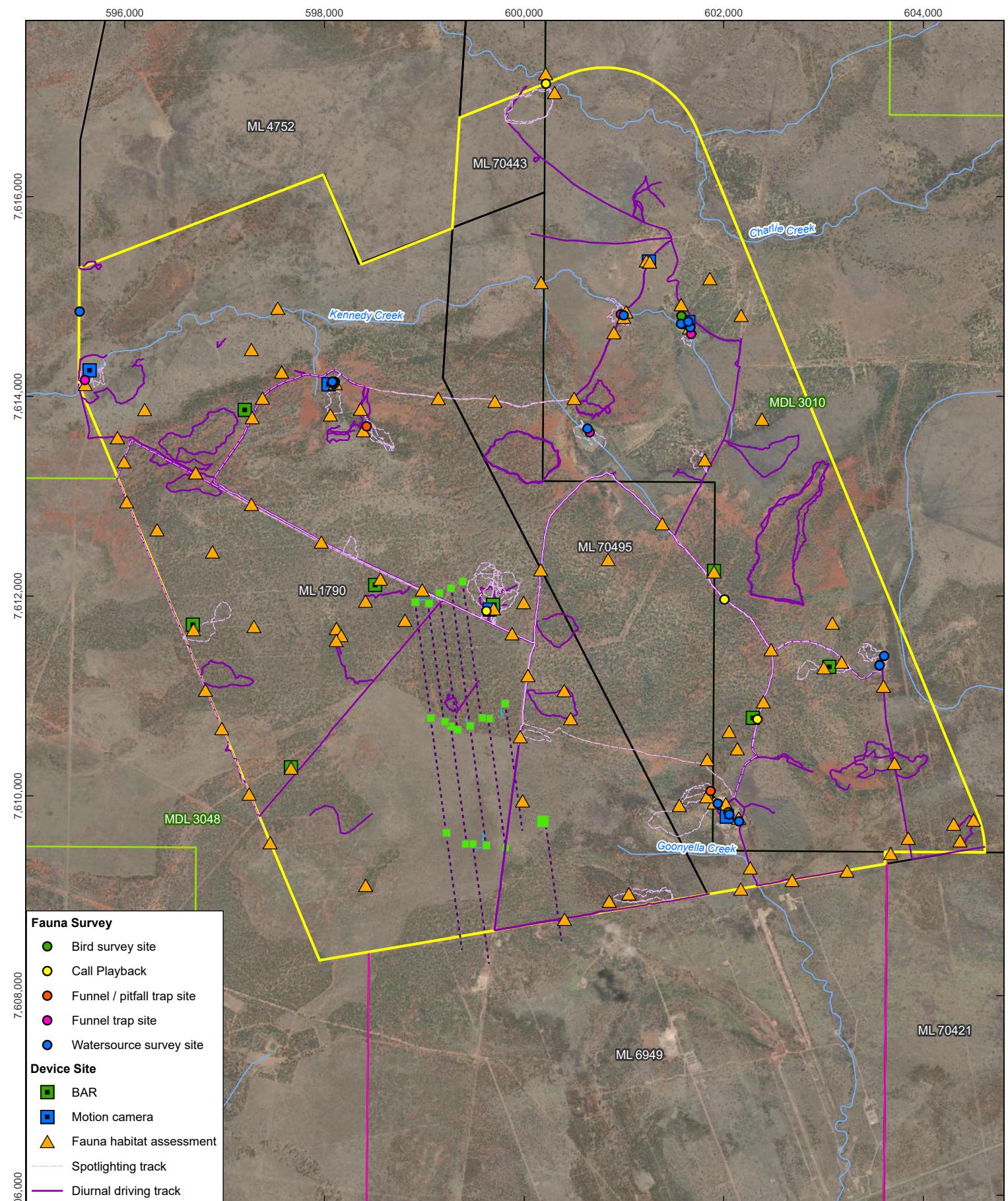
Habitat assessments were undertaken throughout the Study Area to identify the presence of habitat features that may support fauna. Assessments were completed at 90 sites during the wet season and focused on the identification of key microhabitat features for general fauna as well as threatened species (refer to **Figure A.3**). Fauna habitat assessments were conducted within representative habitat throughout the Study Area to document:

- The presence and condition of watercourses, wetlands, or artificial waterbodies (e.g., dams), including relative permanency of water
- Abundance of feed trees and Locally Important Koala Tree species (LIKTs) and ancillary shelter species as identified by (Youngentob et al., 2021)
- Presence and abundance of native grasses and forbs
- Abundance of hollow bearing trees and logs
- Abundance of coarse, woody debris and leaf litter
- Soil crack abundance and depth, and
- Evidence of existing threats, including:
 - Presence and abundance of feral species (i.e. wild dogs, feral cats, European foxes etc.)
 - Woody weed encroachment, and
 - Presence and abundance of barbed wire fencing, etc.



The outcomes of these habitat assessments were used to direct additional fauna survey effort in the dry season.





Fauna Survey

- Bird survey site
- Call Playback
- Funnel / pitfall trap site
- Funnel trap site
- Wtersource survey site

Device Site

- BAR
- Motion camera
- ▲ Fauna habitat assessment
- Spotlighting track
- Diurnal driving track

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:50,000 at A4
Project Number: 620.040594.00001
Date Drawn: 09-Sep-2024
Drawn by: RB

LEGEND

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

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FAUNA SURVEY SITES



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APPENDIX A.3

Pitfall and funnel trapping

Pitfall and funnel trapping was undertaken during the wet season to target threatened reptile species, particularly ornamental snake (*Denisonia maculata*), in accordance with the Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles (DSEWPC, 2011a). Each trap site utilised the 'T configuration', comprising a 30 m and 15 m drift fence with pitfall buckets and funnel traps arranged at set distance along the drift fences, as described by (Eyre et al., 2022). Two sites contained both funnel and pitfall traps, while four sites only contained funnel traps. A total of six trap sites were installed within suitable habitat each deployed over a four-night period at the locations depicted in **Figure A.3**.

Nocturnal Spotlighting

Nocturnal spotlighting surveys were undertaken to target fauna that are most active and detectable at night and are a prescribed survey method for applicable species under the following guidelines:

- Survey guidelines for Australia's threatened reptiles (DSEWPC, 2011b)
- Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022)
- Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles (DSEWPC, 2011a), and
- Species specific guidelines published by the Commonwealth DCCEEW (2024).

A team of two ecologists walked parallel, meandering transects using a handheld torch and/or a head torch to detect eye shine and investigate microhabitats (e.g. peeling bark or lifting coarse woody debris). Nocturnal spotlighting commenced approximately 30 minutes after sunset for a duration of approximately four to five hours per night for a combined nine nights over the wet and dry season surveys. This method was used to target greater glider (*Petauroides volans*), koala (*Phascolarctos cinereus*) and ornamental snake (*Denisonia maculata*). Spotlighting tracks are depicted in **Figure A.3**.

During the dry season, slow drive vehicle transects were the primary survey technique employed, allowing for more extensive areas to be surveyed efficiently. The slow-drive transects involved scanning suitable vegetation with handheld spotlights (50-100W). This method was used to target greater glider (*Petauroides volans*) and koala (*Phascolarctos cinereus*) in areas of eucalypt woodlands.

Call Playback

Call playback was undertaken at four locations within the Study Area in association with spotlighting surveys, as shown in **Figure A.3**. Calls of koala were broadcast on a loudspeaker for a period of two minutes, followed by 15 minutes of silence, during which observers listened for call backs. Calls of koala were then broadcast a second time (for a period of two minutes) followed by another 15-minute listening period.

Diurnal Bird Surveys

Standardised bird surveys were undertaken in the early morning and late afternoon across multiple sites within the Study Area (**Figure A.3**). Bird surveys occurred in accordance with the area search method prescribed in the Survey guidelines for Australia's threatened birds (DEWHA, 2010). Surveys were completed within 100 x 200 m survey sites (2 ha) located in suitable habitat and any threatened bird species observed and/or heard during the survey period were recorded.



Bird surveys were undertaken at eight water sources targeting threatened and migratory species, such as Latham's snipe (*Gallinago hardwickii*), Australian painted snipe (*Rostratula australis*), glossy ibis (*Plegadis falcinellus*) and squatter pigeon (southern) (*Geophaps scripta scripta*). These visual and flushing surveys were undertaken at dawn, dusk and other times of day, as depicted in **Figure A.3**.

Diurnal Searches

Diurnal active searches were undertaken concurrently with diurnal bird surveys and opportunistically with other fauna habitat assessments, following methods prescribed in the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022). Active searches involved searching suitable microhabitat (e.g. fallen woody debris, leaf litter, decorticated bark) for the species or evidence of the species presence (e.g. scats, scratches, burrows). These surveys were targeted to ornamental snake, koala and squatter pigeon (southern).

Diurnal slow-drive vehicle transects were also undertaken when moving between survey sites targeting squatter pigeon (southern).

Motion Cameras

Baited camera traps were deployed at six locations within the Study Area (**Figure A.3**) over seven consecutive nights during the dry season survey. This assisted in the detection of targeted threatened fauna and pest fauna species that may pose a threat to native species (i.e. wild dogs, feral cats and feral pigs).

Bioacoustic Recorders

Four bioacoustics records (BARs) were deployed (and moved) over seven consecutive nights during the wet season survey. BARs were installed at eight locations of suitable habitat within the Study Area (**Figure A.3**) to record calls projected by koalas.

Opportunistic Surveys

Fauna species for which evidence of presence was not detected via other survey methods, were recorded as opportunistic observations. Non-target fauna observed during fauna surveys and driving between survey sites were also recorded.

Species Habitat Mapping

The results of desktop and field surveys were used to generate habitat mapping for threatened flora and fauna species assessed as known or likely within the Study Area. Specifically, species habitat was mapped using the following categories:

- Preferred habitat: is most important to the species and provides breeding, roosting and/or foraging habitat that is required for the species to persist in the area.
- Suitable habitat: is habitat that provides breeding, roosting and/or reliable foraging habitat but is not essential for the species to persist in the area. It may occasionally provide resources or be in low density of resources and only be used intermittently.
- Marginal habitat: is habitat that provides limited resources for the species and may only be occupied infrequently, during transit between suitable habitat, or when desired habitat is scarce. The species is unlikely to be undertaking key activities such as breeding, roosting or extensive foraging.



Not all categories are relevant for each species due to their ecological role and regional context. What constitutes these categories for each species is discussed in **Sections 6.5.1.3, 6.5.1.5 and 6.5.1.6**.

Likelihood of Occurrence Assessment

A likelihood of occurrence assessment evaluates the qualitative probability that a flora or fauna species, can physically occupy the Study Area during all or part (e.g. breeding season, migration) of its life cycle. The assessment evaluates:

- Species-specific ecological and physiological requirements.
- Recorded species observations including during field surveys and existing records.
- The resources and constraints present in the Study Area informed by the desktop assessment.
- The resources and constraints present in the Study Area informed by the field surveys.

Following the field surveys, the likelihood of occurrence assessment was evaluated for the Study Area using the field data to modulate the target species list prior to further assessment. It has now been re-evaluated for the Project Area to direct the assessment of Project impacts.

The likelihood of occurrence assessment criteria is detailed in **Table A.2**.

Table A.2 Likelihood of threatened and migratory species to occur in the Project Area

Assessment Outcome	Criteria
Known to occur	The species or community has been observed within the Study Area or Project Area
Likely to occur	Suitable habitat to support the species/community is present; and the species/community has been previously recorded within the desktop search extent based on field observations and/or contemporary records.
Possible to occur	The Project Area is located within the species/community's known distribution and suitable habitat to support the species/community is present, however: • The species/community has not previously been recorded within the desktop search extent; and/or • Suitable habitat is degraded, limited in extent, and/or isolated from areas of known occupied habitat, thereby reducing the likelihood of occurrence.
Unlikely to occur	The Project Area does not comprise suitable habitat for the species/community and/or is outside of the species known distribution; or failure to detect the species during targeted surveys suggests the species is likely absent from the Project Area.



Aquatic Ecology Assessment

Aquatic ecological assessments were undertaken by Hydrobiology Pty Ltd (Hydrobiology) within a broader Study Area encompassing the Project Area and surrounds located within MLs 1790, 70495, and MDL 3010 (**Figure A.4**) and some areas just outside of this.

Hydrobiology have undertaken two field surveys, comprising:

- An 'early-wet season' survey undertaken in mid February 2024, and
- A 'late-wet season' survey undertaken in late April 2024.

These surveys were timed to adequately capture the nature and spatial extent of seasonal ecological / hydrological changes. More specifically, they were conducted at times where the aquatic habitat(s) and/or wetland(s) were assessed at their full range of productivity and inherent seasonal variation, while also capturing the dynamics of fish and other aquatic biota migratory responses to seasonal variability.

Aquatic Values

During the fieldwork planning phase, potential sites within representative habitats and relevant localities were identified that appeared to be accessible. Specifically, the site locations were selected on the basis that:

- They encompass all four creeks relevant to the Project, these being Kennedy Creek, Charlie Creek, Goonyella Creek and Skull Creek. They also include the ultimate receiving environment, the Isaac River
- They best represent identified habitat variation within the Study Area (determined from aerial imagery and review of historical reports and State and Federal databases)
- They encompassed the range of potential Groundwater Dependent Ecosystem (GDE) types present in the Study Area (BoM 2019)
- They could be readily accessed through existing infrastructure, and
- The selected survey techniques could be safely carried out.

Survey Sites

Sites surveyed for aquatic values are listed in **Table A.3** and shown in **Figure A.4**. All sites were within the Study Area except for site four, located approximately 350 m northwest from the Study Area boundary. Sites one and three were dams and Sites one, four, five and six were identified aurally as containing potential creek habitat.

Table A.3 Aquatic values and survey sites

Site	Latitude	Longitude	Lot and Plan	Survey Techniques*
1	-21.6181	147.989	2 SP214117	H, G, L
2	-21.5978	148.0005	2 SP214117	H, G, M, IW, E, F, B, C, L
3	-21.5677	147.9812	2 SP214117	H, G, M, IW, E, F, B, C, L
4	-21.5598	147.9907	8 GV807254	H, G, L
5	-21.5489	147.9772	2 SP214117	H, G, L
6	-21.5715	147.9253	2 SP214117	H, G, M, IW, E, F, L



* H: Habitat, G: Groundwater Dependant ecosystems, M: Macroinvertebrate, IW: In situ water, E: electrofishing, F: fyke netting, B: Box traps, C: Cathedral traps and L: Likelihood of occurrences

Methods

An overview of implemented methods is displayed in **Table A.4**. The implemented survey methods for the identified threatened and special least concern species included both passive (habitat assessments and visual assessment) and active (cathedral trapping and fyke netting) survey techniques. Identified active survey methods for the survey of *Elseya albagula* (white throated snapping turtle), (*Rheodytes leukops*) Fitzroy River turtle; and (*Ornithorhynchus anatinus*) platypus followed current defined guidelines as detailed in **Table A.4**.

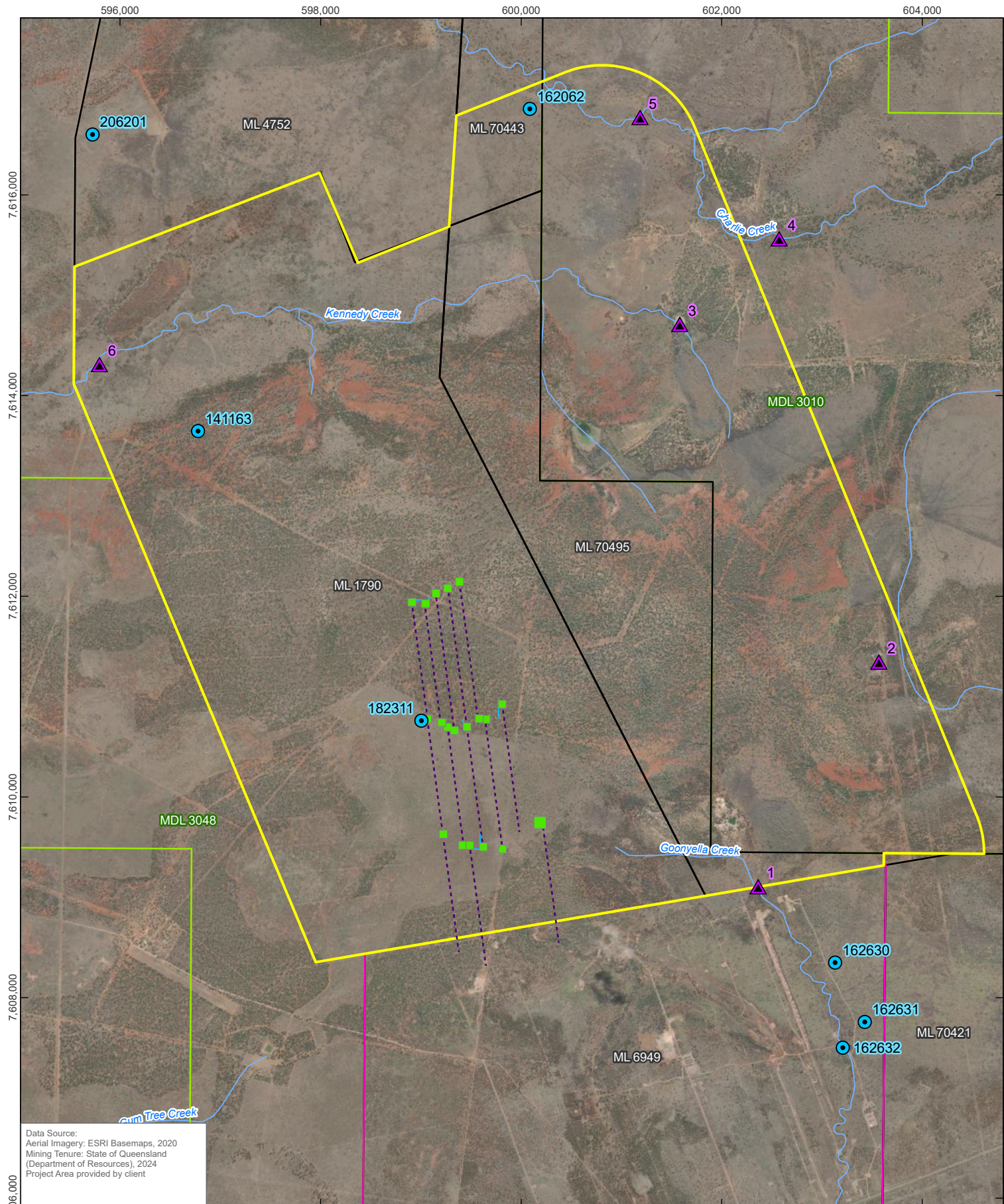
Table A.4 Sampling methods for the Study Area and associated guidelines

Species	Method	Guideline and Standards
Aquatic Fauna		
Fish	Overnight fyke netting Overnight box trapping Visual observations; and Likelihood of occurrence assessments based off areas occurrence and presence of preferred habitat features.	DES (2018a) Monitoring and sampling manual DSEWPaC (2011) Guidelines for Threatened Fish
Turtles	Overnight cathedral trapping Visual observations; and Likelihood of occurrence assessments based off areas occurrence and presence of preferred habitat features.	DSEWPaC (2011b) Guidelines for threatened reptiles DES (2018a) Monitoring and sampling manual
Platypus	Overnight fyke netting Burrow searches and visual observations; and Likelihood of occurrence assessments based off areas occurrence and presence of preferred habitat features.	DES (2018a) Monitoring and sampling manual Lugg et al. (2017) Optimal survey designs for eDNA sampling
Habitat and Water Quality		
Aquatic habitat (including macrophytes) and stream condition	Habitat and condition assessments in accordance with AUSRIVAS and State of the Rivers protocols. Macro (riffles, pools, runs, dry, etc.) and micro habitat (large woody debris, leaf litter, etc.) presence/cover. Macrophyte identification and density River bioassessment condition assessment Bank and stream morphology Identification of local land use and pressures Documentation of erosion and sedimentation Substrate analysis	Parsons et al. (2002) Australian River Assessment System: AusRivAS Physical Assessment Protocol DNRM (2001) AusRivAS for Queensland streams Cover estimate methods as per DNRM (2001)



Species	Method	Guideline and Standards
Aquatic GDEs	Analysis of aerial imagery to identify water permanence. Ground-truthing of surface GDE presence based on the series of questions described in Eamus et al. (2006) and Doody et al. (2019) in IESC (2018) GDE value characterisation as per the criteria identified in IESC (2018) To characterise groundwater connectivity, both surface and groundwater quality results regarding major ion composition will be relied upon to determine chemical signature matches.	Eamus et al. (2006) Doody et al. (2019) IESC (2018)
In-situ water quality	In-situ physiochemical analysis including temperature, pH, turbidity, dissolved oxygen, electrical conductivity	DES (2018a) Monitoring and sampling manual





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:50,000 at A4
Project Number: 620.040594.00001
Date Drawn: 09-Sep-2024
Drawn by: RB

-  Aquatic Values Survey Site
-  Stygofauna Survey Site
-  Watercourse
-  Study Area
-  Mining Lease
-  Centurion Coal Mine
-  Mineral Development Licence
-  Lateral Well Length
-  Drill Pad
-  Access Track

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**AQUATIC ECOLOGY
SURVEY SITES**



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APPENDIX A.4

Stygofauna

The stygofauna pilot survey was conducted in accordance with the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (DSITI 2015) using the methods described in DES (2018a). A single sampling event was undertaken during the early-wet season survey between the 12th and 17th of February 2024.

Survey Sites

A total of 19 bores were visited, however only nine groundwater bores could be sampled for stygofauna with sampling sites located both on-lease and off-lease (**Table A.5** and **Figure A.4**). The remaining 10 bores were either too narrow for sampling or not present at the registered coordinates.

Table A.5 Stygofauna bore sampling sites

Bore ID	Latitude	Longitude	Lot and Plan	Standing Water Level (SWL) (m)	Type
141163	-21.5775	147.934809	2SP214117	-26.02	Deep
162053	-21.525	147.934208	2SP214117	-11.07	Shallow
162062	-21.5482	147.96652	2SP214117	-13.53	Shallow
162065	-21.5233	147.93544	411SP285383	-11.54	Shallow
162630	-21.625	147.996484	411SP285383	-20.33	Shallow
162631	-21.6303	147.99938	411SP285383	-18.32	Shallow
162632	-21.6327	147.99728	411SP285383	-15.76	Shallow
182311	-21.6035	147.956487	11SP235906	-25	Deep
206201	-21.5508	147.924516	2SP214117	-25.93	Deep





Appendix B MSES significant residual impact assessments

Environmental Authority Amendment Application Supporting Report

P-EA-100658735 and P-PRCP-100669070_V1

SLR Project No.: 620.040594

13 September 2024

B.1 MSES protected wildlife habitat

Definitions and terminology

Term	Definition under the EO Act
Habitat	An area occupied, or periodically or occasionally occupied, by any species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles.
Essential Habitat	A Category B area shown on the regulated vegetation management map under the <i>Vegetation Management Act 1999</i>: i. that has at least three essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; OR ii. in which the protected wildlife, at any stage of its life cycle, is located. Please Note: Under the SRI Guidelines, Essential Habitat is assessed in accordance with the MSES Protected Wildlife assessment criteria.
Long-term decrease	Any decline in a local population that is greater than which would be apparent without the action being present
Population	An occurrence of the species in a particular area. In relation to Endangered, Vulnerable and Special Least Concern species, occurrences include but are not limited to: • a geographically distinct regional population, or collection of local populations; or • a population, or collection of local populations, that occurs within a particular bioregion.

B.1.1 *Dichanthium queenslandicum* (king blue-grass)

MSES protected wildlife habitat for *Dichanthium queenslandicum* identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i>. This amount comprises less than 1% of preferred habitat for the species mapped within the broader Study Area. Any individuals to be removed would be a small portion of the population within the habitat patch that is being disturbed. Any indirect activities from the project are unlikely to reduce the quality of surrounding habitat to the point where populations will decline. Therefore, while some habitat for the species will be cleared, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely <i>D. queenslandicum</i> is found across three population areas, including the area between Nebo and Monto and west to Clermont and Rolleston (SEWPaC 2013). The extent of occurrence of the species is estimated at around 245 km² (SEWPaC 2013). Given that the Project Area is central to this range and that the extent of clearing equates to less than 0.01% of the extent of occurrence of the species, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i> across two gas extraction wells. Small portions of the habitat patch will be removed however the patch will not be split into two or more patches. The species is wind dispersed and is therefore not limited by small scale linear network infrastructure. Therefore, it is considered unlikely that the Project will fragment an existing population of the species.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i> across two gas extraction wells. Small portions of the habitat patch will be removed however the patch will not be split into two or more patches. The species is wind dispersed and is therefore not limited by small scale linear network infrastructure. Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely One of the known threats to <i>D. queenslandicum</i> is invasion from weeds such as <i>Parthenium hysterophorus</i> (parthenium) and <i>Parkinsonia aculeata</i> (SEWPaC 2013). Parthenium has been recorded within the broader Study Area in high densities in wet areas. The implementation of weed control and monitoring to reduce and prevent the incursion and spread of weeds and pests (refer to Section 6.5.4.2) will minimise the potential for parthenium and other invasive species to become established in <i>D.</i>

MSES Significant Residual Impact Guideline criteria	Response
	<i>queenslandicum</i> habitat. As such, the Project is considered unlikely to result in invasive species harmful to <i>D. queenslandicum</i> spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely There are no known diseases that impact <i>D. queenslandicum</i> and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for <i>D. queenslandicum</i> . The Project will result in the direct clearing of 1.53 ha of preferred habitat for the species, which equates to less than 0.01% of the extent of occurrence of the species (SEWPaC 2013). Therefore, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i> , however, this comprises less than 1% of preferred habitat for the species mapped within the broader Study Area. Retained habitat in the Study Area will continue to support individuals of the species and provide habitat, and therefore it is considered unlikely that the Project will disrupt ecologically significant locations for the species.
Conclusion	The Project is unlikely to result in a significant residual impact on <i>D. queenslandicum</i> .

B.1.2 Koala (*Phascolarctos cinereus*)

MSES protected wildlife habitat for koala identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The species was recorded on bioacoustic devices and was not identified during extensive spotlighting surveys nor were scat frequently observed within the Study Area. The Project Area does not contain any preferred habitat for the species such as riparian areas with large eucalypts that contain high-moisture content. Areas of preferred habitat are limited to Charlie creek in the north of the Study Area. Therefore, the species is considered to be at low densities within the Study Area. Due to the small proportion of habitat being cleared for the Project and low density of individuals, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The listed population of the koala has a wide but patchy distribution that spans the coastal and inland areas of Queensland north to the Herberton area, extending westwards into hotter and dryer semi-arid climates of central Queensland, New South Wales and the Australian Capital Territory (DAWE 2022). In Queensland, the species are widespread and patchy across their range, often occurring in low density populations (DAWE 2022). The extent of occurrence of the species is estimated at around 1,665,850 km² (DAWE 2022). The Project is not located near the edge of this known distribution and the extent of clearing equates to less than 0.01% of the extent of occurrence of the species. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Koala has a wide but patchy distribution within Queensland in which it is generally present in low density populations (DAWE 2022) and it has been recorded once within 25 km of the Project Area (BMA 2014). Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species as mapped within the Study Area. The 19 well gas

MSES Significant Residual Impact Guideline criteria	Response
	network will not prevent dispersal for the species within the Study Area. Koala has a wide but patchy distribution within Queensland in which it is generally present in low density populations (DAWE 2022) and it has been recorded once within about 25 km of the Project Area (BMA 2014). Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely Known threats to koala relevant to the Project Area include: • direct predation from dogs leading to mortality of individuals; and • invasion of weeds leading to habitat degradation (DAWE 2022). Wild dogs (<i>Canis lupus</i>) have been recorded multiple times within the broader Study Area. Pest fauna will be monitored, and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land (refer to Section 6.5.4.2). Invasive flora within the Study Area is not considered to pose a threat to the point where Koala dispersal is hindered. The implementation of mitigation measures to reduce and prevent the incursion and spread of invasive species (refer to Section 6.5.4.2) will minimise the potential for invasive species to become established in retained habitat. Therefore, it is considered unlikely that the Project will result in invasive species harmful to koala spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely One of the known threats to koala is infection from diseases and viruses in the population, including <i>Chlamydia pecorum</i>, koala retrovirus and koala herpesvirus (DAWE 2022). The implementation of mitigation measures to reduce and prevent the incursion and spread of these diseases (refer to Section 6.5.4.2) will minimise the potential for diseases to become established in retained habitat. Therefore, it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely The national recovery plan for the koala includes the follow strategies: • build and share knowledge • engage and partner with the community in listed koala conservation • increase the area of protected habitat for the listed koala • integrate koala conservation into policy, statutory and land use plans • strategically restore listed koala habitat; and • actively management koala metapopulations (DAWE 2022). The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. Due to the

MSES Significant Residual Impact Guideline criteria	Response
	small proportion of habitat being cleared for the project and low density of individuals, the clearing of koala habitat within the Project Area is considered unlikely to interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. The species was identified through bioacoustic recorders and was not identified during spotlighting surveys nor were scat frequently observed within the Study Area. The Project Area does not contain any preferred habitat for the species such as riparian areas with large eucalypts that contain high-moisture content. Areas of preferred habitat are limited to Charlie creek in the north of the Study Area. This area would be considered an ecologically significant location. Due to the small proportion of habitat being cleared for the project and low density of individuals, it is considered unlikely that the Project will disrupt ecologically significant locations for the species.
Conclusion	The Project is unlikely to result in a significant residual impact on koala.

B.1.3 Ornamental snake (*Denisonia maculata*)

MSES protected wildlife habitat comprising Essential Habitat for ornamental snake mapped within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake. Seasonal targeted surveys for the species (comprising pitfall trapping and spotlighting) within the Study Area failed to detect the species, and suitable habitat was not identified. Therefore, ornamental snake is assessed as unlikely to occur within the Study Area and Project Area and it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The distribution of ornamental snake includes the Brigalow Belt North and South Bioregions, with the stronghold of the species being within the Fitzroy and Dawson River catchments, particularly in the area surrounding Moranbah (DCCEW 2024). The extent of occurrence for the species has not been estimated. The Project is not located near the edge of this known distribution and the species is identified as unlikely to occur within the Study Area and Project Area. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake across multiple gas extraction wells. These wells are located within an area of relatively contiguous DoR mapped Essential Habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. In addition, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake across multiple gas extraction wells. These wells are located within an area of relatively contiguous DoR mapped Essential Habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. In addition, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.

MSES Significant Residual Impact Guideline criteria	Response
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely Known threats to ornamental snake relevant to the Project Area include: • destruction of wetland habitat by feral pigs (<i>Sus scrofa</i>) • poisoning from the ingestion of cane toads (<i>Rhinella marina</i>); and • invasive weeds (DCCEEW 2024; DotE, 2014). Both feral pigs and cane toads have been recorded multiple times within the broader Study Area. Pest fauna will be monitored, and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land (refer to Section 6.5.4.2). Three weed species have been recorded within the broader Study Area. The implementation of mitigation measures to reduce and prevent the incursion and spread of invasive species (refer to Section 6.5.4.2) will minimise the potential for invasive species to become established. In addition, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will result in invasive species harmful to the species spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely There are no known diseases that impact ornamental snake and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for ornamental snake, however conservation actions in the conservation advice for the species include: • reducing habitat loss and disturbance • controlling fauna pests (particularly cane toads); and • raising awareness with the community (DotE, 2014). The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake across multiple gas extraction wells. However, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake. Seasonal targeted surveys for the species (comprising pitfall trapping and spotlighting) within the Study Area failed to detect the species, and suitable

MSES Significant Residual Impact Guideline criteria	Response
	habitat was not identified. Therefore, ornamental snake is assessed as unlikely to occur within the Study Area and Project Area. As such, the Study Area and Project Area is not considered to be an ecologically significant location and it is considered unlikely that the Project will disrupt ecologically significant locations for the species.
Conclusion	The Project is unlikely to result in a significant residual impact on ornamental snake.

B.1.4 Short-beaked echidna (*Tachyglossus aculeatus*)

MSES protected wildlife habitat for short-beaked echidna identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The species was recorded once during field surveys within the Study Area and additional evidence of presence was not observed. Short-beaked echidna has a relatively widespread distribution and occurs where ant and termite species are available, including across a range of modified habitats (Van Dyck & Strahan, 2008). Due to the small portion of habitat being cleared for the Project and widespread distribution of the species across the landscape, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The short-beaked echidna is relatively widespread and occurs throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008). The extent of occurrence for the species has not been estimated. The Project is not located near the edge of the known distribution of the species. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Short-beaked echidna has a widespread distribution, occurring throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008) and it has been recorded multiple times within about 25 km of the Project Area (AECOM 2015; DESI 2024). Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Short-beaked echidna has a widespread distribution, occurring throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008) and it has been recorded multiple times within about 25 km of the Project Area (AECOM 2015; DESI 2024). Therefore, it is

MSES Significant Residual Impact Guideline criteria	Response
	considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna across multiple gas extraction wells. The species was recorded once during field surveys within the Study Area and additional evidence of presence was not observed. Short-beaked echidna has a widespread distribution, occurring throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008) and it has been recorded multiple times within about 25 km of the Project Area (AECOM 2015; DESI 2024). Ecologically significant locations for the species have not been identified and so the precautionary approach can be taken to classify all habitat areas as ecologically significant. Retained habitat in the broader landscape within the Study Area and surrounds will continue to support individuals of the species and provide suitable habitat that individuals will be able to move into and use for breeding, feeding and as a refuge area. Due to the small portion of habitat being cleared for the Project and widespread distribution of the species across the landscape, it is considered unlikely that the Project will disrupt ecologically significant locations of the species.
Conclusion	The Project is unlikely to result in a significant residual impact on the short-beaked echidna.

B.1.5 Squatter pigeon (southern) (*Geophaps scripta scripta*)

MSES protected wildlife habitat for squatter pigeon (southern) identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern). This comprises less than 1% of suitable habitat for the species within the broader Study Area. A total of 65 squatter pigeon (southern) individuals were recorded across the Study Area, all of which were nearby dams. Such permanent and seasonal waterbodies are known to be important habitat features for the species (Squatter Pigeon Workshop, 2011). Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). Due to the small proportion of habitat being cleared and fact that the Project Area does not intercept with permanent or seasonal waterbodies, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). The extent of occurrence of the species is estimated at around 440,000km² (DCCEEW 2024). The Project is not located near the edge of this known distribution and the extent of clearing equates to less than 0.01% of the extent of occurrence of the species. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). In addition to records during E2M's field surveys, the species has been recorded a total of 13 times within the Study Area and twice within 25 km of the Project Area (AECOM 2015; BMA 2014). Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction

MSES Significant Residual Impact Guideline criteria	Response
	wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEE 2024). In addition to records during E2M's field surveys, the species has been recorded a total of 13 times within the Study Area and twice within 25 km of the Project Area (AECOM 2015; BMA 2014). Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely Known threats to squatter pigeon (southern) include: • direct predation from feral cats (<i>Felis catus</i>) and foxes (<i>Vulpes vulpes</i>) • trampling of nests by livestock • habitat degradation by invasive weeds; and • overgrazing of habitat by livestock and feral herbivores such as rabbits (<i>Oryctolagus cuniculus</i>) (DCCEE 2024; TSSC 2015). Feral cats and rabbits have been recorded within the broader Study Area. Pest fauna will be monitored, and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land (refer to Section 6.5.4.2). Three weed species have been recorded within the broader Study Area. The implementation of mitigation measures to reduce and prevent the incursion and spread of invasive species (refer to Section 6.5.4.2) will minimise the potential for invasive species to become established in retained habitat. Therefore, it is considered unlikely that the Project will result in invasive species harmful to squatter pigeon (southern) spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely There are no known diseases that impact squatter pigeon (southern) and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for squatter pigeon (southern), however conservation actions in the conservation advice for the species include: • identify sub-populations of high conservation priority • protect and rehabilitate areas of vegetation that support important sub-populations • protect sub-populations through the development of covenants, conservation agreements or inclusion in reserve tenure • develop and implement a stock management plan for key sites

MSES Significant Residual Impact Guideline criteria	Response
	• develop and implement a management plan, or nominate an existing plan to be implemented, for the control and eradication of feral herbivores in areas inhabited by the squatter pigeon (southern) • raise awareness of the squatter pigeon (southern) within the local community • monitor selected sub-populations; and • undertake a range of activities for information and research priorities (TSSC 2015). The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction wells. Due to the small proportion of habitat being cleared and the Project Area's location within the broader distribution of the species, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction wells. A total of 65 squatter pigeon (southern) individuals were recorded across the Study Area, all of which were nearby dams. Such permanent and seasonal waterbodies are known to be important habitat features for the species (Squatter Pigeon Workshop, 2011). Such features could be considered ecologically significant locations. Retained habitat in the broader landscape within the Study Area and surrounds will continue to support individuals of the species and provide suitable habitat that individuals will be able to move into and use for breeding, feeding and as a refuge area. Due to the small proportion of habitat being cleared and fact that the Project Area does not intercept with permanent or seasonal waterbodies, it is considered unlikely that the Project will disrupt ecologically significant locations of the species.
Conclusion	The Project is unlikely to result in a significant residual impact on squatter pigeon (southern).

B.1.6 White-throated needletail (*Hirundapus caudacutus*)

MSES protected wildlife habitat for white-throated needletail identified within the Project Area has been assessed against the SRI Guideline below.

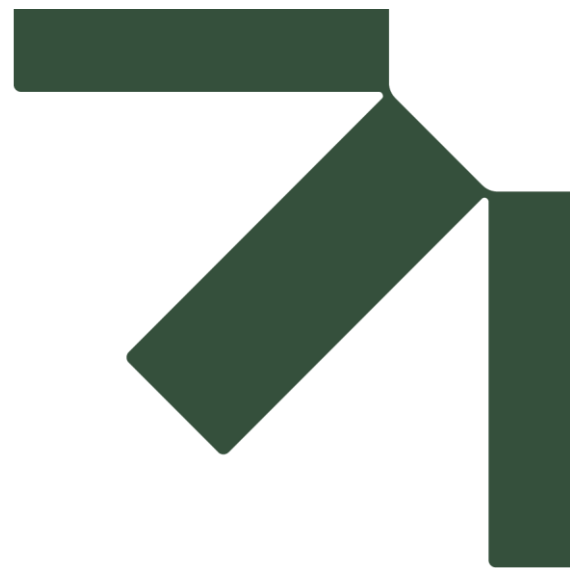
MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia (DCCEEW 2024). The species can occur over most habitat types, however, because the species is aerial, it has been suggested that conventional habitat descriptions are inapplicable (DCCEEW 2024). As such, the clearing of vegetation is considered largely inconsequential to the species. Aerial space above the Project Area is considered to comprise marginal habitat for white-throated needletail. Due to the species use of a broad range of habitats and its wide-ranging distribution, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Due to the mobile nature of the species (i.e. movement by flight), it is considered unlikely that the Project will fragment a population of the species.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Furthermore, the species is a non-breeding visitor to Australia that migrates to the northern hemisphere during the breeding season (DCCEEW 2024). Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely There are no known invasive species that are harmful to the white-throated needletail and therefore it is considered unlikely that the Project will result in invasive species harmful to the species spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely

MSES Significant Residual Impact Guideline criteria	Response
	There are no known diseases that impact white-throated needletail and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for white-throated needletail. Due to the species use of a broad range of habitats and its wide-ranging distribution, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Furthermore, the species is a non-breeding visitor to Australia that migrates to the northern hemisphere during the breeding season (DCCEEW 2024). It is therefore considered that Australia is not part of an ecologically significant location. Due to the species use of a broad range of habitats and its wide-ranging distribution, it is considered unlikely that the Project will disrupt ecologically significant locations of the species.
Conclusion	The Project is unlikely to result in a significant residual impact on white-throated needletail.

B.2 Connectivity areas

MSES connectivity areas identified within the Project Area have been assessed against the SRI Guideline below. The Landscape Fragmentation and Connectivity Tool was used to assess the significance of impact on connectivity areas.

Output	Value
Significance test one	
Regional total area	139,258.37 ha
Regional extent of core remnant	57,952.33 ha (41.61%)
Area of core at the local scale (pre impact)	5,700.58 ha
Area of core at the local scale (post impact)	5,679.82 ha
Percent change of core at the local scale (post impact)	0.36%
Significance test two	
The number of core remnant areas occurring on the site	1
The number of core remnant areas occurring on the site post impact	1
Result	
This analysis has determined no significant impact on connectivity areas.	



Appendix C Greenhouse Gas Abatement Plan

Environmental Authority Amendment Application Supporting Report

P-EA-100658735 and P-PRCP-100669070_V1

SLR Project No.: 620.040594

13 September 2024



Greenhouse Gas Abatement Plan

P-EA-100658735 and P-PRCP-100669070_V1

Centurion Coal Mining Pty Ltd.

Moranbah, Queensland 4744

Prepared by:

SLR Consulting Australia

SLR Project No.: 620.040594.00001

13 September 2024

Revision: 1.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	13 September 2024	D. Heuff	R. Byrne	R. Byrne
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Centurion Coal Mining Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



Table of Contents

Basis of Report	i
1.0 Introduction and Project Details	2
2.0 Greenhouse Gas Abatement	2
2.1 Corporate Strategy	2
2.2 Project Strategy	4
2.3 Project GHG Emission Estimates	5
3.0 Greenhouse Gas Risk Assessment	5

Tables

Table 2.1 Summary of Peabody's Greenhouse Gas Abatement Plan	3
Table 2.2 Project Specific Greenhouse Gas Abatement Plan.....	4
Table 2.3 Summary of GHG Emissions Inventory	5
Table 3.1 Greenhouse Gas Risk Assessment.....	6

Figures

Figure 2.1 Peabody Scope 1 and 2 emissions from 2018 - 2023	3
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1.0 Introduction and Project Details

Centurion Coal Mining Pty Ltd (a subsidiary of Peabody Energy Australia PCI PTY LTD) is seeking an amendment to environmental authority (EA) P-EA-100658735 and associated progressive rehabilitation and closure plan (PRCP) P-PRCP-100669070_V1, to authorise activities associated with the proposed pilot coal seam gas (CSG) exploration and extraction programme (the Project).

The Project is to be located on mining lease (ML) 1790, approximately 40 kilometres north-west of Moranbah, Queensland. Further details regarding the Project can be found in the accompanying supporting documents to the EA and PRCP amendment application.

As the Project consists of petroleum and gas activities, it is considered to be a 'medium to high' emission category, as per Table 3 of the Queensland Government's Department of Environment, Science and Innovation (DESI) *Guideline: Greenhouse gas emissions* (2024) (the Guidelines). As such, the EA amendment application is required to be accompanied by the following:

- Greenhouse gas (GHG) emissions inventory
- GHG emission mitigation and management practices
- A risk assessment that outlines the scale of expected GHG emissions from the activity and how they are expected to contribute to climate change impacts on Queensland's environmental values, and
- GHG abatement plan (this document).

This document provides the GHG abatement plan (GHGA Plan) for the Project. A GHGA Plan identifies the GHG emissions to be generated by a project and details ongoing emission mitigation and management measures proposed to be implemented throughout the life of the project to progressively reduce Scope 1 and Scope 2 GHG emissions. This will ensure long-life projects contribute to transitioning to a low carbon global economy.

2.0 Greenhouse Gas Abatement

2.1 Corporate Strategy

Peabody is a leading global coal producer, operating 17 mines throughout the United States and Australia that supply both thermal and metallurgical coal products into domestic and seaborne markets.

Peabody believes that a concerted global effort is required to reduce GHG emissions, including those resulting from the use of energy resources such as coal.

Peabody has a responsibility to reduce GHG emissions and has established an ambition of achieving net-zero emissions (Scope 1 and 2) by 2050 through setting measurable, near-term emission reduction goals. Peabody remains committed to playing a role in the energy transition and is rebalancing its portfolio to become a provider of the steelmaking coal necessary to build the new energy infrastructure.

Peabody continues to responsibly mine its existing thermal coal reserves, while reducing annual volumes from the U.S. thermal mines by 20-40 million tons by 2035 (versus 2021 production), which will result in emission reductions in this segment.

Within the Australian operations, Peabody operates six mines that are subject to the Australian Safeguard Mechanism and is implementing facility decarbonisation strategies that support the emission reduction targets outlined by the legislation.



Peabody currently reports Scope 1 and 2 emissions annually in both our Sustainability report, as well as through the National Greenhouse Gas and Energy Reporting (NGER) Scheme in Australia.

Figure 2.1 illustrates Peabody's scope 1 and 2 emissions from 2018 – 2023 measured at a corporate level and this information is publicly available in the Peabody 2024 Sustainability Report.

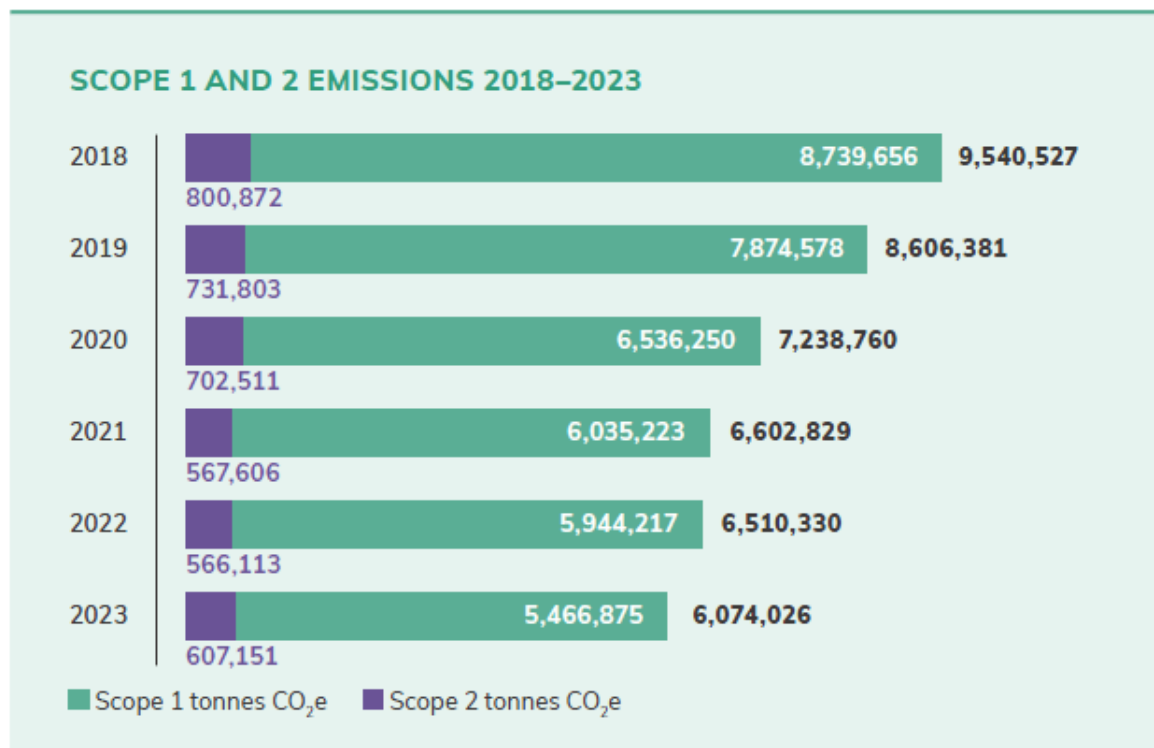


Figure 2.1 Peabody Scope 1 and 2 emissions from 2018 - 2023

Table 2.1 presents a summary of Peabody's GHGA Plan.

Table 2.1 Summary of Peabody's Greenhouse Gas Abatement Plan

Element	Comments
Peabody emissions reference point	Emission reduction will be measured based on the site-specific emission intensity approved by the Clean Energy Regulator for the Centurion Coal Mine.
Peabody emissions reduction targets	Centurion Coal Mining Pty Ltd is implementing emission reductions in alignment to the annual targets outlined by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Safeguard Mechanism.
Emission reduction measures	Flaring of drained CSG is currently utilized as a key emission reduction measure.
Abatement opportunities / advancing technologies	Communication enhancement to optimize equipment runtime.



Element	Comments
Reporting	Annual reporting of emissions in compliance with the NGERs Act

2.2 Project Strategy

Table 2.2 outlines the Project specific GHGA Plan including emission estimates, abatement measures and reporting requirements.

Table 2.2 Project Specific Greenhouse Gas Abatement Plan

Element	Comments
Emissions projections and commencing abatement measures	Emissions projections were developed in Section 6.2.2 of the EA Amendment Supporting Document. For completeness, a summary of the emissions projections are provided in Table 2.3. Mitigation measures to be implemented at the commencement of the Project include: • Use of fuel-efficient plant and equipment • Monitoring of diesel use • Operator training • Operation of flares at >95% availability • Use of personal methane gas monitors to detect fugitive emissions • Real time monitoring of the flare's ignition system with alarms (1); and • Full-time Gas Drainage Engineer employed to monitor and address performance of gas drainage and flare operation
Project GHG emissions reference point	Level of emissions as per the emissions projections provided in Table 2.3 .
Emission reduction measures	• Maintenance of plant and equipment to optimise fuel use • Monitor flare performance and minimise down time • Tracking response times to alarms
Abatement opportunities	• Minimising the risk of fugitive emissions of methane by ensuring optimised flame uptime • Implementing gas-flow shut off valves
Reporting	• Annual reporting of emissions in compliance with the NGER Act • Monthly review of facility emissions data

Note (1): Centurion Coal Mining Pty Ltd has overhauled and upgraded or purchased upgraded flare units that have higher reliability and auto-ignition functions. If the flare stops, the temperature sensor triggers an auto-reignite to immediately re-start flaring. If for any reason the auto-reignite fails, then an alarm is sent to the control room and an operator is dispatched to rectify, response times are generally within 20 minutes. With the new systems in place the flare rate has increased to above 99%.



2.3 Project GHG Emission Estimates

Table 2.3 provides an estimated inventory of GHG emissions over the life of the Project, highlighting the flaring of CSG as the primary source of emissions. It is noted that CSG flaring will occur primarily during Year 2 of the Project.

It is also noted that it has conservatively been assumed that the CSG flow rate of 500 l/s will be sustained across all thirteen vertical wells throughout a 1½ to 2-year period. In practice, CSG flow rates will be both spatially and temporally variable.

Table 2.3 Summary of GHG Emissions Inventory

Scope	Project Phase	Source	Tonnes of CO2-e	Percentage of Total
Scope 1	Construction	Combustion of diesel in equipment during drill pad and access track construction	170 - 260	0.02 - 0.03
		Combustion of diesel in drill rig during construction of vertical and lateral wells	1,600 - 2,400	0.23 - 0.30
	Operation	Combustion of diesel in generators during operation of vertical and lateral wells	5,000 – 8,700	0.71 – 1.07
		Flaring of CSG	700,00 – 800,000	98.6 – 99.0
Scope 1 Total			706,770 – 811,360	100 %
Scope 2	Construction & operation	Electricity consumption	0	0
Scope 2 Total			0	0 %
Scope 3	Operation	Downstream use	0	0
(Downstream) Scope 3 Total			0	0 %

3.0 Greenhouse Gas Risk Assessment

Most of the Project CO₂-e emissions occur over the 2-year period associated with the flaring of CSG. The summary of emissions provided in **Table 2.3** suggests an annual Project-related contribution to GHG emissions in the range of approximately 0.35 Mt and 0.4 Mt of CO₂-e per year.

The latest Australian GHG emissions inventory (2021-2022) provided in the DCCEEW 'National Inventory Report 2022' (DCCEEW, 2024) indicates Australia's total GHG emissions (including land use, land use change and forestry activities) was 432.6 million tonnes (Mt) of CO₂-e.

The Energy Sector is the largest contributor to the national inventory with an estimated circa 400 Mt of CO₂-e emissions during 2021-2022. The *Oil, Natural Gas and other emissions from energy production (CRT Category 1.b.2)* subsection of the Energy Sector which includes flaring of natural gas reporting c. 23 Mt CO₂-e for this same period.

Queensland's contribution to the 2022 national inventory was estimated to be 124.1 Mt of CO₂-e.



Thus, the Project's contribution of between 0.35 Mt and 0.4 Mt of CO₂-e represents:

- Between 0.08% and 0.09% of Australia's 2022 GHG emissions,
- Between 0.09% and 0.1% of the National Energy Sector emissions,
- Between 1.5% and 1.7% of the O&G subsection of the National Energy Sector reported emissions for 2021-2022, and
- Between 0.28% to 0.33% of Queensland's 2021-2022 emissions.

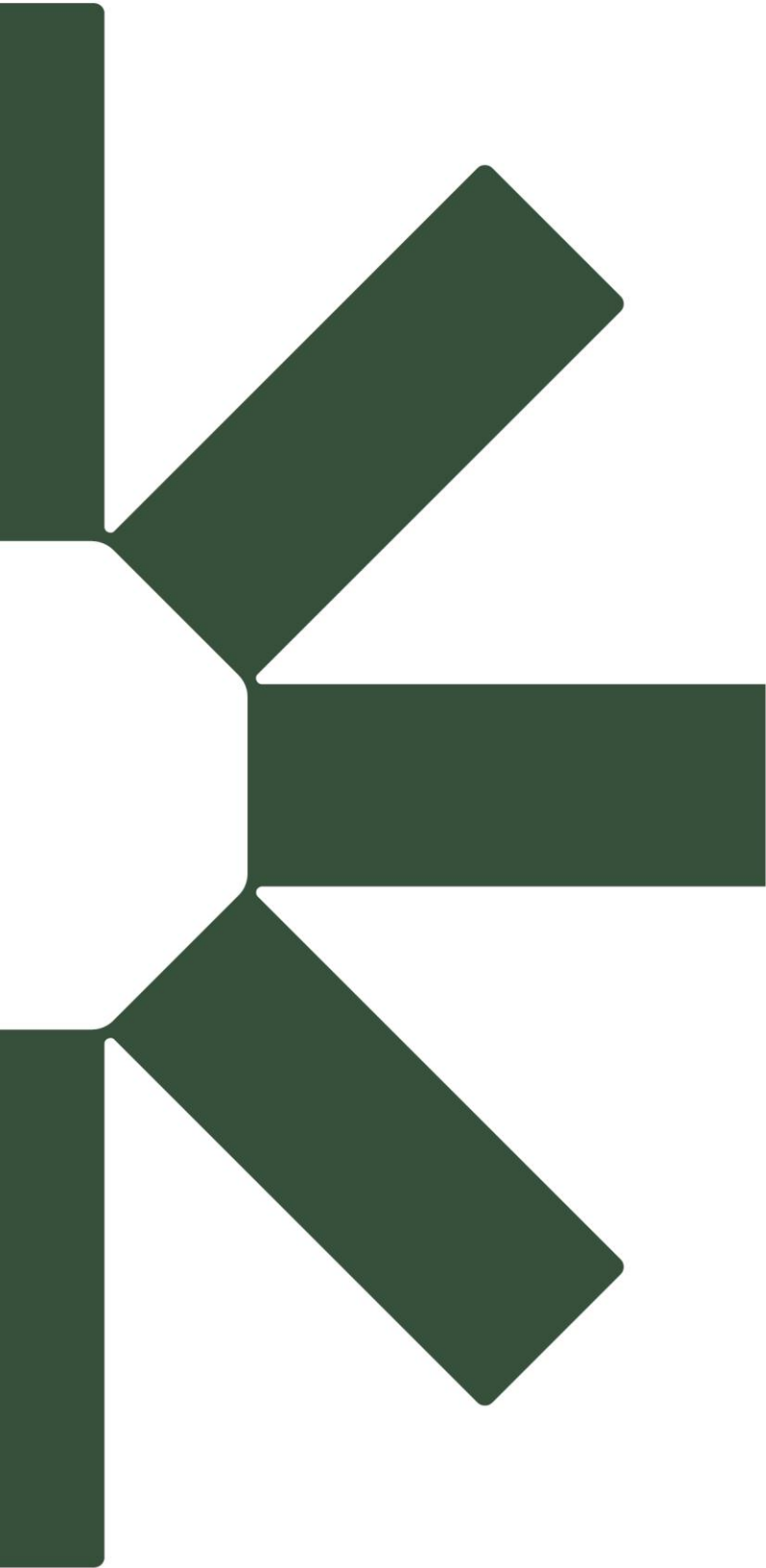
However, the abatement of GHG emissions associated with the Project will be managed through mechanisms outlined in **Table 2.2**.

Thus, the risk that impacts of GHG emissions associated with the Project will have a material change on Queensland's Climate Outcomes is considered **Low (Table 3.1)**.

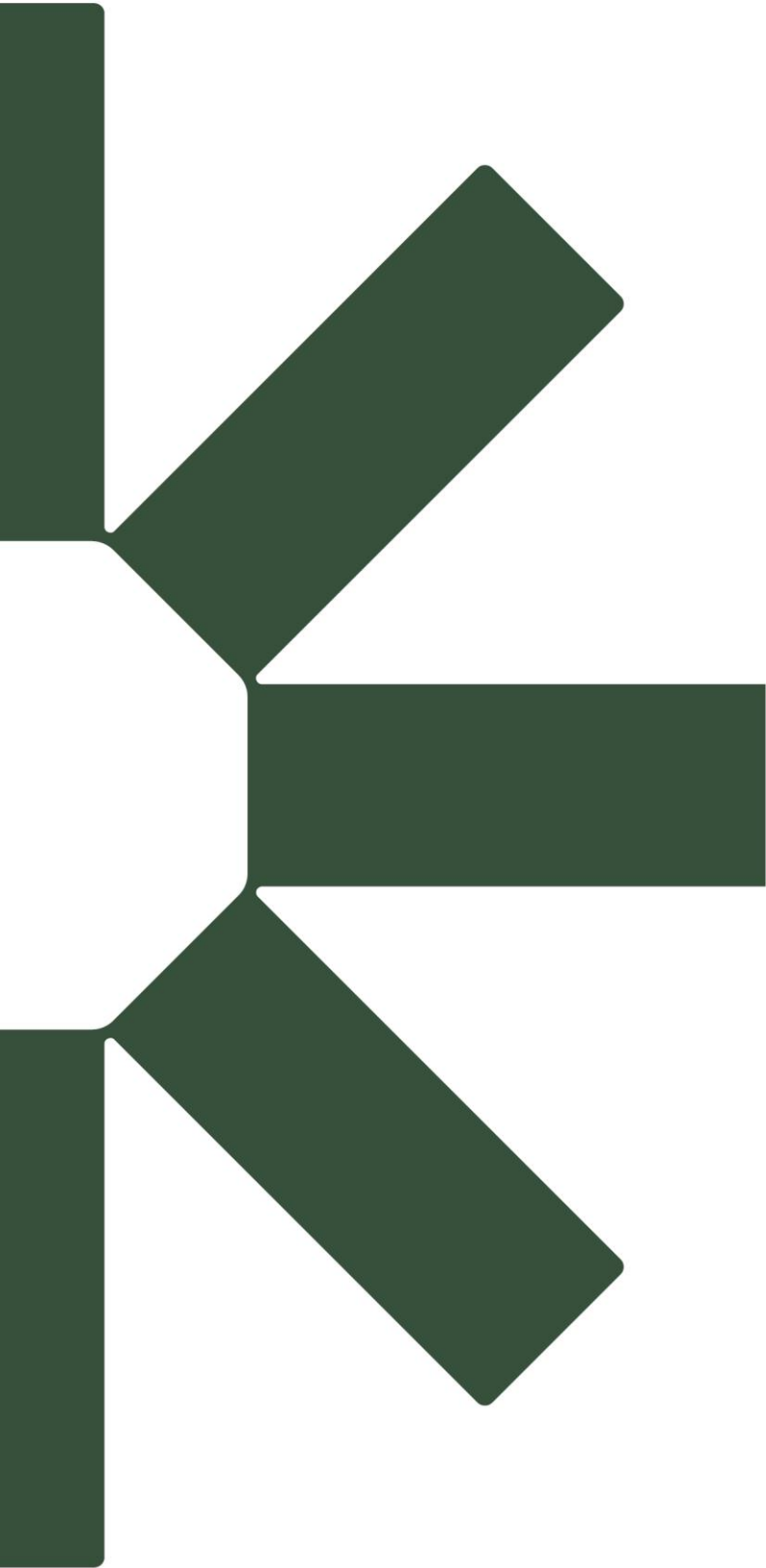
Table 3.1 Greenhouse Gas Risk Assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Fugitive emissions of GHG associated with the Project will contribute to climate change	Possible (3)	Minor (1)	Low	Although any contribution to GHG may contribute to climate change in theory, it is unlikely that the scale of the contribution of fugitive emissions of greenhouse gases from the project would result in a material change in climate outcomes. Nonetheless, all practicable strategies to reduce the risk of fugitive emissions of CSG throughout the life of the Project should be implemented.





Making Sustainability Happen



Making Sustainability Happen

Application form

Environmental Protection Act 1994

Application to amend a progressive rehabilitation and closure plan schedule (PRCP schedule) or joint PRCP schedule and environmental authority

This approved form is to be used when applying for a progressive rehabilitation and closure plan schedule (PRCP schedule) amendment or a joint PRCP schedule and Environmental Authority (EA) amendment under section 224 to 226B of the Environmental Protection Act 1994 (EP Act).

IMPORTANT NOTE: Before completing this application form it is recommended that you:

- Read the [Guideline - Progressive Rehabilitation and Closure Plans \(ESR/2019/4964\)](#), which explains the information required in a PRCP schedule.
- Have a pre-lodgement meeting. To request a pre-lodgement meeting, please fill out and lodge the form [Application for pre-lodgement services \(ESR/2015/1664\)](#).

This application form is split in to three parts. The table below provides details of which parts must be completed for the different applications.

Application type	Parts that must be completed
PRCP schedule amendment	Part 1 – Amendment application information Part 3 – Declaration and payment of fees
Joint PRCP schedule and EA amendment	All parts

If you require assistance in answering any part of this form, or have any questions about your application, please contact the relevant business centre. Contact details are at the end of this form.

Privacy statement

The Department of Environment, Science and Innovation (the Department) is collecting the information on this form in accordance with and as authorised by Chapter 5 of the Environmental Protection Act 1994 (EP Act). Some of the information may be disclosed to the Department of Resources and Queensland Treasury for the purpose of processing this application.

Pursuant to section 540 of the EP Act, the Department is required to maintain a register of certain documents and information authorised under the EP Act. A copy of this document will be kept on the public register. The register is available for inspection by members of the public who are able to take extracts, or copies of the documents from the register. Documents that are required to be kept on the register are published in their entirety, unless alteration is required by the EP Act. There is no general discretion allowing the Department to withhold documents or information required to be kept on the public register. For more information on the Department's public register, search 'public register' at www.qld.gov.au. For queries about privacy matters please email privacy@des.qld.gov.au or telephone 13 74 68.



Application to amend a PRCP schedule or joint PRCP schedule and EA

Part 1—Amendment application information

All sections within Part 1 must be completed for all amendment application types.

Section 1 – Environmental authority and PRCP schedule number	
Environmental authority number this PRCP schedule relates to.	P-EA-100658735
PRCP schedule reference number.	P-PRCP-100669070_V1

Section 2 – Applicant details	
Details of the applicant are to be provided in this section. The person nominated as the application contact will receive correspondence relating to this application.	
NAME / COMPANY NAME*	TRADING NAME (*IF AN ORGANISATION)
Centurion Coal Mining Pty Ltd	Centurion Coal Mining Pty Ltd
REGISTERED BUSINESS ADDRESS / RESIDENTIAL ADDRESS (NOT A POST OFFICE BOX) *	POSTAL ADDRESS (*WHERE DIFFERENT)
Level 14, 31 Duncan Street, Fortitude Valley, QLD 4006	Peabody Australia, GPO Box 164, Brisbane, QLD 4001
ABN / ACN (*IF AN ORGANISATION)	NAME OF APPLICATION CONTACT*
50 010 879 526	Marianne Gibbons
EMAIL*	TELEPHONE*
mgibbons@peabodyenergy.com	0427 321 361
☒ INDICATE IF YOU WANT TO RECEIVE CORRESPONDENCE VIA EMAIL ☐ INDICATE IF THERE ARE JOINT HOLDERS OF THE ENVIRONMENTAL AUTHORITY. IF THERE ARE JOINT HOLDERS, PROVIDE THE ADDITIONAL CONTACT DETAILS AS AN ATTACHMENT.	

Section 2.1 – Agent details	
If there is an agent acting on behalf of the applicant, details of the agent are to be provided. An agent could be a consultant or contactor for the applicant.	
Is this form being completed by an agent for the applicant? *	☐ Yes – Provide details below ☒ No – Go to next section
NOTE: If an agent is nominated, please provide evidence of appointment by the authority holder/s.	
NAME / COMPANY NAME	TRADING NAME
Insert.	Insert.
REGISTERED / RESIDENTIAL ADDRESS	POSTAL ADDRESS (WHERE DIFFERENT)
Insert.	Insert.
ABN / ACN (IF AN ORGANISATION)	CONTACT NAME
Insert.	Insert.
EMAIL	TELEPHONE
Insert.	Insert.

Application to amend a PRCP schedule or joint PRCP schedule and EA

Section 3 – Major or Minor Amendment, PRCP schedule

The administering authority decides if an application is a minor amendment or a major amendment and will send you a notice of the decision. A single assessment level decision will be made, and a single decision notice issued, where an application is made to amend both the EA and PRCP schedule at the same time.

If the application is a major amendment, an assessment fee of 30% of the annual fee for your environmental authority is required to be paid. The assessment of your amendment application will not proceed until the assessment fee is paid. No additional assessment fees apply if your application is determined to be a minor amendment.

By considering what type of amendment your application is likely to be, you will have a better idea of whether the assessment fee will be payable.

For further information see the [Guideline - Major and minor amendments \(ESR/2015/1684\)](#) and section 223 of the EP Act. If you have questions regarding whether your amendment will be a minor or major amendment you are encouraged to arrange a pre-lodgement meeting with the administering authority. Only an indication can be given as to whether the proposed changes are likely to be a minor or major amendment, at a pre-lodgement meeting as this decision can only be made when the actual application is submitted.

Is the application for a major or minor amendment to the PRCP schedule?	☐ Major amendment for a PRCP schedule. ☒ Minor amendment (PRCP threshold).
Would approval of the amendment application for the PRCP schedule result in the PRCP schedule to which the application relates being inconsistent with the relevant EA?	☐ No – Go to next section. ☒ Yes – This application must be a joint PRCP schedule and EA amendment application.
The amendment to the PRCP schedule must not be inconsistent with the EA, otherwise you must apply to amend your EA.	

Section 4 – Major or Minor Amendment, EA

Is this application for a joint PRCP schedule and EA amendment?	☐ No – Go to next section. ☒ Yes – Provide details below.
Is the application for a major or minor EA amendment?	☐ Major amendment for an EA. ☒ Minor amendment for an EA (threshold).

Section 5 – Website address

Provide the website address for the application notice and application documents.	Insert.	
If this application is for a joint EA and PRCP schedule amendment, will the application notice and application documents for both amendments be published together?	☐ No. ☒ Yes.	
Provide details of the contact person if technical assistance is required.	NAME	TELEPHONE
	Marianne Gibbons	0427 321 361
	EMAIL	
	mgibbons@peabodyenergy.com	

Application to amend a PRCP schedule or joint PRCP schedule and EA

Section 6 – Describe the proposed amendment

Provide a detailed description of your proposed amendment. Include justification of how your proposed amendment meets the criteria for a major or minor amendment and attach any supporting information to this application. If the amendment is to add or delete a location, tenure or activity, or to change the threshold of an activity, provide details below.

Please see the attached supporting information document.

☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION AND PROVIDED DETAILS BELOW.

Include information regarding where the additional details are located Insert

Section 7 – Describe the land that will be affected by the proposed amendment

Describe if the activity will be carried out within the existing designated areas of the environmental authority/PRCP schedule or a new area.

Please see the attached supporting information document.

☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION.

Section 8 – Environmental values

Attach a document that provides an assessment of the likely impact of the proposed amendment on all environmental values (EVs) listed. Note: Where there is no impact stated, justification must be included as to why this is the case.

Environmental Values

☒ Water	☐ Wetlands	☐ Land use	☒ Acoustic
☒ Groundwater	☒ Land	☒ Air	☒ Waste

☒ I HAVE ATTACHED A DOCUMENT THAT PROVIDES AN ASSESSMENT OF LIKELY IMPACTS ON EVs.

Note that the EP Act, s226A(1)(f) states the information required relating to impacts on EVs which include:

- (i) a description of the environmental values likely to be affected by the proposed amendment; and
- (ii) details of any emissions or releases likely to be generated by the proposed amendment; and
- (iii) a description of the risk and likely magnitude of impacts on the environmental values; and
- (iv) details of the management practices proposed to be implemented to prevent or minimise adverse impacts; and
- (v) if a PRCP schedule does not apply for each relevant activity - details of how the land the subject of the application will be rehabilitated after each relevant activity ends.

Application to amend a PRCP schedule or joint PRCP schedule and EA

Section 9 – Site contact	
Would you like to nominate a site contact?	
☐ No – Go to next section ☒ Yes – Provide details below	
SITE CONTACT NAME Michael Guy	POSITION Environmental Superintendent
EMAIL mguy@peabodyenergy.com	TELEPHONE +61 4 1729 4603
☒ INDICATE IF YOU WANT THE SITE CONTACT TO RECEIVE CORRESPONDENCE VIA EMAIL	
A site contact is an alternative contact nominated by the legal entity which holds, or will in future hold, a relevant authority issued by the department. The department may direct correspondence relating to actual or potential compliance matters to the site contact.	

PRCP schedule amendment information

Section 10 – Proposed amendment(s)				
Provide information about the proposed amendment(s) below. Only complete the parts of this section that are relevant to the application. Please attach an additional sheet to this application form if there is not enough space in this section.				
Final site design				
Reference	Amendment	Current (if amending)	Proposed	Justification
Figure 1 in Schedule B of PRCP schedule P-PRCP-100669070_V1	Amend	Amend	Amend	See attached documentation.
Section C – Post-mining land use, (RA1) rehabilitation area 1, total rehabilitation size (ha)	Amend	Amend	Amend	See attached documentation.
Insert Rehabilitation or Improvement area reference.	Choose an item.	Choose an item.	Choose an item.	Provide justification for the proposed amendment.
Milestone and Milestone Criteria				
Reference	Amendment	Current (if amending)	Proposed	Justification
Insert milestone or milestone criteria reference.	Choose an item.	Insert current milestone or milestone criteria to be amended.	Insert proposed milestone or milestone criteria.	Provide justification for the proposed amendment.
Insert milestone or milestone criteria reference.	Choose an item.	Insert current milestone or milestone criteria to be amended.	Insert proposed milestone or milestone criteria.	Provide justification for the proposed amendment.

Insert milestone or milestone criteria reference.	Choose an item.	Insert current milestone or milestone criteria to be amended.	Insert proposed milestone or milestone criteria.	Provide justification for the proposed amendment.
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Timeframes

Reference	Amendment	Current (if amending)	Proposed	Justification
Insert the reference for the milestone to which the timeframe relates.	Choose an item.	Insert current date.	Insert proposed date.	Provide justification for the proposed amendment.
Insert the reference for the milestone to which the timeframe relates.	Choose an item.	Insert current date.	Insert proposed date.	Provide justification for the proposed amendment.
Insert the reference for the milestone to which the timeframe relates.	Choose an item.	Insert current date.	Insert proposed date.	Provide justification for the proposed amendment.

Section 11 – Amend Conditions

Do you wish to amend the condition(s) of the PRCP schedule?		☒ No – Go to next section. ☐ Yes – Provide details below.
Provide details of: (a) condition number(s); (b) proposed change; and (c) justification for the change.		
Provide details.		

Section 12 – Spatial Information

Does this application propose to amend the final site design of the current approved PRCP schedule?	☐ No – Go to next section. ☒ Yes – This section applies.
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Include spatial information, as required in the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964) . See Attachment 1 of this form for details on how spatial information must be submitted	☒ Spatial information has been submitted.
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Section 13 - PRCP schedule	
The proposed PRCP schedule must comply with section 126D of the EP Act, and be written in accordance with the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964) .	
Include an updated PRCP schedule prepared using the PRCP schedule template (ESR/2019/5103) .	☒ Yes ☐ No

Section 14– Non-use management areas (NUMA)	
Does this application propose to include a new or amend a current approved NUMA(s)?	☒ No – Go to next section. ☐ Yes.
Has a public interest evaluation been carried out by a qualified entity for the proposed NUMA(s)?	☐ No – Go to next section. ☐ Yes.
Has the proposed NUMA(s) changed since the public interest evaluation was carried out?	☐ No – Go to next section. ☐ Yes – Provide details below.
How has the proposed NUMA(s) changed since the public interest evaluation was carried out?	Insert.

Section 15 – Rehabilitation planning part
An amendment application for a PRCP schedule must be accompanied by an amended rehabilitation planning part of the PRC plan that complies with section 126C of the EP Act in relation to the proposed amendment. This includes updating the rehabilitation planning part in relation to the proposed amendment to meet the information requirements described in the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964), in accordance with section 126C(1) of the EP Act. For each requirement below, insert a reference to the section of the PRC plan which satisfies the requirement. Justification must be provided for any requirement for which the response is Not Applicable (NA).

If more space is required, please attach a separate sheet.			
Rehabilitation plan Requirement	Requirement met? (Yes / NA)	Rehabilitation Plan Section No.	Justification
Project description			
Describe the following in relation to the proposed amendment:			
each resource tenure, including the area of each tenure, to which this application relates;	Yes	Sections 2.0 and 2.1.1	Insert.
the relevant activities to which this application relates;	Yes	Sections 2.0 and 2.1.2 and 2.1.3	Insert.
the likely duration of the relevant activities	Yes	Section 2.1.4	Insert.
Include a detailed description, including maps, of how and where the relevant activities are to be carried out.	Yes	Sections 2.1.2 and 2.1.3 and Figure 3	Insert.
Consultation			
Include details of the consultation undertaken by the applicant in developing the proposed amended PRCP schedule.	Yes	Section 3	Insert.
Include details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan.	Yes	Section 3.3	Insert.
Post-mining land use (PMLU)			
State the extent to which each proposed post-mining land use identified in the proposed PRCP schedule is consistent with the outcome of consultation with the community in developing the proposed PRCP schedule.	Yes	Section 4.2	Insert.

State the extent to which each proposed post-mining land use identified in the proposed PRCP schedule is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.	Yes	Section 4.3	Insert.
Non-use management area (NUMA)			
State the extent to which each proposed non-use management area identified in the PRCP schedule is consistent with the outcome of consultation with the community in developing the proposed PRCP schedule.	NA	Insert.	There is no NUMA
State the extent to which each proposed non-use management area identified in the PRCP schedule is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.	NA	Insert.	There is no NUMA
For each proposed non-use management area, state the reasons the applicant considers the area cannot be rehabilitated to a stable condition because of a matter mentioned in section 126D(2).	NA	Insert.	There is no NUMA
For each proposed NUMA listed in the line above, include copies of reports or other evidence relied on by the applicant for each proposed non-use management area.	NA	Insert.	There is no NUMA
Rehabilitation and management methodology			
<i>Note: Section 3.5 of the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964) outlines the range of information that must be included as appendices to the rehabilitation planning part of the PRC plan.</i>			
For each proposed post-mining land use, state the proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP schedule.	Yes	Section 7 to Section 7.5 (Section 7.6 provides summary of these sections)	Insert.

For each proposed non-use management area, state the proposed methodology for achieving best practice management of the area to support the management milestones under the proposed PRCP schedule for the area.	NA	Insert.	There is no NUMA
Risk assessment			
Identify the risks of a stable condition for land described as a post-mining land use not being achieved, and how the applicant intends to manage or minimise the risks.	Yes	Section 8	Insert.
PRCP Guideline			
Include any other information prescribed by the administering authority in the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964) .	Yes	Insert.	Insert.
Other information			
Include the other information the administering authority reasonably considers necessary to decide whether to approve the proposed PRCP schedule amendment.	Yes	Insert.	Insert.

Part 2—EA amendment information

Part 2 only applies if your application is for a joint PRCP schedule and EA amendment, you must complete all sections in this part. If you are applying for a PRCP schedule amendment only, do not complete Part 2.

Section 16 – Type of application	
Does this application relate to a joint PRCP schedule and EA amendment application?	☐ No – Part 2 does not apply to you, do not complete the sections in this part. ☒ Yes – Complete all of the sections in this part.

Section 17 – Checklist questions	
An application to amend an EA is not appropriate in all circumstances. If you answer Yes to any of the preliminary questions below, you cannot use this application form to amend your EA. If you answer No to all of the preliminary questions, you may continue to use this application form to amend your EA.	
Is the amendment to correct a clerical or formal error?	☐ Yes ☒ No
If yes, you cannot use this form. This request should be made in writing directly to the administering authority (no fees apply).	
Is the amendment to add an ERA to an amalgamated project authority and the proposed activity does not form part of the single integrated operation conducted under the authority?	☐ Yes ☒ No
If yes, you cannot use this form. You will need to apply for a new environmental authority.	
Is the amendment to add an ERA to the EA and the addition of the ERA would result in the EA not meeting the definition of an 'ERA project'?	☐ Yes ☒ No
If yes, you cannot use this form. You will need to apply for a new environmental authority.	
Is the amendment to remove or amend a condition requiring compliance with the eligibility criteria, and is a result of changes to the activity?	☐ Yes ☒ No
If yes, you cannot use this form. Please make a site-specific application for a new environmental authority. Note: If the required amendment to the eligibility criteria condition is a result of factors beyond your control such as residential encroachment, rather than a change to the activity, you can use this form. The amendment will be a major amendment.	
Is the amendment to amalgamate two or more environmental authorities?	☐ Yes ☒ No
If yes, you cannot use this form. Please use either the form Application to amalgamate two or more environmental authorities into an amalgamated corporate authority (ESR/2015/1734) .	
Is the amendment to amend estimated rehabilitation cost only?	☐ Yes ☒ No
If yes, you cannot use this form. Please use the form Application for a decision on the estimated rehabilitation cost (ESR/2018/4426) .	
Is the proposed amendment to add a prescribed ERA, other than an ancillary activity, to an environmental authority for a resource project?	☐ Yes ☒ No
If yes, you cannot use this form. You can apply using the standard, variation or site-specific application forms.	
Is the amendment for a partial surrender of an environmental authority for a mining activity?	☐ Yes ☒ No
If yes, you cannot use this form. Please use the form Application for surrender or partial surrender of an environmental authority (resource activity) (ESR/2015/1751) .	

Section 18 – EA Amendment Options

Tick all that apply

I would like to amend the EA:

- ☒ Activities – includes changes to thresholds.
- ☐ Conditions – includes conversion to standard conditions and variations.
- ☒ Locations – removal/addition or activity locations.

Section 19 – Amend Activities

Do you wish to amend activities under the EA, including removing ERAs, adding ERAs or changes to threshold(s)?

- ☒ No – Go to next section.
- ☐ Yes – Provide details below.

Section 19.1 – Removing ERA(s)

Does the proposed amendment remove an ERA from the EA?

- ☐ No – Go to section 19.2
- ☐ Yes – Continue on below

Section 19.1 - Details of the ERA(s) to be removed.

Provide a list of all the ERAs that are to be removed from the EA and identify whether the ERA has commenced.

ERA number	Threshold	Name of ERA	Has the ERA commenced?
Insert,	Insert,	Insert,	☐ Yes ☐ No
Insert,	Insert,	Insert,	☐ Yes ☐ No
Insert,	Insert,	Insert,	☐ Yes ☐ No
Insert,	Insert,	Insert,	☐ Yes ☐ No
Insert,	Insert,	Insert,	☐ Yes ☐ No

☐ I HAVE ATTACHED DETAILS OF ADDITIONAL ERA(s) TO BE REMOVED.**Section 19.2 – Adding ERA(s)**

Does the proposed amendment add an ERA to the EA?

- ☒ No – Go to next section
- ☐ Yes – Continue on below

Provide details of which ERA(s) you wish to add. If the ERA has eligibility criteria and standard conditions, identify whether you can comply with them. Select "N/A" where there are no eligibility criteria and standard conditions for that ERA. If you cannot comply with all of the applicable standard conditions, select "No" and attach details of the standard conditions you cannot comply with

ERA number	Threshold	Name of ERA	I can comply with the eligibility criteria	I can comply with all the standard conditions
Insert,	Insert,	Insert,	☐ Yes ☐ N/A	☐ Yes ☐ No
Insert,	Insert,	Insert,	☐ Yes ☐ N/A	☐ Yes ☐ No

Insert.	Insert.	Insert.	☐ Yes ☐ N/A	☐ Yes ☐ No
Insert.	Insert.	Insert.	☐ Yes ☐ N/A	☐ Yes ☐ No
Insert.	Insert.	Insert.	☐ Yes ☐ N/A	☐ Yes ☐ No

☐ I HAVE ATTACHED DETAILS OF ADDITIONAL ERA(s) TO BE ADDED.

☐ I HAVE ATTACHED DETAILS OF THE STANDARD CONDITIONS THAT I CANNOT COMPLY WITH.

If you cannot comply with the eligibility criteria as a result of the proposed amendment, then an amendment to the relevant eligibility criteria condition will also be required. The department will only approve an amendment of the eligibility criteria condition if it is a result of factors beyond your control such as residential encroachment, rather than a change to the activity.

Section 20 – Single Integrated Operation Confirmation

Will the activities be undertaken as a single integrated operation?	☐ Yes ☒ No
PROVIDE DETAILS OF THE ACTIVITIES THAT WILL BE OPERATED AS A SINGLE INTEGRATED OPERATION AND SUPPORTING INFORMATION SHOWING THEY ARE A SINGLE INTEGRATED OPERATION:	
Insert.	
Single integrated operation occurs when all of the below criteria are met:	
(a) the activities are carried out under the day-to-day management of a single responsible individual, for example, a site or operations manager; (b) the activities are operationally interrelated; (c) the activities are, or will be, carried out at one or more places; and (d) the places where the activities are carried out are separated by distances short enough to make feasible the integrated day-to-day management of the activities.	

Section 21 – Seek to vary conditions

Are you looking to vary the condition(s) of the EA?	☐ No – Go to next section. ☒ Yes – Provide details below.
IMPORTANT NOTE: The administering authority considers what is necessary or desirable when setting the conditions of an environmental authority. Seeking to vary the conditions is likely to change the environmental risk of an activity and will require an assessment of the environmental values. If this is not provided, the application may not be valid.	
Provide details of: (a) condition number(s); (b) proposed change; and (c) justification for the change.	
Please see the attached supporting information document.	
☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION.	
If the activities were assessed as part of a coordinated project declared under the <i>State Development and Public Works Organisation Act 1971</i> , you are only able to amend Coordinator General conditions if the Coordinator General's evaluation report for the project has lapsed. If you are unsure if the Coordinator General's evaluation report has lapsed, contact the Department of State Development for more information.	

Section 22– Amend location(s)		
Does the proposed amendment relate to the location where the ERA(s) are undertaken, including adding a location, removing a location or changing a location? This section is not applicable to changes in monitoring locations, infrastructure locations ect. unless the new location is outside the currently authorised area for the environmental authority. Amendments to change the location of monitoring or infrastructure where the monitoring or infrastructure location is still within the currently authorised area are considered amendments to vary conditions		☒ No – Go to next section. ☐ Yes – Provide details below.
ERA number and threshold	Tenure(s)	Add or remove
Insert.	Insert.	Select.
Insert.	Insert.	Select.
Insert.	Insert.	Select.
Insert.	Insert.	Select.
Insert.	Insert.	Select.
Insert.	Insert.	Select.
Insert.	Insert.	Select.
☐ I HAVE ATTACHED DETAILS OF ADDITIONAL LOCATIONS FOR THIS SECTION.		

Section 23 – Compliance with any eligibility criteria

Are there any eligibility criteria for the activity(s)?

☒ No – Go to next section.☐ Yes – Provide details below.

State whether each relevant activity will, if the amendment is made, comply with any eligibility criteria for the activity.

Insert.

Include a declaration (below) that the above statement is correct

I Insert,

(INSERT NAME, POSITION AND COMPANY NAME OF PERSON MAKING THE STATEMENT)

- make the statement by or for the holder of the environmental authority;
- confirm that, to the best of my knowledge, all information provided as part of this statement, including attachments, is true, correct and complete.
- understand that it is an offence under section 480 of the *Environmental Protection Act 1994*, to give the administering authority information that I know, or ought reasonably know, is false or misleading in a material particular;
- understand that under section 480A of the *Environmental Protection Act 1994* that, if I am required to give a document to the administering authority, it is an offence to give a document that I know, or ought reasonably to know, contains incomplete information in a material particular;
- confirm that, to the best of my knowledge, this statement, including attachments, does not include false, misleading or incomplete information;
- confirm that, to the best of my knowledge, I have not knowingly failed to reveal any relevant information or document to the administering authority;
- confirm that, to the best of my knowledge, all information provided in this statement, including attachments, address the relevant matters and are factually correct;
- confirm that the opinions expressed in this statement, including attachments, are honestly and reasonably held; and
- understand that all information supplied as part of this statement, including attachments, can be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

SIGNATURE

DATE

Click or tap to enter a date.

Only a person with appropriate environmental expertise and/or experience in planning and executing site operations should sign this statement. This person may be the environmental authority holder, a full time employee of the environmental authority holder or a consultant to the environmental authority holder.

Section 24 – Environmental Offsets	
Will the ERA(s) being applied for cause, or be likely to cause, a significant residual impact to a prescribed environmental matter (other than a matter of local environmental significance)?	☒ No – Go to next section. ☐ Yes – Provide details below.
☐ Yes - Attach supporting information that: • details the magnitude and duration of the likely significant residual impact on each prescribed environmental matter (other than matters of local environmental significance) for the entire activity; • demonstrates that all reasonable measures to avoid and minimise impacts on each of those matters will be undertaken; • includes a notice of election, if it has not already been submitted; and • if the activity is to be staged, details of how the activity is proposed to be staged.	
An environmental offset may be required for an ERA where despite all reasonable measures to avoid and minimise impacts on certain environmental matters, there is still likely to be a significant residual impact on one or more of those matters. You must verify the presence, whether temporary or permanent, of those environmental matters. For more information refer to the State Significant Impact Guideline at the Queensland Government website, at: www.qld.gov.au/environment/pollution/management/offsets/index.html .	

Section 25 – Regional Interest Areas	
Is the resource activity located anywhere within an area of regional interest?	☒ No – Go to next section. ☐ Yes – Provide details below.
If yes - Which area of regional interest, has or will require a regional interest development approval (RIDA)? ☐ Priority agricultural areas (PAAs) ☐ Priority living areas (PLAs) ☐ Strategic environmental areas (SEAs) ☐ Strategic cropping area (SCA) ☐ No RIDA required, I am an exempt activity.	
If you have applied or been approved for a RIDA, provide the application reference:	Insert.
A regional interests development approval (RIDA) is required when a resource activity is proposed in an area of regional interest under the <i>Regional Planning Interests Act 2014</i> . Further information, including application forms, can be found on the Department of State Development, Infrastructure, Local Government and Planning website at www.statedevelopment.qld.gov.au .	

Section 26 – Matters of National Environmental Significance	
Would the carrying out of the proposed ERA, or where relevant the ERA project, be likely to have a significant impact on any matters of national environmental significance?	☒ No – Go to next section. ☐ Yes – Provide details below.
Are the impacts covered by transitional provisions for the <i>Environmental Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	☐ No – Provide details below ☐ Yes – Provide details in an attachment
Has the proposal been referred to the Federal Government Environment Minister or a delegate for formal assessment and approval?	☐ No – Go to next section. ☐ Yes – Provide details below.
If Yes - Has an approval issued under the EPBC Act required an environmental offset for the same, or substantially the same, impact and the	☐ No – Go to next section.

same, or substantially the same, matters of national environmental significance?	☐ Yes – Provide details below.
If Yes - Are there any matters of national environmental significance which are assessed under the EPBC Act which are the same, or substantially the same as any matters of national environmental significance, but that were not conditioned in the approval?	☐ No – Go to next section. ☐ Yes – Provide details below.
☐ I HAVE ATTACHED DETAILS OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE INCLUDING ANY APPLICABLE TRANSITIONAL PROVISIONS. ☐ I HAVE ATTACHED A COPY OF THE EPBC ACT APPROVAL.	
There are currently nine matters of national environmental significance (MNES) which have been defined in the <i>Environmental Protection and Biodiversity Conservation Act 1999 (Cth)</i> . To determine whether the proposed ERA(s) will have a significant impact on MNES and for referral requirements, please refer to the guidance provided by the Federal Government's Department of Environment on www.australia.gov.au and www.environment.gov.au .	

Section 27 – ANZSIC Code

Provide the ANZSIC code for the resource activity.

- | | |
|--|--|
| ☒ 1101 Black coal mining | ☐ 1313 Copper ore mining |
| ☐ 1102 Brown Coal Mining | ☐ 1314 Gold ore mining |
| ☐ 1311 Iron ore mining | ☐ 1315 Mineral sand mining |
| ☐ 1312 Bauxite mining | ☐ 1316 Nickel ore mining |
| ☐ 1317 Silver-lead-zinc ore mining | ☐ 1319 Metal ore mining (other metallic mineral ores) |
| ☐ 1200 Oil and gas extraction | |
| ☐ Other (provide details): Insert. | |

The Australian and New Zealand Industrial Classification (ANZSIC) is used by the Australian Bureau of Statistics. It is required to be displayed in the public register.

Section 28 – Environmental Impact Statement

Has a decision been made that an environmental impact statement (EIS) will be required for the proposed amendment activity?	☒ No - Provide details below ☐ Yes - Provide details below
☐ I HAVE ATTACHED THE DECISION.	
Has an EIS process that includes the proposed amendment been completed?	☒ No – Go to next section. ☐ Yes – Provide details below.
If yes - Has the EIS assessment report lapsed under section 59A of the EP Act?	☐ No - Provide details below ☐ Yes – Go to next section
I have assessed the environmental risks of the proposed amendment and consider them to be: ☐ The same as was assessed in the EIS process. ☐ Different to what was assessed in the EIS process.	
☐ I HAVE ATTACHED THE ASSESSMENT OF THE ENVIRONMENTAL RISKS OF THE PROPOSED AMENDMENT.	
For further information refer to the guideline: Triggers for Environmental Impact Statements under the <i>Environmental Protection Act 1994</i> for mining, petroleum and gas activities. This guideline is available at www.qld.gov.au , using the search term 'triggers for environmental impact statements'.	

Section 29 –Environmental Impact Statement Triggers *

Is the application to amend/alter an existing mine?	☒ No - Continue below ☐ Yes - Answer questions 1-6
Is the application for petroleum and gas activities?	☐ No – Go to next section ☒ Yes – Answer questions 7-9
For proposals to amend/alter an existing mine	
1. Is the proposed amendment for an increase in the annual extraction of more than 100% or 5 million tonnes per year (whichever is the lesser)? <i>NOTE: Only answer this question if the current ERA project is for an existing mine extracting between 2–10 million tonnes per year of run of mine (ROM) ore or coal; otherwise select N/A.</i>	☐ Yes ☐ No ☐ N/A
2. Is the proposed amendment for an increase in annual extraction of more than 50% or 10 million tonnes per year (whichever is the lesser)? <i>NOTE: Only answer this question if the current ERA project is for an existing mine extracting over 10 million tonnes per year of ROM ore or coal; otherwise select N/A.</i>	☐ Yes ☐ No ☐ N/A
3. Is the proposed amendment for an increase in annual extraction of greater than 25%? <i>NOTE: Only answer this question if the current ERA project is for an existing mine extracting over 20 million tonnes per year of ROM ore or coal extraction; otherwise select N/A.</i>	☐ Yes ☐ No ☐ N/A
4. Would the proposed amendment involve an extension into and significant impact on a Category A or B environmentally sensitive area, which is not already authorised by the State?	☐ Yes ☐ No
5. Would the proposed amendment involve a substantial change in mining operations—such as from underground to open cut, or (for underground mining) a change in operations from one causing little subsidence to one likely to cause substantial subsidence?	☐ Yes ☐ No
6. Would the proposed amendment introduce a novel or unproven resource removal process, technology or activity?	☐ Yes ☐ No
For petroleum and gas activities	

7. Would the proposed amendment involve a total disturbance area of greater than 2,000 hectares at any one time during the life of the proposed project? This includes areas occupied by well pads (single or multi-directional), access tracks and roads, water storages, and process plants?	☐ Yes ☒ No
8. Would the proposed amendment involve the construction of a high pressure pipeline over a distance of 300 kilometres or greater?	☐ Yes ☒ No
9. Would the proposed amendment involve the construction of a liquefied natural gas plant?	☐ Yes ☒ No
☐ I HAVE ATTACHED DETAILS OF HOW THE CRITERION IS TRIGGERED INCLUDING DETAILS OF THE IMPACT.	
* EIS refers to both the EIS process under the <i>EP Act</i> and the EIS process under the <i>State Development and Public Works Organisation Act 1971</i> .	
* There are numerous criteria used to make the EIS decision, for further information about the EIS process is available at www.qld.gov.au , using the search term 'environmental impact statements'.	

Section 30 – Waste

Attach a document that provides details of the proposed measures for minimising and managing waste generated by any amendment(s) to the relevant activity.

- ☒ I have attached a document that provides the required information; or
- ☐ If waste is to be managed according to an existing waste management plan, provide the name of the plan and the relevant page or section numbers below:

Insert.

Section 31 – Underground water rights

Does the proposed amendment involve changes to the exercise of underground water rights?

- ☒ No – Go to next section.
- ☐ Yes – Provide details below.

- ☐ I have attached a document that details:
- The areas in which underground water rights are proposed to be exercised;
 - For each aquifer affected, or likely to be affected, by the exercise of underground water rights:
 - a description of the aquifer;
 - an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers and surface water and
 - a description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights; and
 - the predicted quantities of water to be taken or interfered with because of the exercise of underground water rights during the period in which resource activities are carried out.
 - The environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values;
 - Any impacts on the quality of groundwater that will, or may happen because of the exercise of underground water rights during or after the period in which resource activities are carried out; and
 - Strategies for avoiding, mitigating or managing the predicted impacts on the environmental values of the impacts on the quality of groundwater.

For more information about exercising underground water rights or the associated requirements refer to the guideline [Requirements for site-specific and amendment applications - underground water rights \(ESR/2016/3275\)](#)

Section 32 – Estimated Rehabilitation Cost (ERC)

Do you currently have estimated rehabilitation cost funds held as part of the approved environmental authority?	☐ No – Go to next section. ☒ Yes – Provide details below.
☐ I will not need to change the estimated rehabilitation cost in relation to this amendment.	
☒ I will be applying for a new estimated rehabilitation cost decision if this amendment application is approved.	

Section 33 – Compliance and enforcement tools or site management plan

Is this land currently subject to an environmental enforcement order (EEO), environmental protection order (EPO), transitional environmental program (TEP) or a site management plan (SMP)?	☒ No – Go to next section. ☐ Yes (EEO) - provide details below. ☐ Yes (EPO) - provide details below. ☐ Yes (TEP) - provide details below. ☐ Yes (SMP) - provide details below.
PROVIDE THE REFERENCE NUMBER AND BRIEF DETAILS INCLUDING: DESCRIPTION OF LAND; LOT AND PLAN NUMBERS; AND LOCAL GOVERNMENT AREA. Insert.	

Section 34 – Environmental Management Register

Is any part of the land currently recorded in, or has previously been removed from, the environmental management register?	☒ No – Go to next section. ☐ Yes – Provide details below.
☐ The land is currently in the environmental management register.	
☐ The land has been removed from the environmental management register. <u>You must attach evidence (e.g. Notice) advising that the details have been removed.</u>	

Part 3—Declaration and payment of fees

All sections within Part 3 Declaration and payment of fees must be completed, regardless of the amendment application type.

Section 35 – Payment of fees

Application fee: \$ Insert.

- ☐ Email the completed application with a request to pay the application fee by Bpoint. Please do not email your credit card details – we will send you a link to pay securely by credit card by Bpoint.

An application fee is payable at the time the application is made. Information on the fee can be located in the information sheet [Fees for permits for environmentally relevant activities \(ERAs\) \(ESR/2015/1721\)](#). Where the proposed amendment is determined by the administering authority to be a major amendment, an assessment fee of 30% of the annual fee for the authority at the time of application, is also payable. The assessment fee is payable once notification of the assessment level decision is issued. The assessment fee must be paid before the assessment of the amendment application can proceed.

The supplementary annual fee is payable where the amendment is approved and results in the aggregate environmental score (and hence the annual fee) for the EA increasing. The supplementary annual fee is a pro-rata adjustment to the annual fee for the period from when the amended EA takes effect to the next anniversary day for the EA. This is payable within 20 business days after the approval date. The supplementary annual fee can be calculated using the [Fee calculator \(ESR/2015/1731\)](#).

Section 36 – Declaration

Note: If you have not told the truth in this application you may be prosecuted.

I declare that:

- I am the holder of the environmental authority, or authorised signatory for the holder of the environmental authority.
- The information I have provided is true and correct to the best of my knowledge.
- I understand that under section 480 of the EP Act, it is an offence to give the administering authority or an authorised person a document that contains information that I know, or ought reasonably know, to be false or misleading in a material particular.
- I understand that under section 480A of the EP Act, if I am required to give a document to the administering authority, it is an offence to give a document that I know, or ought reasonably to know, contains incomplete information in a material particular.
- I understand that failure to provide sufficient information may result in the application being refused. I understand that an incomplete application may be invalid. Invalid applications will be returned without processing and will only be processed if resubmitted with all invalidating issues addressed.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.
- If the proposed amendment is made, the relevant activities will continue to comply with the ERA Standard (eligibility criteria and standard conditions) for all eligible ERAs, or where they cannot comply, I have indicated otherwise in my application and provided the required supporting information.
- If the proposed amendment is made I will continue to comply with all conditions of my environmental authority as well as any relevant provisions in the *Environmental Protection Act 1994*.
- If the proposed amendment is made I will comply with all conditions and milestones of my PRCP schedule as well as any relevant provisions in the *Environmental Protection Act 1994*.

- I understand that I am responsible for managing the environmental impacts of these activities, and that approval of this application is not an endorsement by the administering authority of the effectiveness of management practices proposed or implemented.

Where an agreement is in place between all holders of the environmental authority, one holder can sign on behalf of the other joint holders. Please tick the checkbox below.

☒ I HAVE AUTHORITY TO SIGN THIS FORM ON BEHALF OF ALL THE JOINT HOLDERS OF THE ENVIRONMENTAL AUTHORITY.

Applicant's or authorised signatory's signature

FULL NAME Insert. <i>Michael Carter</i>	POSITION Insert. <i>Director</i>	COMPANY / ORGANISATION Insert. <i>Centurion Coal Mining Pty Ltd.</i>
SIGNATURE <i>[Signature]</i>		DATE Select. <i>23/9/2024</i>

Joint holder(s) signature if applicable

NAME, POSITION AND COMPANY NAME Insert.	SIGNATURE	DATE Select.
NAME, POSITION AND COMPANY NAME Insert.	SIGNATURE	DATE Select.

OR ☐ I HAVE ATTACHED A DOCUMENT THAT PROVIDES THE REQUIRED INFORMATION FOR ALL JOINT HOLDERS.

Where the environmental authority holder is a company, this form must be signed by an authorised person for that company. Where there is more than one holder of the environmental authority, this declaration is to be signed by all holders, unless there is an agreement between all holders that one can sign on behalf of the other(s).

If you are signing on behalf of the environmental authority holder(s) you must provide a letter of authorisation.

Submission and definitions

Submission

Please submit your completed application to:

Post Permit and Licence Management
Department of Environment, Science and Innovation
GPO Box 2454
BRISBANE QLD 4001

Enquiries Website: www.business.qld.gov.au
Phone: 1300 130 372 (Option 4)
Business Centre, Coal
Email: CRMining@des.qld.gov.au
Business Centre, Minerals
Email: ESCairns@des.qld.gov.au

Applications and enquiries should not be submitted to individual officers. The latest version of this publication can be found at [Application to amend an environmental authority \(ESR/2015/1733\)](#).

Definitions of terms used in this form	
(Where there is inconsistency between the definition of terms used here and the terms used in the EP Act, the terms in the EP Act apply)	
Available for improvement	In relation to land in an improvement area, means land in the area is not being mined, other than land to which any of the following applies– (a) the land is being used for operating infrastructure or machinery for mining, including, for example, a dam or water storage facility; (b) the land is identified in the PRCP schedule or the application for an environmental authority relating to the schedule as containing a probable or proved ore reserve that is to be mined within 10 years after the land would otherwise have become available for improvement; (c) the land is required for the mining of a probable or proved reserve mentioned in paragraph (b).
Available for rehabilitation	For a rehabilitation area, means land in the area is not being mined, unless– (a) the land is being used for operating infrastructure or machinery for mining, including, for example, a dam or water storage facility; or (b) the land is identified in the PRCP schedule or the application for an EA relating to the schedule as containing a probable or proved ore reserve, under section 126D(6) of the EP Act, that is to be mined within 10 years after the land would otherwise have become available for rehabilitation; or (ba) the land is required for the mining of a probable or proved reserve mentioned in paragraph b); or (c) the land contains permanent infrastructure identified in the proposed PRCP schedule as remaining on the land for a post-mining land use.
Eligibility criteria	For an environmentally relevant activity, means eligibility criteria that are in effect for the activity under – (a) An ERA standard; or (b) A code of environmental compliance; or (c) A regulation in respect of a mining activity.
Environmentally relevant activity (ERA)	A resource activity or a prescribed ERA.
ERA Project	A prescribed ERA project or a resource project.
ERA Standard	For an environmentally relevant activity, means the eligibility criteria and/ or the standard conditions set by the administering authority.
Improvement area	For a non-use management area, means an area of land in the non-use management area to which a management milestone relates.

Land outcome document	For land, means the following documents relating to the land– (a) an environmental authority for a resource activity on the land; (b) a document made under a condition of an environmental authority mentioned in paragraph (a), if– (i) the document relates to the management of a void within the meaning of section 126D of the EP Act on the land, or the rehabilitation of the land; and (ii) the document was received by the administering authority before the assent date; and (iii) the administering authority has not, within 20 business days after the assent date, given notice to the environmental authority holder that the document is insufficient in a material particular relevant to a matter mentioned in subparagraph (i); and (iv) before the assent date, the document has not been superseded; (c) a document made under a condition of an environmental authority mentioned in paragraph (a), if– (i) the document relates to the management of a void within the meaning of section 126D of the EP Act on the land, or the rehabilitation of the land; and (ii) the environmental authority requires the document to be given to the administering authority on a stated day that is on or after the assent date, or does not state a day when the document must be given; and (iii) the document is received by the administering authority within three years after the assent date; and (iv) the administering authority does not, within 20 business days after receiving the document, give the environmental authority holder a notice that the document is insufficient in a material particular relevant to a matter in subparagraph (i); (d) a report evaluating an EIS under the <i>State Development and Public Works Organisation Act 1971</i>, section 34D; (e) an EIS assessment report; (f) a written agreement between the holder of an environmental authority mentioned in paragraph (a) and the State that is in force on the assent date
Major amendment	For an environmental authority or PRCP schedule, means an amendment that is not a minor amendment.
Management milestone	For a non-use management area, means each significant event or step necessary to– (a) achieve best practice management of the area; and (b) minimise risks to the environment.
Minor amendment	For an environmental authority or PRCP schedule, means an amendment that is –

	(a) for an environmental authority – (i) a condition conversion; or (ii) a minor amendment (threshold); or (b) for a PRCP schedule – a minor amendment (PRCP threshold).
Minor amendment (PRCP threshold)	For a PRCP schedule, means an amendment that – (a) does not change a post-mining land use or non-use management area; or (b) does not affect whether a stable condition will be achieved for land under the schedule; or (c) does not change the way a post-mining land use will be achieved, or a non-use management area will be managed, in a way likely to result in significantly different impact on environmental values compared to the impacts on the values under the schedule before the change; or (d) does not relate to a new mining tenure for the schedule; or (e) does not change when a rehabilitation milestone or management milestone will be achieved by more than 5 years after the time stated in the schedule when it was first approved; or (f) does not extend the day by which rehabilitation of land to a stable condition will be achieved.
Minor amendment (threshold)	For an environmental authority, means an amendment that the administering authority is satisfied— (a) is not a change to a condition identified in the authority as a standard condition, other than— (i) a change that is a condition conversion; or (ii) a change that is not a condition conversion but that replaces a standard condition of the authority with a standard condition for the environmentally relevant activity to which the authority relates; or (iii) a change that will not result in a change to the impact of the relevant activity on an environmental value; and (b) does not significantly increase the level of environmental harm caused by the relevant activity; and (c) does not change any rehabilitation objectives stated in the authority in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the authority; and (d) does not significantly increase the scale or intensity of the relevant activity; and (e) does not relate to a new relevant resource tenure for the authority that is— (i) a new mining lease; or (ii) a new petroleum lease; or

	(iii) a new geothermal lease under the Geothermal Energy Act; or (iv) a new GHG injection and storage lease under the GHG storage Act; and (f) involves an addition to the surface area for the relevant activity of no more than 10% of the existing area; and (g) for an environmental authority for a petroleum activity— (i) if the amendment involves constructing a new pipeline— the new pipeline does not exceed 150km; and (ii) if the amendment involves extending an existing pipeline—the extension does not exceed 10% of the existing length of the pipeline; and (h) if the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—the amendment application under section 224 seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit.
Non-use management area	Means an area of land the subject of a PRC plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC plan carried out on the land have ended.
Post-mining land use	For land the subject of a PRC plan, means the purpose for which the land will be used after all relevant activities for the PRC plan carried out on the land have ended.
PRC plan	For land the subject of a mining lease, means a progressive rehabilitation and closure plan for the land that consists of – (a) the rehabilitation planning part of the PRC plan; and (b) the PRCP schedule for the PRC plan, including any conditions imposed on the schedule.
PRCP schedule	For a PRC plan, means a schedule of the plan that – (a) complies with section 126D of the EP Act; and (b) is approved under chapter 5, part 5, division 2 of the EP Act, with or without conditions.
Prescribed ERA	An environmentally relevant activity that is not a resource activity and is prescribed under section 19 of the EP Act.
Prescribed ERA project	All prescribed ERAs carried out, or proposed to be carried out, as a single integrated operation.
Registered suitable operator	A person who, or a corporation which, under section 318I of the EP Act has been assessed as being suitable to carry out an ERA and has been listed on the suitable operator register.

Rehabilitation area	For land the subject of a post-mining land use, means an area of the land to which a rehabilitation milestone for the post-mining land use relates.
Rehabilitation milestone	For the rehabilitation of land, means each significant event or step necessary to rehabilitate the land to a stable condition.
Resource activity	An activity that is any of the following: (a) a geothermal activity (b) a greenhouse gas (GHG) storage activity (c) a mining activity (d) a petroleum activity.
Resource project	Resource activities carried out, or proposed to be carried out, under 1 or more resource tenures, in any combination, as a single integrated operation.
Single integrated operation	Occurs when all of the below criteria are met: (a) the activities are carried out under the day-to-day management of a single responsible individual, for example, a site or operations manager; (b) the activities are operationally interrelated; (c) the activities are, or will be, carried out at one or more places; and (d) the places where the activities are carried out are separated by distances short enough to make feasible the integrated day-to-day management of the activities.
Underground water rights	Means any of the following: (a) underground water rights within the meaning of the <i>Mineral Resources Act 1989</i> ; (b) underground water rights within the meaning of the <i>Petroleum and Gas (Production and Safety) Act 2004</i> ; (c) underground water rights within the meaning of the <i>Petroleum Act 1923</i> , section 87(3).

Attachment 1—Spatial data requirements for PRC plan

Attachment 1 provides guidance on the required content of spatial information (shapefiles) for the submission of a proposed amendment to a PRCP schedule. Spatial information is only required to be submitted with an amendment application where the application proposes to amend the final site design of the current approved PRCP schedule. This attachment should be read in conjunction with the department's [Guideline - Spatial Information Submission \(ESR/2018/4337\)](#). The following sections provide information about the required fields and attributes for datasets.

Required files—Table 1

If the application proposes to amend the final site design of the current approved PRCP schedule, you must submit shapefiles detailing the following in relation to the proposed amendment:

- the location and maximum extent of disturbance footprint for the mine life
- the PMLU and NUMAs for the area within the resource tenure(s)
- the rehabilitation and improvement areas within the resource tenure(s)
- any sensitive receptors
- extent of a floodplain
- existing rehabilitation.

A minimum of one (1) shapefile must be submitted for a PRC plan, detailing all the above-listed information, as outlined within Table 1. Each file must be named in accordance with the requirements outlined within the department's [Guideline - Spatial Information Submission \(ESR/2018/4337\)](#).

A spreadsheet containing the schema (in Table 2) and a shapefile template for PCR plan are available on the department's website at www.des.qld.gov.au, using the search term "submission of spatial information".

Table 1: Shapefile checklist

File	Spatial information requirement	Schema	Example file name (e.g. using submission date of 30 June 2020)
1	PRC plan - polygon	Table 2	EP00372556_PRCP_PY_30062020.zip

Where:

PY = polygon (geometry)

Table 2: Schema for PCR plan

Field Name	Type	Length	Definition	Domain Values ¹	Domain Value Description	Mandatory/ Optional
PERMIT_REF	TEXT	50	The alpha-numeric environmental authority number relevant to the spatial information (if this PRC plan does not relate to an existing EA, please provide the relevant application number instead).			Mandatory
PROCESS	TEXT	4	The relevant process spatial data is being submitted for	PRCP	Progressive rehabilitation and closure plan	Mandatory
SITE_NAME	TEXT	254	Site name relating to the environmental authority.			Mandatory
SITE_ID	TEXT	20	This field contains a unique identifier for the spatial feature, which has been generated by the applicant.			Mandatory
FEATURE	TEXT	10	This field contains the land use feature on site which this polygon or point is describing. Select the relevant option of either post-mining land use, rehabilitation area, non-use management area, improvement area, maximum disturbance footprint, sensitive receptor, existing rehabilitation or floodplain using the codes specified.	PMLU	Post-mining land use	Mandatory
				REHAB_AREA	Rehabilitation area	Mandatory
				NUMA	Non-use management area	Mandatory if the PRC plan schedule proposes or changes a non-use management area
				IMPRV_AREA	Improvement area	Mandatory if the PRC plan schedule proposes or changes a non-use management area
				FOOTPRINT	Maximum disturbance footprint over mine life	Mandatory
				SR	Sensitive receptor	Mandatory
				EX_REH	Existing rehabilitation	Mandatory if the application is for an

¹ If blank, populate based on Attribute type & definition

						existing EA and there is existing rehabilitation undertaken
				FLDP	Floodplain	Mandatory if there is a floodplain located within the EA boundary
FEAT_DESC	TEXT	254	Feature description		This field provides a description of the feature identified in 'FEATURE'.	Mandatory
PMLU_TYPE	TEXT	10	This field provides a description of the post mining land use type. If PMLU_TYPE is 'Other' additional information in the comments field is required.	GRAZ	Grazing	Mandatory for each PMLU.
				NAT_ECO	Native ecosystem	
				WTR_ST	Water storage	
				REC	Recreation	
				HB_ECS	Habitat and ecosystem services	
				AGRI	Agriculture	
				FOR	Forestry	
				CROP	Cropping	
				PERM_INFRA	Permanent infrastructure	
				IND	Industrial	
DATE_SUBMT	DATE	dd/mm/yyyy	Date of submission. This field identifies the date the spatial information was submitted.	LNDFL	Landfill	Mandatory
				Oth	Other	
SOURCE	TEXT	5	This field identifies the source of the spatial information and the capture methodology for the spatial information provided.		Date of submission	Mandatory
				DIG	Digitising (Tracing over Ortho Imagery)	
				GPSD	GPS Differential Survey	
				GPSND	GPS Non Differential Survey	
				RTK	Real-Time Kinematic (RTK) Survey	
AREA_HA	DOUBLE	N/A	This field indicates the area in Hectares. (Polygon only)	UK	Unknown	Mandatory if GEOMETRY = polygon.

COMMENTS	TEXT	254	A free text field has been provided to include any additional information the proponent wishes to provide in relation to the data.			Mandatory if PMLU_TYPE = Oth
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CENTURION NORTH

Progressive Rehabilitation and Closure Plan

Prepared for: Department of Environment, Science and Innovation

Prepared by: Peabody Energy Australia Pty Ltd

EA and PRCP Schedule holder: Centurion Coal Mining Pty Ltd

Tenure number: ML 1790 and ML 70495

Version: 001

Date of Submission: 13 September 2024

TABLE OF CONTENTS

1.	Introduction	1
2.	SECTION A: REHABILITATION PROJECT PLANNING	4
2.1	Project description	4
2.1.1	Mining tenements	4
2.1.2	Primary mine features and infrastructure on-site	6
2.1.3	Type of mining operation	9
2.1.4	Proposed duration of the operation	9
2.2	Baseline information	9
2.2.1	Site topography	10
2.2.2	Climate	10
2.2.2.1	Temperature	10
2.2.2.2	Rainfall.....	10
2.2.2.3	Evaporation	11
2.2.2.4	Wind	11
2.2.3	Geological setting.....	11
2.2.3.1	Coal seams.....	12
2.2.4	Site hydrology and fluvial networks.....	12
2.2.5	Groundwater levels and properties	17
2.2.6	Soil types, properties and productivity	20
2.2.7	Land stability	23
2.2.8	Vegetation communities and ecological data.....	24
2.2.8.1	Vegetation communities	24
2.2.8.2	Category B environmental sensitive areas – endangered regional ecosystems	31
2.2.8.3	Threatened ecological communities	31
2.2.8.4	Threatened flora	31
2.2.9	Fauna presence and populations	34
2.2.9.2	Migratory Fauna.....	37
2.2.9.3	Pest Fauna	37
2.2.10	Pre-mining land use.....	38
2.2.11	Underlying landholders	39
2.3	Design for closure.....	39
2.4	Rehabilitation and improvement planning	41
2.4.1	Relevant activities	41
2.4.2	Rehabilitation areas and milestones.....	41
2.4.3	Existing rehabilitation.....	42
2.4.4	Seismic activities	43
3.	Community consultation	44
3.1	Consultation to date.....	44
3.2	Community consultation register	45
3.3	Ongoing consultation	50
3.3.1	Consultation objectives, engagement type and frequency	50
3.3.2	Consultation objectives, engagement type and frequency	53
3.3.3	Addressing feedback and comments	53
4.	Post-mining land uses.....	54
4.1	Nominated PMLUs	54
4.1.1	Grazing land suitability	56

4.2	Community Consultation	58
4.3	Regional planning integration	58
5.	Non-use management areas	60
5.1	Nominated NUMAs	61
5.2	Management methods	61
5.3	Community considerations	61
5.4	Regional planning integration	61
6.	Voids in floodplains	62
7.	Rehabilitation and management methodology	63
7.1	General rehabilitation practices	63
7.1.1	Hydrogeology	63
7.1.2	Flooding.....	66
7.1.3	Waste characterisation	68
7.1.4	Soil and capping material	68
7.1.4.1	Topsoil stripping.....	68
7.1.4.2	Topsoil management.....	69
7.1.4.3	Topsoil application	69
7.1.4.4	Amelioration requirements.....	69
7.1.5	Landform design.....	71
7.1.5.1	Landform structures.....	71
7.1.5.2	Erosion assessment	71
7.1.5.3	Slope profile design	71
7.1.5.4	Hydrological and hydrogeological assessments.....	71
7.1.5.5	Waste placement strategy	71
7.1.5.6	Specific landform requirements.....	72
7.1.5.7	Monitoring of control measures	72
7.1.5.8	Long-term landform stability	72
7.1.5.9	Quality assurance / quality control	72
7.1.5.10	Trial methodology	72
7.1.6	Cover design.....	72
7.1.7	Water Management.....	73
7.1.8	Revegetation	73
7.1.8.1	Revegetation objectives	74
7.1.8.2	Revegetation species and seed mixes for a cattle grazing PMLU	74
7.1.8.3	Establishing and managing revegetation	75
7.1.8.4	Topsoil.....	75
7.2	Tailings storage facility	76
7.3	Voids	77
7.3.1	Mining final void.....	77
7.3.2	Final void dimensions.....	77
7.3.3	Final void wall stability	77
7.3.4	Final void wall angles.....	78
7.3.5	Void hydrology	78
7.3.6	Design plan	78
7.3.7	Rehabilitation and management strategies.....	78
7.4	Underground mining	78
7.5	Built infrastructure	78
7.5.1	Decommissioning, demolition and removal	79
7.5.1.1	Exploration	79

7.5.2	Contaminated land assessment	79
7.6	Summary of key rehabilitation and management practices.....	80
8.	Risk assessment	83
8.1	Identifying, assessing and treating risks	83
8.1.1	Risk methodology	83
8.2	Risk identification	84
8.2.1	Risk analysis, evaluation and relevant treatments	84
9.	Monitoring and maintenance	91
9.1.1	Analogue sites and grazing PMLU monitoring	93
9.1.2	Rehabilitation monitoring phases	93
9.2	Initial monitoring method.....	95
9.2.1	Desktop monitoring	95
9.2.2	Field monitoring	95
9.2.2.1	Landform and erosion	95
9.2.2.2	Soil and spoil	96
9.2.2.3	Vegetation	98
9.2.2.4	Groundwater	98
9.3	Minor monitoring methods	98
9.3.1	Desktop monitoring	98
9.3.2	Field monitoring	99
9.3.2.1	Landform and erosion	99
9.3.2.2	Soils and spoil	99
9.3.2.3	Vegetation	99
9.4	Major monitoring methods.....	100
9.4.1	Desktop monitoring	100
9.4.2	Field monitoring	100
9.4.2.1	Landform and erosion	100
9.4.2.2	Soil and spoil	100
9.4.2.3	Vegetation	100
9.4.2.4	Grazing land suitability assessment	102
9.5	Achieving monitoring across the PRCP schedule	103
9.6	Maintenance.....	103
9.7	Data analysis and reporting	103
9.8	Quality assurance and quality control	103
10.	SECTION B: PRCP SCHEDULE	105
10.1	Final site design.....	105
10.2	Post-mining land use milestones.....	107
10.3	Non-use management area milestones	112
10.4	Reference maps	112
10.5	Schedule	114
11.	REFERENCES	116
12.	APPENDICES	119

Appendices

- Appendix 1 Environmental Authority EA (P-EA-100658735) (3 September 2024).
Appendix 2 Golder Associate (23 December 2020): Wards Well Mine – PRCP Hydrogeological Conceptual Model. Ref. No. 20360652-001-R-REVA.
Appendix 3 Ecological Australia (10 June 2016): Wards Well/Lancewood Brigalow TEC Assessment.

Appendix 4	Ecological Australia (18 August 2017): Wards Well Coal Project- Ecological Assessment Report. Project No. 17 BRIECO-4089.
Appendix 5	Sinclair Knight Merz (26 June 2012): Wards Well Mine Project: Soil Survey. Version A, Ref No. QE09811.
Appendix 6	SMC Wards Well PRCP Community Consultation Plan and Stakeholder Register.
Appendix 7	NOT USED
Appendix 8	BHP (10 February 2021): Preliminary Site Investigation Wards Well Mine.
Appendix 9	NOT USED
Appendix 10	Wards Well PRCP Risk Assessment.
Appendix 11	NOT USED

Tables

Table 1	Wards Well mining tenements.....	6
Table 2	Primary mine features and infrastructure at Wards Well, as approved within the EA	6
Table 3	Moranbah monthly average rainfall	11
Table 4	Water environmental values for the Wards Well area	13
Table 5	Summary of Wards Well watercourses and dams	16
Table 6	Soil types within the Centurion North area	20
Table 7	Rehabilitation-related chemical properties and productivity of soil types found within the Centurion North area	21
Table 8	Vegetation communities ground-truthed within the Wards Well area	25
Table 9	Ground-truthed REs within the Study Area	28
Table 10	Fauna populations within the Wards Well area	34
Table 11	Underlying landholders for the Wards Well project area	39
Table 12	Relevant activities requiring rehabilitation at Wards Well	41
Table 13	Rehabilitation areas (RAs) and rehabilitation milestones (RMs) for Wards Well	42
Table 14	Key stakeholders identified as part of the Wards Well’s community consultation register	47
Table 15	Process to be followed for ongoing community consultation for the Centurion North PRCP.....	50
Table 16	Wards Well EA post-mine land use objectives, indicators and acceptance criteria for cattle grazing.....	55
Table 17	Land suitability ruleset for cattle grazing on rehabilitation at Centurion North	57
Table 18	Recommended topsoil stripping depths and stockpile heights for Centurion North	68
Table 19	Recommended sufficiency levels for rehabilitation materials at Wards Well	70
Table 20	Landform structures for Centurion North.....	71
Table 21	Recommended species list and sowing rates for a mixed native/exotic pasture for sustainable beef cattle grazing on Centurion North soils during rehabilitation.....	74
Table 22	Infrastructure associated with the approved Wards Well activities.....	79
Table 23	Key rehabilitation activities identified to drive achievement of Centurion North’s rehabilitation milestones	82

Table 24	Necessary risk treatments identified to achieve a stable condition for the PMLU	85
Table 25	Rehabilitation milestones with relevant reporting requirements	91
Table 26	Rehabilitation parameters measured during rehabilitation monitoring phases.....	94
Table 27	Soil and soil analysis parameters for Wards Well’s monitoring programs	96
Table 28	States of erosion.....	99
Table 29	Preferred, intermediate and undesirable pasture species	101
Table 30	Pasture condition assessment table (criteria to assign pasture rankings).....	101
Table 31	Centurion North rehabilitation areas and relevant rehabilitation milestones	107
Table 32	Centurion North rehabilitation milestones and milestone criteria.....	108

Figures

Figure 1	Regional Location map	3
Figure 2	Mining tenements	5
Figure 3	Existing and Authorised EA Disturbance	8
Figure 4	General site topography at Wards Well.....	10
Figure 5	Ephemeral Eaglefield, Kennedy and Charlie creeks and their tributaries that drain the Wards Well area within the Burdekin Basin to the west.....	13
Figure 6	Watercourses and Drainage.....	15
Figure 7	Wards Well baseline hydrogeological conceptual model (Golder, 2020).....	18
Figure 8	Groundwater management areas.....	19
Figure 9	Soils map	22
Figure 10	Areas in Wards Well that are characteristic of the local soil types and vegetation - a) Brigalow and grasslands with cattle grazing on cracking clay Vertosols; b) Ironbark, Brigalow and erosion-prone areas on Sodosols; c) Low shrubs and grassland with cattle grazing on Dermosols and d) Open grasslands with remnant vegetation and cattle grazing on Kandosols.....	23
Figure 11	Evidence of surface erosion due to existing grazing activities and historical land clearance in the Wards Well area - a) Sheet erosion adjacent to creek; b) Stream bank erosion; c) Sheet erosion leading to flow concentrating features; and d) Stream bank erosion.....	24
Figure 12	TEC mapping.....	33
Figure 13	Evidence of existing cattle grazing-related land uses at Wards Well	38
Figure 14	Land ownership	40
Figure 15	Wards Well drill site DB12 before and after rehabilitation	43
Figure 16	Potentiometric surface-tertiary	65
Figure 17	DoR 1% AEP flood depths (left) and extreme event flood depths (right)	67
Figure 18	Summary of key rehabilitation and management practices for Centurion North	81
Figure 19	ISO 3100-compliant risk-based approach followed for the Centurion North PRCP	83
Figure 20	Likelihood and severity tables, with resulting residual risk rating (RRR) heat map.....	85
Figure 21	Flow diagram of the Centurion North rehabilitation monitoring program	94
Figure 22	Quality assurance/quality control process to be followed for ongoing rehabilitation monitoring at Centurion North	104
Figure 23	Centurion North final site design	106
Figure 24	Centurion North reference map.....	114

GLOSSARY of TERMS and ABBREVIATIONS

Key terms and abbreviations, and associated definitions used in this report are listed below.

Term / abbreviation	Description
2D / 3D	2-dimensional / 3-dimensional
3P grasses	Perennial, productive and palatable
AEP	Annual exceedance probability
AMD	Acid and Metalliferous Drainage (AMD). Includes acid/acidic drainage (AD), pH-neutral and metalliferous drainage (NMD) and sulphide-derived saline drainage (SD) – and/or any combination of these.
AMWU	Australian Manufacturing Workers’ Union
ASC	Australian Soil Classification
bcm	Bank cubic meter. One cubic meter of material as it lies in the natural bank state.
Biodiversity Act	Biodiversity Act 2004 (Queensland)
BMC	BHP Mitsui Coal Pty Limited
BOM	Bureau of Meteorology (Australia)
CCP	Community Consultation Plan
CEC	Cation exchange capacity
CFMEU	Construction, Forestry, Mining and Energy Union
CHPP	Coal handling and preparation plant
C-RES	BHP cost-neutral organization. (BMC’s community-related Local Buying Program is delivered in a strategic partnership between BHP and C-RES).
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DAWE	Department of Agriculture, Water and Environment (Australia)
DEM	Digital elevation model
DESI	Department of Environment, Science and Innovation (Queensland) (The Adminstrating Authority)
DM	Dry matter (with reference to vegetation)
DoR	Department of Resources (Queensland)
DSI	Detailed site investigation
DSITI	Department of Science, Information Technology and Innovation (Queensland)
DTMR	Department of Transport and Main Roads (Queensland)
EA	Environmental Authority (in terms of the Environmental Protection Act 1994, Queensland)
EC	Electrical conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP Act	Environmental Protection Act 1994 (Queensland)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERA	Environmentally relevant activities
ESP	Exchangeable sodium percentage
ETU	Electrical Trades Union
FCCM	Fort Cooper Coal Measures
FOS	Factor of safety
GL	Goonyella Lower coal seam
GM	Goonyella Middle coal seam

GLOSSARY of TERMS and ABBREVIATIONS

Key terms and abbreviations, and associated definitions used in this report are listed below.

Term / abbreviation	Description
GP	Goonyella P coal seam
Ha	Hectares
Interburden	Non-carbonaceous or carbonaceous mine waste located between coal seams. In this report the term ‘overburden’ shall be used to define overburden and interburden.
IRC	Isaac Regional Council
km	Kilometer
lcm	Loose cubic meter. One cubic meter of material which has been disturbed and has swelled as a result of movement
LGA	Local Government Area
LOA	Life-of-asset
LOD	Land outcomes document
LOM	Life-of-mine
LSA	Land suitability assessment
MERFP Act	Mineral and Energy Resources (Financial Provisioning) Act 2018 (Queensland)
Mine waste	Material comprising overburden, ± coarse/fine reject (dewatered), ± waste coal. Sometimes called ‘mineral waste’ or ‘mining waste’.
ML	Mining Lease
MLES	Matter of local environmental significance
MNES	Matter of national environment significance
MCM	Moranbah Coal Measures
MSES	Matter of state environmental significance
NAF	Non-acid forming
NC Act	Nature Conservation Act 1992 (Queensland)
NEPM	National environment protection measure
NNTT	National Native Title Tribunal - an independent body established under the Native Title Act 1993 in Australia as a special measure for the advancement and protection of Aboriginal and Torres Strait Islander peoples.
NUMA	Non-use management area
Overburden	Non-carbonaceous or carbonaceous mineral waste located above (overburden proper) or between (interburden) coal seams. Carbonaceous overburden is generated during mining of non-ore material and may be represented by sedimentary units (non-coal) rich in organic carbon. Carbonaceous overburden does not include coarse reject, seam floor, seam roof or coal partings. Overburden reports to spoils dumps.
Overburden stockpile	Out-of-pit landform containing mine waste (also referred to as a spoil dump or waste dump)
PAF	Potentially acid forming
PMLU	Post-mining land use
PRC plan	Progressive Rehabilitation and Closure Plan (in terms of the Environmental Protection Act 1994 (Queensland))
PRCP Guideline	Progressive Rehabilitation and Closure Plan Guideline (November 2019) (DES, Queensland)
PSI	Preliminary site investigation

GLOSSARY of TERMS and ABBREVIATIONS

Key terms and abbreviations, and associated definitions used in this report are listed below.

Term / abbreviation	Description
RA	Rehabilitation area. As defined in the PRCP Guideline: a rehabilitation area, for a post-mine land use, means an area of land in the post-mine land use to which a rehabilitation milestone for the post-mining use relates.
RE	Regional ecosystems
Reject	Waste material produced during coal washing, separated from run-of-mine (ROM) coal in the coal handling and preparation plant (CHPP). Can be separated and disposed as fine rejects (tailings) and coarse reject, or co-disposed as mixed plant reject which is a mixture of coarse reject and 'dewatered' fine reject
Remnant coal	In-situ coal that remains exposed on the pit walls (highwall) and/or pit floor. Remnant coal can be ore grade or waste coal. Remnant coal can be fresh, oxidized or coked (heat affected).
ROM	Run-of-mine
RM	Rehabilitation milestone. As defined in the PRCP Guideline: a rehabilitation milestone, for the rehabilitated land, means each significant event or step necessary to rehabilitate the land to a stable condition (section 115 of the <i>EP Act</i>).
RRR	Residual risk rating (with reference to the risk assessment)
Qld	Queensland
SEVT	Semi-evergreen vine thicket
SMART	Specific, measurable, achievable, reasonable/relevant, time-specific
Spoil	Mine waste comprising non-ore (non-ROM) material such as overburden and waste coal. Within this report, unless stated otherwise, spoil is assessed as a whole (bulk material) with no distinction made between carbonaceous and non-carbonaceous overburden.
SPR	Source-pathway-receptor
TDS	Total dissolved solids
TEC	Threatened ecological communities
Waste coal	Sub-economical coal that reports to the spoil dumps as waste. Waste coal can be fresh or oxidised. All oxidised and coked (cindered) coal is waste.
WQOs	Water Quality Objectives
WW	Wards Well

1. INTRODUCTION

Stanmore SMC Pty Ltd (SMC) is a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore). SMC is the holder of mining leases (ML) 1790, ML 4752, ML 70443 and ML 70495, together referred to as the Wards Well MLs. The Wards Well MLs are situated in Bowen Basin, central Queensland, approximately 40 to 60 km north of Moranbah, as shown in *Figure 1*.

Stanmore acquired BHP Mitsui Coal Pty Ltd (BMC), formerly a subsidiary of BHP Group Limited (BHP), on 3 May 2022. BMC was renamed as SMC on 11 May 2022. The Wards Well MLs were held by BMC prior to the acquisition.

The Wards Well MLs are subject to an environmental authority (EA) with environmentally relevant activities (ERAs) listed in the EA. A Progressive Rehabilitation and Closure Plan (PRC plan / PRCP) schedule for Wards Well MLs was originally approved by the Department of Environment and Science (DES) on 31/01/2022.

DES approved an amendment to the Wards Well EA and PRCP schedule on 29 April 2024, which authorised additional exploration activities.

Details of the EA and PRCP schedule are:

- Environmental Authority and PRCP schedule Holder: Centurion Coal Mine Pty Ltd
- Environmental Authority Number: P-EA-100658735 (03 September 2024)
- PRCP Schedule Number: P-PRCP-100669070_V1
- Land description ML 1790, ML 70495, ML 70443, ML 4752

It is proposed to de-amalgamate the Wards Well MLs as SMC is proposing to transfer ML 1790 and ML 70495 to Centurion Coal Mining Pty Ltd (Centurion) a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (ACN 096 909 410) with the overall parent company being Peabody Energy Corporation (Peabody), with these two MLs hereafter referred to as the Centurion North MLs (also 'Centurion North'). ML 4752 and ML 70443 will continue to be held by SMC and are hereafter referred to as the Lancewood MLs (also 'Lancewood').

It is noted that realignment of the boundaries of the Wards Well MLs was approved by the Department of Resources on 12/03/2024 and subsequently updated on the Department mapping system. The overall size and shape of the combined Wards Well MLs was unchanged by the internal boundary realignment. This PRC plan describes the realigned ML boundaries, except where noted.

This PRC plan has been prepared for the Centurion North MLs:

- in accordance with the amendments promulgated via the Mineral and Energy Resources (Financial Provisioning) Act 2018 (*MERFP Act*) to the Environmental Protection Act 1994 (*EP Act*).
- on the basis that environmentally relevant activities (ERAs) listed on the Wards Well EA (Appendix 1) will be apportioned to the Centurion North MLs where those ERAs are currently listed on the EA for the MLs.
- to meet the requirements of the Progressive Rehabilitation and Closure Plan Guideline (PRCP Guideline).

This PRC plan refers to the Wards Well MLs (also 'Wards Well') in the context of historical or background information that formed part of the original PRC plan application in February 2021 that resulted in the current approved PRCP schedule. However, this PRC plan has been modified to remove reference to activities that will not form part of the Centurion North MLs. Appendices to this PRC plan are the same as

those that supported the original PRC plan application, and therefore reference the original Wards Well MLs. Never-the-less these appendices continue to provide relevant and useful information to support this PRC plan.

The EA for the Wards Well MLs was the land outcome document (LOD) for the approved PRP schedule.

This PRC plan comprises two parts:

- **Section A:** Rehabilitation planning part – provides information about the site, the rehabilitation plans, and evidence and justification to support the development of the proposed PRCP schedule; and
- **Section B:** PRCP schedule – includes maps of rehabilitation and closure outcomes for the site and tables of time-based milestones.

This PRC plan also includes **Section C: Appendices**, which provides key information and specialist studies used to support development of this plan.

PRCP for exploration activities

The current EA and PRCP schedule allow for bulk sample and other exploration activities at Wards Well. However, bulk sample activities (box cut, bulk sample, underground and associated infrastructure) are not proposed on the Centurion North MLs at this time and therefore this PRC plan does not describe rehabilitation of bulk sample activities. The rehabilitation activities described in this PRC plan relate solely to the exploration activities as proposed for de-amalgamation of the approved current EA.

The uncertain nature of the outcomes of the exploration activities and the potential requirement for a future amendment process have been taken into consideration in development of the PRCP schedule.

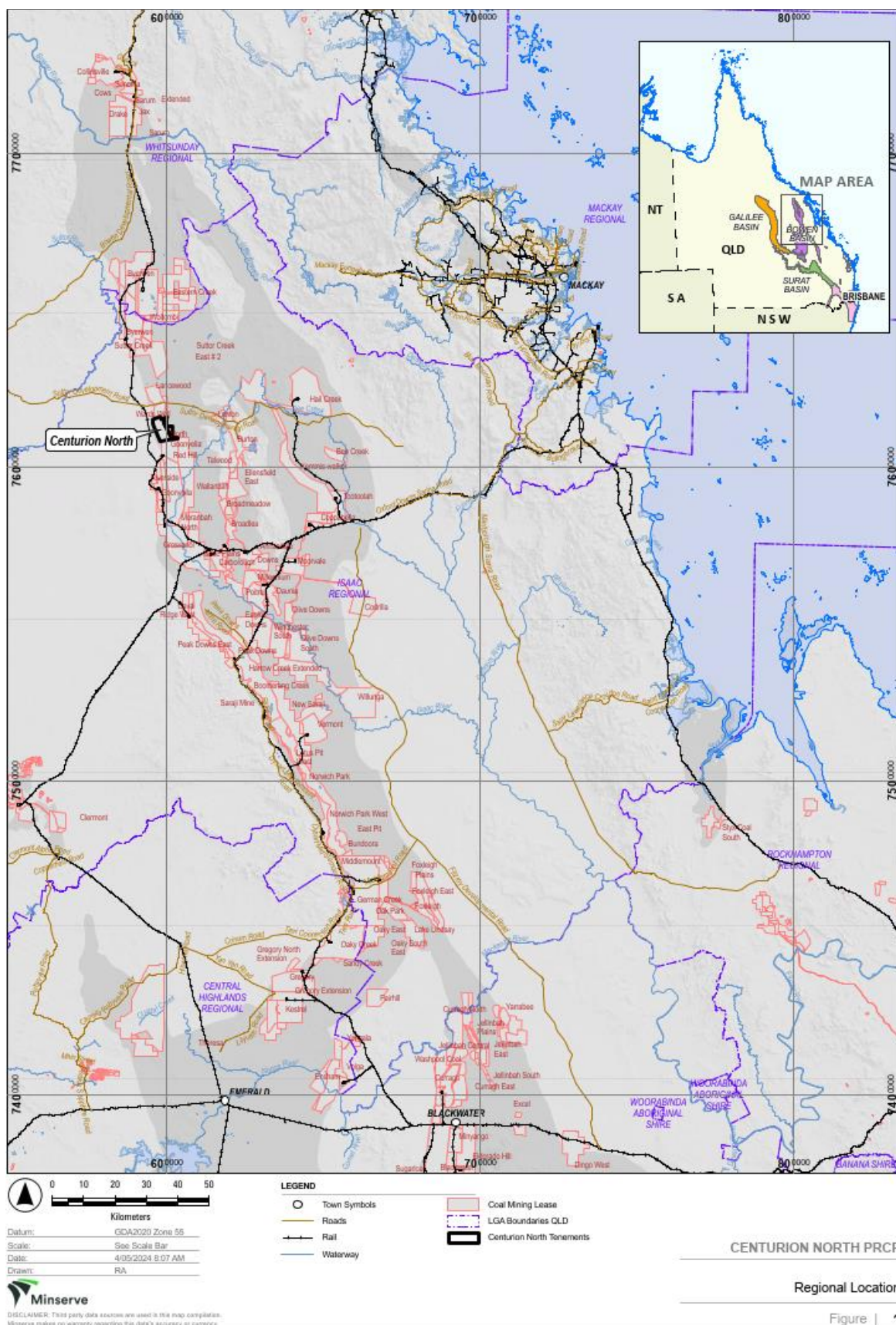


Figure 1 Regional Location map

2. SECTION A: REHABILITATION PROJECT PLANNING

Legislative Requirement

In accordance with Section 126C(1)(b) and (c)(ii) of the *EP Act*, the rehabilitation planning part of the PRC plan must include a description of:

- each resource tenure, including the area of each tenure;
- the relevant activities to which the application relates;
- the likely duration of the relevant activities; and
- how and where the relevant activities are to be carried out, including maps.

PRCP Guideline

The following spatial information must be submitted as part of the PRC plan:

- the location and maximum extent of disturbance footprint for the mine life;
- the PMLUs and NUMAs for the area within the resource tenures; and
- any sensitive receptors.

In addition to the list above, the PRC plan must include spatial information outlining the rehabilitation and improvement areas that correspond to the proposed PRCP schedule. The spatial information must show the locations of the rehabilitation and improvement areas for a 10-year period (minimum).

All spatial information must be prepared and submitted in accordance with the guideline '*Spatial Information Submission*' (ESR/2018/4337).

2.1 Project description

Centurion North is located within the northern region of the Bowen Basin approximately 30 kilometres (km) south of Glenden and approximately 150km south-west of Mackay in Central Queensland (Qld). It is located immediately to the north of the existing Centurion Mine (owned and operated by Peabody) and approximately 50km north of Moranbah (*Figure 1*).

Suttor Development Road is a public road that runs east-west to the north of Centurion North. Site access is either via Red Hill Road from the south and/or Suttor Development Road.

Centurion North covers approximately 3,471 hectares (ha) and is identified as a hard coking coal resource.

EA EPPR00668513 limits activity at Wards Well to bulk sample exploration and other exploration activities. Exploration drilling and seismic surveys have been occurring since the 1970s. It is anticipated that exploration drilling will continue on the Centurion North MLs in accordance with the EA and PRC schedule requirements (or subsequent amendments) until a sufficient understanding of the resource is gained, further informing bulk sample exploration and future mining operations.

2.1.1 Mining tenements

Details of the Wards Well MLs are provided in **Table 1** along with the location and boundaries of these MLs shown in **Figure 2**.



Table 1 Wards Well mining tenements

Mining Lease	Name	EA holder	Purpose	Area (ha)
ML 4752	Lancewood	Stanmore SMC PTY LTD	Mining for coal and mineral hydrocarbons	4,027.2
ML 1790	Wards Well (part of Centurion North)	Stanmore SMC PTY LTD	Mining for coal and mineral hydrocarbons	2,722.8
ML 70443	Wards Well East (part of Lancewood)	Stanmore SMC PTY LTD	Mining coal	611.4
ML 70495	Wards Well South-east (part of Centurion North)	Stanmore SMC PTY LTD	Mining coal	747.8
Total area				8,109.20

2.1.2 Primary mine features and infrastructure on-site

The main features and infrastructure approved within the EA for Wards Well are summarised in **Table 2** and illustrated in **Figure 3**. **Table 2** identifies whether the mine features and infrastructure are applicable to the Centurion North MLs. Activities that are not applicable do not form part of this PRC plan and PRCP schedule.

Table 2 Primary mine features and infrastructure at Wards Well, as approved within the EA

Mine domain	Mine feature name	Applicability to the Centurion North MLs
Exploration activities	Drill holes and pads LOX line drilling 3D seismic survey program	Drill holes and pads are authorised on the Centurion North MLs. Lox line drilling and 3D seismic survey program are not currently authorised on the Centurion North MLs. Some additional access tracks required where existing tracks are not suitable.
	Access roads & tracks	
Exploration box-cut area	Box-cut pit	Not applicable
Combined bulk sample area	Overburden stockpile Topsoil stockpiles Run-of-mine (ROM) coal stockpile Water management infrastructure, including mine water dam and stormwater dam	Not applicable
Underground	Underground exploration drive	Not applicable
Dams	Mine water dam Stormwater dam	Not applicable

Mine domain	Mine feature name	Applicability to the Centurion North MLs
Ancillary infrastructure	Industrial area and workshop	Not applicable, other than roads and tracks to support drill holes and pads (moved to Exploration activities domain)
	Administration area	
	Laydown areas	
	Roads and tracks	
	Exploration camp accommodation including sewage treatment plant	

Historical exploration drilling and seismic surveys are shown in the final site design map (**Figure 23**), as well as included in the hectares in the PRCP schedule.

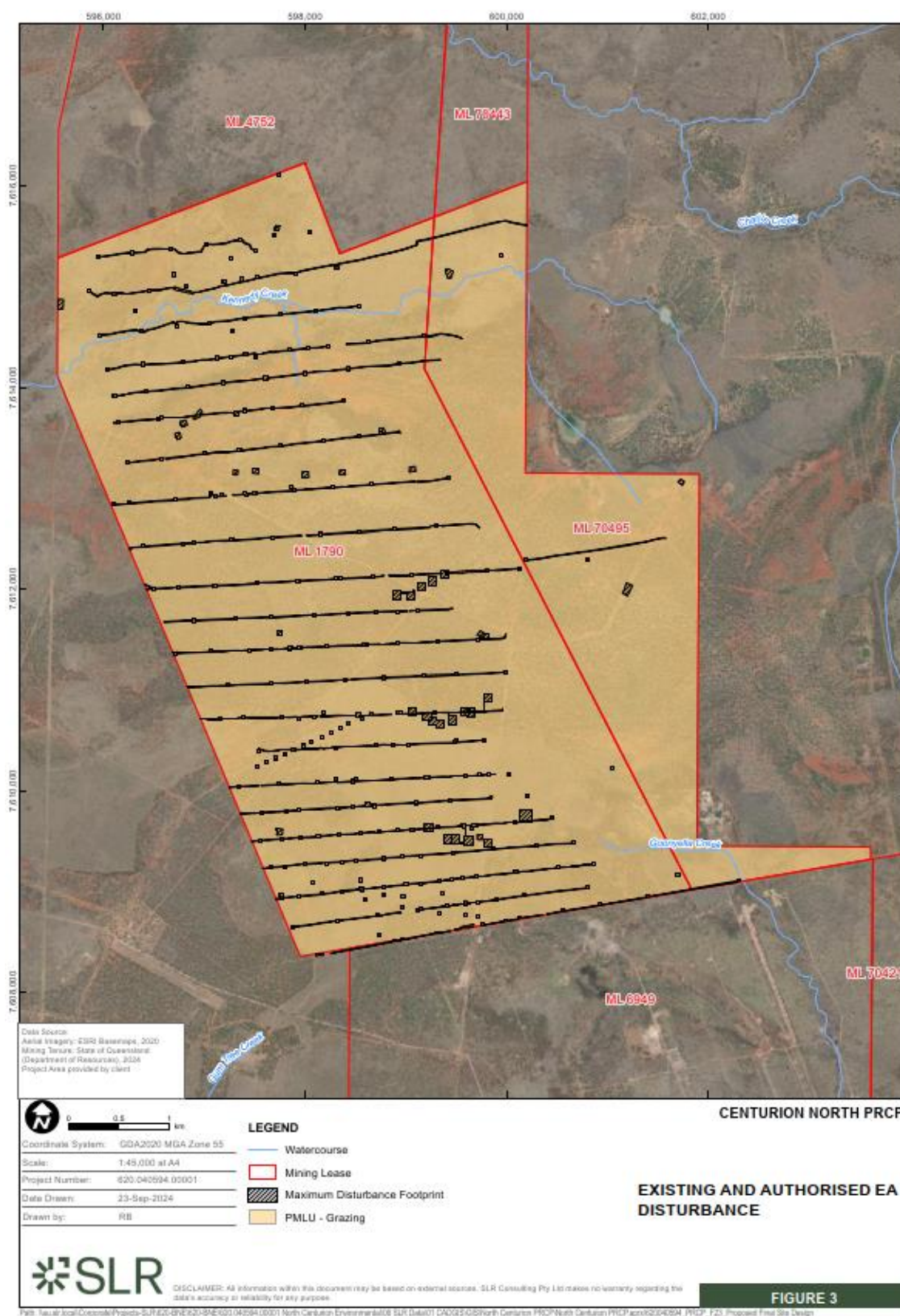


Figure 3 Existing and Authorised EA Disturbance

2.1.3 Type of mining operation

Wards Well, at the time of preparation of this PRC plan, is a greenfield mine site with some historic and approved exploration drilling and seismic activities. Exploration bulk sampling activities are currently authorised on the Lancewood MLs under the EA and PRCP schedule (but have not commenced).

Ongoing exploration drilling and environmental data assessment is planned to continue on the Centurion North MLs for the evaluation of an underground operation to be accessed from the adjacent Centurion ML (ML6949). The Centurion North MLs are intended to be transferred to the holder of the Centurion ML under a commercial arrangement between SMC and Peabody.

2.1.4 Proposed duration of the operation

Exploration activities have been occurring at Wards Well since the 1970s, with BMC (previous EA holder) having conducted exploration drilling and seismic surveys since 2010. Centurion plans to continue exploration drilling activities on the Centurion North MLs where these are authorised under the EA.

2.2 Baseline information

PRCP Guideline (Section 3.1)

In addition to the legislative requirements, the following information about the site, where relevant, is considered necessary by the administering authority (as per section 126C(1)(j) of the *EP Act*) to decide whether to approve the PRCP schedule:

- site topography (locally and regionally);
- climate (general and specific (rain, evaporation, temperatures)) including long-term projections;
- geological setting;
- site hydrology and fluvial networks;
- groundwater levels and properties;
- soil types, properties, and productivity;
- land stability (pre-existing land degradation/erosion and predisposition to ongoing stability issues);
- vegetation communities and ecological data (including existing regional ecosystem mapping);
- fauna presence and populations;
- pre-mining land use; and
- identification of underlying landholders.

PRC plans must include any baseline information collected as part of an EIS process or original EA application. If this information is unavailable, the reasons should be explained in this section of the rehabilitation planning part.

Any expansion to an existing site must demonstrate how it has been designed for closure. The rehabilitation/improvement planning must include data from when mining first commenced up until planned surrender. The provisions of the *EP Act* include an exceptional circumstance for when land is available for rehabilitation.

Much of the baseline information presented in this section is relevant to Wards Well, which encompasses both Lancewood and Centurion North, and therefore remains relevant.

2.2.1 Site topography

The regional topography of the Bowen Basin is dominated by flat to gently sloping landforms and low rolling hills.

The Wards Well MLs topographical features are consistent with the regional landscape and consist of level plains and gently undulating plains and rises. The slope across the majority of the site is between 1-2%, sloping gently towards the southwest (**Figure 4**). Steeper slopes up to 11% exist in the far north and on the south-eastern parts of the site. Within the footprint of the Wards Well area, the highest ground elevations lie within the north-west (about RL380) with the lowest in the middle of the area toward the western boundary (about RL310).

The area encompasses two shallow valleys, associated with Eaglefield Creek (the closest creek to the box-cut area) and Kennedy Creek (located in the southern half of the lease).



Figure 4 General site topography at Wards Well

2.2.2 Climate

Wards Well is located in a semi-arid area with warm dry winters and hot humid summers. Weather data was collected at the Moranbah Water Treatment Plant (Station No. 034038) between 1972 and 2012 and since 2012 it has been collected at the Moranbah Airport (Station No. 034035). The Moranbah weather stations are located about 60km south of Wards Well.

2.2.2.1 Temperature

Maximum temperatures range from 24°C in June/July to 35°C in December/January, with minimum temperatures ranging from 9°C in July to 22°C in January^{1&2}.

2.2.2.2 Rainfall

Although rainfall occurs throughout the year, it is more prevalent in the summer months (December, January and February) (**Table 3**).

¹ Accessed from the Bureau of Meteorology (1972-2012)

² Accessed from www.willyweather.com.au (2012-2020)

Table 3 Moranbah monthly average rainfall

Month	Station no. 034038 (mm)	Station no. 034035 (mm)
January	103.8	88.0
February	100.7	100.5
March	55.4	92.6
April	36.4	23.8
May	34.5	30.1
June	22.1	16.7
July	18.0	28.0
August	25.0	9.0
September	9.1	8.3
October	35.7	24.0
November	69.3	38.3
December	103.9	55.3
Annual	613.9	514.6

2.2.2.3 Evaporation

The evaporation rate is highest in the summer months - mean daily rate of 8.2mm in January, and lowest in the cooler months - mean daily rate of 3.6mm in June. The annual average rate of evaporation is 2,372.5mm, which greatly exceeds the annual rainfall; a characteristic of semi-arid environments.

2.2.2.4 Wind

The region tends to have winds of low velocity (less than 10km/hr) with the prevailing wind direction predominantly from the north and north-east during spring and summer and from the south-east during autumn and winter.

Wind records for Moranbah for January-April show an easterly predominance of moderate strength (1-20km/h), with easterlies dominating during May-July with some south-easterly influence. Easterly winds predominate for August and December which tend north to north-easterly from October-December.

2.2.3 Geological setting

Wards Well is located within the Bowen Basin in Central Queensland. The Bowen Basin is part of a connected group of Permian-Triassic basins in eastern Australia that includes the Sydney and Gunnedah

Basins. The Bowen Basin contains large reserves of Permian coals, which have been mined on a large scale by open-cut and underground methods since the 1970s.

The Wards Well deposit is situated on the north-western margin of the Bowen Basin, west of the Nebo Synclinorium and on the southern side of the Collinsville Shelf. The Wards Well deposit dips broadly eastwards at between 2 to 5 degrees, with local steepening in places. In the district the Bowen Basin is characterised by typical basin-fill fluvial (and some marine) sediments, comprising mudstones, siltstones, sandstones and coal seams. Both normal and thrust faults are present.

2.2.3.1 Coal seams

The following two major coal bearing geological formations of Permian age occur in the Wards Well area:

- Fort Cooper Coal Measures (FCCM); and
- Moranbah Coal Measures (MCM).

The MCM is comprised of three coal seam groups (listed in stratigraphic order from youngest to oldest):

- Goonyella P (GP) seam;
- Goonyella Middle (GM) seam; and
- Goonyella Lower (GL) seam.

2.2.4 Site hydrology and fluvial networks

The Centurion North MLs are located within the Burdekin and Fitzroy Basins. The boundary between the two basins crosses the south-eastern corner of Centurion North MLs. The basins, as they relate to Centurion North MLs, are as follows:

- **Burdekin Basin** – Majority of ML1790 and northern portion of ML70495. The portion of the site within the Burdekin Basin is contained within the Suttor River Sub-basin and the Upper Suttor River catchment. The ephemeral Eaglefield, Kennedy and Charlie creeks (**Figure 5**) and their tributaries, drain the Centurion North area and Lancewood MLs within the Burdekin Basin to the west. These creeks drain into the Suttor River, which in turn runs to the north and into Lake Dalrymple (130km to the north-west) and the Burdekin River.
- **Fitzroy Basin** – South-east corner of ML1790 and the southern half of ML70495 (in total, approximately 515ha). The portion of the site within the Fitzroy Basin is contained within the Isaac River Sub-basin and Isaac Northern Rivers catchment. This portion of Wards Well drains toward Goonyella Creek, whose headwaters are located in ML1790.

Figure 6³ illustrates the location of the basins and mining leases.

³ <https://qldglobe.information.qld.gov.au/> (accessed November 2020)

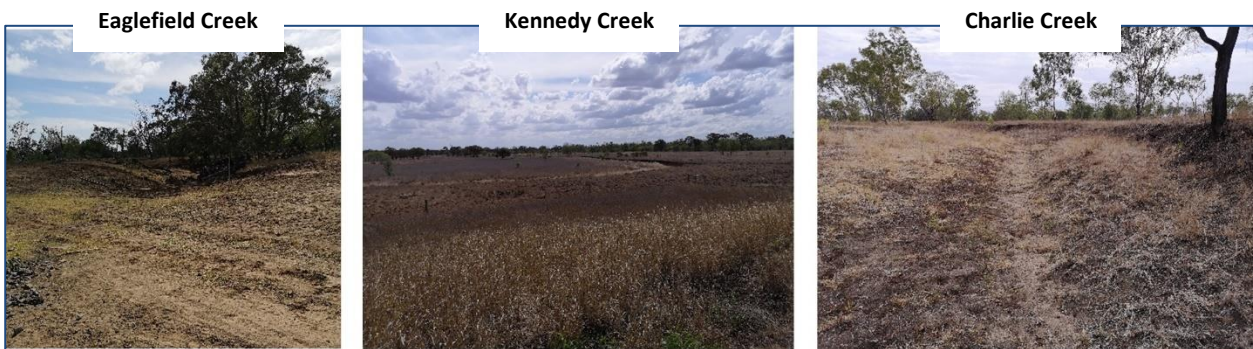


Figure 5 Ephemeral Eaglefield, Kennedy and Charlie creeks and their tributaries that drain the Wards Well area within the Burdekin Basin to the west.

The environmental values and water quality objectives established for the Burdekin and Fitzroy Basins under the Queensland Environment Protection (Water and Wetland Biodiversity) Policy (2019) are documented in the following:

- NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan 2016, NQ Dry Tropics, Townsville; and
- Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (Part).

The environmental values identified for the Upper Suttor River are summarised in **Table 4**.

Table 4 Water environmental values for the Wards Well area

Basin	Catchment	Aquatic ecosystems	Irrigation	Farm use	Stock watering	Aquaculture	Human consumption	Primary recreation	Secondary recreation	Visual recreation	Raw drinking water	Industrial use	Cultural and spiritual
Burdekin (Draft)	Upper Suttor River – Surface Waters	✓	-		✓	-	✓	✓	✓	✓	✓	✓	✓
	Upper Suttor River – Groundwaters	-	✓	✓	✓	-	-	-	-	-	✓	✓	-
Fitzroy	Isaac Northern Tributaries – Surface Waters	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓

Isaac – Groundwaters	✓	✓	✓	✓	-	-	✓	-	-	✓	-	✓
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Note: The Environmental values provided within the NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan 2016 are draft only.

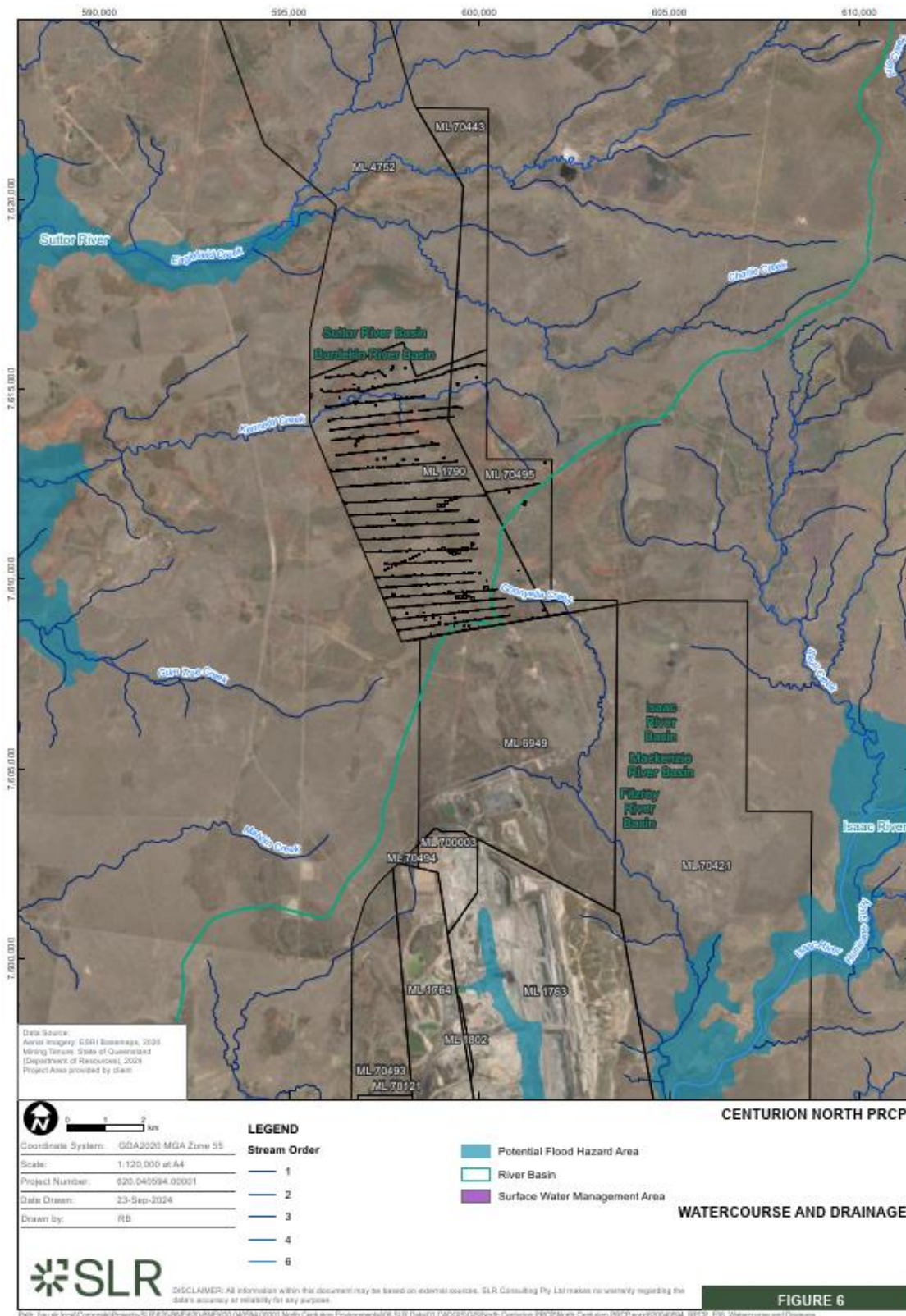


Figure 6 Watercourses and Drainage

summary of watercourses and dams located within and immediately surrounding the Wards Well MLs are summarised in **Table 5**.

No fourth order streams or above, or diversions, are present within the Wards Well mining leases.

Table 5 Summary of Wards Well watercourses and dams

Watercourse	Perennially	Hierarchy	Stream order	Comment
Burdekin Basin				
Eaglefield Creek	Non-perennial	Minor	3	Runs east to west across ML4752 and ML70443 to the north of Suttor Creek Development Road. To the west of the investigation area the stream classification changes to a Hierarchy of Major and a Stream Order of 4.
Charlie Creek	Non-perennial	Minor	2	Runs south-east to north-west across ML70443 and ML4752 to the south of Suttor Development Road. Drains into Eaglefield Creek to the west of ML1790.
Kennedy Creek	Non-perennial	Minor	2	Runs east to west across ML70495 and ML1790. Two minor first order streams drain into the creek from the south. Drains into Eaglefield Creek approximately 10km to the west of the investigation area.
Unnamed	Non-perennial	Minor	1	Runs east to west across ML70443 to the south of Suttor Development Road and drains into Charlie Creek on ML1790.
Unnamed	Non-perennial	Minor-Major	1-2-3	Multiple unnamed drainage lines draining the northern portion of ML4752 and to the north-east of the investigation area. Generally, run north-east to south-west across ML4752 to the north of Suttor Development Road. Drains into Eaglefield Creek to the west of ML4752.
Lake Dalrymple/Burdekin Falls Dam	-	-	-	Located approximately 130km to the north-west of the site.
Farm dams	-	-	-	Numerous small farm water supply dams are present within and immediately surrounding Wards Well.
Fitzroy Basin				
Goonyella Creek	Non-perennial	Minor	1	Headwaters located in the south-eastern corner of ML1790, running to the east along the southern boundary of ML70495 before turning south and draining into the Isaac River.

Watercourse	Perennially	Hierarchy	Stream order	Comment
Burton Gorge Dam	Permanent	-	-	Located on the Isaac River approximately 15km to the east of the investigation area.
Farm dams	-	-	-	Numerous small farm water supply dams are present within and immediately surrounding the investigation area.

2.2.5 Groundwater levels and properties

A hydrogeological assessment and development of pre- and post-mining hydrogeological conceptual models has been undertaken to support the PRC plan⁴ and is contained in **Appendix 2**. Hydrogeological information summarised within this PRC plan is extracted from this assessment.

The groundwater levels and properties for the identified hydrostratigraphic units at Wards Well include the following:

- **Quaternary alluvium** – is located in alluvial sediments associated with Eaglefield, Charlie and Kennedy creek river systems. Quaternary alluvium is also located on older floodplain sediments and alluvial flats. These aquifers are considered porous media aquifers with groundwater occurring within the media pore spaces and are generally unconfined. The depth and availability of the Quaternary alluvium aquifer is likely to be variable and dependant on weather conditions. Therefore, this aquifer is not typically targeted for groundwater extraction at Wards Well. Ecosystems along the creek lines that are potentially groundwater dependent, may be associated with this aquifer. Typical thicknesses of the quaternary alluvium aquifers are believed to be between 15 and 25m.
- **Tertiary strata** – comprises of vesicular basalt flows following Tertiary palaeochannels incised into the Permian Basement. This strata is the predominant aquifer targeted by groundwater extraction bores used for stock watering in the proximity of Wards Well. The typical Total Dissolved Solid (TDS) range between 480 and 2,900mg/L, which is suitable for stock watering; however, it has limited suitability for other beneficial uses such as irrigation, domestic, recreation or drinking water. Groundwater within basalt is a second porosity aquifer with groundwater transmitted through fractures and joints. Low permeability sediment deposits, weathering horizons between basalt flows and low permeability basalts within the centre of the flows, compartmentalise the aquifer. Typical groundwater levels for the Tertiary strata are between 6 and 60m below ground surface, with flow typically from north-east to south-west across Wards Well.
- **Permian strata** – comprises of siltstone, sandstone, calcareous, carbonaceous shales and coal. This aquifer is not expected to be a significant aquifer at Wards Well. The Permian strata is identified primarily as a porosity aquifer in the sandstone units and a secondary porosity aquifer in the shales, siltstone and coal units. The occurrence of the aquifer is variable depending on the interconnection of fractures, faulting and extent of porous sediments. The aquifer is generally considered to be a confined aquifer with lower permeability overburden rocks acting as a confining unit to groundwater in the coal seams. Existing data indicates the water levels are between 6.8 and 42.1m below ground and has a higher salinity than those within the Tertiary strata. This aquifer is generally not targeted for beneficial use due to salinity and low recharge rates.

⁴ Golder (2020): Wards Well Mine PRCP Hydrogeological Conceptual Model. Ref. No. 20360652-001-R-RevA

A baseline hydrogeological conceptual model⁴ illustrating the above hydrostratigraphic units and groundwater flows is illustrated in **Figure 7**.

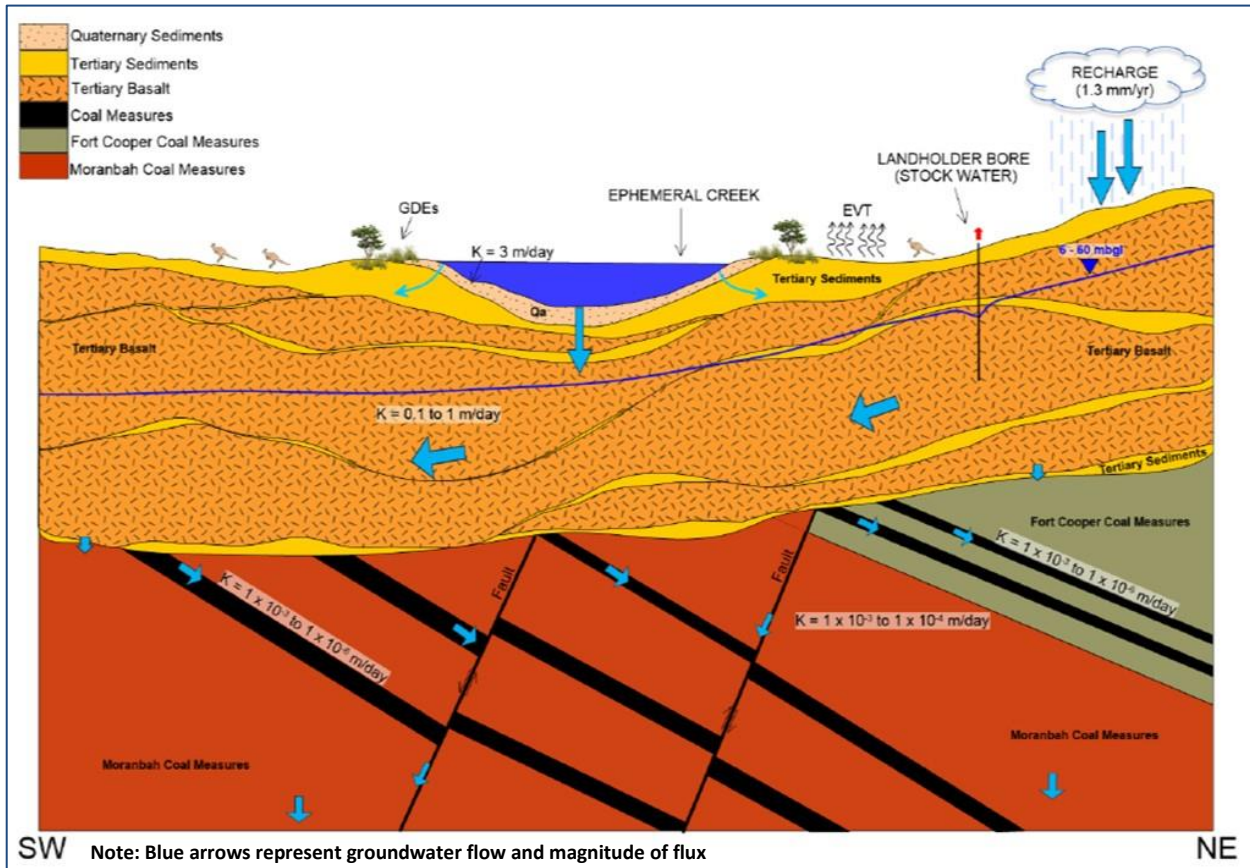


Figure 7 Wards Well baseline hydrogeological conceptual model (Golder, 2020)

The environmental values for groundwater established for the Upper Suttor and Isaac Connors Groundwaters under the Queensland Environment Protection (Water and Wetland Biodiversity) Policy (2019) are summarised in **Table 5**. The Highlands Underground Water Area (Burdekin Basin) and the Isaac Connors Groundwater Management Area (Fitzroy Basin) intersect the southern portions of ML 1790 and ML 70495 (**Figure 8**)⁵. The approved box-cut and bulk sampling area is not contained within the groundwater management areas.

There are 16 registered groundwater bores within 10km of the box-cut (both on and off lease), which were listed as existing⁶. Two of the 16 bores were listed for monitoring purposes. The usage for remaining 14 existing bores was not listed, however is expected to be for stock watering or monitoring. Registered bores within 10km of the proposed bulk sample activities on the Lancewood MLs are shown on **Appendix 2**, Figure 10.

⁵ Accessed from <https://qldglobe.information.qld.gov.au/> (November 2020)

⁶ DNRME (2020): Queensland Groundwater Database, accessed via <https://www.data.qld.gov.au/dataset/groundwater-database-queensland>

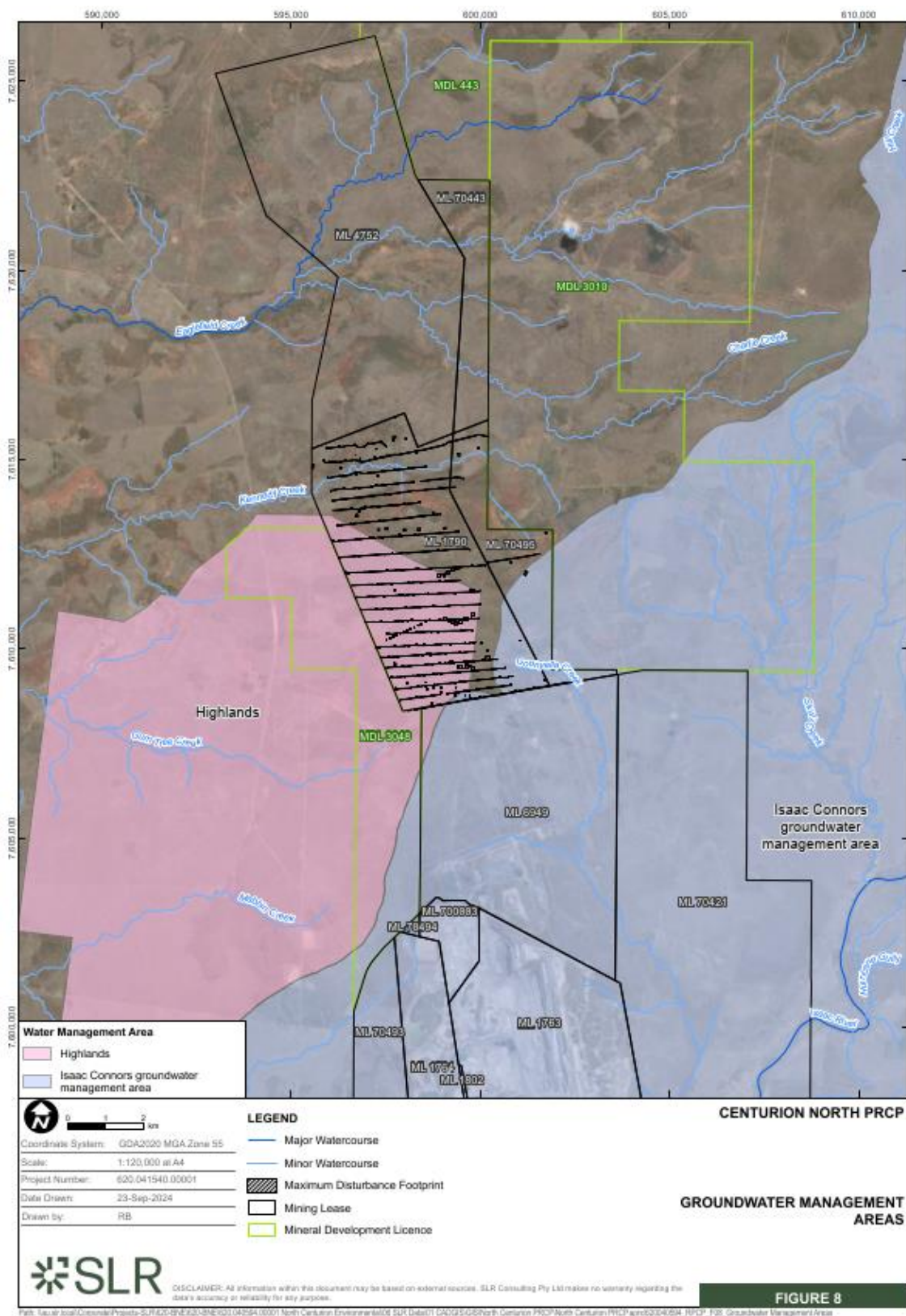


Figure 8 **Groundwater management areas**

Groundwater monitoring of the Tertiary aquifers has been undertaken since 2011 for parameters specified within the EA, including a range of metals, total recoverable hydrocarbons, pH, electrical conductivity and alkalinity. As mining operations have not commenced at Wards Well, the groundwater monitoring results are indicative of background concentrations. Locations of the existing monitoring bores are shown on **Appendix 2**, Figure 3.

The existing groundwater data, collected by BMC and SMC, indicates that selected analytes may be present at background concentrations above the Water Quality Objectives (WQOs) for the Burdekin and/or Fitzroy Basins. Therefore, site-specific trigger levels and closure criteria will need to be developed in consideration of the 2021 Department of Environment and Science (DES) *“Using monitoring data to assess groundwater quality and potential environmental impacts – Version 2”*.

2.2.6 Soil types, properties and productivity

A soil resources and pre-mining assessment of agricultural land suitability was undertaken in 2011 to determine soil type and properties to understand baseline soil characteristics and suitable rehabilitation resources (**Appendix 5**)⁸. The scale of survey at Wards Well was 1:25,000 for planned disturbed areas and up to 1:50,000 for planned undisturbed areas, equivalent to a high intensity soil survey (McKenzie *et al*, 2008). Soil types were identified according to the Australian Soil Classification (ASC). A follow-up site observation of the surface condition was undertaken in 2020; this focussed on soil characteristics within the planned box-cut area.

During the 2011 soil survey, site access challenges prohibited machinery access to sample and examine soil profiles in the planned box-cut area. These access challenges were again identified during the 2020 observation. During the 2020 observation, an assessment was completed on vegetation communities, surface condition and topsoil physical characteristics, with comparisons made to soils that have been examined in more detail adjacent to the area. Light self-mulching clays were identified in the A1 horizon in the box-cut area with surface cracking present. This is consistent with Vertosols identified in the adjacent area during the 2011 assessment, at sites 85, 86 and 87⁷.

Both the survey and observation found Vertosols, Sodosols, Dermosols and Kandosols to be present (**Figure 9**). A summary of physical properties of these soil types is described in **Table 6**, with the associated rehabilitation-related chemical properties (from a productivity perspective) provided in **Table 7**. All soil types within the Centurion North area support a pre-mining land use of grazing.

Table 6 Soil types within the Centurion North area

Australian Soil Classification	Properties	Area (%)	Area (ha)
Vertosol	Occurring on plains/floodplains and mafic volcanic rocks	17%	575
	Brown, Grey and Black, greater than 35% clay content, self-mulching over Basalt		
	Soils may become saline to epihypersodic with depth		
	Moderately to well drained and are generally alkaline to very alkaline with depth		
Dermosol	Occuring on low angle pediments with low shrublands, to surrounding Vertosol plains	23%	781
	Red, Brown Light to Medium Clays, well-structured and well drained		

⁷ Sinclair Knight Merz (26 June 2012): Wards Well Mine Project: Soil Survey. Version A, ref. no. QE09811

Australian Soil Classification	Properties	Area (%)	Area (ha)
	Dispersion potential Poor drainage and low overall fertility		
Kandosol	Occurring on level to gently undulating plains often in association with ferricrete deposits Red Sandy Loams and Medium Clays Often very deep (>3m) and clay-rich Good surface drainage Good pasture soil with low to moderate fertility	53%	1,786
Sodosol	Occurring on alluvial and part-colluvial deposits, as well as igneous, sedimentary and metamorphic rocks Sodic Duplex and Gradational Brown Loams Dispersive, hard setting and prone to erosion Good surface drainage and poor subsoil drainage Sodosol areas are grazed at Wards Well but erosion is present	7%	245

Table 7 Rehabilitation-related chemical properties and productivity of soil types found within the Centurion North area

Parameter	Unit	Vertosol	Dermosol	Kandosol	Sodosol
pH _{water}	N/A	7.8 - 8.6	7.2 - 7.8	6.7 - 7.5	
EC _{water}	dS/m	0.1 - 0.66	0.025 - 0.15	0.014 - 0.034	
Plant Available Water Content	mm	125 - 450	100 - >125	>125	
Organic carbon	%	5.1	1.4	3.6	Sodosols - minimal disturbance; hence data has not been included
CEC	cmol/kg	57 - 72.4	8.1 - 20.3	17.4 - 31	
ESP	%	0 - 12	5 - 11	0 - 5	
Ca/Mg ratio	N/A	1.1 - 2.1	0.8 - 1.2	1.2 - 1.7	
Productivity	-	Predominant soil type in the region. Soil properties sufficient to support grasses and native trees	Suitable for rehabilitation for cattle grazing on flat to gentle slopes	Suitable for rehabilitation of steeper slopes due to good soil structure	

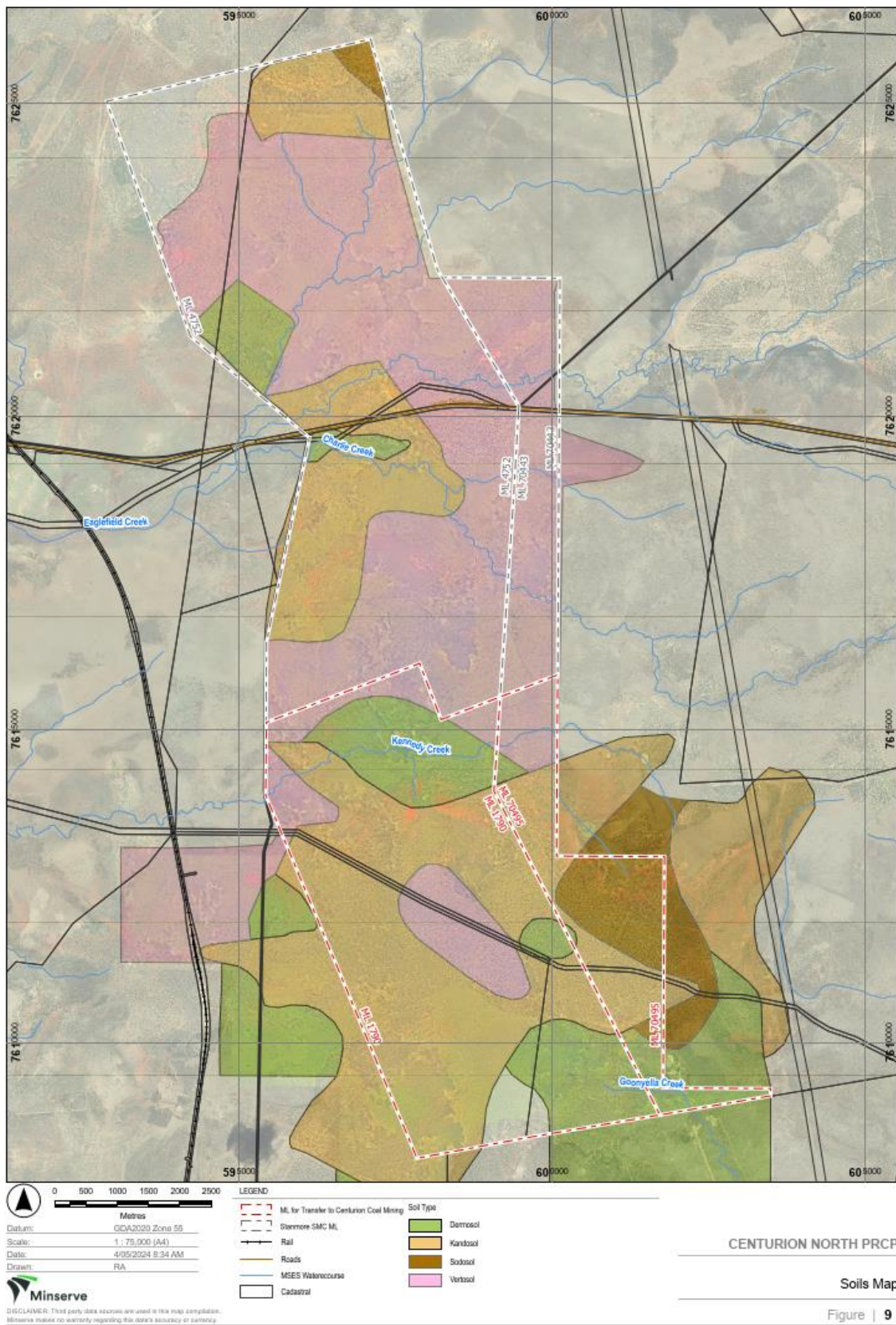


Figure 9 Soils map

Figure 10 illustrates various areas in Wards Well that are characteristic of the local soil types and associated vegetation.

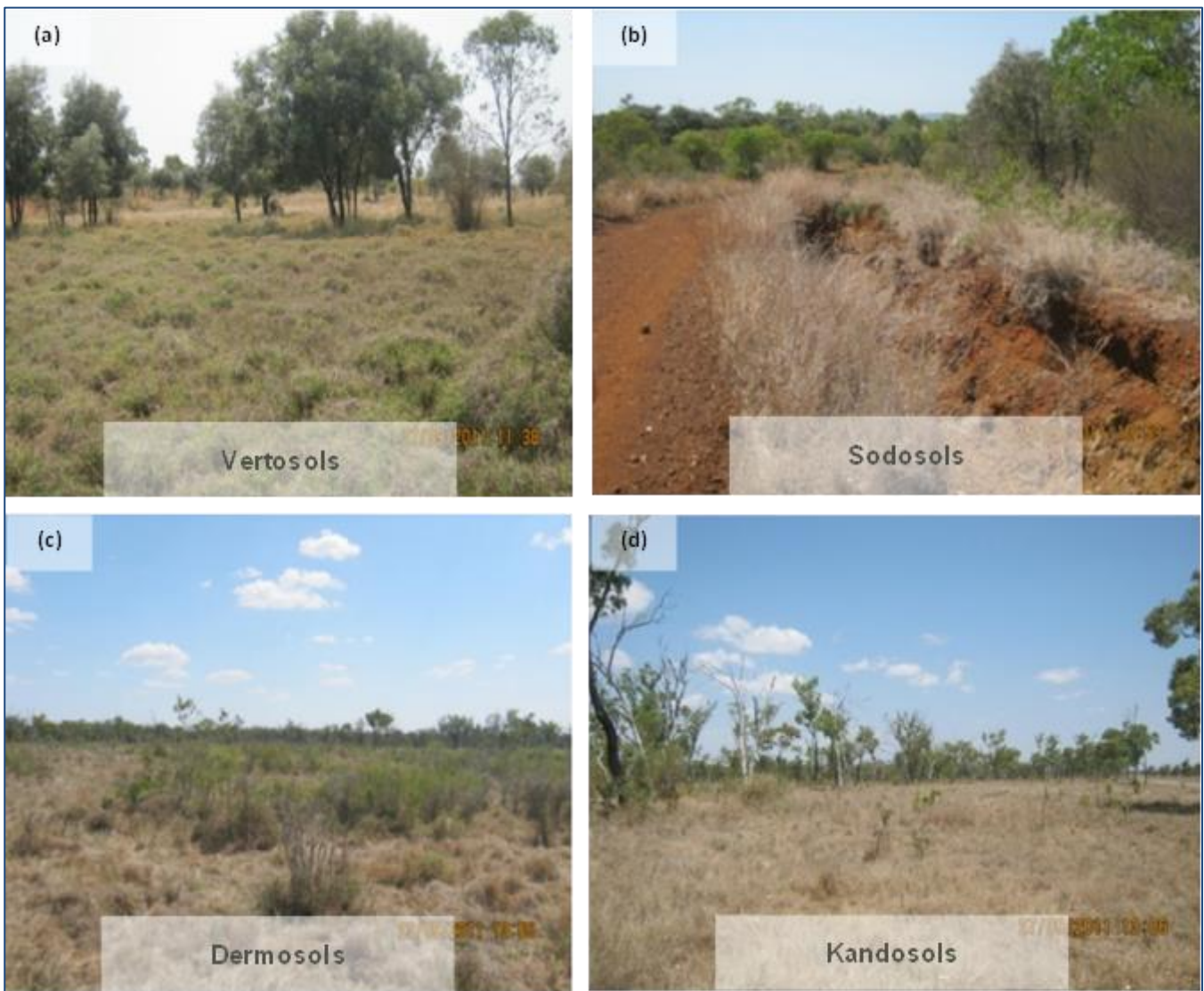


Figure 10 Areas in Wards Well that are characteristic of the local soil types and vegetation - a) Brigalow and grasslands with cattle grazing on cracking clay Vertosols; b) Ironbark, Brigalow and erosion-prone areas on Sodosols; c) Low shrubs and grassland with cattle grazing on Dermosols and d) Open grasslands with remnant vegetation and cattle grazing on Kandosols.

2.2.7 Land stability

The regional topography is dominated by flat to gently sloping landforms which is consistent with the landscape at Wards Well. In the context of land stability, erosion is isolated to areas of the landscape where land use has exposed soil types with limited erosion resistance. Pre-mining surface erosion in drainage areas and creek crossings is evident across the site and is mainly associated with existing grazing activities and historically cleared areas. During the soil survey, erosion was noted at 16 of the 98 sample locations and on all four soil types.

Erosion was most prevalent on Sodosols in the north-east of Lancewood MLs and will have a tendency to be unstable if not ameliorated post-disturbance. Stream bank erosion was also identified within drainage lines, and sheet erosion on land adjacent to dirt tracks (see Figure 11).

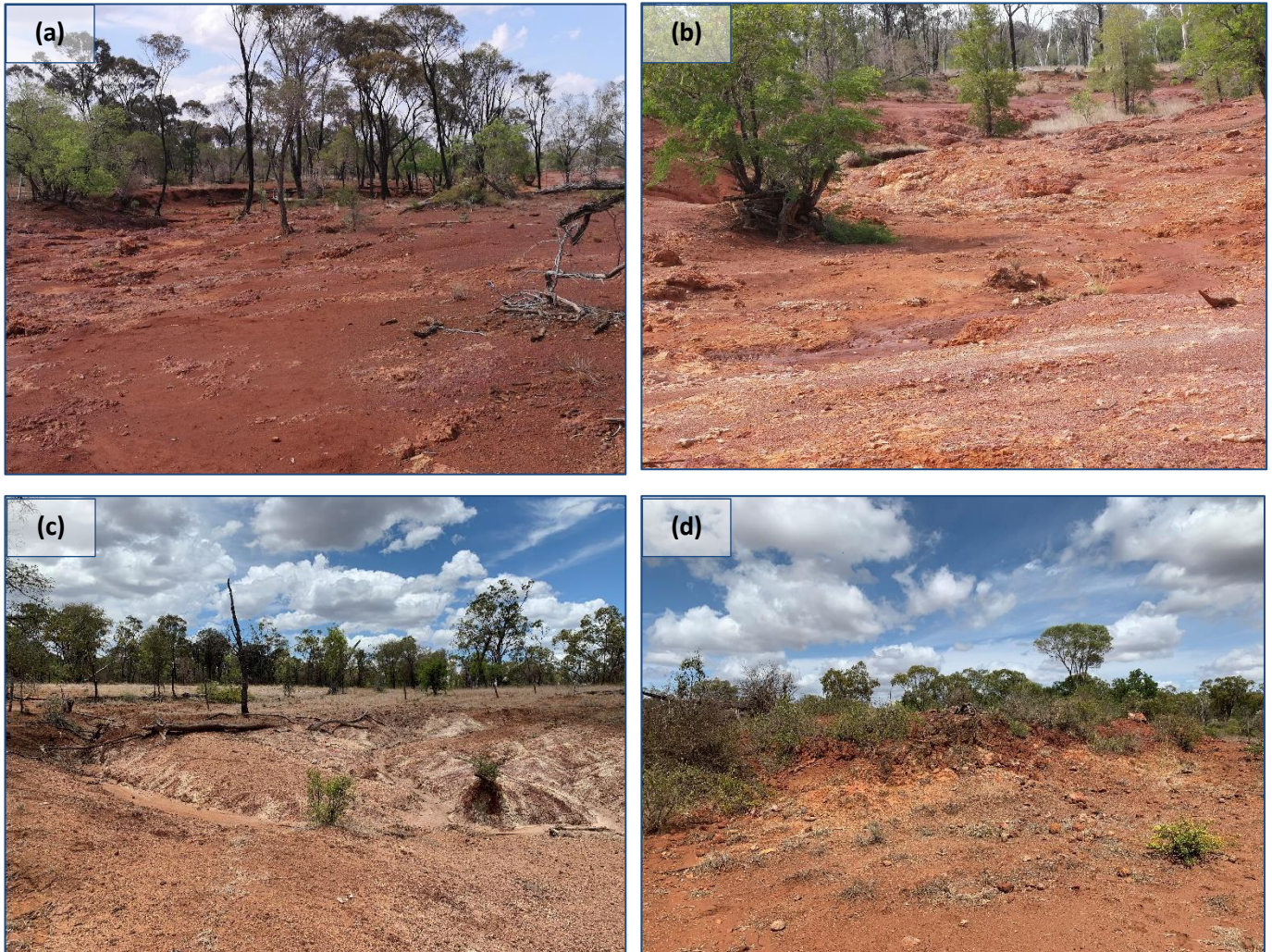


Figure 11 *Evidence of surface erosion due to existing grazing activities and historical land clearance in the Wards Well area - a) Sheet erosion adjacent to creek; b) Stream bank erosion; c) Sheet erosion leading to flow concentrating features; and d) Stream bank erosion.*

2.2.8 Vegetation communities and ecological data

2.2.8.1 Vegetation communities

The vegetation communities at Wards Well comprises a mix of non-remnant pasture, remnant vegetation and regrowth vegetation.

Disturbance due to historical land uses, including grazing, have created a mosaic of intact and regrowth communities at varying stages of maturity which are interspersed with non-remnant areas. The area north of Suttor Development Road is dominated by remnant natural grasslands and *Eucalyptus orgadophila* open grassy woodlands on basalt derived soils, most of which has been highly disturbed due to grazing.

The western boundary contains lateritic jump-up areas and the far northern boundary contains Acacia thickets and Eucalypt woodlands on weathered Tertiary surfaces. Brigalow dominated forest/woodland communities are also scattered throughout the area north of Suttor Development Road.

Vegetation south of Suttor Development Road is also dominated by natural grasslands and *Eucalyptus orgadophila* open grassy woodlands on basalt derived soils, much of which is in remnant condition. The southern area is dominated by a mosaic of *Eucalyptus crebra* and *Eucalyptus populnea* woodlands on weathered Tertiary surfaces, with small pockets of semi-evergreen vine thicket (SEVT) and sections of Brigalow dominated woodlands on the southern boundary.

Waterways that traverse the northern and central portion of the study area support fringing riparian Eucalypt communities.

The ground-truthed vegetation communities recorded at Wards Well and the associated Regional Ecosystems (RE), and the remnant or regrowth status is listed in **Table 8 (Appendix 3)**⁸. The remainder of the vegetation recorded in the Wards Well study area is represented as non-remnant (**Appendix 3**).

Table 8 Vegetation communities ground-truthed within the Wards Well area

RE	Short description	Biodiversity status ¹	Condition	Area (ha)
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Endangered	Remnant	11.1
			Mature regrowth	51.6
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Of concern	Remnant	79.9
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains	Of concern	Remnant	4.4
11.3.3a	<i>Melaleuca bracteata</i> woodland. On alluvial plains. Riverine wetland or fringing riverine wetland	Of concern	Remnant	34.1
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	Endangered	Remnant	39.0
			Mature regrowth	56.1
11.4.9	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	Endangered	Remnant	48.2
			Mature regrowth	252.1

⁸ Ecological Australia (10 June 2016): Wards Well/Lancewood Brigalow TEC Assessment

RE	Short description	Biodiversity status ¹	Condition	Area (ha)
11.5.3	<i>Eucalyptus populnea</i> ± <i>E. melanophlois</i> ± <i>Corymbia clarksoniana</i> woodland on Cainozoic sandy plains and/or remnant surfaces	No concern at present	Remnant	429.4
			Mature regrowth	81.8
11.5.3b	<i>Eucalyptus populnea</i> on closed depressions	No concern at present	Remnant	40.3
11.5.9	<i>Eucalyptus crebra</i> woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	Remnant	1,361.0
			Mature regrowth	106.5
11.5.15	Semi-evergreen vine thicket on Tertiary surfaces	Endangered	Remnant	57.5
11.7.1x	Semi-evergreen vine thicket	Of concern	Regrowth	5.2
11.7.2	<i>Acacia spp.</i> woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	No concern at present	Remnant	11.8
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of concern	Remnant	1,661.8
11.8.11a	<i>Melaleuca bracteata</i> woodland drainage depressions. Occurs in drainage depressions	Of concern	Remnant	9.5
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	No concern at present	Remnant	1,166.2
			Mature regrowth	42.0
11.8.15	<i>Eucalyptus populnea</i> woodland on Cainozoic igneous rocks	Endangered	Remnant	9.3
11.9.2	<i>Eucalyptus melanophloia</i> and/or <i>E. orgadophila</i> woodland on Cainozoic fine grained sediments	No concern at present	Remnant	65.0
11.9.5	<i>Acaia harphphylla</i> and/or <i>Casuarina cristata</i> open forest with semi-evergreen vine thicket understorey	Endangered	Remnant	18.7
			Mature regrowth	204.1

RE	Short description	Biodiversity status ¹	Condition	Area (ha)
11.9.7	<i>Eucalyptus populnea</i> woodland on Cainozoic fine grained sediments	Of concern	Remnant	8.4
			Mature regrowth	8.7
11.9.7a	<i>Eucalyptus populnea</i> shrubby woodland on Cainozoic fine grained sediments	Of concern	Remnant	25.3
11.9.9	<i>Eucalyptus crebra</i> grassy woodland on Cainozoic fine grained sediments	No concern at present	Remnant	92.0
-	Brigalow regrowth	-	-	394.4
-	Eucalypt regrowth	-	-	86.5

¹ Vegetation Management Act 1999 (VM Act)

Additional terrestrial ecology surveys were undertaken across the MLs in 2024. The surveys identifies a total of approximately 3,729 ha of remnant vegetation and 441 ha of mature regrowth was ground-truthed within the MLs. A summary of REs, associated vegetation condition class and area is provided in Table 9. REs recorded within the MLs comprised:

- 3,728.58 ha of remnant vegetation;
- 441.23 ha of mature regrowth vegetation;
- 1,018.80 ha non-remnant vegetation, comprising:
- 269.82 ha of non-remnant young woody regrowth vegetation; and
- 748.98 ha of non-remnant (other vegetation).

Endangered (VM Act class) communities were associated with Cainozoic sand plains (land zone 5) and undulating country on fine grained sedimentary rocks (land zone 9) within the MLs.

Of Concern (VM Act class) REs were located along riparian corridors (land zone 3) and Cainozoic basalt plains (land zone 8) within the MLs.

The extent of remnant vegetation throughout the MLs was largely consistent with DoR Vegetation Management mapping (DoR, 2021a). Inconsistencies between DoR mapped and ground-truthed vegetation extents within the MLs include:

- heterogenous polygons were observed to contain fewer RE types than mapped in some instances, and in other instances more RE types were recorded than mapped by DoR.
- some areas mapped by DoR as non-remnant were observed to support remnant and regrowth vegetation.

Table 9 **Ground-truthed REs within the Study Area**

RE	RE description	RE type	Biodiversity status	VM Act class	Broad Vegetation Group (BVG) (1:1M)	Extent within Study Area (ha)
11.3.25d	<i>Eucalyptus tereticornis</i> , <i>E. camaldulensis</i> and <i>Melaleuca bracteata</i> woodland fringing drainage lines	Remnant	Of concern	Least concern	22c	30.54
11.5.3	<i>Eucalyptus brownii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Remnant	No concern at present	Least concern	17a	170.11
		Mature regrowth	No concern at present	Least concern	17a	29.64
		Non-remnant: young woody regrowth	NA	NA	NA	29.91
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces	Remnant	Endangered	Least concern	7a	32.02
		Mature regrowth	Endangered	Least concern	7a	3.99
		Non-remnant: young woody regrowth	NA	NA	NA	114.58
11.5.16	<i>Acacia harpophylla</i> open forest in depressions on Cainozoic sand plains and remnant surfaces	Remnant	Endangered	Endangered	25a	196.66
		Mature regrowth	Endangered	Endangered	25a	221.16

RE	RE description	RE type	Biodiversity status	VM Act class	Broad Vegetation Group (BVG) (1:1M)	Extent within Study Area (ha)
		Non-remnant: young woody regrowth	NA	NA	NA	122.48
11.5.17	<i>Eucalyptus tereticornis</i> and <i>E. camaldulensis</i> woodland in depressions on Cainozoic sand plains and remnant surfaces	Remnant	Endangered	Endangered	34d	4.16
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland. Occurs on Cainozoic sandplains formed on plateaus and broad crests of hills and ranges. Soils are generally deep red earths.	Remnant	No concern at present	Least concern	18b	2119.64
		Mature regrowth	No concern at present	Least concern	18b	35.35
		Non-remnant: young woody regrowth	NA	NA	NA	34.66
11.7.1x1	Semi-evergreen vine thicket on the slopes and scarps of rocky residual ranges with Cainozoic lateritic duricrust.	Remnant	Of concern	Least concern	7a	10.67
11.7.2	Acacia spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	Remnant	No concern at present	Least concern	24a	3.50

RE	RE description	RE type	Biodiversity status	VM Act class	Broad Vegetation Group (BVG) (1:1M)	Extent within Study Area (ha)
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks.	Remnant	Of concern	Of concern	30b	741.57
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	Remnant	No concern at present	Least concern	11a	421.79
		Mature regrowth	No concern at present	Least concern	11a	20.19
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	Mature regrowth	Endangered	Endangered	25a	99.48
Non-remnant	Cleared paddocks and disturbed areas dominated by introduced pasture grasses such as <i>Cenchrus ciliaris</i>	non-remnant: other vegetation	NA	NA	NA	320.95

2.2.8.2 Category B environmental sensitive areas – endangered regional ecosystems

Under the *EP Act*, all REs with a biodiversity status as Endangered are classified as a Category B Environmentally Sensitive Areas (ESA).

Requirements for managing impacts to Category B ESAs are included in the EA and PRCP schedule. Condition PRCP4 requires: *“Rehabilitation of areas disturbed in Category B Environmentally Sensitive Area or within 500m of a Category B Environmentally Sensitive Area must commence as soon as practicable to the extent that erosion impacts are minimised and be completed as soon as practicable but no longer than three (3) months after completion of the disturbance activity”*.

Figure 1 of the proposed de-amalgamated EA shows mapping of Category B ESAs associated with Endangered REs as approved under the EA and includes a 500m shaded buffer area.

Exploration activities have been designed to avoid, where possible Category B ESAs, or have implemented management actions to reduce impacts such as minimising ground impacts by slashing or accessing each proposed drill site utilising existing tracks wherever possible. Where new tracks are required, tracks will be positioned to cause the least environmental impact.

2.2.8.3 Threatened ecological communities

Three threatened ecological communities (TECs) listed as Matters of National Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) were ground-truthed within the Wards Well area (**Appendix 3**) and (**Appendix 4**), and included:

- Brigalow (*Acacia harpophylla* dominated and co-dominated) Threatened Ecological Community (Brigalow TEC);
- Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Best quality);
- Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Good quality) and/or
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC).

The Brigalow TEC was identified in small patches across the Wards Well MLs, within a total area of 91.2ha (**Figure 12**). Natural Grasslands dominate the centre and north of the Wards Well MLs - patches meeting the key diagnostic and condition threshold of the TEC in good quality were identified within an area of 234.0 ha and best quality within 552.4 ha (**Figure 12**). SEVT TEC was identified in small patches in the south, within an area of 57.5 ha (**Appendix 4**) (**Figure 12**)¹⁶.

For exploration activities, areas of Brigalow and SEVT TEC are subject to management measures to reduce impacts. However, the impact of clearing activities is inherently diminished in Natural Grassland TEC areas and opportunities exist to further minimise disturbance through managed slashing.

2.2.8.4 Threatened flora

The threatened flora species *Dichanthium queenslandicum*, which is currently listed as Endangered under the EPBC Act and Vulnerable under the Nature Conservation Act 1992 (NC Act), was previously identified in Natural Grassland habitat within the Wards Well MLs.

There are no specific requirements in the Wards Well EA or PRCP schedule for inclusion of threatened flora species in the rehabilitation planning.

Additional terrestrial ecology surveys were undertaken across the MLs in 2024. The surveys identified the likelihood of occurrence assessment identified two threatened flora species that are known to occur within the MLs. The species include:

- *Dichanthium queenslandicum* – Endangered under the EPBC Act and Nature Conservation Act 1992 (NC Act).
- *Digitaria porrecta* – Near Threatened under the NC Act.

Dichanthium Queenslandicum

1,800 tussocks of this species were identified within the northern part of the MLs in association with areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance.

Preferred habitat mapped for the species within the MLs includes:

- Areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance (RE 11.8.11 and 11.8.5) where records of *D. queenslandicum* were present within the ML.

Digitaria Porrecta

71 tussocks were identified within the northern and central eastern part of the ML in associations with areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance.

Preferred habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance (RE 11.8.11 and 11.8.5) where records of *D. porrecta* were present within the Study Area.

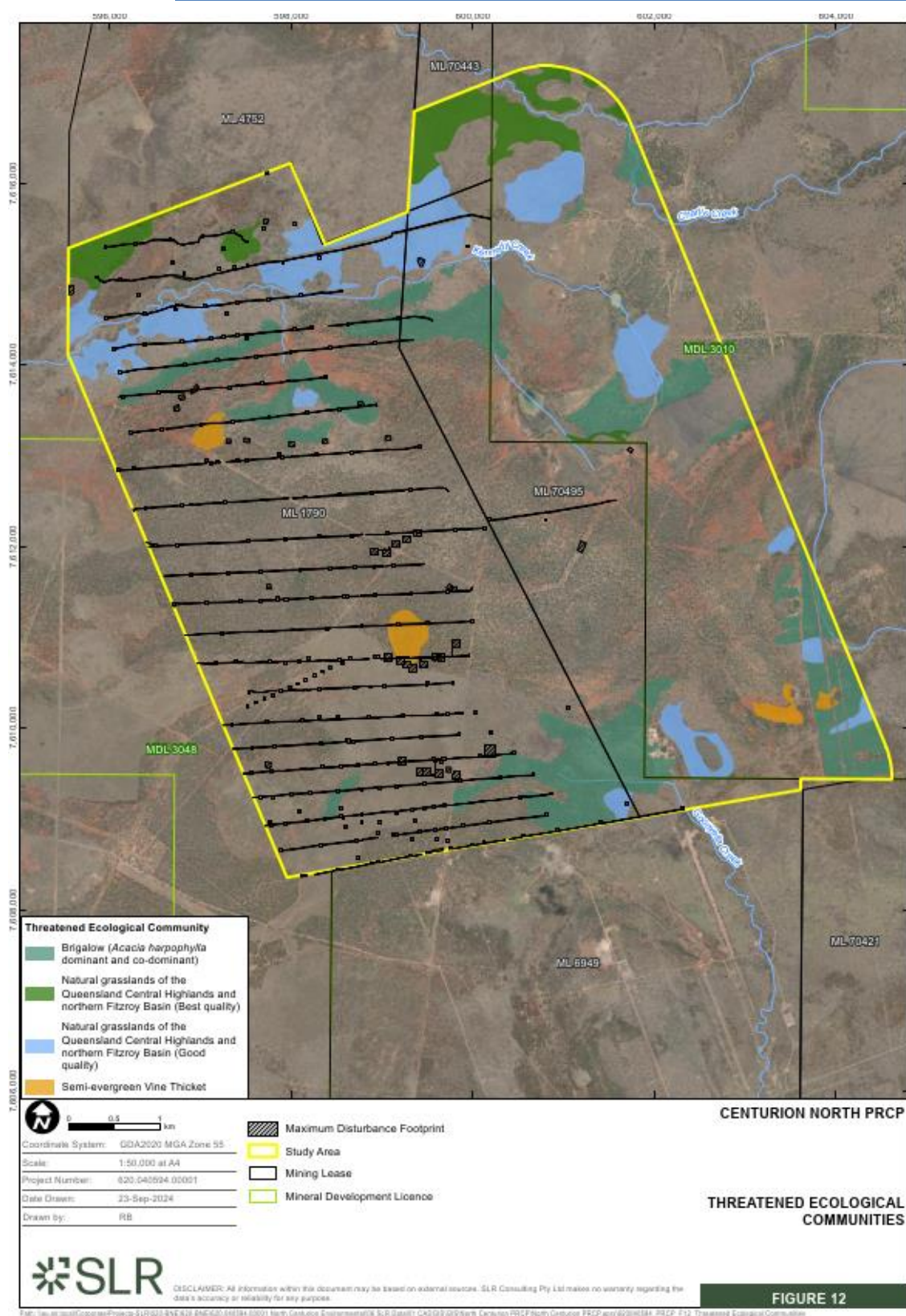


Figure 12 TEC mapping

2.2.9 Fauna presence and populations

A desktop and field based ecological assessment was undertaken to identify the potential presence of native and introduced fauna populations at Wards Well⁹ (**Appendix 4**).

There were 19 threatened fauna species and 11 migratory species listed under the *EPBC Act* and/or *NC Act* returned from initial desktop searches that may occur within the Wards Well area. The likelihood of occurrence of each of these species was assessed based on each species known distribution, habitat quality and species occurrence within the region. The results of the likelihood of occurrence assessment are summarised in **Table 10**. The results returned two threatened fauna species as likely to occur, two threatened mammal species with potential to occur, four migratory species with potential to occur, and eight declared pest species under the *Biosecurity Act 2014* as potentially occurring within the wards well study area.

There are no specific requirements in the Wards Well EA or PRCP schedule for inclusion of fauna habitat planning in the rehabilitation planning.

Table 10 Fauna populations within the Wards Well area

Species name	Common name	Status	Likelihood of occurrence
Threatened species			
<i>Geophaps scripta</i>	Squatter Pigeon	Vulnerable EPBC Act and NC Act	Likely
<i>Denisonia maculata</i>	Ornamental Snake	Vulnerable EPBC Act and NC Act	Likely
<i>Phascolarctos cinereus</i>	Koala	Vulnerable EPBC Act and NC Act	Potential
<i>Petauroides volans</i>	Greater Glider	Vulnerable EPBC Act and NC Act	Potential
Migratory species			
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory	Potential
<i>Hirundapus caudacutus</i>	White Throated Needletail	Migratory	Potential
<i>Monarcha melanopsis</i>	Black Faced Monarch	Migratory	Potential
<i>Plegadis falcinellus</i>	Glossy Ibis	Migratory	Potential
Introduced species			
-	Feral deer	Restricted invasive	Potential

⁹ Ecological Australia (18 August 2017): Wards Well Coal Project – Ecological Assessment Report. Project No. 17BRIECO-4089

Species name	Common name	Status	Likelihood of occurrence
<i>Capra hircus</i>	Goat	Restricted invasive	Potential
<i>Felis catus</i>	Cat	Restricted invasive	Potential
<i>Mus musculus</i>	House mouse	Other invasive	Potential
<i>Oryctolagus cuniculus</i>	Rabbit	Restricted invasive	Potential
<i>Bufo marinus</i>	Cane toad	Other invasive	Potential
<i>Sus scrofa</i>	Pig	Restricted invasive	Potential
<i>Vulpes</i>	Red fox	Restricted invasive	Potential

Additional terrestrial ecology surveys were undertaken across the MLs in 2024. The surveys identified the likelihood of occurrence assessment identified two threatened fauna species and one conservation significant species that are known to occur within the MLs. Given the presence of mapped habitat within the MLs, these species are also considered known to occur. The species include:

- Koala (*Phascolarctos cinereus*) – Endangered under the EPBC Act and NC Act.
- Short-beaked echidna (*Tachyglossus aculeatus*) – Special least concern under the NC Act.
- Squatter pigeon (southern) (*Geophaps scripta scripta*) – Vulnerable under the EPBC Act and the NC Act.

An additional threatened fauna species was assessed as likely to occur within the Study Area and Project Area, including:

- White-throated needletail (*Hirundapus caudacutus*) – Vulnerable under the EPBC Act and the NC Act.

2.2.9.1.1 Koala

Individuals were identified from two BAR locations within the central western and central parts of the MLs. All records were in areas of *Eucalyptus crebra* woodland and *Eucalyptus brownii* woodland (RE 11.5.9c).

Koala habitat within the MLs has been mapped as either preferred, suitable or marginal habitat, with guidance from *A review of koala habitat assessment criteria and methods* (Youngentob et al., 2021).

Preferred habitat mapped for the species within the MLs includes:

- Areas of remnant riparian eucalypt woodland RE 11.3.25d with locally important koala trees (LIKTs) present with high moisture content (*E. tereticornis* and *E. camaldulensis*) and connectivity to other areas of preferred habitat.

Suitable habitat mapped for the species within the MLs includes:

- Areas of remnant and mature regrowth eucalypt woodland REs 11.5.3, 11.5.9c, 11.8.5 and 11.5.17 providing abundant LIKTs (*E. brownii*, *E. crebra* and *E. tereticornis*) where koalas were recorded within the MLs.

Marginal habitat mapped for the species within the ML includes:

- Areas of remnant and regrowth brigalow dominated communities RE 11.5.16 and 11.9.5 providing few LIKTs (*E. cambageana*) and ancillary habitat trees (*A. harpophylla*) that provide limited feeding resources but may facilitate dispersal to other areas of suitable and preferred habitat.

2.2.9.1.2 Short-beaked Echidna

One individual was identified with the central part of the ML. This record was recorded in remnant *Eucalyptus crebra* woodland (RE 11.5.9c). Scats attributable to the species were also recorded in multiple locations in remnant vegetation within the MLs.

Short-beaked echidna habitat within the MLs has been mapped as either suitable or marginal habitat.

Suitable habitat mapped for the species within MLs includes:

- Areas of remnant and mature regrowth woodland REs providing habitat features such as large woody debris, shrubby areas and logs suitable for short-beaked echidna.

Marginal habitat mapped for the species within the MLs includes:

- Areas of grasslands and young woody regrowth vegetation providing limited habitat features such as large woody debris, shrubby areas and logs suitable for short-beaked echidna and provides dispersal habitat between areas of preferred habitat.

2.2.9.1.3 Squatter Pigeon (southern)

A total of 65 squatter pigeon (southern) individuals were recorded across the MLs. Records were in proximity to dams where there were trees nearby to disperse into when startled. Wooded areas with tree cover had lower levels of grass productivity with mid-dense to sparse ground cover. These areas are likely to be more suitable for squatter pigeon (southern) foraging habitat.

Squatter pigeon (southern) habitat within the MLs has been mapped as either preferred, suitable or marginal habitat with guidance from the DCCEEW species profile (DotE, 2022).

Preferred habitat mapped for the species within the MLs includes:

- Areas within 1 km of permanent water source suitable for breeding, that are areas of remnant and mature regrowth eucalypt woodland REs suitable for foraging.

Suitable habitat mapped for the species within the MLs includes:

- Areas within 3 km of permanent water source that are areas of remnant and mature regrowth eucalypt woodland REs suitable for foraging.

Marginal habitat mapped for the species within the MLs includes:

- Dispersal habitat which includes non-remnant areas within 3km of a permanent water source.

2.2.9.1.4 White-throated Needletail

White-throated needletail was not detected during the field surveys, however, has been previously recorded nearby (approximately 20 km) the MLs (ALA, 2024) and is considered likely to occur. Suitable habitat for the species includes a broad range of vegetation communities that support feeding resources

in which they fly in the airspace above. No areas of emergent trees with hollows in woodlands or tall trees at the edges of clearing were observed within the MLs.

Marginal habitat mapped for the species within the MLs includes:

- All areas that provide aerial space above suitable for foraging.

2.2.9.2 Migratory Fauna

The likelihood of occurrence assessment identified two migratory fauna species that are likely to occur within the ML, including:

- Fork-tailed swift (*Apus pacificus*) – Migratory under the EPBC Act and Special least concern under the NC Act.
- Oriental cuckoo (*Cuculus optatus*) - Migratory under the EPBC Act and Special least concern under the NC Act.

An additional two migratory fauna species were assessed as likely to occur within the MLs. These species include glossy ibis (*Plegadis falcinellus*) and Latham's snipe (*Gallinago hardwickii*) (Migratory under the EPBC Act and Special least concern under the NC Act).

2.2.9.2.1 Fork-tailed Swift

Fork-tailed swift was not detected during the field surveys, however, has been previously recorded nearby (approximately 20 km) the MLs (ALA, 2024) and is considered likely to occur. Suitable habitat for the species include a broad range of vegetation communities that support feeding resources in which they fly in the airspace above.

Marginal habitat mapped for the species within the MLs includes:

- All areas that provide aerial space above suitable for foraging.

2.2.9.2.2 Oriental Cuckoo

Oriental cuckoo was not detected during the field surveys, however, has been previously recorded approximately 17 to 25 km from the MLs (BMA, 2014; ALA, 2024) and is considered likely to occur. The species does not breed in Australia. Suitable habitat for the species' only includes intermittent roosting and foraging habitat (DotE, 2015). Suitable habitat for the species includes a broad range of vegetation communities that support feeding and dispersal of the species. Therefore, oriental cuckoo habitat within the MLs has been mapped as marginal habitat with guidance from the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DotE, 2015).

Marginal habitat mapped for the species within the ML includes:

- All areas of remnant and regrowth woodland communities that intermittently provide roosting, feeding and dispersal opportunities.

2.2.9.3 Pest Fauna

Five pest fauna species were recorded within the MLs. Four of these species were listed as restricted matters under the Biosecurity Act, including:

- Cane toad (*Rhinella marina*).
- Cat (*Felis catus*) – Category 3, 4 and 6 restricted matter.
- Wild dogs (*Canis lupus*) – Category 3, 4 and 6 restricted matter.

- European rabbit (*Oryctolagus cuniculus*) – Category 3, 4, 5, and 6 restricted matter.
- Feral pig (*Sus scrofa*) – Category 3, 4, and 6 restricted matter.

Pest fauna species have varying adverse impacts on the environment. Pigs are known to contribute to habitat degradation by damaging the banks of wetlands, creek lines and gilgai, uprooting vegetation, causing soil erosion, spreading weeds and browsing/grazing native flora. Evidence of habitat degradation caused by pig rooting was observed within the Study Area including damage around gilgai as well as within SEVT vegetation.

Carnivorous pest fauna such as feral cats and dingos and opportunistic carnivores such as feral pigs, are known to directly predate native fauna. In addition, cane toads outcompete native amphibians and are toxic to animals such as ornamental snake that predate upon them.

2.2.10 Pre-mining land use

The pre-mining land use of the area is cattle grazing. Some areas have previously been subject to vegetation clearing. Farm infrastructure such as water tanks, property water pipelines, windmills, bores, water troughs, feed troughs and dams are located throughout the area (**Figure 13**):

- cattle and feed stations; and
- windmills for livestock watering.



Figure 13 Evidence of existing cattle grazing-related land uses at Wards Well

Existing soil erosion is evident across the Wards Well area and is mainly associated with existing land use grazing activities; this includes evidence of historically cleared drainage lines and creeks (i.e. gully erosion) (**Figure 11 (a)** and **13(b)**).

The pre-mining land suitability classification for grazing of Wards Well, according to the DSITI & DNRM (2015) Guidelines for Agricultural Land Evaluation in Queensland¹⁰ and the soil survey⁷, is Class 2 for areas of Kandosol soil (i.e. suitable with minor limitations), and Class 3 for the Sodosol, Vertosol and Dermosol soil areas (i.e. suitable with moderate limitations). Class 2 land suitability covers approximately 53% of the Wards Well site and Class 3 covers the remaining 47% of the site⁷.

¹⁰ DSITI & DNRM (2015) Guidelines for agricultural land evaluation in Queensland, second edition, The State of Queensland (prepared by Department of Science, Information Technology and Innovation and Department of Natural Resources and Mines), Brisbane

2.2.11 Underlying landholders

The underlying landholders for the Wards Well leases are shown in **Table 11**, and illustrated in **Figure 14**.

Table 11 Underlying landholders for the Wards Well project area.

Mining Lease	Property	Landholder
ML 4752	Lancewood	Pini family
	Lenton Downs	Mason family
	Dabin Holding	Stanmore SMC Pty Ltd
ML 1790	Dabin Holding	Stanmore SMC Pty Ltd
	Denham Park	Stanmore SMC Pty Ltd
ML 70443	Dabin Holding	Stanmore SMC Pty Ltd
	Lenton Downs	Mason family
ML 70495	Dabin Holding	Stanmore SMC Pty Ltd

2.3 Design for closure

This PRC plan has been developed to proactively manage progressive rehabilitation of the Centurion North site to a stable PMLU, aiming to minimise long-term management requirements as well as associated closure costs. Importantly, a focused design for closure underpins all sections of this plan from:

- the proposed exploration methods to development of the rehabilitation knowledge base (baseline information);
- engagement with relevant stakeholders to define suitable PMLUs;
- defining and implementing rehabilitation practices to identify risks that could influence achievement of milestone criteria; and
- demonstrating successful rehabilitation through defined site monitoring to develop a feasible PRCP schedule.

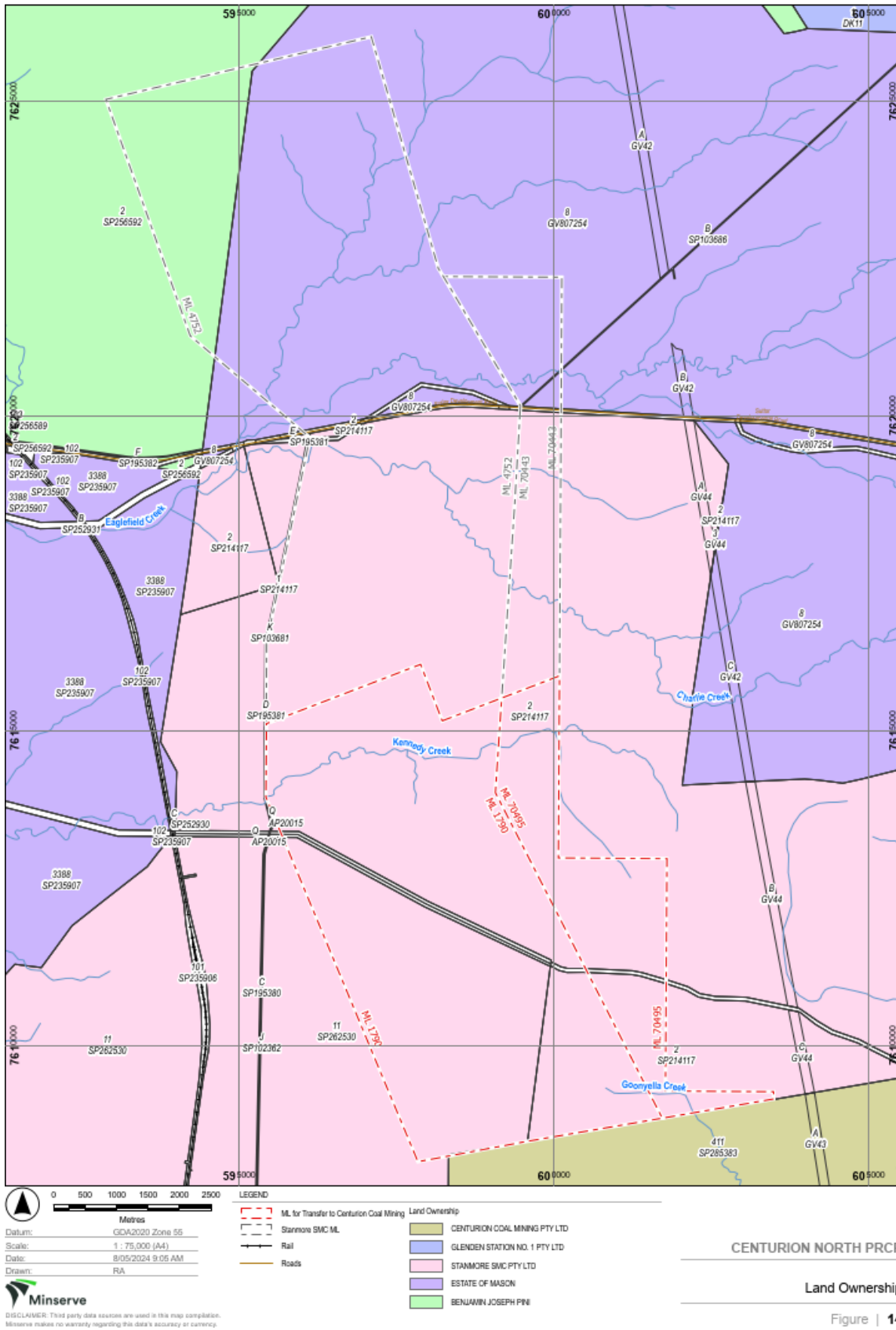


Figure 14 Land ownership

2.4 Rehabilitation and improvement planning

Legislative Requirement

In accordance with sections 126C(1)(b) and (c)(ii) of the *EP Act*, the rehabilitation planning part must include:

- identification of all relevant activities on the mine site;
- the predicted duration of each of the relevant activities proposed for the mine site;
- the size/extent of the relevant activities; and
- whether the different relevant activities can be progressively rehabilitated.

PRC Plan Guideline (Section 3.1)

Under section 126C(1)(j) of the *EP Act*, PRC plans must also include the following details about any existing rehabilitation already completed at the time of submission of the proposed PRC plan:

- a description of the rehabilitation works previously carried out;
- when the rehabilitation works commenced and were completed; and
- whether the rehabilitation has been applied for or approved as progressively certified under the *EP Act*.

2.4.1 Relevant activities

The relevant activities at Centurion North that will require rehabilitation are provided in **Table 12**. This table also provides the predicted duration of each activity from when the activity commences i.e. where topsoil is stripped, until it is available for rehabilitation.

Exploration drill areas will be progressively rehabilitated once drilling is complete.

Table 12 Relevant activities requiring rehabilitation at Wards Well

Relevant activity	Predicted duration	Size (ha)	Availability for progressive rehabilitation
Exploration drilling area (RA1)			
Exploration drilling pads and tracks	2021-2036	145	Areas to be progressively rehabilitated during this time period once pad and tracks are no longer required

*EA indicates 1.8ha, which is the surface area of the box-cut floor

2.4.2 Rehabilitation areas and milestones

The activities in **Table 12** are grouped by rehabilitation area (RA). A rehabilitation area is defined in the PRCP Guideline as “an area of land in the post-mine land use to which a rehabilitation milestone for the post-mining use relates”. A rehabilitation milestone (RM) for the rehabilitated land, means each significant event or step necessary to rehabilitate the land to a stable condition (section 115 of the *EP Act*)¹. *EP Act*

The RAs and RMs for Centurion North are referred to throughout this PRC plan and are summarised in **Table 13**. (These are further illustrated in **Figure 24**, and detailed in the PRCP schedule).

Table 13 Rehabilitation areas (RAs) and rehabilitation milestones (RMs) for Wards Well

Rehabilitation area (RA)	Rehabilitation milestone (RM)
	RM1 Infrastructure decommissioning and removal
	RM2 Remediation of contaminated land
	RM3 Landform development and reshaping
	RM4 Surface preparation
RA1 Exploration drilling area	RM5 Revegetation (cattle grazing)
	RM6 Achievement of surface requirements (cattle grazing)
	RM7 Achievement of post-mining land use to a stable condition (cattle grazing)

2.4.3 Existing rehabilitation

Rehabilitation of drill pads, tracks and seismic has occurred at Centurion North. **Figure 15** shows a drill site before (a) and after rehabilitation (b), which included the following standard Wards Well rehabilitation activities:

- Removing hole casings from drill holes;
- Draining any existing water from associated mud sumps;
- Backfilling drill chips in the drill hole and/or the associated mud sump;
- Blocking drill holes, and cementing surface hole where necessary;
- Covering and levelling drill pad area to allow for settlement, and then covering with topsoil;
- Removing all rubbish, casings and/or fencing from the site;
- Re-shaping and levelling the drill pad area;
- Ripping associated tracks to promote regrowth;
- Re-spreading topsoil (previously removed from the site) over the area;
- Contour ripping immediately after topsoil placement to control erosion; and
- Seeding the area.

The existing rehabilitation of drill sites – and the subsequent trajectory towards achievement of milestone criteria, has been determined based on a combination of aerial imagery analysis before and after approved drilling programs, as well as by field visits which have indicated the self-regeneration of pastures on rehabilitated drill sites (**Figure 15**)b.

No rehabilitation areas have applied for progressive certification under the *EP Act*.

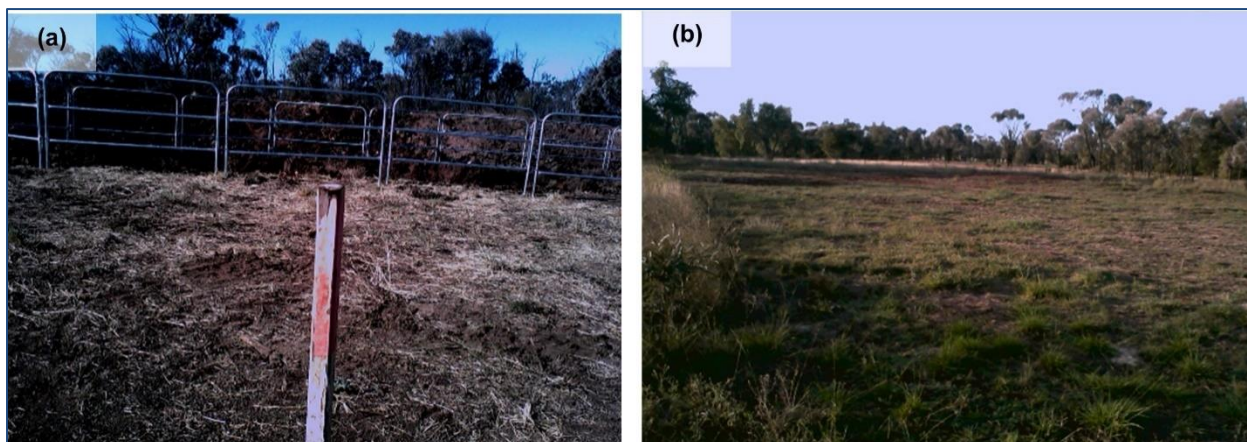


Figure 15 **Wards Well drill site DB12 before and after rehabilitation**

2.4.4 Seismic activities

No further seismic activities are currently planned for Centurion North.

3. COMMUNITY CONSULTATION

Legislative Requirement

In accordance with section 126C(1)(c)(iii) and (iv) of the *EP Act*, the rehabilitation planning part of the PRC plan must include:

- details of the consultation undertaken by the applicant in developing the proposed PRC plan; and
- details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan.

PRCP Guideline (Section 3.5)

In developing the proposed PRC plan, the community should at least be engaged on the plan for the mine, PMLUs or NUMAs, areas of disturbance, rehabilitation and management methods, progressive rehabilitation, and closure timeframes. Ongoing community consultation should continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community.

Community consultation carried out through different processes (such as an EIS) may be used to address the requirements in section 126C(1)(c) of the *EP Act*. The details of this consultation must be provided in the rehabilitation planning part of the proposed PRC plan).

PRC plans are still required to meet the legislative requirements in section 126C(1)(c) of the *EP Act*. All proposed PRC plans must contain a community consultation plan regardless of whether the site has an existing EA.

3.1 Consultation to date

Land within the Wards Well MLs was acquired in 2007. Further compensation agreements on other land parcels were executed in 2011 - 2012. Engagement with the affected landowners was undertaken to develop compensation, leasing and agistment agreements. This included advice that:

- in the near term, exploration activities were the only activities planned;
- underground mine was proposed for some time in the future; and
- until land was required for exploration or mining, it would be available for cattle grazing within the terms of the agistment agreements and leases.

Consultation has been undertaken for the Wards Well MLs, which incorporates the Lancewood MLs and Centurion North MLs and therefore remains relevant.

In essence, the outcome of consultation during the acquisition processes was that landowners and cattle would be excluded from affected areas whilst land disturbance was occurring, and the land would then be rehabilitated, and the landform returned to a state suitable for cattle grazing. The existing use for grazing (managed under agistment agreements and leases) has been discussed with directly-affected landholders as part of regular meetings between SMC and these stakeholders.

Consultation undertaken as part of the application for the original PRC plan and PRCP schedule preparation for Wards Well includes the following:

1. Meeting with Isaac Regional Council (IRC) about Wards Well's approved activities, PRC planning process and PMLUs; providing a presentation for Council's information, and an invitation for further discussion with Council about their involvement in future PRC plan consultations.

2. Writing to the three landholders that own or lease land within the MLs to provide a project update and information about the approved activities and PMLUs under Wards Well's EA; inviting feedback; and discussing ongoing engagement regarding the form of landholder involvement in future PRC planning consultations.
3. Writing to Widi People who are the Traditional Owners of land within ML1790 and ML70495 to provide an update on Wards Well and information on approved activities and PMLUs within the MLs.
4. Writing to utility owners and the owners of overlapping tenures (mining and gas exploration) within the Wards Well MLs to advise that a PRC plan was being prepared, and to let them know that further engagement in future stages of Wards Well's development will be undertaken.
5. Writing to other interested stakeholders including adjacent landholders, IRC and government representatives to advise that a PRC plan was being prepared; provide information about Wards Well's progressive rehabilitation and approved PMLUs; and invite stakeholders to contact SMC if they would like to discuss the PRC plan or obtain more information.

3.2 Community consultation register

A community consultation register has been provided as part of the application for the original PRC plan and PRCP schedule in compliance with section 126C(1)(c)(iii) of the *EP Act* and includes:

- identification of each community member/stakeholder;
- all recorded previous engagements with the community;
- consultation date(s);
- description of consultation type (e.g. letters, meetings and communication strategies);
- information provided to the community;
- issues raised/discussed;
- how issues raised and the outcomes of engagement have been considered in decision-making; and
- commitments made by the applicant.

The stakeholders identified as part of this register are considered as having a genuine, demonstrable and legitimate interest in Wards Well's ongoing rehabilitation and closure planning. Relevant stakeholders identified for Wards Well's PRC planning and the proposed exploration program are provided in

Table 14.

The complete community consultation register provided in **Appendix 6**, and will be a live instrument that will be updated for recording future consultation on Centurion North PRC plan.

Table 14 Key stakeholders identified as part of the Wards Well’s community consultation register

Stakeholders	Details	Interests
Affected stakeholders		
Traditional owners - Widi People	The Widi People (whose claim was recognised by the NNTT (National Native Title Tribunal) in 2015) are the Traditional Owners of land to the east of Wards Well, with a small area of land within ML1790 and ML70495 within the Widi People’s claim area.	• Cultural heritage impacts. • Impacts on Native Title. • Potential for impacts on the cultural landscape or connections to Country. • Post-mining land use and landform / landscape. • Environmental management / stewardship. • Employment and business opportunities in exploration, environmental management and monitoring, rehabilitation.
Affected landowners and lessees	SMC has agreements with three landholders within the Wards Well MLs – two landowners and two lessees of land owned by BMC. Land within the MLs is used for grazing. Compensation Agreements are in place for properties within the MLs. The two landholder properties do not overlap the Centurion North MLs; however they remain stakeholders.	• Access to land owned by SMC whilst not required for mining purposes. • Future access to and ownership of lands. • Compensation for impacts on land use. • Water access – water allocations, water pipelines. • Environmental management / stewardship. • PMLU and landform/landscape.
Utility owners • Powerlink • Aurizon • Sunwater • DTMR	Utility owners with assets within Wards Well MLs include Powerlink (electricity transmission), Sunwater (Burdekin water supply pipeline and Eungella water pipelines), Aurizon (rail infrastructure) and DTMR (Suttor Development Road and an unformed road). SMC engages with utility owners as required, i.e. through issue-specific or transactional engagement. Implementation of the PRC plan will require update to agreements with utility owners. Some infrastructure assets may not be located on the Centurion North MLs; however utility owners remain as stakeholders.	• Impact on assets/asset value. • Remediation of impacts on assets. • Service disruptions and mitigations. • Crossing/interface agreements.
Owners of overlapping tenures • Arrow Energy	Arrow Energy have overlapping tenures with the Centurion North MLs (for coal seam gas production). Relationships with overlapping tenures owners are managed as part of statutory and commercial processes.	• Any impacts on the use or availability of land within overlapping tenures. • Water access. • Access to land owned by SMC whilst not required for mining purposes. • Crossing/interface agreements.

Stakeholders	Details	Interests
Adjacent private landholders	To the east and west of Wards Well MLs, SMC owns land which is used as a buffer to manage the potential for conflicting land uses. Peabody's North Goonyella mine adjoins the southern boundary of the mining lease. Land owned by private landowners is located to the west and east. Land uses on adjacent land holdings include grazing and mining.	• Environmental management / stewardship. • PMLU and landform/landscape. • Access to land owned by BMC whilst not required for mining purposes. • Rehabilitation schedule. • Future access to and ownership of lands.
Local Government • Isaac Regional Council	Isaac Regional Council is the local government and planning authority for the Isaac LGA which encompasses some 58,000km ² and 17 distinct and diverse communities.	• Local job opportunities. • Economic and community sustainability and transformation (towards post-mining). • Environmental stewardship. • Effects of on Council services and infrastructure e.g. changes to infrastructure agreements, water supply or road maintenance. • Mine rehabilitation progress. • Management of closure impacts on employment and businesses. • Accordance of SMC rehabilitation plans with local and regional planning goals.
Interested stakeholders		
Other nearby landholders	Several landholders are located within a 5-6km radius around Wards Well. SMC has established relationships with landholders to the south and east of Wards Well.	• Post-mining land use and landform/landscape. • Access to land owned by SMC. • Rehabilitation schedule. • Future access to and ownership of lands.
Jangga People	The Jangga People (whose claim was recognised in 2012) are the Traditional Owners of land to the west of Wards Well's MLs.	• Potential for impacts on the cultural landscape or connections to Country. • PMLU and landform / landscape. • Employment and business opportunities in exploration, environmental management and monitoring, rehabilitation.
Stanmore employees and contractors	Centurion North does not have an established on-site workforce. Exploration and land management functions are performed by contractors. Other SMC personnel will be interested in closure planning if they perceive that it may affect their employment security.	• Job opportunities. • Loss of jobs with closure. • Closure planning in context with other mining industry changes e.g.

Stakeholders	Details	Interests
Unions	Unions with members who are employed by SMC include the Construction, Forestry, Mining and Energy Union (CFMEU), the Australian Manufacturing Workers' Union (AMWU) and the Electrical Trades Union (ETU). SMC maintains relationships with unions with respect to enterprise bargaining agreements, working conditions and workplace health and safety.	technology advances, autonomous haulage. - Workers' conditions. - Sustainability of communities that are dependent on mining.
Businesses	SMC has processes to identify small, local businesses as well business owned by traditional owners. Stanmore seeks to promote vendor growth through improving working capital in a timely manner, i.e. favorable payment terms.	- Opportunities to participate in supply chain (e.g. exploration, environmental management, rehabilitation). - Economic transformation (towards post-mining). - Economic and community sustainability. - Loss of supply opportunities with closure.
Community members and groups	SMC is strongly affiliated with the communities of Moranbah and nearby smaller regional towns (in the Isaac LGA).	- Local job opportunities. - Local business opportunities. - Community and regional sustainability. - Environmental management. - Future use of mined land. - With closure of an operation, loss of jobs and supply opportunities. - Rehabilitation schedules.
Queensland Government	State government representatives and agencies with an interest in PRC planning include: - Office of the Minister for Resources - Office of the Minister for Environment, Great Barrier Reef, Science and Innovation - Member for Burdekin - Member for Gregory - Shadow Minister for Resources and Critical Minerals - Department of Resources (DoR) - Deputy Director-General Georesources - DESI – PRCP Team and Emerald Business Centre	- Legislative compliance. - Resource development. - Employment opportunities. - Public interest. - Environmental management. - Financial assurance. - Environmental risk identification and management. - Future land use and landform. - Company responses to stakeholder views.
Federal Government	The Department of Climate Change, Energy, the Environment and Water (DCCEEW) is the lead agency for environmental protection at Commonwealth level.	

3.3 Ongoing consultation

3.3.1 Consultation objectives, engagement type and frequency

A dedicated Community Consultation Plan (CCP) has been compiled for Wards Well's PRC planning¹¹ (**Appendix 6**). This plan documents the iterative consultation process to be followed to enable ongoing engagement with relevant stakeholders (**Table 15**) and will form the basis for consultation on Centurion North.

Table 15 **Process to be followed for ongoing community consultation for the Centurion North PRCP**

Consultation objective	Develop strong and cooperative stakeholder relationships with affected stakeholders to enable their informed consideration of PRC plans and identification of shared value and/or beneficial future land uses	
Stakeholders	Engagement type	Consultation frequency
- Landowners and lessees within the MLs - Traditional owners – Widi People and Jangga People - Adjacent private landholders - Isaac Regional Council - Utility owners – Powerlink, Aurizon, Sunwater, DTMR - Owners of overlapping tenures – Arrow Energy, Anglo American	Advise affected stakeholders in writing when the PRC plan is approved and provide a copy of the PRC plan for their information	One-off
	Provide information in writing to all affected stakeholders on PRC plan progress, and invite affected stakeholders' feedback on: the approved PMLU e.g. rehabilitation methods which would optimize future grazing opportunities areas where land disturbance through approved exploration activities are proposed i.e. any particular values in certain areas rehabilitation methods, schedule and milestones	Initially on commencement of rehabilitation; subsequent consultation to be defined thereafter
	Meet with directly affected and adjacent landholders, Widi People and Jangga People to provide an update on the Centurion North concept plan, communicate progress with rehabilitation against the PRC plan schedule, and discuss any other items of interest (e.g. particular values pertaining to disturbed areas, or shared value initiatives).	Ongoing engagement process
	As part of biannual meetings with IRC (or as determined with Council), provide an update on the status of the EA (approved activities and PMLUs), the PRC plan and concept plan (as progressed), and progress with rehabilitation against the PRC plan schedule, and forecast upcoming PRC plan consultations for other SMC assets.	Bi-annual
	Notify affected stakeholders in writing when an EA amendment application for further exploration has commenced, providing information on the scope and location of the activities for which the amendment is sought, seeking feedback on the proposed updated rehabilitation schedule, disturbance footprint and proposed PMLUs to be included in the PRC plan/amendment accompanying the EA amendment application, and advising on how to access information about the EA amendment notification process.	One-off

¹¹ BHP (December 2020): PRCP Wards Well Community Consultation Plan

Consultation objective	Develop strong and cooperative stakeholder relationships with affected stakeholders to enable their informed consideration of PRC plans and identification of shared value and/or beneficial future land uses	
Stakeholders	Engagement type	Consultation frequency
	Meet with Widi People and Jangga People to provide an update on Centurion North and proposed disturbance areas / activities for which an EA amendment is sought. With Widi People, this will include consultation on cultural heritage management requirements, rehabilitation species, methods and timeframes. This consultation may also identify Traditional Owners' interest in and capacity for involvement in rehabilitation works.	Ongoing engagement process
	Meet with DTMR to develop an Infrastructure Plan and update/develop agreements, if required, with terms and conditions tailored to the planned exploration / mining activity as part of a future EA amendment application process.	Meetings as required
	Through correspondence and/or meetings, co-operate with Powerlink, Sunwater and Aurizon to develop interface agreements, if required, with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process.	One-off process
Consultation objective	Demonstrate transparency regarding SMC's PRC intentions and timeframes to local communities	
Stakeholders	Engagement type	Consultation frequency
Moranbah and Glenden community members and groups	Using SMC's website and community forums such as interagency meetings, partnership meetings and community and business networks, provide community updates on PRC planning (Centurion North-specific and portfolio wide) and advise community members of progress towards further exploration and development of Centurion North.	Ongoing engagement process
	Via Smart Transformations Advisory Committee members, CSIRO Local Voices pulse surveys and/or PRC plan-specific workshops or focus groups, seek the involvement of community members and groups in articulating community aspirations for rehabilitation of SMC operations, PMLUs and economic transformation.	One-off process
SMC employees, contractors and unions	Via internal SMC communications, provide regular updates on PRC planning (Centurion North-specific and portfolio wide) and updates on the Centurion North concept planning process.	Ongoing engagement process
Young people	Share accessible information (e.g. on-line or printed learning resources) with Moranbah and Glenden schools and community organisations (e.g. Moranbah Youth and Community Centre and Youth Advisory Committee) to enable young people to understand mine planning and rehabilitation planning and implementation.	One-off
Local businesses and suppliers	Via the Moranbah Traders Association, provide updates on PRC planning (Wards Well-specific and portfolio wide), including	One-off

Consultation objective		
Develop strong and cooperative stakeholder relationships with affected stakeholders to enable their informed consideration of PRC plans and identification of shared value and/or beneficial future land uses		
Stakeholders	Engagement type	Consultation frequency
	rehabilitation plans and progress, approved PMLUs and potential future supply opportunities.	
Elected representatives and Government agencies	Provide updates via letter and/or meeting on PRC planning to: • Office of the Minister for Resources (Queensland) • Office of the Minister for Environment, Great Barrier Reef, Science and Innovation (Queensland) • Office of the Minister for Resources and Critical Minerals • Member for Burdekin (Queensland Parliament) • Member for Gregory (Queensland Parliament) • Member for Capricornia (Australian Parliament) • DES PRCP Team and Emerald Business Centre • Deputy Director-General Georesources, DoR • Assistant Secretary Assessments and Governance Branch, DCCEEW	As requested, or as agreed with individual representatives /agencies
Consultation objective		
Incorporate community objectives and aspirations for land use and landform planning post-mining in future plans for Centurion North.		
Stakeholders	Engagement type	Consultation frequency
Traditional Owners and Indigenous businesses	Meet with Traditional Owners and Indigenous businesses to understand business capabilities and communicate the pipeline of opportunities relating to rehabilitation work and land management (portfolio-wide).	One-off
	In cooperation with Traditional Owners including Widi People, Jangga People and other First Nations within Isaac LGA, plan and implement an Indigenous business capability development program to match rehabilitation opportunities, if this is required.	One-off
Isaac Regional Council	Meet with IRC to understand Council's strategic analysis and planning for Isaac LGA and the Centurion North project area as relevant, to identify objectives to be considered as part of future PRC planning for Wards Well.	Annually, or as agreed with Council
	Share the results of SMC research and industry partnership projects relevant to rehabilitation with Council.	One-off, or as agreed with Council
	Participate in Council-led initiatives which aim to harness social value from mine closure and rehabilitation planning, and/or work towards from economic transformation.	As invited
Local businesses and suppliers	Share information on local supply opportunities relevant to rehabilitation implementation and hold a workshop/s for interested businesses, to	One-off process

Consultation objective	Develop strong and cooperative stakeholder relationships with affected stakeholders to enable their informed consideration of PRC plans and identification of shared value and/or beneficial future land uses	
Stakeholders	Engagement type	Consultation frequency
	identify and develop local capabilities for involvement in rehabilitation work.	

3.3.2 Consultation objectives, engagement type and frequency

Information to be released as part of ongoing community consultation will include:

- Rationale and scope for PRC Plan and PRCP Schedule;
- Approved activities and PMLUs for Centurion North;
- On-site activities and areas of disturbance;
- Proposed rehabilitation methods, schedule and milestones; and/or
- Opportunities for community consultation as part of the PRC Plan’s implementation.

Where required, communication tools could include:

- A holding statement for general enquiries;
- Frequently asked questions and answers (FAQs) and a PRC Planning fact sheet available to support consultation activities;
- Face-to-face and virtual meetings; and/or
- Updates and fact sheets about PRC Planning.

3.3.3 Addressing feedback and comments

As noted in the PRCP Guideline, in addition to the annual return requirements that relate to EAs, if a PRC Plan applies to the activities, the annual return must also include an evaluation of the effectiveness of the PRC Plan, including the environmental management carried out under the PRCP Schedule, for the year to which the annual return relates.

Centurion will monitor and report on the progress and outcomes of progressive rehabilitation activities against rehabilitation milestones provided in the PRCP Schedule. This monitoring will aim to demonstrate a successful rehabilitation trajectory towards achievement of the approved PMLU, and/or to inform corrective action where required, which will be reported as part of annual returns.

Information about rehabilitation progress will also be delivered as part of the consultation methods detailed in **Table 15**, and any feedback will be considered in subsequent updates of this PRC Plan.

The PRC Plan Community Consultation Register will also be updated as community consultation activities outlined in **Table 15** are completed. Feedback recorded in the Community Consultation Register will be considered in framing and detailing future PRC Plan amendments for Wards Well.

The above is also documented as part of the Community Consultation Register (**Appendix 6**).

Relationship with PRCP Schedule

Consultation was undertaken for the original PRC plan application and will continue as per the process documented in the CCP. Achievement of the PMLU of cattle grazing is consistent with the outcome of consultation completed to date.

4. POST-MINING LAND USES

Legislative Requirement

In accordance with section 126C(1)(d) of the *EP Act*, the rehabilitation planning part of the PRC Plan must state the extent to which each post-mining land use for land identified in the PRCP schedule for the plan is consistent with:

1. the outcome of consultation with the community in developing the plan, and
2. any strategies or plans for the land of a local government, the State or the Commonwealth.

PRCP Guideline (Section 3.2)

A PMLU is defined under section 112 of the *EP Act* as the purpose for which the land will be used after all relevant activities for the PRC Plan carried out on the land have ended. Relevant activity for a PRC plan is defined in the *EP Act* as the relevant activities to be carried out on land the subject of the plan. It is not the intention of this definition to include third-party activities or assets that continue to exist once mining activities have ceased, such as third- party pipeline easements, power easements or overlapping tenures for other EAs.

The rehabilitation planning part of the PRC plan must include a detailed description of the nominated PMLU(s) for the site. The description must include (where relevant), but is not limited to:

- a description of the use of the land;
- if applicable, the specific vegetation types (e.g. RE 13.2.9) or land suitability classification (e.g. Class 4);
- identification of any permanent or essential management infrastructure to be included as part of the PMLU; and
- completion criteria for measuring whether the PMLU has been successfully achieved.

Where a PMLU has been previously addressed in a land outcome document and is able to be transitioned into the PRCP schedule, the holder is not required to complete the information requirements under section 126C(1)(j) of the *EP Act* in this section for those PMLUs.

However, the legislative requirements under section 126C(1)(d) of the *EP Act* still apply. All PMLUs transitioned into the PRCP schedule must still meet the requirements of a PMLU explained in this section, particularly that the PMLU can be rehabilitated to a stable condition.

4.1 Nominated PMLUs

Cattle grazing is approved in the PRCP schedule as the only PMLU for the site.

The EA acceptance criteria, as they existed prior to approval of the PRCP schedule, for the PMLU of cattle grazing (

Table 16) were transitioned to the milestone criteria in the PRCP schedule for the final milestone of achieving the post-mining land use to a stable condition. The approved PRCP schedule has cattle grazing PMLU for all rehabilitation areas.

Table 16 Wards Well EA post-mine land use objectives, indicators and acceptance criteria for cattle grazing

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5
	Rehabilitation is erosionally stable	Extent, slope gradient and groundcover	1. Groundcover >50% 2. 70% of slopes ≤20%
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines
Able to sustain an agreed post-mining land use	Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment for cattle grazing	Land suitability class ≤3 or not different from pre-mining class if ≥4 Assessment completed in accordance with <i>LSA Framework for Open-Cut Coal Mine Rehabilitation 2018. (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland)</i> unless otherwise agreed in writing between the Adminstrating Authority and the environmental authority holder ¹²

¹² It is noted that this LSA Framework, as referenced in the EA, is a draft document and may be refined over time as site knowledge is refined.

Goal	Objective	Indicator	Acceptance criteria
		<i>Leucaena</i> stem density	<250 stems >2m height per ha (1 per 40m ²), mean total area

4.1.1 Grazing land suitability

The assessment of pre-mining and post-mining land suitability for cattle grazing, as specified in the PRCP schedule, is based on the ‘Rule-set for land suitability assessment of cattle grazing on coal mine rehabilitation’¹³ (hereafter referred to as the grazing rule-set).

The land use limitations in the grazing rule-set identified for cattle grazing have been selected from the comprehensive list provided in the Queensland Land Evaluation Guidelines based on:

- The target PMLU of sustainable cattle grazing;
- The regional-scale of application across the Bowen Basin; and
- Diagnostic attributes that can be readily correlated to mapping units at potential mapping scales of 1:50,000 and larger.

Table 17 provides further detail on the specific indicators for assessing land suitability class of the grazing ruleset. The Class 1 to Class 2 boundary represents the attribute level at which the limitation starts to affect productivity; and the Class 3 to Class 4 boundary determines whether the rehabilitation is suitable or not and therefore able to sustain an agreed PMLU of grazing as required under the PRCP schedule.

It is important for long-term sustainable grazing land management on rehabilitated lands to plan for the establishment and maintenance of good condition pastures. The rehabilitation planning and revegetation process is therefore based on sowing preferred pasture species aligned to the associated rehabilitation soils and land topography. The ongoing assessment of pasture condition, after the revegetation process, is used to assess the condition of the pasture and guide ongoing maintenance and management of pastures on rehabilitated lands. The pasture condition milestones are described in further detail in Section 7.

¹³ Short, T. (2020): A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin, Queensland Highlands Environmental, Emerald

Table 17 Land suitability ruleset for cattle grazing on rehabilitation at Centurion North

Limitation	Indicator	Units	Suitability class				
			1	2	3	4	5
Water availability	PAWC in ERD	mm/0.6d	> 75	75 - 60	< 60 - 45	< 45 - 30	< 30
Nutrient supply	P in 0.1m	mg / kg	> 20	20 - 14	< 14 - 8	< 8 - 4	< 4
	pH in 0.1m	pH units	7.3 – 6.6	< 6.6. – 6.0 or > 7.3 – 8.0	< 6.0 – 5.5 or > 8.0 – 8.5	< 5.5 – 5.0 or > 8.5 – 9.0	< 5.0 or > 9.0
Soil physical factors	Surface soil structure	variable	Fine (peds < 10mm)	Coarse (peds > 10mm)	Surface crust	Very hard setting	Massive
Salinity	EC in ERD	dS/m	< 2	2 - < 4	4 - < 10	10 - < 16	≥ 16
Rockiness	Fragments on surface	%	< 5	5 - 10	10 - 30	30 - 60	> 60
Topography (slope)	Gradient, surface	%	< 5	5 - < 10	10 - < 15	15 - < 20	≥ 20
	Vertical interval, surface	m	Nil ripping furrows	Regular ripping furrows < 0.2m	Regular ripping furrows > 0.2 – 0.4m	Regular ripping furrows > 0.4 – 0.6m	Regular ripping furrows > 0.6m
Water erosion, surface soil	Slope (ESP in 0.1m < 6)	%	< 5	5 - 8	> 8 - 12	> 12 - 18	> 18
	Slope (ESP in 0.1m > 6 - < 14)	%	< 3	3 - 6	> 6 - 10	> 10 - 12	> 12
	Slope (ESP in 0.1m > 14)	%	< 1	1 - 2	> 2 - 4	> 4 - 6	> 6
Sub-soil erosion	ESP at 0.5m	%	< 7	7 - 14	> 14 - 23	> 23 - 34	> 34
Potentially acid forming materials	pH < 4.5	pH units	Not likely to be present within 5m of surface	Not likely to be present within 3m of surface	Not likely to be present within 2m of surface	Present immediately below root zone (0.9 – 0.6m)	Present within root zone (surface 0.6m)

4.2 Community Consultation

Achievement of the PMLU of cattle grazing is consistent with the outcome of consultation completed to date (Section 3).

4.3 Regional planning integration

The PMLU at Wards Well, and consequently Centurion North, considers the pre-mining land use, neighbouring land use and EA conditions. Existing land use in the area is primarily grazing of beef cattle. Some areas have been subject to cultivation (ploughing) and clearing. Wards Well and the neighbouring beef cattle stations also feature remnant woodland vegetation with farm infrastructure such as water tanks, windmills, troughs, and dams located throughout the area.

Under the Isaac Regional Planning Scheme (2021), Wards Well is located in a 'rural' zone, which includes uses such as grazing, farming, forestry, tourism and extractive industries. Land use performance outcomes for this rural zone include ensuring development:

- (a) is consistent with the rural character of the locality;
- (b) supports the primary rural function of the zone;
- (c) protects rural, natural and scenic values of the locality.

In addition, the Queensland Government, via its Mackay, Isaac and Whitsunday Regional Plan (2021), maps Wards Well in a 'regional landscape and rural production area', which includes land used for agriculture, water catchment, traditional uses, conservation areas and native forests.

The defined uses in both plans are consistent with the PMLUs approved for Wards Well in the PRCP schedule.

Relationship with PRCP schedule

Due to the limited disturbance caused by the approved mining activities as well as minimal changes to the pre-mining landform, the PMLU will be cattle grazing. This is consistent with the pre-mining land use. The acceptance criteria for cattle grazing are the milestone criteria for achieving the PMLU in the PRCP schedule.

The information in this section is relevant to the following highlighted
Rehabilitation Areas (RAs) and **Rehabilitation Milestones (RMs)** in the PRCP schedule

RA1

RM1

RM2

RM3

RM4

RM5

RM6

RM7

The following **Milestone Criteria** will demonstrate achievement of PMLU to a stable condition:

RM7

- A hazard assessment has been completed by an appropriately qualified person to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use.
- Groundcover >50%.
- Rainfall runoff from the area is not significantly different to upstream values for the following: pH, EC and turbidity.

	– - Land suitability class ≤ 3, or not different from pre-mining class if ≥ 4. The assessment is to be conducted by an appropriately qualified person and completed in accordance with LSA Framework for Open-Cut Coal Mine Rehabilitation 2018 (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland) unless otherwise agreed in writing between the administering authority and the environmental authority holder. For RM7(d) if the land suitability class is assessed as not different from pre-mining class if ≥ 4 for all or a portion of a rehabilitation area, an assessment of reference sites must be carried out to determine if the limitation/s resulting in the class of ≥ 4 is consistent with that of reference sites. - Certification by an appropriately qualified person that pasture meets a pasture condition rating ≤ 3, based on the Pasture Condition Assessment Table as per Stocktake: Balancing Supply and Demand (https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/), as provided in Table 30.
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5. NON-USE MANAGEMENT AREAS

Legislative Requirement

In accordance with sections 126C(1)(d), (g) and (h) of the *EP Act*, for each proposed non-use management area, the rehabilitation planning part of the PRC plan must:

- state the reasons the applicant considers the area cannot be rehabilitated to a stable condition;
- include copies of reports or other evidence relied on by the applicant for each proposed non-use management area;
- state the extent to which the proposed non-use management area is consistent with the outcome of consultation with the community in developing the plan; and
- state the extent to which the non-use management area is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.

PRCP Guideline (Section 3.3)

A NUMA is defined in the *EP Act* as an area of land the subject of a PRC plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC plan carried out on the land have ended. Proposed NUMAs must be justified under the criteria set out in section 126D(2) of the *EP Act*.

The rehabilitation planning part of the PRC plan must also include:

- a) information demonstrating that the proposed footprint of each NUMA is as small as practicable;
- b) an assessment of the NUMA location options, having regard to the constraint of the resource location, with an analysis of the potential environmental harm and sensitivity of the surrounding environment of each option;
- c) a description of the proposed location of each NUMA and the environmental values of the surrounding environment; and
- d) evidence showing how the proposed location will prevent or minimise environmental harm.

In accordance with section 126D(1)(c) of the *EP Act*, the applicant must develop and implement management milestones within the PRCP schedule which achieve best practice management and minimise environmental harm for any NUMAs contained in the proposed PRC plan. As part of the development of management milestones, the applicant must conduct a NUMA specific risk assessment to identify and quantify risks and associated controls. The risk assessment should have an overarching goal of identifying and controlling any significant risks to the community and the environment.

The proposed PRC plan must include a detailed description of the nominated NUMA(s) for the site. The description must include, but is not limited to:

- description of the land at surrender;
- any relevant safety features; and
- completion criteria for measuring whether the NUMA has achieved sufficient improvement.

Where a NUMA has already been identified in a land outcome document and is able to be transitioned into the PRCP schedule, the applicant is not required to comply with sections 126C(1)(g) or (h) or 126D(2) or (3) of the *EP Act*. NUMAs transitioned into the PRCP schedule are not required to complete the information requirements under section 126C(1)(j) of the *EP Act* in this section for those NUMAs. However, the legislative requirements under section 126C(1)(d) of the *EP Act* still apply.

Where a NUMA has not been pre-approved and is proposed as part of the transition into the PRC plan, the applicant must include all of the requirements identified in this section.

5.1 Nominated NUMAs

There are no NUMAs planned for Centurion North.

5.2 Management methods

Not applicable. There are no NUMAs planned for Centurion North.

5.3 Community considerations

Not applicable. There are no NUMAs planned for Centurion North.

5.4 Regional planning integration

Not applicable. There are no NUMAs planned for Centurion North.

Relationship with PRCP schedule

Not applicable. There are no NUMAs planned for Centurion North.

6. VOIDS IN FLOODPLAINS

Legislative Requirement

In accordance with section 126D(3) of the *EP Act*, if land the subject of the proposed PRCP schedule will contain a void situated wholly or partly in a flood plain, the schedule must provide for the rehabilitation of the land to a stable condition.

PRCP Guideline (Section 3.4)

Section 41C of the EP Regulation states the decision considerations for a void situated wholly or partly in a flood plain. A void is considered to be located in a flood plain if the flood plain modelling shows that, when all relevant activities carried out on the land have ended, the land is the same height as, or lower than, the level modelled as the peak water level 0.1% AEP for a relevant watercourse under the guideline Australian Rainfall and Runoff (2019)(ARR).

Where a land outcome document has a pre-approved land outcome for a void with a location specified, flood plain modelling is not required. If a void has been identified as a NUMA in a land outcome document but the location is not identified, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline. While the provision in the *EP Act* relating to voids located within a floodplain having to rehabilitate to a stable condition does not apply, the PRC plan must include how the proposed location of the void minimises risks to the environment. Therefore, the flood plain modelling is required to support the assessment of the proposed location of the void.

If there are no land outcomes identified in a land outcome document, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline.

Relevance to Centurion North

There current Environmental Authority does not contemplate any residual voids to be left on the Centurion North MLs.

7. REHABILITATION AND MANAGEMENT METHODOLOGY

Legislative Requirement

In accordance with section 126C(1)(e) and (i), the rehabilitation planning part of the PRC plan must:

- For each proposed post-mining land use for land, state the proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP schedule; and
- For each proposed non-use management area, state the proposed methodology for achieving best practice management of the area to support the management milestones under the proposed PRCP schedule for the area.

PRCP Guideline (Section 3.6)

The proposed rehabilitation or management methodologies will underpin the development of the milestone criteria and support how the proposed PMLU will be achieved, or the NUMA will be managed. As per section 126C(1)(j) of the *EP Act*, the administering authority requires information describing how the proposed rehabilitation or management methodologies have been developed and will be implemented.

This section identifies a number of studies or reports that must be provided in the proposed PRC plan. If any of the required information outlined below is not relevant to the specific operation, the applicant must provide justification in the PRC plan outlining why the information is not required.

Information contained in this section was based on information developed for the Wards Well MLs, which incorporate the Centurion North MLs, and hence remain relevant. However, the only activity type that is approved on the Centurion North MLs is exploration drilling and tracks and therefore reference to other activity types (e.g. bulk sample and underground activities) has been removed from this PRC plan.

7.1 General rehabilitation practices

PRCP Guideline (Section 3.6.1)

This section outlines the range of information that the administering authority considers is necessary to underpin the development of the rehabilitation or management methodologies applicable to new and existing mines for most domains. The applicant must include the information as appendices to the rehabilitation planning part.

7.1.1 Hydrogeology

Assess the hydrogeology of the site and all connected strata and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the design of rehabilitation strategies and choice of PMLU or NUMA.

As detailed in **Section 2.2.5**, there are three hydrostratigraphic units identified at Wards Well, namely the Quaternary alluvium, Tertiary and Permian strata aquifers.

Recharge of the Quaternary alluvium and Tertiary strata aquifers is expected to only occur after heavy rainfall in the wet season, which creates flows within the ephemeral creeks and flooding.

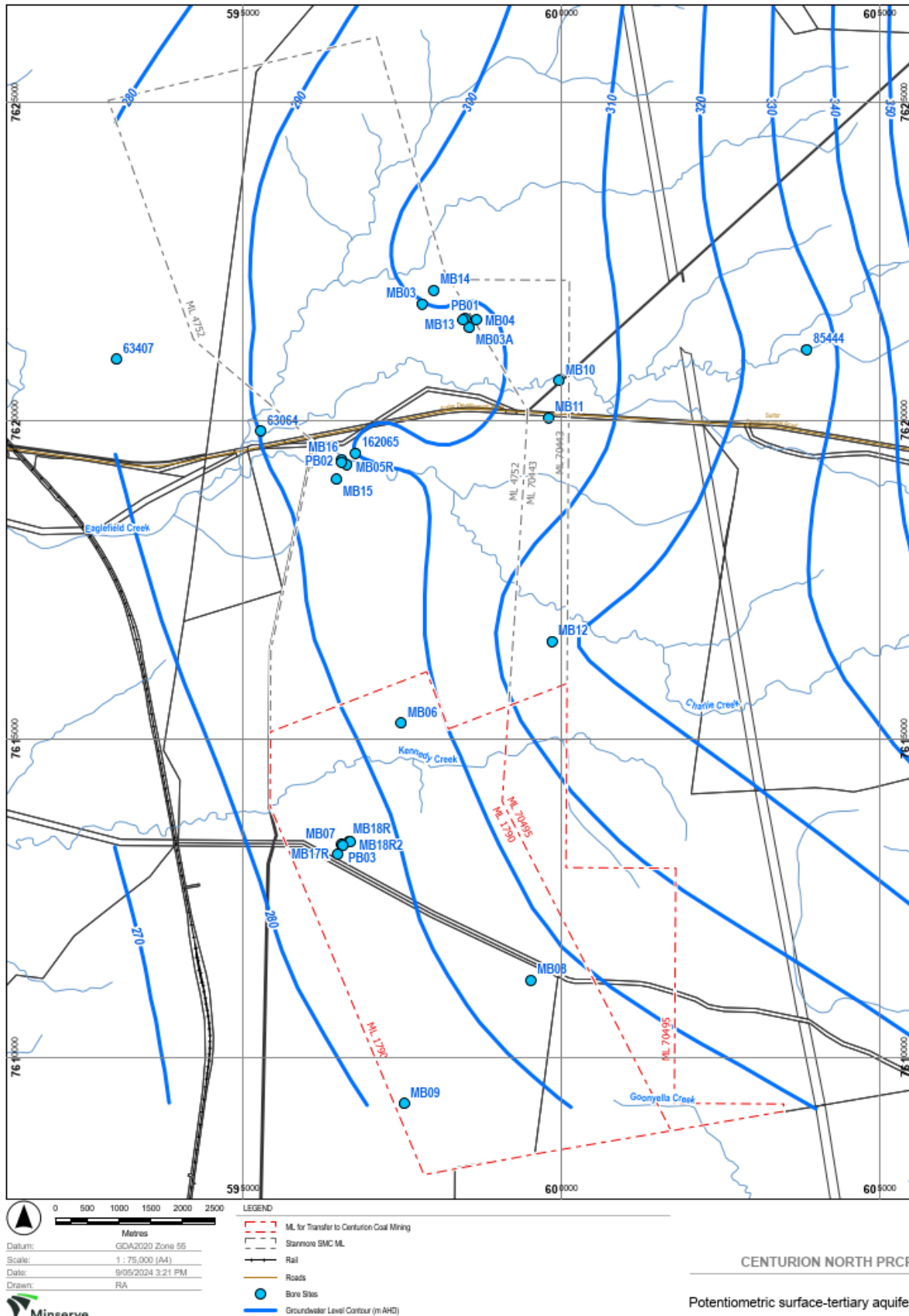
Due to the compartmentalised nature of the basalt aquifer, recharge from groundwater flows from surrounding regional aquifers is not expected to be significant. Predominant recharge of the basalt aquifers is expected to be from overlying quaternary alluvium aquifers and infiltration at basalt outcrops. Recharge of the Permian strata is likely to be driven by downward seepage or through flow from overlying/adjacent aquifers; infiltration at outcrop locations; and leakage between aquifers through faults or other structural discontinuities.

Primary discharge mechanisms in the Quaternary alluvium and Tertiary strata groundwater systems include evapotranspiration; through flow into adjacent or underlying aquifers; and groundwater extraction. Discharge from the Permian strata is likely to occur through down gradient flow into Permian - Triassic strata; flow into adjacent aquifers; seepage into underlying aquifers through structural discontinuities; and groundwater extraction (such as dewatering).

Groundwater investigations at Wards Well to date have focused on the Tertiary strata, which are the aquifers predominantly targeted for groundwater use (stock watering). These aquifers are sodium chloride dominated with total dissolved solid concentrations ranging between 480 and 2,900mg/L. Only limited groundwater data collected during exploration activities is available for the Permian aquifers. Review of available data indicated the salinity of the Permian aquifers is expected to be significantly higher than that within the overlying basalt aquifers.

The potentiometric surface for the Tertiary basalt aquifer has been assessed using data from on-site monitoring bores and available registered bores. The general flow direction at Wards Well in the Tertiary basalts is from the northeast to the southwest. The potentiometric surface of the Tertiary strata is illustrated in **Figure 16**.

A review of the registered groundwater bores within 10km of the Lancewood box-cut identified a total of 16 bores, which were listed as existing (**Appendix 2**). Two of the 16 were listed for monitoring purposes. The usage of the remaining 14 existing bores was not listed, however is expected to be for stock watering or monitoring purposes.



Relationship with PRCP schedule

The current Environmental Authority does not contemplate any significant excavation on the Centurion North MLs and, as such, impacts on local groundwater use and groundwater dependent ecosystems are expected to be negligible.

The information in this section is relevant to the following highlighted **Rehabilitation Areas** and **Rehabilitation Milestones** in the PRCP schedule

RA1						
RM1	RM2	RM3	RM4	RM5	RM6	RM7

The following **Milestone Criteria** will demonstrate achievement of the Rehabilitation Milestones:

RM2	- All contamination is remediated or removed from site in accordance with relevant legislation - A contaminated land survey is carried out by a suitably qualified person confirming the land does not present an unacceptable risk to proposed future land uses or the environment
-----	--

7.1.2 Flooding

PRCP Guideline (Section 3.6.1)

Section 3.4 of this guideline requires flood plain modelling for the purpose of voids located within a flood plain being rehabilitated to a stable condition. In addition to this, the applicant must also assess the flooding susceptibility and influence across the site. If flooding is a consideration, develop a hydrologic model of the catchment and a hydraulic model of the proposed mining area. Knowledge of flooding is integral to the rehabilitation planning process, including the placement and design of mine domains.

The activities currently approved under the Environmental Authority will result in negligible change to final landform from the original topography.

An assessment of flood susceptibility has been used to inform a risk-based approach to determine basis for this flood assessment.

In addition to the final landform described above, the assessment of flood susceptibility identified the following:

- The DoR flood mapping (**Figure 17**) indicates only limited impact to the ML surface area from a 1% AEP flood event.
- The approved activities do not require diversion or interruption of creeks or streams; and
- There are no fourth order or higher streams present on the Wards Well area.

Based on the above, the final landform will not adversely alter pre-mining flows and the identified risk associated with flooding is low (see Section 8, Risk Assessment), therefore further flood modelling is not required.

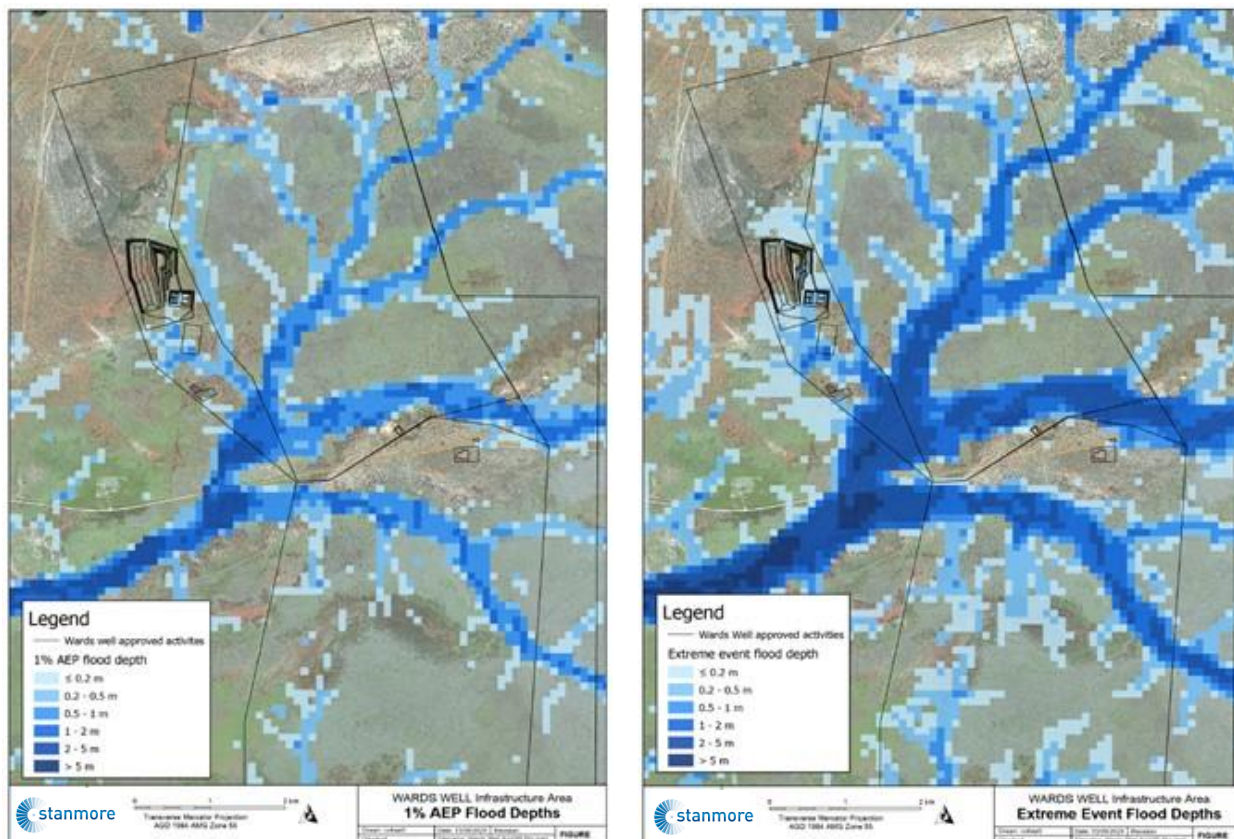


Figure 17 DoR 1% AEP flood depths (left) and extreme event flood depths (right)

Relationship with PRCP schedule

The final post-mining landform will not alter pre-mining water flows. The risk of flooding after closure has been deemed low.

The information in this section is not relevant to the
Rehabilitation Areas and **Rehabilitation Milestones** in the Centurion North PRCP schedule

RA1						
RM1	RM2	RM3	RM4	RM5	RM6	RM7

The following **Milestone Criteria** will demonstrate achievement of the Rehabilitation Milestones:

RM3	Landform is reshaped to be free-draining with slopes $\leq 5\%$ and consistent with the surrounding topography
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7.1.3 Waste characterisation

Not relevant to the Rehabilitation Areas or Milestones for Centurion North.

7.1.4 Soil and capping material

PRCP Guideline (Section 3.6.1)

The rehabilitation and management methodology should include that soil assessment activities are supplemented by additional surveys conducted at appropriate intervals to assess soil resources in planned disturbance areas. In addition to the assessment of soils, the proposed rehabilitation methodologies in the rehabilitation planning part must also address topsoil management. Topsoil management must ensure sufficient topsoil quantity and quality is available to support the proposed PMLU. The available soil resources and capping material should be assessed prior to the commencement of operations.

7.1.4.1 Topsoil stripping

Areas approved for disturbance that will require stripping of topsoil for re-use in rehabilitation include exploration drill pads, potentially tracks. Specific recommendations for topsoil stripping at Centurion North are summarised in **Table 18**. However, as topsoils stripping activities at Centurion North are limited to exploration drill pads and tracks it is unlikely that topsoil stockpiles will be required, as topsoil is replaced after drilling is completed.

Table 18 Recommended topsoil stripping depths and stockpile heights for Centurion North

Soil	Soil concept	Recommendations
Vertosol	Soils with high clay content, and when dry, crack to a considerable depth	Typical: 200mm Maximum stockpile height: 2m
Dermosol	Texture contrast soils with moderately to strongly structured usually clayey B2 horizons	Typical: 200mm Maximum stockpile height: 2m
Kandosol	Very deep (>3m) clay-rich soils	Typical: 500mm Maximum stockpile height: 2m
Sodosol	Texture contrast soils, with clayey sodic subsoils and dispersive properties	Typical: 100mm Maximum stockpile height: 2m These soils occupy a small portion of the site – stripping should be avoided in favour of deeper stripping on other, better soils

Topsoil volumes for exploration drilling are not calculated as the topsoil is stockpiled at each individual drill pad and replaced at the end of drilling.

7.1.4.2 Topsoil management

Topsoil stockpiles will have a maximum height of 2m to reduce soil degradation.

Compaction of topsoil will be minimised where possible by avoiding the use of machinery, such as graders or watercarts, on stockpiles. All stockpiles shall remain in a free-draining location to avoid long-term soil saturation. The stockpile surface will be left in a coarsely textured condition to promote infiltration and aeration and to minimise erosion until vegetation is established. Where necessary, silt fences or vegetation (from clearing operations) will be installed around topsoil stockpiles as a form of erosion and sediment control.

7.1.4.3 Topsoil application

Topsoil will be replaced where needed to achieve the PMLU of cattle grazing. All the stockpiled topsoil will be used as part of the rehabilitation activities. The following measures will be considered when applying topsoil during rehabilitation:

- Spread topsoil at an average thickness of 200mm. Re-spreading on the contour will aid runoff control and increase moisture retention for subsequent plant growth;
- Level topsoil to an even surface and avoid a compacted or over-smooth finish;
- Rip across the contour in preparation for sowing – this will leave the soil surface in a roughened condition creating a ‘key’ between the soil and underlying material; and
- Minimise vehicle traffic entering the area once topsoil is spread.

7.1.4.4 Amelioration requirements

The parameters provided in **Table 19** are critical nutrient sufficiency ranges for pasture plant nutrition in Queensland^{14, 15,16}. These ranges are designed for rehabilitation to a PMLU of cattle grazing, to promote establishment of pasture species to support >50% surface cover. Topsoil characterisation results detailed in Section 2.2.6 indicate the stockpiled Vertosol and Dermosol soils may have potential to be dispersive. An assessment of the stockpiled soil characteristics will be completed by an appropriately qualified person to determine amelioration requirements to meet the ranges in **Table 19**. It is noted that topsoil will be replaced at exploration drill pads following completion of drilling and hence it may not be necessary to ameliorate the topsoil.

Based on these parameters, amelioration products and application rates will be determined for Wards Well prior to rehabilitation surface preparation commencing. These products could include fertilisers, biosolids and physical amendments such as gypsum.

¹⁴ Hazelton P and Murphy B (2007) Interpreting Soil Test Results, CSIRO Publishing, Melbourne.

¹⁵ Baker D and Eldershaw V (1993) Interpreting Soil Analysis for Agricultural Land Use in Queensland, Queensland Department of Primary Industries, Brisbane.

¹⁶ Hall R (2008) Soil Essentials – Managing your farm’s primary asset, CSIRO Publishing, Melbourne.

Table 19 Recommended sufficiency levels for rehabilitation materials at Wards Well

Parameter	Unit	Ranges	Parameter	Unit	Ranges
pH _{water}	N/A	6.0 - 8.0	Ca/Mg ratio	N/A	>4
pH _{chloride}	N/A	5.0 – 8.0	Ca	cmol/kg	5 – 10
EC _{water}	dS/m	<0.9		%	65 - 80
EC _{sat}	dS/m	<4	Mg	cmol/kg	1 – 3
Chloride	mg/kg	<300		%	10 - 15
Organic carbon	%	1 - 3	K	cmol/kg	0.3 – 0.7
N nitrate	mg/kg	>10		%	1 - 5
N ammonia	mg/kg	N/A	Na	cmol/kg	0.3 – 0.7
P	mg/kg	8 - >20		%	0 - 1
S	mg/kg	>10	Zn	mg/kg	0.5 – 5
CEC	cmol/kg	>12	Cu	mg/kg	0.3 – 5
ESP	%	<6	Fe	mg/kg	2 – 100
			Mn	mg/kg	2 – 50
			B	mg/kg	1 – 2
			Mo	mg/kg	2

Relationship with PRCP schedule

The soil survey and topsoil management methodologies ensure that there is suitable quantity and quality of growth media available to support a PMLU of cattle grazing.

The information in this section is relevant to the following highlighted
Rehabilitation Areas and **Rehabilitation Milestones Reference** in the PRCP schedule

RA1						
RM1	RM2	RM3	RM4	RM5	RM6	RM7

The following **Milestone Criteria** will demonstrate achievement of the Rehabilitation Milestones:

- | | |
|-----|---|
| RM4 | <ul style="list-style-type: none"> • Topsoil is placed an average thickness of 200mm • An assessment of soil and growth media characteristics is completed by an appropriately qualified person, and amelioration and other treatments required identified • Ameliorant and physical treatments are applied as identified, if required for RA1 |
|-----|---|

7.1.5 Landform design

PRCP Guideline (Section 3.6.1)

The final landform design must be based on the proposed PMLUs and NUMAs and demonstrate that the land will be safe and structurally stable.

Landform design considers both the landform structures such as the void and dumps, but also the landform development and reshape of all relevant activity areas after removal of infrastructure and wastes, and prior to placement of topsoil.

The following approved activities at Wards Well have negligible impact on the pre-mining landform:

- Exploration drilling;
- Clearing for access roads & tracks.

7.1.5.1 Landform structures

All relevant activities detailed in Section 2 are considered as landform structures for the purposes of determining the landform design (**Table 20**).

Table 20 Landform structures for Centurion North

Landform structure	Area extent on the surface (ha)	Landform design and rehabilitation
Exploration drilling and tracks	145	• Area will be reshaped to be free-draining and blend in with surrounding topography

Removal of infrastructure (Section 7.5) and contaminated land assessment requirements (Section 7.5.2) will be completed where required, prior to reshaping of the final landform. After reshaping of the final landform, topsoil is spread over the areas and revegetated.

7.1.5.2 Erosion assessment

The majority of the site is undisturbed with only minimal variance in the final landform from the pre-mining landform for 1% of the total site area. The final landform design is approximately 0.6m above pre-mining landform in this area with low slope angles. Soil will also be assessed and amended to promote establishment of pasture species and limit dispersion potential (Section 7.1.4.4). The landform erosion risk is therefore low and further erosion assessments are not a requirement for Wards Well.

7.1.5.3 Slope profile design

Individual exploration drill pads will have maximum slopes of 5%, similar to the natural topography.

7.1.5.4 Hydrological and hydrogeological assessments

The majority of the site will remain undisturbed. Hydrological and hydrogeological risks associated with the approved activities have therefore been evaluated as low, and are unlikely to impact on the final landform.

7.1.5.5 Waste placement strategy

There are no specific requirements.

7.1.5.6 Specific landform requirements

There are no specific requirements.

7.1.5.7 Monitoring of control measures

No control measures, such as liners or seepage collection systems, will be used on-site.

7.1.5.8 Long-term landform stability

The majority of the site is undisturbed Topsoil will be replaced over the disturbed area and revegetated with a pasture seed mix to re-establish a land use of cattle grazing. The landform erosion risk therefore has been assessed as low and modelling of long-term stability is not required.

7.1.5.9 Quality assurance / quality control

The proposed actions referenced in **Table 23** are the key controls that will be put in place to manage the landform risks associated with achieving the PMLU. Quality assurance and quality control activities are built into all necessary execution and verification activities of these controls. Monitoring and reporting processes verify controls and ensure that controls are executed effectively (refer to Section 8).

7.1.5.10 Trial methodology

As the landform design is low risk, no trial methodology is proposed.

Relationship with PRCP schedule

The approved activities result in only minor disturbance and minor changes in the final landform from the pre-mining topography.

The information in this section is relevant to the following highlighted
Rehabilitation Areas and **Rehabilitation Milestones** in the PRCP schedule:

RA1						
RM1	RM2	RM3	RM4	RM5	RM6	RM7

The following **Milestone Criteria** will demonstrate achievement of the Rehabilitation Milestones:

RM3

- Landform is reshaped to be free-draining with slopes $\leq 5\%$ and consistent with the surrounding topography

7.1.6 Cover design

PRCP Guideline (Section 3.6.1)

A cover design is required for the surface treatment of a mine landform or other waste material. Hence, the cover system design must be appropriate for the type(s) of waste the project will generate and reflect a risk-based approach. Where waste has the potential for AMD, neutral mine drainage or saline mine drainage, an appropriate cover system must be designed.

The cover design should include:

- identification and specification of the objectives of the cover system;
- a detailed description of the design including the thickness of each layer;
- a detailed description of construction methodology including any proposed staging of the cover system;
- a quantitative assessment that identifies the location and quantity of proposed capping material available on-site; and
- proposed QA/QC for the construction of the cover system including the timely implementation of corrective actions where deviations from the design are identified.

This is not applicable to activities authorised on the Centurion North MLs.

Relationship with PRCP schedule

There is no environmental risk associated with any material remaining on-site and potential contaminants; therefore no cover designs are required.

7.1.7 Water Management

PRCP Guideline (Section 3.6.1)

The rehabilitation planning part must include a description of the following:

- a description of the contaminants that pose a risk to environmental values of the receiving environment;
- source, pathway and fate of contaminants that have the potential to impact environmental values;
- infiltration and seepage intervention and collection controls;
- surface water diversions and long-term management requirements;
- dewatering requirements;
- ongoing water management and reduction requirements (i.e. treatment).

Water management will be undertaken to minimise the potential for release of contaminants to the surrounding environment. With regard to the exploration activities authorised on the Centurion North MLs, there is negligible risk to receiving waters. At exploration drill pads, small sumps may be used for temporary storage of water during drilling. These will be removed following completion of drilling activities, and rehabilitated as part of the drill pad rehabilitation.

7.1.8 Revegetation

PRCP Guideline (Section 3.6.1)

The revegetation plan must propose activities that will establish self-sustaining vegetation communities that are appropriate for the intended PMLU (e.g. natural ecosystems, grazing, forestry and some agricultural and other land uses). Revegetation should, therefore, not only establish a ground cover, but also, in some domains, establish associated fauna habitat and other ecological services.

The rehabilitation planning part must include details of the site preparation required for rehabilitation activities.

7.1.8.1 Revegetation objectives

The PRCP schedule requires all areas disturbed by mining activities to be rehabilitated to a stable condition suitable for cattle grazing. The required objectives and acceptance criteria for a PMLU of cattle grazing at Wards Well (and hence Centurion North) are listed in the PRCP schedule.

Cattle grazing can be achieved with the materials available for rehabilitation. Section 7.1.4 discusses the types of topsoils at Wards Well as they relate to a post-mining land use of cattle grazing. Section 4.1 further discusses land suitability requirements for cattle grazing (**Table 17**).

Based on the final landform, the topsoil materials available for rehabilitation and the pre-mining land use suitability assessment, a PMLU of cattle grazing is able to be achieved through revegetation activities associated with pasture seeding and additional soil amelioration if required.

7.1.8.2 Revegetation species and seed mixes for a cattle grazing PMLU

Prior to approval of the PRCP schedule, there were no requirements listed in the EA for inclusion of any species of conservation significance or fauna habitat and/or use of analogue sites for the purpose of a PMLU of cattle grazing. Nonetheless, the species mix for revegetating pastures for a PMLU of cattle grazing at Wards Well has been developed based on selecting a combination of both native and exotic pasture grasses listed as perennial, productive and palatable (3P) - these are suited to the topsoils at Wards Well and have either been previously recorded at Wards Well or have been recorded within up to 30km in the surrounding environment of Wards Well. Importantly, native Bluegrass (*Dichanthium sericeum*), Black Spear grass (*Heteropogon contortus*) and native Mitchell grass species (*Astrebla* spp.) that dominate the surrounding natural grasslands, have been included in the seed mix. In addition, exotic pasture species occurring in the surrounding environment have also been included to provide a representative mixed native/exotic grazing pasture to support a PMLU of cattle grazing.

Table 21 lists the revegetation pasture species and recommended sowing rates for a PMLU of cattle grazing at Centurion North. Species availability may fluctuate from year to year and unavailable species would be substituted with other species listed in this table. All pasture seed mixes would include 5 kg/ha of Shirohie millet (*Echinochloa esculenta*) or similar as a cover crop for soil protection, i.e. minimisation of erosion.

No sowing or use of Leucaena is proposed at Centurion North, and Leucaena detected anywhere on the rehabilitation areas will be required to be controlled in accordance with weed management activities.

Table 21 Recommended species list and sowing rates for a mixed native/exotic pasture for sustainable beef cattle grazing on Centurion North soils during rehabilitation

Common name	Scientific name	Sowing rate (kg/ha)	Comment
Queensland Bluegrass	<i>Dichanthium sericeum</i>	6	3P grass
Buffel grass	<i>Cenchrus ciliaris</i> *	4 ^c	3P grass
Stylo ^s	<i>Stylosanthes scabra</i> *	2	Legume requires specific rhizobium inoculum strain CB1650
Black spear grass	<i>Heteropogon contortus</i>	5	3P grass
Mitchell grasses	Bull Mitchell grass (<i>Astrebla squarrosa</i>), Curly Mitchell grass (<i>Astrebla lappacea</i>) and Hoop	3	3P grass

Common name	Scientific name	Sowing rate (kg/ha)	Comment
	Mitchell Grass (<i>Astrebla elymoides</i>)		
Cover crop	(e.g. <i>Echinochloa esculenta</i> *)	5	Cover crop for soil protection
Total		25	

Notes *exotic species, ^c assumes seed is coated, if not coated, use half prescribed rate, ^s must be sown within 28 days of inoculation

7.1.8.3 Establishing and managing revegetation

Both the native and exotic pasture species selected are cognisant of grazing best management practices. A good condition pasture will have a high percentage of 3P grasses and a high frequency of legumes and a low number of weeds.

Pasture seed mixes will be targeted for planting between September and March. Seed quality will be ascertained prior to planting to ensure highest potential for seed strike and vegetation establishment. A friable or crumbly seed bed will be created by ripping on contour followed by direct planting of seed using agricultural equipment. Surface ripping may not be required in all disturbance areas where a suitable seed bed already exists e.g. exploration access tracks and seismic grid lines. As detailed in Section 7.1.4.4, amelioration products and application rates will be determined prior to rehabilitation surface preparation commencing.

The rehabilitation planning and revegetation process is based on sowing preferred 3P pasture species aligned to the associated rehabilitation soils and land topography. As mentioned in Section 3, the ongoing assessment of pasture condition - after the revegetation process, is used to assess the condition of the pasture and guide ongoing maintenance and management of pastures on rehabilitated lands (further detail on monitoring is provided in Section 9).

Scientific evidence supports groundcover¹⁷, including vegetation, as a surrogate for erosion risk in coal mine rehabilitation, with 50% being a conservative target for most slope gradients (less than 20% slope gradient^{18,19,20,21}). For these reasons, rehabilitation must achieve and maintain a groundcover greater than 50% to adequately mitigate erosion risk and prevent land degradation.

7.1.8.4 Topsoil

There is sufficient topsoil on-site to respread over the disturbed areas. Topsoil treatments and depth for rehabilitation are detailed in Section 7.1.4.

Relationship with PRCP schedule

Vegetation species to be used will be suitable for soil type and support a post-mining land use of cattle grazing.

¹⁷ Note: Groundcover refers to anything in contact with the soil surface, e.g. rocks, stones, sticks, leaves, grass, hay, etc.

¹⁸ So, W, Sheridan, G, Loch, R, Carroll, C, Willgoose, G, Short, M and Grabski A 1998 Post-mining landscape parameters for erosion and water quality control, ACARP Project Numbers C4011 and C5009, Australian Coal Research Limited, Brisbane

¹⁹ Loch, R 2000 Effects of vegetation cover on runoff and erosion under simulated rain and overland flow on a rehabilitated site on the Meandu Mine, Tarong, Queensland, Australian Journal of Soil Research, vol. 38, pp 299-312

²⁰ Carroll, C and Tucker, A 2000 Effects of pasture cover on soil erosion and water quality on central Queensland coal mine rehabilitation, Tropical Grasslands, vol. 34, pp 254-262

²¹ Carroll, C, Merton, L and Burger, P 2000 Impact of vegetative cover and slope on runoff, erosion, and water quality for field plots on a range of soil and spoil materials on central Queensland coal mines, Australian Journal of Soil Research, vol. 38, pp.313-327.

The information in this section is relevant to the following highlighted
Rehabilitation Areas and **Rehabilitation Milestones** in the PRCP schedule:

RA1						
RM1	RM2	RM3	RM4	RM5	RM6	RM7

The following **Milestone Criteria** will demonstrate achievement of the Rehabilitation Milestones:

RM5	Completed seeding in accordance with recommended pasture mix (grasses, cover crop and legumes), and seeding rates (up to 25kg/ha)
RM6	- Pasture condition rating ≤ 3, based on the Pasture Condition Assessment Table as per Stocktake: Balancing Supply and Demand (https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/), as provided in Table 33, including: - Preferred pasture species (3P grasses) diversity ≥ 2 species - Preferred pasture (3P grasses) % DM yield $\geq 10\%$ - Annual grass DM yield % $< 70\%$ - Undesirable grasses and other weeds % DM yield $< 80\%$ - Crown cover (3P grasses) – at worst, moderate to low density and some plants dead
RM7	- Groundcover $> 50\%$ - Land suitability class ≤ 3, or not different from pre-mining class if ≥ 4. The assessment is to be conducted by an appropriately qualified person and completed in accordance with LSA Framework for Open-Cut Coal Mine Rehabilitation 2018 (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland) unless otherwise agreed in writing between the administering authority and the environmental authority holder. - Fore RM7(e) if the land suitability class is assessed as not different from pre-mining class if ≥ 4 for all or a portion of a rehabilitation area, an assessment of reference sites must be carried out to determine if the limitation/s resulting in the class of ≥ 4 is consistent with that of reference sites. - Certification by an appropriately qualified person that pasture meets a pasture condition rating ≤ 3, based on the Pasture Condition Assessment Table as per Stocktake: Balancing Supply and Demand (https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/), as provided in Table 30.

7.2 Tailings storage facility

PRCP Guideline (Section 3.6.2)

The tailings require characterisation to determine the geochemistry, rheology and geotechnical parameters that influence the rehabilitation or management strategies and the capacity of the site to support revegetation.

The design for a TSF must include relevant elements:

- lining of TSF (i.e. embankments and base of structure)
- leak detection systems

- c) cellular design of TSF
- d) seepage collection systems
- e) design storage allowance
- f) spillway location
- g) designing TSF for progressive rehabilitation.

Relationship with PRCP schedule

No tailings storage facilities are proposed on Centurion North MLs.

7.3 Voids

PRCP Guideline (Section 3.6.3)

The information requirements of this domain are dependent on the nature of the proposed PMLU or NUMA for the void. For mine sites with voids, the rehabilitation planning part must include a void closure plan, which includes options for minimising final void area and volume; final void dimensions; pit wall geotechnical and geochemical stability, final slope angles, void hydrology, groundwater modelling, water balance and predicted long-term water quality.

A geotechnical report should focus on how the void will achieve post-closure slopes that will exhibit stability characteristics consistent with the planning and design of the post-closure mine void.

If floodwaters are likely to move over backfilled material, an assessment of the hydraulic properties must be conducted to assess whether instability may occur.

The rehabilitation and management strategies in the plan must include the supervision, verification and auditing of engineering works carried out to achieve the post-closure void landform, to ensure construction is consistent with the geotechnical design.

The rehabilitation and management strategy must also include confirmation that the post-closure landform demonstrates the level of stability as specified by the design.

Relevance to Centurion North

No final voids are proposed on Centurion North.

7.3.1 Mining final void

No final void remains.

7.3.2 Final void dimensions

No final void remains.

7.3.3 Final void wall stability

No final void remains.

7.3.4 Final void wall angles

No final void remains.

7.3.5 Void hydrology

No final void remains.

7.3.6 Design plan

No final void remains.

7.3.7 Rehabilitation and management strategies

No final void remains.

7.4 Underground mining

PRCP Guideline (Section 3.6.4)

For underground mining operations, the rehabilitation planning part must include:

- a geotechnical study;
- an assessment of groundwater interactions and potential lowering of groundwater levels;
- the development of a hydrogeological conceptual model;
- subsidence analysis and modelling and a subsidence vegetation/habitat impact assessment;
- consideration of how potential entries to underground workings will be sealed (i.e. through some form of capping or back filling);
- how surface ponding and cracking will be mitigated; and
- identification of post-closure stabilisation of underground workings in order to manage the potential for unplanned surface subsidence and unplanned ground collapse such as sinkholes and pot holing.

Relevance to Centurion North

The current Environmental Authority does not contemplate any underground mining activity on the Centurion North MLs.

7.5 Built infrastructure

PRCP Guideline (Section 3.6.5)

The administering authority's expectation of rehabilitation relating to built infrastructure is that it will be decommissioned, demolished, salvaged and/or disposed of unless it is being formally retained by the landholder to achieve an appropriate PMLU.

The rehabilitation planning part must include:

- g) Identification of infrastructure that will be decommissioned and the methods for decommissioning.
- h) A description of infrastructure that will remain post rehabilitation and the identification of ongoing maintenance requirements.
- i) Evidence of agreement for any infrastructure that will have ownership transferred.

7.5.1 Decommissioning, demolition and removal

Currently, there are no agreements in place for retention of infrastructure by a post mining land owner / holder, but these may be sought in the future if the infrastructure may benefit the post-mining land use.

The infrastructure associated with the approved mining activities (**Table 22**) will be decommissioned and removed from site prior to surrender except where agreed in writing by the post-mining land-owner/holder. It is anticipated that future EA amendments will be sought for further exploration programs and mining operations and some mining infrastructure may be required beyond the current approved exploration activities. This will be incorporated in any future amendments of the PRC plan and PRCP schedule. Further detail on the rehabilitation stages after decommissioning of the infrastructure, such as landform reshape, surface preparation, revegetation and monitoring are covered in the relevant sections.

On-site infrastructure, used solely for grazing purposes (i.e. not related to mining), such as water tanks, property water pipelines, windmills, water troughs, feed troughs and dams will remain to support the post-mining land use.

Table 22 Infrastructure associated with the approved Wards Well activities

Infrastructure	
Exploration	• Drill holes

7.5.1.1 Exploration

Decommissioning of the exploration drill holes will include:

- Assessment of the drill hole to determine if it is required to be sealed;
- Sealing, if required;
- Backfilling drill cuttings into the hole or sump;
- Removing hole collar below the ground level; and
- Removal of all waste products and rubbish.

7.5.2 Contaminated land assessment

In accordance with the EA conditions C16, F1, F2 and F3, spillage of any wastes, contaminants or other materials must be cleaned up as quickly as practicable, stored in accordance with relevant standards and handled in a way that prevents environmental harm. Although contamination at Centurion North is unlikely, a contaminated land assessment will be completed on exploration drill pads, where a risk of contamination may have occurred.

The assessment, if required, will include a Preliminary Site Investigation (PSI) prior to the completion of the approved activities, to identify if any areas require further Detailed Site Investigation (DSI). The investigations will be undertaken in accordance with the National Environment Protection (Assessment of Site Contamination) Measure or equivalent in place at the time of investigation. Where the PSI identifies a requirement for further investigation a targeted DSI will be undertaken to confirm and characterise areas of concern. If contamination is identified, the potential risks will be assessed and, where required, remediation will be undertaken and/or a site management plan developed.

A contaminated land survey will be undertaken to confirm that no contamination unsuitable for the post-mining land use is present.

Relationship with PRCP schedule

The EA requires all infrastructure constructed for the approved activities, must be removed from the site prior to surrender and any spills and releases to be cleaned up and the area remediated.

The information in this section is relevant to the following highlighted **Rehabilitation Areas** and **Rehabilitation Milestones** in the PRCP schedule:

RA1						
RM1	RM2	RM3	RM4	RM5	RM6	RM7

The following **Milestone Criteria** will demonstrate achievement of the Rehabilitation Milestones:

RM1	- All services disconnected - All built and service infrastructure demolished and removed (except where agreed in writing by the post-mining land owner/holder) - All concrete, bitumen and aggregate removed - All waste and rubbish removed - All exploration drill holes decommissioned
RM2	- All contamination is remediated or removed from site in accordance with relevant legislation - A contaminated land survey is carried out by a suitably qualified person confirming the land does not present an unacceptable risk to proposed future land uses or the environment

7.6 Summary of key rehabilitation and management practices

Figure 18 summarises the Centurion North rehabilitation milestones. Exploration drilling is rehabilitated progressively throughout the timeline of exploration activities.

In support of this figure, **Table 23** further details the key rehabilitation activities for RA1 at Centurion North. The rehabilitation activities drive achievement of the Centurion North rehabilitation milestones and inform the associated PRCP schedule.

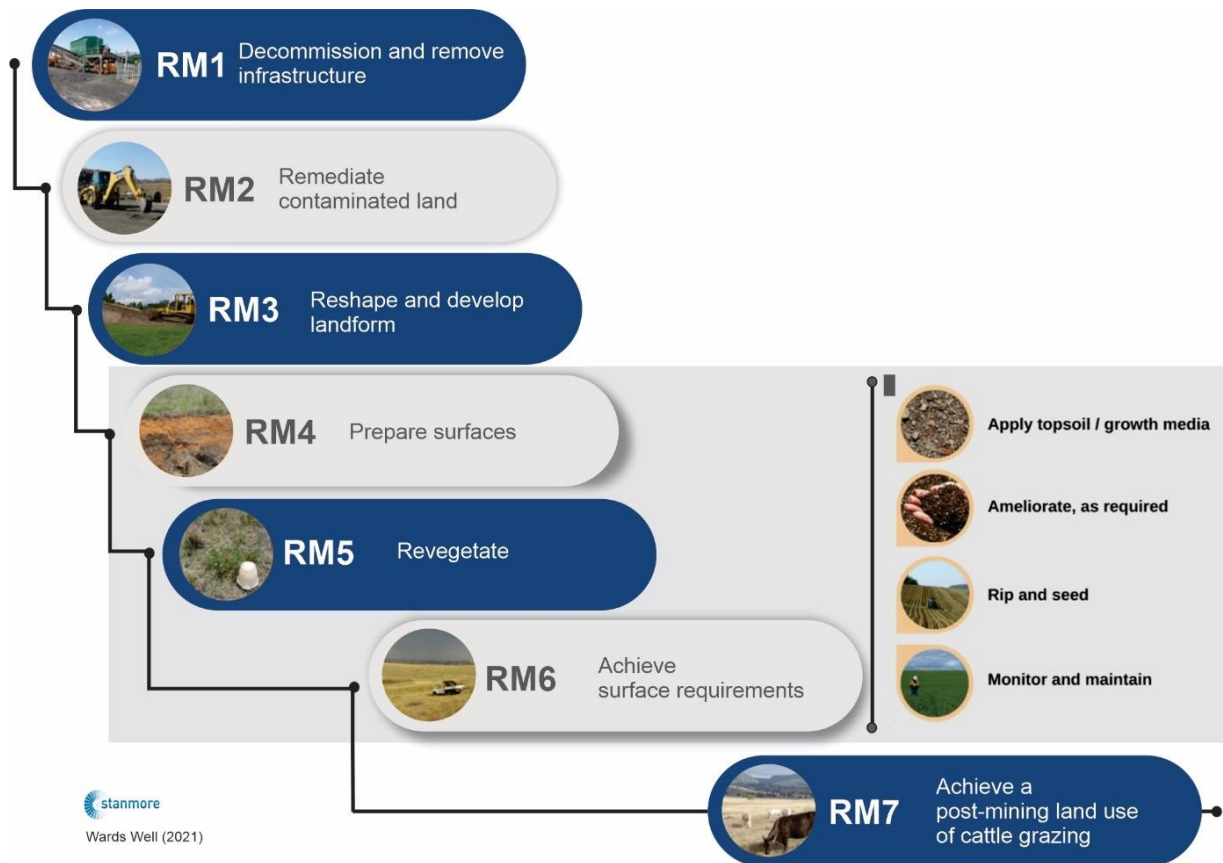


Figure 18 Summary of key rehabilitation and management practices for Centurion North

Table 23 Key rehabilitation activities identified to drive achievement of Centurion North’s rehabilitation milestones

Rehabilitation area	Relevant activities	Area (ha)	Rehabilitation activities (to drive achievement of Rehabilitation Milestones)	Rehabilitation timing	Rehabilitation milestones
RA1	Exploration drill holes and tracks	145	- Decommission drill holes: - Assess if the drill hole needs to be sealed by an appropriately qualified person, and seal if required - Backfill drill cuttings into the hole or sump - Cut collar below ground level - Remove rubbish - Undertake assessment for contaminated land and remediate if required - Reshape the landform to be free-draining and blend to merge in with the surrounding topography - Spread all topsoil stripped from the area back over the area - Rip across contour - Seed - Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU	- Rehabilitation will be completed progressively as drilling is completed - Seeding of all legacy drill holes and tracks (unless required for future access) to be completed by 2026 - Seeding of all new drilling to be completed by 2031	RM1 RM2 RM3 RM4 RM5 RM6 RM7

8. RISK ASSESSMENT

Legislative Requirement

In accordance with section 126C(1)(f) of the *EP Act*, the rehabilitation planning part of the PRC plan must identify the risks of a stable condition for land described as a post-mining land use not being achieved, and how the applicant intends to manage or minimise the risks.

8.1 Identifying, assessing and treating risks

PRCP Guideline (Section 3.7)

As per section 126C(1)(j) of the *EP Act*, the administering authority considers it necessary for the proposed PRC plan to contain a risk assessment of all proposed NUMAs. The risk assessment must be carried out to identify the risks of the NUMA causing environmental harm and not being safe and structurally stable and detail how the applicant intends to manage and minimise the identified risks.

The AS ISO 31000:2018 Risk Management – Guidelines (Standards Australia, 2018) describes risk assessment as the overall process of risk identification, risk analysis, risk evaluation and risk treatment. Each of these aspects must be included in the risk assessment in the rehabilitation planning part.

Information requirements in this section apply to all applicants whether or not they are an existing EA holder. Existing holders may have the required information available from previously submitted plans/reports/applications that, if still valid, can be used in the PRC plan.

8.1.1 Risk methodology

A risk-based approach to the Centurion North PRC planning has been undertaken (**Figure 19**).

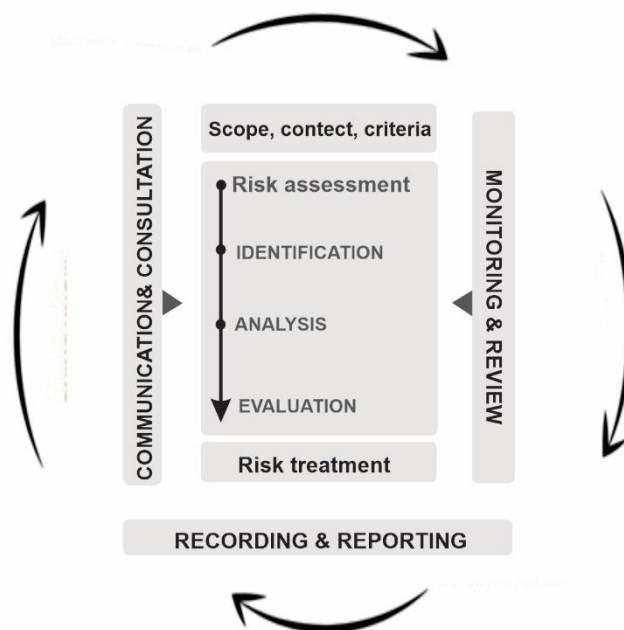


Figure 19 ISO 3100-compliant risk-based approach followed for the Centurion North PRCP

8.2 Risk identification

The risk event - a stable condition for land described as a post-mining land use not being achieved, was assessed per ISO 31000 methodology described in **Figure 19** above (the full risk assessment is included in **Appendix 10**), where stable condition is defined as per section 111A of the *EP Act*:

- The land is safe and structurally stable;
- There is no environmental harm being caused by anything on or in the land; and
- The land can sustain a PMLU.

For Centurion North the PMLU being assessed is cattle grazing as per the PRCP schedule.

A number of scenarios were identified in the risk identification process related to a stable condition for the land described as the PLMU not being achieved:

- Landform failure;
- Alteration of hydrogeological conditions;
- Alteration of surface water systems;
- Alteration of flood hydrology;
- Insufficient, inadequate or inappropriate soil and capping material required for rehabilitation activities;
- Insufficient identification and management of waste characterisation;
- Inadequate and/or inappropriate revegetation;
- Stability failure of rehabilitated void (noting that this is not applicable to centurion North);
- Stability failure of underground mine workings (noting that this is not applicable to centurion North); and
- Deterioration of built infrastructure conditions.

8.2.1 Risk analysis, evaluation and relevant treatments

The table included in **Appendix 10** provides the full detail of risk analysis, risk evaluation and risk treatment for these scenarios. Worst case outcomes where assessed for each scenario, preventative and mitigating controls identified and from there a residual risk rating was calculated. The applied likelihood and severity tables, as well as the outcomes of the residual risk rating (RRR) heat map ratings matrix are provided in **Figure 20**.

LIKELIHOOD TABLE			
Uncertainty	Frequency	Likelihood Factor	Guidance
Highly Likely	Likely to occur within a 1 year period.	3	Event is expected to occur > 80% of the time during a 5 year planning cycle.
Likely	Likely to occur within a 1 - 5 year period.	1	Event is expected to occur 60% to 80% of the time during a 5 year planning cycle.
Probable	Likely to occur within a 5 - 20 year period.	0.3	Event is expected to occur 30% to 60% of the time during a 5 year planning cycle.
Unlikely	Likely to occur within a 20 - 50 year period.	0.1	Event is expected to occur 10% to 30% of the time during a 5 year planning cycle.
Highly Unlikely	Not likely to occur within a 50 year period.	0.03	Event is expected to occur < 10% of the time during a 5 year planning cycle.

SEVERITY TABLE								
Severity Level	Descriptor							Severity Factor
5	Severe impact to the environment and where recovery of ecosystem function takes 10 years or more;							1000
4	Serious impact to the environment, where recovery of ecosystem function takes between 3 and up to 10 years or							300
3	Substantial impact to the environment, where recovery of ecosystem function takes between 1 and up to 3 years							100
2	Measureable but limited impact to the environment, where recovery of ecosystem function takes less than 1 year							30
1	Minor, temporary impact to the environment, where the ecosystem recovers with little intervention							10

		Severity level	S1	S2	S3	S4	S5
		Severity Factor	10	30	100	300	1000
Likelihood	Likelihood	Likelihood Factor	Timeframe	Residual Risk Calculation (with controls in place and effective)			
	Highly Likely	3	Within 1 year	30	90	300	900
	Likely	1	Within 1-5 years	10	30	100	300
	Probable	0.3	Within 5-20 years	3	9	30	90
	Unlikely	0.1	Within 20-50 years	1	3	10	30
	Highly Unlikely	0.03	Within 50 years	0.3	0.9	3	9

Figure 20 Likelihood and severity tables, with resulting residual risk rating (RRR) heat map

With controls in place and implemented effectively, the RRR for the identified risk scenarios of this risk event is deemed to be low (RRR of 3 or lower).

The risk treatments for each scenario that are necessary for achieving a stable condition for the land described as the PLMU are shown below in **Table 24**.

Table 24 Necessary risk treatments identified to achieve a stable condition for the PMLU

Aspect	Risk treatment
Risk event: Landform failure	
Reasons for selecting treatment option	- Method will achieve a stable condition. - Final landform is similar to pre-mining landform.
Responsibility for plan: - Approval - Implementation	- EA Holder. - Exploration team
Proposed actions	- Minimise height and slope gradients of landform structures. - Landform structures reshaped and blended in with surrounding topography. - Surface cover including vegetation to provide erosion resistance.
Resource requirements	- Landform design. - Available material inventory. - Equipment capabilities. - Survey/LiDAR. - Rehabilitation monitoring data.

Aspect	Risk treatment
Performance measures and constraints	Tracking against milestone criteria.
Reporting and monitoring requirements	- Analysis of final landform against design. - Rehabilitation monitoring.
Risk timing and scheduling	From commencement of rehabilitation to final achievement of PMLU.
Risk event: Alteration of hydrogeological conditions	
Reasons for selecting treatment option	- AMD issues not identified. - Hydrogeological conceptual model indicates low potential for impacts to groundwater quality, groundwater use or for long-term changes to hydrogeological condition.
Responsibility for plan: - Approval - Implementation	- EA Holder. - Exploration team.
Proposed actions	- All imported hazardous materials are to be stored and used in accordance with the requirements of EA. - At the completion of operations, all imported hazardous materials and infrastructure that have the potential to release contaminants to groundwater will be removed from site. - Groundwater and ecosystem monitoring to be undertaken in accordance with EA conditions.
Resource requirements	Not applicable.
Performance measures and constraints	Tracking against milestone criteria.
Reporting and monitoring requirements	- Rehabilitation monitoring. - Reporting under existing EA requirements.
Risk timing and scheduling	From commencement of rehabilitation to final achievement of PMLU.
Risk event: Alteration of surface water systems	
Reasons for selecting treatment option	- AMD issues not identified. - No alteration of the alignment of drainage lines or creeks.
Responsibility for plan: - Approval - Implementation	- EA Holder. - Exploration team.
Proposed actions	All imported hazardous materials and to be stored and used in accordance with EA conditions.

Aspect	Risk treatment
	• Surface water monitoring to be undertaken opportunistically when sufficient water is available in the ephemeral creeks and in accordance with EA conditions. • Monitoring of surrounding ecosystems will be undertaken in accordance with EA conditions. • Rehabilitation of disturbed areas will be undertaken after the completion of operations.
Resource requirements	• Not applicable.
Performance measures and constraints	• Tracking against milestone criteria and WQO.
Reporting and monitoring requirements	• Monitoring when surface water flows are available. • Reporting under existing EA requirements.
Risk timing and scheduling	• From commencement of rehabilitation to final achievement of PMLU.
Risk event: Alteration of flood hydrology	
Reasons for selecting treatment option	• No alteration of the alignment of drainage lines or creeks.
Responsibility for plan: • Approval • Implementation	• EA Holder. • Exploration team.
Proposed actions	• Assessment of flooding risks evaluated prior to commencement of operations. Note assessment has confirmed low risk. • Final landforms are to be located, designed and constructed to minimise impact to flooding regimes and to withstand reasonably assessed flooding risks. • Monitoring of surrounding ecosystems to be undertaken in accordance with EA conditions.
Resource requirements	• Not applicable.
Performance measures and constraints	• Tracking against milestone criteria.
Reporting and monitoring requirements	• Rehabilitation monitoring. • Reporting under existing EA requirements.
Risk timing and scheduling	• From commencement of rehabilitation to final achievement of PMLU.
Risk event: Insufficient, inadequate or inappropriate soil and capping material required for rehabilitation activities	
Reasons for selecting treatment option	• Enables utilisation of site resources for greatest chance of stable condition being achieved.
Responsibility for plan: • Approval	• EA Holder. • Exploration team.

Aspect	Risk treatment
Implementation	
Proposed actions	- Undertake rehabilitation planning and preparation in accordance with the specific requirements for soil, seed and management for a cattle grazing PMLU. - Management of topsoil stripping and application during rehabilitation. - Topsoil assessment by an appropriately qualified person to determine if ameliorant and fertiliser requirements are required. - Ameliorants and fertilisers applied, if required.
Resource requirements	- Topsoil inventory. - Survey/LiDAR. - Topsoil assessment. - Rehabilitation monitoring data.
Performance measures and constraints	Tracking against milestone criteria.
Reporting and monitoring requirements	- Topsoil assessment. - Rehabilitation monitoring.
Risk timing and scheduling	From planning of soil stripping to final achievement of PMLU.
Risk event: Insufficient or poor waste characterisation (not relevant to Centurion North)	
Reasons for selecting treatment option	Not applicable.
Responsibility for plan: - Approval - Implementation	Not applicable.
Proposed actions	Not applicable.
Resource requirements	Not applicable.
Performance measures and constraints	Not applicable.
Reporting and monitoring requirements	Not applicable.
Risk timing and scheduling	Not applicable.
Risk event: Inadequate and/or inappropriate revegetation	
Reasons for selecting treatment option	Proposed seed mix has worked successfully in cattle grazing PMLU rehabilitation at other sites.
Responsibility for plan: Approval	- EA Holder. - Exploration team.

Aspect	Risk treatment
Implementation	
Proposed actions	- Management of topsoil stripping and application during rehabilitation. - Topsoil assessment by an appropriately qualified person to determine if ameliorant and fertiliser requirements for planned seed mix are required. - Ameliorants and fertilisers applied, if required. - Management of seed selection and quality. - Plant at optimal time of year.
Resource requirements	- Topsoil inventory. - Topsoil assessment. - Rehabilitation monitoring data.
Performance measures and constraints	Tracking against milestone criteria.
Reporting and monitoring requirements	Rehabilitation monitoring.
Risk timing and scheduling	From planning of soil stripping to final achievement of PMLU.
Risk event: Stability failure of rehabilitated void (not relevant to Centurion North)	
Reasons for selecting treatment option	Not applicable.
Responsibility for plan: - Approval - Implementation	Not applicable.
Proposed actions	Not applicable.
Resource requirements	Not applicable.
Performance measures and constraints	Not applicable.
Reporting and monitoring requirements	Not applicable.
Risk timing and scheduling	Not applicable.
Risk event: Stability failure of underground mine workings (not relevant to Centurion North)	
Reasons for selecting treatment option	Not applicable.
Responsibility for plan: - Approval - Implementation	Not applicable.
Proposed actions	Not applicable.

Aspect	Risk treatment
Resource requirements	• Not applicable.
Performance measures and constraints	• Not applicable.
Reporting and monitoring requirements	• Not applicable.
Risk timing and scheduling	• Not applicable.
Risk event: Deterioration of built infrastructure land conditions	
Reasons for selecting treatment option	• Minimise or prevent contamination.
Responsibility for plan: • Approval • Implementation	• EA Holder. • Exploration team.
Proposed actions	• Clean up and remediate contamination during operational period. • Undertake PSI contaminated land assessment post-mining to identify any areas requiring further DSI. • Remediate any contamination. • A contaminated land survey is carried out by a suitably qualified person confirming no contamination.
Resource requirements	• Infrastructure inventory. • Contaminated land assessments. • Final contaminated land survey. • Rehabilitation monitoring data.
Performance measures and constraints	• Tracking against milestone criteria.
Reporting and monitoring requirements	• Contaminated land assessments. • Final contaminated land survey. • Rehabilitation monitoring.
Risk timing and scheduling	• From the commencement of all activities to final achievement of PMLU.

Due to the limited disturbance area and minimum elevation of the final landform, the rehabilitation outcomes are considered low-risk and no rehabilitation trials will be conducted.

9. MONITORING AND MAINTENANCE

To demonstrate achievement of the RMs, as they relate to achieving a PMLU of cattle grazing, a combination of the following approaches will be used (**Table 25**):

- Rehabilitation reporting requirements (RM1 to RM5); and
- Ongoing rehabilitation monitoring (RM6 and RM7), comprising desktop and field-based assessments and associated reporting (**Figure 21**).

Table 25 Rehabilitation milestones with relevant reporting requirements

Milestone reference	Rehabilitation milestone	Milestone criteria	Reporting requirements
RM1	Infrastructure decommissioning and removal	a) All services disconnected. b) All built and service infrastructure demolished and removed. c) All concrete, bitumen and aggregate removed. d) All waste and rubbish removed. e) All exploration drill holes decommissioned.	• Undertake visual inspections. • Document inspections.
RM2	Remediation of contaminated land	a) All contamination is remediated or removed from site in accordance with relevant legislation. b) A contaminated land survey is carried out by a suitably qualified person confirming the land does not present an unacceptable risk to proposed future land uses or the environment.	• Documentation by a suitably qualified person confirming the land does not present an unacceptable risk to proposed future land uses or the environment.
RM3	Landform development and reshaping	b) Landform is reshaped to be free-draining with slopes $\leq 5\%$ and consistent with the surrounding topography.	• Survey/LiDAR of landform. • Analyse final landform against design.
RM4	Surface preparation	a) Topsoil is placed an average thickness of 200mm. b) An assessment of soil and growth media characteristics is completed by an appropriately qualified person and amelioration and other treatments required identified. c) Ameliorant and physical treatments are applied as identified.	• Survey/LiDAR of surface and extent after topsoil is placed. • Document topsoil depth. • Document soil assessment. • Document soil ameliorants and physical treatments applied.

Milestone reference	Rehabilitation milestone	Milestone criteria	Reporting requirements
RM5	Revegetation (cattle grazing)	a) Completed seeding in accordance with recommended pasture mix (grasses, cover crop and legumes), and seeding rates (up to 25kg/ha).	Document seed mix, planting rates and areas.
RM6	Achievement of surface requirements (cattle grazing)	a) Pasture condition rating ≤ 3 , including: - Preferred pasture species (3P grasses) diversity ≥ 2 species; - Preferred pasture (3P grasses) % DM yield $\geq 10\%$; - Annual grass DM yield % $< 70\%$; - Undesirable grasses and other weeds % DM yield $< 80\%$; and - Crown cover (3P grasses) – at worst, moderate to low density and some plants dead.	Undertake rehabilitation monitoring as per Sections 9.
RM7	Achievement of post-mining land use to a stable condition (cattle grazing)	a) A hazard assessment has been completed by an appropriately qualified person to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. b) n/a. c) Groundcover $> 50\%$. d) Rainfall runoff from the area is not significantly different to upstream values for the following: pH, EC and turbidity. e) n/a. f) Land suitability class ≤ 3 , or not different from pre-mining class if ≥ 4 . The assessment is to be conducted by an appropriately qualified person in accordance with LSA Framework for Open-Cut Coal Mine Rehabilitation 2018 (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland) unless otherwise agreed in writing between the administering authority and the environmental authority holder. For RM7(f), if the land suitability class is assessed as not different from pre-mining class if ≥ 4 for all or a portion of a rehabilitation area, an assessment of reference sites must be carried out to determine if the limitation/s resulting in the class of ≥ 4 is consistent with that of reference sites.	Undertake rehabilitation monitoring as per Sections 9.

Milestone reference	Rehabilitation milestone	Milestone criteria	Reporting requirements
		g) Certification by an appropriately qualified person that pasture meets a pasture condition rating ≤ 3 .	

9.1.1 Analogue sites and grazing PMLU monitoring

Monitoring of analogue or reference sites is not a requirement of the current EA and is not included in the Centurion North rehabilitation monitoring program (unless identified as being required as per RM7(f) (Table 25)).

Monitoring of cattle grazing will be assessed against:

- The pasture condition criteria for RM6 and RM7(g) (Table 25), which is based on standard methods for assessing pasture condition consistent with industry guidelines²²; and
- The land suitability assessment based on the grazing rule-set¹³ criteria for RM7(f) (Table 25).

9.1.2 Rehabilitation monitoring phases

Permanent monitoring plots will be established at the start of the rehabilitation monitoring program. These same plots will also be assessed at the same location during all subsequent phases of the ongoing rehabilitation monitoring.

This rehabilitation monitoring program has been designed to demonstrate achievement of surface requirements (RM6) and post-mining land use to a stable condition (RM7); and follows a phased approach to ensure greater accuracy and efficiency in data collection and analysis. There are three main phases to the rehabilitation monitoring program including 'initial', 'minor', and 'major', as illustrated in Figure 21. Opportunistic monitoring is also conducted in addition to each monitoring phase (Figure 21).

²² Stocktake: Balancing Supply and Demand <https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/#why-choose-stocktake>

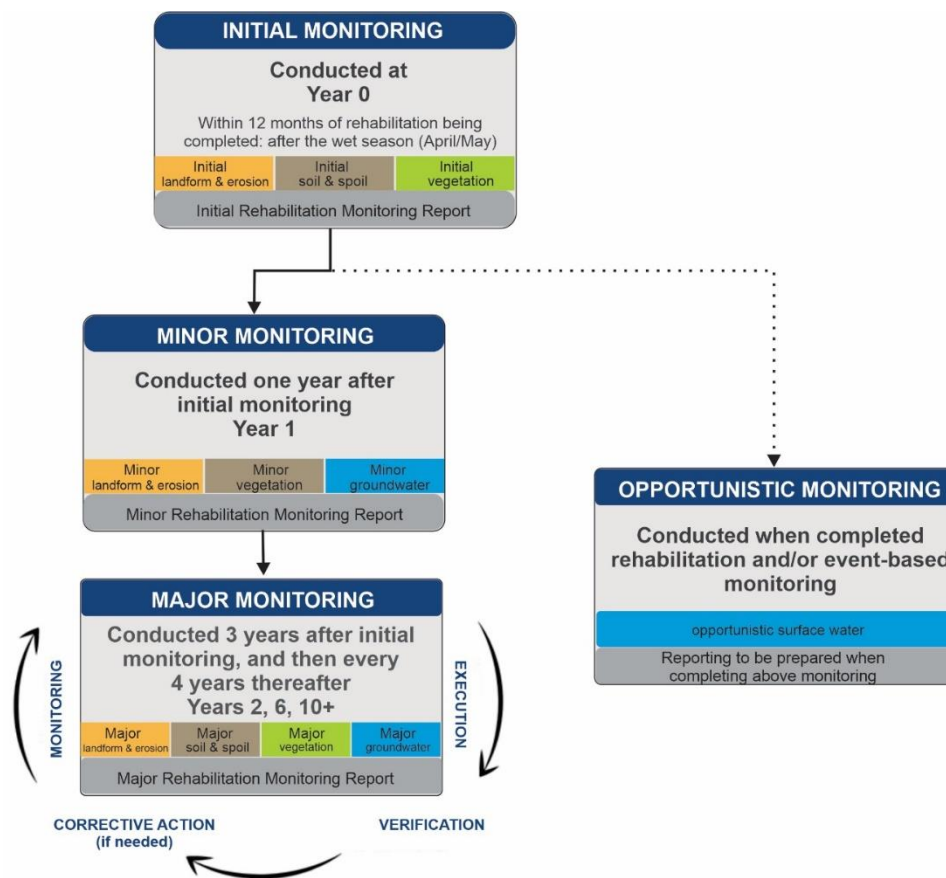


Figure 21 Flow diagram of the Centurion North rehabilitation monitoring program

The ongoing and consistent phased approach of the monitoring program ensures that there is continual monitoring of the rehabilitation parameters against the milestone criteria up to the point of the surrender of the EA. **Table 26** describes how the monitoring schedule progresses over the PRCP period during the phases of monitoring, and includes the parameters monitored during each phase. This allows assessment of the performance and trajectory of the rehabilitation against milestone criteria and accounts for the influence of seasonal variations and extreme weather events over time.

Table 26 Rehabilitation parameters measured during rehabilitation monitoring phases

Rehabilitation parameters	Rehabilitation				
	Year 0	Year 1	Year 2	Year 6	Year 10+
Landform stability	Initial	Minor	Major	Major	Major
Erosion	Initial	Minor	Major	Major	Major
Soil and spoil	Initial	-	Major	Major	Major
Groundcover	Initial	Minor	Major	Major	Major
Invasive plants	Initial	Minor	Major	Major	Major

Rehabilitation parameters	Rehabilitation				
	Year 0	Year 1	Year 2	Year 6	Year 10+
Pasture species Richness	Initial	Minor	Major	Major	Major
Pasture yield and quality	-	-	Major	Major	Major
Pasture condition	-	-	Major	Major	Major
Grazing Land Suitability Assessment	-	-	-	Major	Major

9.2 Initial monitoring method

Initial monitoring will be undertaken at newly established rehabilitation monitoring sites to categorise the site, develop baseline data and identify any risks to rehabilitation success.

Early detection and rectification of drainage and run-off issues can prevent more widespread erosion issues that can lead to rehabilitation failure.

The following aspects of rehabilitation will be assessed during initial monitoring:

- Landform and erosion;
- Soils and spoils; and
- Vegetation.

9.2.1 Desktop monitoring

Prior to commencing any field monitoring work, LiDAR data and aerial imagery will be used to:

- Develop a Digital Elevation Slope Model to assess the landform design;
- Identify potential erosion areas for field validation; and
- Plan the locations to establish permanent, fixed monitoring plots using the following criteria:
 - Representative of rehabilitation slope and PMLU; and
 - Accessibility (vehicle access preferred).

9.2.2 Field monitoring

Field monitoring will be undertaken at the permanent, fixed plot field monitoring sites established as part of the initial desktop monitoring.

9.2.2.1 Landform and erosion

Field based landform and erosion monitoring will focus on assessing initial areas of erosion identified through the desktop assessment.

Whilst the rehabilitated landforms at Centurion North are not complex and the risks associated with instability and erosion are low, provisions for field-based erosion monitoring have been included in the program for any potential areas of erosion identified during desktop analysis.

The field survey involves establishing an erosion monitoring transect by running a 50m tape perpendicular to the slope and across the erosional activity identified during the LiDAR analysis.

9.2.2.2 Soil and spoil

Surface sampling of topsoil refers to the layer at 0 – 10cm; and sub-surface sampling of underlying spoils refers to layers at 10 – 30cm, 30 – 60cm and 90 – 100cm.

Data acquired from soil and spoil monitoring will be analysed by an appropriately qualified person and consider the grazing ruleset. This will be used to establish initial characteristics of the rehabilitated soil profile for trend analysis of these fixed points over time.

The soil and spoil analysis parameters are provided in **Table 27**.

Table 27 Soil and soil analysis parameters for Wards Well’s monitoring programs

Category	Analyte	Purpose of analyte	Depth		Monitoring phase	
			Surface	Sub-surface	Initial	Major
Acidity / alkalinity	pH	Identify anomalies that may affect plant growth and sustainability.	ü	ü	ü	ü
Salinity	EC	Identify leaching profile. High salinity can lead to poor vegetation germination and establishment, reduced plant growth and vigour.	ü	ü	ü	ü
	Chloride	Identify leaching profile. High chloride can lead to poor vegetation germination and establishment, reduced plant growth and vigour.	ü	ü	ü	ü
Exchangeable cations	Cation exchange capacity (CEC)	Major factor in soil fertility. Controls soil stability, nutrient availability and buffers soil’s chemical properties.	ü	ü	ü	ü
	Exchangeable cations	Exchangeable Calcium is linked to soil stability. High levels of exchangeable Magnesium can cause clay dispersion, instability when wet and hard setting.	ü	ü	ü	ü
	Exchangeable Sodium Percentage (ESP)	ESP is a measure of the dominance of sodium ions on the soil’s cation exchange complex. Sodicity in soils can lead to slaking and dispersion which impact soil structure and stability.	ü	ü	ü	ü

Category	Analyte	Purpose of analyte	Depth		Monitoring phase	
			Surface	Sub-surface	Initial	Major
Organic matter	Organic carbon	An indicator of soil nutrient stores and a contributor to improvements in soil structure. Changes through time in organic carbon are a key indicator of rehabilitation success.	ü	-	ü	ü
Major elements	Total Nitrogen	Indicator of soil nutrient store and is also a major plant nutrient.	ü	-	ü	ü
	Extractable Phosphorous (Colwell method)	Indicator of Phosphorous readily available to plants.	ü	-	ü	ü
	Total Phosphorous	Indicator of total store of Phosphorous, some of which is readily available. Key indicator of potential for long-term success or failure of rehabilitation.	ü	-	ü	ü
	Potassium	Important plant nutrient.	ü	-	ü	ü
	Total Sulphur	Indicator of potential for development of Acid Metalliferous Drainage.	ü	-	ü	ü
	Sulphate	Important plant nutrient, and can be an indicator of development of Acid and Metalliferous Drainage.	ü	-	ü	ü
	Calcium	Important plant nutrient.	ü	-	ü	ü
	Magnesium	Important plant nutrient.	ü	-	ü	ü
Trace elements	Manganese	Trace element with minor importance for vegetation success.	ü	-	ü	ü
	Iron	Trace element with minor importance for vegetation success.	ü	-	ü	ü
	Zinc	Trace element important for vegetation success.	ü	-	ü	ü
	Copper	Trace element important for vegetation success.	ü	-	ü	ü
Metals	For example: Se, Zn, and Hg	Metals that have been identified as occurring at elevated levels during material characterisation analysis should be tested during monitoring.	ü	ü	ü	ü

Category	Analyte	Purpose of analyte	Depth		Monitoring phase	
			Surface	Sub-surface	Initial	Major
Physical parameters	Particle size (PSA)	Soil texture strongly affects water entry and storage. Soil texture will impact erosion and vegetation success, and should be considered when planning species mixes for planting.	ü	ü	ü	-
	Emerson aggregate test	Indicator of clay dispersion. Should be interpreted in conjunction with ESP and EC data.	ü	ü	ü	-
Field analysis	Soil profile characteristics	Horizon depths, Field colour, Field texture, Structure, Root density and depth, Soil plant available water capacity (PAWC – initial only).	ü	ü	ü	-

9.2.2.3 Vegetation

As initial monitoring is conducted within 12 months of rehabilitation being completed, vegetation establishment is expected to be limited. Initial vegetation monitoring consists of identifying germinants present at the time of monitoring to species level, where possible, to assess the relative germination success rates of each species in the rehabilitation seed mix.

9.2.2.4 Groundwater

Groundwater monitoring will include ongoing monitoring of the existing groundwater monitoring network. The groundwater monitoring network will be reviewed to ensure sufficient monitoring bores to assess up-gradient potential source areas and down gradient areas. This monitoring network will be used for the collection of post-mining groundwater data and to provide information that will allow for the assessment of future trends of key groundwater indicators.

9.3 Minor monitoring methods

The minor monitoring methodology has been designed to maintain a replicable record of rehabilitation condition, and to quickly identify and resolve issues.

In addition to the existing permanent fixed monitoring points, any new erosion areas that are identified through desktop and field analysis will also be included in the already established monitoring activities. The following aspects will be assessed during the minor monitoring:

- Landform and erosion; and
- Vegetation.

9.3.1 Desktop monitoring

Prior to commencing any field monitoring work, LiDAR data and aerial imagery will be used to:

- Update the Digital Elevation Slope Model;
- Identify new areas of potential sedimentation and/or ponding; and

- Identify new areas of erosion for field validation.

9.3.2 Field monitoring

9.3.2.1 Landform and erosion

For erosion areas identified through the desktop assessment as well as the existing permanent fixed monitoring plots, the following data is recorded:

- Coordinates of erosion point;
- Photo details - coordinates and direction of photos;
- Estimated topsoil coverage of the surrounding rehabilitated area;
- Type of erosional process identified (i.e. sheet erosion, rill erosion, gully erosion, tunnel erosion);
- Evaluation of the severity of the erosion based on previous photographs or knowledge of the area;
- Estimated size of erosional form (using a tape measure to record width and depth); and
- State of erosion²³ (**Table 28**).

Table 28 States of erosion

State of erosion	Description
Active	• One or both of the following conditions apply: • Evidence of sediment movement • Sides and/or floors of erosion form are relatively bare of vegetation
Partly stabilised	• Evidence of some active erosion and some evidence of stabilisation
Stabilised	• One or both of the following conditions apply: • No evidence of sediment movement • Sides and/or floors of erosion form are revegetated

9.3.2.2 Soils and spoil

Soils and spoils baseline sampling is undertaken during the initial phase (refer to Section 9.2.2) and then compared to baseline again during the major monitoring phases (refer to Section 9.4). It is not included in the minor monitoring phase. Only surface conditions are considered in the minor monitoring.

9.3.2.3 Vegetation

Minor monitoring shall be undertaken at the fixed plots established during initial phases of monitoring. The following vegetation parameters are monitored:

- Groundcover;
- Invasive plants; and

²³ McDonald R, Isbell R, Speight J, Walker J and Hopkins M (2009) 'Australian Soil and Land Survey Field Handbook, CSIRO

- Pasture species richness.

9.4 Major monitoring methods

The major monitoring methodology has been designed to provide a detailed assessment of rehabilitation performance. In addition to the existing permanent fixed monitoring points, any new erosion areas that are identified through desktop and field analysis will also be included in monitoring activities. Its purpose is to identify any risks to rehabilitation success and to evaluate the progress of rehabilitation towards milestone criteria and the PMLU of cattle grazing.

The following aspects of rehabilitation will be assessed during major monitoring:

- Landform and erosion;
- Soil and spoil;
- Vegetation (including pasture condition); and
- Grazing Land Suitability Assessment.

9.4.1 Desktop monitoring

Prior to commencing any field monitoring work, a desktop review is to be undertaken including:

- Review of previous rehabilitation monitoring reports to understand historic conditions;
- Update the Digital Elevation Slope Model to compare against previous models and detect any changes in landform over time (e.g. settlement/subsidence); and
- Identify new areas of erosion for field validation.

9.4.2 Field monitoring

9.4.2.1 Landform and erosion

Field based landform and erosion monitoring will focus on assessing erosion at the existing permanent fixed monitoring plots as well as areas identified through the desktop assessment.

9.4.2.2 Soil and spoil

Soil and spoil data acquired from major monitoring is shown in **Table 28** and will be analysed by an appropriately qualified person and consider the grazing rule-set (refer **Table 17**). This data will provide an indication of performance of these parameters at fixed monitoring points over time. Evaluation of rehabilitation performance will consider soil and spoil data to inform trend to achieving milestone criteria or remediation action if required.

9.4.2.3 Vegetation

Ongoing major vegetation monitoring is to take place at the permanently, fixed field monitoring plots established during the initial phase. Vegetation monitoring includes assessment of the following parameters:

- Groundcover;
- Invasive plants;
- Pasture species richness; and
- Pasture condition.

Pasture condition (yield and quality as well as species richness)

The pasture analysis includes an assessment of pasture species richness, yield and quality, and pasture condition. Pasture yield is assessed using percentage dry matter (DM) yield for preferred pasture species as well as the proportion of DM yield for other intermediate species, annual grasses, undesirable grasses and weeds. Pasture condition is assessed by measuring the percentage DM yield, health and diversity of preferred pasture species. Preferred pasture species are identified as perennial grasses that are productive and palatable (3P grasses) to stock. A list of common preferred, other intermediate and undesirable pasture species is provided in **Table 29**.

An overall assessment of pasture condition is undertaken at the first major monitoring assessment at year 2, and every four years thereafter. This initially allows at least two seasons after seeding for pasture species to establish.

Table 29 Preferred, intermediate and undesirable pasture species

Preferred species		Other intermediate species		Other undesirable species	
Scientific name	Common name	Scientific name	Common name	Scientific name	Common name
<i>Cenchrus ciliaris</i>	Buffel Grass	<i>Bothriochloa decipiens</i>	Pitted Bluegrass	<i>Aristida spp.</i>	Wire Grasses
<i>Heteropogon contortus</i>	Black Spear Grass	<i>Cynodon dactylon</i>	Green Couch	<i>Sporobolus spp.</i>	Native Rat's Tail Grasses
<i>Dichanthium sericeum</i>	Queensland Bluegrass	<i>Panicum decompositum</i>	Native millet	<i>Chloris divaricata</i>	Slender Chloris
<i>Astrebla squarrosa</i> , <i>A. appacea</i> , <i>A. elymoides</i>	Bull Mitchell Curly Mitchell Hoop Mitchell	<i>Cymbopogon refractus</i>	Barbwire Grass		

Pasture monitoring is undertaken within three quadrats at each of the existing monitoring sites. Pasture is removed from the quadrat by cutting vegetation to approximately 50mm in height and weighing in the field. It is important to record total sample weight for the quadrat and then separate the sample into preferred pasture species (3P), other pasture species, annual grasses, undesirable grass species and weeds. These are all weighed separately to collect data on initial weight and determine the overall percentage DM yield. Results of each plot are averaged to attain an overall pasture condition rating score for each site.

Pasture condition rating criteria is listed in **Table 30**. Importantly the pasture condition can be assessed at any time pasture species area identifiable, preferably post wet season. The pasture is assessed against the milestone criteria for pasture condition listed in RM6 and RM7(g) (**Table 25**) which is based on standard methods for assessing pasture condition consistent with industry guidelines.

Table 30 Pasture condition assessment table (criteria to assign pasture rankings)

Condition rating	Condition indicators				
	Preferred pasture species		Annual grass % DM yield	Undesirable grasses and other weeds % DM Yield	Preferred pasture species diversity
	% DM yield	Crown cover			
1	> 80 %	Dense and plants healthy	< 20 %	< 20 %	> 5 species
2	60 – 80 %	High to moderate density and some plants unhealthy	20 – 40 %	20 – 30 %	3 – 5 species
3	10 – 60 %	Moderate to low density and some plants dead	40 – 70 %	30 – 80 %	2 – 3 Species
4	< 10 %	Sparse and many plants dead	> 70 %	> 80 %	0 or 1 species

9.4.2.4 Grazing land suitability assessment

An assessment of land suitability, based on the grazing ruleset, is undertaken to demonstrate achievement of RM7(f) for a PMLU of cattle grazing, at the following monitoring times:

- During major monitoring in Year 6 (second time major monitoring is undertaken) to allow time for vegetation to establish; and
- Each scheduled major monitoring from Year 10+ until the rehabilitation succeeds in meeting the milestone criteria.

(Refer to Section 4.1 for more details on the land suitability methodology for the grazing ruleset for a PMLU of cattle grazing).

9.5 Achieving monitoring across the PRCP schedule

For final rehabilitation, it is planned that RM6 – achievement of surface requirements for cattle grazing (pasture condition rating of ≤ 3), is possible within a 10-year timeframe from revegetation. There are a number of factors which can influence the successful establishment of pastures on post-mined land including soils and landform, soil management and amelioration, species selection, sowing rates, and sowing timing plus rainfall. The revegetation plan has considered these elements, and allows a period up to 10 years to achieve RM6 for seasonal rainfall variation to successfully establish a pasture suitable for a PMLU of cattle grazing at Centurion North. For seismic areas requiring return to native vegetation, 5 years will be sufficient to achieve RM6. This is due to minimal disturbance from seismic activities, allowing vegetation to regenerate from the existing root ball as solid will not be disturbed for the majority of seismic activities.

Achievement of post-mining land use to a stable condition for cattle grazing (RM7), is planned within a 15-year timeframe from revegetation. Achieving RM7 relies on successfully achieving RM6 within 10 years, accounting for seasonal variation of rainfall. An additional 5 years has been allowed for achievement of RM7 to demonstrate the ongoing sustainability of the PMLU for cattle grazing through additional rehabilitation monitoring data associated with landform, erosion, soils, vegetation, pastures, and surface water (Section 9.2).

9.6 Maintenance

Maintenance will be implemented when monitoring identifies issues with the rehabilitation, or milestone criteria are not being met. In order to select the most appropriate remedial actions, the likely cause would be assessed. Contributing factors may be related to:

- Climatic conditions (i.e. droughts);
- Weed presence;
- Poor drainage design;
- Insufficient vegetation cover;
- Influence of adjacent land use; and/or
- Soil type.

Required rehabilitation actions are to be entered into a work management system for actioning.

9.7 Data analysis and reporting

Rehabilitation monitoring data will be collected and analysed by appropriately qualified and experienced persons and assessed against the milestone criteria. The data will be analysed to identify changes and trends, as well as map the trajectory of rehabilitation to identify whether it is on track to achieve the rehabilitation milestones or requires remedial actions or maintenance.

The rehabilitation data will be stored and processed within internal geospatial and document management systems.

9.8 Quality assurance and quality control

The quality assurance and quality control (QA/QC) process to be followed as part of Centurion North ongoing rehabilitation monitoring is illustrated in **Figure 22**. The process provides for initial execution of the rehabilitation in accordance with the rehabilitation measures, followed by verification of how this execution was undertaken (again, according to these measures). Based on the verification outcomes, allowance is made for implementation of corrective action and/or maintenance, as needed.

The rehabilitated areas as well as corrected and/or maintenance areas then undergo further rehabilitation monitoring; and subsequent execution of the rehabilitation measures.

This process allows for a repetitive execution-verification-monitoring QA/QC approach, to ensure rehabilitation areas progress on a trajectory towards achievement of milestone criteria and eventual certification.



Figure 22 Quality assurance/quality control process to be followed for ongoing rehabilitation monitoring at Centurion North

Relationship with PRCP schedule

The rehabilitation monitoring program is designed to track rehabilitation performance over time to identify compliance to milestone criteria and ensure continuous improvement in rehabilitation methodologies.

10. SECTION B: PRCP SCHEDULE

Legislative Requirement

In accordance with section 126D(1) of the EP Act, the PRCP schedule in the PRC Plan must:

- j) describe the area of each resource tenure either a post-mining land use or non-use management area, and
- k) for each post-mining land use state:
 - i. each rehabilitation milestone required to achieve a stable condition, and
 - ii. when each rehabilitation milestone is to be achieved, and
- l) for each non-use management area state:
 - i. each management milestone, and
 - ii. when each management milestone is to be achieved, and
- m) include maps showing the land mentioned in (a), (b) and (c).

10.1 Final site design

The final site design for Centurion North, including maximum disturbance, tenure boundaries, the PMLU and the extreme event flood plain, is shown in **Figure 23**.

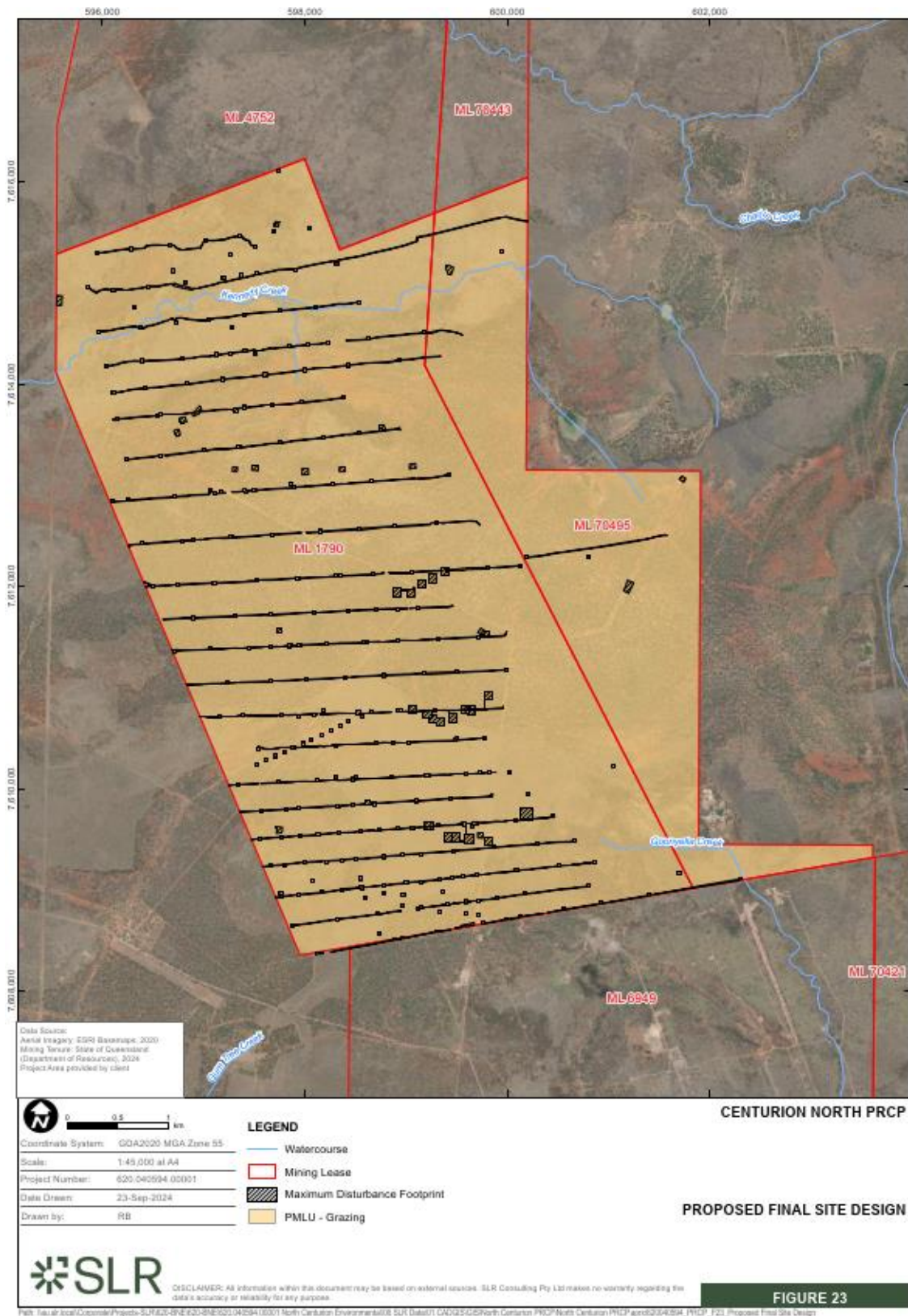


Figure 23 Centurion North final site design

10.2 Post-mining land use milestones

The Centurion North rehabilitation areas and relevant rehabilitation milestones are shown in **Table 31**. These are illustrated in the reference map provided in Section 10.4.

Table 31 Centurion North rehabilitation areas and relevant rehabilitation milestones

Rehabilitation area	Relevant activities	PMLU	Relevant rehabilitation milestones
RA1 (formerly RA5)	Exploration drilling and associated tracks	Cattle grazing	RM1 RM2 RM3 RM4 RM5 RM6 RM7

The rehabilitation milestones and milestone criteria for Centurion North are shown in **Table 32**.

Table 32 Centurion North rehabilitation milestones and milestone criteria

Milestone reference	Rehabilitation milestone	Milestone criteria
RM1	Infrastructure decommissioning and removal	a) All services disconnected. b) All built and service infrastructure demolished and removed (except where agreed in writing by the post-mining land owner/holder). c) All concrete, bitumen and aggregate removed. d) All waste and rubbish removed. e) All exploration drill holes decommissioned.
RM2	Remediation of contaminated land	a) All contamination is remediated or removed from site in accordance with relevant legislation. b) A contaminated land survey is carried out by a suitably qualified person confirming the land does not present an unacceptable risk to proposed future land uses or the environment.
RM3	Landform development and reshaping	a) Landform is reshaped to be free-draining with slopes $\leq 5\%$ and consistent with the surrounding topography.
RM4	Surface preparation	a) Topsoil is placed an average thickness of 200mm. b) An assessment of soil and growth media characteristics is completed by an appropriately qualified person¹, and amelioration and other treatments required identified. c) Ameliorant and physical treatments are applied as identified in RM4(b).

Milestone reference	Rehabilitation milestone	Milestone criteria																								
RM5	Revegetation (cattle grazing)	a) Completed seeding in accordance with the recommended pasture mix (grasses, cover crop and legumes) of Table RM5 – Recommended Pasture Mix , and seeding rates (up to 25kg/ha).																								
		Table RM5 – Recommended Pasture Mix																								
		<table><tr><th>Common name</th><th>Scientific name</th><th>Sowing rate (kg/ha)</th></tr><tr><td>Queensland Bluegrass</td><td><i>Dichanthium sericeum</i></td><td>6</td></tr><tr><td>Buffel grass</td><td><i>Cenchrus ciliaris</i></td><td>4</td></tr><tr><td>Stylo</td><td><i>Stylosanthes scabra</i></td><td>2</td></tr><tr><td>Black spear grass</td><td><i>Heteropogon contortus</i></td><td>5</td></tr><tr><td>Mitchell grasses</td><td>Bull Mitchell grass (<i>Astreb​la squarrosa</i>), Curly Mitchell grass (<i>Astreb​la lappacea</i>) and Hoop Mitchell Grass (<i>Astreb​la elymoides</i>)</td><td>3</td></tr><tr><td>Shirohie millet</td><td><i>Echinochloa esculenta</i></td><td>5</td></tr><tr><td colspan="2">TOTAL</td><td>25</td></tr></table>	Common name	Scientific name	Sowing rate (kg/ha)	Queensland Bluegrass	<i>Dichanthium sericeum</i>	6	Buffel grass	<i>Cenchrus ciliaris</i>	4	Stylo	<i>Stylosanthes scabra</i>	2	Black spear grass	<i>Heteropogon contortus</i>	5	Mitchell grasses	Bull Mitchell grass (<i>Astreb​la squarrosa</i>), Curly Mitchell grass (<i>Astreb​la lappacea</i>) and Hoop Mitchell Grass (<i>Astreb​la elymoides</i>)	3	Shirohie millet	<i>Echinochloa esculenta</i>	5	TOTAL		25
		Common name	Scientific name	Sowing rate (kg/ha)																						
		Queensland Bluegrass	<i>Dichanthium sericeum</i>	6																						
		Buffel grass	<i>Cenchrus ciliaris</i>	4																						
		Stylo	<i>Stylosanthes scabra</i>	2																						
		Black spear grass	<i>Heteropogon contortus</i>	5																						
		Mitchell grasses	Bull Mitchell grass (<i>Astreb​la squarrosa</i>), Curly Mitchell grass (<i>Astreb​la lappacea</i>) and Hoop Mitchell Grass (<i>Astreb​la elymoides</i>)	3																						
		Shirohie millet	<i>Echinochloa esculenta</i>	5																						
TOTAL		25																								
RM6	Achievement of surface requirements (cattle grazing)	a) Pasture condition rating ≤3, based on the Pasture Condition Assessment Table as per Stocktake: Balancing Supply and Demand (https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/), as provided in Table 33 including: - Preferred pasture species (3P grasses²) diversity ≥2 species; - Preferred pasture (3P grasses²) % DM yield ≥10%; - Annual grass DM yield % <70%; - Undesirable grasses and other weeds % DM yield <80%; and - Crown cover (3P grasses²) – at worst, moderate to low density and some plants dead.																								
		3P grasses: native and naturalised exotic grass species that are perennial, palatable, and productive plants to stock.																								

Milestone reference	Rehabilitation milestone	Milestone criteria																																				
RM7*	Achievement of post-mining land use to a stable condition (cattle grazing)	a) A hazard assessment has been completed by an appropriately qualified person¹ to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. b) n/a c) Groundcover³ >50%. d) Rainfall runoff from the area is not significantly different to upstream values for the following: pH, EC and turbidity. e) n/a. f) Land suitability class ≤3, or not different from pre-mining class if ≥4, as per Table RM7 – Land Suitability Rule-Set (Cattle Grazing). The assessment is to be conducted by an appropriately qualified person¹ and completed in accordance with LSA Framework for Open-Cut Coal Mine Rehabilitation 2018 (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland) unless otherwise agreed in writing between the administering authority and the environmental authority holder. For RM7(f), if the land suitability class is assessed as not different from pre-mining class if ≥4 for all or a portion of a rehabilitation area, an assessment of reference sites⁴ must be carried out to determine if the limitation/s resulting in the class of ≥4 is consistent with that of reference sites. g) Certification by an appropriately qualified person¹ that pasture meets a pasture condition rating ≤3, based on the Pasture Condition Assessment Table as per Stocktake: Balancing Supply and Demand, as provided in Table 30. ³Groundcover: to anything in contact with the soil surface, for example, rocks, stones, sticks, leaves, grass, hay ⁴Reference site: representative undisturbed grazing land adjacent to the disturbance areas Table RM7 – Land Suitability Rule-Set (Cattle Grazing) <table><tr><th rowspan="2">Limitation</th><th rowspan="2">Indicator</th><th rowspan="2">Units</th><th colspan="5">Suitability class</th></tr><tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr><tr><td rowspan="2">Water availability</td><td>PAWC in ERD</td><td>mm/0.6d</td><td>> 75</td><td>75 - 60</td><td>< 60 - 45</td><td>< 45 - 30</td><td>< 30</td></tr><tr><td>P in 0.1m</td><td>mg / kg</td><td>> 20</td><td>20 - 14</td><td>< 14 - 8</td><td>< 8 - 4</td><td>< 4</td></tr><tr><td rowspan="2">Nutrient supply</td><td>pH in 0.1m</td><td>pH units</td><td>7.3 – 6.6</td><td>< 6.6 – 6.0 or > 7.3 – 8.0</td><td>< 6.0 – 5.5 or > 8.0 – 8.5</td><td>< 5.5 – 5.0 or > 8.5 – 9.0</td><td>< 5.0 or > 9.0</td></tr></table>	Limitation	Indicator	Units	Suitability class					1	2	3	4	5	Water availability	PAWC in ERD	mm/0.6d	> 75	75 - 60	< 60 - 45	< 45 - 30	< 30	P in 0.1m	mg / kg	> 20	20 - 14	< 14 - 8	< 8 - 4	< 4	Nutrient supply	pH in 0.1m	pH units	7.3 – 6.6	< 6.6 – 6.0 or > 7.3 – 8.0	< 6.0 – 5.5 or > 8.0 – 8.5	< 5.5 – 5.0 or > 8.5 – 9.0	< 5.0 or > 9.0
Limitation	Indicator	Units				Suitability class																																
			1	2	3	4	5																															
Water availability	PAWC in ERD	mm/0.6d	> 75	75 - 60	< 60 - 45	< 45 - 30	< 30																															
	P in 0.1m	mg / kg	> 20	20 - 14	< 14 - 8	< 8 - 4	< 4																															
Nutrient supply	pH in 0.1m	pH units	7.3 – 6.6	< 6.6 – 6.0 or > 7.3 – 8.0	< 6.0 – 5.5 or > 8.0 – 8.5	< 5.5 – 5.0 or > 8.5 – 9.0	< 5.0 or > 9.0																															

Milestone reference	Rehabilitation milestone	Milestone criteria							
		Soil physical factors	Surface soil structure	variable	Fine (peds < 10mm)	Coarse (peds > 10mm)	Surface crust	Very hard setting	Massive
		Salinity	EC in ERD	dS/m	< 2	2 - < 4	4 - < 10	10 - < 16	≥ 16
		Rockiness	Fragments on surface	%	< 5	5 - 10	10 - 30	30 - 60	> 60
		Topography (slope)	Gradient, surface	%	< 5	5 - < 10	10 - < 15	15 - < 20	≥ 20
			Vertical interval, surface	m	Nil ripping furrows	Regular ripping furrows < 0.2m	Regular ripping furrows > 0.2 – 0.4m	Regular ripping furrows > 0.4 – 0.6m	Regular ripping furrows > 0.6m
		Water erosion, surface soil	Slope (ESP in 0.1m <6)	%	< 5	5 - 8	> 8 - 12	> 12 - 18	> 18
			Slope (ESP in 0.1m > 6 - < 14)	%	< 3	3 - 6	> 6 - 10	> 10 - 12	> 12
			Slope (ESP in 0.1m > 14)	%	< 1	1 - 2	> 2 - 4	> 4 - 6	> 6
		Sub-soil erosion	ESP at 0.5m	%	< 7	7 - 14	> 14 - 23	> 23 - 34	> 34
		Potentially acid forming materials	pH < 4.5	pH units	Not likely to be present within 5m of surface	Not likely to be present within 3m of surface	Not likely to be present within 2m of surface	Present immediately below root zone (0.9 – 0.6m)	Present within root zone (surface 0.6m)

10.3 Non-use management area milestones

Not applicable to Centurion North as there are no NUMAs.

10.4 Reference maps

The Centurion North reference map showing the rehabilitation areas is shown in **Figure 24**.

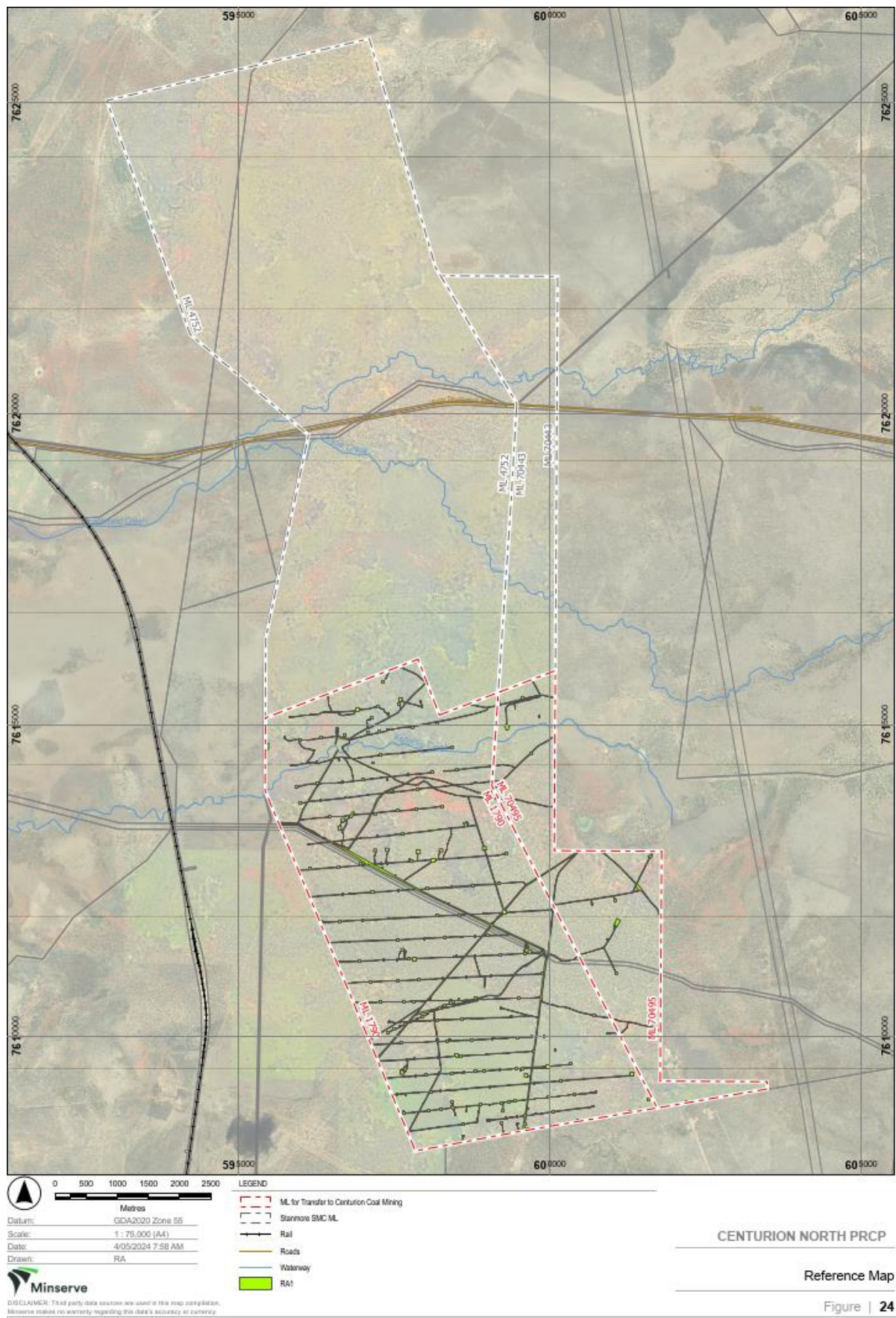


Figure 24 **Centurion North reference map**

10.5 Schedule

The schedule is based on the land being rehabilitated as soon as practicable after the land becomes available, as required under section 126D(4) of the *EP Act*.

Rehabilitation milestones RM1, RM2, RM3, RM4 and RM5 will be completed in the same time period, while completion of RM6 and RM7 is dependent on varying weather seasonality and undesirable weather periods. Achievement of rehabilitation milestones RM6 and RM7 will be demonstrated prior to the scheduled date if possible.

The proposed PRCP schedule is provided on the following pages.

POST MINING LAND USES (PMLU)													
Rehabilitation area	RA1												
Disturbance description	Exploration – drilling and associated tracks												
Total size of rehabilitation area (ha)	145												
Commencement of first milestone RM1	10/12/2021												
PMLU	Cattle grazing												
Date area is available	10/12/21	10/12/28											
Cumulative area available (ha)	19	145											
Milestone completed by	Milestone completed by												
	10/12/26	10/12/31	10/12/36	10/12/41	10/12/46								
Milestone Reference	Cumulative area achieved (ha)												
RM1	19	145											
RM2	19	145											
RM3	19	145											
RM4	19	145											
RM5	19	145											
RM6			19	145									
RM7				19	145								

11. REFERENCES

The following references have been used to support development of the PRC Plan:

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Baker D and Eldershaw V (1993) Interpreting Soil Analysis for Agricultural Land Use in Queensland, Queensland Department of Primary Industries, Brisbane.

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BHP Coal (August 2020): Guideline for Climate Change Adaptation in Mine Water Planning and Hydrological Assessments – BHP Queensland. Ref. no. CTD-WTR-GLD-001

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The following online resources were also used:

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<https://qldglobe.information.qld.gov.au/> (accessed November 2020)

<https://environment.des.qld.gov.au/management/water/quality-guidelines/sampling-manual>

<https://longpaddock.qld.gov.au/qld-future-climate/data-info/tern/>

Stocktake: Balancing Supply and Demand:

<https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/#why-choose-stocktake>

12. APPENDICES

List of Appendices	
Appendix 1	Environmental Authority EA (P-EA-100658735) (3 September 2024)
Appendix 2	Golder Associates (23 December 2020): Wards Well Mine – PRCP Hydrogeological Conceptual Model. Ref. No. 20360652-001-R-RevA
Appendix 3	Ecological Australia (10 June 2016): Wards Well/Lancewood Brigalow TEC Assessment
Appendix 4	Ecological Australia (18 August 2017): Wards Well Coal Project – Ecological Assessment Report. Project No. 17BRIECO-4089
Appendix 5	Sinclair Knight Merz (26 June 2012): Wards Well Mine Project: Soil Survey. Version A, ref. no. QE09811
Appendix 6	BHP (February 2021): Wards Well PRCP Community Consultation Plan and Stakeholder Register
Appendix 7	NOT USED
Appendix 8	BHP (10 February 2021): Preliminary Site Investigation Wards Well Mine
Appendix 9	NOT USED
Appendix 10	Wards Well PRCP Risk Assessment
Appendix 11	NOT USED

APPENDIX 1
ENVIRONMENTAL AUTHORITY EA (P-EA-100658735) (3 SEPTEMBER 2024)

Permit

Environmental Protection Act 1994

Environmental authority P-EA-100658735

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Environmental authority number: P-EA-100658735

Environmental authority takes effect on 3 September 2024

The anniversary date of this environmental authority is the same day each year and remains 15 September. The payment of the annual fee will be due each year on this day.

An annual return will be due each year on 01 April.

Environmental authority holder(s)

Name(s)	Registered address
Centurion Coal Mining Pty Ltd	Level 14, 31 Duncan Street, Fortitude Valley QLD 4006

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Ancillary 08 - Chemical Storage 1: Storing a total of 50t or more of chemicals of dangerous goods class 1 or class 2, division 2.3 under subsection (1)(a)	ML70495, ML1790
Schedule 3 09: A mining activity involving drilling, costeaning, pitting or carrying out geological surveys causing significant disturbance	ML70495, ML1790

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days);

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

- a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority-on the nominated day; or
- b) if the authority states a day or an event for it to take effect-on the stated day or when the stated event happens; or
- c) otherwise-on the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the *Sustainable Planning Act 2009* or an SDA Approval under the *State Development and Public Works Organisation Act 1971*), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.

Cate Puschmann

Department of Environment and Science
Delegate of the administering authority
Environmental Protection Act 1994

Date issued: 12 Septmeber 2024

Enquiries:
Business Centre Coal
Department of Environment and Science
Phone: (07) 4987 9320
Email: crmining@des.qld.gov.au

Privacy statement

Pursuant to section 540 of the EP Act, the Department is required to maintain a register of certain documents and information authorised under the EP Act. A copy of this document will be kept on the public register. The register is available for inspection by members of the public who are able to take extracts, or copies of the documents from the register. Documents that are required to be kept on the register are published in their entirety, unless alteration is required by the EP Act. There is no general discretion allowing the Department to withhold documents or information required to be kept on the public register. For more information on the Department's public register, search 'public register' at www.qld.gov.au. For queries about privacy matters please email privacy@des.qld.gov.au or telephone 13 74 68.

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

Other permits required

This permit only provides an approval under the Environmental Protection Act 1994. In order to lawfully operate you may also require permits / approvals from your local government authority, other business units within the department and other State Government agencies prior to commencing any activity at the site. For example, this may include permits / approvals with your local Council (for planning approval), the Department of Transport and Main Roads (to access state controlled roads), the Department of Resources (to clear vegetation), and the Department of Agriculture and Fisheries (to clear marine plants or to obtain a quarry material allocation).

Conditions of environmental authority

Schedule A: General	
Condition number	Condition
A1	Prevent and/or minimise likelihood of environmental harm In carrying out the environmentally relevant activities, the environmental authority holder must take all reasonable and practicable measures to prevent and/or to minimise the likelihood of environmental harm being caused. Any environmentally relevant activity, that, if carried out incompetently, or negligently, may cause environmental harm, in a manner that could have been prevented, shall be carried out in a proper manner in accordance with the conditions of this authority. <i>Note: This authority authorises the environmentally relevant activity. It does not authorise environmental harm unless a condition contained within this authority explicitly authorises that harm. Where there is no condition or the authority is silent on a matter, the lack of a condition or silence shall not be construed as authorising harm.</i>
A2	Maintenance of measures, plant and equipment The environmental authority holder must ensure: a) that all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority are installed; b) that such measures, plant and equipment are maintained in a proper condition; and c) that such measures, plant and equipment are operated in a proper manner.
A3	No change, replacement or alteration of any plant or equipment is permitted if the change, replacement or alteration increases, or is likely to substantially increase, the risk of unlawful environmental harm caused by the mining activities.
A4	Monitoring Record, compile and keep for a minimum of five (5) years all monitoring results required by this environmental authority and make available for inspection all or any of these records upon request by the administering authority.
A5	Where monitoring is a requirement of this environmental authority, ensure that a competent person(s) conducts all monitoring.
A6	Record Keeping Unless otherwise specified by a condition of this environmental authority and records must be: a) kept for a period of 5 years and; b) provided to the administering authority upon request and in the format required.

A7	Notification of emergencies, incidents and exceptions All reasonable actions are to be taken to minimise environmental harm, or potential environmental harm, resulting from any emergency, incident or circumstances not in accordance with the conditions of this environmental authority.
A8	As soon as practicable after becoming aware of any emergency, incident or information about circumstances which results or may result in environmental harm not in accordance with the conditions of this environmental authority, the administering authority must be notified in writing.
A9	Not more than ten (10) business days following the initial notification of an emergency, incident or information about circumstances which result or may result in environmental harm, written advice must be provided to the administering authority in relation to: a) proposed actions to prevent a recurrence of the emergency or incident; b) the outcomes of actions taken at the time to prevent or minimise environmental harm; and c) proposed actions to respond to the information about circumstances which result or may result in environmental harm.
A10	As soon as practicable, but not more than six (6) weeks following the initial notification of an emergency, incident or information about circumstances which result or may result in environmental harm, environmental monitoring must be performed and written advice must be provided of the results of any such monitoring performed to the administering authority.
A11	The notification of emergencies, incidents or circumstances (incident) which result or may result in environmental harm in accordance with condition A9 must include but not be limited to the following: a) the holder of the environmental authority; b) the location of the incident; c) the number of the environmental authority; d) the name and telephone number of the designated contact person; e) the time of the incident; f) the time the holder of the environmental authority became aware of the incident; g) the suspected cause of the incident; h) the environmental harm caused, threatened, or suspected to be caused by the incident; and i) actions taken to prevent any further incident and mitigate any environmental harm caused by the incident.
A12	Mining activities – general All land subject to mining activities must be rehabilitated to a non-polluting, safe, stable and self-sustaining landform.
A13	Contaminants must not be released to the receiving environment unless they are in accordance with the contaminant limits authorised by this environmental authority.

A14	This environmental authority does not authorise environmental harm unless a condition contained within the authority explicitly authorises that harm. Where there is no condition or the authority is silent on a matter, the lack of a condition or silence shall not be construed as authorising harm.
A15	The only mining activities to be carried out under this environmental authority are the mining activities defined within the parameters in Table 1 (Mining Activities) and identified in Figures 1 to 5 attached to this environmental authority. <i>Note: Variation of mining activities to those identified within the conceptual designs is considered to be in accordance with these conditions as long as the variation is not significantly different to the conceptual design or causes a significant increase in environmental harm.</i>
A16	Definitions Words and phrases used throughout this environmental authority are defined in the Definitions section of this authority. Where a definition for a term used in this environmental authority is sought and the term is not defined within this environmental authority, the definitions in the <i>Environmental Protection Act 1994</i>, its regulations and policies must be used.
A17	Conditions The conditions of this environmental authority are in force until a surrender of the authority is accepted pursuant to the <i>Environmental Protection Act 1994</i>. The conditions apply unless an amendment is approved pursuant to the <i>Environmental Protection Act 1994</i>.

Table 1 (Mining Activities)

Mine Domain	Mine Feature Domain	Location (GDA94)	Maximum Disturbance Area	Constraints
Exploration activities	Drill holes and pads	As per Figure 1	1400 metres squared per drill pad	Total disturbed area must not exceed 1.4 ha
	Historic holes and pads	As per Figure 1	3000 metres squared per drill pad	Quantity: 310 drill holes
Ancillary Infrastructure	Roads and tracks	As per Figure 1		Scale and intensity

Schedule B: Air	
Condition number	Condition
B1	Dust nuisance Subject to conditions B2 and B3 of this environmental authority, the release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.
B2	When requested by the administering authority, dust and particulate monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.
B3	If the environmental authority holder can provide evidence through monitoring that the following limits are not being exceeded then the holder is not in breach of B1: a) dust deposition of 120 milligrams per square metre per day, averaged over one month, when monitored in accordance with AS 3580.10.1 <i>Methods for sampling and analysis of ambient air – Determination of particulates – Deposited matter – Gravimetric method</i> of 1991 (or more recent editions), or b) a concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM₁₀) suspended in the atmosphere of 50 micrograms per cubic metre over a 24 hour averaging time, at a sensitive or commercial place downwind of the operational land, when monitored in accordance with i. Particulate matter – Determination of suspended particulate PM₁₀ high-volume sampler with size-selective inlet – Gravimetric method, when monitored in accordance with AS 3580.9.6 <i>Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM₁₀ high volume sampler with size-selective inlet – Gravimetric method</i> of 1990 (or more recent editions); and ii. any alternative method of sampling PM₁₀, which may be permitted by the <i>Air Quality Sampling Manual</i> as published from time to time by the administering authority.
B4	If monitoring indicates exceedance of the relevant limits in condition B3, then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and b) immediately implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance.

Schedule C: Water	
Condition number	Condition
C1	Contaminant release Contaminants that will or have the potential to cause environmental harm must not be released directly or indirectly to any waters.
C2	Water reuse Water contaminated by mining activity may be piped or trucked or transferred by some other means that does not contravene the conditions of this authority during periods of dry weather for the purpose of supplying stock water to directly adjoining properties owned by the environmental authority holder or a third party and subject to compliance with the quality release limits specified in Table 2 (Stock water release limits) .
C3	Water contaminated by mining activity may be piped or trucked or transferred by some other means that does not contravene the conditions of this authority during periods of dry weather for the purpose of supplying irrigation water to directly adjoining properties owned by the environmental authority holder or a third party and subject to compliance with quality release limits in Table 3 (Irrigation water release limits) .

Table 2 (Stock water release limits)

Quality characteristic	Units	Minimum	Maximum
pH	pH units	6.5	8.5
Electrical Conductivity	µS/cm	N/A	5000

Table 3 (Irrigation water release limits)

Quality characteristic	Units	Minimum	Maximum
pH	pH units	6.5	8.5
Electrical Conductivity	µS/cm	N/A	TBD [Note 1]

[Note 1] A site-specific value to be determined in accordance with ANZECC & ARMICANZ (2000) Irrigation Guidelines

C4	Water contaminated by mining activity may be piped or trucked off the mining lease for the purpose of supplying water to a third party for purpose of construction and/or road maintenance in accordance with the conditions of this environmental authority.
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C5	If the responsibility of water contaminated by mining activities (the water) is given or transferred to another person in accordance with conditions C2, C3 or C4: a) the responsibility of the water must only be given or transferred in accordance with a written agreement (the third party agreement); and b) include in the third party agreement a commitment from the person utilising the water to use water in such a way as to prevent environmental harm or public health incidences and specifically make the persons aware of the General Environmental Duty (GED) under section 319 of the <i>Environmental Protection Act 1994</i>, environmental sustainability of the water disposal and protection of environmental values of waters.
C6	Water general All determinations of water quality must be: a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements; b) made in accordance with methods prescribed in the latest edition of the administering authority's Water Quality Sampling Manual; c) collected from the monitoring locations identified within this environmental authority, within 10 hours of each other where possible; d) carried out on representative samples; and e) laboratory testing must be undertaken using a laboratory accredited (e.g. NATA) for the method of analysis being used. <i>Note: Condition C6 requires the Water Quality Manual to be followed and where it is not followed because of exceptional circumstances this should be explained and reported with the results.</i>
C7	Temporary interference with waterways Temporarily destroying native vegetation, excavating, or placing fill in a watercourse, lake or spring necessary for and associated with mining activity must be undertaken in accordance with Department of Environment and Resource Management <i>Guideline - Activities in a Watercourse, Lake or Spring associated with Mining Activities</i>.
C8	Saline drainage The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of saline drainage.
C9	Acid rock drainage The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of acid rock drainage.
C10	Stormwater and water sediment controls An erosion and sediment control plan must be developed by an appropriately qualified person and implemented for all stages of the exploration and mining activities on the site to minimise erosion and the release of sediment to waters and contamination of stormwater.
C11	The maintenance and cleaning of any vehicles, plant or equipment must not be carried out in areas from which contaminants can be released into any receiving waters.

C12	Any spillage of wastes, contaminants or other materials must be cleaned up as quickly as practicable to minimise the release of wastes, contaminants or materials to any stormwater drainage system or receiving waters.
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Schedule D: Acoustic	
Condition number	Condition
D1	Noise and Vibration Subject to conditions D2 and D3, noise from the mining activity must not cause an environmental nuisance at any sensitive or commercial place.
D2	When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.
D3	If the environmental authority holder can provide evidence through monitoring that the limits defined in Table 4 (Noise Limits), are not being exceeded then the holder is not in breach of condition D1. Monitoring must include: a) L_A, max adj, T; b) relevant background sound level; c) the level and frequency of occurrence of impulsive or tonal noise; d) atmospheric conditions including wind speed and direction; and e) location, date and time of recording.
D4	If monitoring indicates exceedance of the limits in Table 4 (Noise Limits), then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and b) immediately implement noise abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.
D5	The method of measurement and reporting of noise levels must comply with the latest edition of the administering authority's <i>Noise Measurement Manual</i>.

Table 4 (Noise Limits)

Noise Levels dB(A)	Monday to Sunday (including public holidays)		
	7am-6pm	6pm-10pm	10pm-7am
	Noise measured at a 'sensitive or commercial place'		
L_{A10} , adj, 10mins	B/G + 5	B/G + 5	B/G + 3
L_{A1} , adj, 10mins	B/G + 10	B/G + 10	B/G + 5

Note: Where "Background" means background sound pressure level measured in accordance with the latest edition of the administering authority's *Noise Measurement Manual*. **Table 6 (Noise Limits)** does not purport to set operating hours for the mining activities.

Schedule E: Waste	
Condition number	Condition
E1	Storage of tyres Scrap tyres stored awaiting disposal or transport for take-back and recycling, or waste- to-energy options must be stored in stable stacks and at least 10 metres from any other scrap tyre storage area, or combustible or flammable material, including vegetation.
E2	All reasonable and practicable fire prevention measures must be implemented, including removal of grass and other materials within a 10 metre radius of the scrap tyre storage area.
E3	Where possible and practical, cleared vegetation must be mulched and/or replaced in rehabilitated areas. Cleared vegetation may be burnt as a last resort and only if there is minimal risk of causing nuisance to the neighbouring sensitive receptors. <i>Note: This condition does not exempt the environmental authority holder from obtaining any approval required under other legislation to conduct a burn.</i>
E4	General waste must not be burnt or be allowed to burn on the licensed site unless permitted by the administering authority. <i>Note: This condition does not exempt the environmental authority holder from obtaining any approval required under other legislation to conduct a burn.</i>
E5	All regulated waste removed from the site must be removed by a person who holds a current approval to transport such waste under the provisions of the <i>Environmental Protection Act 1994</i>.
E6	Regulated waste must only be removed to a facility licensed under the <i>Environmental Protection Act 1994</i> to receive such waste.

Schedule F: Land	
Condition number	Condition
F1	Preventing contaminant release to land Contaminants must not be released to land in manner which constitutes nuisance, material or serious environmental harm.
F2	Storage and Spillage of Chemicals and Flammable or Combustible Liquids All flammable or combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm and maintained in accordance with the current version of AS 1940 - Storage and handling of flammable and combustible liquids.
F3	Spillage of all flammable and combustible liquids must be controlled in a manner that prevents environmental harm.
F4	Topsoil Topsoil must be strategically stripped ahead of exploration activity and stockpiled no more than 2 metres in height to preserve topsoil bio-organic integrity.
F5	Exploration The environmental authority holder is authorised to carry out exploration activities listed in Table 1 in and within 500m of any Category B Environmentally Sensitive Area. When carrying out exploration activities in and within 500m of any Category B Environmentally Sensitive Area the holder of the environmental authority must do so in accordance with conditions F6 to F22.
F6	In carrying out exploration activities on mining leases (ML) ML1790 and ML70495, all reasonable and practicable measures must be taken to prevent or minimise the likelihood of environmental harm being caused to any Category B Environmentally Sensitive Area (ESA).
F7	Exploration activities undertaken must be consistent with Figures 1 to 4 attached to this environmental authority.
F8	Exploration activities undertaken must be consistent with Control Strategies as outlined in Section 3 of the Environmental Management Plan for Wards Well, 2012.
F9	The operational area of individual drill sites must not exceed 1400 square metres.
F10	The construction of sumps must not exceed 12 square metres.
F11	Drill holes are to be a maximum of 400mm in diameter.
F12	Existing access and fence line tracks must be used wherever possible. New tracks must be constructed to a width of less than 5 metres.

F13	Authorised track construction involving blade clearing of established ground cover vegetation and/or clearing of mature trees is to be minimised in accordance with condition F13 .
F14	All new tracks are to be recorded with GPS in GDA94 coordinate system and records kept of their location and made available to the administering authority on request.
F15	Tracks should not be used when soil is saturated and prone to displacement or erosion by vehicle movement.
F16	All equipment such as earthmoving and drilling equipment must be used in a manner which prevents the spread of weeds and minimises unnecessary disturbance of topsoil and ground cover vegetation.
F17	Prior to entering the project area, all vehicles, machinery and equipment must be washed down in accordance with the latest version of the Queensland Department of Parks, Recreation, Sport and Racing (or its successor) checklist for clean down procedures.
F18	Campsites must not be established within a Category B Environmentally Sensitive Area or within 500m of a Category B Environmentally Sensitive Area.
F19	Sediment control barriers installed on ML1790 and ML70495 should be made of non-organic material to prevent the spread of weeds. <i>Note: For example, synthetic sediment fencing is to be used.</i>
F20	Rehabilitation of areas disturbed in Category B Environmentally Sensitive Area or within 500m of a Category B Environmentally Sensitive Area must commence as soon as practicable to the extent that erosion impacts are minimised, and be completed as soon as practicable but no longer than three (3) months after completion of the disturbance activity.
F21	An annual report must be prepared and submitted with each annual return. The report must include a map showing the location of completed drill holes authorised by this environmental authority, and include full details of progressive rehabilitation works completed to demonstrate compliance with condition F21 of this environmental authority. <i>Note: Progressive rehabilitation refers to pad by pad rehabilitation as practical.</i>
F22	Prescribed environmental matters – matters of State environmental significance Impacts to matters of State environmental significant (MSES) as a result of carrying out exploration activities must only occur to the maximum extent stated in Table F1 – Authorised residual impacts to MSES' and consistent with general exploration activities depicted in Figure 3 'Authorised impacts to MSES Regulated Vegetation' and Figure 4 'Authorised impacts to MSES Protected Wildlife Habitat'.
F23	All impacts to MSES must be determined, documented, and mapped by an appropriately qualified person.

F24	Records of impacts to MSES in condition F24 must be kept for the life of the environmental authority and include: a) The size and extent of impact; and b) Details about the condition of the MSES (e.g. dominant vegetation and remnant status); and c) A determination of whether the impact is a significant residual impact.
F25	PRCP Schedule Rehabilitation of the disturbed land must be carried out in accordance with the approved Progressive Rehabilitation and Closure Plan (PRCP) schedule for this environmental authority.
F26	Surrender The holder must meet the conditions and rehabilitation milestones under the PRCP schedule prior to the surrender of the environmental authority.

Table F1 'Authorised residual impact to prescribed environmental matters'

Prescribed environmental matters – matter of State environmental significance (MSES)	Location of impact	Offset requirements under Environmental Offsets Act 2014	Maximum extent of impact (ha)
Regulated vegetation – Endangered or Of Concern Regional Ecosystem			
Grassland Regional Ecosystem (11.8.11)	In accordance with Figure 3	No	0.28
Sparse Regional Ecosystem (11.3.4, 11.4.2)	In accordance with Figure 3	No	0
Dense / Mid Dense Regional Ecosystem (11.3.1, 11.9.5)	In accordance with Figure 3	No	0
Regulated Vegetation – Located in the defined distance from the defining banks of a watercourse			
Grassland Regional Ecosystem (11.8.11)	In accordance with Figure 3	No	0
Sparse Regional Ecosystem (11.3.4, 11.4.2)	In accordance with Figure 3	No	0
Dense / Mid Dense Regional Ecosystem (11.3.1)	In accordance with Figure 3	No	0
Protected Wildlife Habitat – Essential habitat for an endangered or vulnerable animal or plant			
<i>Dichanthium queenslandicum</i> (King Blue Grass)	In accordance with Figure 4	No	0.28
Protected Wildlife Habitat – A habitat for endangered or vulnerable wildlife or Special Least Concern animal			
Squatter Pigeon	In accordance with Figure 4	No	1.43
Grey Falcon	In accordance with Figure 4	No	1.50
Fork Tailed Swift	In accordance with Figure 4	No	1.50
Koala	In accordance with Figure 4	No	1.17
Greater Glider	In accordance with Figure 4	No	0.88
Short Beaked Echidna	In accordance with Figure 4	No	1.50
Ornamental Snake	In accordance with Figure 4	No	0.09

Schedule G: Community	
Condition number	Condition
G1	All complaints received must be recorded including investigations undertaken, conclusions formed and action taken. This information must be made available to the administering authority on request.
G2	The holder of this environmental authority must record the following details for all complaints received and provide this information to the administering authority on request: a) name, address and contact number for complainant (if not available; record 'not identified'); b) time and date of complaint; c) investigations undertaken; d) conclusions formed; e) actions taken to resolve complaint; f) any abatement measures implemented; and g) person responsible for resolving the complaint.
G3	When requested by the administering authority, the environmental authority holder must undertake relevant specified monitoring within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint of environmental harm at any sensitive place or commercial place. The results of the investigation (including an analysis and interpretation of the monitoring results) and abatement measures implemented must be provided to the administering authority within fourteen (14) days of completion of the investigation.

END OF CONDITIONS

Definitions

Key terms and/or phrases used in this document are defined in this section. Environmental authority holders should note that where a term is not defined, the definition in the *Environmental Protection Act 1994*, its regulations or environmental protection policies must be used. If a word remains undefined it has its ordinary meaning.

Accepted engineering standards in relation to dams, means those standards of design, construction, operation and maintenance that are broadly accepted within the profession of engineering as being good practice for the purpose and application being considered. In the case of dams, the most relevant documents would be publications of the Australian National Committee on Large Dams (ANCOLD), guidelines published by Queensland government departments, and relevant Australian and New Zealand Standards.

Acid rock drainage means any contaminated discharge emanating from a mining activity formed through a series of chemical and biological reactions, when geological strata is disturbed and exposed to oxygen and moisture as a result of mining activity.

Administering authority is the agency or department that administers the environmental authority provisions under the *Environmental Protection Act 1994*.

Airblast overpressure means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dBL).

Annual exceedance probability or AEP means the probability that at least one event in excess of a particular magnitude will occur in any given year.

ANZECC means the Australian and New Zealand Guidelines for Fresh Marine Water Quality 2000

Appropriately qualified person means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature.

Assessed or assessment by a suitably qualified and experienced person in relation to a consequence assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit of the assessment:

- a) exactly what has been assessed and the precise nature of that determination;
- b) the relevant legislative, regulatory and technical criteria on which the assessment has been based;
- c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts; and
- d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.

Authority means an environmental authority or a development approval.

Bed and banks for a waters, river, creek, stream, lake, lagoon, pond, swamp, wetland or dam means land over which the water of the waters, lake, lagoon, pond, swamp, wetland or dam normally flows or that is normally covered by the water, whether permanently or intermittently; but does not include land adjoining or adjacent to the bed and banks that is from time to time covered by floodwater.

Blasting means the use of explosive materials to fracture:

- a) rock, coal and other minerals for later recovery; or
- b) structural components or other items to facilitate removal from a site or for reuse.

Certification or certified by a suitably qualified and experienced person in relation to a design plan or an annual report regarding dams, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time:

- a) exactly what is being certified and the precise nature of that certification
- b) the relevant legislative, regulatory and technical criteria on which the certification has been based
- c) the relevant data and facts on which the certification has been based, the source of that material, and the efforts made to obtain all relevant data and facts
- d) the reasoning on which the certification has been based using the relevant data and facts, and the relevant criteria.

Chemical means:

- a) an agricultural chemical product or veterinary chemical product within the meaning of the *Agricultural and Veterinary Chemicals Code Act 1994 (Commonwealth)*; or
- b) a dangerous good under the dangerous goods code; or
- c) a lead hazardous substance within the meaning of the *Workplace Health and Safety Regulation 1997*; or
- d) a drug or poison in the Standard for the Uniform Scheduling of Drugs and Poisons prepared by the Australian Health Ministers' Advisory Council and published by the Commonwealth; or
- e) any substance used as, or intended for use as:
 - i. a pesticide, insecticide, fungicide, herbicide, rodenticide, nematocide, miticide, fumigant or related product; or
 - ii. a surface active agent, including, for example, soap or related detergent; or
 - iii. a paint solvent, pigment, dye, printing ink, industrial polish, adhesive, sealant, food additive, bleach, sanitiser, disinfectant, or biocide; or
 - iv. a fertiliser for agricultural, horticultural or garden use; or
- f) a substance used for, or intended for use for:
 - i. mineral processing or treatment of metal, pulp and paper, textile, timber, water or wastewater; or
 - ii. manufacture of plastic or synthetic rubber.

Commercial place means a work place used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employees accommodation or public roads.

Construction or constructed in relation to a dam includes building a new dam and modifying or lifting an existing dam, but does not include investigations and testing necessary for the purpose of preparing a design plan.

Contaminate means to render impure by contact or mixture.

Contaminated means the substance has come into contact with a contaminant.

Contaminant can be

- a) a gas, liquid or solid; or
- b) an odour; or
- c) an organism (whether alive or dead), including a virus; or
- d) energy, including noise, heat, radioactivity and electromagnetic radiation; or
- e) a combination of contaminants.

Dam means a land-based structure or a void that contains, diverts or controls flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works.

Design plan is a document setting out how all identified consequence scenarios are addressed in the planned design and operation of a regulated structure.

Design storage allowance or DSA means the minimum storage required in a dam at the first of November each year in order to meet the hydraulic performance requirements.

Disturbance of land includes:

- a) compacting, removing, covering, exposing or stockpiling of earth;
- b) removal or destruction of vegetation or topsoil or both to an extent where the land has been made susceptible to erosion;
- c) carrying out mining within a watercourse, waterway, wetland or lake;
- d) the submersion of areas by tailings or hazardous contaminant storage and dam/structure walls;
- e) temporary infrastructure, including any infrastructure (roads, tracks, bridges, culverts, dam/structures, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc.) which is to be removed after the mining activity has ceased; or
- f) releasing of contaminants into the soil, or underlying geological strata.

However, the following areas are not included when calculating areas of disturbance:

- a) areas off lease (e.g. roads or tracks which provide access to the mining lease);
- b) areas previously disturbed which have achieved the rehabilitation outcomes;
- c) by agreement with the administering authority, areas previously disturbed which have not achieved the rehabilitation objective(s) due to circumstances beyond the control of the mine operator (such as climatic conditions);
- d) areas under permanent infrastructure. Permanent infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dam/structures, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc.) which is to be left by agreement with the landowner; or
- e) disturbance that pre-existed the grant of the tenure.

Effluent means treated waste water released from sewage treatment plants.

Environmental authority means an environmental authority granted in relation to an environmentally relevant activity under the *Environmental Protection Act 1994*.

Environmental authority holder means the holder of this environmental authority.

Environmentally relevant activity means an environmentally relevant activity as defined under section 18 of the *Environmental Protection Act 1994*.

Flowable substance means matter or a mixture of materials that can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.

General waste means waste other than regulated waste.

Hazard in relation to a dam as defined, means the potential for environmental harm resulting from the collapse or failure of the dam to perform its primary purpose of containing, diverting or controlling flowable substances.

Hazard category means a category, either low significant or high, into which a dam is assessed as a result of the application of tables and other criteria in the Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland (DME 1995).

Hydraulic performance means the capacity of a regulated dam to contain or safely pass flowable substances based on the probability (AEP) of performance failure specified for the relevant hazard category in the *Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland* (DME 1995).

Infrastructure means water storage dams, roads and tracks, buildings and other structures built for the purpose of mining activities but does not include other facilities required for the long-term management of mining impacts or the protection of potential resources. Such other facilities include dams, waste rock dumps, voids, or ore stockpiles and buildings as well as other structures whose ownership can be transferred and which have a residual beneficial use for the next owner of the mining leases or the background land owner.

L_{A10}, adj, 10 mins means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period, using Fast response.

L_{A1}, adj, 10 mins means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10 minute measurement period, using Fast response.

Land in the “land schedule” of this document means land excluding waters and the atmosphere.

Mandatory reporting level or MRL means a warning and reporting level determined in accordance with the criteria in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (Version 4, 10 April 2014)* (EM635) published by the administering authority.

Mature trees means any tree relevant to the tenure that is classified as a commercial sized tree by the *Code of Practice for Native Forest Timber Production 2002*

mg/L means milligrams per litre.

Native vegetation means vegetation that occurs naturally in a certain area.

Mining operations authorised activities-

- a) Including mine construction, resource extraction, mineral processing, mine site management, rehabilitation and decommissioning.
- b) Excluding exploration activities detailed in the current ERC.
 - i. Exploration activities do not include activities involved in the combined bulk sampling area.

Operational land means the land associated with the project for which this environmental authority has been issued.

Peak particle velocity or ppv means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mm/s).

Progressive rehabilitation means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining operations are ongoing.

Receiving environment, in relation to an activity that causes or may cause environmental harm, means the part of the environment to which the harm is, or may be, caused. The receiving environment includes (but is not limited to):

- a) a watercourse;
- b) groundwater;
- c) land; and
- d) sediments.

Receiving waters means the waters into which this environmental authority authorises releases of mine affected water.

Regulated dam means any dam in the significant or high hazard category as assessed using the *Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland* (DME 1995).

Regulated waste is defined in the *Environmental Protection Regulation 2008*.

Rehabilitation means the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

Representative means a sample set that covers the variance in monitoring or other data due to either natural changes or operational phases of the mining activities.

Saline drainage is the movement of waters, contaminated with salt(s), as a result of the mining activity.

Scheme fund means the scheme fund established under section 24 of the *Mineral and Energy Resources (Financial Provisioning) Act 2018*.

Self-sustaining means an area of land which has been rehabilitated and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.

Sensitive place means:

- a) a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- b) a motel, hotel or hostel; or
- c) an educational institution; or
- d) a medical centre or hospital; or
- e) a protected area; or
- f) a public park or gardens.

Sewage means the used water of persons to be treated at a sewage treatment plant.

Stable in relation to land, means land form dimensions are or will be stable within tolerable limits now and in the foreseeable future. Stability includes consideration of geotechnical stability, settlement and consolidation allowances, bearing capacity (trafficability), erosion resistance and geochemical stability with respect to seepage, leachate and related contaminant generation.

Stormwater means all surface water runoff from rainfall.

Suitably qualified and experienced person in relation to dams means one who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the Professional Engineers Act 2002, OR registered as a National Professional Engineer (NPER) with the Institution of Engineers Australia, OR holds equivalent professional qualifications to the satisfaction of the administering authority for the Act; AND the administering authority for the Act is satisfied that person has knowledge, suitable experience and demonstrated expertise in relevant fields, as set out below:

- a) knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impact of dams
- b) a total of five years of suitable experience and demonstrated expertise in at least four of the following categories, with the 'geomechanics of dams' category being compulsory:
 - i. geomechanics of dams with particular emphasis on stability, geology and geochemistry
 - ii. investigation, design or construction of dams
 - iii. operation and maintenance of dams
 - iv. hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology
 - v. hydraulics with particular reference to sediment transport and deposition, erosion control, beach processes
 - vi. hydrogeology with particular reference to seepage, groundwater
 - vii. solute transport processes and monitoring thereof
 - viii. dam safety

The Act means the *Environmental Protection Act 1994*.

Waste as defined in section 13 of the *Environmental Protection Act 1994*.

Waste and resource management hierarchy has the meaning given by section 9 of the *Waste Reduction and Recycling Act 2011*.

Water quality means the chemical, physical and biological condition of water.

Waters includes all or any part of a river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water in natural or artificial watercourses, bed and banks of a watercourse, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater.

µg/L means micrograms per litre.

µS/cm means microsiemens per centimetre.

END OF DEFINITIONS

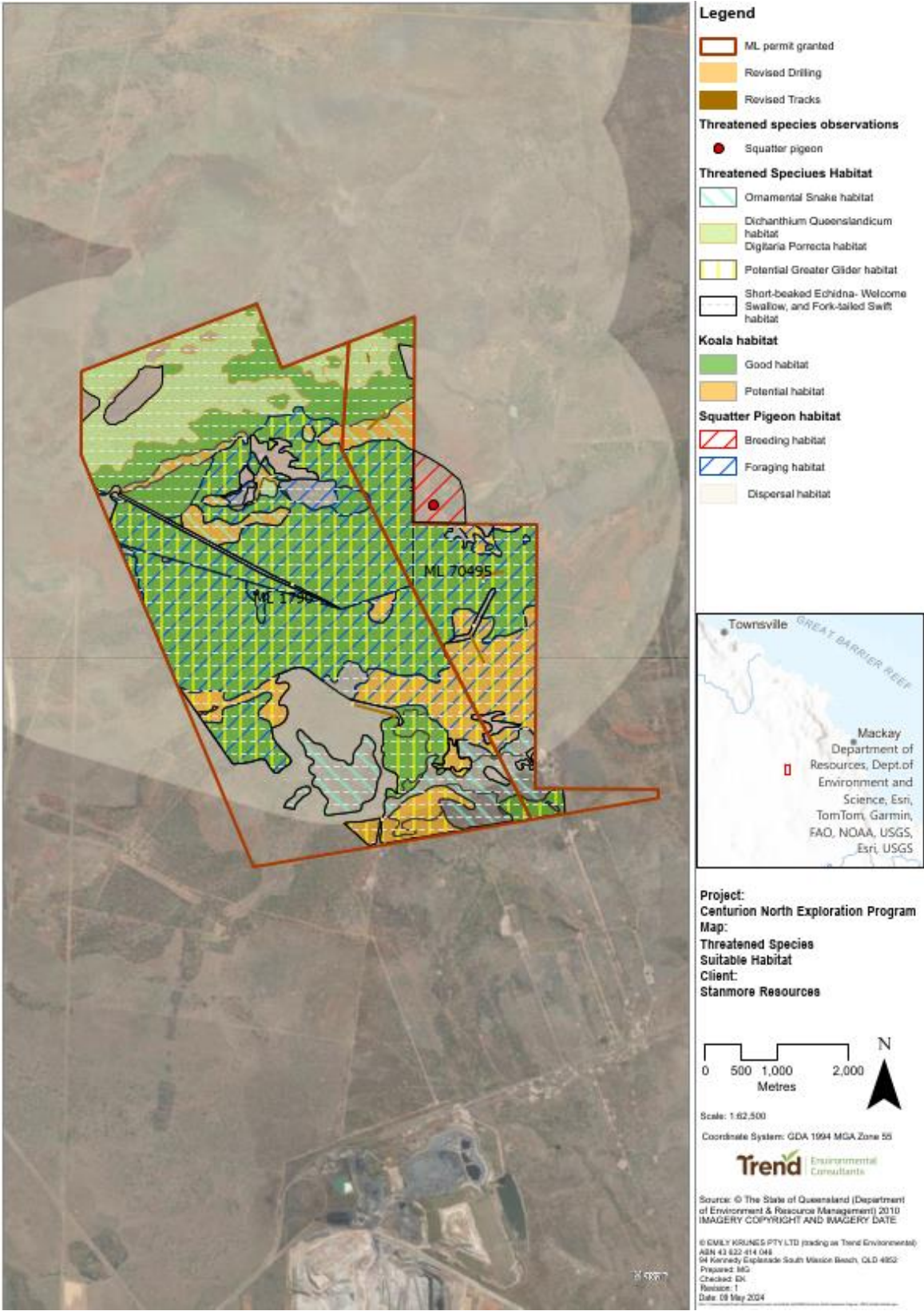
Figure 1: Location of Exploration and Mineral Development Activities



Figure 2: Wards Well Mining Tenements



Figure 4: Authorised impacts to MSES Protected Wildlife Habitat



END OF ENVIRONMENTAL AUTHORITY

Notice

Environmental Protection Act 1994

Correction of a clerical or formal error in an environmental authority

This statutory notice is issued by the administering authority¹ to advise you that your environmental authority has been amended under section 211 of the Environmental Protection Act 1994 to correct a clerical or formal error.

Centurion Coal Mining Pty Ltd
Level 14, 31 Duncan Street
Fortitude Valley QLD 4006
By email transmission only
Email: mgibbons@peabodyenergy.com

Our reference: P-EA-100658713

Attention: Marianne Gibbons

Amendment of an environmental authority to correct a clerical or formal error

1. Permit details

Environmental authority number P-EA-100658713 dated 3/09/2024.

Land description: ML1790, ML70495.

2. Amendment

The administering authority has become aware that there is a formal error on the environmental authority that requires correction. These corrections are minor in nature and will not adversely impact your or anyone else's interests. As a result, the following amendments have been made to your environmental authority:

The company name Stanmore SMC Pty Ltd was changed to Centurion Coal Mining Pty Ltd. The registered address was changed from Level 32, 12 Creek Street, Brisbane City, QLD 4100 to Level 14, 31 Duncan Street, Fortitude Valley QLD 4006.

The amended environmental authority is enclosed with this notice

3. Human rights

A human rights assessment was carried out in relation to this decision/action, and it was determined that:

No human rights were engaged by the decision / action.

Should you have any questions in relation to this notice, please contact Business Centre Coal on telephone (07) 4987 9320.

¹ The Department of Environment and Science is the administering authority under the *Environmental Protection Act 1994*.

Correction of a clerical or formal error in an environmental authority



Signature

11 September 2024

Date

Cate Puschmann
Department of Environment and Science
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Business Centre Coal
PO Box 3028, Emerald QLD 4720
Phone: (07) 4987 9320
Email: CRMining@des.qld.gov.au

APPENDIX 2

GOLDER ASSOCIATES (23 DECEMBER 2020): WARDS WELL MINE – PRCP HYDROGEOLOGICAL
CONCEPTUAL MODEL. REF. NO. 20360652-001-R-REVA



REPORT

Wards Well Mine - Progressive Rehabilitation and Closure Plan

Hydrogeological Conceptual Model

Submitted to:

Matthew Chenery

Water Planning Team

480 Queen Street

Brisbane, QLD 4000

Australia

Submitted by:

Golder Associates Pty Ltd

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20360652-001-R-Rev0

23 December 2020

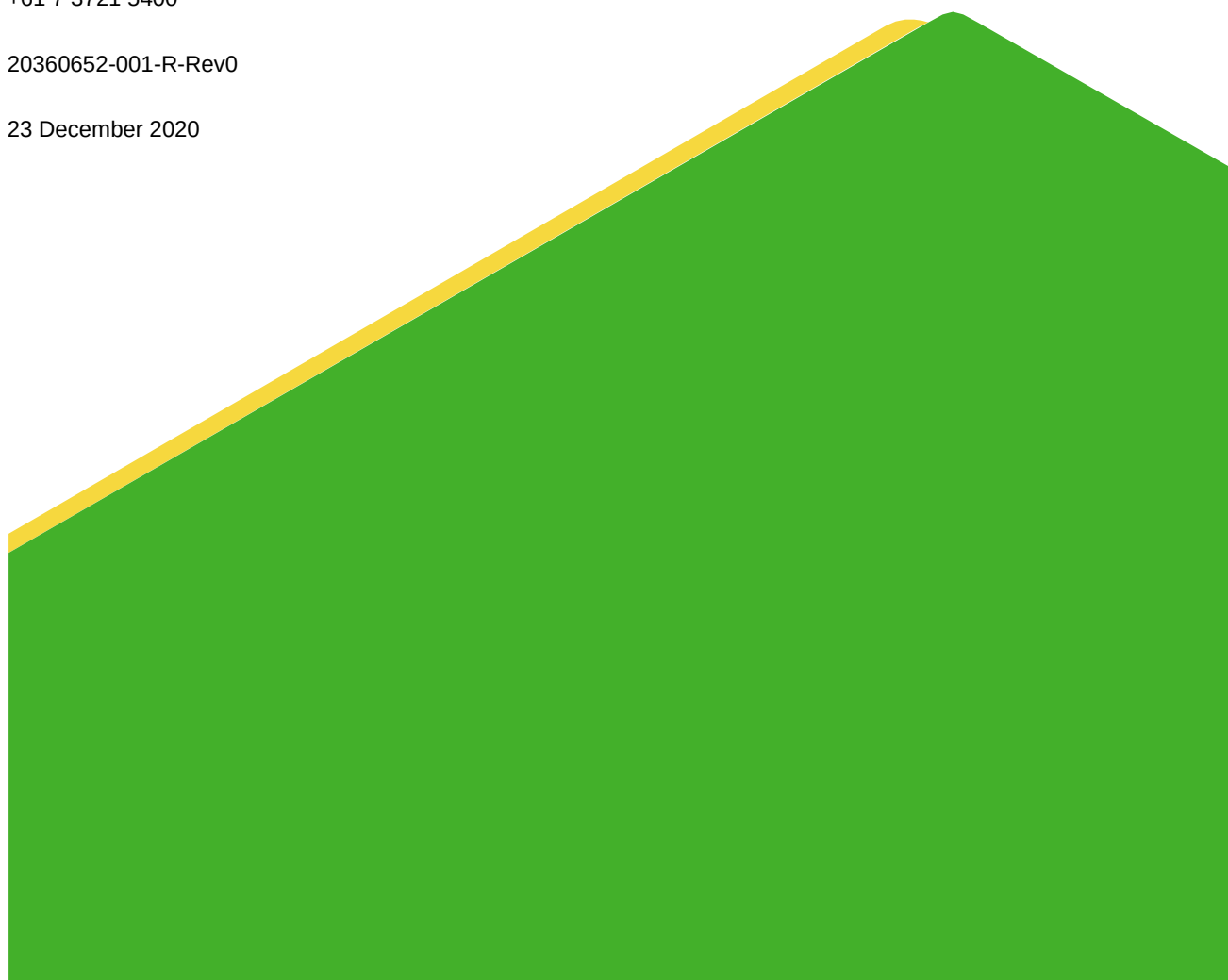


Table of Contents

1.0 INTRODUCTION	1
2.0 BACKGROUND	1
3.0 SCOPE OF WORK.....	1
4.0 LEGISLATIVE FRAMEWORK.....	2
5.0 EXISTING ENVIRONMENT	7
5.1 Location and Land Use	7
5.2 Climate	7
5.3 Topography and Drainage	10
6.0 BASELINE HYDROGEOLOGICAL CONCEPTUAL MODEL.....	10
6.1 Desktop Review	10
6.2 Geological Setting	11
6.2.1 Regional setting	11
6.2.2 Depositional Setting	11
6.3 Hydrogeological Setting	15
6.4 Hydrostratigraphy	15
6.4.1 Quaternary Alluvium.....	15
6.4.2 Tertiary Strata	15
6.4.3 Permian Strata	17
6.5 Structural Influence on Groundwater Flow.....	17
6.6 Hydraulic Parameters.....	17
6.7 Groundwater Level Variations.....	21
6.8 Aquifer Recharge and Discharge	24
6.9 Groundwater Quality	24
6.10 Environmental Values	25
6.10.1 Groundwater Use	26
6.10.2 Groundwater Dependent Ecosystems	26
7.0 QUALITATIVE RISK ASSESSMENT	29
7.1 Identification of system elements	31
7.2 Post-mining hydrogeological conceptual model.....	32

7.3	Qualitative risk assessment under post-mining conditions	34
8.0	CONCLUSIONS	37
9.0	IMPORTANT INFORMATION	37
10.0	REFERENCES	37

TABLES

Table 1:	Land use within 10 km of exploration box cut	7
Table 2:	Reviewed information and sources	10
Table 3:	Pumping Test Data Analysis PB03 (AGE, 2012)	18
Table 4:	Pumping Test Data Analysis PB01 and PB02 (AGE, 2012)	19
Table 5:	Hydraulic Properties of the Permian Strata	20
Table 6:	Estimated annual recharge rate for the Wards Well and Lancewood mining leases (AGE, 2012)	24
Table 7:	Risk Matrix	36

FIGURES

Figure 1:	Water Management Areas	6
Figure 2:	Average monthly rainfall over the period 2012 to 2020 (station number 34035, BOM 2020a)	8
Figure 3:	Site Location	9
Figure 4:	Solid Geology and Structures	13
Figure 5:	Detailed Surface Geology	14
Figure 6:	Baseline Hydrogeological Conceptual Model (BHCM) <i>Blue arrows show likely groundwater flow directions, with the size of the arrow reflecting the magnitude of groundwater flux.</i>	16
Figure 7:	Groundwater Level Hydrographs. VVPs tapping Permian strata are shown on the graph to the left and monitoring bores tapping basalt and sediments shown on the right.	22
Figure 8:	Potentiometric Surface - Tertiary Basalt Aquifer	23
Figure 9:	Piper Plot - Tertiary Basalts Water Quality	25
Figure 10:	Groundwater Dependent Ecosystems and Registered Bores within 10 km of the Exploration Box Cut	28
Figure 11:	Assumed temporal evolution of the site (time scale is provisional). The purple rectangle shows the time period of the assessment presented in this report.	30
Figure 12:	Qualitative hydrogeological conceptualisation of the post-mining conditions. <i>Blue arrows show likely groundwater flow directions, with the size of the arrow reflecting the magnitude of groundwater flux.</i>	33
Figure 13:	Adopted risk matrix: likelihood vs. consequence	35

APPENDICES

APPENDIX A

Wards Well Groundwater Monitoring Network Construction Details

APPENDIX B

Groundwater Quality Table

APPENDIX C

Important Information

1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) was commissioned by BHP Billiton Mitsui Coal Pty Ltd (BMC) to develop a qualitative hydrogeological conceptual model (HCM) for the Wards Well site, which will inform the site Progressive Rehabilitation and Closure Plan (PRCP). The HCM addresses hydrogeology requirements described within the Department of Environment and Science (2019) Guideline – Progressive Rehabilitation and Closure Plans (PRC Plans). The information provided herein will be used to assist in development of the PRCP associated with Environmental Authority (EA) number EPPR00668513 for the Wards Well Mine.

2.0 BACKGROUND

The Wards Well mine (the site) is situated in the north-western reaches of the Bowen Basin, approximately 30 km south of the town of Glenden and to the north of the North Goonyella Mine.

The Department of Environment and Science issued a Guidelines for Progressive Rehabilitation and Closure Plans (PRCP) on 1 November 2019 (Guideline). The PRCP is a fundamental element of the Queensland Government's Mined Land Rehabilitation Policy. Holders of an existing EA are notified by the administering authority to develop and submit a PRCP to the Department of Environment and Science. The PRCP replaces the rehabilitation requirements in an EA and defines progressive rehabilitation plans throughout the life of the mine.

3.0 SCOPE OF WORK

Golder has been tasked with the compilation and interpretation of groundwater conditions at Wards Well to support the development of the PRCP. The following are the primary objectives to address hydrogeological requirements described within the DES (2019) Guideline:

- Objective 1: Undertake a baseline conceptual hydrogeological assessment.
- Objective 2: Complete a qualitative risk assessment of post mining hydrogeological conditions.

A review of historical data and reports has been completed using information provided to Golder by BMC supplemented with publicly available data and maps.

Objective 1 includes the development of a baseline hydrogeological conceptual model (BHCM). A hydrogeological conceptual model is a descriptive representation of a groundwater system that incorporates knowledge and interpretation of the geological, hydrological and hydrogeological conditions (Anderson and Woessner, 1992; Barnett et al., 2012). The conceptual model works to consolidate the hydrogeological understanding of key processes, such as recharge and discharge, and the influence of boundaries and stresses that may be present in the system. For the purposes of this project, the hydrogeological conceptual model will include a detailed summary of each of the system components and main hydrogeological processes. The BHCM represents the baseline conditions of the Wards Well site prior to mining and is presented both schematically and with detailed written descriptions of each of the system components.

Objective 2 includes a qualitative risk assessment, which estimates potential impacts to the groundwater system as a result of the mining activities described in the Environmental Authority (EA). The risk assessment has been carried out as per the AS ISO 31000:2018 Risk Management – Guidelines (Standards Australia, 2018) and includes the following steps:

- 1) Risk identification,
- 2) Risk analysis,
- 3) Risk evaluation, and

4) Risk treatment.

The most probable scenario at the point of mine closure (i.e. the scenario with the highest likelihood of occurrence) has been defined based on expert opinion. An exposure pathway assessment has been completed for that most probable closure scenario, which defines the complete and incomplete pathways to qualitatively evaluate likely impacts to the relevant identified receptors.

4.0 LEGISLATIVE FRAMEWORK

The primary legislative requirements relating to the project are summarised below.

Environmental Protection Act 1994

The *Environmental Protection Act 1994* (Qld) (EP Act) was put in place to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The EP Act states that any undertaking of an environmentally relevant activity (ERA), such as resource activities (mining or petroleum and gas), requires an Environmental Authority (EA). The EA describes legislative requirements and conditions requiring the holder to conduct the ERA in an environmentally responsible manner. The Wards Well mine development is subject to conditions described in EA EPPR00668513 issued by the Department of Environment and Heritage Protection (now Department of Environment and Science), which took effect on 25 January 2018. Under EA EPPR00668513, the approved activities at Wards Well include the following:

- Exploration and drilling: drill holes and pads, LOX line drilling, and 3D seismic survey program,
- Exploration box cut,
- Underground exploration entry point and in seam sampling,
- Mine water dam and stormwater dam,
- Mineral extraction and processing: topsoil stockpiles and overburden dump (temporary, to be used to backfill box cut with the exception of approximately 1.5 m high stockpile of residual matter),
- Run of mine and product stockpile (up to 250,000 tonnes),
- Ancillary infrastructure: industrial area/workshop, administration, petroleum storage, laydown areas, sewage treatment and roads, and
- Accommodation within an exploration fly camp.

Under the EA, any exploration activities on mining leases (ML) ML4752, ML1790, ML70443 and ML70495 must be carried out using all reasonable and practical measures to prevent or minimise the likelihood of environmental harm being caused to any Environmentally Sensitive Area (ESA).

Mineral and Energy Resources (Financial Provisioning) Act 2018

In an effort to improve rehabilitation and financial assurance outcomes in the resources sector, the Queensland Government has released the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (Qld) (MERFP Act). The MERFP Act was passed on 30 November 2018 and established the following key changes in legislation:

- 1) The MERFP Act replaces the financial assurance arrangements for resource activities under the Environmental Protection Act 1994 with a new financial provisioning scheme,

- 2) Changes how the estimated rehabilitation cost for an environmental authority (EA) is calculated, and
- 3) Amends the EP Act to introduce new requirements for the progressive rehabilitation and closure of mined land.

A critical element of the Queensland Government's Mined Land Rehabilitation Policy is the Progressive Rehabilitation and Closure Plan (PRCP). Under new legislation, EA applicants are required to develop and submit a proposed PRC plan as part of their application. The MERFP Act also describes transitional provisions for the application of the PRC plan requirement concerning existing mines. Holders of an existing EA are issued with a notice specifying a start date by which a PRCP must be developed and submitted to the Department of Environment and Science (the administering authority). Such a notice was issued to BMC for the Wards Well project, stating that the EA holder must submit a proposed PRC plan to the administering authority by 26 February 2021.

The primary purposes of the PRCP are as follows:

- To require the holder of an EA to plan for how and where activities will be carried out on land in a way that maximises the progressive rehabilitation of the land to a stable condition and
- To provide for the condition to which the holder must rehabilitate the land before the EA may be surrendered.

Water Act 2000

The *Water Act 2000* (Qld) (Water Act) is the primary legislation surrounding the sustainable management of water and the management of impacts on underground water. The Water Act is enacted under a water planning framework, which is used to sustainably manage and allocate water resources in Queensland. Water resource plans (WRPs) are developed based on technical assessments using environmental, economic, social, hydrologic and cultural data to determine the amount and type of water available so that water can be shared sustainably. WRPs include specification of Groundwater Management Areas (GMAs), which have been established for the protection and management of underground water resources.

The majority of the Wards Well site is located within sub-catchment area E in the eastern portion of the Water Plan (Burdekin Basin) 2007 area. Sub-catchment area E is not a defined water management zone within the Burdekin Basin. However, there is a declared underground water area intersecting the south western portion of the site: Highlands Underground Water Area (CAS2055). Section 1046(1) of the Water Act states that declared underground water areas may be subject to the following regulations:

- Regulate the taking of, or interfering with, underground water; and
- State the types of works for taking or interfering with underground water that are assessable development or accepted development of the Planning Act.

Water Regulation 2016¹, which describes the relevant legislation surrounding declared underground water areas, states that the Highlands Underground Water Area does not require water entitlement, water permit or seasonal water assignment notice for stock or domestic purposes or a prescribed activity. Prescribed activities in the context of mining operations include:

- Washing down equipment, plant, or vehicles,

¹ Water Regulation 2016 is a supplemental piece of legislation which prescribes administrative and operations matters for the Water Act 2000.

- Supplying water for temporary camps or living quarters for staff, for example, for operating toilets, showers, kitchens, or laundries,
- Construction works, infrastructure or plant that are temporary and reasonably necessary for, or incidental to, carrying on mining under a mining lease granted under the Mineral Resources Act,
- Constructing, but not maintaining, roads with the area of a mineral development licence, or mining lease, granted under the Mineral Resources Act,
- The following activities in relation to pumps, wells, or bores –
 - Constructing or drilling (including site establishment and rehabilitation and drill bit lubrication),
 - Proving supply,
 - Testing water quality,
 - Flushing out
- Rehabilitation of riparian land.

Any dewatering requirements occurring within the bounds of the Highlands Underground Water Area will be subject to obtainment of a water entitlement, water permit or seasonal water assignment notice.

The south eastern portion of the Wards Well site falls within the Isaac Connors GMA as defined by the Water Resource (Fitzroy Basin) Plan 2011 (Fitzroy Basin WRP). The Isaac Connors GMA consists of two groundwater units:

- Unit 1 – Quaternary alluvium aquifers
- Unit 2 – Subartesian aquifers (all aquifers other than those classified as Unit 1)

Surface water resources in the southern portion of the Wards Well site also fall into the Isaac Connors Water Management Area under the Fitzroy Basin WRP.

Environmental Protection Policy (Water and Wetland Biodiversity) 2019

The purpose of the Environmental Protection Policy (Water and Wetland Biodiversity) 2019 (EPP) is to protect Queensland's waters while supporting ecologically sustainable development. The policy replaces previous legislation [Environmental Protection (Water) Policy 2009] but does not contain any significant policy changes from expired legislation. The purpose of the EPP is to achieve the following:

- Identify environmental values or waters and wetlands to be enhanced or protected
- Identify management goals for waters
- State water quality guidelines and water quality objectives (WQOs) for enhancing or protecting the environmental values of waters
- Providing a framework for making consistent, equitable and informed decisions about waters, and
- Monitoring and reporting of the condition of waters.

The majority of the Wards Well site lies within the Suttor Catchment of the Burdekin Basin, which currently lacks established environmental values (EVs) and WQOs. However, a Water Quality Improvement Plan (WQIP) has been established for the Burdekin Dry Tropics Natural Resource Management (NRM) region, which supports and guides decision making and investment around protection of local ecosystems as they relate to water quality. The plan addresses human activities in the region which have the potential to have a

major influence on regional water quality (NQ Dry Tropics, 2016). The WQIP has been developed to address requirements for Healthy Waters Management Plans (HWMP) specified in Section 24 of the EPP.

Draft EVs for groundwater resources within the Suttor Catchment of the Burdekin Basin described in the WQIP include the following:

- Irrigation
- Farm water supply
- Stock water
- Drinking water
- Industrial use

Guidelines for EVs of groundwater associated with aquatic ecosystems are currently being developed and as such are not included in the above list (NQ Dry Tropics, 2016).

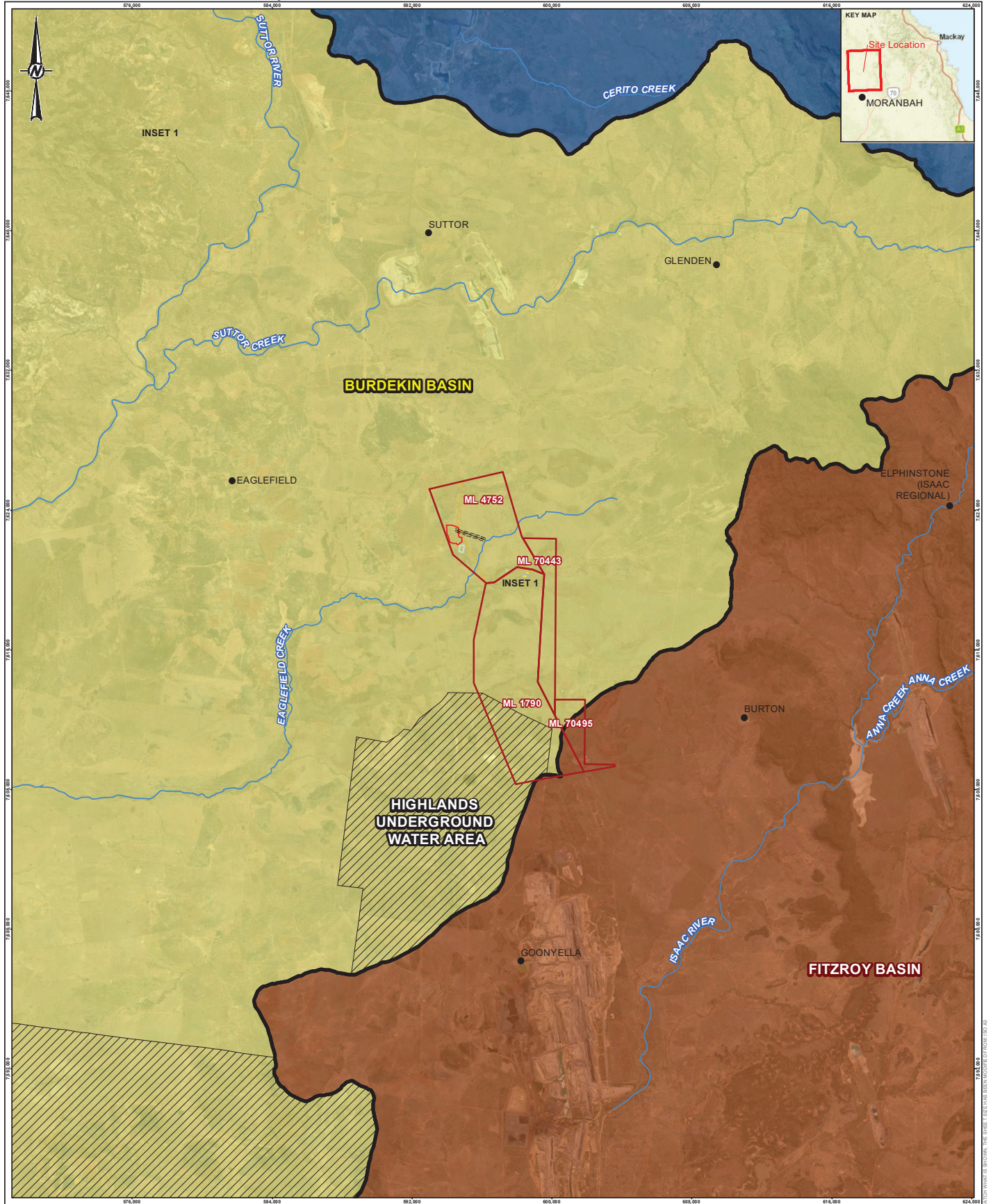
The southern portion of the site lies within the Fitzroy Basin WRP. Groundwater resources in the southern portion of the site are subsequently scheduled under the EPP as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301) and are subject to EVs and WQOs outlined in this plan.

The following EVs are associated with groundwaters within the Isaac River Sub-basin:

- Aquatic ecosystems
- Irrigation
- Farm water supply
- Stock water
- Primary Recreation
- Drinking Water
- Industrial Use
- Cultural and spiritual values

The EPP prescribes water quality guidelines (quantitative measures or statements of indicators) for the protection of EVs of groundwater. Water quality guidelines are decided based on site specific documents for water, such as the NQ Dry Tropics WQIP, or other published information including the Australian and New Zealand guidelines for fresh and marine water quality (ANZECC & ARMCANZ, 2018), the Australian drinking water guidelines (ADWG) (NHMRC, 2011), and Guidelines for managing risks in recreational waters (NHMRC, 2008).

Water management areas are displayed in Figure 1.



LEGEND

- Place Names
- Watercourse
 - Major
- Wards Well EA Approved Activities
 - Administrative Area
 - Box Cut Area
 - Industrial Area
 - Seismic Investigation Area
 - Storm Water Dam
 - Underground Exploration
- Declared Underground Water Areas
- Catchment Boundary
- Water Plan Catchments
 - Subcatchment
 - Bowen River
 - Isaac-Connors Rivers
 - Sutor River

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
BHP BILLITON MITSUI COAL PTY LTD (BMC)

CONSULTANT



DD-MM-YYYY	16-12-2020
DESIGNED	HG
PREPARED	HG
REVIEWED	TRE
APPROVED	TRE

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Place Names, Watercourse, Mining Lease Tenements: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019 - 2020 2. Water Plan Catchments, Declared Underground Water Areas: © State of Queensland (Department of Natural Resources, Mines and Energy) 2020 3. Wards Well EA Approved Activities: BMC, 2020

PROJECT
WARDS WELL MINE PROGRESSIVE REHABILITATION AND CLOSURE PLAN - HYDROGEOLOGICAL CONCEPTUAL MODEL

TITLE
WATER MANAGEMENT AREAS

PROJECT NO.	CONTROL	REV.	FIGURE
20360652	001	0	1

5.0 EXISTING ENVIRONMENT

5.1 Location and Land Use

The Wards Well project site is located near the western extent of the Bowen Basin in Central Queensland, approximately 50 km northwest of Moranbah. The project area comprises four mining leases, including: ML1790, ML4752, ML70443, and ML 70495. The majority of the exploration activities, including the box cut and underground bulk sampling areas fall within the Lancewood Mining Lease (ML4752).

The site location is displayed in Figure 3.

Spatial land use data was acquired from the Department of Environment and Science (DES, 2020) to assess primary land use types in the vicinity of the Wards Well site. Land use in the proposed exploration areas is primarily production from relatively natural environments, including grazing native vegetation, with some localised areas of intensive uses, including residential and farm infrastructure. A statistical breakdown of land use by proportional area is provided in Table 1.

Table 1: Land use within 10 km of exploration box cut

Land Use (Tertiary)	Percent Total Area (%)
Grazing Native Vegetation	99.01
Marsh / wetland (production)	0.66
Farm buildings / infrastructure	0.08
Water storage – intensive use / farm dams	0.08
Mines	0.08
Other minimal use	0.06
Rural residential without agriculture	0.03
Tailings	0.01

Note: Land use is classified according to the Australian Land Use and Management Classification (ALUMC) for the Burdekin NRM Region (DES, 2020)

5.2 Climate

The Central Queensland climate is classified as semi-arid and is characterised by warm, dry winters and hot, humid summers. Almost all rainfall occurs during the wet season, between the months of November and April (BOM, 2020a). Daily rainfall records since 2012 are available from the Moranbah Airport weather station (No. 34035), located approximately 50 km south of the site. The yearly distribution of average monthly rainfall is presented in Figure 2. The average annual rainfall (using rainfall data from 2012 to 2020) is approximately 529 millimetres per year (mm/yr).

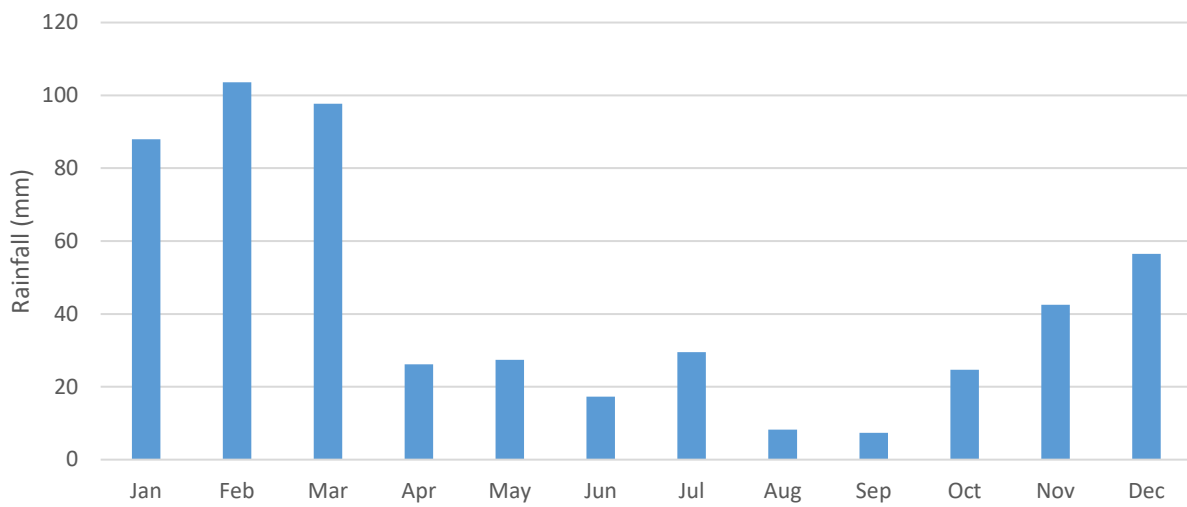
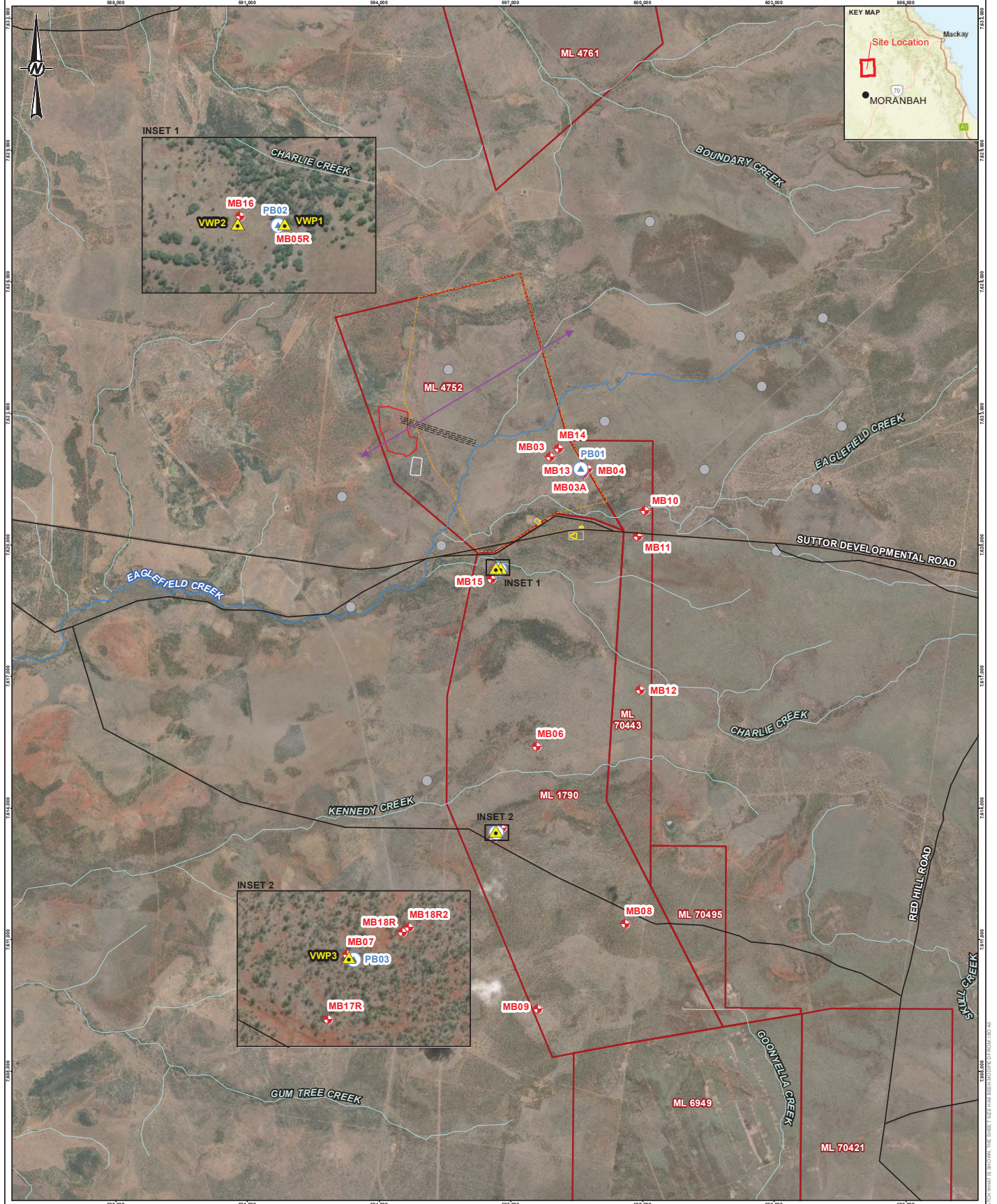


Figure 2: Average monthly rainfall over the period 2012 to 2020 (station number 34035, BOM 2020a)



LEGEND

	Monitoring Bore		Wards Well EA Approved Activities
	Pumping Bore		Administrative Area
	VWP		Box Cut Area
	Registered Bore		Industrial Area
	Roads and Tracks		Seismic Investigation Area
	Watercourse		Storm Water Dam
	Major		Underground Exploration
	Minor		Mining Lease Tenement
	Conceptual Cross-Section		

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

0 1,000 2,000 3,000
1:80,000 @ A3 METRES

CLIENT
BHP BILLITON MITSUI COAL PTY LTD (BMC)

CONSULTANT



DD-MM-YYYY	14-12-2020
DESIGNED	HG
PREPARED	HG
REVIEWED	TRE
APPROVED	TRE

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGSC, (c) OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Roads and Tracks, Watercourse, Topography, Mining Lease Tenements: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019 - 2020
2. Registered Bore: Bureau of Meteorology Groundwater Bore Database, 2020
3. Wards Well EA Approved Activities: BMC, 2020

PROJECT
WARDS WELL MINE PROGRESSIVE REHABILITATION AND CLOSURE PLAN - HYDROGEOLOGICAL CONCEPTUAL MODEL

TITLE
SITE LOCATION

PROJECT NO.	CONTROL	REV.	FIGURE
20360652	001	0	3

5.3 Topography and Drainage

The topography of the project area generally slopes from the north west to south east, with elevations typically ranging between RL 300 and RL 380 m. Topographic highs occur in the north west of the mining lease, near the location of the exploration box cut. Two shallow valleys associated with Eaglefield Creek and Kennedy Creek run broadly east to west through the central portion of the mining lease area, sloping to the west.

Three major creek systems exist within the project area, including Eaglefield Creek in the north, Charlie Creek in the centre and Kennedy Creek in the south. The creeks and associated tributaries are ephemeral, with flow occurring only after periods of intense rainfall during wetter summer months. These creek systems discharge towards the Suttor River, which is situated to the west of the mining lease.

The southern portion of the site is located on the edge of the Fitzroy Basin, within the Upper Isaac River catchment fresh waters. The headwaters of Goonyella Creek are located in the south eastern portion of ML1790, with surface water flowing south towards the Isaac River.

Ephemeral creeks and associated tributaries are displayed in Figure 3.

6.0 BASELINE HYDROGEOLOGICAL CONCEPTUAL MODEL

6.1 Desktop Review

A conceptual understanding of the existing hydrogeological environment at the Wards Well site was developed through a desktop review of existing reports and data. The desktop review included information provided in Table 2.

Table 2: Reviewed information and sources

Topic	Data	Source
Environmental Legislation	- Progressive Rehabilitation and Closure Plan Notice (2020) - Environmental Authority (EA) – EPPR00668513 (2018)	Provided to Golder by BMC, September 2020
Historic Reports	- Wards Well Environmental Impact Study, Groundwater Assessment (AGE, 2012) - Geochemical Assessment of Potential Coal Reject and Spoil Materials, Wards Well Project (RGS Terrenus, 2012) - Summary Report – Assessment of Groundwater Monitoring Bore BHP Wards Well (4T Consultants, 2019) - Wards Well Project Groundwater Monitoring Network Review (SLR, 2019) - Prediction of Water Inflows to Broadmeadow Mine and Recommended Pumping Capacity (Seedsman Geotechnics, 2015) - Wards Well Planned Hydro Geophysics Requirements (BHP, 2017)	Provided to Golder by BMC, September 2020
	Wards Well Water Management Options Assessment (Golder, 2017)	Historic Golder Report, accessed from Golder archives.

Topic	Data	Source
Mine Operations	BMC Wards Well FY18-FY22 Plan of Operations (BMC, 2017)	Provided to Golder by BMC, September 2020
Background Data	- Groundwater level data: 2016 to 2019 (Standing water levels and logger data) - Groundwater quality data: 2016 to 2019 - VWP Data: 2012	Provided to Golder by BMC, September 2020
Spatial Data	Shapefile: WW_Aproved_Activities.shp	Provided to Golder by BMC, September 2020
	Geodatabase: - Detailed Surface Geology and Structures (QLD) (2018) - Regional Geology 1985 – Bowen Basin (2003)	DNRME, Accessed via QSpatial (http://qldspatial.information.qld.gov.au/catalogue/)
	GDE Database – Burdekin River Region: Terrestrial, Subterranean and Aquatic (2020)	Bureau of Meteorology (BOM), accessed via the GDE Atlas (http://www.bom.gov.au/water/gro/undwater/gde/map.shtml)
	Tabular Data: Groundwater Database – Queensland (2020)	DNRME, Accessed via QSpatial (http://qldspatial.information.qld.gov.au/catalogue/)

6.2 Geological Setting

6.2.1 Regional setting

The Wards Well site is located on the Collinsville Shelf, near the western reaches of the Bowen Basin in Central Queensland. The Collinsville Shelf has a shallow, easterly dip between 2 to 5 degrees with localised steepening. The Bowen Basin is part of a connected group of Permian-Triassic basins spanning across eastern Australia, including the Sydney and Gunnedah Basins, and is characterised by a thick Permian-Triassic succession of siliciclastics succeeded by coal measures (Withnall & Cranfield, 2013).

6.2.2 Depositional Setting

The depositional setting of the project area comprises Quaternary alluvial and poorly consolidated sediments and basalt flows of the Tertiary Suttor Formation unconformably overlying Permian age strata.

Quaternary Sediments

The Quaternary sediments consist of sand, clay and silt of varying content that have been unconformably deposited in an eroded, valley-fill environment associated with creeks and drainage channels. The deposits are likely irregular in thickness and lensoidal in nature. Alluvial sediments have been mapped on 1:250 000 scale geology maps and are associated with Eaglefield and Charlie Creek in the north of the site and Kennedy Creek in the south.

Tertiary Strata

The Tertiary strata comprise four major basalt flows intercalated with pyroclastic ash flow and ash fall tuffs, volcanic breccias, clays, muds, lignites and unconsolidated fine to coarse grained sand and gravels. Basalt

flows originated from local eruption vents, with the thickest basalt accumulations (up to 60 m thick) occurring in palaeochannels downgradient of the vents. Basalt thickness tends to reduce in the upper reaches of the palaeochannels to the east and north of the Wards Well mining leases and eventually the occurrences of basalt discontinue. To the west, basalts plunge below a thick veneer of Tertiary sediments and eventually discontinue at an unknown distance to the northwest mine lease boundary. To the south the basalt flows are increasingly interbedded with Tertiary clay and sand. Sediment deposits are heterogeneous with clay, silt and sand content varying laterally with depth (Golder, 2017).

Permian Strata

The underlying Permian strata comprises the Fort Cooper Coal Measures (FCCM) and Moranbah Coal Measures (MCM) which generally dip to the east at the Wards Well site. The FCCM unconformably underlies the Tertiary sediments and is typically massive, coarse grained sandstone, fine to medium grained sandstone, dark grey siltstone, carbonaceous shale and mudstone and coal seams with tuffaceous claystone bands.

The MCM conformably underlies the FCCM and comprises low ash coal seams, laminated claystones, siltstones, interbedded siltstones/sandstones and massive sandstones. There are nine coal seams within the MCM, three of which are economically viable, including:

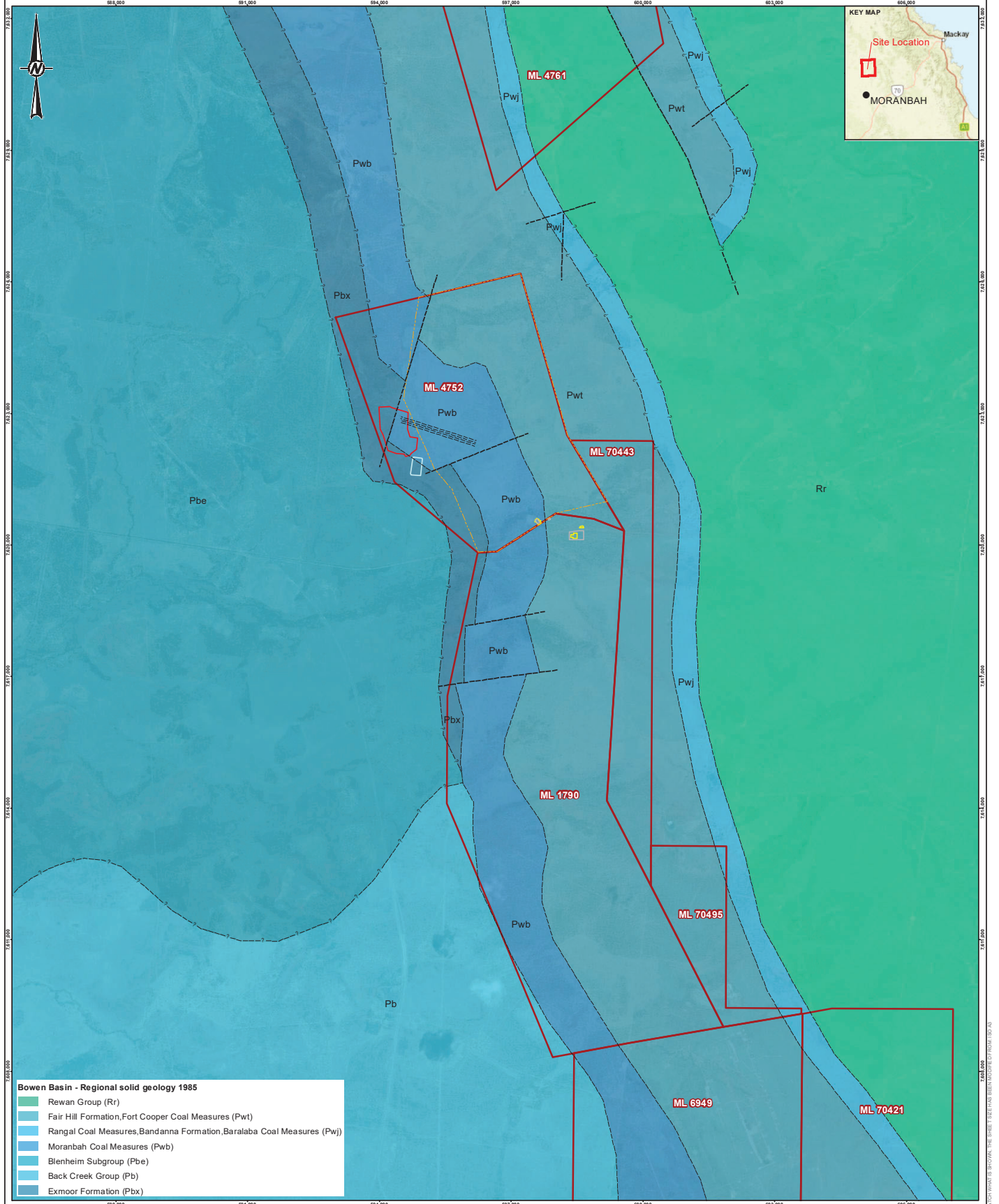
- Goonyella Upper (GU) seam,
- Goonyella Middle (GM) seam, and
- Goonyella Lower (GL) seam.

The 'target' seam for the Wards Well project is the Goonyella Middle seam, which is continuous throughout the project area. The seam ranges in thickness from four to eight metres and is situated at depths of 130 m below ground in the west to 690 m down dip in the east (AGE, 2012).

Geological Structures

Two main fault sets have been identified at the project site during previous site investigations: normal faults striking east-west with a vertical displacement of approximately five to ten metres, and thrust faults striking north-south with approximately three metre upthrust to the east. Exploration drilling also intersected a number of normal and thrust faults located throughout the mining lease areas (AGE, 2012).

Detailed solid geology and surface geology is displayed in Figure 4 and Figure 5, respectively. Geological structures are included on Figure 4.



- Bowen Basin - Regional solid geology 1985**
- Rewan Group (Rr)
 - Fair Hill Formation, Fort Cooper Coal Measures (Pwt)
 - Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwj)
 - Moranbah Coal Measures (Pwb)
 - Blenheim Subgroup (Pbe)
 - Back Creek Group (Pb)
 - Exmoor Formation (Pbx)

LEGEND

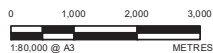
Wards Well EA Approved Activities

- Administrative Area
- Box Cut Area
- Industrial Area
- Seismic Investigation Area
- Storm Water Dam
- Underground Exploration

Bowen Basin - Regional structure 1985

- Fault Approximate
- Fault Inferred
- Geological Boundary Approximate
- Geological Boundary Inferred
- Mining Lease Tenement

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994



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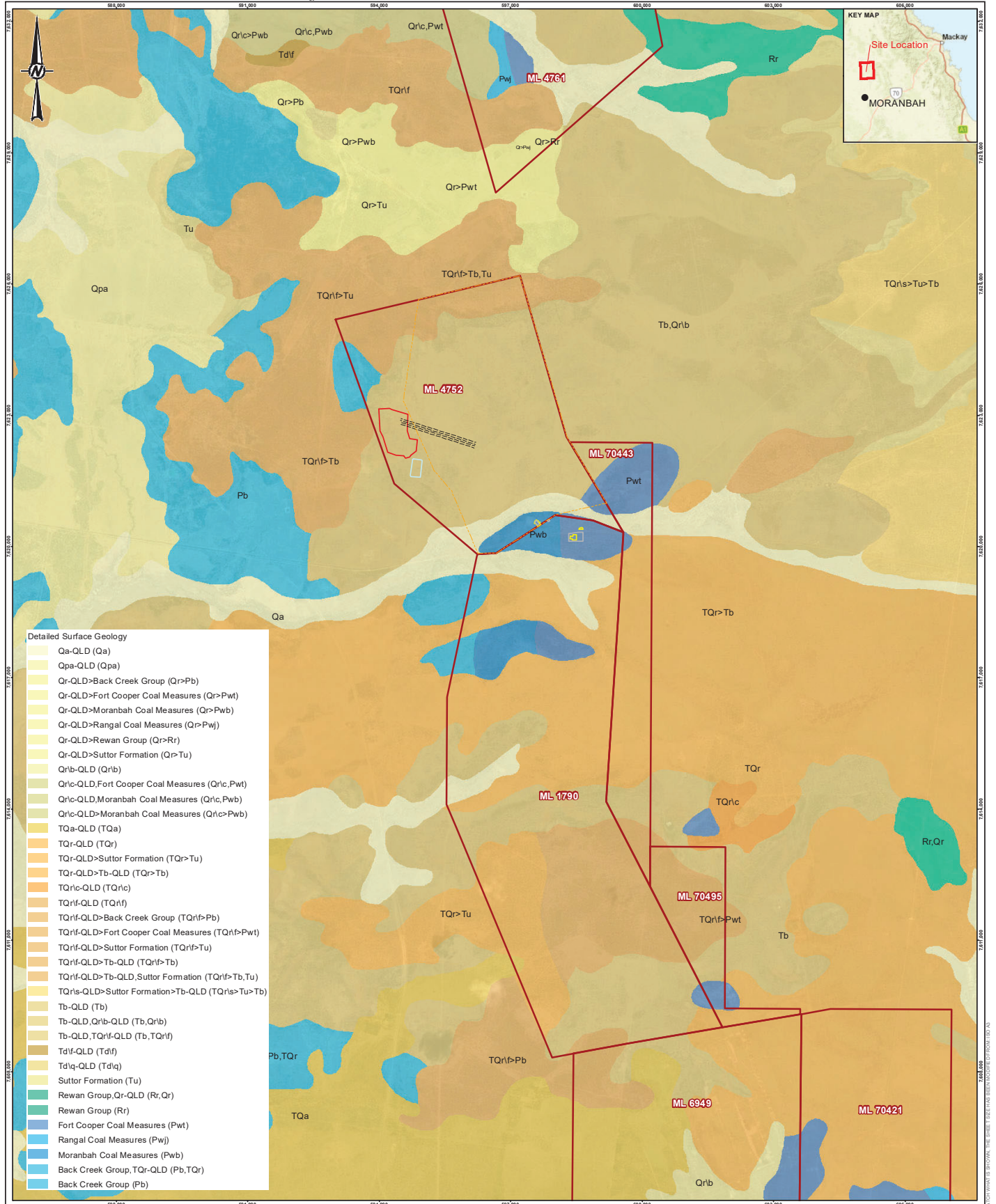
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REFERENCE(S)
1. Bowen Basin Solid Geology and Structures, Mining Lease Tenements: © State of Queensland (Department of Natural Resources, Mines and Energy) 2005 - 2020
2. Wards Well EA Approved Activities: BMC, 2020

PROJECT
WARDS WELL MINE PROGRESSIVE REHABILITATION AND CLOSURE PLAN - HYDROGEOLOGICAL CONCEPTUAL MODEL

TITLE
SOLID GEOLOGY AND STRUCTURES

PROJECT NO.	CONTROL	REV.	FIGURE
20360652	001	0	4



Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

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NOTE(S)
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REFERENCE(S)
1. Bowen Basin Detailed Surface Geology, Mining Lease Tenements: © State of Queensland (Department of Natural Resources, Mines and Energy) 2016 - 2020
2. Wards Well EA Approved Activities: BMC, 2020

PROJECT
WARDS WELL MINE PROGRESSIVE REHABILITATION AND CLOSURE PLAN - HYDROGEOLOGICAL CONCEPTUAL MODEL

TITLE
DETAILED SURFACE GEOLOGY

PROJECT NO. 2036052 **CONTROL** 001 **REV.** 0 **FIGURE** 5

6.3 Hydrogeological Setting

Previous exploration drilling campaigns and investigative reports have been reviewed to describe the hydrogeological setting at the Wards Well Site. The following summary is derived from the Wards Well Environmental Impact Study (EIS) Groundwater Assessment (AGE, 2012), the Wards Well Water Management Opportunities Assessment Report (Golder, 2017) and the Underground Water Impact Report – For Authority to Prospect 1103 for Consultation (Arrow, 2012).

6.4 Hydrostratigraphy

Three hydro-stratigraphic units have been identified at the Wards Well site:

- Quaternary alluvium,
- Tertiary strata, and
- Permian strata.

The occurrence and continuity of these aquifers varies throughout the mining lease area. A baseline hydrogeological conceptual model (BHCM) is presented in Figure 6. The BHCM is a schematic cross section displaying the key hydrogeological system components and the main hydrogeological processes occurring at the Wards Well site. The BHCM is loosely based on the cross-section location displayed in Figure 3. The following sections will discuss each of the aquifer systems in further detail.

6.4.1 Quaternary Alluvium

The Quaternary alluvium aquifer is composed of alluvial sediments associated with major river systems and older sediments associated with floodplains and alluvial flats. The Quaternary alluvial deposits are generally associated with Eaglefield Creek and Charlie Creek towards the north of the project area and Kennedy Creek in the south. The Quaternary alluvium is classed as a porous media aquifer where groundwater occurs within the voids between individual grain particles and is generally unconfined (Arrow, 2012).

Extensive investigations of the properties of the alluvial aquifers have not been undertaken to date. However, regional investigations of the Quaternary alluvial aquifers indicate that the aquifer thickness is typically between 15 m and 25 m and groundwater flow direction generally follows the topographic profile (Arrow, 2012).

6.4.2 Tertiary Strata

The primary source of groundwater at the Wards Well site occurs within the Tertiary strata, comprising a set of vesicular basalt flows following Tertiary palaeochannels incised into the Permian basement. The Tertiary basalt aquifer is classed as a secondary porosity aquifer, where groundwater is typically stored and transmitted through fractures, joints, and discontinuities within the rock mass (Arrow, 2012). The aquifer is compartmentalised due to the presence of low permeability sediment deposits and weathering horizons developed between basalt flows. Additionally, low permeable massive basalts in the centre of basalt flows typically separate the high permeable vesicular basalts, which develop at the top and bottom of the basalt flow (Golder, 2017). In most areas the basalt is underlain by a clay layer of variable thickness, however, in some areas the basalt is in direct connection with underlying Permian units.

Groundwater levels in the basalt aquifer typically range between 6 m and 60 m below the ground surface, with groundwater flow in the Tertiary strata (basalts and sediments) flowing from the northeast to the southwest of the project site. Groundwater quality in the basalts is mainly sodium chloride dominated water with Total Dissolved Solids (TDS) concentrations ranging between 480 and 2900 mg/L.

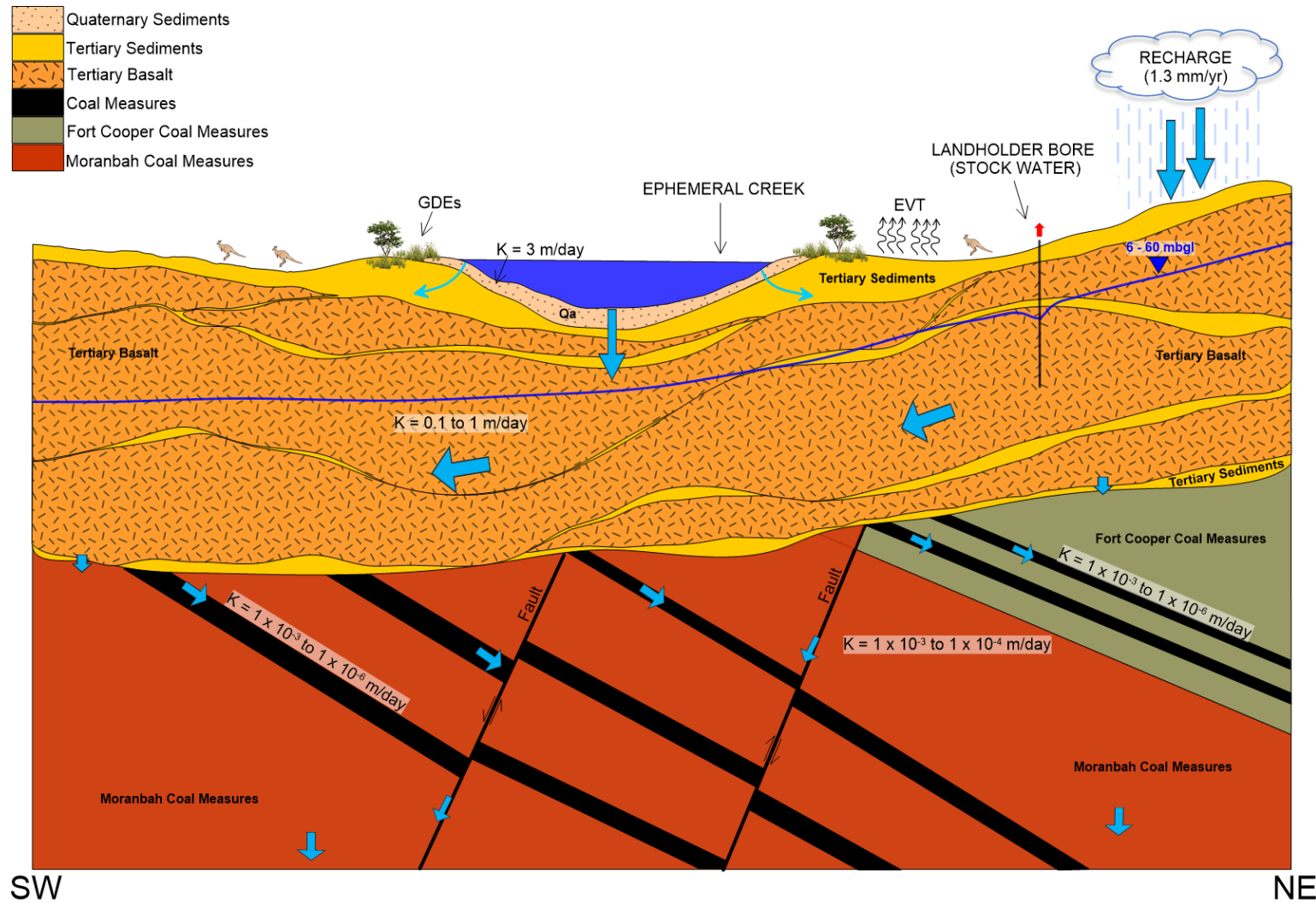


Figure 6: Baseline Hydrogeological Conceptual Model (BHCM) Blue arrows show likely groundwater flow directions, with the size of the arrow reflecting the magnitude of groundwater flux.

6.4.3 Permian Strata

The Permian strata generally comprises siltstone, sandstone, calcareous and carbonaceous shales and coal. Limited investigation into the hydraulic properties of the Permian strata indicate that the unit is not expected to be a significant aquifer at the project site. However, regional investigations into the hydrogeological properties of the Permian strata identified primary porosity aquifers in the sandstone units and secondary porosity aquifers in the shales, siltstones, and coal units. The secondary porosity aquifers, where water flow is primarily through fractures, joints, and discontinuities in the rock mass, are generally the most dominant. In the coal measure sequences of the Permian strata, the jointed sandstone overburden and interburden is locally important for storage and transmittal of groundwater (Arrow, 2012).

The occurrence and depth of the Permian aquifers varies depending on the depth, extent, and interconnection of fractures on a local scale and faulting on a regional scale as well as the depth and lateral extent of porous sediments. Previous investigations have indicated water levels ranging from 6.8 m to 42.1 m below the ground level (AGE, 2012). Groundwater drained from the GM seam aquifer is expected to be higher salinity than that of the Tertiary basalts (Golder, 2017).

6.5 Structural Influence on Groundwater Flow

Primary groundwater flow within and between hydrostratigraphic units is likely driven by the presence of geological structures, such as fractures, joints and faults, which have been encountered at the Wards Well site. Locations of regional fault systems located within the mine lease areas are displayed in Figure 4.

In the Tertiary strata, vesicular zones contributing to primary porosity are typically discontinuous and therefore do not provide the primary conduit for water flow. However, pore spaces within the vesicular basalt flows do provide space for groundwater storage. Therefore, groundwater is likely transmitted through fractures and contact surfaces between basalt flows (AGE, 2012).

Within the Permian strata, overburden units are generally of low permeability and may act as a confining unit to groundwater within the coal seams. The drainable porosity of the Permian units is therefore secondary in nature and primarily contributed by joints and bedding partings. Additionally, permeability is thought to be higher along thrust faults intersecting the Permian overburden rocks. Broad scale northeast, northwest and north-northwest to north trending structural zones are inferred to occur within the Permian strata across the Wards Well site by previous studies using drilling data and interpretation of geomagnetic survey data (Golder, 2017).

6.6 Hydraulic Parameters

The hydraulic properties of the three primary hydrostratigraphic units have been estimated through field testing and regional studies completed within the vicinity of the Wards Well site.

Quaternary Alluvium

Investigations of hydraulic properties of the Quaternary alluvium within the Wards Well mining lease have not been completed to date. However, hydraulic tests were completed by Golder (2005) in the Suttor Creek alluvium, approximately 35 km to the north of the Wards Well mining lease. The hydraulic conductivity value derived from the Suttor Creek alluvium was approximately 3 m/d (which is a representative value for the cleaner sand layers). This unit is likely similar in composition to the alluvium found at the project site, which is associated with Eaglefield, Charlie and Kennedy Creeks. As the clay content increases locally then hydraulic conductivity can be expected to decrease to values in the order of 1×10^{-1} to 1×10^{-3} m/d.

Regional studies of the alluvial sediments in the Bowen Basin indicate values of horizontal and vertical conductivity values of up to 20 m/d and 2 m/d, respectively (Arrow, 2012). These upper estimates would reflect testing in localised coarser grained sand and gravel.

Tertiary Sediments

Hydraulic conductivity values for the Tertiary sediments of the Suttor Formation have been derived from a single 100-day constant rate discharge test conducted on a sand layer encountered in Pumping Bore 03 (PB03) in 2012. The location of this pumping bore is presented in Figure 3. Hydraulic conductivity values are presented in Table 3.

Table 3: Pumping Test Data Analysis PB03 (AGE, 2012)

Test Bore	Observation Bore	Distance from Pumping Well (m)	Assumed Aquifer Thickness (m)	Analysis Method*	Calculated Transmissivity (m²/d)	Approximate Hydraulic Conductivity (m/d)	Storage Coefficient
PB03	PB03	NA	6	1	4.2	0.7	NA
				2	4.5	0.8	NA
	MB07	16		1	2.3	0.4	0.007
				2	5	0.8	NA
	MB18R	128		1	1.9	0.3	0.00007
				2	3.7	0.6	NA
	MB18R2	146		1	2.1	0.3	0.0001
				2	4.4	0.7	NA

Note: *Analysis Method 1 refers to Cooper-Jacob. Analysis method 2 refers to Theis-Jacob Recovery.

The values derived from the pumping test at PB03 are generally in agreement with estimates for sandy sediments of the Suttor Formation found to the south in the Isaac River Palaeochannel deposits east of the Goonyella-Riverside complex. Silt and clay layers frequently observed in boreholes across the southern half of the Wards Well mining lease area are expected to have hydraulic conductivity values several orders of magnitude less but similar storage coefficients (Golder, 2017).

Tertiary Basalts

Hydraulic conductivity estimates for the Tertiary basalt aquifer were completed by Streamline Hydro in 2012. The tests comprised one 100-day constant rate discharge test conducted in Pumping Bore 01 (PB01) and one 90-day constant rate discharge test conducted in Pumping Bore 02 (PB02). The locations of the pumping bores are presented in Figure 3. PB01 was completed in an approximately 140 m thick sequence of mostly fresh basalts in the northern part of the Wards Well site. Geological and geophysical logs of bores in this area show little occurrence of sediment deposition between basalt layers. PB02 intersects approximately 75 m of slightly weathered basalts.

The test results were previously reported by AGE Consultants in 2012. A summary of test results for PB01 and PB02 is provided in Table 4.

Table 4: Pumping Test Data Analysis PB01 and PB02 (AGE, 2012)

Test Bore	Observation Bore	Distance from Pumping Well (m)	Assumed Aquifer Thickness (m)	Analysis Method*	Calculated Transmissivity (m²/d)	Approximate Hydraulic Conductivity (m/d)	Storage Coefficient
PB01	PB01	NA	44	1	27	0.6	NA
				2	27.1	0.6	NA
	MB03	723		1	106	2.4	0.0006
				2	104	2.4	NA
	MB03A	139		1	21	0.5	0.001
				2	19.9	0.5	NA
	MB04	176		1	21.5	0.5	0.0008
				2	21.3	0.5	NA
	MB13	22		1	21.2	0.5	0.05
				2	30.4	0.7	NA
MB14	674	1	34.1	0.8	0.0001		
		2	39.2	0.9	NA		
PB02	PB02	NA	41	1	0.6	0.01	NA
				2	1.4	0.03	NA
	MB05R	18		1	0.6	0.01	0.00002
				2	2.6	0.06	NA
	MB15	287		1	15.8	0.4	0.00006
				2	12.3	0.3	NA

Note: *Analysis Method 1 refers to Cooper-Jacob. Analysis method 2 refers to Theis-Jacob Recovery.

Local and regional testing of the hydraulic properties of the basalts indicate highly variable aquifer transmissivity, with values typically in the range of 20 to 100 m²/day but with localised exceedances of 500 m²/day (Golder, 2017). The variability in aquifer transmissivity is likely due to heterogeneity of the Tertiary strata resulting from regional geological depositional history and the intensity, size, and interconnectivity of fractures within individual basalt flows.

Permian Strata

Hydraulic properties of the Permian overburden and coal seams have been investigated at a local and regional scale. Previous Golder reports produced for the Wards Well mining lease indicate permeability of the Permian overburden rocks in the range of 1×10^{-3} m/day and 1×10^{-4} m/day (Golder, 2017).

Permeability of the coal seams within the mining lease area has been determined from packer testing conducted by SKM, reported in AGE, 2012. Packer testing was completed for coal seams between 100 m and 550 m below ground level (m bgl). Estimated permeability values range from 1×10^{-3} m/day to 1×10^{-6} m/day. The most common permeability values encountered during testing were in the range of 2×10^{-5} m/day and 4×10^{-4} m/day, which are considered relatively low in comparison to typical values for the Bowen Basin (AGE, 2012).

Hydraulic testing of Permian coal seams and overburden rocks has also been completed for nearby mine sites, including the Goonyella Broadmeadows Complex as well as the Red Hill mining lease. Interpreted hydraulic conductivity of Permian strata reported from the site and surrounding areas are summarised in Table 5.

Table 5: Hydraulic Properties of the Permian Strata

Area of Investigation	Permian Strata Investigated	Hydraulic Conductivity (m/day)	Source
GBMC ⁺ (Goonyella No2)	GM Seam	0.003 to 0.034	URS, 2013
GBMC (Airstrip Box cut)	GL Seam	0.06 to 0.47	
GBMC (Goonyella Ramp 8)	GL Seam	0.01 to 0.1	
	Interburden	2×10^{-5} to 0.33	
Red Hill (EIS Study Area)	Interburden	2×10^{-6} to 3×10^{-5}	
GBMC	GU Seam	0.01	Golder, 2016
GBMC	GM Seam	0.01	
GBMC	GL Seam	0.01	
GBMC	Overburden, Interburden and Underburden	8×10^{-4}	
Wards Well Mining Lease	Coal Seams (undifferentiated)	0.001 to 1×10^{-6} #	AGE, 2012

Notes: ⁺GBMC refers to Goonyella Broadmeadow Complex

#Hydraulic conductivity values provided by AGE (2012) cover entire range of testing depth (100 m to 550 m bgl).

Permeability values estimated for the overburden are generally lower than those of the coal seams, with overburden rocks acting as a confining unit to groundwater in the coal seams. Additionally, hydraulic conductivity in the overburden is likely higher along thrust faults, which occur throughout the Wards Well mining lease area.

Coal seam permeability values generally decrease with depth, which is likely a function of overburden pressure compressing the fractures and cleats associated with the secondary porosity features that primarily conduct groundwater movement within the coal seams.

6.7 Groundwater Level Variations

Groundwater level data was provided for site monitoring bores and VWPs by BMC. Groundwater monitoring bore and VWP locations are displayed in Figure 3. The groundwater monitoring network construction details are provided in APPENDIX A.

Groundwater level data from VWPs was available between February and May 2012. Monitoring bore data was available from select bore locations between 2017 and 2019. Groundwater level variations between 2012 and 2019 were compiled into a hydrograph, displayed in Figure 7. The hydrograph indicates that vertical hydraulic gradients are primarily downward (i.e. the basalt heads are consistently higher than the coal seam heads in similar areas), with groundwater flowing from the Quaternary and Tertiary strata into the underlying Permian strata. Minor variations in hydraulic gradients are observed in VWP 3, where there is a localised upward gradient observed in Tip 4. The location of VWP3 is likely influenced by local heterogeneity in geological units, however the exact cause of the localised upward gradient is unclear. Overall, the system displays downward vertical gradients, which have been assumed in the conceptual model.

Figure 7 shows a distinct decrease in groundwater level observed at MB13, for the period between July 2018 and July 2019. This decrease in groundwater level is unusual compared to nearby monitoring locations screened in similar strata, however, not enough information is available to determine the cause of the decrease. It may be reasonable to assume the data for MB13 is not representative of the system as a whole.

A potentiometric surface for the Tertiary aged basalt aquifer (Figure 8) has been created using BMC groundwater level data as well as data from nearby registered bores acquired from the Queensland Groundwater Database (DNRME, 2020). The water level data used to produce the potentiometric surface is a snapshot of historical water levels measured in site monitoring bores and local registered bores associated with the basalt aquifer. General flow direction in the basalts is from the northeast to the southwest of the Wards Well site.

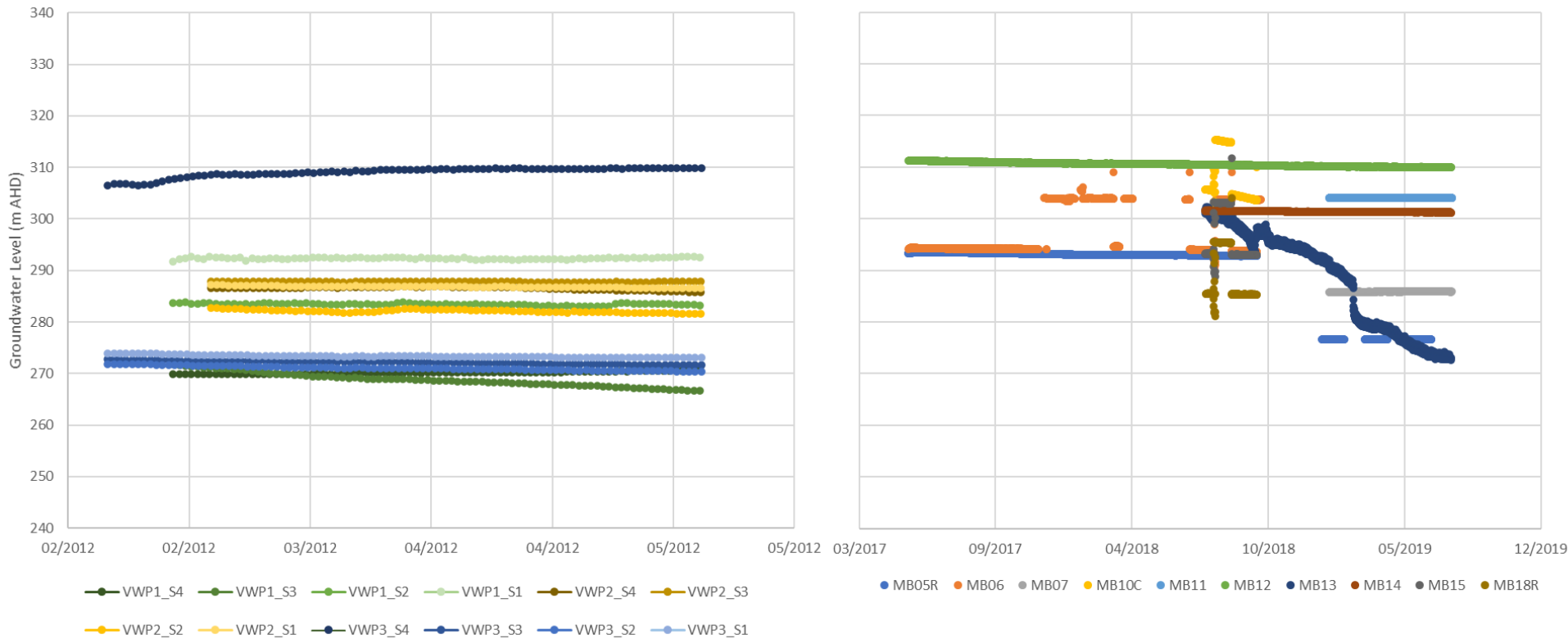
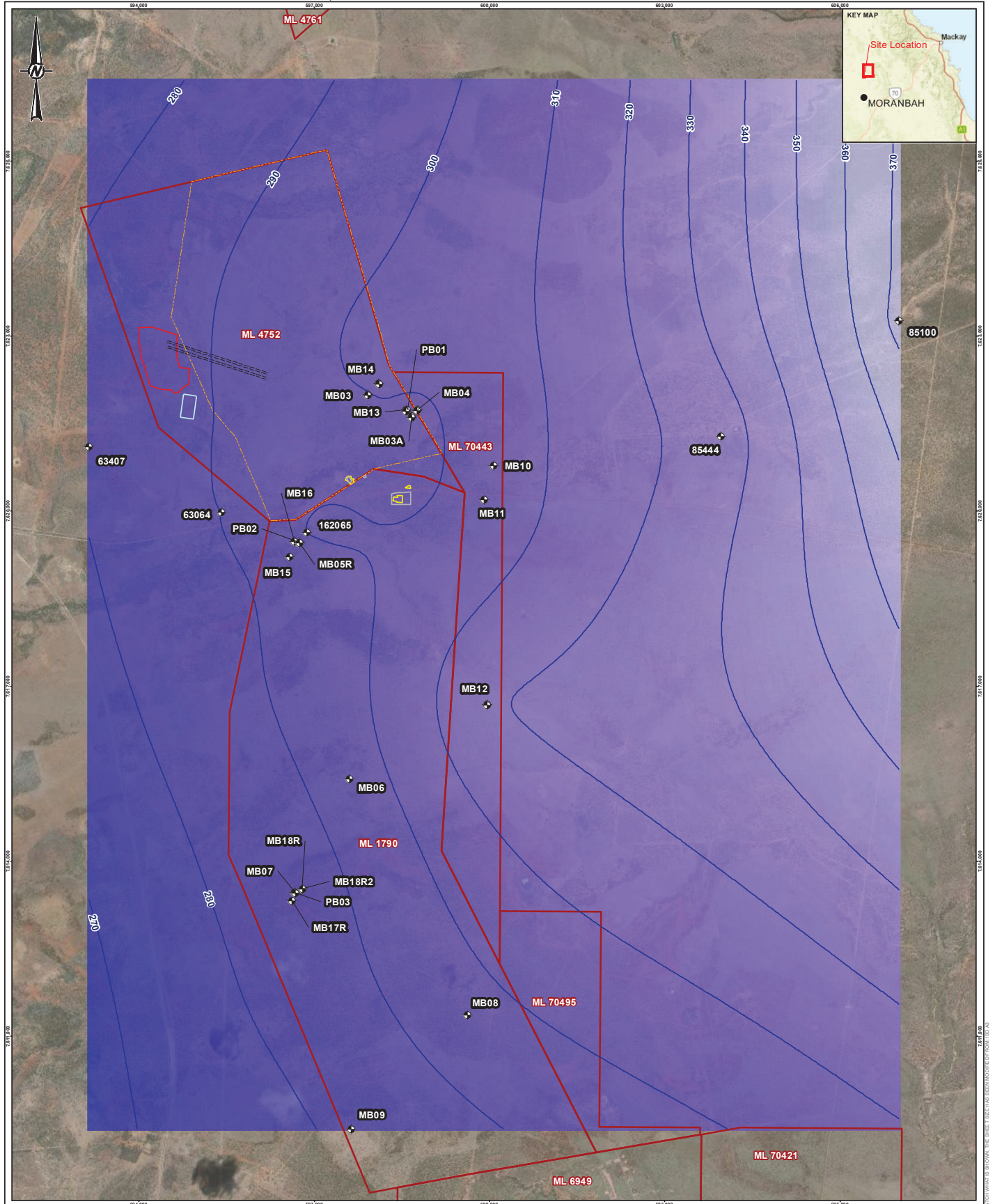


Figure 7: Groundwater Level Hydrographs. VWPs tapping Permian strata are shown on the graph to the left and monitoring bores tapping basalt and sediments shown on the right.



LEGEND

- + Bore used to create potentiometric surface
- Mining Lease Tenement
- Wards Well EA Approved
- Administrative Area
- Box Cut Area
- Industrial Area
- Seismic Investigation Area
- Storm Water Dam
- Underground Exploration
- Groundwater Level Contour (m AHD)

Groundwater Elevation (m AHD)

High : 373

Low : 267

Coordinate System: GDA 1994 MGA Zone 55
 Projection: Transverse Mercator
 Datum: GDA 1994

0 500 1,000 1,500 2,000
 1:60,000 @ A3 METRES

CLIENT
BHP BILLITON MITSUI COAL PTY LTD (BMC)

CONSULTANT

DD-MM-YYYY

DESIGNED

PREPARED

REVIEWED

APPROVED

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REFERENCE(S)
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PROJECT
WARDS WELL MINE PROGRESSIVE REHABILITATION AND CLOSURE PLAN - HYDROGEOLOGICAL CONCEPTUAL MODEL

TITLE
POTENTIOMETRIC SURFACE - TERTIARY BASALT AQUIFER

PROJECT NO.	CONTROL	REV.	FIGURE
20360652	001	0	8

6.8 Aquifer Recharge and Discharge

Recharge to the Quaternary and Tertiary sediment deposits at the Wards Well site is believed to occur only after intense storms during the wet season have provided sufficient runoff to cause flash flooding and ephemeral flow in the higher reaches of the Suttor Creek and its tributaries. Due to the compartmentalisation of basalt aquifers underlying the Wards Well site, recharge is likely to occur from rainfall infiltration in rocky outcrop areas and through vertical seepage from overlying aquifers rather than through groundwater flow from basalt aquifers of regional extent (Golder, 2017).

Recharge to the Permian strata is likely to occur through rainfall infiltration and overland flow in rock outcrop and sub-crop areas as well as from downward seepage or through flow from overlying or adjacent aquifers. Additionally, leakage between aquifers may occur through faults or other structural discontinuities in overburden and interburden sediments (Arrow, 2012).

AGE Consultants (2012) estimated a plausible range of groundwater recharge rates for the basalt aquifer within the Wards Well mining lease area using a spreadsheet method developed by CSIRO. The two methods applied for the estimation of groundwater recharge values include the following:

- Groundwater chloride mass balance (GCMB) and
- Method of last resort (MOLR)

A summary of the estimated recharge values is provided in Table 6.

Table 6: Estimated annual recharge rate for the Wards Well and Lancewood mining leases (AGE, 2012)

Parameter	GCMB	MOLR
Mean (mm/year)	1.3	1.2
Minimum (mm/year)	0.6	0.1
Maximum (mm/year)	2.3	24
Areal Recharge Estimate (m ³ /year) [based on mean]	8.8	8.1

Note: GCMB – Groundwater Chloride Mass Balance method, MOLR – Method of Last Resort

Primary discharge mechanisms in the Quaternary and Tertiary strata may include evapotranspiration and throughflow into adjacent or underlying aquifers as well as groundwater extraction in areas where these aquifers are used for water supply. Discharge from the Permian strata is likely to occur through downgradient flow into Permian - Triassic strata, throughflow into adjacent aquifers (outcropping or sub-cropping coal seams) or seepage into underlying aquifers through structural discontinuities. Discharge may also occur through groundwater extraction from the Permian strata due to mining activities (such as dewatering) (Arrow, 2012).

6.9 Groundwater Quality

The Wards Well mining lease falls on the boundary between the Burdekin and Fitzroy Basins in Central Queensland. Aquifers within this region have been categorized into groundwater chemistry zones using background ranges of water quality to establish appropriate groundwater quality guidelines for the region. The majority of the project area falls within the Suttor River catchment, located in the eastern portion of the Burdekin Basin. The alluvial groundwaters associated with the Suttor River catchment are generally high salinity (up to 6,600 µS/cm) sodium chloride dominated, although fresher groundwater can be found near streams and in small sub-catchment areas. Groundwater from the Tertiary sediment aquifers in the Burdekin

Basin range from moderate to high salinity while groundwater in the underlying Eastern Bowen Coal Measures (including the FCCM and MCM) is typically of high to very high salinity (McNeil et al., 2018).

Local investigations of groundwater quality have been undertaken for the Tertiary basalts and Permian aquifers within the Wards Well mining lease. Groundwater in the basalts was found to be basically sodium chloride dominated with Total Dissolved Solids (TDS) concentrations ranging between 480 to 2900 mg/L, based on the results collected from 13 monitoring bores between 2015 and 2019. A piper plot of the data collected from this time period is provided in Figure 9.

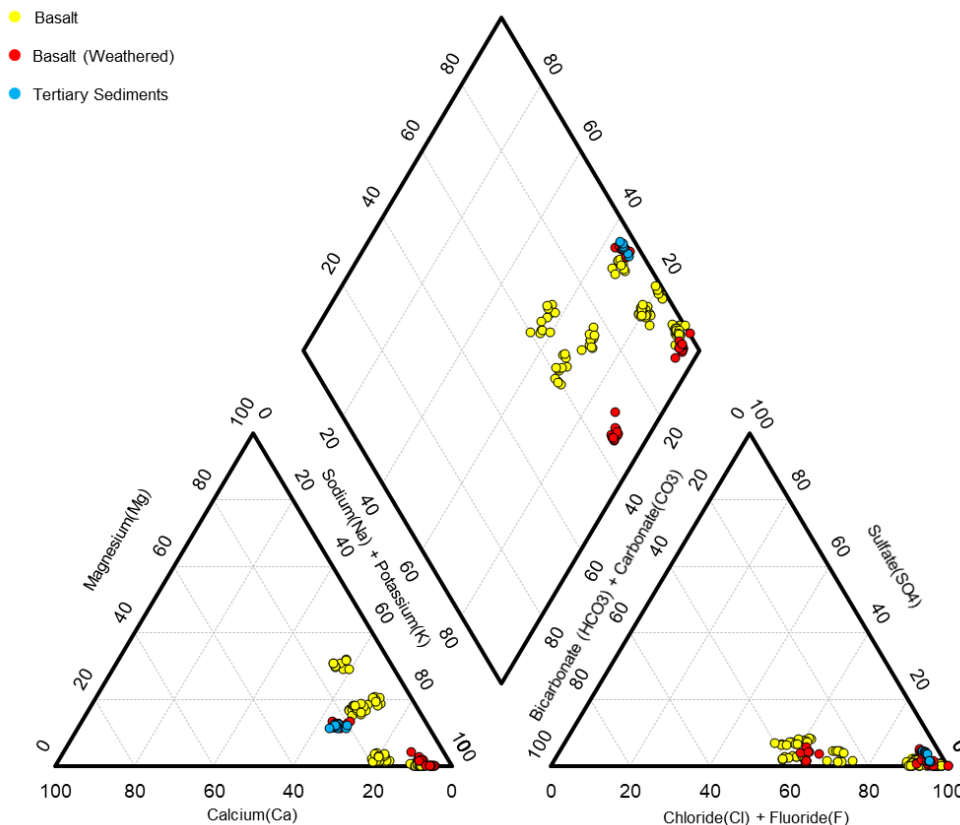


Figure 9: Piper Plot - Tertiary Basalts Water Quality

Water quality data from monitoring bores with screens installed in the coal measures are currently unavailable. However, chemistry results of grab samples collected from open exploration bores during November to December in 2011 indicate that groundwater in the coal measures is likely significantly higher in salinity when compared to samples collected in the basalt aquifer. It is noted that the grab samples were likely mixed with water partially from the coal measures and partially from the basalt aquifer (Golder, 2017).

6.10 Environmental Values

Combined environmental values associated with groundwaters within the Wards Well mining lease include the following:

- Aquatic ecosystems (Fitzroy Basin)
- Irrigation (Burdekin Basin, Fitzroy Basin)
- Farm water supply (Burdekin Basin, Fitzroy Basin)
- Stock water (Burdekin Basin, Fitzroy Basin)

- Primary Recreation (Fitzroy Basin)
- Drinking Water (Burdekin Basin, Fitzroy Basin)
- Industrial Use (Burdekin Basin, Fitzroy Basin)
- Cultural and spiritual values (Fitzroy Basin)

A study area has been established to determine the potential impacts to relevant EVs of groundwater within 10 km of the exploration box cut area. As the study area is located entirely within the Burdekin Basin, draft EVs of groundwater derived in the WQIP (NQ Dry Tropics, 2016) will apply. EVs for groundwater associated with the Fitzroy Basin WRP are outside of the 10 km buffer and are therefore not applicable.

Although aquatic ecosystems are excluded from the Burdekin Basin WQIP (NQ Dry Tropics, 2012) list of EVs associated with groundwaters, the document states the following in reference to aquatic ecosystem guidelines: “Generally these guidelines should apply to quality both of surface water and groundwater since the environmental values they protect relate to above-ground uses...An important exception is for the protection of underground aquatic ecosystems and their novel fauna...given their high conservation value the groundwater upon which they depend should be given the highest level of protection.” Therefore, Groundwater Dependent Ecosystems (GDEs) have been included in the evaluation of EVs of groundwater within the vicinity of exploration activities.

EVs associated with groundwaters under the Burdekin Basin WQIP (including aquatic ecosystems as mentioned above) are described in the context of exploration activities in the following subsections.

6.10.1 Groundwater Use

A local search of groundwater users within a 10 km radius of the proposed exploration box cut was performed using the Queensland Groundwater Database (DNRME, 2020). The search discovered 25 groundwater bores within 10 km of the exploration box cut, 16 of which are classified as existing facilities. Two of these registered bores are listed as being utilised for Sub-Artesian monitoring. The role of the remaining 14 bores is unknown, however most are likely in use for stock watering purposes based on original bore names (e.g. “Pearce Dam Bore”). Aquifer data is available for 13 of the 16 existing bores. Twelve of the 13 bores are installed within the basalts or Tertiary sediments aquifer and one (1) is within the Blackwater Group.

As the primary land use within 10 km of the exploration buffer is related to grazing native vegetation, it is assumed that the registered landholder bores would be used primarily for stock water and to a lesser extent farm water supply and drinking water. Groundwater quality from site monitoring bores has been compared to ANZECC (2000) guidelines for livestock drinking water as well as ADWG (2018) for health and aesthetics. Groundwater was found to be generally suitable for use as stock watering but primarily unsuitable for drinking due to exceedances related to aesthetics guidelines. Historical groundwater samples compared to guidelines are presented in APPENDIX B. As there are no industrial or irrigated agricultural areas indicated within the buffer zone, EVs of groundwater used for industry and irrigation would not be applicable to this area.

Registered groundwater bores within 10 km of the exploration box cut are displayed in Figure 10.

6.10.2 Groundwater Dependent Ecosystems

To determine the potential impacts of mining operations on local GDEs, a search for GDEs within 10 km of the exploration box cut location was conducted using data from the GDE Atlas (BOM, 2020b). Terrestrial and aquatic GDE types were discovered within 10 km of the exploration area.

Aquatic GDEs discovered within the 10 km search radius include riverine wetlands associated with unconfined alluvial, basalt and sedimentary rock aquifers. Groundwater recharge to these systems is predominantly

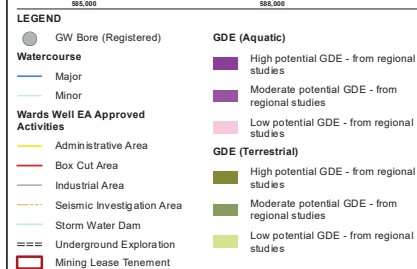
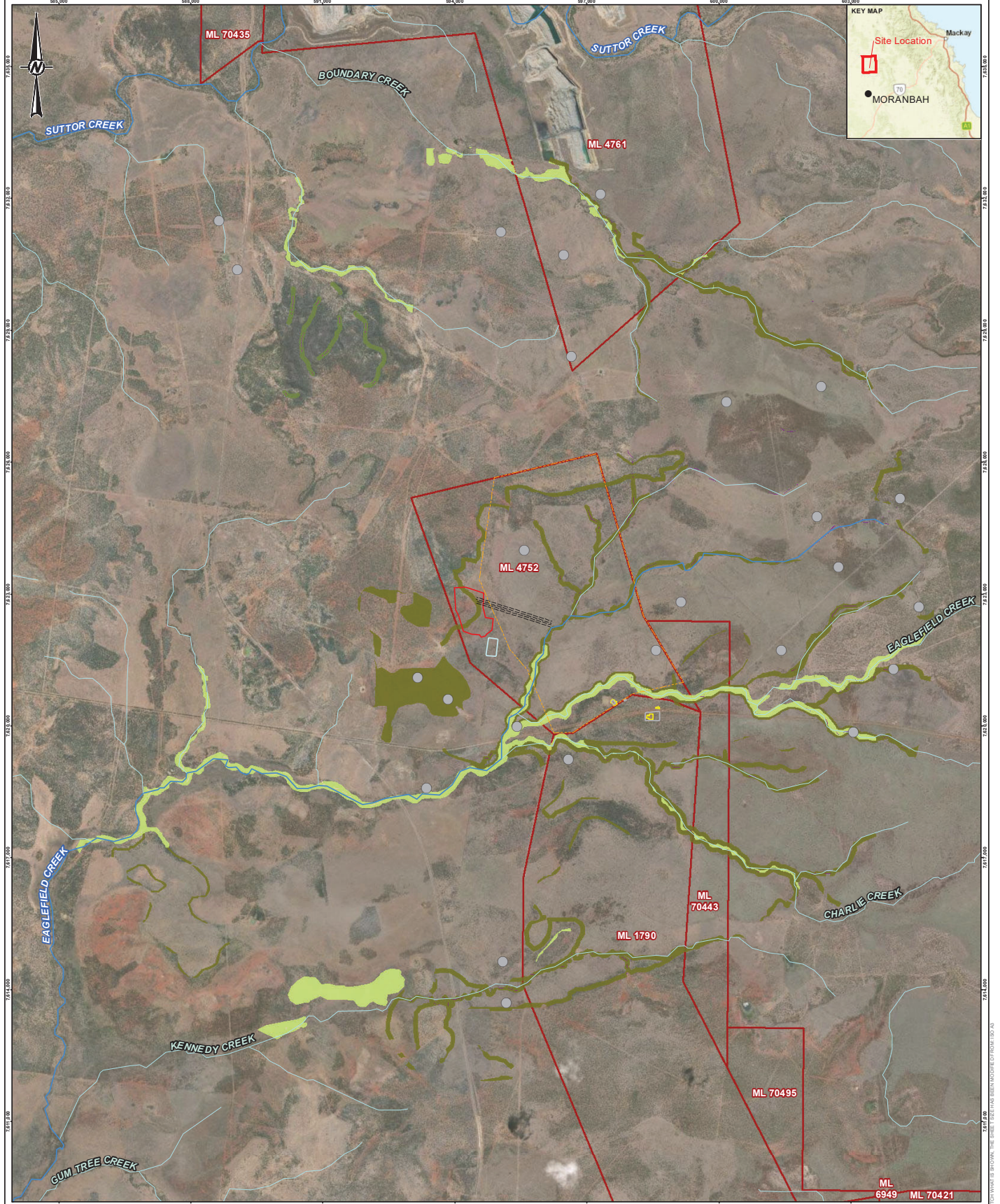
through local infiltration. Aquatic GDEs in this area are classified as having low to high potential for interaction with groundwater, based on regional studies.

Terrestrial GDEs discovered within the search area include riverine wetlands, vegetation, and riparian vegetation ecosystem types. Terrestrial GDEs are associated with unconfined aquifers associated with alluvia, basalt, and sedimentary rocks. Groundwater recharge to these systems is predominantly through local infiltration. Based on regional studies, Terrestrial GDEs are classed as having a low, moderate or high potential for interaction with groundwater, which identifies the likelihood of the ecosystem being dependent on a connection to groundwater.

Notably, a terrestrial GDE with high potential to rely on interacting with groundwater is directly overlying the location of the exploration box cut. The ecosystem type is described as a “treed regional ecosystem within 50 metres of the basalt plains and hills contact zone with fresh, intermittent flow” (BOM, 2020b). The Queensland State Government has mapped the riparian vegetation associated with this GDE as a non-remnant regional ecosystem, which is not associated with a threatened ecological community (The State of Qld, 2019).

The likely presence of GDEs within the vicinity of exploration activities is indicative that EVs of groundwater related to aquatic ecosystems, as prescribed in the Burdekin Basin WQIP, should be considered for the study area.

The distribution of GDEs within 10 km of the exploration box cut is displayed in Figure 10.



Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
BHP BILLITON MITSUI COAL PTY LTD (BMC)

CONSULTANT



DD-MM-YYYY	16-12-2020
DESIGNED	HG
PREPARED	HG
REVIEWED	TRE
APPROVED	TRE

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REFERENCE(S)
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3. Wards Well EA Approved Activities: BMC, 2020

PROJECT
WARDS WELL MINE PROGRESSIVE REHABILITATION AND CLOSURE PLAN - HYDROGEOLOGICAL CONCEPTUAL MODEL

TITLE
GROUNDWATER DEPENDENT ECOSYSTEMS AND REGISTERED GROUNDWATER BORES WITHIN 10 KM OF EXPLORATION BOX CUT

PROJECT NO.	CONTROL	REV.	FIGURE
20360652	001	0	10

7.0 QUALITATIVE RISK ASSESSMENT

The Guideline (Department of Environment and Science, 2019) states that a Progressive Rehabilitation and Closure plan “must include a risk assessment identifying the risks of a stable condition for land not being achieved and how the applicant intends to manage or minimise the identified risks”. In addition, “the risk assessment must be carried out to identify the risks of the NUMA (non-use management area) causing environmental harm and not being safe and structurally stable and detail how the applicant intends to manage and minimise the identified risks” (126C(1)(j), EP Act).

The risk identification should involve assessment of risk source, areas of impacts, events and their causes and their potential consequences. Also, a “comprehensive list of risks based on events, which may impede, enhance, delay or accelerate the rehabilitation of a land to a stable condition or the potential for environmental harm and inability of a NUMA being safe and structurally stable”.

In order to meet these requirements Golder has developed a qualitative risk assessment of the likely impact that approved EA mining activities may have on the groundwater system. The risk assessment involves three main stages:

- Identification and defining main system elements in post mining phase.
- Development of a qualitative hydrogeological conceptual model for post-mining conditions.
- Understanding likely risks under post-mining conditions.

In theory the evolution of the mine site can be divided into several phases (Figure 11):

- Pre-mining phase – current conditions (“steady state”), Section 6.0
- Mine development transient phase – the phase in which the box cut, underground sampling tunnel and any other mine infrastructures are under development, groundwater level declines gradually as the mining activity proceeds (transient).
- Operational phase - a new “steady state” in which the natural and operating mine elements are in “equilibrium”.
- Post-mining transient phase – the box cut, underground openings are gradually backfilled, and groundwater starts to recover (transient).
- Post-closure phase – the mine site is completely closed, and a new hydrogeological “equilibrium” develops (“steady state”).

For any risk assessment it is important to define the temporal and spatial scale of investigation. In this report Golder presents the most likely post-mining scenario (Figure 11). The impact of the mine over a larger time scale (more than hundreds to thousands of years after mine closure) is not discussed and assessed in this report (see Figure 11). Also, since risk assessment time and spatial scales are in close relationship (the longer the time, the larger the scale of impact is), Golder investigated the impact only in the close vicinity of the site (within several kilometres of the site).

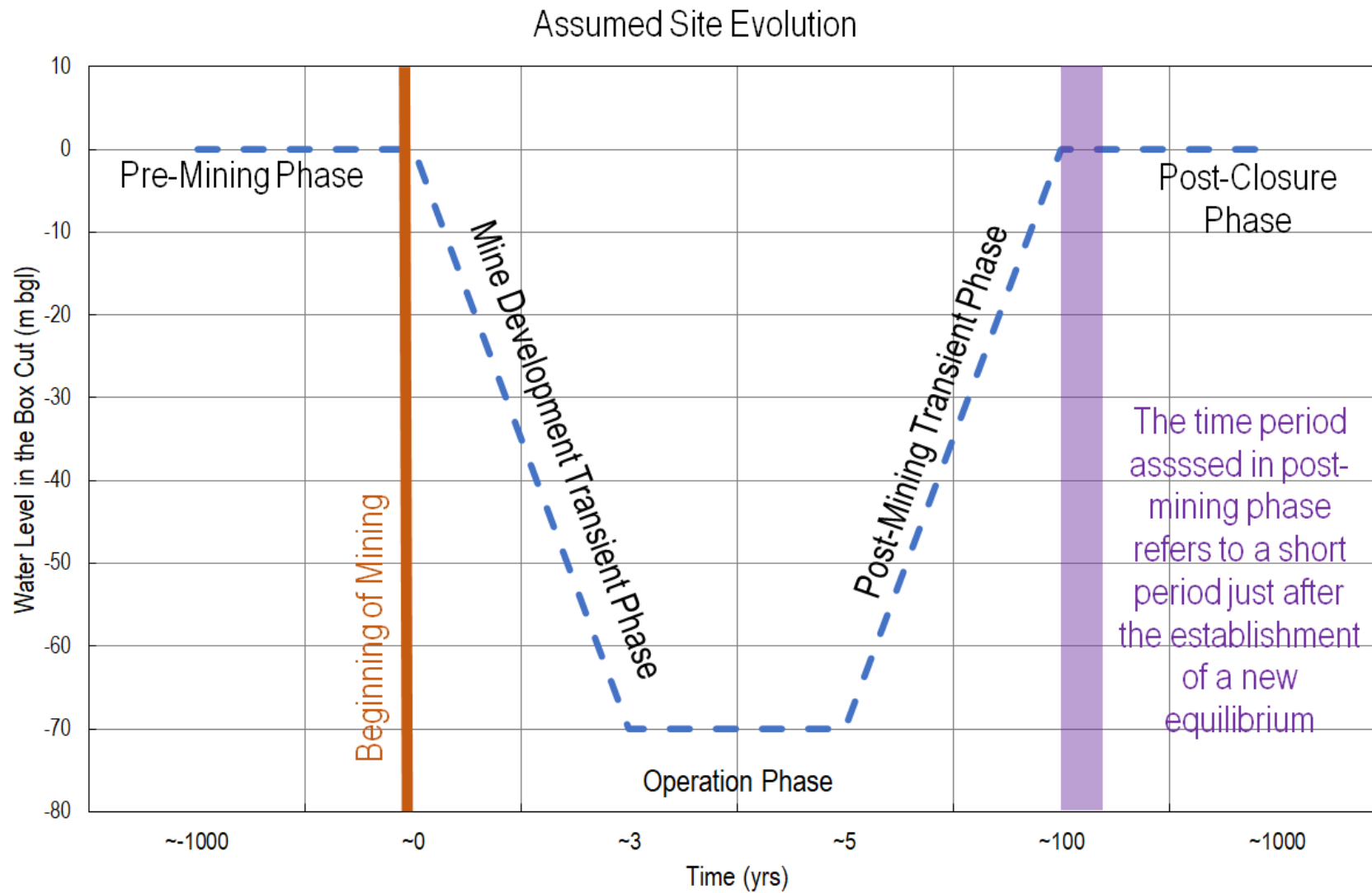


Figure 11: Assumed temporal evolution of the site (time scale is provisional). The purple rectangle shows the time period of the assessment presented in this report.

7.1 Identification of system elements

Any impact assessment is the subject of uncertainty. Uncertainty means a lack or limitation of relevant knowledge and can be grouped into the following categories:

- Uncertainties over the future states of the system studied
- Uncertainty in the models (conceptual, mathematical and numerical)
- Parameter uncertainty
- Uncertainty about human behaviour

As no residual voids will be present after site closure, and there will be no long-term/on-going chemical storage or other waste disposal at the site, a qualitative hydrogeological conceptual model is deemed to be suitable for the development of the site's PRCP. This means that a qualitative assessment should focus on the likely future state(s) of the site under post-mining conditions (first bullet point above). Since numerical model development is not warranted for the PRCP, model and parameter uncertainty are not considered in this report. Also, the most likely scenario assumes that human behaviour/activity in the study area will not undergo any changes in the near future.

Based on these assumptions Golder developed the qualitative post-mining representation on the basis of the BHCM (Baseline Hydrogeological Conceptual Model, Section 6.0, Figure 6). The workflow developed assumes the following:

- The BHCM accurately represents the dominant hydrological, geological and hydrogeological conditions under post-mining conditions away from the site, and conditions are not different from that of the pre-mining BHCM.
- The near site area includes all remaining elements (see below) of the mine in post-closure phase.
- The interaction of the mine elements and the BHCM will result in a new hydrogeological “equilibrium” condition which defines the conditions for post-mining risk assessment.

The BHCM is presented in detail in Section 6.0 and visually displayed in Figure 6.

The remaining mine infrastructure considered in the post-mining risk assessment are as follows:

- Box cut and associated backfill material.
- Underground entry and in-seam sampling, and associated backfill material.

These two elements have potential to interact with the existing hydrogeological regime during post-closure of the mine.

It is assumed that all other mine infrastructures are fully or mostly removed and decommissioned from the site, including:

- Exploration holes
- LOX line drilling
- Topsoil, overburden and ROM coal stockpile
- Water sump
- Mine and stormwater dam

- Infrastructure (industrial area, workshop, administration area, fuel and lubricant storage, lay down/maintenance area, sewage treatment area, roads and tracks)
- Accommodation area.

It is assumed that these elements present no potential to interact with the post-closure hydrogeological regime.

7.2 Post-mining hydrogeological conceptual model

The schematic representation of the recommended post-mining qualitative HCM is shown in Figure 12. The natural elements of the concept are described in Section 6.0, while the near field elements (remaining mine infrastructure) are listed in Section 7.1.

The likely main hydrogeological processes assumed on the site can be summarised as follows (Figure 12):

- The box cut material is recharged from the unsaturated zone and the basalt aquifer.
- The two sources of recharge to the box cut may mix establishing a new blended water quality. This water then moves downward according to the downward vertical hydraulic gradient.
- At the horizon of the basalt – Permian aquifer interface it is assumed that low salinity basalt water mixes with more saline Permian water resulting in a transient water quality between these two end members.
- Also, it is likely that water of Permian origin may not upwell into the basalt layers due to its higher salt concentration and density and lower hydraulic heads. It is expected that the mixing zone will remain very close to the basalt-Permian interface.
- The box cut may partially be discharged to the southwest, back into the basalt aquifer according to the local horizontal hydraulic gradient.
- A small portion of backfill water may mix with more saline Permian water and through the backfilled underground excavation. Coal seams and faults may intrude at larger depth according to the current vertical gradient. It is likely that this basalt water intrusion may locally dilute the more saline Permian groundwater.

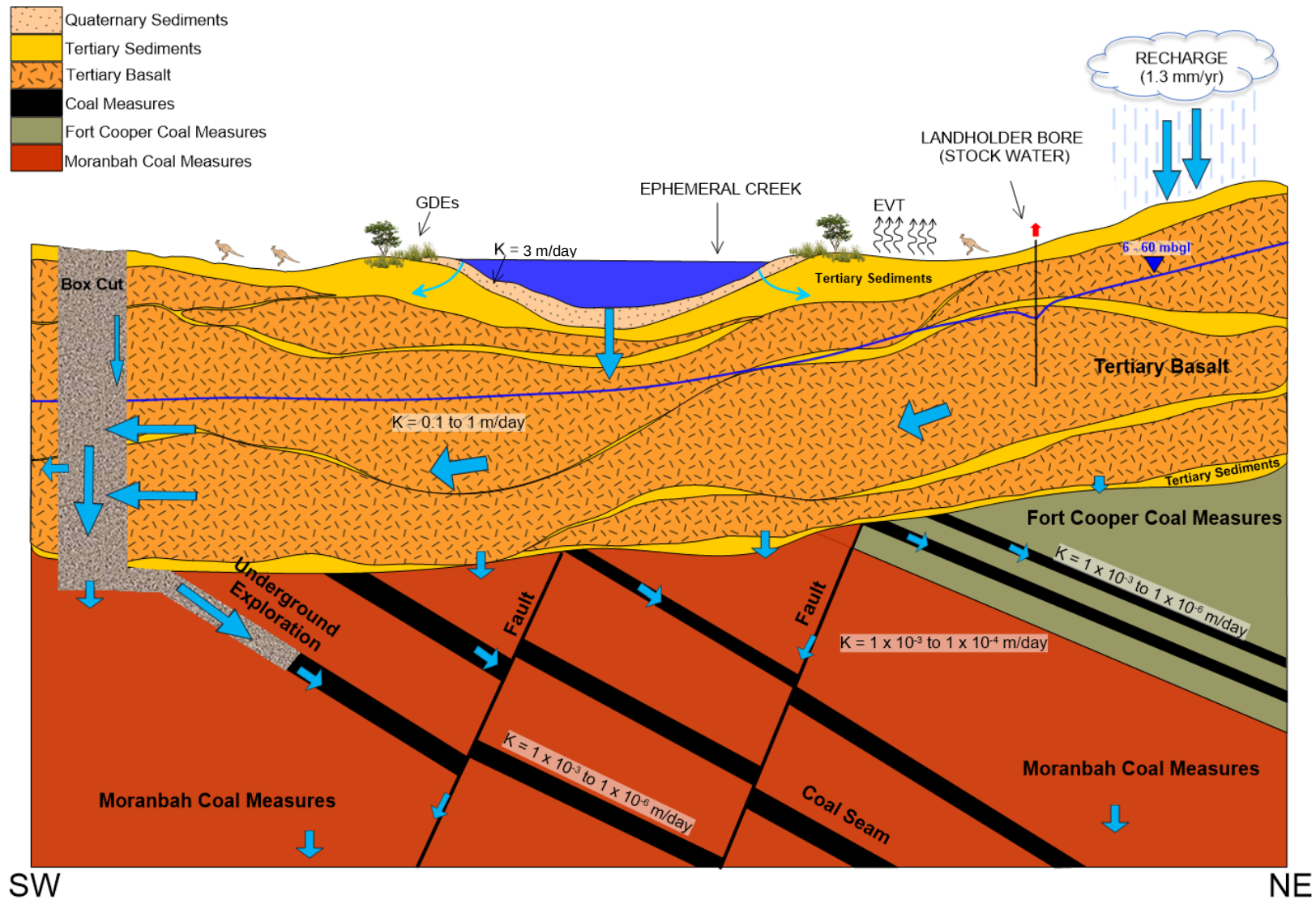


Figure 12: Qualitative hydrogeological conceptualisation of the post-mining conditions. Blue arrows show likely groundwater flow directions, with the size of the arrow reflecting the magnitude of groundwater flux.

7.3 Qualitative risk assessment under post-mining conditions

In any risk assessment there are two methods to assess potential pathways between source and receptors:

- Top-down approach: the pathway analysis starts with the identification of potential impacts (for instance regulatory limits) and then through pathway analysis it tries to map potential sources of impact.
- Bottom-up approach: the complete pathways are developed from the source to identify potential impacts at the receptors.

In this report the second option (bottom-up) has been selected to identify potential connected pathways and undertake exposure pathway assessment.

Based on the most likely post-mining HCM (where the hydraulic gradient in the moderate permeability backfill material returns relatively quickly to a new equilibrium as a result of recharge from the basalt) it can be assumed that the dominant direction of the hydraulic gradient will remain downward resulting in downward water flow from the basalt to the Permian formations. It is likely that the better-quality basalt groundwater will dominate the water quality in the backfill material as the much higher permeability of the basalt (see Section 6.6) will lead to higher rates of inflow. Also, any unlikely contamination caused by the operational phase of the mine will move downward through the backfill and will be highly diluted by the voluminous basaltic water. In addition, the post-mining HCM suggests that the saline, poor quality Permian waters will not move upward, closer to the surface, since the local vertical gradient directs groundwater flow downward and the Permian coal seam groundwater will remain to be of poorer quality characterised by higher salinity and density.

Also, the small footprint of the proposed operations and limited depth of the box cut (70m below ground surface) will limit the inflow of groundwater to the backfilled void and therefore will have minimal disturbance to the regional basalt groundwater levels. As the void will be backfilled it will not act as a long-term sink for the basalt aquifer. Further, the compartmentalised nature of the basalt flows will also tend to limit the spatial propagation of drawdown during operations or under the post-closure scenario. As the basalt is unconfined and readily recharged by seasonal rainfall infiltration, it is expected that any drawdown during operations will rapidly recover during the post-closure period (especially when the backfilling of the void occurs). As such no impacts on local groundwater use (registered bores in use) is expected. In addition, since the post-mining HCM indicates no change in groundwater level and groundwater quality, local groundwater dependent ecosystems are unlikely to be impacted after mine closure.

Evaluation of Risk to Environmental Values

The PRCP guideline states that the AS ISO 31000:2018 Risk Management – Guidelines (Standards Australia, 2018) must be applied for the process of risk assessment in rehabilitation planning. To meet this requirement, a risk matrix for evaluation of likelihood, consequence, and level of risk to EVs of groundwater near exploration activities has been completed. A description of relevant EVs of groundwater within 10 km of the exploration box cut are provided in Section 6.10. The adopted risk matrix used in assessing risk as a function of likelihood and consequence is presented in Figure 13. The completed risk matrix is displayed in Table 7.

		CONSEQUENCE				
		1 Minor	2 Measurable but Limited	3 Substantial	4 Serious	5 Severe
LIKELIHOOD	5 Almost Certain	Moderate 5	High 10	Extreme 15	Extreme 20	Extreme 25
	4 Likely	Moderate 4	High 8	High 12	Extreme 16	Extreme 20
	3 Possible	Low 3	Moderate 6	High 9	High 12	Extreme 15
	2 Unlikely	Low 2	Moderate 4	Moderate 6	High 8	High 10
	1 Rare	Low 1	Low 2	Low 3	Moderate 4	Moderate 5

Figure 13: Adopted risk matrix: likelihood vs. consequence

Table 7: Risk Matrix

Environmental Value	Source-Receptor Pathway	Likelihood	Consequence	Overall Risk
Aquatic Ecosystems (GDEs)	No change in groundwater level and groundwater quality is indicated in the post-mining HCM. Therefore, there is no complete pathway for degradation of GDEs due to mining or exploration activities.	1 (Rare) – No complete pathway between source (exploration activities including box cut) and receptor (GDEs) has been identified.	1 (Minor) – Any potential changes to shallow groundwater level or quality associated with GDEs would be temporary.	1 (Low)
Landholder Groundwater Use: Agriculture (Stock Water) and Farm Water Supply	As the box cut void will be backfilled, it will not act as a long-term sink for the basalt aquifer. Limited drawdown that may occur during operations will recover rapidly during the post-closure period. No complete pathway between landholder bores has been identified in the post-mining HCM.	1 (Rare) – No complete pathway between source (exploration activities including box cut) and receptor (stock and farm water supply bores) has been identified.	1 (Minor) – Groundwater systems near exploration activities will recover rapidly in post-mining conditions, after box cut is backfilled.	1 (Low)

Note: only relevant environmental values of groundwater identified in Section 6.10 have been addressed for the qualitative risk assessment.

8.0 CONCLUSIONS

Based on the knowledge gained from the baseline hydrogeological conceptual model, and considering that the small box cut void and coal sampling zones will be backfilled prior to closure, it has been assessed that there is a very low risk (contamination, water level and quality change) of the proposed operations causing any long-term permanent impacts to the basalt or Quaternary aquifer water quality or groundwater levels. The compartmentalised nature of the basalt flows will also limit the spatial propagation of drawdown during operations. Further, an exposure pathway assessment has determined that there are no complete pathways from the backfilled void to nearby groundwater users or GDEs, as current and future hydraulic gradients will remain downwards.

9.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - "Important Information Relating to this Report", which is included in APPENDIX C of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

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[https://golderassociates.sharepoint.com/sites/133798/project files/6 deliverables/20360652-001-r-rev0-hydrogeological conceptual model/20360652-001-r-rev0 wards well mine prcp - hydrogeological conceptual model.docx](https://golderassociates.sharepoint.com/sites/133798/project%20files/6%20deliverables/20360652-001-r-rev0-hydrogeological%20conceptual%20model/20360652-001-r-rev0%20wards%20well%20mine%20prcp%20hydrogeological%20conceptual%20model.docx)

APPENDIX A

**Wards Well Groundwater
Monitoring Network Construction
Details**

Bore ID	Installation Type	Coordinates*		Surface Elevation (m AHD**)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Screened Unit
		Easting	Northing				
MB03	Open Standpipe	597925.07	7621998.61	317.394	267.7	255.7	Basalt
MB03A	Open Standpipe	598676.78	7621620.44	324.198	188.2	176.2	Basalt
MB04	Open Standpipe	598774.09	7621735.12	325.76	186.8	177.8	Basalt
MB05R	Open Standpipe	596746.19	7619459.28	303.27	170.3	164.3	Basalt
MB06	Open Standpipe	597605.70	7615404.28	314.62	235.1	229.1	Basalt (weathered)
MB07	Open Standpipe	596666.66	7613468.67	311.91	248.9	242.9	Basalt
MB08	Open Standpipe	599625.26	7611360.25	335.89	267.9	264.9	Basalt
MB09	Open Standpipe	597636.22	7609408.33	323.26	274.3	271.3	Basalt
MB10	Open Standpipe	600074.08	7620779.23	320.71	218.7	203.7	Basalt
MB11	Open Standpipe	599910.19	7620190.93	319.7	204.7	198.7	Basalt
MB12	Open Standpipe	599965.54	7616688.78	322.4	291.4	288.4	Basalt
MB13	Open Standpipe	598576.56	7621731.84	325.69	198.7	180.7	Basalt (weathered)
MB14	Open Standpipe	598107.00	7622196.00	317.67	247.4	235.4	Basalt
MB15	Open Standpipe	596585.00	7619217.00	303.31	173.3	164.3	Basalt
MB16	Open Standpipe	596665.22	7619479.51	311.52	185.3	173.3	Basalt
MB17R	Open Standpipe	596622.82	7613321.01	312.67	247.7	244.7	Basalt
MB18R	Open Standpipe	596791.82	7613519.67	312.66	222.7	216.7	Tertiary Sediments (sand)
MB18R2	Open Standpipe	596807.12	7613530.89	312.68	234.7	228.7	Basalt (weathered)
PB01	Pumping Bore	598598.17	7621735.58	325.78	225.2	187.1	Basalt
PB02	Pumping Bore	596750.26	7619458.96	303.03	187.6	157.6	Basalt (weathered)
PB03	Pumping Bore	596679.15	7613457.74	311.91	236.7	230.7	Tertiary Sediments

Bore ID	Installation Type	Coordinates*		Surface Elevation (m AHD**)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Screened Unit
		Easting	Northing				
							(clayey sand)
VWP1_S1	Vibrating Wire Piezometer	596765	7619461	303.31	-9.2	-9.2	Overburden
VWP1_S2					-30.2	-30.2	Goonyella Upper 0
VWP1_S3					-142.2	-142.2	Goonyella Middle 0
VWP1_S4					-208.2	-208.2	Goonyella Lower 8
VWP2_S1	Vibrating Wire Piezometer	596658.37	7619459.05	302.98	103	102	Overburden
VWP2_S2					90	90	Goonyella Lower 8
VWP2_S3					73	73	Interburden
VWP2_S4					57.5	57.5	Goonyella Lower 10
VWP2_S1	Vibrating Wire Piezometer	596669.03	7613459.80	311.84	146.4	146.4	Interburden
VWP2_S2					105.84	105.84	Goonyella Middle 0
VWP2_S3					79.84	79.84	Goonyella Lower 3
VWP2_S4					47.84	47.84	Goonyella Lower 8

Note: *Coordinates in AGD84, Zone 55. **m AHD refers to metres Australian Height Datum

APPENDIX B

Groundwater Quality Table

	Heavy Metals															PAH	Sample Quality Parameters										Total Petroleum Hydrocarbons																
	Aluminium	Antimony	Arsenic	Barium	Boron	Chromium	Copper	Iron	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Zinc	Naphthalene	Electrical Conductivity @ 25°C	pH (Lab)	Total Dissolved Solids @180°C (Filtered)	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate as SO4 - Turbidimetric	Sulphate (as SO4)	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)	Hydroxide Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3)	Total Suspended Solids	TRH C6 - C9 Fraction	TRH C10 - C14 Fraction	TRH C15 - C28 Fraction	TRH C29 - C36 Fraction	TRH+C10 - C36 (Sum of total) (Lab Reported)	TRH C6 - C10 Fraction F1	TRH C6 - C10 Fraction Less BTEX F1	TRH >C10 - C16 Fraction F2	TRH >C10 - C16 Fraction Less Naphthalene F2	TRH >C16 - C34 Fraction F3	TRH >C34 - C40 Fraction F4	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm	pH Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
ADWG 2018 Aesthetic			0.01		4		1	0.3							3			6.5-8.5	600	180					250		250																
ADWG 2018 Health		0.003		2			2		0.001	0.05	0.02	0.01	0.1	0.017																													
ANZECC 2000 Livestock Drinking Water	5		0.5		5	1	0.4		0.002	0.15	1	0.02		0.2	20							1000				1000																	

Sample ID	Sampled Date Time	<0.05	<0.005	0.002	0.09	0.13	<0.001	0.001	<0.05	<0.0001	<0.005	0.001	<0.001	<0.005	<0.05	0.012	<0.02	1900	7.9	1000	290	2.9	45	3	520	<5	<5	89	<10	<10	89	3.6	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB05R	13/08/2015	<0.05	<0.005	<0.001	0.07	0.16	<0.001	0.002	<0.05	<0.0001	0.005	0.001	<0.001	<0.005	<0.005	0.022	<0.02	2100	8.1	1100	300	3.6	56	4.4	560	5.9	5.9	91	<10	<10	91	<1	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB05R	26/11/2015	<0.05	<0.005	<0.001	0.06	0.14	0.009	0.003	<0.05	<0.0001	0.005	0.005	<0.001	<0.005	<0.005	0.033	<0.01	2100	7.8	1400	300	3.2	59	4.2	540	6.8	6.8	91	<10	<10	91	2.6	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB05R	23/03/2016	<0.05	<0.005	<0.001	0.07	0.07	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.037	<0.01	2000	7.9	1200	320	3.3	68	5	560	6.5	6.5	90	<10	<10	90	11	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB05R	7/06/2016	<0.01	<0.001	<0.001	0.075	0.16	<0.001	<0.001	<0.05	<0.0001	0.005	<0.001	<0.01	<0.001	<0.001	0.008	<0.005	2110	7.92	1180	347	4	67	5	631	20	20	84	<1	<1	84	8	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB05R	13/09/2016	0.07	<0.005	<0.001	0.07	0.14	<0.001	<0.001	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.001	0.005	<0.01	2100	8.2	1200	310	6.2	64	5.1	530	6.5	6.5	100	<10	<10	100	250	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB05R	2/11/2016	<0.01	<0.001	<0.001	0.123	0.14	<0.001	<0.001	<0.05	<0.0001	0.004	0.001	<0.01	<0.001	<0.001	0.016	<0.1	1970	7.61	1270	337	3	62	5	625	19	19	92	<1	<1	92	<5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB05R	14/02/2017	0.01	<0.001	<0.001	0.071	0.15	<0.001	<0.001	<0.05	<0.0001	0.006	0.001	<0.01	<0.001	<0.001	0.005	<0.1	2070	7.52	1200	343	3	59	5	614	21	21	83	<1	<1	83	770	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB05R	16/05/2017	<0.01	<0.001	<0.001	0.075	0.17	<0.001	<0.001	<0.05	<0.0001	0.005	<0.001	<0.01	<0.001	<0.001	<0.005	<0.1	2160	7.8	1290	354	3	61	5	599	21	21	89	<1	<1	89	465	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB05R	20/04/2018	<0.01	<0.001	<0.001	-	-	-	-	0.14	<0.0001	0.005	-	<0.01	<0.001	-	-	<0.1	2030	7.69	1210	350	4	58	5	612	19	19	83	<1	<1	83	6	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB05R	26/07/2018	<0.01	0.002	0.001	-	-	-	-	0.05	<0.0001	0.006	-	<0.01	<0.001	-	-	<0.1	2100	7.86	1220	338	3	65	5	663	20	20	82	<1	<1	82	9	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB05R	25/01/2019	<0.01	<0.001	<0.001	-	-	-	-	0.06	<0.0001	0.006	-	<0.01	<0.001	-	-	<5	2010	7.75	1190	310	3	59	5	652	19	19	87	<1	<1	87	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB05R	22/07/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.006	-	<0.01	<0.001	-	-	<5	2140	7.92	1310	328	3	63	5	659	20	20	91	<1	<1	91	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB06	28/05/2015	<0.05	<0.005	<0.001	<0.02	<0.05	0.001	0.004	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.05	0.013	<0.02	960	8.5	500	170	1.6	12	1.5	190	6	6	180	<10	<10	190	1.6	0.04	<0.05	<0.1	<0.1	<0.1	0.04	0.02	<0.05	<0.05	<0.1	<0.1
MB06	12/08/2015	<0.05	<0.005	<0.001	<0.02	0.05	<0.001	0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.006	<0.02	900	8.4	490	180	2	11	1.6	190	6.3	6.3	180	<10	<10	180	7.2	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB06	25/11/2015	<0.05	<0.005	<0.001	<0.02	<0.05	0.006	0.008	<0.05	<0.0001	<0.005	0.004	<0.001	<0.005	<0.005	0.016	<0.01	980	8.2	490	170	1.7	12	1.5	200	6	6	190	<10	<10	190	6.4	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB06	24/03/2016	<0.05	<0.005	<0.001	<0.02	<0.05	<0.001	0.002	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.023	<0.01	970	8.5	480	180	2	13	2.2	190	6.1	6.1	180	<10	<10	190	15	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB06	8/06/2016	0.01	<0.001	<0.001	0.004	<0.05	<0.001	0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.007	<0.005	1000	8.47	556	197	2	13	3	212	19	19	156	17	<1	173	<5	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB06	15/09/2016	0.37	<0.005	<0.001	<0.02	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.001	0.01	<0.01	980	8.4	510	180	1.8	13	2	190	6.5	6.5	180	<10	<10	190	<1	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB06	3/11/2016	<0.01	<0.001	<0.001	0.004	<0.05	<0.001	<0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.009	<0.1	1050	8.38	606	200	2	16	5	246	18	18	169	14	<1	182	<5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB06	17/05/2017	0.02	<0.001	<0.001	0.013	<0.05	<0.001	<0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	<0.005	<0.1	1000	8.37	552	200	2	12	2	195	19	19	177	3	<1	180	<5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB06	20/04/2018	0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<0.1	946	8.33	559	198	2	12	2	194	19	19	167	5	<1	172	<5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB06	27/06/2018	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<0.1	963	8.46	547	187	2	12	2	208	19	19	161	14	<1	175	<5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB06	25/01/2019	0.02	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	959	8.36	536	180	2	12	3	212	27	27	171	12	<1	175	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB06	22/07/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	982	8.46	518	184	2	11	2	209	19	19	187	10	<1	197	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB07	28/05/2015	<0.05	<0.005	0.001	<0.02	0.39	<0.001	0.011	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.05	0.06	<0.02	3100	7.8	1800	390	7.3	89	47	920	<5	<5	120	<10	<10	120	3.1	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB07	11/08/2015	<0.05	<0.005	<0.001	<0.02	0.51	<0.001	0.006	<0.05	<0.0001	<0.005	0.001	<0.001	<0.005	<0.05	0.048	<0.02	2800	8.1	2000	390	7.9	89	52	920	<5	<5	120	<10	<10	120	4.8	<0.02	<0.05	<0.1	<							

	Heavy Metals															PAH	Sample Quality Parameters										Total Petroleum Hydrocarbons																
	Aluminium	Antimony	Arsenic	Barium	Boron	Chromium	Copper	Iron	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Zinc	Naphthalene	Electrical Conductivity @ 25°C	pH (Lab)	Total Dissolved Solids @ 180°C (Filtered)	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate as SO4 - Turbidimetric	Sulphate (as SO4)	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)	Hydroxide Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3)	Total Suspended Solids	TRH C6 - C9 Fraction	TRH C10 - C14 Fraction	TRH C15 - C28 Fraction	TRH C29 - C36 Fraction	TRH+C10 - C36 (Sum of total) (Lab Reported)	TRH C6 - C10 Fraction F1	TRH C6 - C10 Fraction Less BTEX F1	TRH >C10 - C16 Fraction F2	TRH >C10 - C16 Fraction Less Naphthalene F2	TRH >C16 - C34 Fraction F3	TRH >C34 - C40 Fraction F4	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
ADWG 2018 Aesthetic							1	0.3							3			6.5-8.5	600	180				250		250																	
ADWG 2018 Health		0.003	0.01	2	4		2		0.001	0.05	0.02	0.01	0.1	0.017																													
ANZECC 2000 Livestock Drinking Water	5		0.5		5	1	0.4		0.002	0.15	1	0.02		0.2	20						1000				1000																		

Sample ID	Sampled Date Time	<0.05	<0.005	<0.001	<0.02	<0.05	<0.001	0.001	<0.05	<0.0001	<0.005	0.001	<0.001	<0.005	<0.05	0.007	<0.02	2600	7.4	1400	430	2.5	38	<0.5	790	<5	<5	37	<10	<10	37	3.9	<0.02	<0.05	<0.1	<0.1	<0.1	0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB10	29/05/2015	<0.05	<0.005	<0.001	<0.02	0.07	<0.001	0.001	<0.05	<0.0001	<0.005	0.001	<0.001	<0.005	<0.05	0.007	<0.02	2600	7.4	1400	430	2.5	38	<0.5	790	<5	<5	37	<10	<10	37	3.9	<0.02	<0.05	<0.1	<0.1	<0.1	0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB10	13/08/2015	<0.05	<0.005	<0.001	<0.02	0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.005	<0.02	2300	7.2	1400	420	2.7	36	<0.5	790	<5	<5	20	<10	<10	20	2.2	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB10	25/11/2015	<0.05	<0.005	<0.001	0.02	<0.05	0.008	0.001	<0.05	<0.0001	<0.005	0.004	<0.001	<0.005	<0.005	0.015	<0.01	2600	7.4	1500	420	2.9	36	<0.5	760	<5	<5	39	<10	<10	39	3.7	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB10	22/03/2016	<0.05	<0.005	<0.001	<0.02	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.005	<0.01	2600	7.9	1400	420	3.3	39	0.5	740	<5	<5	35	<10	<10	35	5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB10	8/06/2016	0.01	<0.001	<0.001	0.018	<0.05	<0.001	0.002	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.01	<0.005	2590	7.83	1440	447	2	40	2	810	<1	<1	42	<1	<1	42	23	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB10	13/09/2016	<0.05	<0.005	<0.001	0.08	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.002	<0.01	2600	7.6	1500	440	2.6	39	0.9	690	<5	<5	36	<10	<10	36	84	<0.02	<0.05	<0.1	0.4	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB10	1/11/2016	<0.01	<0.001	<0.001	0.025	0.06	<0.001	<0.001	<0.05	<0.0001	0.003	<0.001	<0.01	<0.001	<0.001	<0.005	<0.1	2470	7.87	1420	460	2	38	<1	838	<1	<1	52	<1	<1	52	62	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB10	14/02/2017	<0.01	<0.001	<0.001	0.063	<0.05	<0.001	<0.001	<0.05	<0.0001	0.003	<0.001	<0.01	<0.001	<0.001	<0.005	<0.1	2640	7.94	1450	478	2	38	<1	821	<1	<1	54	<1	<1	54	128	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB10	16/05/2017	0.01	<0.001	<0.001	0.059	0.06	<0.001	<0.001	<0.05	<0.0001	0.003	<0.001	<0.01	<0.001	<0.001	<0.005	<0.1	2690	7.68	1540	505	2	38	<1	794	<1	<1	38	<1	<1	38	109	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB10	19/04/2018	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.003	-	<0.01	<0.001	-	-	<0.1	2530	7.47	1460	488	3	36	1	799	1	1	42	<1	<1	42	6	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB10	26/07/2018	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<0.1	2570	7.74	1440	468	4	42	<1	843	<1	<1	42	<1	<1	42	5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB10	24/01/2019	0.03	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	2770	8	1610	466	3	46	2	915	3	3	49	<1	<1	49	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB10	22/07/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	2690	7.59	1580	463	2	40	2	865	1	1	45	<1	<1	45	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB11	29/05/2015	<0.05	<0.005	0.001	<0.02	0.08	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.05	0.012	<0.02	2000	6.9	1100	330	2.5	24	<0.5	590	<5	<5	29	<10	<10	29	2.5	0.03	<0.05	<0.1	<0.1	0.03	<0.02	<0.05	<0.05	<0.1	<0.1	
MB11	13/08/2015	<0.05	<0.005	<0.001	<0.02	0.07	<0.001	0.002	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.011	<0.02	2100	7.4	1000	340	2.8	24	<0.5	610	<5	<5	<20	<10	<10	<20	1.9	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB11	26/11/2015	<0.05	<0.005	0.001	<0.02	0.05	0.007	0.005	<0.05	<0.0001	<0.005	0.004	<0.001	<0.005	<0.005	0.032	<0.01	2100	7.2	1200	320	2.9	24	<0.5	570	<5	<5	28	<10	<10	28	3.9	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB11	22/03/2016	<0.05	<0.005	<0.001	<0.02	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.01	<0.01	2000	7.9	1100	360	3	28	<0.5	560	<5	<5	28	<10	<10	28	3.9	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB11	8/06/2016	<0.01	<0.001	<0.001	0.016	0.06	<0.001	0.002	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.015	<0.005	2060	7.63	1110	360	2	26	<1	652	<1	<1	31	<1	<1	31	15	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB11	13/09/2016	<0.05	<0.005	<0.001	0.03	0.06	<0.001	0.002	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.015	<0.01	2100	8	1200	370	2.8	28	0.6	530	<5	<5	29	<10	<10	29	7.2	<0.02	<0.05	<0.1	<0.1	0.4	<0.02	<0.02	<0.05	<0.05	0.3	<0.1
MB11	1/11/2016	<0.01	<0.001	<0.001	0.013	0.07	<0.001	0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.009	<0.1	1980	7.7	1200	380	2	28	<1	666	<1	<1	35	<1	<1	35	23	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB11	14/02/2017	<0.01	<0.001	0.001	0.025	0.07	<0.001	<0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.006	<0.1	2090	7.98	1160	384	2	26	<1	675	<1	<1	29	<1	<1	29	15	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB11	16/05/2017	<0.01	<0.001	<0.001	0.02	0.08	<0.001	<0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	<0.005	<0.1	2130	7.41	1180	392	2	26	<1	618	1	1	29	<1	<1	29	9	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB11	19/04/2018	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.003	-	<0.01	<0.001	-	-	<0.1	2020	7.27	1150	389	3	25	<1	629	1	1	60	<1	<1	60	<5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB11	26/07/2018	<0.01	<0.001	0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<0.1	2010	7.01	1130	359	2	28	<1	670	8	8	24	<1	<1	24	5	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB11	24/01/2019	0.02	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	2110	7.53	1190	357	2	29	1	708	3	3	36	<1	<1	36	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB11	23/07/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	2050	7.18	1150	360	4	26	<1	666	<1	<1	30	<1	<1	30	22	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB12	28/05/2015	<0.05	<0.005	<0.001	0.07	0.19	<0.001	0.007	<0.05	<0.0001	<0.005	0.001	<0.001	<0.005	<0.05	0.03	<0.02	1200	8	640	170	3.1	32	21	230	12	12	280	<10	<10	280	7.1	<0.02	<0.05	<0.1	<0.1	<						

	Heavy Metals															PAH	Sample Quality Parameters												Total Petroleum Hydrocarbons															
	Aluminium	Antimony	Arsenic	Barium	Boron	Chromium	Copper	Iron	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Zinc	Naphthalene	Electrical Conductivity @ 25°C	pH (Lab)	Total Dissolved Solids @180°C (Filtered)	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate as SO4 - Turbidimetric	Sulphate (as SO4)	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)	Hydroxide Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3)	Total Suspended Solids	TRH C6 - C9 Fraction	TRH C10 - C14 Fraction	TRH C15 - C28 Fraction	TRH C29 - C36 Fraction	TRH+C10 - C36 (Sum of total) (Lab Reported)	TRH C6 - C10 Fraction F1	TRH C6 - C10 Fraction Less BTEX F1	TRH >C10 - C16 Fraction F2	TRH >C10 - C16 Fraction Less Naphthalene F2	TRH >C16 - C34 Fraction F3	TRH >C34 - C40 Fraction F4		
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm	pH Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
ADWG 2018 Aesthetic							1	0.3							3			6.5-8.5	600	180					250		250																	
ADWG 2018 Health		0.003	0.01	2	4		2		0.001	0.05	0.02	0.01	0.1	0.017																														
ANZECC 2000 Livestock Drinking Water	5		0.5		5	1	0.4		0.002	0.15	1	0.02		0.2	20						1000				1000																			

Sample ID	Sampled Date Time	<0.05	<0.005	0.002	0.91	0.05	<0.001	0.006	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.05	0.055	<0.02	4300	7.4	2700	610	6.4	130	5.6	1400	5	5	35	<10	<10	35	7.7	0.03	<0.05	<0.1	<0.1	<0.1	0.03	<0.02	<0.05	<0.05	<0.1	<0.1
MB14	29/05/2015	<0.05	<0.005	0.002	0.91	0.05	<0.001	0.006	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.05	0.055	<0.02	4300	7.4	2700	610	6.4	130	5.6	1400	5	5	35	<10	<10	35	7.7	0.03	<0.05	<0.1	<0.1	<0.1	0.03	<0.02	<0.05	<0.05	<0.1	<0.1
MB14	12/08/2015	<0.05	<0.005	0.002	1.1	0.06	<0.001	0.003	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.031	<0.02	4500	7.5	2700	640	7.1	120	5.9	1400	5.1	5.1	34	<10	<10	34	2.7	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB14	25/11/2015	<0.05	<0.005	0.002	1.1	<0.05	0.009	0.005	<0.05	<0.0001	<0.005	0.005	<0.001	<0.005	<0.005	0.027	<0.01	4300	7.6	2900	640	6.9	120	6.2	1300	<5	<5	40	<10	<10	40	11	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB14	22/03/2016	<0.05	<0.005	0.002	1	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.022	<0.01	4100	7.6	2800	660	6.9	130	6.1	1300	<5	<5	33	<10	<10	33	100	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB14	7/06/2016	<0.01	<0.001	0.001	1.1	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.001	0.012	<0.005	4280	7.61	2560	688	6	134	6	1310	15	15	36	<1	<1	36	80	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB14	13/09/2016	<0.05	<0.005	0.002	1.1	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.005	0.006	<0.01	4200	7.8	2600	660	7	130	6.2	1200	5.1	5.1	37	<10	<10	37	32	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB14	1/11/2016	<0.01	<0.001	0.002	0.998	<0.05	<0.001	<0.001	<0.05	<0.0001	<0.001	0.001	<0.01	<0.001	<0.001	0.006	<0.1	3840	7.4	2470	662	5	128	6	1290	14	14	41	<1	<1	41	32	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB14	14/02/2017	0.02	<0.001	0.002	1.1	0.05	<0.001	<0.001	<0.05	<0.0001	<0.001	0.001	<0.01	<0.001	<0.001	0.011	<0.1	4360	7.36	2570	725	6	128	7	1370	14	14	35	<1	<1	35	86	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB14	16/05/2017	<0.01	<0.001	0.002	1.1	0.06	<0.001	<0.001	<0.05	<0.0001	<0.001	0.001	<0.01	<0.001	<0.001	<0.005	<0.1	4280	7.39	2520	725	6	123	6	1240	14	14	34	<1	<1	34	23	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB14	20/04/2018	<0.01	<0.001	0.002	-	-	-	-	<0.05	<0.0001	<0.001	-	<0.01	<0.001	-	-	<0.1	4230	7.32	2550	741	6	122	7	1310	14	14	34	<1	<1	34	7	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB14	26/07/2018	<0.01	<0.001	0.002	-	-	-	-	<0.05	<0.0001	<0.001	-	<0.01	<0.001	-	-	<0.1	4300	7.59	2430	690	6	137	7	1370	15	15	37	<1	<1	37	14	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB14	24/01/2019	0.01	<0.001	0.001	-	-	-	-	<0.05	<0.0001	<0.001	-	<0.01	<0.001	-	-	<5	4250	7.36	2420	678	6	130	6	1390	15	15	39	<1	<1	39	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB14	22/07/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	<0.001	-	<0.01	<0.001	-	-	<5	4410	7.66	2630	687	6	134	6	1380	14	14	38	<1	<1	38	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB15	30/05/2015	<0.05	<0.005	0.002	0.03	0.15	<0.001	0.003	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.05	0.067	<0.02	1700	7.7	950	250	3	47	4.5	470	<5	<5	83	<10	<10	83	51	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB15	13/08/2015	<0.05	<0.005	0.002	0.04	0.15	<0.001	<0.001	<0.05	<0.0001	<0.005	0.001	<0.001	<0.005	<0.005	0.015	<0.02	1800	8	950	260	3.2	48	5.4	480	<5	<5	80	<10	<10	80	12	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB15	26/11/2015	<0.05	<0.005	0.002	0.03	0.14	0.008	0.006	<0.05	<0.0001	<0.005	0.006	<0.001	<0.005	<0.005	0.07	<0.01	1800	8	1000	250	3.1	46	5.1	450	<5	<5	84	<10	<10	84	10	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB15	23/03/2016	<0.05	<0.005	0.002	0.03	0.06	<0.001	<0.001	<0.05	<0.0001	<0.005	<0.001	<0.001	<0.005	<0.005	0.057	<0.01	1700	7.9	1000	260	2.8	49	5.3	450	<5	<5	76	<10	<10	76	41	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB15	7/06/2016	0.02	<0.001	0.002	0.045	0.14	<0.001	<0.001	<0.05	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	0.011	<0.005	1820	8.01	1110	289	3	53	6	551	8	8	78	<1	<1	78	249	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB15	14/09/2016	<0.05	<0.005	0.002	0.04	0.12	<0.001	<0.001	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.005	0.021	<0.01	1800	8	1000	270	5.1	52	6.1	450	<5	<5	85	<10	<10	85	190	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB15	2/11/2016	<0.01	<0.001	0.002	0.055	0.13	<0.001	<0.001	<0.05	<0.0001	0.002	0.001	<0.01	<0.001	<0.001	0.016	<0.1	1690	7.79	1030	278	3	52	6	546	7	7	88	<1	<1	88	70	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB15	14/02/2017	<0.01	<0.001	0.002	0.042	0.16	<0.001	<0.001	<0.05	<0.0001	0.002	0.001	<0.01	<0.001	<0.001	0.01	<0.1	1770	7.72	1060	291	3	49	6	532	6	6	81	<1	<1	81	581	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB15	16/05/2017	0.02	<0.001	0.002	0.044	0.16	<0.001	0.004	<0.05	<0.0001	0.002	0.001	<0.01	<0.001	<0.001	0.031	<0.1	1810	7.88	1080	302	3	50	6	504	7	7	82	<1	<1	82	663	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB15	20/04/2018	<0.01	<0.001	0.002	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<0.1	1700	7.7	1030	285	4	46	7	512	6	6	81	<1	<1	81	22	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB15	26/07/2018	<0.01	0.003	0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<0.1	1740	7.84	1020	274	3	53	7	547	7	7	78	<1	<1	78	17	<0.02	<0.05	<0.1	<0.1	<0.1	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
MB15	25/01/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	1700	7.77	1000	258	3	48	7	547	8	8	88	<1	<1	88	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB15	22/07/2019	<0.01	<0.001	<0.001	-	-	-	-	<0.05	<0.0001	0.002	-	<0.01	<0.001	-	-	<5	1800	7.96	1110	283	3	54	7	552	7	7	82	<1	<1	82	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100
MB18R	28/05/2015	<0.05	<0.005	0.003	0.13	0.45	<0.001	<0.001	<0.05	<0.0001	<0.005	0.002	<0.001	<0.005	<0.05	0.052	<0.02	4000	7.8	2800	460	8.1	160	44	1200	29	29	84	<10	<10	84	110	<0.02	<0.05	<0.1	<0.1	<0.1	0.02	<0.02	<0.05	<0.05	<0.1	<0.1
MB18R	11/08/2015	<0.05	<0.005	0.002	0.14	0.55	<0.001	0.003	<0.05	<0.0001	&																																

	Heavy Metals															PAH	Sample Quality Parameters										Total Petroleum Hydrocarbons																
	Aluminium	Antimony	Arsenic	Barium	Boron	Chromium	Copper	Iron	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Zinc	Naphthalene	Electrical Conductivity @ 25°C	pH (Lab)	Total Dissolved Solids @180°C (Filtered)	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate as SO4 - Turbidimetric	Sulphate (as SO4)	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)	Hydroxide Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3)	Total Suspended Solids	TRH C6 - C9 Fraction	TRH C10 - C14 Fraction	TRH C15 - C28 Fraction	TRH C29 - C36 Fraction	TRH+C10 - C36 (Sum of total) (Lab Reported)	TRH C6 - C10 Fraction F1	TRH C6 - C10 Fraction Less BTEX F1	TRH >C10 - C16 Fraction F2	TRH >C10 - C16 Fraction Less Naphthalene F2	TRH >C16 - C34 Fraction F3	TRH >C34 - C40 Fraction F4	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm	pH Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
ADWG 2018 Aesthetic							1	0.3								3		6.5-8.5	600	180																							
ADWG 2018 Health		0.003		2	4		2		0.001	0.05	0.02	0.01	0.1	0.017																													
ANZECC 2000 Livestock Drinking Water	5		0.5		5	1	0.4		0.002	0.15	1	0.02		0.2	20							1000				1000																	

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APPENDIX C

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification



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APPENDIX 3
ECOLOGICAL AUSTRALIA (10 JUNE 2016): WARDS WELL/LANCEWOOD BRIGALOW TEC
ASSESSMENT

Taryn Shears
Specialist Exploration Geology - Validation
BHP Billiton
Brisbane, QLD 4000

10 June 2016

Dear Taryn,

RE: Wards Well/Lancewood Brigalow TEC Assessment

A field survey has been conducted to verify the presence, extent and condition of a potential area of Brigalow (*Acacia harpophylla*) vegetation within the Wards Well project area. The potential occurrence of Brigalow vegetation was previously identified during baseline ecological assessments undertaken across the area in 2010. The area of Brigalow vegetation (from herein referred to as the target area) is located within the northern portion of the Wards Well / Lancewood Mining Lease (ML 4752) (the study area) (**Figure 1**).

The purpose of the field survey was to identify any potential State and Federal approval triggers and requirements that may be associated with exploration activities currently proposed within the target area. Specifically, the survey was undertaken to:

- confirm whether the vegetation constitutes a Threatened Ecological Community (TEC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- determine whether the vegetation classifies as a Category B Environmentally Sensitive Area (ESA) under the *Environmental Protection Act 1994* (EP Act)

The following sections outline the methodology of the assessment as well as the results. Recommendations have been provided based on the outcomes of the assessment.

Methodology

A desktop assessment of relevant environmental documents, databases and maps was initially undertaken to identify the likelihood of the TEC as well as Category B ESA to occur within the study area. A targeted field survey was then undertaken on the 26th May 2016 to validate whether the TEC and / or Category B ESA were present. The field survey involved:

- Diagnostic and condition assessments for Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC in accordance with the criteria and thresholds in the Approved Conservation Advice (Threatened Species Scientific Committee (TSSC), 2013)
- BioCondition Assessments in accordance with the Queensland Herbarium assessment manual “*A Condition Assessment Framework for Biodiversity in Queensland*” (version 2.2) to determine condition of the vegetation
- Regional Ecosystem (RE) Assessments in accordance with the Queensland Herbarium methodology (Nelder *et al.* 2012) to verify the structure and RE classification of the vegetation

- Quaternary vegetation assessments in accordance with the Queensland Herbarium methodology (Nelder *et al.* 2012) to validate the Regional Ecosystem (RE) classification and extent of vegetation communities

The location of all field survey sites are shown in **Figure 2**.

Results

Category B ESA

Under the *Environmental Protection Regulation 2008*, Endangered REs as defined in the Regional Ecosystem Description Database (REDD) are classified as Category B Environmentally Sensitive Areas (ESA). The results of the field survey identified one Endangered RE, RE 11.4.8 within the middle of the target area (**Figure 3**). The Endangered RE was also located just outside the boundary of the study area (to the east).

The Endangered RE within the target area was ground-truthed to occupy an area of approximately 1 ha and was found to comprise the same structural and compositional features as RE 11.4.8 that is described in REDD. The area was identified as remnant and BioCondition assessments scored the area within the second highest condition category (category 2 – functional biodiversity condition).

The balance of the target area was found to comprise predominantly Brigalow regrowth. BioCondition scores for the regrowth vegetation were within the lowest condition category (category 4 - dysfunctional biodiversity condition). In addition, canopy height (average 7.5 m) was recorded to be well below the typical height for Brigalow REs (approximately 15 m), key dominant species from Brigalow REs were absent and weed incursion was high. Due to these factors the regrowth vegetation within the target area is not considered to include the compositional or structural components that are required to meet the definition of this Brigalow RE listed in REDD. As such the vegetation is not considered to be an Endangered RE and therefore is not considered to be a Category B ESA.

Table 1 Error! Reference source not found. describes the ground-truthed Endangered REs within the target area, whilst **Figure 3** illustrates the Endangered RE within and adjacent to the target area.

Table 1: Ground-truthed Endangered REs within the target area

RE	REDD Short Description	VM Act Class / Biodiversity Status	Condition
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	Endangered / Endangered	Remnant

Threatened Ecological Communities

Three TECs were identified in the desktop assessment as potentially occurring within the study area, including:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandwear Bioregions

The field survey identified only Brigalow dominated vegetation within the target area, which is one of the key diagnostic criteria for the Brigalow TEC. Whilst the Queensland State RE mapping identified a semi-evergreen vine thicket dominant community (RE 11.8.13) within the target area, this was confirmed to be incorrect during field investigation.

To determine whether the Brigalow dominated vegetation met all of the key diagnostic criteria and condition thresholds for the Brigalow TEC, 13 Brigalow TEC assessments were undertaken across and directly adjacent to the target area. The findings of these assessments are provided within **Attachment 1**.

Results of the TEC assessments indicate that only one patch of vegetation within the target area meets the classification for the Brigalow TEC. The remnant Brigalow vegetation analogous to RE 11.4.8 (also Category B ESA) was found to meet all diagnostic, structure and patch size criteria for the Brigalow TEC. The area also met the required condition thresholds as weed incursion was recorded at only 20% of the total ground cover. Another area of similar composition and condition ground-truthed just outside of the study area was also found to meet the Brigalow TEC criteria.

The remaining regrowth areas within the target area were found to be of a sufficient patch size; however all areas fell below the required condition threshold for Brigalow TEC due to high weed incursion. In these areas, weed incursion occupied between 60 – 90% of the ground cover.

Overall, only two discrete patches of vegetation classify as the Brigalow TEC, with only one of these patches occurring within the target area, occupying an area of 1 ha (refer to **Figure 4** and **Attachment 2**).

Significant Impact Assessment

Potential impacts to the Brigalow TEC were assessed in accordance with the Matters of National Environmental Significance Significant Impact Guidelines 1.1. This assessment identified that the clearing will not have a significant impact due the very minor loss of TEC and no reduction in the TECs extent of occurrence and area of occupancy (**Table 2**).

Table 2 Significant impact assessment

Criteria	Significant impact	Reason
Reduce the extent of an ecological community	No	The clearing will result in the loss of one patch of Brigalow which is approximately 1 ha. The extent of occurrence of the TEC will not be reduced as a result of this activity.
Fragment or increase fragmentation of an ecological community,	No	The clearing will not fragment

for example by clearing vegetation for roads or transmission lines		any patches of Brigalow
Adversely affect habitat critical to the survival of an ecological community	No	The clearing will result in the loss of one patch of Brigalow which is approximately 1 ha. The extent of occurrence and area of occupancy of the TEC will not be reduced as a result of this activity.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	No	The activity will result in minor impacts that will not affect the viability of other TEC patches in the area.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	No	Remaining patches of Brigalow will not be impacted by the activity.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	No	Remaining patches of Brigalow will not be impacted by the activity. These areas are currently highly disturbed and do not meet the TEC criteria.
Interfere with the recovery of an ecological community.	No	The clearing will result in a very minor loss (1 ha) of Brigalow TEC.

Conclusion & Recommendations

The field surveys have confirmed a 1 ha patch of Brigalow TEC within the target area. This area was also ground-truthed as an Endangered RE and a Category B ESA. Another area of Brigalow TEC and Category B ESA was identified outside of the target area but in close proximity to the study area.

Clearing of the 1 ha patch of Brigalow TEC within the target area is unlikely to be a significant impact, therefore, potential impacts can be self-assessable and referral to the Department of the Environment is not required.

The balance of Brigalow regrowth vegetation within the target area was assessed to be in poor condition and did not contain the necessary compositional or structural components to be classified as an Endangered RE. In addition, the regrowth vegetation was found to not meet the Brigalow TEC criteria due to the high weed incursion recorded across the area.

It is recommended that where possible, measures are undertaken to avoid and / or minimise impacts to the identified areas of the Brigalow TEC / Category B ESA.

Where disturbance within Category B ESA is unavoidable, all exploration activities are to be conducted in accordance with Conditions of the Wards Well Environmental Authority (MIN100496707).

If you have any questions about any aspect of the above information, please contact me on (07) 3503 7194.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Liz Fisher', with a stylized flourish at the end.

Liz Fisher

Senior Ecologist

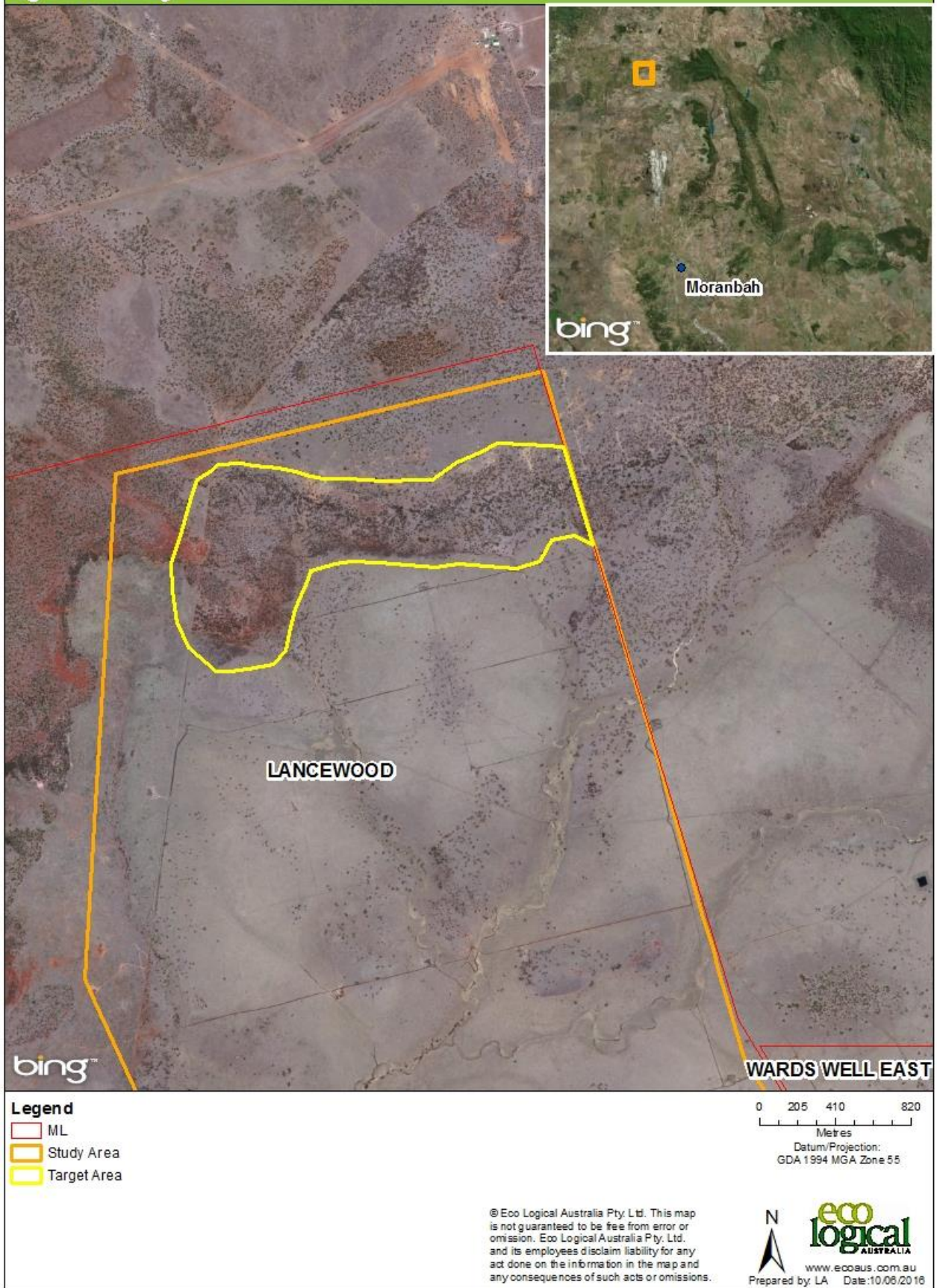
Figure 1 - Study Area**Figure 1 - Study Area**

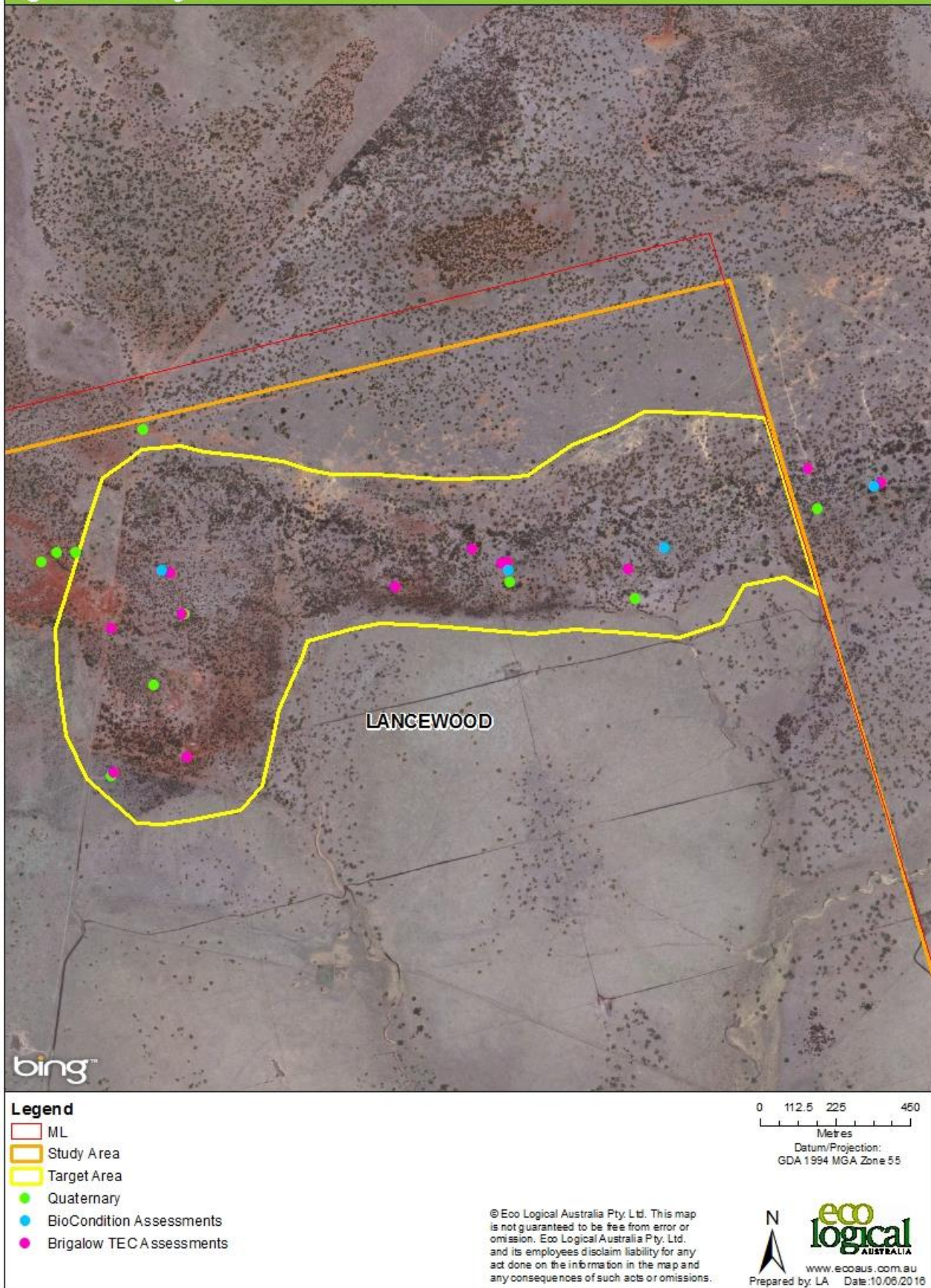
Figure 2 - Survey Sites**Figure 2 - Survey Sites**

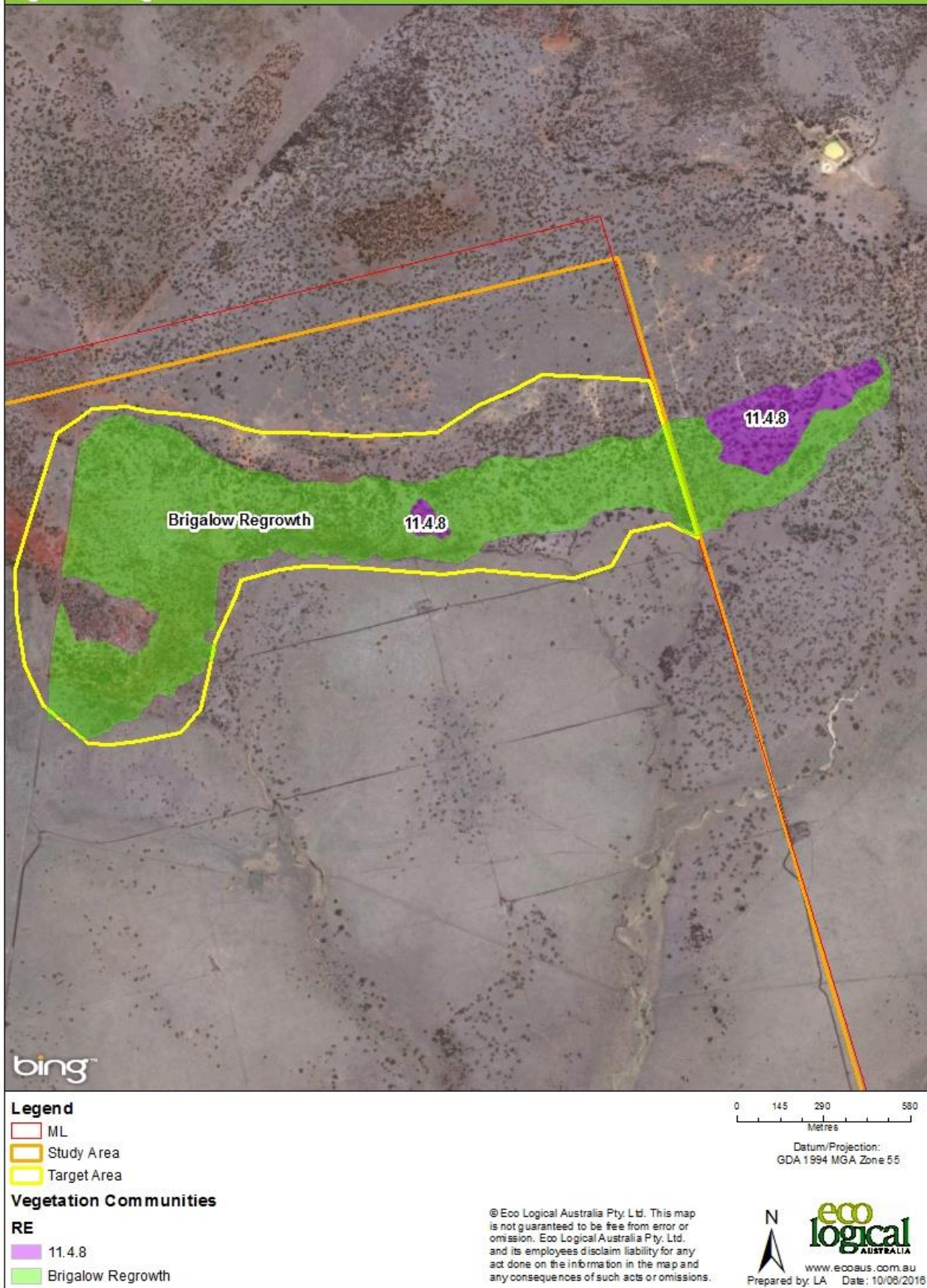
Figure 3 - Vegetation Communities**Figure 3 - Vegetation Communities**

Figure 4 - Brigalow TEC

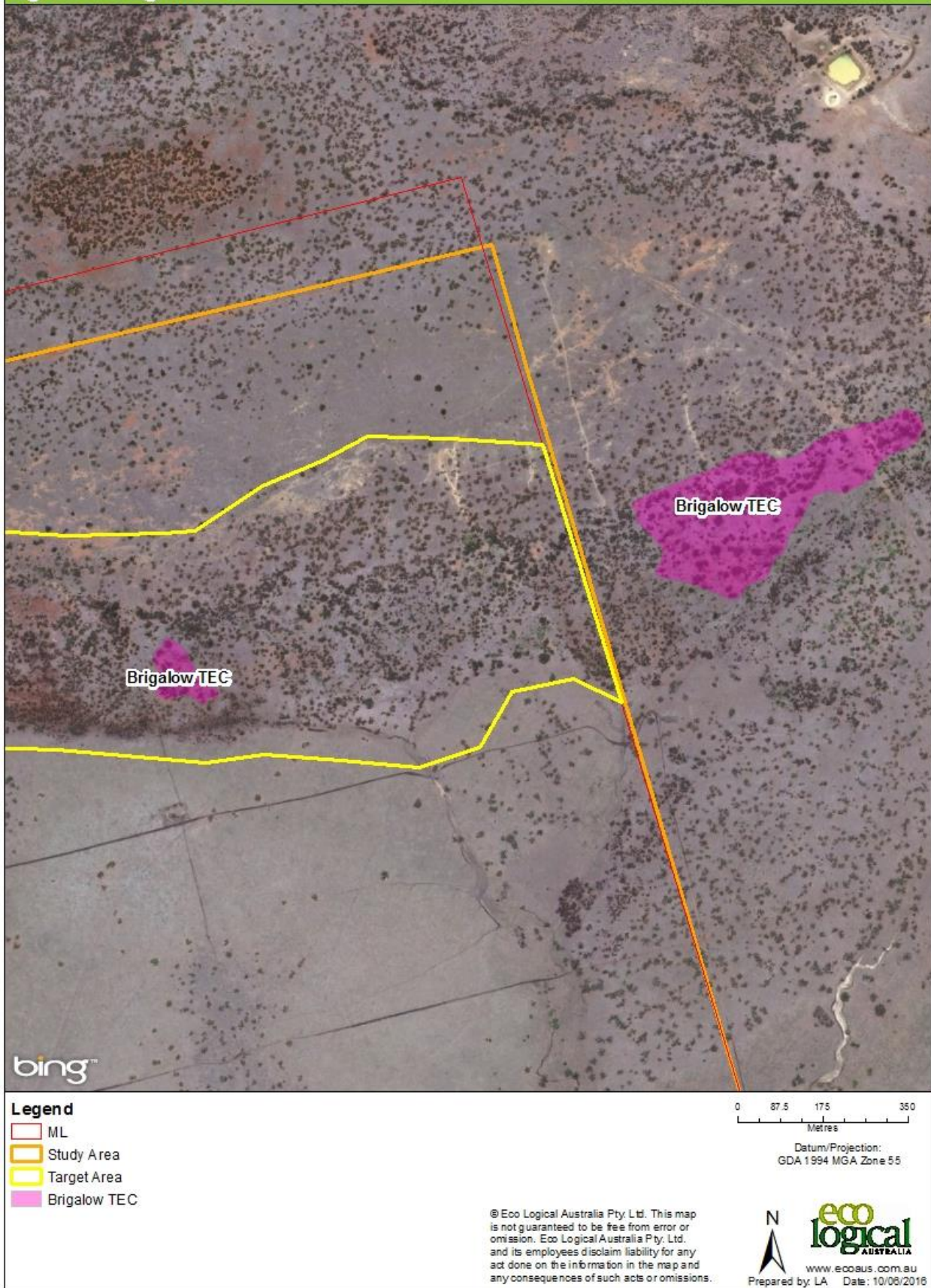


Figure 4 - Brigalow TEC

Attachment 1 – Brigalow TEC Assessments

Survey Site	RE	Tree Layer	Age	Patch Size	Weed Cover
1	-	Dominant	5-15 yrs	>0.5 ha	80
2	-	Dominant	5-15 yrs	>0.5 ha	70
3	-	Dominant	>15 yrs	<0.5 ha	70
4	11.4.8	Co-dominant	>15 yrs	>0.5 ha	20
5	-	Dominant	5-15 yrs	>0.5 ha	60
6	-	Dominant	5-15 yrs	>0.5 ha	65
7	-	Dominant	5-15 yrs	>0.5 ha	60
8	-	Dominant	5-15 yrs	>0.5 ha	60
9	11.4.8	Co-dominant	>15 yrs	>0.5 ha	20
10	-	Dominant	5-15 yrs	>0.5 ha	80
11	-	Dominant	5-15 yrs	>0.5 ha	60
12	-	Dominant	5-15 yrs	>0.5 ha	70
13	-	Dominant	5-15 yrs	>0.5 ha	90

Attachment 2 – Representative Photos Brigalow TEC



APPENDIX 4
ECOLOGICAL AUSTRALIA (18 AUGUST 2017): WARDS WELL COAL PROJECT – ECOLOGICAL
ASSESSMENT REPORT. PROJECT NO. 17 BRIECO-4089



Wards Well Coal Project

Ecological Assessment Report

Prepared for
BHP

18 August 2017



DOCUMENT TRACKING

Item	Detail
Project Name	Wards Well Coal Project – Ecological Assessment Report
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Reviewed by	Liz Fisher
Approved by	Ailsa Kerswell
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Cover photo	Top left: Natural Grasslands; Top Right: <i>Accipiter fasciatus</i> (Brown Goshawk); Bottom Left: Brigalow woodlands; Bottom right: <i>Dichanthium setosum</i> (Bluegrass) taken by Renee Whitchurch and Jessie McCudden, June 2017

This report should be cited as 'Eco Logical Australia 2017. *Wards Well Coal Project – Ecological Assessment Report*. Prepared for BHP.'

ACKNOWLEDGEMENTS

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Template 29/9/2015

Contents

Executive summary.....	vi
1 Introduction.....	7
1.1 Project Background	7
1.2 Objectives and Scope of Work	7
1.3 Study Area Description.....	8
2 Methods.....	10
2.1 Desktop Assessment.....	10
2.2 Field Survey.....	11
2.2.1 Flora Assessment.....	11
2.2.2 Fauna Assessment.....	13
2.3 Data Analysis.....	18
2.3.1 Bat Call Analysis.....	18
2.3.2 GIS Analysis	18
2.3.3 Habitat quality scoring	18
2.4 Survey Limitations	18
3 Results.....	20
3.1 Survey Conditions	20
3.2 Floristic Values	20
3.2.1 Vegetation Communities	20
3.2.2 Category B ESAs.....	22
3.2.3 Threatened Ecological Communities.....	23
3.2.4 Threatened Flora	23
3.2.5 Weeds.....	24
3.3 Habitat Values	27
3.3.1 Habitat Types.....	27
3.3.2 Essential Habitat.....	29
3.4 Fauna Values.....	31
3.4.1 Threatened Species	31
3.4.2 Pests.....	32
3.5 Landscape Values	35
3.5.1 Wetlands and Watercourses	35
3.5.2 Context and Connectivity.....	35
4 Ecological constraints	36
4.1 Commonwealth.....	36

4.2	State	37
5	Mitigation and Management	40
5.1	Introduction	40
5.2	Avoidance Measures	40
5.3	Minimisation Measures	40
5.4	Mitigation Measures	41
6	Summary and Conclusion	42
	References	43
	Appendix A Habitat Quality Scoring Tables	44
	Appendix B Environmentally Sensitive Areas	46
	Appendix C Koala Habitat Assessment Results	47
	Appendix D Habitat Quality Assessment Data	48
	Appendix E Brigalow TEC Assessment Results	49
	Appendix F Squatter Pigeon Habitat Assessment Results	51
	Appendix G Koala Habitat Assessment Results	52
	Appendix H Ornamental Snake Habitat Assessment Results	53
	Appendix I Natural Grassland TEC Assessment Results	54
	Appendix J Likelihood of Occurrence Table	58
	Appendix K Bat Call Analysis Report (Greg Ford)	65

List of figures

Figure 1: Study Area	9
Figure 2: Survey Sites	16
Figure 3: Targeted Fauna Survey Sites	17
Figure 4: Ground-truthed Vegetation Communities	25
Figure 5: Category B ESAs, TECs and <i>Dichanthium queenslandicum</i> and <i>D. setosum</i> habitat	26
Figure 6: Habitat Types	30
Figure 7: Threatened Fauna Habitat	34

Figure 8: Ecological Constraints.....	39
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List of tables

Table 1: Condition classes for the Natural Grassland TEC	12
Table 2: REs included in the SEVT TEC.....	13
Table 3: Weather conditions preceding and during the field survey	20
Table 4: Vegetation communities ground-truthed within the study area	21
Table 5: Category B ESA vegetation identified within the study area.....	22
Table 6: Declared weeds identified during desktop assessment as potentially occurring within the study area	24
Table 7: Declared pests identified during desktop assessment as potentially occurring within the study area	32
Table 8: Summary of ecological assessment key finding	42

Abbreviations

Abbreviation	Description
EHP	Department of Environment and Heritage Protection
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESA	Environmentally Sensitive Area
GES	General Ecological Significance
ML	Mining Lease
NC Act	<i>Nature Conservation Act 1992</i>
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SEVT	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
TEC	Threatened Ecological Community
VM Act	<i>Vegetation Management Act 1999</i>

Executive summary

An ecological assessment has been undertaken to identify and quantify ecological values located within the proposed Wards Well Coal Project disturbance area. This information is required to assist in determining legislative constraints associated with exploration works for the Wards Well Coal Project.

The ecological assessment included a desktop review of available ecological databases and mapping and a field survey to validate and ground-truth the findings of the desktop assessment. The field survey consisted of quaternary surveys to identify vegetation communities, site condition assessments, Threatened Ecology Community (TEC) assessments and targeted habitat assessments for threatened fauna species, including Greater Glider (*Petauroides volans*), Koala (*Phascolarctos cinereus*) and microchiropteran bats.

A number of ecological values were identified within the proposed disturbance area. These include the identification of three TECs. Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC was ground-truthed within an area of 91.2 ha, Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (Natural Grasslands) TEC was ground-truthed within an area of 786.4 ha and Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC was ground-truthed within an area of 57.3 ha. Category B Environmentally Sensitive Areas (ESAs) are defined as Regional Ecosystems (REs) which have an Endangered Biodiversity status. REs meeting the definition of Category B ESA were ground-truthed within an area of 828.4 ha.

Dichanthium queenslandicum is currently listed as Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and a total of 813 ha of habitat for the species was identified within the study area. In addition to threatened flora habitat, habitat for four threatened fauna species was also identified. Habitat for Koala, listed as Vulnerable under the EPBC Act and *Nature Conservation Act 1992* (NC Act) was ground-truthed within an area of 1,911.5 ha, habitat for Greater Glider listed as Vulnerable under the EPBC Act and Vulnerable under the NC Act was ground-truthed within an area of 315.2 ha, Squatter Pigeon listed as Vulnerable under the EPBC Act and Vulnerable under the NC Act was ground-truthed within an area of 171.2 ha and habitat for Ornamental Snake, listed as Vulnerable under the EPBC Act and NC Act was ground-truthed within an area of 213.6 ha. An additional area of 1,774.7 ha was found to contain MSES values associated with Regulated Vegetation, connectivity and watercourses.

The ecological values detailed above are located across the proposed disturbance area, interspersed with areas of non-remnant and regrowth vegetation which are not environmentally constrained. It is recommended that exploration works are limited to areas outside of identified and mapped ecological values. Where this is not possible additional management and mitigation measures may be employed to avoid and reduce impacts. Where there is the potential for residual impacts, regulatory requirements should be carefully considered prior to activities commencing.

1 Introduction

1.1 Project Background

BHP are currently preparing to undertake exploration activities within the Wards Well Coal Project area. The Wards Well Coal Project is located north of the Red Hill Mine Project as well as the existing Goonyella Riverside and Broadmeadow Mine complex, approximately 50 km north of Moranbah and 135 km south-west of Mackay.

Exploration activities have previously been undertaken across the Wards Well Coal Project area, for which a referral under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted. The referral was for an exploration program across the three adjoining tenements (ML1790, ML4752 and EPC1061) involving 55 drill pads, approximately 42 km of seismic survey lines and associated exploration activities such as tracks. The project received a referral decision notice “not a controlled action if undertaken in a particular manner” on the 1 March 2011 by the Commonwealth Department of the Environment (DoE) (EPBC 2011/5820). This allowed for the program to proceed and specifically permitted the disturbance of the Threatened Ecological Community (TEC) *Natural Grasslands of the Queensland and Central Highlands and the northern Fitzroy Basin* and listed threatened grass species. Disturbance was permitted in accordance with specified disturbance limits and management actions.

Environmental Authority (EA) EPPR00668513 was also granted under the *Environmental Protection Act 1994* (EP Act) to permit exploration drilling & 3D seismic across ML4752, ML1790, ML70443 and ML70495. Works are permitted in accordance with the specified maximum disturbance areas, constraints and conditions outlined in the EA. This includes permitted disturbance to Category B Environmentally Sensitive Areas (ESAs) as per the designed exploration program disturbance footprint included in the EA.

Previous exploration activities have disturbed xx ha [BHP to advise] of the approved disturbance limit for the Grassland TEC consistent within the 2011 EPBC Act referral determination. If additional disturbance above the disturbance limit is required and/or other MNES have the potential to be significantly impacted, then further assessment and/or approvals may be required. Furthermore, the current EA may not be valid due to the potential inconsistencies between the approved exploration program under the EA and the proposed exploration activities. As such, disturbance associated with the proposed exploration activity may not be covered or only partially covered under existing approvals. This ecological assessment has been prepared to identify and quantify ecological values located within the study area as well as associated legislative constraints for consideration in upcoming exploration activities.

1.2 Objectives and Scope of Work

The objective of this assessment is to validate the ecological values within the project area, using both desktop and field verified data, to assist in the identification of ecological constraints for exploration activities.

Specifically, the scope of works included:

- Confirming the presence and absence of Commonwealth and State significant species and associated habitats
- Validating the habitat values of the study area, particularly in relation to supporting significant species such as Koala (*Phascolarctos cinereus*), Greater Glider (*Petauroides volans*),

Ornamental Snake (*Denisonia maculata*), Squatter Pigeon (*Geophaps scripta scripta*) and microchiropteran bats.

- Confirming the extent of Regulated Vegetation, including vegetation analogous to Endangered Regional Ecosystems
- Assessing the condition and extent of Commonwealth listed Threatened Ecological Communities (TECs)
- Determining the quality of vegetation communities present, including identification of weed and pest infestations
- Assessing the landscape values including corridor functions
- Determining the associated legislative constraints for identified ecological values
- Recommending measures to avoid, mitigate and manage potential impacts associated exploration activities

1.3 Study Area Description

The Wards Well Coal Project area encompasses approximately 8,343.1 ha of land, formally described as Lot 8 on GV807254 and Lot 2 on SP214117, which are covered under the Wards Well Mining Leases (ML) ML4752, ML1790 and Exploration Coal Permit (EPC) EPC1016 (project area). The exploration activities will be designed to enhance the understanding of the coal resource for potential mining activities. The focus of the ecological assessment is within the proposed seismic area (study area), which encompasses 7,145 ha and overlays a significant proportion of the MLs and EPC (**Figure 1**).

The study area is predominantly vegetated and consists of a mixture of intact and regrowth woodland communities as well as natural grasslands. Cattle grazing is the predominant land use across the study area as well as in the surrounding area. The Goonyella Mine is located south of the study area. Suttor Development Road intersects the northern portion of the study area. Various minor watercourses also traverse the study area.

Figure One: Study Area

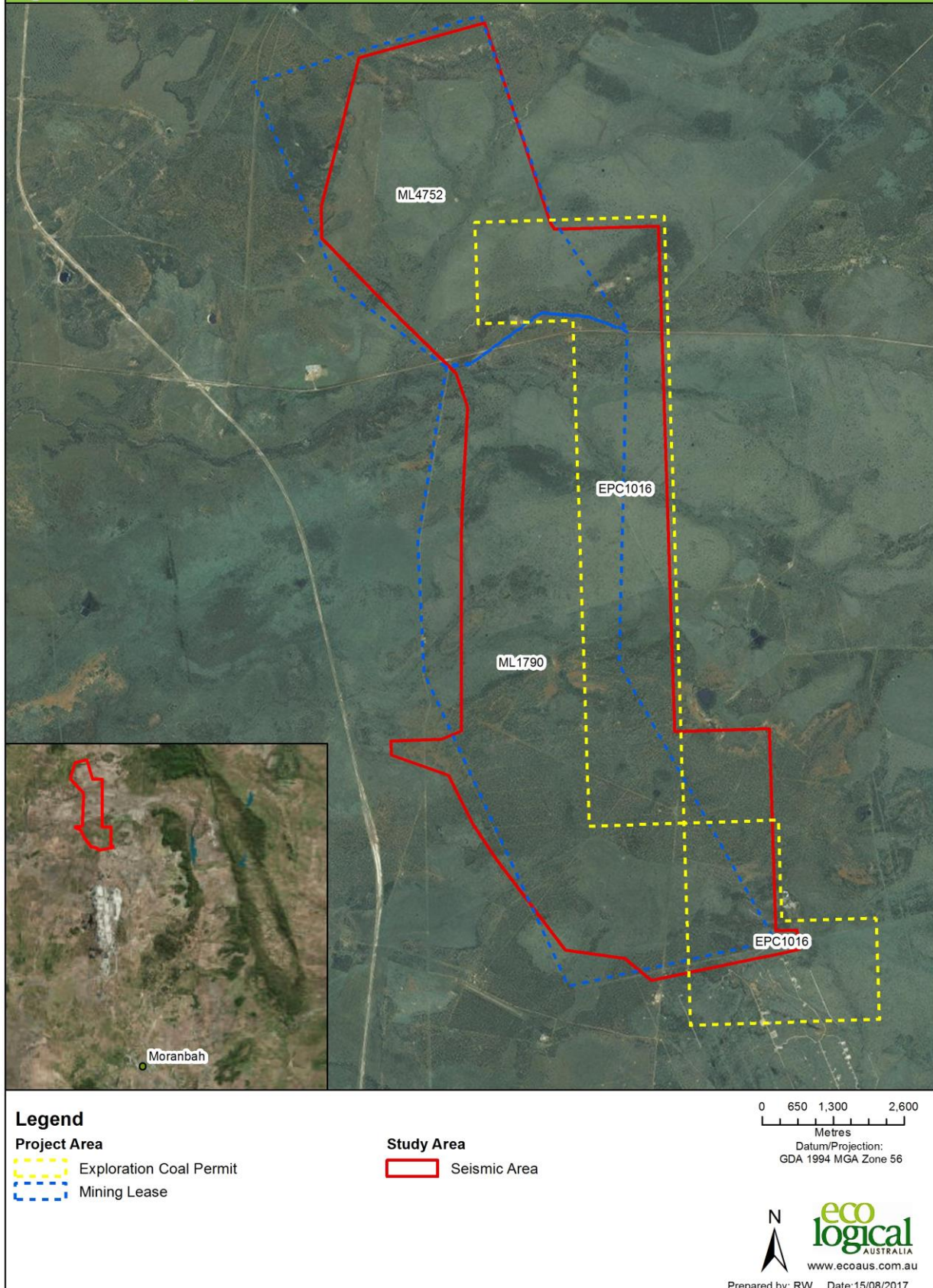


Figure 1: Study Area

2 Methods

2.1 Desktop Assessment

The desktop assessment involved reviewing the relevant environmental documents, databases, maps and legislation (Federal, State and Local) to identify potential ecological values that may occur within the study area. This included the following documents, databases and maps:

- Wards Well / Lancewood Environmental Baseline Survey (SKM 2010)
- Protected Matters Search Tool (PMST) Report (central coordinate of -21.547; 147.949; 20km buffer)
- Wildnet database (central coordinate of -21.547; 147.949; 30km buffer)
- Atlas of living Australia (ALA) species search (central coordinate of -21.547; 147.949; 30km buffer)
- Environmentally Sensitive Areas Map
- Protected Plants Flora Survey Trigger Map
- Regional Ecosystem (RE) mapping version 9.0
- Queensland geological digital data (DNRM, 2012)
- Isaac-Comet land-systems mapping (CSIRO, 1967)
- Essential Habitat mapping version 4.18
- Referrable Wetland mapping
- Wetland Protection Area mapping
- *Vegetation Management Act 1999* (VM Act) watercourse data
- VM Act wetland data
- Matters of State Environmental Significant (MSES) mapping
- Aerial imagery
- Historical aerial imagery (QImagery)

Preliminary vegetation mapping of the study area was also undertaken to further refine the results of the desktop assessment and to provide indicative survey sites to guide field survey effort and ensure sufficient stratification of sampling sites across the study area. Preliminary vegetation mapping was based on mapped RE, geology, land-systems mapping and previous field survey data in conjunction with Aerial Photographic Interpretation (API). API using historical aerial imagery was utilised to differentiate between areas of natural and derived grassland within the study area. Preliminary vegetation mapping involved delineating the study area into assessment units, which are homogenous assessment units defined by a unique RE and broad condition state (i.e. non-remnant, regrowth or remnant). This was done in accordance with the Guide to Determining Terrestrial Habitat Quality (Version 1.2).

Preliminary vegetation mapping and survey sites were uploaded onto a Differential GPS device (Trimble) to assist with navigation during the field survey.

2.2 Field Survey

The field survey was undertaken over ten days, from the 13 to 22 June 2017 to collect additional and more detailed information on the relevant potential ecological values identified from the desktop assessment. The field survey was undertaken by three qualified ecologists and included a flora, fauna and targeted habitat assessment. Survey sites are illustrated in **Figure 2** and **Figure 3**.

Targeted surveys for threatened grass species were also undertaken over eight days between the 19 and 26 April 2017. The methodology and associated results are outlined in the Wards Well Pre-clearance Report (ELA, 2017).

2.2.1 Flora Assessment

The flora assessment consisted of ground-truthing the preliminary vegetation mapping across the study area as well as validating the presence of Regulated Vegetation, TECs and Category B ESAs. Data on vegetation characteristics (floristic and structural form), ecological condition and extent of the vegetation communities, including RE and TEC classification was collected via three methodologies – site condition assessments, quaternary surveys and TEC assessments.

Site Condition Assessment

Site condition assessments were undertaken within the study area in accordance with the *Guide to determining terrestrial habitat quality* (DEHP 2014, Version 1.2). Site condition assessments involved the collection of the following 13 site based attributes within a 100 m x 50 m nested sampling plot:

- Recruitment of woody perennial species
- Native tree species richness
- Native shrub species richness
- Native grass species richness
- Native forb species richness
- Tree canopy height
- Tree canopy cover
- Shrub canopy cover
- Native perennial grass cover
- Organic litter cover
- Number of large trees
- Coarse woody debris abundance
- Non-native plant cover

In total 35 site condition assessments were conducted across the study area (**Figure 2**).

Quaternary Assessments

Quaternary surveys were conducted to validate the extent, classification and condition of ground-truthed vegetation communities and habitat types within the study area. Quaternary surveys were undertaken in accordance with the *'Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland'* (Nelder *et. al.*, 2012). At each survey point, the following information was recorded:

- RE classification
- Vegetation condition (remnant, high-value regrowth, regrowth, non-remnant)

RE classification was determined based on the vegetation, soil and landform characteristics identified in the field, geological mapping for the region and the Regional Ecosystem Description Database (REDD).

Condition status for woody vegetation was evaluated utilising the definitions of remnant vegetation under the VM Act.

A total of 249 quaternary surveys were conducted across the study area (Error! Reference source not found.).

TEC Assessments

TEC assessments were undertaken to confirm the presence of TECs identified during the desktop assessment, namely:

- Brigalow (*Acacia harpophylla* dominated and co-dominated) Threatened Ecological Community (Brigalow TEC)
- Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Natural Grassland TEC)
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nadewar Bioregions (SEVT TEC)

Brigalow TEC assessments were undertaken to identify vegetation communities meeting the key diagnostic and condition threshold criteria as described in the Commonwealth Approved Conservation Advice (TSSC, 2013). The assessment consisted of collecting the following data at various sites within Brigalow vegetation:

- Dominance or co-dominance of Brigalow
- Brigalow listed RE
- Exotic perennial cover
- Age of community
- Patch size

Natural Grassland TEC assessments were undertaken in areas preliminary mapped as naturally derived grassland to identify areas meeting the key diagnostic and condition threshold criteria as described in the Commonwealth Listing Advice (TSSC, 2008). The assessment consisted of collecting the following data at various sites within natural grassland communities:

- Tree canopy cover
- Presence of listed indicator species in the ground layer
- Assessment against condition thresholds (**Table 1**)

Table 1: Condition classes for the Natural Grassland TEC

	Best quality	Good quality
Patch size	At least 1 ha	At least 5 ha
Grasses	At least 4 native perennial grass species from the list of perennial native grass indicator species	At least 3 native perennial grass species from the list of perennial native grass indicator species
Tussock cover	At least 200 native grass tussocks	At least 200 native grass tussocks
Woody shrub cover	Total projected canopy cover of shrubs is < 30%	Total projected canopy cover of shrubs is < 50%
Introduced species	Perennial non-woody introduced species are < 5% of the total projected plant cover	Perennial non-woody introduced species are < 30% of the total projected plant cover

There are currently no key diagnostic criteria or condition thresholds for the Semi-evergreen Vine Thicket (SEVT) TEC, however, the Commonwealth Listing Advice (TSSC, 2001) details REs that comprise the TEC. Therefore assessments for SEVT consisted of ground truthing RE mapping (quaternary surveys as above) and assigning any REs that are known to comprise the TEC as SEVT.

REs included in the SEVT TEC, the short description as per the REDD and the Biodiversity status of each RE are provided in **Table 2**.

Table 2: REs included in the SEVT TEC

RE	Short description	Biodiversity status
11.3.11	Semi-evergreen vine thicket on alluvial plains	Endangered
11.4.1	Semi-evergreen vine thicket ± <i>Casuarina cristata</i> on Cainozoic clay plains	Endangered
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces	Endangered
11.8.13	Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks	Endangered
11.9.4	Semi-evergreen vine thicket or <i>Acacia harpophylla</i> with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks	Endangered
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding	Endangered
11.2.3	Microphyll vine forest ("beach scrub") on sandy beach ridges and dune swales	Of concern
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	Of concern
11.8.6	Macropteranthes leichhardtii thicket on Cainozoic igneous rocks	Of concern
11.9.8	Macropteranthes leichhardtii thicket on fine grained sedimentary rocks	Endangered

A total of 35 Brigalow TEC and 112 Natural Grassland TEC assessments were conducted across the study area (Error! Reference source not found.). Quaternary surveys were used to identify vegetation communities analogous to SEVT TEC listed REs.

2.2.2 Fauna Assessment

The fauna assessment consisted of nocturnal searches (spotlighting), bat detection and habitat assessments to determine the actual or likely presence/absence of targeted threatened, migratory and pest species and their habitats. The target species are species listed under the EPBC Act or *Nature Conservation Act 1992* (NC Act) considered likely or potential to occur within the study area based on the desktop assessment and preliminary vegetation mapping results. This included threatened reptile, bird and mammal species, namely Ornamental Snake, Squatter Pigeon and , Koala, Greater Glider.

Fauna assessments were undertaken within REs that were considered to contain important macro and micro habitat features for the targeted species. Areas with the following habitat features were assessed for the target species:

- Koala and Greater Glider: Eucalypt woodlands containing koala food trees and hollow bearing trees
- Ornamental Snake: Brigalow woodlands containing cracking clays and gilgais
- Squatter Pigeon: areas within landzones 5 and 7 near permanent water bodies

The fauna assessment was designed to include appropriate detection methods for identified target species, which are discussed further in the sections below.

Targeted habitat assessments

Targeted habitat assessments were conducted for Squatter Pigeon, Koala, Greater Glider, microchiropteran bats and Ornamental Snake to quantify the presence and extent of habitat within the study area. The assessments also provide sufficient data for species habitat index scoring as per the Guide of Determining Terrestrial Habitat Quality. Habitat assessments were species specific and included identifying the presence of key values such as:

- Habitat condition (i.e. remnant or regrowth)
- Presence of foraging resources
- Presence of water
- Soil type
- Occurrence of species specific habitat features (i.e. deep cracking clays, gilgai, tree hollows)
- Species specific threat presence and severity

A total of 13 Squatter Pigeon, 10 Koala and 15 Ornamental Snake habitat assessments were conducted across the study area (Error! Reference source not found.).

Areas that contained an abundance of tree hollows suitable for species such as Greater Glider and microchiropteran bats were also recorded (**Figure 2**).

Spotlighting Searches

Spotlighting searches targeting Greater Glider and Koala were undertaken across four nights (15 to 18 June) within areas where suitable micro-habitat features occurred (i.e. tree hollows and foraging resources).

In total 20 person hours of surveying was undertaken across the study area, consisting of both vehicle and on-foot spotlighting searches. Spotlighting surveys were conducted in a new area each night where micro-habitat features were identified (**Figure 3**). Spotlighting searches undertaken meet the recommended spotlighting survey guidelines (DSEWPC 2011)

Acoustic Bat Detection

Acoustic bat detection using Songmeter SM3 devices targeting microchiropteran bats was undertaken across four nights (16 to 19 June). Two devices were deployed across four consecutive nights and placed in different locations across the study area to increase the likelihood of call detection (**Figure 3**).

Passive acoustic detection techniques are used to identify the use of areas by microchiropteran bats, which can then be followed up by appropriate level of trapping if threatened species are potentially

detected. Detection devices were placed in natural flyways or suspected bat foraging areas, to optimize the potential recordings. A total of six detection nights were undertaken across the study area.

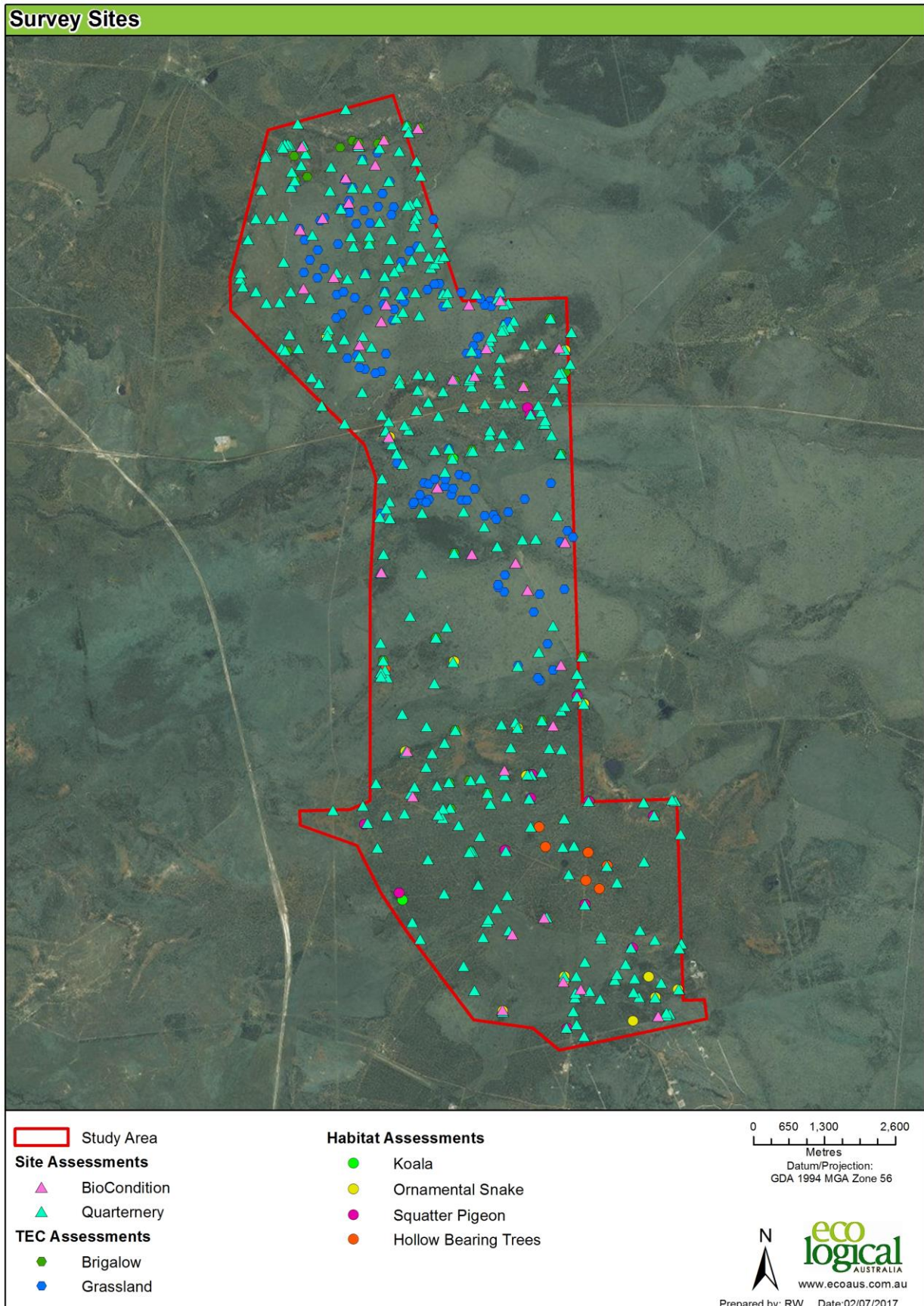


Figure 2: Survey Sites

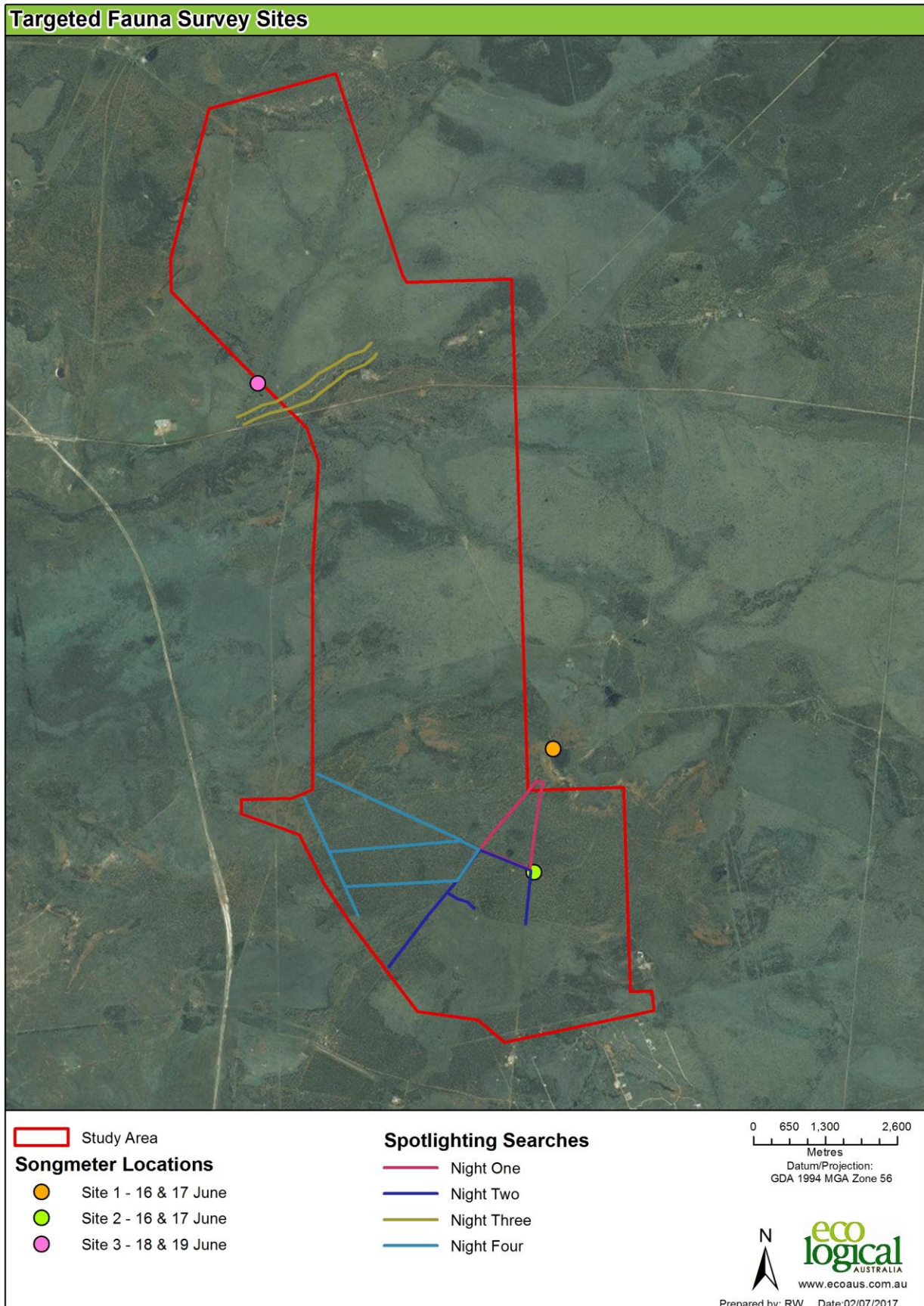


Figure 3: Targeted Fauna Survey Sites

2.3 Data Analysis

2.3.1 Bat Call Analysis

Analysis of all bat calls collected during the survey period was undertaken by a qualified specialist, Greg Ford of Balance Environmental. A total of four nights of recordings were analysed from three different areas across the study area. The format and content of the analysis summary reports complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon, 2003).

2.3.2 GIS Analysis

Spatial data collected during the field survey was imported into ArcView GIS (Version 10.2) and analysed against preliminary vegetation mapping. Where necessary, vegetation community and habitat boundaries were refined and/or verified using the collected spatial data to produce final ground-truthed mapping. TEC condition thresholds associated with patch size were also confirmed through GIS analysis of the final ground-truthed mapping.

Final ground-truthed mapping was then used to undertake site context assessments to provide a quantitative assessment of the landscape values of the study area as well as an overall condition score in accordance with the Guide to determining Terrestrial Habitat Quality (Version 1.2) (**Section 2.3.2**).

Site context assessment

Landscape-scale attributes were assessed within a 'Fragmented Landscape', as per the Guide to determining Terrestrial Habitat Quality (Version 1.2). Attributes calculated included:

- Patch Size
- Connectedness
- Context
- Ecological corridors

The spatial layers used to assess the site context attributes were:

- Ground-truthed vegetation mapping of the study area (ELA, 2017)
- Regulated Vegetation Mapping (Version 9.0)

2.3.3 Habitat quality scoring

Habitat quality scoring was conducted in accordance with the Guide to determining Terrestrial Habitat Quality (Version 1.2). This involved accumulating the average site condition and site context scores for each relevant assessment unit and dividing the total against the maximum score for the ecosystem type (i.e. woodland = maximum score of 106). Where relevant, species habitat index scoring was included in the calculations.

Benchmark data to complete the comparison value assessment for the site condition assessment was sourced from Queensland Herbarium prepared benchmarks for each assessment unit's ground-truthed RE (or closest RE benchmark within the same Broad Vegetation Group). Where multiple field survey sites were assessed for one assessment unit, habitat quality scores were averaged.

2.4 Survey Limitations

Flora

It should be noted that the detectability of plants and the ability to accurately identify plants to species level may vary greatly with the time of year, prevailing climatic conditions and the presence of reproductive material (e.g. flowers, fruit, and seed capsules). Specifically, native grass species can be difficult to

identify due to seasonality. For this reason, pre-clearance surveys for threatened grass species were conducted prior to this survey when conditions were more optimal. However, results of both surveys should not be regarded as conclusive evidence that certain protected plants do not occur within the study area.

Fauna

All fauna assessments are subject to inherent limitations in the detection success of targeted species. These limitations often result in a degree of false-absence records (i.e. a species is present, but not detected). It is important, therefore, that the limitations to surveys are identified and the survey results are viewed with these constraints in mind.

The general limitations to the fauna assessment conducted in the study area may include the following:

- Species with large home ranges may not be present in this part of their home range during the survey.
- The difficulty detecting certain species during the survey period (e.g. cryptic species and species present in the study area in low densities).
- Biological factors such as sex, age-class, and breeding biology, which may influence species' habitat use and detectability during different times of year.

In addition to these limitations, the survey was undertaken during the winter months, which provided less optimal conditions and/or timing to detect some fauna groups. The target reptile and mammal species are generally more active in the warmer months, which increases the likelihood of detection.

In response to the abovementioned limitations the fauna assessment with a suitable survey effort was designed to ensure every chance of detecting target species where present. For species not detected, habitat assessments were undertaken to determine the value of the study area for supporting such species i.e. absence of a species was not assumed because it was not detected.

3 Results

3.1 Survey Conditions

The weather conditions leading up to and at the time of the survey are shown in **Table 3**. Data was obtained from recordings taken at the Moranbah Airport, located 50 km south of the Project area.

Table 3: Weather conditions preceding and during the field survey

Date	Temperature (°C)		Total Rainfall (mm)	Max Wind Speed (km/h)
	Mean minimum	Mean Maximum		
March 2017	21.5	33.5	257.8	100
April 2017	14.6	28.4	0.00	57
May 2017	13.7	26.2	101.2	50
13/06/2017	6.8	24.0	0.00	35
14/06/2017	8.2	23.5	0.00	43
15/06/2017	9.7	NA	0.00	NA
16/06/2017	10.4	24.8	0.00	33
17/06/2017	9*.4	25.9	0.00	24
18/06/2017	8.7	26.2	0.00	39
19/06/2017	7.1	24.3	0.00	37
20/06/2017	7.0	24.7	0.00	41
21/06/2017	7.8	24.2	0.00	37
22/06/2017	4.5	23.9	0.00	33

3.2 Floristic Values

3.2.1 Vegetation Communities

The study area is currently mapped by the Department of Environment and Heritage Protection (EHP) as a mosaic of Category B remnant vegetation and Category X non-remnant areas. Ground-truthing of vegetation communities across the study area revealed numerous inaccuracies in current mapping, including the extent of remnant vegetation as well as the identification and classification of RE types.

The study area was found to comprise predominantly remnant and regrowth vegetation, within which 21 vegetation communities were ground-truthed (**Table 4, Figure 4**). Disturbance due to historical land uses including grazing have created a mosaic of intact and regrowth communities at varying stages of maturity which are interspersed with non-remnant areas.

The study area north of Suttor Development Road is dominated by natural grasslands and *Eucalyptus orgadophila* open woodlands on basalt derived soils, most of which has been highly disturbed due to grazing. The western boundary contains lateritic jump-up areas and the far northern boundary contains Acacia thickets and Eucalypt woodlands on tertiary surfaces. Brigalow dominated woodland communities are also scattered throughout the area north of Suttor Development Road. Vegetation south of Suttor

Development Road is also dominated by natural grasslands and *E. orgadophila* open woodlands on basalt derived soils, much of which is in remnant condition. The southern area is dominated by a mosaic of *Eucalyptus crebra* and *Eucalyptus populnea* woodlands on tertiary surfaces, with small pockets of semi-evergreen vine thicket and sections of Brigalow dominated woodlands on the southern boundary. Waterways that traverse both the northern and central portion of the study area also support fringing riparian Eucalypt communities.

Table 4: Vegetation communities ground-truthed within the study area

RE	Short Description	Biodiversity Status	Condition	Area (ha)
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Endangered	Remnant	11.1
			Mature Regrowth	51.6
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Of concern	Remnant	79.9
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains	Of concern	Remnant	4.4
11.3.3a	<i>Melaleuca bracteata</i> woodland. On alluvial plains. Riverine wetland or fringing riverine wetland	Of concern	Remnant	34.1
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	Endangered	Remnant	39.0
			Mature Regrowth	56.1
11.4.9	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	Endangered	Remnant	48.2
			Mature Regrowth	252.1
11.5.3	<i>Eucalyptus populnea</i> ± <i>E. melanophloia</i> ± <i>Corymbia clarksoniana</i> woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	Remnant	429.4
			Mature Regrowth	81.8
11.5.3b	<i>Eucalyptus populnea</i> on closed depressions	No concern at present	Remnant	40.3
11.5.9	<i>Eucalyptus crebra</i> woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	Remnant	1,361.9
			Mature Regrowth	106.5
11.5.15	Semi-evergreen vine thicket on Tertiary surfaces	Endangered	Remnant	57.5
11.7.1x	Semi-evergreen vine thicket	Of concern	Regrowth	5.2
11.7.2	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	No concern at present	Remnant	11.8
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of concern	Remnant	1,661.8
11.8.11a	<i>Melaleuca bracteata</i> woodland drainage depressions. Occurs in drainage depressions.	Of concern	Remnant	9.5
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	No concern at present	Remnant	1,166.2
			Mature Regrowth	42.0

RE	Short Description	Biodiversity Status	Condition	Area (ha)
11.8.15	<i>Eucalyptus populnea</i> woodland on Cainozoic igneous rock	Endangered	Remnant	9.3
11.9.2	<i>Eucalyptus melanophloia</i> and/or <i>Eucalyptus orgadophila</i> woodland on Cainozoic fine grained sediments	No concern at present	Remnant	65.0
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest with semi-evergreen vine thicket understorey	Endangered	Remnant	18.7
			Mature Regrowth	204.1
11.9.7	<i>Eucalyptus populnea</i> woodland on Cainozoic fine grained sediments	Of concern	Remnant	8.4
			Mature Regrowth	8.7
11.9.7a	<i>Eucalyptus populnea</i> shrubby woodland on Cainozoic fine grained sediments	Of concern	Remnant	25.3
11.9.9	<i>Eucalyptus crebra</i> grassy woodland on Cainozoic fine grained sediments	No concern at present	Remnant	92.0
-	Brigalow regrowth	-		394.4
-	Eucalypt regrowth	-		86.5

3.2.2 Category B ESAs

Under the *Environmental Protection Regulation 2008*, REs with an Endangered Biodiversity status as defined in the REDD are classified as Category B ESAs. The current Queensland Environmentally Sensitive Areas map identifies several patches of Category B ESA throughout the study area (Error! Reference source not found.).

Field survey confirmed the presence of Category B ESA within the study area, with ground-truthed Category B ESA found to comprise a total area of 747.5 ha, significantly exceeding the mapped extent of 70 ha (**Table 5, Figure 5**). Category B ESA within the study area was found to be analogous to RE11.3.1, RE11.4.8, RE11.4.9, RE11.5.15, RE11.8.15 and RE11.9.5 all of which have an endangered Biodiversity status. Condition ranged from remnant to mature regrowth. These endangered vegetation communities were identified in large contiguous patches and smaller fragments throughout the entire study area.

Table 5: Category B ESA vegetation identified within the study area

RE	Short Description	VM Act status	Biodiversity Status	Area (ha)
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Endangered	Endangered	62.7
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	Endangered	Endangered	95.0
11.4.9	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	Endangered	Endangered	300.2

RE	Short Description	VM Act status	Biodiversity Status	Area (ha)
11.5.15	Semi-evergreen vine thicket on Tertiary surfaces	Endangered	Endangered	57.5
11.8.15	<i>Eucalyptus populnea</i> woodland on Cainozoic igneous rock	Endangered	Endangered	9.3
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest with semi-evergreen vine thicket understorey	Endangered	Endangered	222.8
Total Category B ESA:				747.5

3.2.3 Threatened Ecological Communities

Three TECs were identified in the desktop assessment as potentially occurring within the study area, including:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (Natural Grasslands)
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT)

Field survey confirmed the presence of all three TECs within the study area (**Figure 5**).

Vegetation meeting the key diagnostic criteria for the Brigalow TEC were identified as the listed Brigalow REs RE11.3.1, RE11.4.8, RE11.4.9 and RE11.9.5 with *Acacia harpophylla* (Brigalow) dominant or co-dominant within the canopy. However, only a few patches of these vegetation communities were found to meet the condition thresholds of the TEC, namely to be > 15 years old, > 0.5 ha in area and have an exotic perennial plant coverage of < 50% (**Appendix E**). A total of 91.2 ha of Brigalow TEC was identified across the study area.

Vegetation meeting the key diagnostic criteria for the Natural grasslands TEC was identified as RE11.8.11 within the study area. Assessment against the condition thresholds identified Natural Grassland TEC of good and best quality, predominantly within the northern and central portion of the study area (**Appendix I**). Good quality Natural Grassland TEC within the study area was found to occur in patches of > 5 ha, comprise at least three native perennial indicator species as described in the Commonwealth Listing Advice and has a perennial non-woody introduced species cover of < 30%. Best quality Natural Grassland TEC within the study area was found to occur in patches >1 ha, comprise of at least four native perennial indicator species and has a perennial non-woody introduced species cover or < 5%. A total of 552.4 ha of best and 234.0 ha of good quality natural grassland TEC was identified across the study area.

Small areas of SEVT were identified as RE11.5.15. These REs were identified within scattered patches across the study area encompassing a total 57.3 ha. There are currently no key diagnostic characteristics or condition thresholds for the SEVT TEC, so the entirety of the mapped RE comprises the TEC.

3.2.4 Threatened Flora

Desktop assessment identified nine threatened flora species that may occur within the study area. One species, *Dichanthium queenslandicum* has previously been recorded within the study area. Seven species were assessed as potentially occurring due to suitable habitat within the study area and records in the surrounding area. These species include *Dichanthium setosum*, *Digitaria porrecta*, *Samadera*

bidwillii, *Kelita uncinella*, *Bertya opposens*, *Bertya pedicellata* and *Cerbera dumicola*. One species was assessed as unlikely to occur; *Cycas ophiolitica* (**Appendix J**).

Extensive targeted surveys were undertaken within the study area which identified a substantial population of *Dichanthium queenslandicum*. The identification of *Dichanthium queenslandicum* was confirmed by the Queensland Herbarium. *Dichanthium queenslandicum* occurs in natural grassland communities identified as RE11.8.11 that are present throughout the northern and central portion of the study area.

A localised population of *Dichanthium setosum* were also identified within the study area during targeted surveys and confirmed by the Queensland Herbarium (ELA 2017). *Dichanthium setosum* also occurs in natural grassland communities identified as RE11.8.11. Detailed information on the results of grassland pre-clearance surveys of the study area is contained in the Wards Well Pre-clearance Report (ELA, 2017)

None of the other species listed above were identified within the study area.

3.2.5 Weeds

Desktop assessment identified seven weeds listed as Restricted Invasive Plants under the *Biosecurity Act 2014* as potentially occurring within the study area (**Table 6**).

Table 6: Declared weeds identified during desktop assessment as potentially occurring within the study area

Species name	Common name	Restricted Invasive Plant	Biosecurity Act
<i>Acacia nilotica</i> subsp. <i>Indica</i>	Prickly Acacia	✓	Category 5
<i>Cryptostegia grandiflora</i>	Rubber Vine	✓	Category 5
<i>Jatropha gossypifolia</i>	Cotton-leaved Physic-Nut	✓	Category 5
<i>Lantana camara</i>	Lantana	✓	Category 5
<i>Parkinsonia aculeata</i>	Parkinsonia	✓	Category 5
<i>Parthenium hysterophorus</i>	Parthenium	✓	Category 5
<i>Vachellia nilotica</i>	Prickly Acacia	✓	Category 5

Of the seven listed weed species identified as potentially occurring only *Parthenium* was identified within the study area. In addition, Biosecurity Act Category 5 declared weed, *Harrisia* spp. (*Harrisia* Cactus), was also recorded within the study area.

Parthenium was recorded in moderate to high abundance at several locations across the study area, however, as it is an annual species it may be more widespread and abundant at particular times of year. *Harrisia* Cactus was recorded in isolated occurrences. In addition, the non-declared exotic species *Cenchrus ciliaris* (Buffel Grass) dominated the ground layer across large portions of the study area.

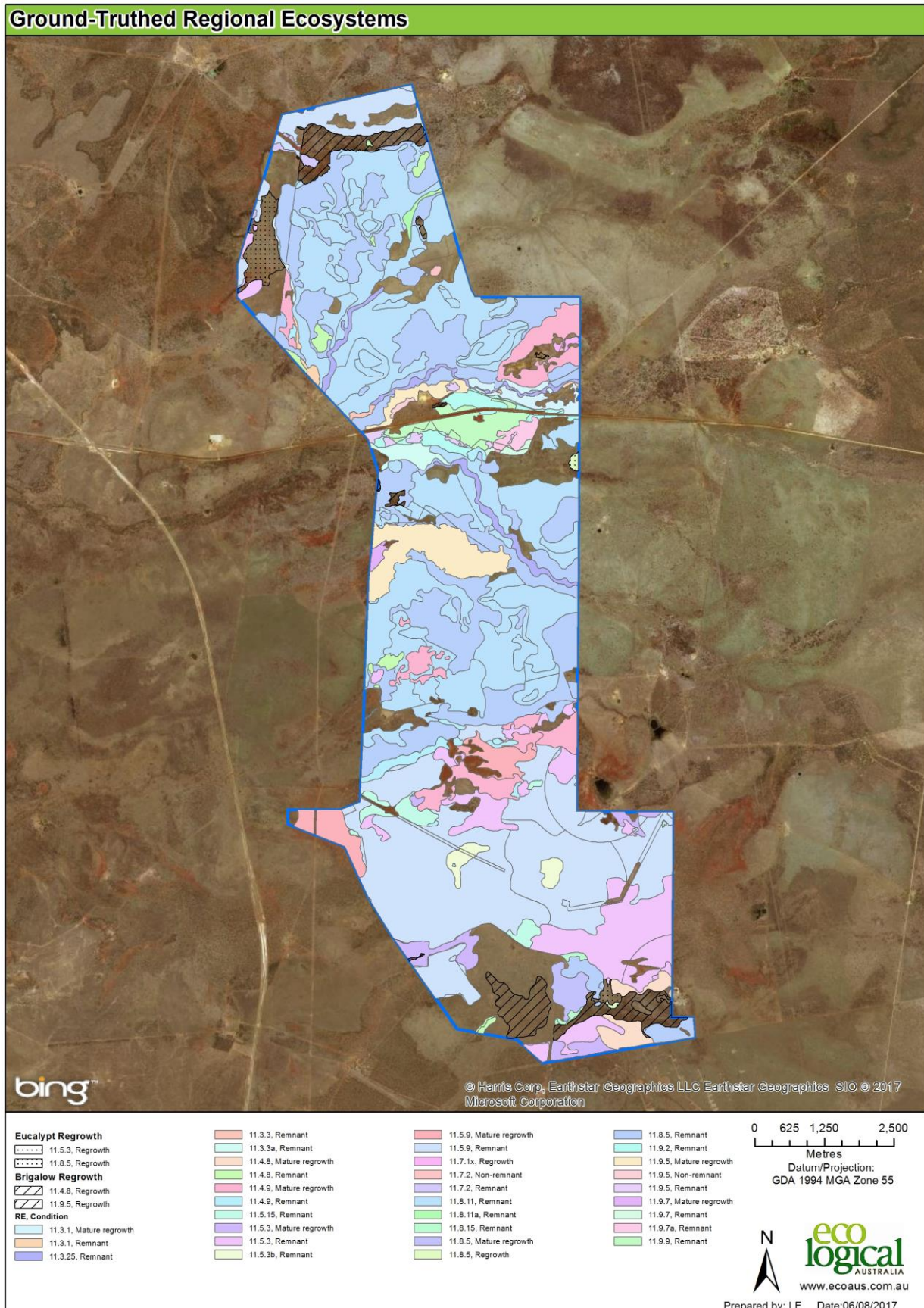


Figure 4: Ground-truthed Vegetation Communities

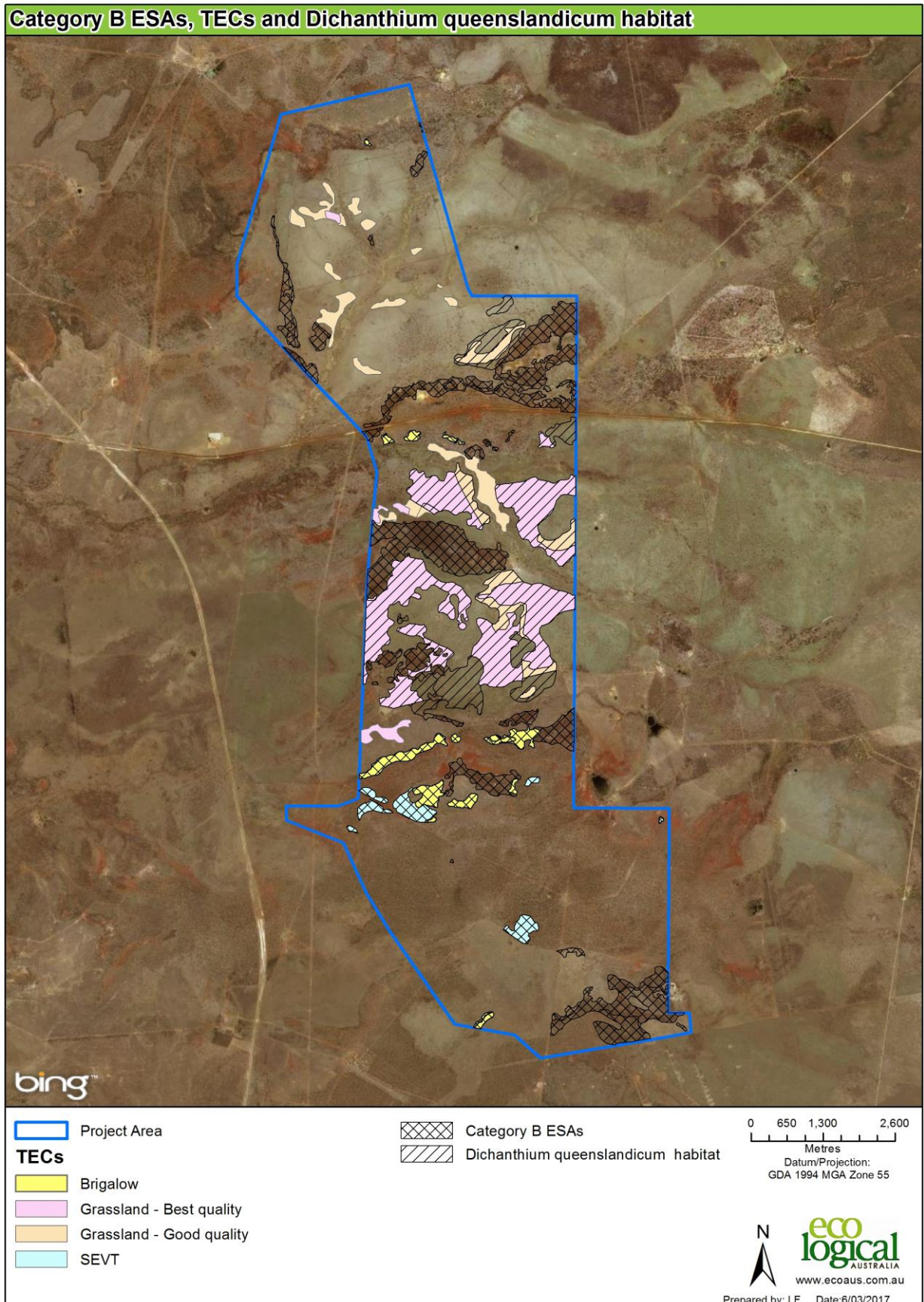


Figure 5: Category B ESAs, TECs and *Dichanthium queenslandicum* and *D. setosum* habitat

3.3 Habitat Values

3.3.1 Habitat Types

Seven broad habitat types were identified as occurring within the study area. These habitats provide a range of resources for native fauna species, including threatened species as discussed in **Section 3.4.1**. The following sections outline the condition and values of each habitat type.

- Fringing riparian forest
- Dry Eucalypt woodland
- Brigalow woodland containing ephemeral gilgais
- Brigalow woodland without ephemeral gilgais
- Natural grasslands
- SEVT
- Acacia open forest

Fringing Riparian Forest

Fringing Riparian Forest habitat is associated with Kennedy, Charlie and Eaglefield Creeks that cross the project area in the centre and north (**Figure 6**). Habitat in these areas was found to contain a sparse canopy of *Eucalyptus camaldulensis* (River Red Gum) and *Melaleuca* sp. and reduced sub-canopy layer. With a low abundance of Koala food trees, canopy connectivity and hollow bearing trees, these areas provide moderate habitat values for arboreal species such as Koala and Greater Glider.

The creeks within the project area were mostly dry during the survey. Water resources are important habitat features for many bat and bird species. The ephemeral nature of the creeks are likely to provide resources during the wet season, however they provide low habitat values for species that require permanent water sources, such as the Squatter Pigeon.

Dry Eucalypt Woodland and Regrowth

Dry Eucalypt Woodland dominates the southern section of the study area and is predominantly in remnant condition, with some areas of mature regrowth and regrowth (**Figure 6**). *Eucalyptus crebra* and *E. populnea* dominate the canopy, both of which are Koala food trees. Habitat values for the Koala are good in the southern section, providing both foraging resources and connectivity. Within the remnant areas, the canopy layer cover is high with a large number of hollow bearing trees in some parts, providing shelter and foraging resources for Greater Glider, hollow roosting bats and nesting birds.

A dense sub-canopy layer was also present in parts of the Eucalypt woodlands in the south, providing good quality habitat for bats and birds, with high structural complexity for foraging. Similar habitat resources were recorded within the mature regrowth and regrowth areas; however due to the younger age of these areas, a mature canopy layer was absent.

The ground layer was found to be moderately complex providing habitat resources for ground-dwelling species. Permanent water resources are available in the form of dams are located in the south, this in conjunction with a complex ground cover provides ideal habitat for Squatter Pigeon and other ground-dwelling birds, reptiles and mammals.

Brigalow woodland and regrowth containing ephemeral gilgais

Brigalow woodland on deep cracking clays and containing ephemeral gilgais was identified predominantly within the southern and northern portion of the study area (**Figure 6**). This habitat has a moderate structural complexity consisting of a moderately dense canopy layer, a sparse sub-canopy layer and an extremely sparse shrub layer. This level of structural complexity provides suitable foraging and nesting habitat for numerous woodland birds. However, the low number of hollow bearing trees within this habitat

means there is limited sheltering, nesting and breeding habitat for hollow dependent birds, arboreal mammals and microbats.

This habitat also contains a relatively complex ground layer, consisting of moderate grass cover, large amounts of woody debris, moderate amounts of leaf litter and a high number of soil cracks. These features provide optimal foraging resources, shelter, breeding refuges and basking areas for numerous reptile species, including the threatened species Ornamental Snake. The presence of ephemeral gilgais within this habitat also provides optimal habitat for amphibians, which in turn provides optimal foraging habitat for snakes, including Ornamental Snake. Water was observed in a number of gilgais during the June survey, indicating these areas can provide suitable habitat into the dry season.

Brigalow woodland and regrowth without ephemeral gilgais

Brigalow woodland without ephemeral gilgais was identified throughout the study area in remnant, mature regrowth and regrowth condition (**Figure 6**). The habitat has a varied structural complexity depending on condition state. Remnant areas supported a relatively complex structure, with moderate canopy cover, a sparse shrub layer and a complex ground layer, comprising moderate to dense grass cover, a moderate abundance of fallen woody debris, a moderate amount of leaf litter and few or absent soil cracks. This level of structural complexity provides suitable foraging and nesting habitat for numerous woodland birds, mammals and reptiles. However, the low number of hollow bearing trees within this habitat means there is limited sheltering, nesting and breeding habitat for hollow dependent birds, arboreal mammals and microbats.

Similar habitat resources were recorded within the mature regrowth and regrowth areas; however due to the younger age of these areas, the canopy layer was less well developed. A more simplistic ground layer in mature regrowth and regrowth areas is likely to only contain suitable habitat for generalist reptiles, amphibians and mammals.

Natural grasslands

Natural grassland habitat occurs predominantly in the central and northern portions of the study area (**Figure 6**). The habitat has a simple structure, with an absent or very sparse canopy and shrub layers and moderate to dense grass cover. Although structural complexity is low, this habitat still provides foraging and nesting resources for woodland birds, as well as foraging and dispersal habitat for species preferring more open grassland habitats. However, the absence of hollow bearing trees within this habitat means there is no sheltering, nesting and breeding habitat for hollow dependent birds, arboreal mammals and microbats. Some grassland areas have a high proportion of exotic species, limiting their value as foraging habitat for herbivorous mammals.

SEVT

SEVT habitat occurs in scattered patches across the study area (**Figure 6**). This habitat was found to have a dense, low canopy and tangled understorey of vines and shrubs. The ground layer was relatively simplistic, with bare ground interspersed with scattered grasses and forbs. This habitat provides foraging and nesting resources for woodland birds and small mammals.

Acacia Open Forest

Small areas dominated by stands of *Acacia* sp. were present in the north and north-west section of the project area. A tall canopy layer and moderate shrub layer provides good habitat for foraging and nesting bird species. Whilst the sparse ground-cover and lateritic soils are a preferred foraging habitat feature of Squatter Pigeon.

3.3.2 Essential Habitat

Current Essential Habitat mapping shows two small areas of essential habitat for *Dichanthium queenslandicum* mapped within the north-east corner of the study area. Field survey confirmed the presence of *Dichanthium queenslandicum* within the study area; however ground-truthing of habitat types revealed suitable habitat for the species that far exceeds the current mapped extent of Essential Habitat for the species.

Essential habitat for protected wildlife is defined under the Vegetation Management Act. It is defined as a category A area (vegetation offset area), a category B area (remnant vegetation) or category C area (high-value regrowth vegetation) shown on the regulated vegetation management map:

- 1) That has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) In which the protected wildlife, at any stage of its life cycle, is located.

A total of 813 ha of Essential Habitat for *Dichanthium queenslandicum* occurs within the study area. The area of essential habitat was defined based on extensive meander surveys which were undertaken across the study area to identify the presence of threatened grass species. Further information is available in the Wards Well Pre-clearance Report (ELA, 2017).

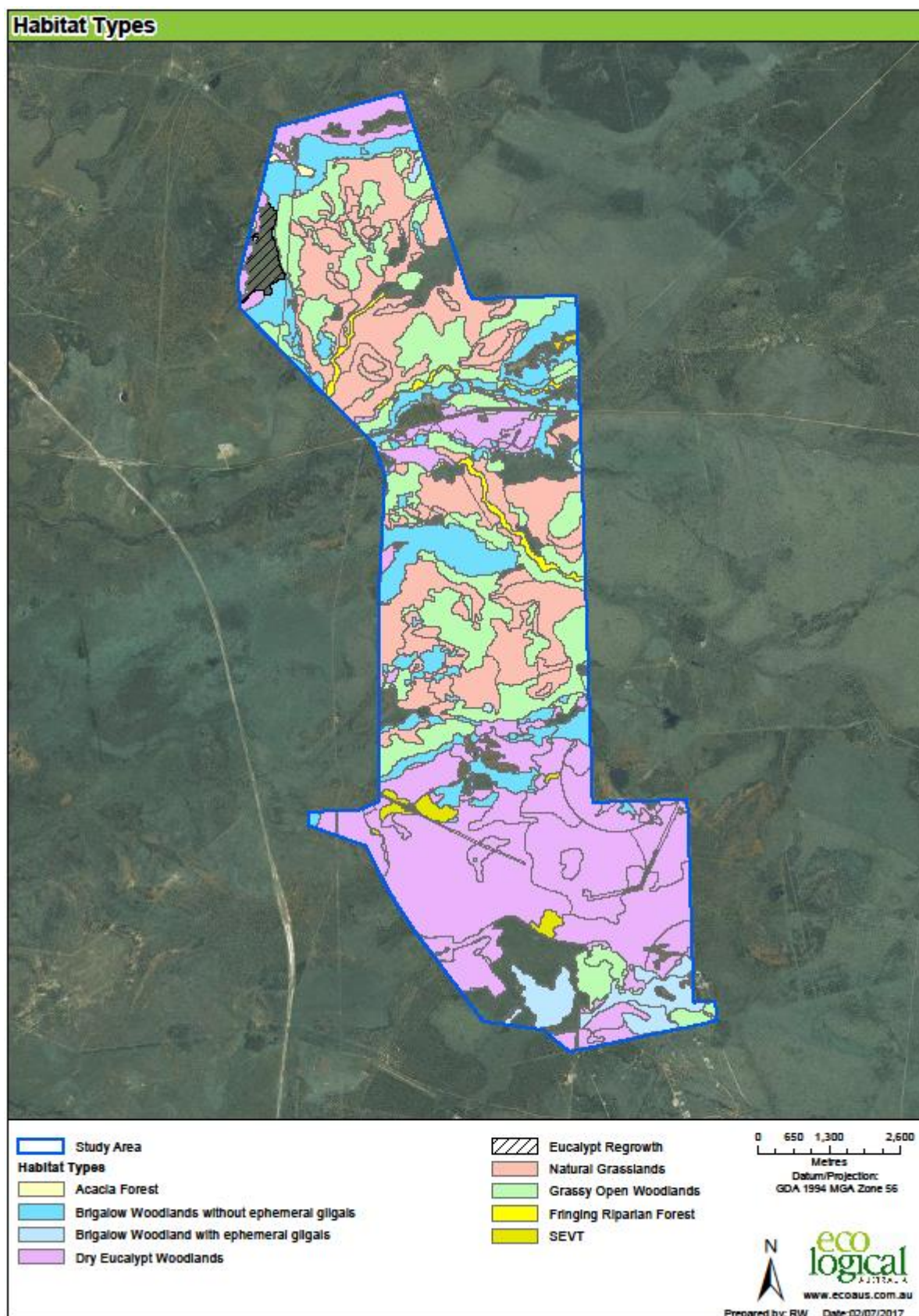


Figure 6: Habitat Types

3.4 Fauna Values

3.4.1 Threatened Species

Desktop assessment identified 19 threatened fauna species and 11 migratory species that may occur within the study area. The likelihood of occurrence of each species was assessed based on the species' known distribution, habitat quality within the study area, species occurrence within the region and species occurrence within the study area. Based on these criteria two species, Squatter Pigeon and Ornamental Snake, were assessed as likely to occur. Two mammals (Koala and Greater Glider) were assessed as potentially occurring within the study area. Four migratory birds (Fork-tailed Swift, White Throated Needletail, Black Faced Monarch and Glossy Ibis) were also assessed as potentially occurring within the study area. A full likelihood of occurrence assessment is provided in **Appendix J**.

No threatened species were recorded during field surveys, however, habitat for species considered likely or potentially occurring was ground-truthed within the study area. A description of the potential extent and utilisation, as well as current observed threats for these species within the study area is provided below.

Squatter Pigeon

Squatter Pigeon is listed as vulnerable under both the EPBC Act and Queensland NC Act. Breeding habitat for this species occurs on stony rises occurring on sandy or gravelly soils and in close (<1 km) proximity to water. Foraging habitat includes remnant or regrowth open-forest to sparse, open-woodland dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species, on sandy or gravelly soils and in close proximity to water (<3 km). Previous Squatter Pigeon records also exist within 13 km of the project area.

Squatter Pigeon habitat was ground-truthed within an area of 171.2 ha that was identified to contain essential microhabitat features (**Figure 7**).

Koala

Koala is listed as vulnerable under both the EPBC Act and Queensland NC Act. Suitable habitat for Koala was identified within remnant Eucalypt woodlands in the southern portion of the study area. Koala habitat was ground-truthed within an area of 1,911.5 ha that was found to contain a high proportion of known Koala food tree species (**Figure 7**). Targeted Koala habitat assessments identified small areas of fringing riparian forest and adjacent floodplain Eucalypt forest, as well as eucalypt woodland habitat to contain a high proportion (> 75%) of Koala food tree species within the canopy layer. Fringing riparian habitat and adjacent floodplains contained the known Koala food tree species River Red Gum (*Eucalyptus camaldulensis*) whilst open woodland areas were dominated by Narrow Leaved Ironbark (*Eucalyptus crebra*) and Poplar Box (*Eucalyptus populnea*).

Quality of Koala habitat within the project disturbance footprint has been assessed using the Commonwealth Koala habitat assessment tool (Error! Reference source not found.). A score of 5 out of a potential maximum of 10 was obtained for the study area. This score is reflective of the availability of habitat, the limited presence of key threats, a level of regional habitat connectivity, but a lack of important recovery habitat.

Greater Glider

Greater Glider is listed as vulnerable under both the EPBC Act and Queensland NC Act. The species is largely restricted to eucalypt forests and woodlands that have a high abundance of tree hollows, which it requires for daytime shelter. Suitable habitat for the Greater Glider was identified within the remnant Eucalypt woodlands in the southern portion of the study area where a high density of hollows were recorded in some parts. Greater Glider habitat was ground-truthed within an area of 315.2 ha that was found to contain a high proportion of tree hollows (**Figure 7**).

Ornamental Snake

Ornamental Snake is listed as vulnerable under both the EPBC Act and Queensland NC Act. Suitable habitat for Ornamental Snake was identified within remnant, mature regrowth and regrowth RE11.4.8 and RE11.4.9 Brigalow woodland within the southern and northern portion of the study area. Multiple records also exists within 5 km of the project area. Ornamental Snake habitat was ground-truthed within an area of 213.6 ha that was identified to contain essential microhabitat features such as deep cracking clay soils and gilgai formations, which provide shelter and suitable habitat for the species main form of prey, frogs (**Figure 7**). Additional areas of clay soil and Brigalow vegetation within the study area were found to lack the essential microhabitat features required to support Ornamental Snake.

Migratory birds

Four migratory birds were assessed as potentially occurring within the project area. Fork-tailed Swift and White-throated Needletail are almost exclusively aerial however may roost in woodlands with dense foliage and tree hollows. Black Faced Monarch may use eucalypt woodlands and semi-evergreen vine thicket, however this habitat is considered marginal and likely to be used only when on passage. The Glossy Ibis may use large dams within the project area when on passage.

Habitat for potential migratory species within the project area is marginal and is considered not to be an ecological constraint. Migratory birds are not discussed further in this report.

Microchiropteran Bats Six nights of acoustic bat detection data was analysed by specialist Greg Ford (Appendix K). At least 11 and possibly 13 species were recorded during the surveys, mostly contributed by *Chaerephon jobensis* and the unresolved species group of *Chalinolobus nigrogriseus* / *Scotorepens greyii* / *S. sanborni*.

No threatened bat species were recorded during the survey. Habitat for potential threatened bats is marginal and considered not to be an ecological constraint and these species are not discussed further.

3.4.2 Pests

Desktop assessment identified eight declared pest species under the Biosecurity Act as potentially occurring within the study area (**Table 7**).

Table 7: Declared pests identified during desktop assessment as potentially occurring within the study area

Species name	Common name
-	Feral Deer
<i>Capra hircus</i>	Goat
<i>Felis catus</i>	Cat
<i>Mus musculus</i>	House Mouse
<i>Oryctolagus cuniculus</i>	Rabbit
<i>Bufo marinus</i>	Cane Toad
<i>Sus scrofa</i>	Pig
<i>Vulpes vulpes</i>	Red Fox

Of the eight declared pest species identified as potentially occurring within the study area, three were recorded during the field survey. These included Rabbit (*Oryctolagus cuniculus*), Cat (*Felis catus*) and Cane Toad (*Bufo marinus*). Evidence of Pigs (*Sus scrofa*) was observed (i.e. rooting), tracks of Feral

Dogs (*Canis lupus*) or Red Fox (*Vulpes vulpes*) were also observed. Based on habitat resources and condition it is also expected that the study area contains House Mouse (*Mus musculus*).

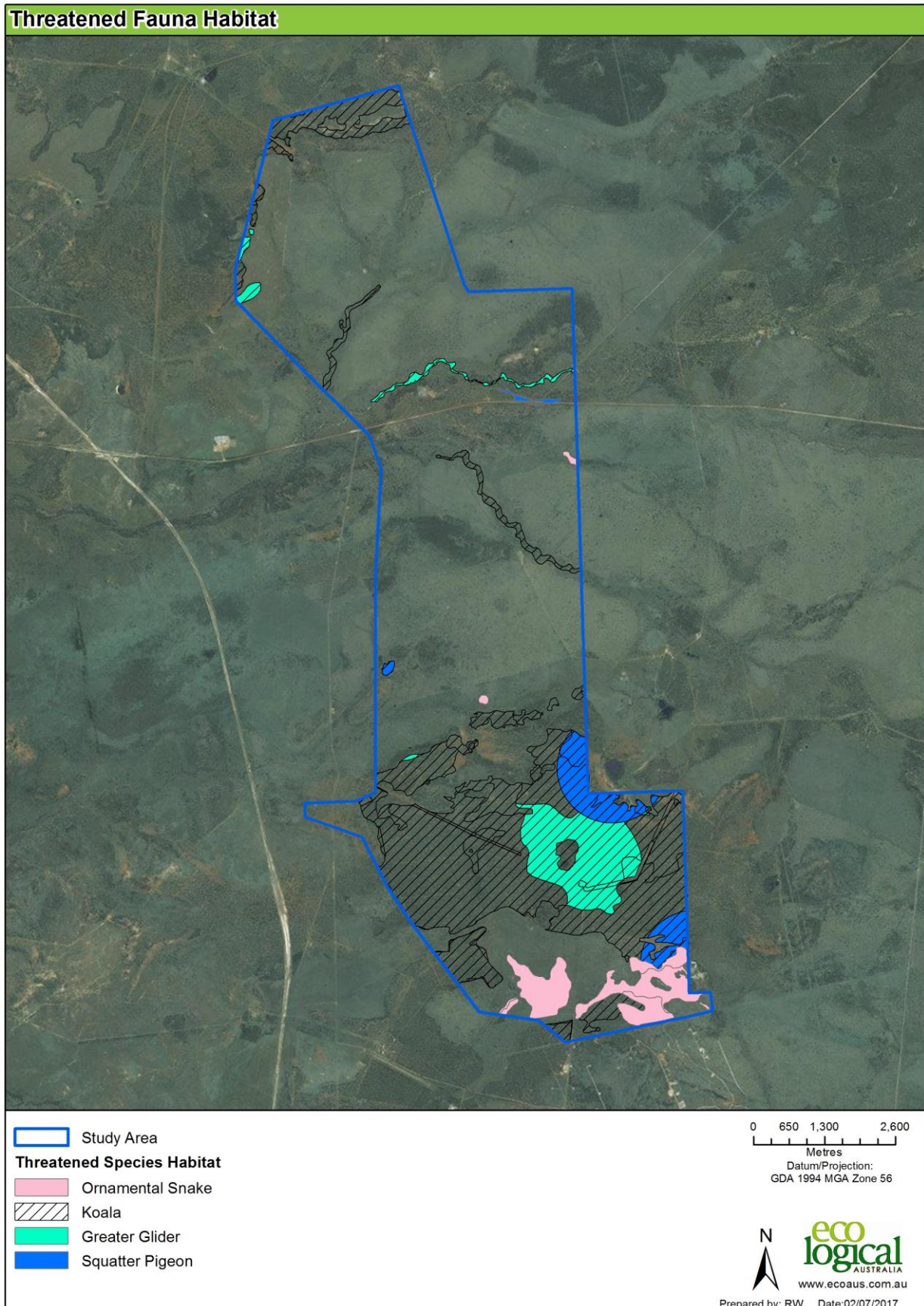


Figure 7: Threatened Fauna Habitat

3.5 Landscape Values

3.5.1 Wetlands and Watercourses

Kennedy, Charlie and Eaglefield Creeks cross the project area in the centre and north, and all are mapped on the VM Act watercourse and drainage feature map. There are no wetlands associated with these creek lines. No watercourse or wetland values shown on the VM Act wetland maps or Wetland Protection Area maps were identified within the study area.

Brigalow habitat containing gilgais do provide some wetland values; however due to the ephemeral nature of the gilgais, the values are provided periodically and for short durations during high rainfall conditions.

3.5.2 Context and Connectivity

The landscape surrounding the study area is heavily fragmented due to widespread clearing activity from historical land uses including agriculture and current mining operations. Suttor Development Road, Red Hill Road and the Goonyella Riverside Mine rail corridor are also significant barriers to connectivity within the landscape. Context and connectivity values of the study area are therefore considered moderate to low. This assessment is supported by the low to moderate site context scores evaluated as part of the Habitat Quality Assessment of the study area (refer to **Appendix D**).

The values that are present within and around the project area include:

- Kennedy, Charlie and Eaglefield Creeks, which cross the project area in the north and centre provide riparian corridors to the west, connecting to the Suttor River
- Vegetation to the west is relatively fragmented, however riparian corridors provide connectivity to large areas of vegetation that are further afield including Nairana National Park, and large patches of vegetation in the north
- The southern portion of the project area provides a contiguous patch of vegetation. This is connected through Goonyella Creek which ends within the Brigalow woodland communities near the southern boundary and provides a riparian corridor to the south and east, connecting to the Isaac River. This also connects to habitat areas in the east, onto Homevale National Park
- Whilst the grasslands that dominate the north and centre of the project area are remnant, these areas only provide connectivity for more mobile species, such as macropods and birds

4 Ecological constraints

4.1 Commonwealth

Field survey identified a number of ecological values within the study area which are currently protected as Matters of National Environmental Significance (MNES) under Commonwealth EPBC Act. These include TECs and habitat for threatened flora and fauna species (**Figure 8**).

The following sections provide an overview of protected values and associated constraint level. In areas of overlapping values, the highest constraint level takes precedence.

TECs

Three TECs were ground-truthed within the project area. Brigalow TEC was identified in small patches across the site, within a total area of 91.2 ha. Natural grasslands dominate the centre and north of the project area, and patches meeting the key diagnostic and condition threshold of the TEC in good quality were identified within an area of 234.0 and best quality within 552.4 ha. SEVT TEC was identified in small patches in the south of the project area, within an area of 57.5 ha.

For exploration activities, areas of Brigalow and SEVT TEC are considered highly constrained as disturbance through clearing activities would be required. However, the severity of clearing activities is inherently diminished in Natural Grassland TEC areas and opportunities exist to further minimise disturbance through managed slashing. As such these areas are considered moderately constrained for exploration activities.

A significant impact assessment should be undertaken in accordance with the Commonwealth Significant Impact Guidelines (Version 1.1) prior to any disturbance to MNES. Where impacts are deemed likely to be significant, the project is required to be referred to the Commonwealth for assessment.

Threatened flora and fauna

The threatened flora species *Dichanthium queenslandicum*, which is currently listed as endangered under the EPBC Act and vulnerable under the NC Act, was identified in large populations in natural grassland habitat within the study area. Additionally, flora species *Dichanthium setosum*, which is currently listed as Vulnerable under the EPBC Act was also identified within isolated areas.

Suitable habitat for the threatened fauna species Koala, Greater Glider, Squatter Pigeon and Ornamental Snake was also identified within the study area. Koala is currently listed as vulnerable under both the EPBC Act and Queensland NC Act. Suitable habitat for Koala was ground-truthed within an area of 1,911.5 ha of remnant Eucalypt woodlands in the south, along riparian corridors and in the far north.. Greater Glider is listed as Vulnerable under the EPBC Act and NC Act. Suitable habitat for Greater Glider was ground-truthed within an area of 315.2 ha where there was a high abundance of tree hollows. Squatter Pigeon is currently listed as Vulnerable under the EPBC Act and NC Act. Suitable habitat for Squatter Pigeon was ground-truthed within an area of 171.2 ha where sparse or open scrub with sandy or gravelly soil was located within 3 km of permanent water. Ornamental Snake is listed as vulnerable under both the EPBC Act and Queensland NC Act. Suitable habitat for Ornamental Snake was identified within remnant, mature regrowth and regrowth RE11.4.8 Brigalow woodland occupying an area of 213.6 ha within the southern portion of the study area.

As with the Natural Grassland TEC, the severity of clearing activities is inherently diminished in the grassland habitat supporting *Dichanthium queenslandicum* and *Dichanthium setosum*, and opportunities exist to further minimise disturbance through managed slashing and onsite weed hygiene protocols.

Similarly, the severity of clearing activities in Greater Glider, Squatter Pigeon, Ornamental Snake and Koala habitat can be reduced if these activities avoid removal of key habitat features that are important to the species i.e. canopy trees, hollow bearing trees and understorey microhabitat features. As such areas of threatened species habitat are considered moderately constrained for exploration activities.

A significant impact assessment should be undertaken in accordance with the Commonwealth Significant Impact Guidelines (Version 1.1) prior to any disturbance to MNES. Where impacts are deemed likely to be significant, the project is required to be referred to the Commonwealth for assessment. Additional State approval and permit requirements may also be required for species also listed under the NC Act (**Section 4.2**).

4.2 State

Field survey identified a number of ecological values within the study area which are currently protected under Queensland environmental legislation. These include threatened species listed under the NC Act and Category B ESAs, protected under the *Environment Protection Regulation 2008*. In addition, ecological values recognised as Matters of State Environmental Significance (MSES) that are regulated under the *Environmental Offsets Act 2014* (EO Act) were also identified within the study area (**Figure 8**).

The following sections provide an overview of protected values and associated constraint level. In areas of overlapping values, the highest constraint level takes precedence.

Threatened flora and fauna

As discussed in **Section 4.1** above, 1,911.5 ha of suitable habitat for Koala, 315.2 ha for Greater Glider, 171.2 ha for Squatter Pigeon and 213.6 ha of suitable habitat for Ornamental Snake was identified within the study area. In addition, 1,661.8 ha of habitat for *Dichanthium queenslandicum* was identified within the northern and central portions of the study area.

Legislative constraints associated with these threatened species would be addressed initially at a Commonwealth level. As such the same level of constraint at a Commonwealth level is applicable for threatened species habitat protected at a State level for exploration activities. However, additional permitting considerations would be triggered under the Queensland protected plant framework for disturbance to *Dichanthium queenslandicum*.

Under the framework, a protect plant permit is required for the taking of any protected plants listed under the NC Act. Taking includes actions of plucking, gathering and cutting and would therefore extend to the slashing of grassland areas. Assessment of residual impacts on protected plants following the development of management and rehabilitation strategies, and submission of required permits should be undertaken prior to disturbance of threatened grass habitat.

Category B ESAs

Category B ESAs are defined as REs with an Endangered Biodiversity status. A total of 828.4 ha Category B ESA was ground-truthed within the study area. Category B ESA was identified as RE11.3.1, RE11.4.8, RE11.4.9, RE11.9.5 and RE11.5.15 and occurs throughout the study area.

Approval to clear Cat B ESA has been granted under the current EA for Wards Well. However this approval is based on previously mapped extents of Cat B ESA, and any additional areas identified in this survey may trigger an EA amendment. Disturbance on Category B ESAs is listed as a scenario where a substantial increase in the risk of environmental harm is considered likely. Proposed amendments resulting in a substantial increase in the risk of environmental harm can trigger a major amendment

assessment under the EP Act. As such for exploration activities, these areas are considered highly constrained.

MSES

Regulated Vegetation containing Endangered REs, Of Concern REs, essential habitat or adjacency to mapped watercourses are MSES values. Protected wildlife habitat and remnant areas supporting connectivity values are also MSES values within the study area. The majority of MSES values overlaps with other ecological values protected under Commonwealth and State legislation. The additional area of MSES values that is regulated under the EO Act encompasses 1,774.7 ha of the study area.

MSES are regulated under the EO Act through the provision of offset conditions only as a result of an assessment trigger. As such these areas are considered to be moderately constrained for exploration activities. If a State approval mechanisms is triggered for exploration activities within the study area i.e. under the EP Act or NC Act, a significant impact assessment should be undertaken in accordance with the Queensland Significant Residual Impact Guideline prior to any disturbance to MSES.

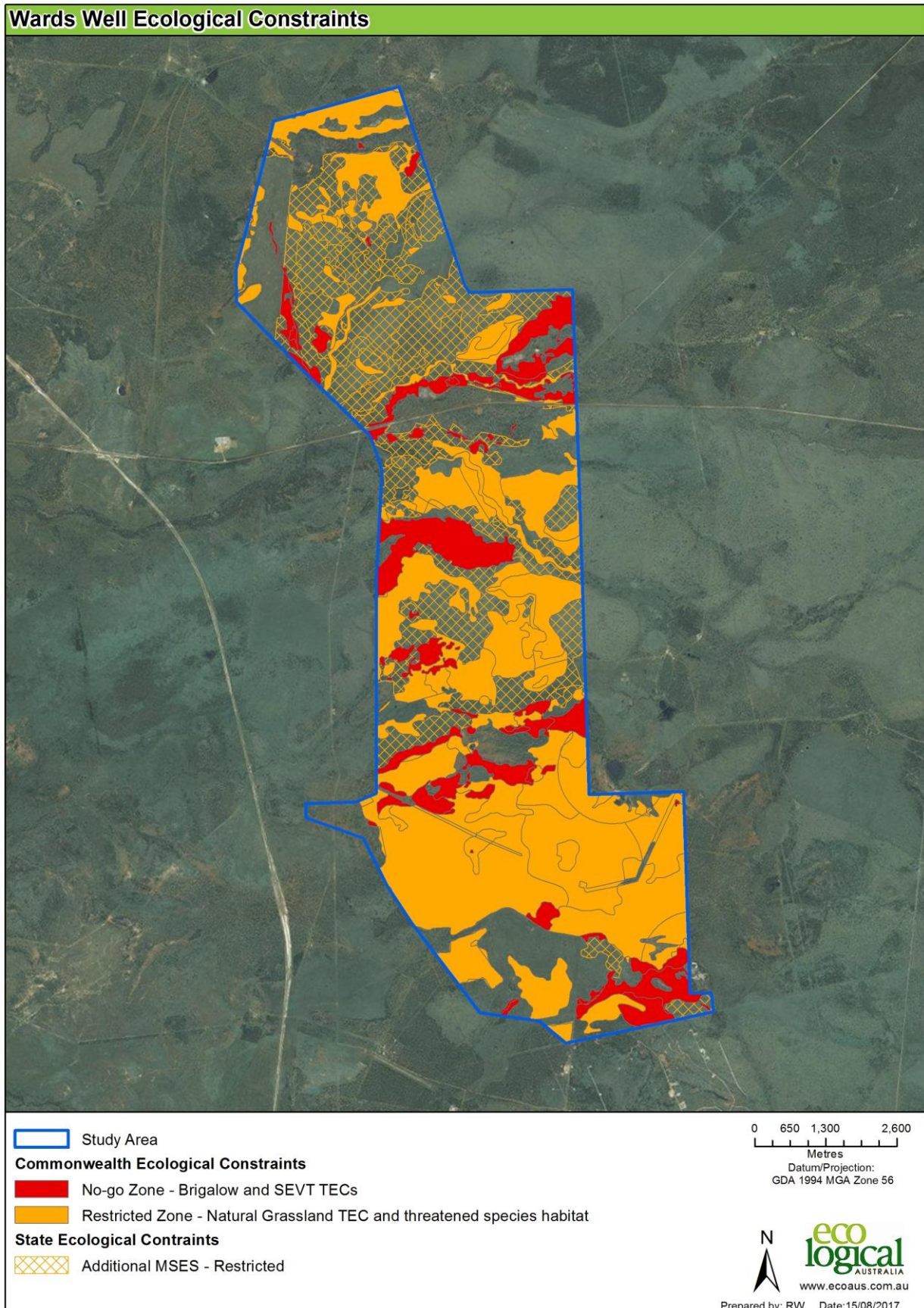


Figure 8: Ecological Constraints

5 Mitigation and Management

5.1 Introduction

The study area contains several Commonwealth and State significant ecological values including TECs, Category B ESAs, threatened species and associated habitats. Any potential future impacts on these values can be reduced and compensated through the implementation of measures to avoid, minimise, mitigate and offset (in that order) impacts associated with the project. A mitigation strategy that employs this hierarchy should be implemented to reduce the potential impacts of any future proposed activities and where possible, avoid a net-loss of habitat, especially for threatened species and TECs within the study area.

Key elements of an effective control strategy are further described below.

5.2 Avoidance Measures

Impacts to environmental values should be avoided as far as practicable by preferentially locating drill pads and associated infrastructure outside of areas containing mapped values. Where it is not possible to completely avoid disturbance to environmental values within the Project area, consideration should be given to the nature of the environmental value. Disturbance should occur preferentially in areas of lower ecological value. Mapped Category B ESA, Brigalow TEC and SEVT are not to be disturbed until the appropriate approvals are in place.

5.3 Minimisation Measures

Where avoidance of clearing and disturbance is not possible due to other constraints, efforts should be made to minimise impacts on ecological values by adopting general management measures across the study area including:

- Minimising the disturbance footprint as much as possible
- Placing buffers between disturbance areas and areas of retained vegetation
- Clearly demarcating the extent of vegetation clearing and areas to be retained prior to the commencement of clearing activities
- Ensuring designated access tracks are utilised wherever possible to prevent additional disturbance
- Reducing speed limits along access tracks to minimise the potential for collision with native fauna

Management measures to be employed when disturbing or clearing Koala and Greater Glider habitat include:

- Avoiding disturbance to Eucalypt canopy trees or regrowth
- Avoiding disturbance to hollow bearing trees
- Utilising a spotter-catcher prior to clearing activities being undertaken. If Koalas or Greater Gliders are identified in the area, clearing activity to be postponed until they have left the area
- Low speed limits to be enforced when travelling within habitat areas
- Strict equipment and vehicle wash down procedures

Management measures to be employed when disturbing or clearing Ornamental Snake habitat include:

- Limit ground disturbance as much as possible, including driving on established tracks to avoid ground compaction
- Utilising a spotter-catcher prior to clearing activities being undertaken
- Avoid conducting works during period of peak reptile activity (September – May)
- Avoid conducting works while water is present in gilgais
- Pruning of vegetation permitted
- No clearing of access tracks or repeat vehicle / equipment traverses (compaction of soils)
- No filling of gilgais with road base gravel, mats, etc
- No removal of fallen woody debris
- No surface scraping

Management measures to be employed when disturbing or clearing Squatter Pigeon habitat include:

- Avoid undertaking seismic activities during optimal breeding times between April and October (when food sources are most abundant)
- Avoid impacts to permanent water sources such as farm dams
- Preventing weeds from being introduced and outcompeting with native grasses
- Utilising a spotter-catcher prior to clearing activities being undertaken
- Low speed limits to be enforced when travelling within habitat areas

Management measures to be employed when disturbing or clearing Natural Grasslands include:

- Limit ground disturbance as much as possible, including driving on established tracks to avoid ground compaction
- Implement strict vehicle wash down procedures to limit spread of weeds
- Slashing permitted during non-flowering times (generally July to October)
- No clearing of access tracks or repeat vehicle / equipment traverses (compaction of soils)
- No covering of ground with road base gravel, mats, etc
- No surface scraping

If management measures are unable to be complied with in areas of identified Koala, Greater Glider, Squatter Pigeon, Ornamental Snake and *Dichanthium queenslandicum*, *Dichanthium setosum* habitat, or Natural Grassland TEC and areas of MSES value, disturbance should not occur until further assessment of potential impacts has been undertaken.

5.4 Mitigation Measures

Where potential impacts still exists following implementing avoidance and minimisation strategies, mitigation measures should be undertaken to further assist in reducing the severity of impacts. These measures are usually outlined in management plans and should include but not be limited to:

- Implementing sensitive clearing techniques where practicable (e.g. trimming branches wherever possible rather than tree removal, selective tree removal rather than broad scale clearing, 'vibrating' hollow-bearing trees prior to felling)
- Ensuring appropriate measures are implemented to reduce fauna entrapment in the trenches and open excavation areas (e.g. reducing the amount of open trench, providing ramps at regular intervals) and undertaking regular inspections of the trenches for fauna
- Implementing erosion and sediment control measures
- Managing water quality and water runoff
- Managing noise, dust and light levels

6 Summary and Conclusion

An ecological assessment has been undertaken to identify and quantify ecological values located within the proposed Wards Well Coal Project disturbance area. This information is required to assist in determining legislative constraints associated with exploration works for the Wards Well Coal Project. This assessment involved both a desktop and field assessment that targeted potential Commonwealth and State values that could constrain the area for future development.

Table 8: Summary of ecological assessment key finding

Ground-truthed ecological value	Area (ha)
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) TEC	91.2
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (Natural Grasslands) TEC	Good – 234.0
	Best – 552.4
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC	57.3
Category B ESA	828.4
<i>Dichanthium queenslandicum</i> habitat	813.0
Koala habitat	1,911.5
Ornamental Snake habitat	213.6
Greater Glider	315.2
Squatter Pigeon	171.2
Additional areas of MSES value	1,774.7

The ecological values detailed above are located across the proposed disturbance area, interspersed with areas of non-remnant and regrowth vegetation which are not environmentally constrained. It is recommended that exploration works are limited to areas outside of identified and mapped ecological values. Where works are required to be undertaken within mapped ecological values, appropriate environmental approvals must be sought and mitigation and management measures employed to limit impacts as far as practicable.

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Department of Environment and Heritage Protection (2014). Guide to Determining Terrestrial Habitat Quality Version 1.2

Eco Logical Australia (ELA) (2017). Wards Well Pre-clearance Survey Report, prepared for BHP.

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Threatened Species Scientific Committee (2013). Approved Conservation Advice for the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community. Department of the Environment and Energy, Australian Government, Canberra.

Threatened Species Scientific Committee (2008). Commonwealth Listing Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin. Department of the Environment and Energy, Australian Government, Canberra.

Threatened Species Scientific Committee (2001). Commonwealth Listing Advice on Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions. Department of the Environment and Energy, Australian Government, Canberra.

URS (2013). Red Hill Mining Lease – Flora Survey Report, prepared for BM Alliance Coal Operations Pty Ltd

Appendix A Habitat Quality Scoring Tables

Site Condition Scoring Table

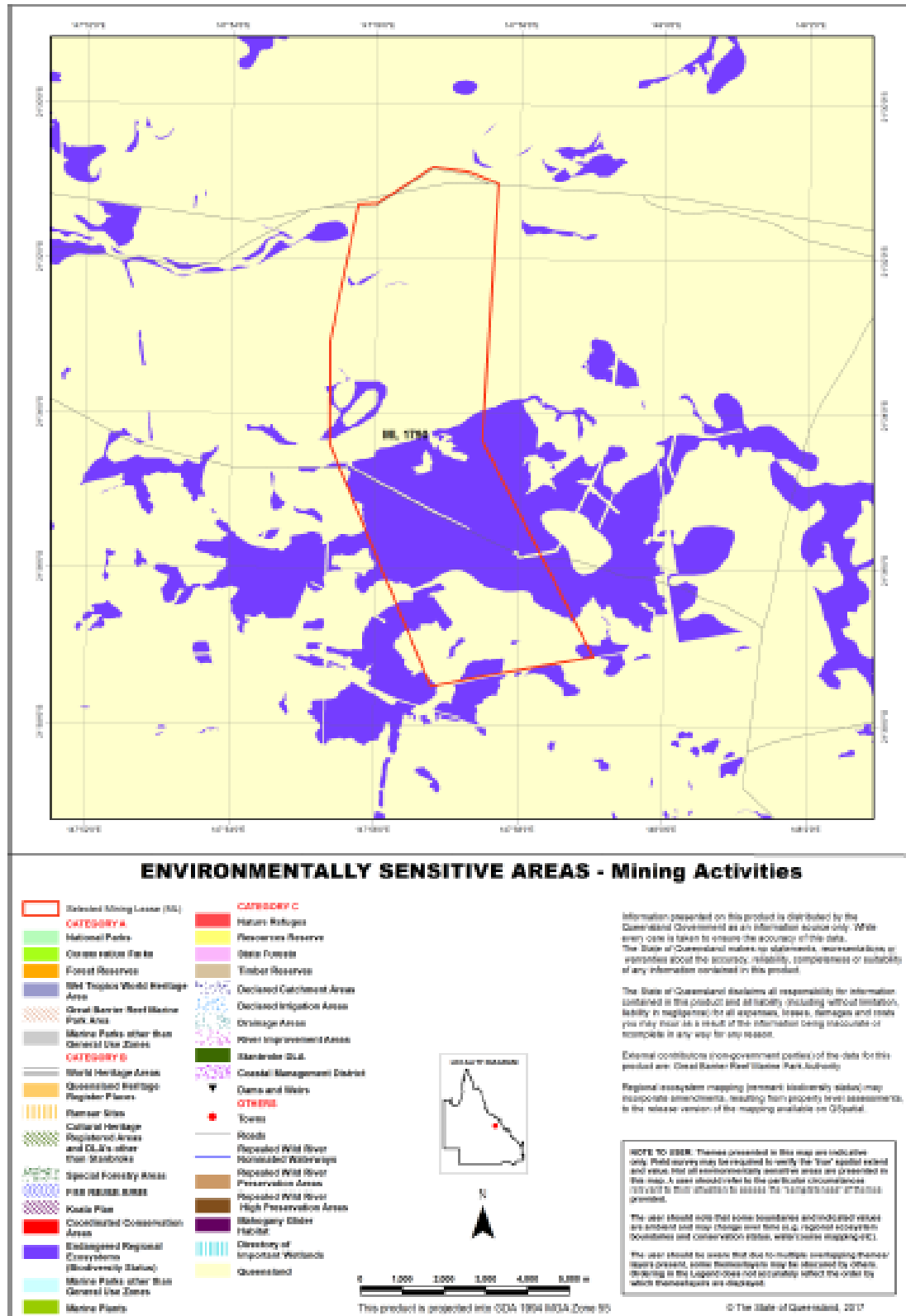
Indicator	Description	Score
1. Recruitment of woody perennial species	<20% of canopy species present as regeneration	0
	≥20 -75 of canopy species present as regeneration	3
	≥75% of canopy species present as regeneration	5
2. Native plant species richness (trees, shrubs, grasses, forbs)	<25% of benchmark number of species within each life-form	0
	≥25% to 90% of benchmark number of species within each life-form	2.5
	>90% of benchmark number of species within each life-form	5
3. Tree canopy height	<25% of benchmark height	0
	≥25% to 70% of benchmark height	3
	≥70% of benchmark height	5
4. Tree canopy cover	<10% of benchmark	0
	≥10% and <50% of benchmark	2
	≥50% to ≤200% of benchmark	5
	>200% of benchmark	3
5. Shrub canopy cover	<10% of benchmark shrub cover	0
	<50% or >200% of benchmark shrub cover	3
	≥50% to ≤200% of benchmark shrub cover	5
6. Native perennial grass cover	<10% of benchmark perennial grass cover	0
	≥10 to 50% of benchmark perennial grass cover	1
	>50 to 90% of benchmark perennial grass cover	3
	>90% of benchmark perennial grass cover	5
7. Organic litter cover	<10% of benchmark organic litter	0
	<50% or >200% of benchmark organic litter	3
	≥50% to ≤200% of benchmark organic litter	5
8. Large trees	No large trees present	0
	0 to 50% of benchmark large trees	5
	>50% to 100% of benchmark of large trees	10
	>benchmark number of large trees	15

Indicator	Description	Score
9. Coarse woody debris (CWD)	<10% of benchmark number or total length of CWD	0
	<50% or >200% of benchmark number or total length of CWD	2
	≥50% or ≤200% of benchmark number or total length of CWD	5
10. Weed cover	>50% weed cover	0
	>25 to 50% weed cover	3
	≥5 to 25% weed cover	5
	<5% weed cover	10

Site Context Scoring Table

Indicator	Description	Score
11. Size of patch <i>(measured only in fragmented landscapes)</i>	<5 ha	0
	5-25 ha	2
	26-100 ha	5
	101-200 ha	7
	>200 ha	10
12. Connectivity <i>(measured only in fragmented landscapes)</i>	The assessment unit is not connected using any of the below descriptions	0
	The assessment unit adjoins with adjacent remnant vegetation along ≥10% to <50% of its perimeter	2
	The assessment unit adjoins with adjacent remnant vegetation along 50% to 75% of its perimeter	4
	The assessment unit adjoins with adjacent remnant vegetation along >75% of its perimeter; or includes >500 ha remnant vegetation	5
13. Context <i>(measured only in fragmented landscapes)</i>	<10% remnant vegetation within 1km radius	0
	≥10% to 30% remnant vegetation within 1km radius	2
	≥30% to 75% remnant vegetation within 1km radius	4
	>75% remnant vegetation within 1km radius	5
15. Ecological Corridors	Not within state, bioregional, regional or sub-regional corridors	0
	Sharing a common boundary within state, bioregional, regional or sub-regional corridors	4
	Within (whole or part) a state, bioregional, regional or sub-regional corridors	6

Appendix B Environmentally Sensitive Areas



Appendix C Koala Habitat Assessment Results

Attribute	Score	Inland	Score	Evidence
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	0	Closest Koala record is in Moranbah, approximately 45 km south of the study area.
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years.		
	0 (low)	None of the above.		
Vegetation composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	2	Woodlands containing > 75 % of Koala food tree species occur in the southern part of the study area. Up to 2 known Koala food trees are present in the south, however are absent from the majority of the study area.
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.		
	0 (low)	None of the above.		
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 1000 ha.	2	Vegetation within the impact area is not well connected to adjacent remnant vegetation.
	+1 (medium)	Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha.		
	0 (low)	None of the above.		
Key existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. Areas which score 0 for koala occurrence and have no dog or vehicle threat present	1	Wild dogs have been recorded within the study area.
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree of dog or vehicle threat present.		
	0 (low)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, OR Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.		
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	0	Suitable habitat for Koala within the study area is limited to the south of the area with little connectivity and is unlikely to be important habitat for the species within the region. The proposed activity will not lead to removal of important habitat refuges for the species during droughts or periods of extreme heat and will not impact on the quality, extent and connectivity of habitat surrounding these refuges.
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		
TOTAL SCORE			5	A limited area of suitable Koala was identified within the study area. Key threats such as dog attack are present, indicating that habitat within the project area is not of a high quality.

Appendix D Habitat Quality Assessment Data

[illegible]

Appendix E Brigalow TEC Assessment Results

Survey site	RE	Tree layer	Age (years)	Patch size	Weed cover (%)	Key diagnostic criteria	Condition threshold criteria
A1	11.4.9	Dominant	>15yrs	<0.5ha	0	Pass	Fail
A2	11.4.8	Co-dominant	5-15yrs	>0.5ha	60	Fail	Fail
A3	11.4.7	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A4	11.4.9	Dominant	>15yrs	>0.5ha	30	Pass	Pass
A5	11.4.9	Dominant	>15yrs	>0.5ha	10	Pass	Pass
A6	11.4.9	Dominant	>15yrs	>0.5ha	20	Pass	Pass
A7	11.4.9	Dominant	>15yrs	>0.5ha	10	Pass	Pass
A8	11.4.9	Dominant	>15yrs	>0.5ha	10	Pass	Pass
A9	11.4.9	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A10	11.4.9	sub-dominant	5-15yrs	>0.5ha	40	Fail	Pass
A11	11.4.9	Dominant	>15yrs	>0.5ha	20	Pass	Pass
A12	11.4.9	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A13	11.4.9	Dominant	>15yrs	<0.5ha	20	Pass	Fail
A14	11.4.9	Co-dominant	>15yrs	>0.5ha	40	Pass	Pass
A15	11.4.9	Co-dominant	>15yrs	>0.5ha	80	Pass	Fail
A16	11.4.9	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A17	11.4.9	Dominant	>15yrs	>0.5ha	5	Pass	Pass
A18	11.4.9	Dominant	>15yrs	>0.5ha	5	Pass	Pass
A19	11.4.9	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A20	11.3.1	Dominant	>15yrs	>0.5ha	70	Pass	Fail
A21	11.3.1	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A22	11.9.5	Dominant	>15yrs	>0.5ha	5	Pass	Pass
A23	11.4.9	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A24	11.9.5	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A25	11.4.9	Dominant	>15yrs	>0.5ha	70	Pass	Fail
A26	11.9.5	Dominant	5-15yrs	>0.5ha	90	Fail	Fail
A27	11.4.8	Dominant	>15yrs	>0.5ha	60	Pass	Fail
A28	11.4.8	Dominant	>15yrs	>0.5ha	60	Pass	Fail

Survey site	RE	Tree layer	Age (years)	Patch size	Weed cover (%)	Key diagnostic criteria	Condition threshold criteria
A29	11.4.9	Dominant	>15yrs	>0.5ha	90	Pass	Fail
A30	11.4.8	sub-dominant	>15yrs	>0.5ha	90	Fail	Fail
A31	11.9.5	Dominant	5-15yrs	>0.5ha	90	Fail	Fail
A32	11.3.1	Dominant	>15yrs	>0.5ha	90	Pass	Fail
A33	11.4.8	Dominant	>15yrs	>0.5ha	55	Pass	Fail
A34	11.4.9	Dominant	5-15yrs	>0.5ha	70	Fail	Fail

Appendix F Squatter Pigeon Habitat Assessment Results

Survey site	Soil Type	RE	Canopy Cover (%)	Bare Ground (%)	Distance to Water (km)
SP1	Silty sand	11.5.9	40	10	3
SP2	Silty sand	11.5.3	50	20	1.5
SP3	Silty sand	11.5.3	35	30	0.8
SP4	Silty sand	11.5.9	25	33	1.8
SP5	Red silty sand	11.5.9	40	35	2.0
SP6	Silty sand	11.5.9	35	20	1.7
SP7	Silty sand	11.5.9	30	45	0.6
SP8	Silty sand	11.5.9	35	10	0.2
SP9	Silty sand	11.5.9	35	35	1.5
SP10	Silty sand	11.5.3	25	40	1.2
SP11	Loam	11.5.3	20	15	0.1
SP12	Silty sand	11.9.2	15	35	0.4
SP13	Silty sand	11.9.7	25	35	0.6

Appendix G Koala Habitat Assessment Results

Survey site	Koala presence	Koala food tree presence	Koala food tree dominance
K1	No	1 species	> 75 %
K2	No	2 species	> 75 %
K3	No	2 species	> 75 %
K4	No	1 species	21 – 50%
K5	No	1 species	51 – 75 %
K6	No	0 species	na
K7	No	1 species	> 75%
K8	No	1 species	> 75%
K9	No	2 species	51 - 75 %
K10	No	1 species	> 75%

Appendix H Ornamental Snake Habitat Assessment Results

Survey site	Gilgais	Soil cracks	Water	Aquatic vegetation	Fallen woody debris
OS1	Absent	Present	Absent	No	Nil
OS2	Present	Absent	Absent	Yes	Common
OS3	Present	Absent	Absent	No	Occasional
OS4	Absent	Absent	Absent	No	Occasional
OS5	Present	Present	Absent	Yes	Common to Abundant
OS6	Present	Present	Absent	No	Common to Abundant
OS7	Absent	Absent	Absent	No	Occasional to Common
OS8	Present	Present	Absent	No	Occasional to Common
OS9	Present	Present	Absent	No	Rare to Occasional
OS10	Present	Absent	Absent	No	Common
OS11	Present	Present	Present	Yes	Occasional to Common
OS12	Present	Present	Absent	No	Rare to Occasional
OS13	Present	Absent	Absent	No	Abundant
OS14	Present	Present	Absent	No	Abundant
OS15	Present	Present	Absent	No	Common to Abundant

Appendix I Natural Grassland TEC Assessment Results

Survey site	RE	Patch size	Tussock count	Shrub cover (%)	Weed cover (%)	Number of listed grass species
WWTEC1	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC2	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC3	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC4	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC5	N/A	1-5 ha	< 200	<30%	>30%	0
WWTEC6	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC7	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC8	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC9	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC10	11.8.11	>5 ha	>200	<30%	5-30%	5
WWTEC11	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC12	11.8.11	>5 ha	>200	<30%	<5%	3
WWTEC13	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC14	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC15	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC16	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC17	11.8.11	1-5 ha	>200	<30%	5-30%	4
WWTEC18	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC19	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC20	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC21	11.8.11	>5 ha	>200	<30%	>30%	0
WWTEC22	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC23	11.8.11	> 5ha	>200	<30%	>30%	2
WWTEC24	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC25	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC26	11.8.11	>5 ha	>200	<30%	>30%	0
WWTEC27	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC28	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC29	11.8.11	>5 ha	>200	<30%	>30%	0

Survey site	RE	Patch size	Tussock count	Shrub cover (%)	Weed cover (%)	Number of listed grass species
WWTEC30	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC31	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC32	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC33	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC34	11.8.11	1-5 ha	>200	<30%	5-30%	4
WWTEC35	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC36	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC37	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC38	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC39	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC40	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC41	11.8.11	1-5 ha	>200	<30%	5-30%	4
WWTEC42	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC43	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC44	11.4.9	>5 ha	>200	<30%	>30%	3
WWTEC45	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC46	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC47	11.8.11	1-5 ha	>200	<30%	5-30%	4
WWTEC48	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC49	11.8.11	1-5 ha	>200	<30%	5-30%	3
WWTEC50	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC51	11.8.11	1-5 ha	>200	<30%	>30%	4
WWTEC52	11.8.11	>5 ha	>200	<30%	>30%	1
WWTEC53	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC54	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC55	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC56	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC57	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC58	11.8.11	>5 ha	>200	<30%	>30%	6
WWTEC59	11.8.11	>5 ha	>200	<30%	>30%	4
WWTEC60	11.8.11	1-5 ha	>200	<30%	>30%	3
WWTEC61	11.8.11	>5 ha	>200	<30%	>30%	3

Survey site	RE	Patch size	Tussock count	Shrub cover (%)	Weed cover (%)	Number of listed grass species
WWTEC62	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC63	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC64	11.8.11	1-5 ha	>200	<30%	5-30%	4
WWTEC65	11.8.11	1-5 ha	>200	<30%	>30%	3
WWTEC66	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC67	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC68	11.8.11	1-5 ha	>200	<30%	5-30%	3
WWTEC69	11.8.11	>5 ha	>200	<30%	>30%	1
WWTEC70	11.8.11	>5 ha	>200	<30%	>30%	2
WWTEC71	11.8.11	1-5 ha	>200	<30%	5-30%	4
WWTEC72	11.8.11	>5 ha	>200	<30%	<5%	0
WWTEC73	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC74	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC75	11.8.11	>5 ha	>200	<30%	5-30%	5
WWTEC76	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC77	11.8.11	>5 ha	>200	<30%	5-30%	0
WWTEC78	11.8.11	>5 ha	>200	<30%	<5%	5
WWTEC79	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC80	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC81	11.8.11	>5 ha	>200	<30%	<5%	5
WWTEC82	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC83	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC84	11.8.11	>5 ha	>200	<30%	<5%	0
WWTEC85	11.8.11	>5 ha	>200	<30%	<5%	0
WWTEC86	11.8.11	>5 ha	>200	<30%	<5%	5
WWTEC87	11.8.11	>5 ha	>200	<30%	5-30%	5
WWTEC88	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC89	11.8.11	>5 ha	>200	<30%	<5%	0
WWTEC90	11.8.11	1-5 ha	>200	<30%	>30%	1
WWTEC91	11.8.11	>5 ha	>200	<30%	<5%	7
WWTEC92	11.8.11	>5 ha	>200	<30%	<5%	5
WWTEC93	11.8.11	>5 ha	>200	<30%	5-30%	4

Survey site	RE	Patch size	Tussock count	Shrub cover (%)	Weed cover (%)	Number of listed grass species
WWTEC94	11.8.11	>5 ha	>200	<30%	<5%	6
WWTEC95	11.8.11	1-5 ha	>200	<30%	>30%	3
WWTEC96	11.8.11	1-5 ha	>200	<30%	>30%	2
WWTEC97	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC98	11.8.11	>5 ha	>200	<30%	<5%	6
WWTEC99	11.8.11	>5 ha	>200	<30%	<5%	6
WWTEC100	11.8.11	>5 ha	>200	<30%	>30%	3
WWTEC101	11.8.11	>5 ha	>200	<30%	5-30%	3
WWTEC102	11.8.11	>5 ha	>200	<30%	>30%	0
WWTEC103	11.8.11	>5 ha	>200	<30%	<5%	7
WWTEC104	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC105	11.8.11	>5 ha	>200	<30%	<5%	6
WWTEC106	11.8.11	>5 ha	>200	<30%	5-30%	4
WWTEC107	11.8.11	>5 ha	>200	<30%	<5%	0
WWTEC108	11.8.11	>5 ha	>200	<30%	5-30%	0
WWTEC109	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC110	11.8.11	>5 ha	>200	<30%	<5%	0
WWTEC111	11.8.11	>5 ha	>200	<30%	<5%	4
WWTEC112	11.8.11	>5 ha	>200	<30%	5-30%	3

Appendix J Likelihood of Occurrence Table

Species Name	Common Name	NC Act	EPBC Act	Wildnet / ALA Records*	Likelihood	Distribution & Habitat**	Justification
Threatened Birds							
<i>Calidris ferruginea</i>	Curlew Sandpiper		CE		Unlikely	Usual habitat is intertidal mudflats of estuaries, lagoons, mangroves channels, dams, floodwaters and inland lakes.	Suitable coastal habitat is not present within the study area.
<i>Erythroriorchis radiatus</i>	Red Goshawk	E	V		Unlikely	The Red Goshawk is sparsely dispersed across 15% of coastal and sub-coastal Australia. Recent records in Queensland suggest that both southern and northern Queensland birds are in existing national parks or state forests with a strongholds in north-east Queensland and eastern Cape York Peninsula. The species is mainly associated with regional ecosystems at risk with rugged terrain in southern and northern Queensland. Nesting habitat has been defined as a stand of tall trees within 1km of permanent water.	Study area does not contain suitable habitat for the species, specifically extensive vegetated tracts of mosaic communities, and the presence of permanent water i.e. large river systems.
<i>Geophaps scripta scripta</i>	Squatter Pigeon (Southern Subspecies)	V	V	✓	Likely	Habitat is defined as open forests, dominated by Eucalyptus, Corymbia, Acacia or Callitris species, vegetation communities which are remnant or regrowth and within 3 km of a water source. These areas also have well-draining soils to allow the Squatter Pigeon to breed in shallow depressions, generally after heavy rainfall.	Suitable habitat was ground truthed during the survey. Records exist near site.
<i>Neochmia ruficauda ruficauda</i>	Star Finch		E		Unlikely	The distribution of the Star Finch is poorly known but thought to only occur in central Queensland. It is a sedentary species that forms small foraging flocks in grasslands and grassy woodlands near permanent water.	Study area does not contain suitable permanent water sources
<i>Poephila cincta cincta</i>	Black-throated Finch (Southern)		E		Unlikely	Distribution is now restricted and known from two areas near Townsville. The Black-throated Finch (southern) occurs mainly in grassy, open woodlands and forests, typically dominated by Eucalyptus, Corymbia and Melaleuca, and occasionally in tussock grasslands or other habitats (for example freshwater wetlands), often along or near watercourses, or in the vicinity of water.	Marginal habitat on site however there are no records in area and population now severely fragmented

Species Name	Common Name	NC Act	EPBC Act	Wildnet / ALA Records*	Likelihood	Distribution & Habitat**	Justification
<i>Rostratula australis</i>	Australian Painted Snipe		E		No	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.	Suitable wetland habitat is not present within the study area
<i>Tyto novaehollandiae kimberli</i>	Masked Owl		V		Unlikely	Distribution not well known, three sub-populations. Masked Owl has been recorded from riparian forest, rainforest, open forest, Melaleuca swamps and the edges of mangroves, as well as along the margins of sugar cane fields	Suitable coastal habitat is not present and the study area is outside of the species known distribution.
Migratory Birds							
<i>Apus pacificus</i>	Fork-Tailed Swift		Mi	✓	Potential	Migrant to Australia between October and late April. The Fork-tailed Swift is predominantly aerial and occurs over inland areas and occasionally above the foothills in coastal areas with dry and open habitat. They can also occur over low scrub, heathland, saltmarsh and riparian woodlands.	Species has been recorded nearby and potentially flies over the study area.
<i>Cuculus optatus</i>	Oriental Cuckoo		Mi	✓	Unlikely	Inhabits monsoonal rainforest, vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands. Frequently at edges or ecotones between habitat types.	Preferred rainforest and mangrove habitat not present within study area.
<i>Gallinago hardwickii</i>	Latham's Snipe		Mi		No	The Latham's Snipe prefers freshwater wetlands, soft moist ground or shallow flooded areas and has a large altitudinal range, up to 2000 m.	Suitable wetland habitat was not identified within the study area.
<i>Hirundapus caudacutus</i>	White-throated Needletail	SL	Mi	✓	Potential	The White-throated Needletail is almost exclusively aerial. They almost always forage aerially, at heights up to 'cloud level', above a wide variety of habitats ranging from heavily treed forests to open habitats, such as farmland, heathland or mudflats. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces.	Marginal roosting habitat within the study area and records in area
<i>Hydroprogne caspia</i>	Caspian Tern	SL	Mi		No	Habitat usually coastal, prefers sheltered estuaries, inlets, bays with muddy or sandy shores. Also extends well inland on temporary floodwater, large rivers, reservoirs, sewerage ponds	No suitable habitat exists onsite
<i>Monarcha melanopsis</i>	Black-faced Monarch	SL	Mi	✓	Potential	The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Species may be found within Eucalypt woodlands found onsite when migrating, records in area

Species Name	Common Name	NC Act	EPBC Act	Wildnet / ALA Records*	Likelihood	Distribution & Habitat**	Justification
<i>Motacilla flava</i>	Yellow Wagtail		Mi		Unlikely	Open country near swamps, salt marshes, sewerage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	Marginal habitat, no records in area
<i>Pandion haliaetus</i>	Osprey		Mi		No	Adult Eastern Ospreys are mostly resident or sedentary around breeding territories. Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging.	Suitable habitat including extensive areas of open fresh, brackish or saline water for foraging was not identified within the study area.
<i>Plegadis falcinellus</i>	Glossy Ibis		Mi	✓	Potential	The Glossy Ibis' preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs. May use drainage lines and creeks on site during wet season.	Species may use dams or drainage lines found on site, records in area
<i>Rhipidura rufifrons</i>	Rufous Fantail		Mi		Unlikely	In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum. When on passage a wider range of habitats are used, including dry eucalypt forests and woodlands	Species may be found within Eucalypt woodlands found onsite when migrating, no records in area
<i>Symposiachrus trivirgatus</i>	Spectacled Monarch		Mi		No	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	No suitable habitat
Mammals							
<i>Dasyurus hallucatus</i>	Northern Quoll		E		Unlikely	The Northern Quoll is known to occur as far south as Gracemere and Mt Morgan, south of Rockhampton, as far north as Weipa in Queensland and extends as far west into central Queensland to the vicinity of Carnarvon Range National Park. The Northern Quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert	Preferred habitat for the species, including rugged, rocky habitat is limited within the study area.

Species Name	Common Name	NC Act	EPBC Act	Wildnet / ALA Records*	Likelihood	Distribution & Habitat**	Justification
<i>Egernia rugosa</i>	Yakka Skink		V		Unlikely	Isolated populations occur throughout sub-humid to semi-arid areas in the interior of Queensland from St George in the south, to Coen and Cape York Peninsula in the north. The species is known from rocky outcrops, sand plain areas and dense ground vegetation, in association with open dry sclerophyll forest (ironbark) or woodland, Brigalow forest and open shrub land. Habitat for the Yakka Skink is often found in association with common woodland and open forest types such as Brigalow, Mulga, Bendee, Lancewood, Belah, Poplar Box and Ironbark. The species lives in colonies around these microhabitat features and commonly digs tunnels beneath the debris.	Suitable habitat, no records in area
<i>Elseya albagula</i>	Southern Snapping Turtle		CE		No	The white-throated snapping turtle is only found in the Burnett, Fitzroy, Raglan and Mary river drainages of south-east Queensland. It prefers permanent flowing water habitats where there are suitable shelters and refuges (e.g. fallen trees).	No suitable habitat
<i>Furina dunmalli</i>	Dunmall's Snake		V		Unlikely	Dunmall's Snake is found from near the Queensland border throughout the Brigalow Belt South and Nandewar bioregions, and as far south as Ashford in New South Wales. As it utilises micro habitat features such as fallen timber and ground litter for shelter, distribution is highly fragmented due to agricultural activities limiting available habitat within the Brigalow Belt Bioregion.	Suitable habitat, no records in area
<i>Lerista allanae</i>	Allan's Lerista		E		Unlikely	Allan's Lerista is only known from black soil downs in the Brigalow Belt North Bioregion in Queensland, between Clermont and Capella. The species was found in association with Mountain Coolabah / Red Bloodwood open woodlands and Black Tea-tree. These sites were mapped as Regional Ecosystem 11.8.5 and 11.8.11.	Suitable habitat, no records in area
<i>Rheodytes leukops</i>	Fitzroy River Turtle		V		No	The Fitzroy River Turtle is only found in flowing streams and permanent waterbodies within the Fitzroy River catchment, Queensland.	No suitable habitat

Species Name	Common Name	NC Act	EPBC Act	Wildnet / ALA Records*	Likelihood	Distribution & Habitat**	Justification
<i>Denisonia maculata</i>	Ornamental Snake	V	V	✓	Likely	The species core distribution occurs within the drainage system of the Fitzroy and Dawson Rivers. The species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions and is likely to be found in Brigalow, Gidgee, or Coolabah dominated vegetation communities, or pure grassland associated with gilgais. Preferred habitat is also defined as areas which favour prey, including Burrowing Frog species and a number of tree frog species.	Suitable habitat identified within the study area supporting gilgai microrelief, records in area
Flora							
<i>Bertya opposens</i>			V	✓	Potential	<i>Bertya opposens</i> has been recorded growing in a variety of community types including mixed shrubland, lancewood woodland, mallee woodland, eucalypt/acacia open forest with shrubby understorey, eucalypt/callitris open woodland and semi-evergreen vine-thicket. Record 10 km east of study area.	Suitable habitat within the study area, records in area; however flora surveys did not detect the species within the study area.
<i>Bertya pedicellata</i>		NT		✓	Potential	Rocky hillsides in eucalypt forest or woodland, Acacia woodland or shrubland and open heathland or vine thicket communities. Soils are recorded mostly as skeletal to shallow sandy, sandy clay or clay loams overlaying rhyolite, trachyte or sandstone substrates. Record 7 km west of site.	Suitable habitat within the study area, records in area; however flora surveys did not detect the species within the study area.
<i>Cerbera dumicola</i>		NT		✓	Potential	Records have been found within non-remnant modified open grassland which was dominated by a dense layer of Buffel grass with <i>Cerbera dumicola</i> observed as shrub species growing one to three metres in height. Record 20 km south of site.	Suitable habitat within the study area, records in area; however flora surveys did not detect the species within the study area.

Species Name	Common Name	NC Act	EPBC Act	Wildnet / ALA Records*	Likelihood	Distribution & Habitat**	Justification
<i>Cycas ophiolitica</i>			E		Unlikely	Grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as <i>Corymbia dallachiana</i> , <i>C. erythrophloia</i> , <i>C. xanthope</i> and <i>Eucalyptus fibrosa</i> . Also been found on mudstone in association with <i>Corymbia dallachiana</i> , <i>C. erythrophloia</i> and <i>Eucalyptus crebra</i> , and on alluvial loams with <i>Corymbia intermedia</i> , <i>Eucalyptus drepanophylla</i> and <i>E. tereticornis</i>	Marginal habitat within the study area and no records in surrounding area.
<i>Dichanthium queenslandicum</i>		V	E	✓	Known	Grows on heavy black cracking clays in tussock grasslands on basalt downs. Often associated with RE 11.8.11. Records within study area (ELA 2017, ALA 2017).	Species previously recorded within the study area, and confirmed during 2017 pre-clearance survey (ELA 2017).
<i>Dichanthium setosum</i>		V			Known	Species usually occurs in grasslands with underlying basaltic geology and often associated with RE11.8.11 which occurs within the study area. Records within study area (ELA 2017)	)Species confirmed during April 2017 pre-clearance survey (ELA 2017)
<i>Digitaria porrecta</i>		NT		✓	Potential	Grows on heavy black cracking clays in tussock grasslands on basalt downs. Often associated with RE 11.8.11. Records adjacent to study area (ALA 2017)	Previous records adjacent to the study area, suitable habitat. Extensive pre-clearance surveys across suitable habitat did not detect the species.
<i>Kelita uncinella</i>		E		✓	Potential	Kelita uncinella is known only from the vicinity of the Newlands coal mine about 130 km west of Mackay in Queensland. It grows on the slopes of tertiary plateaux (or 'jump-ups'), appearing to prefer south-facing slopes (Bean, 2010)	Suitable habitat, records in area; however flora surveys did not detect the species within the study area.
<i>Samadera bidwillii</i>			V		Potential	Species commonly occurs in lowland rainforest, however is also known to occur in open forest and woodland on lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils	Suitable habitat, no records in area; however flora surveys did not detect the species within the study area.

* Records obtained from Atlas of Living Australia (ALA) and Wildnet Databases. Records after 1980 and within 50 km of the study area included.

** Information on species habitat and distribution obtained from Species Profile and Threats Database (DoE 2017), unless referenced otherwise.

Appendix K Bat Call Analysis Report (Greg Ford)



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APPENDIX 5

SINCLAIR KNIGHT MERZ (26 JUNE 2012): WARDS WELL MINE PROJECT: SOIL SURVEY.
VERSION A, REF. NO. QE09811

Wards Well Mine Project



WARDS WELL: SOIL SURVEY

- Soil Survey
- Version A
- 26 June 2012



BHP Mitsui Coal

Wards Well Mine Project

WARDS WELL: SOIL SURVEY

- Version A
- 26 June 2012

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Contents

1.	Introduction	1
1.1.	Project Location	1
1.2.	Project Site	3
1.3.	Study Objectives	4
1.4.	Desktop Study	4
1.5.	Field Sampling Method	5
1.6.	Soil Description	6
1.7.	Sampling and Laboratory Analysis	7
1.8.	Report Structure	9
2.	Geomorphology	10
3.	Soil Units	13
3.1.	Vertosol	13
3.2.	Sodosol	17
3.3.	Dermosol	21
3.4.	Kandosol	23
4.	Agricultural Land Suitability	27
4.1.	Existing Land Use Patterns	27
4.2.	Methodology	27
4.2.1.	Plant Available Water Capacity	28
4.2.2.	Nutrient Deficiency	29
4.2.3.	Salinity	29
4.2.4.	Soil Physical factors	29
4.2.5.	Erosion	30
4.2.6.	Workability, Flooding and Wetness	30
4.2.7.	Microrelief and Rockiness	30
4.2.8.	Topography	31
4.3.	Results	31
4.3.1.	Plant available water capacity	32
4.3.2.	Nutrient deficiency	32
4.3.3.	Salinity	32
4.3.4.	Soil Physical Factors	33
4.3.5.	Erosion	33
4.3.6.	Workability, Flooding and Wetness	33
4.3.7.	Microrelief and Rockiness	33
4.3.8.	Topography	33
4.3.9.	Pre-mining Land Suitability for Cropping and Grazing	38

SINCLAIR KNIGHT MERZ



5. Good Quality Agricultural Land	41
5.1. Method	41
5.2. Results	42
6. Strategic Cropping Land	45
6.1. Method	45
6.2. Results	46
7. Post Mine Land Suitability	48
8. Erosion Potential and Control	50
8.1. Soil Erosion Potential – Sodic Soils	50
8.2. Hillslope Erosion	55
8.3. Erosion Control	57
8.3.1. Rehabilitation of Eroded Areas	58
9. Topsoil Management	60
9.1. Topsoil Stripping Management	60
9.2. Topsoil Stripping and Stockpile Management	62
9.3. Topsoil Application During Rehabilitation	63
9.4. Reuse of Competent Spoil	64
10. Conclusion	66
11. References	67
Appendix A Soil Logs	70
Appendix B Tabulated Laboratory Results	72
Appendix C ALS Laboratory Documents	74
Appendix D Land Suitability Assessment	76
Appendix E Strategic Cropping Land Assessment	93
Appendix F Hillslope Erosion	94
Figures	
■ Figure 1-1 Wards Well Project Location	2
■ Figure 2-1 Surface Geology	12
■ Figure 3-1 Sample Locations and Australian Soil Classification	14
■ Figure 3-2 3 Vertosol: Profile (Site 6)	16
■ Figure 3-3 Sodosol: Profile (Site 49)	19
■ Figure 3-4 Dermosol: Profile (Site 28)	22
■ Figure 3-5 Kandosol: Profile (Site 69)	25



■	Figure 4-1 Slope	34
■	Figure 4-2 Pre-mining Land Suitability for Cropping	39
■	Figure 4-3 Pre-mining Land Suitability for Grazing	40
■	Figure 5-1 Revised Good Quality Agricultural Land Classifications	44
■	Figure 6-1 Mapped potential SCL	47
■	Figure 8-1 Hillslope Erosion rates	56
■	Figure 9-1 Topsoil Stripping Depth	61

Tables

■	Table 1-1 Compliance with Current Requirements	6
■	Table 1-2 Australian Soil Classification Descriptors	7
■	Table 1-3 Physical and Chemical Laboratory Analysis	7
■	Table 2-1 Comparison of Published Geomorphology Descriptions in Project Area	10
■	Table 3-1 Soil Types	13
■	Table 3-2 Vertosol: Representative Description and Management (Site 6)	15
■	Table 3-3 Vertosol: Particle Size Distribution (Site 6)	16
■	Table 3-4 Vertosol: Soil Chemistry (Site 6)	17
■	Table 3-5 Sodosol Representative Description and Management (Site 49)	18
■	Table 3-6 Sodosol: Particle Size Distribution (Site 49)	18
■	Table 3-7 Sodosol: Soil Chemistry (Site 49)	19
■	Table 3-8 Dermosol: Representative Description and Management (Site 28)	21
■	Table 3-9 Dermosol: Particle Size Distribution (Site 28)	22
■	Table 3-10 Dermosol: Soil Chemistry (Site 28)	23
■	Table 3-11 Kandosol: Representative Description and Management (Site 69)	24
■	Table 3-12 Kandosol: Particle Size Distribution (Site 69)	25
■	Table 3-13 Kandosol: Soil Chemistry (Site 69)	26
■	Table 4-1 Land Suitability Classes	27
■	Table 4-2 PAWC: Land Suitability for Cropping / Grazing (DME, 1995)	28
■	Table 4-3 Erosion Limitations for Cattle grazing – Effects of Slope (DME, 1995)	30
■	Table 4-4 Land Suitability Class Criteria	31
■	Table 4-5 Estimated Plant Rooting Depth, PAWC and Land Suitability Class	32
■	Table 4-6 Land Suitability Assessment: Cropping and Grazing	35
■	Table 4-7 Pre-mining Land Suitability Classes	38
■	Table 5-1 Scheme for Classifying Agricultural Land (DPI / DLGP, 1993)	41
■	Table 5-2 Land Suitability Ranking and Agricultural Land Class Correlation	42

SINCLAIR KNIGHT MERZ



■	Table 5-3 Existing and Revised Land Class Areas	43
■	Table 5-4 ALC and GQAL	43
■	Table 6-1 Summary of Criteria for Identifying SCL (DERM, 2011)	45
■	Table 6-2 Criteria for Estimating PAWC (DERM, 2011)	45
■	Table 6-3 Summary Assessment of SCL	46
■	Table 8-1 Erosion Susceptibility	52
■	Table 8-2 Erosion Control for Mining Activities	57
■	Table 9-1 Topsoil Stripping Guide	60



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1. Introduction

SKM was commissioned by BHP Biliton Mitsu Coal Pty Ltd (BMC) to undertake a soil survey assessing soil classes for Good Quality Agricultural Land (GQAL) (DPI/DHLGP, 1993), Land Suitability for cropping and grazing (DPI, 1990 and DME, 1995) and Strategic Cropping Land (DERM, 2011 and DERM, 2012). This is to form part of the Environmental Impact Statement (EIS) to support the development application for the project. The proposed mine project includes a multi-seam underground coal mine, a Coal Handling and Preparation Plant (CHPP) and Mine Industrial Areas (MIAs) and other industrial areas including a rail line loop and aeroplane runway. The Project is expected to produce up to 15 million tonnes per annum (Mtpa) of high quality hard coking coal product for the export market over a life of approximately 30 years.

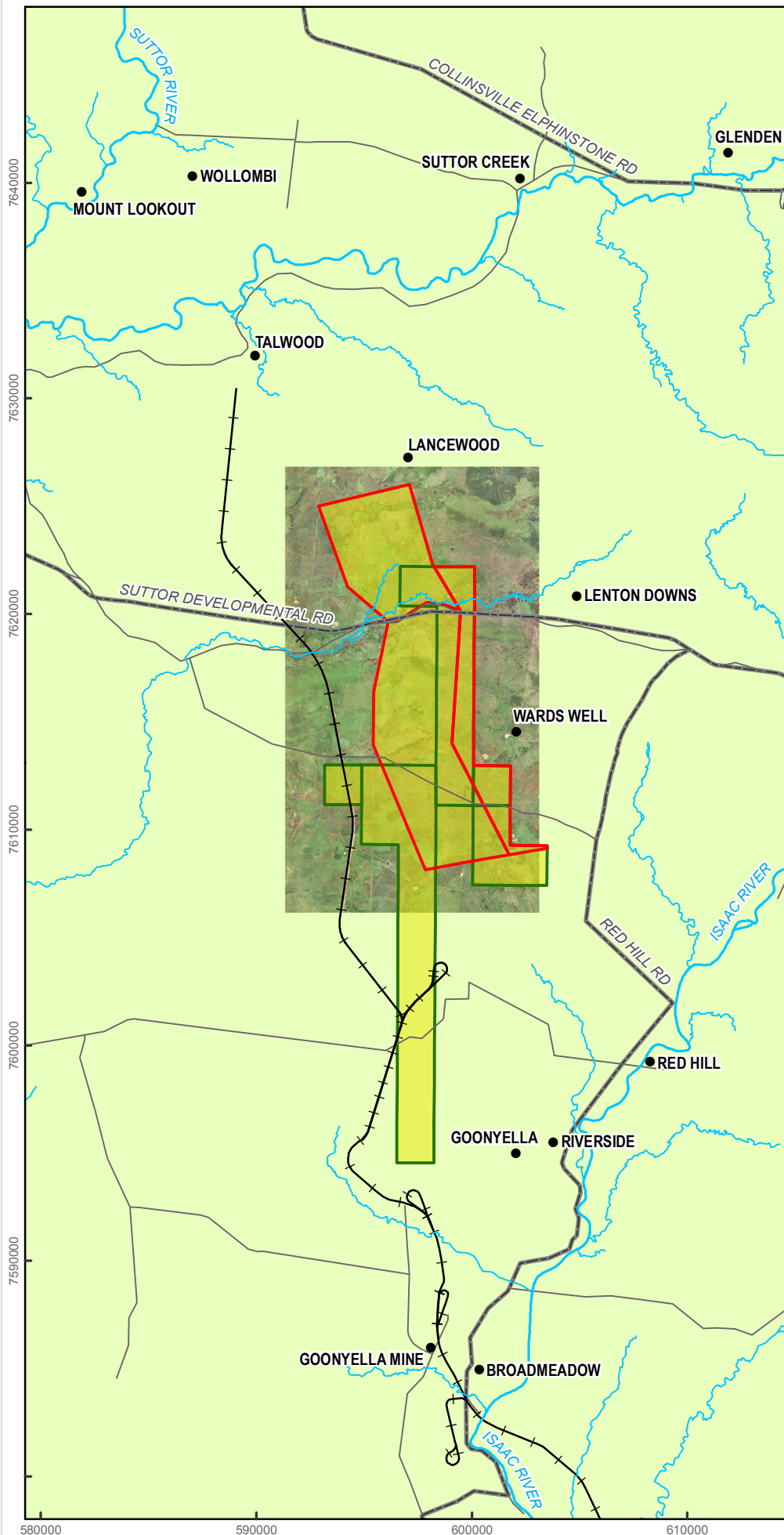
The Wards Well project will inevitable include ground disturbance. Soil resources will be impacted by the mining operations. Development of the underground mine and infrastructure including, dams, roads, hardstands and storages all have the potential to impact on the local soil resource. To ensure sufficient soil resources are available for post-mining rehabilitation, it is important that all suitable natural soil reserves are identified and recovered ahead of this disturbance. If not adequately managed, impacts within the project site may also cause impacts further downstream through the sedimentation of watercourses, especially if saline and / or sodic soils are encountered. Disturbance to the ground surface and landscape character may also reduce the agricultural suitability of land with the project site or downstream.

1.1. Project Location

The Project area is located within the northern region of the Bowen Basin approximately 30 kilometres south of Glenden (further via road network) and approximately 150 kilometres southwest of Mackay, Queensland. The project site is located within the Belyando Shire. A locality map showing the project site in a regional context is provided in **Figure 1-1**, the Project area is located immediately to the north of the existing North Goonyella Mine.

The region contains rich thermal and metallurgical coal resources at depth, and several open-cut and underground mines operating nearby supply both domestic and export markets. BMA mines, including Peak Downs (some 50 km south), have been operating since 1968. Other regional industries include beef cattle grazing and limited cropping.

WARDS WELL PROJECT LOCATION



LEGEND

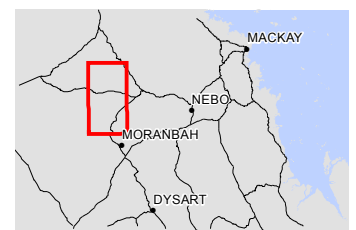
- Town
- Minor Watercourse
- Major Watercourse
- Existing Railway
- Major Road / Highway
- Minor Road / Local Road
- ▭ Mining Lease
- ▭ Exploration Permit Coal
- ▭ Wards Well Project Area

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WARDS WELL MINE PROJECT - EIS SOILS AND LAND SUITABILITY BASELINE SURVEY

FIGURE 1



1.2. Project Site

The project is comprised of land that is to be disturbed by the project and surrounding land which will not be disturbed by the project, consisting of 12,006.5 ha, which has been divided into key areas of disturbance for assessment purposes. The key areas of disturbance are described as follows:

- **Disturbance.** This area consists of XX ha or XX % of the project site. The mine infrastructure supporting Wards Well will be located along the western boundary of the Wards Well mining lease area and include:
 - Underground entries and underground mine (including subsidence);
 - Mine water storage facilities;
 - Accommodation camps;
 - Run-of-mine (ROM), Raw and Product coal stockpiles;
 - CHPP;
 - Two mine industrial areas (MIAs).
 - Rail loop and train load out facility;
 - Dry reject disposal area;
 - Gas pre-treatment plant;
 - On-site gas fired power plant;
 - Power supply;
 - Air strip Haul and access roads; and
 - Wards Well Airstrip.
- **Undisturbed Areas.** The area consists of XX ha or X % of the project site. The undisturbed areas are defined as all areas not used for surface infrastructure or not impacted by subsidence from the underground mine operation



1.3. Study Objectives

To assist BMC with operational soil and land management, a soil resources and pre-mining assessment of agricultural land suitability was undertaken. The major objectives of the soil and land suitability assessment, according to the projects Terms of Reference (ToRs), were to:

- **Objective 1. Classify and determine the soil types within the project site.** To satisfy Objective 1, the soil taxonomic classification system used was the Australia Soil Classification (ASC) system. The system is routinely used as the soil classification system in Australia. The scale of mapping used in the project area was 1:25,000 for planned disturbed areas and up to 1:50,000 for planned undisturbed areas across the overall site.
- **Objective 2. Assess the pre-mining Land Suitability classes within the project site.** To satisfy Object 2, the *Guidelines for Agricultural land Evaluation in Queensland* (DPI, 1990 and DERM, 1995)) were used. This includes a standard list of limitations for assessing agricultural land suitability in Queensland.
- **Objective 3. Assess the pre-mining Agricultural Land Classes (ALC) with the project site.** To satisfy Objective 3, the *Planning Guidelines: Identification of Good Quality Agricultural Land* was used (DPI/DHLGP, 1993). The guidelines define four classes of agricultural land.
- **Objective 4. Assess the pre-mining Good Quality Agricultural Land (GQAL) classes within the project site.** To satisfy Objective 4 the *Planning Guidelines: Identification of Good Quality Agricultural Land* was used (DPI/DHLGP, 1993). The guideline sets conditions for land in terms of limitations, rating and ability of the land to maintain a sustainable level of agricultural productivity.
- **Objective 5. Assess the pre-mining Strategic Cropping Land (SCL) within the project site and provide soil management recommendations for management.** To satisfy Objective 5, the relevant guideline applied was the *Protecting Queensland's strategic cropping land; Proposed criteria for identifying strategic cropping land* (DERM, 2011). This guideline allows for on ground assessment of the project site against the criteria that will define the extent of strategic cropping at a reconnaissance level.
- **Objective 6. Assess the suitability of topsoil for future rehabilitation including the identification of unfavourable soil in the project site.**
- **Objective 7. Assess the potential erosion rates for various scenarios during the construction, and operational phases of the project.**

1.4. Desktop Study

There are several existing surveys that have information relating to soils and land suitability that are relevant to the Project. The first soil and land suitability work in the survey area was completed

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by CSIRO who mapped land system boundaries (Gunn et al., 1967) and described soil types. Bourne and Tuck (1993) described agricultural management units (AMU's) for the Central highlands region of Queensland that includes the Project area. Other work relevant to the area includes the CSIRO Land Systems mapping (Story et al., 1967).

In addition to the publications described above, the following maps have been used to describe soils, topsoil thickness and land suitability as part of initial desktop review:

- DERM (2011a) Strategic Cropping Land – Trigger Mapping;
- DERM (2010) Good Quality Agricultural Land Mapping;
- National Resource Information Centre (1991) Australian Soil Classification digital map. Mapped by McKenzie and Hook (1992) using soil descriptions provided in the Atlas of Australian Soils (Northcote et. al., 1968); and
- CSIRO digital map interpreted from Northcote et al., (1960-1968) 'Atlas of Australian Soils'.

1.5. Field Sampling Method

The survey has been designed to provide sufficient information on land resources to allow the determination of land suitability, SCL, soil erosion potential, rehabilitation potential and storm water runoff quality consistent with the methods set out by the Queensland DPI (1990), Shields and Williams (1991) and DME (1995). Fieldwork investigations were conducted over the period 15 to 24 August 2011. Soil was described at 98 sample locations with a further 384 observation sites corresponding to an overall soil mapping and sampling scale of 1:25,000.

An assessment has been made of land suitability for grazing and cropping using the Land Resources Branch (1990) system which is considered the most appropriate for this survey and forms the basis for GQAL assessment as well as selection criterion for SCL.

A free survey technique (Gunn et al 1988) has been used to verify mapped soil types and assign boundaries to each. Free survey is a commonly used method in broader scale agricultural lands as it enables flexibility in site selection (over grid mapping techniques), to achieve a more accurate and time effective result. The survey focused on areas that are likely to be affected by mining operations, although sampling beyond planned disturbance areas has also been undertaken to enable soil units to be extended into the adjoining areas not proposed for future mining activity. Generally sampling and profile inspection points have been positioned to characterise all landform elements and soil units.

Ground truthing of mapped soil types was required for the following reasons:



- The dominant soil from each unit may occupy a very limited area (perhaps 20%) within that unit. Any analysis based on an interpretation of the dominant soil is therefore of restricted value;
- It is normal for there to be a very large variation within each map unit. Some units have up to 20 soils listed. It is common for the within unit variation to be as great as the between unit variation;
- As a consequence, it is essential to use the range of soils and their interpreted values when making judgements on soil character and behaviour for any area;
- Many landscape processes (e.g. erosion, salinisation etc.) do not correlate in a simple way (if at all) with the Australian Soil Atlas units because the description of soils is based on profile morphology. Profile morphology may have a poor or complex relationship with soil processes. Furthermore, landscape processes required more information before even synoptic predictions can be made; and
- The spatial arrangement of soils within a landscape may have an overriding impact on landscape processes (e.g. erodible soils along stream banks).

Details regarding the compliance of the survey density with the current recommended sampling densities are summarised in **Table 1-1**.

■ **Table 1-1 Compliance with Current Requirements**

Item	Recommendations	Actual	Compliance
Total number of locations assessed	4 to 16 per 100 ha	MLA Area: 5,089.17 ha	Yes
Survey Scale	1:25,000	206 locations assessed which represents 4 locations per 100 ha	Yes
Detailed Sites	10-30 %	1:24,705	Yes
Sites subject to laboratory Analysis	1-5%	51 out of 206 locations which represents approximately 40% of the survey points	Yes

1.6. Soil Description

Profile descriptions have been described with due regard to the Australian Soil and Land Survey Field Handbook (MacDonald et al., 1990), the Australian Soil Classification (Isbell, 1996) and Munsell soil colour charts. Profiles were sampled using a hand auger and where possible profiles at cuttings, excavated pits and eroded channels were recorded.

Major soil characteristics were determined from examination of soil profile morphology for the attributes presented in **Table 1-2**. Physical properties such as permeability and drainage

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characteristics were inferred from profile morphological characteristics such as concretions, depth to rock, observed root depth, colour and mottling. Slope, landform, vegetation, land condition were also described at inspection points.

■ **Table 1-2 Australian Soil Classification Descriptors**

Descriptor	Application
Horizon depth	Weathering characteristics, soil development
Field Colour	Permeability, susceptibility to dispersion / erosion
Field Texture Grade	Erodibility, hydraulic conductivity, moisture retention, root penetration
Boundary Distinctions and Shape	Erosional / Dispositional status, textural grade
Consistence Force	Structural stability, dispersion, ped formation
Structure Pedality Grade	Soil structure, root penetration, permeability, aeration
Structure Ped and Size	Soil structure, root penetration, permeability, aeration
Stones – Amount and Size	Water holding capacity, weathering status, erosional / dispositional character

1.7. Sampling and Laboratory Analysis

Assessment of GQAL, Land Suitability and SCL included laboratory analysis of 1-2 kg of sample collected during the site soil survey. DME (1995) Guidelines suggest a sampling density of between 4 and 16 sample points per 100 ha for a 1:25,000 scale survey depending on pre existing resource information as well as the local knowledge and experience of the surveyor. Further, the guideline also recommends that between 1% and 5% of all sites are sampled and subject to laboratory analysis and that between 10% and 30% of sites are described in detail (i.e. field profile morphological description). The survey has included 98 description locations with samples taken from 16 locations collected through the soil profile at each horizon roughly corresponding to 0 mm, 300 mm and 600 mm depth. In total 46 samples have been analysed by the NATA accredited ALS Laboratories, for chemical and physical characterisation as specified in **Table 1-3**. Of these samples, 27 were analysed for Particle Size Distribution (PSD) and **32 samples analysed for aggregate stability.**

■ **Table 1-3 Physical and Chemical Laboratory Analysis**

Test	Soils Analysed	Reason for Inclusion
Chemical Analysis		
pH, Electrical Conductivity and Chloride Content	Surface and subsoil	pH is regarded as a useful indicator of other soil properties (e.g. values >8.5 usually indicate high exchangeable sodium levels and the presence of carbonates) and of the need for amendment with lime. Some plants tolerate a wide range of pH, while some are sensitive to acidity and some to alkalinity. The availability of some nutrients will be affected by soil pH. The measure of EC is used as a means of appraising soil salinity. The electrical conductance increases with soluble salt content and thus allows simple interpretation of readings. Plants vary considerable in their tolerance to salt The chloride anion is usually present in soil in association with sodium and is an important constituent of many salty soils. Its high mobility makes it a valuable indicator of the direction of

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Test	Soils Analysed	Reason for Inclusion
Carbonate Content	Surface and subsoil	salt and water movement, and it can be specifically toxic to some plants. Carbonate may exist in soil as predominately either calcite or dolomite. Its presence, which may vary from trace amounts to high percentages of the soil, is of significance because of its effect on the general physical condition, especially on consistence. When present in large amounts as fine-earth carbonate it can modify soil texture. It can constitute a potential source of calcium for the replacement of exchangeable sodium, thus improve stability.
Cation Exchange Capacity and Exchangeable Ca, Mg, Na (Cations)	Surface and subsoil	The amounts and relative proportions of the exchangeable cations in soil have important effects on both physical and chemical properties. High levels of exchangeable sodium cause dispersion and increased swelling, reducing water movement and affecting near surface aeration whereas exchangeable calcium flocculates colloids and will reduce swelling tendencies. Excessively high or low concentrations of one or the other of the cations may result in nutritional disturbances to germinating plants. Exchangeable cations are held in the soil at negatively charged surfaces and are exchanged by all 'strong' cations. The total amount that can be held is designated the cation exchange capacity.
Soluble Ca, Mg, Na, K, CO ₃ , HCO ₃ , SO ₄	Surface and subsoil	Knowledge of soluble cations and anions and their relative proportions is valuable in assessing saline and alkaline soils and their response to various treatments. Chloride is usually the principal anion in extracts of soil and it is specifically toxic to some plants. Other anions may also be toxic to plants. Bicarbonate is a normal constituent of saline and sodic soil extracts. Both CO₃ and HCO₃ have a tendency to precipitate the divalent cations Ca and Mg, resulting in an increase in the ratio of Na to Ca-Mg in the soil solution. This favours the absorption of Na by the exchange complex and the development of unfavourable sodic-soil conditions.
Phosphorous, Nitrogen, Potassium	Surface soil	If the amount of phosphorous in soil is too small then yield is jeopardised, but increasing reserves to very high levels is an unnecessary expense. Thus the concept of a critical level in soil is necessary.
Organic Matter	Surface soil	Organic matter is important in maintaining soil structure, in slightly increasing the soil's water holding capacity and holding a small store of N, P, S and trace elements in organic forms. These cannot be taken up directly by plant roots but have first to be converted by soil microbes to inorganic (ionic) forms identical to those supplied in fertilisers.
Total digest for molybdenum, manganese, iron, copper, zinc, boron, chloride, sodium and cobalt.	Surface and subsoil	Although only required in small amounts, trace elements (or micronutrients) are essential for plant growth. These nutrients often act as catalysts in chemical reactions. It is possible to have toxicities of trace elements, as well as deficiencies. A deficiency may reduce plant growth. An excess of a trace element, although not common, may be toxic to the plant and may cause an imbalance, reduced yield, impaired quality or increased susceptibility to disease.
Bicarbonate Extractable Phosphorus (P)	Surface soil	Defines the very soluble (also termed available or labile) phosphorus in soils.
Physical Analysis		
Particle Size Distribution (PSD)	Subsoil	Defines the relative amounts of silt, clay and sand in the sample
PAWC	Derived empirically for surface and subsoil	Where the plant available water capacity is marginal or requires more detailed evaluation than estimations from morphological attributes, then PAWC analysis has been undertaken. Some Brigalow scrub soils may fall into this category.
Aggregate Stability	Surface and	This classifies the behaviour of soil aggregates, when immersed, and their coherence in water. Testing is done only on soils with suitable aggregates. Sands and gravels are usually unsuitable

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Test	Soils Analysed	Reason for Inclusion
(Emerson Aggregate Test)	subsoil	for the test. The soils are divided into seven classes on the basis of their coherence in water, with one further class being distinguished by the presence of calcium-rich materials. Typically Class i and 2 soils are highly likely to pollute stormwater of exposed to rainfall or flowing water of any kind. Treatment of these soils with gypsum will most likely be required. Class 3 and 5 soils disturbed by cut and fill operations or construction traffic are highly likely to pollute stormwater, i.e. cause turbid run-off. Chemical stabilisation will likely be required. Any Emerson Class 1, 2, 3 and 5 subsoils that are to be revegetated and need to be covered with a non-dispersive topsoil as soon as possible.

1.8. Report Structure

This technical report is presenting the following:

- The methodology used to assess the land quality of the project area
- The findings of the desktop assessment
- The findings of the field survey in regards to:
 - The description of the soils as per the Australian Soil Classification (ASC).
 - The ground truthing of the ASC orders as mapped in the desktop study.
 - The determination of the erosion susceptibility of the surface and subsurface soil.
 - The prediction of likely SCL areas and QGAL.
- A discussion of the results in relation to the mitigation and rehabilitation measures for the project.



2. Geomorphology

This section provides a description of the soil origins and landform of the project area based on existing published data and survey results. The soil logs are provided in **Appendix A** and tabulated laboratory results in **Appendix B**. The ALS laboratory documents are provided as **Appendix C**.

The geomorphology of the project area has been deduced from the following resources:

- R.H. Gunn and H.A. Nix in the 1:1,000,000 mapping Geomorphic Categories and Land Units of the Fitzroy Region, Queensland, Australia (1977);
- Gunn, RH, Galloway, RW, Pedley, L and Fitzpatrick, EA (1967) Lands of the Nogoa-Belyando Area, Queensland. Land Research Series No. 18, CSIRO, Melbourne;
- Atlas of Australian Soils (Northcote et al, 1960-68). Digital Map published by CSIRO; and
- Geoscience Australia (2002) 1:1,000,000 electronic vector mapping data of surface geology.

R.H Gunn et al (1967) have described the relief of the Nogoa-Belyando Area where the project is located. After the formation of extensive basalt sheets in early Tertiary times, prolonged erosion etched out areas of softer rocks to form lowlands while leaving harder rocks standing up as scarps and hill masses. Later in the Tertiary, erosion attacked these higher areas and covered the adjacent lowlands with detrital deposits ranging from conglomerate and sandstone to clay. The result was a gently undulating Tertiary land surface that was depositional over extensive lowland areas and erosional on limited higher areas. Deep weathering associated with this landscape produced the Tertiary weathered zone with laterite overlying mottled and pallid zones.

Subsequently the Tertiary land surface and weathered zone were partially eroded and in places removed entirely. This erosion resulted in the development of a soil catena and associated vegetation types on a wide range of rocks, particularly the Tertiary sediments.

Table 2-1 provides a comparison of published geomorphology descriptions in the project area along with geology and Australian Soil Classification (ASC) found during the field survey. A map showing surface geology is provided in **Figure 2-1**.

■ **Table 2-1 Comparison of Published Geomorphology Descriptions in Project Area**

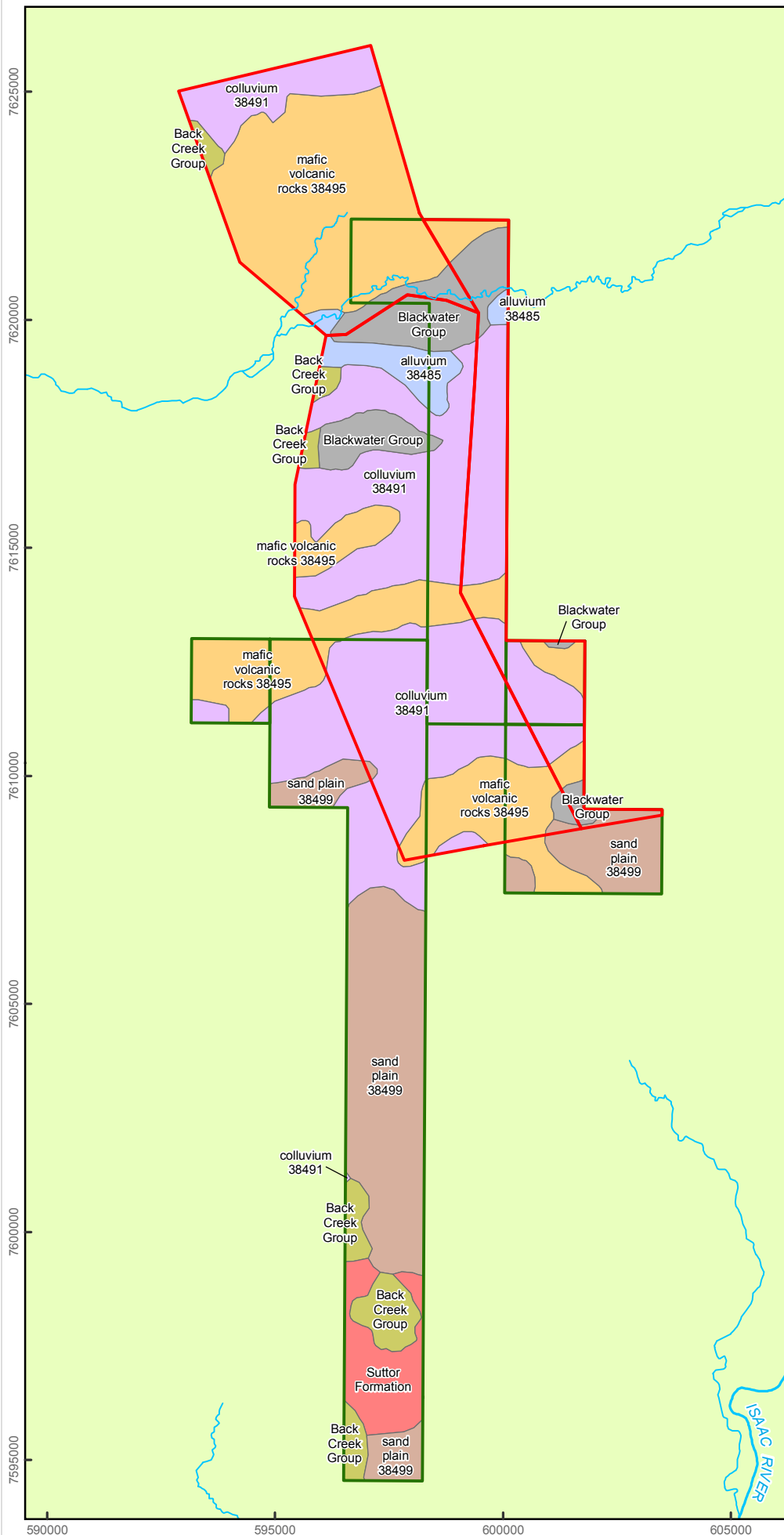
Part of Site	RH Gunn and HA Nix (1977)	Northcote et al (1960 – 1968)	Geology and Soils
North	Lowlands (stable) and occasional low tabular hills on basalt giving rise to sedimentary soil mainly on basalt:	Gently to broadly undulating plains interrupted by some stony ridges, basalt flow scarps, broad low hill crests, or occasional low conical hills: dominant soils are shallow to moderately deep dark grey or dark brown cracking clays.	Mafic volcanic rocks, Alluvium, Colluvium, Blackwater Group (Sandstone, siltstone, shale, mudstone, coal, tuff, conglomerate).

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Part of Site	RH Gunn and HA Nix (1977)	Northcote et al (1960 – 1968)	Geology and Soils
Central	May Downs - Dark self mulching deep clay (≥ 90 cm).	Ug5.12 Ug5.16	Kandosol, Vertosol, Sodosol (minimal inclusion).
	Minor Arcturus – Dark self-mulching moderately shallow clays (60-90 cm).	Ug 5.12 Ug5.14	
	Teviot – Dark self mulching moderately deep to deep clay soils.	Ug5.12 Ug5.14 Ug5.22	
	Lowlands (erosional) and occasional low tabular hills on basalt giving rise to Red earths:	Gently undulating lands with broad ridge crests and low rises. Loamy or occasionally sandy red earths.	Mafic volcanic rocks, Colluvium.
	Dunrobin – Deep loamy red earths.	Gn2.12 Gn2.11	
	Minor Struan – Deep loamy yellow earths.	Gn2.22 Gn2.21 Gn2.62	Kandosol, Vertosol, Dermosol, Sodosol.
	Annandale – Deep sandy red earths.	Gn2.12 Gn2.11	
Southern	Gently undulating stable plans giving rise to transported weathered materials:	Level or very gently undulating clay plains with slight to moderate (1-2 ft) gilgai microrelief, occasionally stronger (2-4 ft). Where the unit is adjacent to major streams many small braided channels occur and the area is subject to flooding. Dominant soils are deep grey clays.	Sand Plain (Sand plain, may include some residual alluvium; sand dominant, gravel, clay).
	Natal – Dark self mulching deep clays, neutral to strongly alkaline throughout.	Ug5.24 Ug5.16	
	Logan – Dark self mulching deep clays, neutral to strongly alkaline at or near surface, slightly to strongly acid at depth, gypseous.	Ug5.24 Ug5.16	Vertosol, Dermosol.

SURFACE GEOLOGY



LEGEND

- Minor Watercourse
- Major Watercourse
- Mining Lease
- Exploration Permit Coal

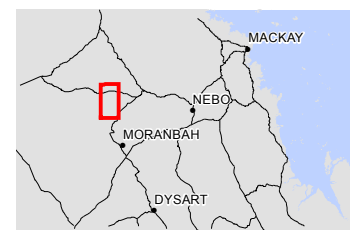
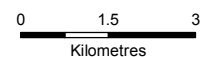
Surface Geology (Unitname)

- alluvium 38485
- Back Creek Group
- Blackwater Group
- colluvium 38491
- mafic volcanic rocks 38495
- sand plain 38499
- Suttor Formation

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**WARDS WELL MINE PROJECT - EIS
SOILS AND LAND SUITABILITY BASELINE SURVEY**

FIGURE 2



3. Soil Units

The Survey has found Vertosols, Sodosols, Dermosols and Kandosols to be present in the project area. The nature and occurrence of the soils in the Project area is described in **Table 3-1**.

■ **Table 3-1 Soil Types**

Australian Soil Classification	Description	Area (%)	Area (ha)
Vertosol	Brown, Grey and Black, greater than 35% clay content, self mulching over Basalt	38%	4,466
Sodosol	Sodic Duplex and Gradational Brown Loams	5%	545
Dermosol	Red, Brown Clays, well structured and well drained	20%	2,355
Kandosol	Red Sandy Loams	37%	4,299

A map showing the survey sample locations and Australian Soil Classification (ASC) is provided in **Figure 3-1**.

All soil test results are provided in **Appendix B** and **Appendix C**.

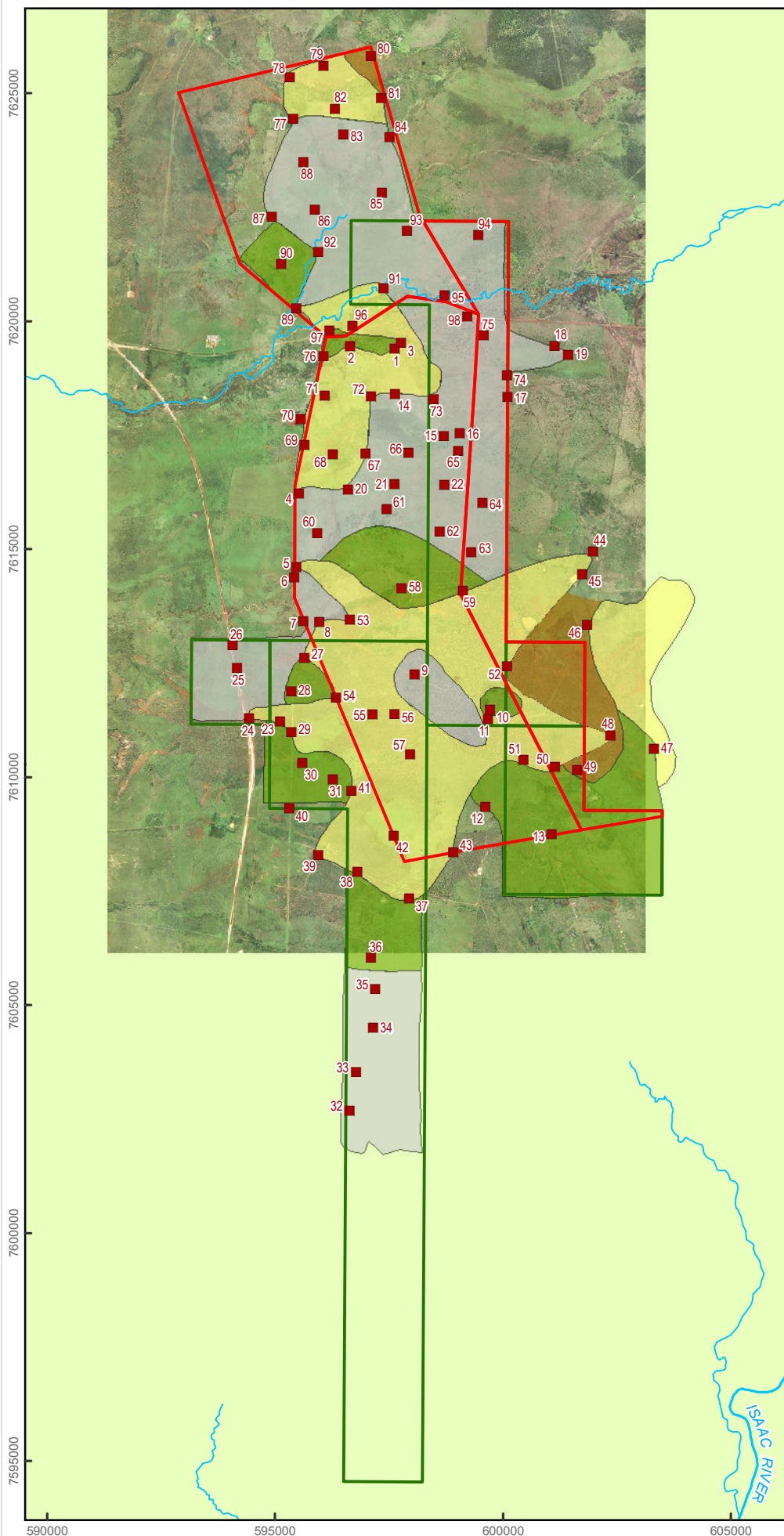
3.1. Vertosol

Vertosols (**Table 3-2**) generally occupy undulating plains and extensive floodplains of inland streams, and are derived from alluvial clayey sediments, shales, mudstones, limestone, and basalts. They are characterised by high clay content, and when dry, crack to a considerable depth (McKenzie et al., 2004).

Vertosols cover 4,466km (38%) of the project area. The observed Vertosols display characteristic features: occurrence on plains/floodplains and mafic volcanic rocks. They have a strongly developed structure and high clay content and the majority of these soils in the region are used for grazing.

Figure 3-2 presents a soil profile description for a Vertosol (site 6). These cracking clays generally consist of very dark brown to dark greyish black medium to heavy clays (**Table 3-3**). These soils are moderately to well drained and are generally alkaline and become very alkaline with depth. These soils may also become saline to epihypersodic with depth.

SAMPLE LOCATIONS AND AUSTRALIAN SOIL CLASSIFICATION



LEGEND

- Sample Locations
- Minor Watercourse
- Major Watercourse
- ▭ Mining Lease
- ▭ Exploration Permit Coal

Australian Soil Classification

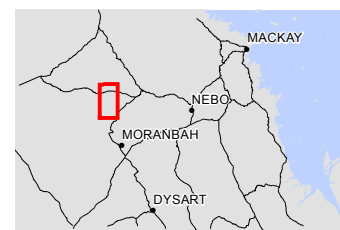
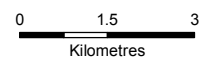
- Dermosol
- Kandasol
- Sodosol
- Vertosol

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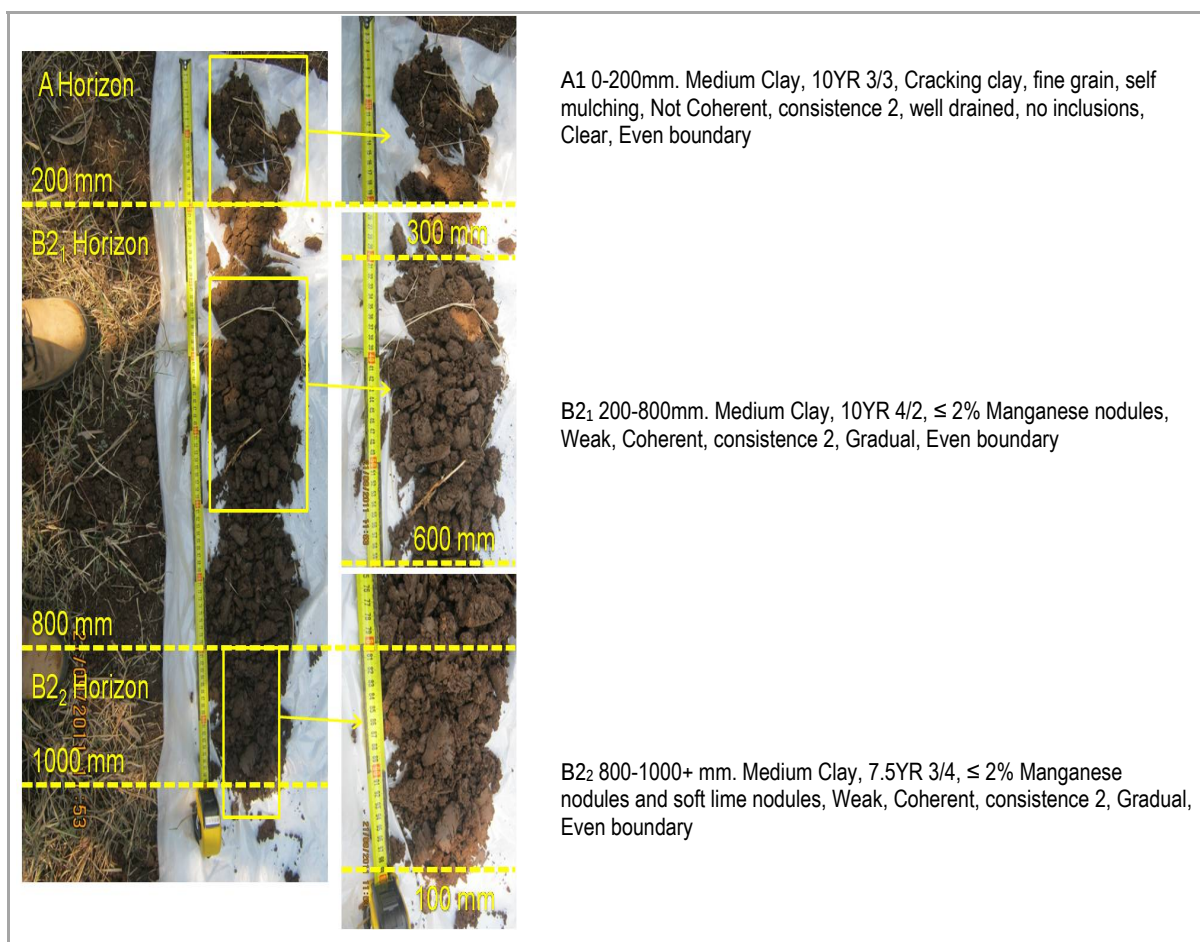


**WARDS WELL MINE PROJECT - EIS
SOILS AND LAND SUITABILITY BASELINE SURVEY**

FIGURE 3

■ **Table 3-2 Vertosol: Representative Description and Management (Site 6)**

Soil	Vertosol	
AMG Reference	0595544, 7614553	
Site No	6	
Landform Element	Creek bank	
Landform Pattern	≤ 1% old flood plain	
Slope %	1%	
Microrelief	Nil	
Drainage	Good	
Surface Condition	Cracking clay, fine grain, self mulching	
Land Condition	Buffel grass, Brigalow	
Land Use	Grazing	
Major Vegetation Form and Type	Extensively cleared with open areas of Buffel grass	
Sample for analysis	0-100 mm, 200-300 mm, 800-900 mm	
General Comments	Overall good fertility, saline at 800-900mm reducing cropping potential, alkaline pH below 100mm	
Recommended Topsoil Strip Depth	Topsoil can be stripped to a maximum 500mm where topsoil is deep however some Vertosols in centre of site are saline at 200mm and should not be striped below this depth	
Land Suitability Summary	Cropping: 4 Grazing: 3	
Preferred Rehabilitation Application	Vertosols where the salt bulge is at depth (below 800mm) have good structure and high moisture storage potential and would readily germinate and support both grasses & native trees. Vertosols with high salinity have high ESPs making them prone to dispersion and are not suited to rehabilitation application due to high erosion potential	



■ **Figure 3-2 3 Vertosol: Profile (Site 6)**

■ **Table 3-3 Vertosol: Particle Size Distribution (Site 6)**

Depth	Silt %	Clay %	Sand %	Gravel %	Unified Soil Classification
>200 - <300 mm	12	68	12	8	Medium Clay

Major Chemical and Physical characteristics are summarised in **Table 3-4**. The following summary comments apply to Vertosol soil found within the project area:

- Good overall fertility;
- Becoming sodic and saline below 300mm which limits plant rooting depth and PAWC;
- Desirable pH range;
- Excellent levels of nitrates, phosphorus and metals; and
- Soil has good structure at surface (high organic matter, high Ca compared to Mg) but can become dispersive below 300mm.

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■ **Table 3-4 Vertosol: Soil Chemistry (Site 6)**

Analyte	Unit	Soil Sufficiency (Baker and Eldershaw, 1993)	> 100 mm	>200 - <300 mm	>800 - <900 mm	Comment
pH Value	pH Unit		7.8	8.6	8.6	neutral tending alkaline
Electrical Conductivity	mS/cm	<0.8	0.107	0.137	0.659	Low in surface, moderate at 800mm
Sulfate as SO ₄ 2-	mg/kg	8	20	<10	120	High, low at 200mm
Chloride	mg/kg	800	<10	<10	1000	low in surface, high at 800mm
Exch Calcium	meq/100g	2	37.3	37.2	33.7	Very high
Exch Magnesium	meq/100g	2	17.4	24.7	30.2	Very high
Exch Potassium	meq/100g	0.2	2.2	0.5	0.1	high at surface, low below 300
Exch Sodium	meq/100g		0.2	2.4	8.4	sodic at 800
CEC	meq/100g	>5	57	64.8	72.4	High
ESP		<6%	0%	4%	12%	Dispersive at 800mm
Ca/Mg ratio		<0.5	2.1	1.5	1.1	Good structure due to high Ca
Bicarbonate Alkalinity as CaCO ₃	mg/kg		254	470	444	
Boron	mg/kg	>1-4	<50			
Cobalt	mg/kg		66			
Copper	mg/kg	0.4	38			Very high
Iron	mg/kg		69600			
Manganese	mg/kg		1290			Very high
Molybdenum	mg/kg	5	<2			
Zinc	mg/kg	0.8	76			Very high
Bicarbonate Extractable P	mg/kg		42			High
Nitrite + Nitrate as N (Sol.)	mg/kg		19.8			
Total Kjeldahl Nitrogen as N	mg/kg		2630			
Total Nitrogen as N	mg/kg	1500mg/kg	2650			High
Total Phosphorus as P	mg/kg	200mg/kg	494			High
Organic Matter	%	>1.5%	5.1			

3.2. Sodosol

Sodosols are widely distributed in eastern Queensland and are associated with dry climates. They are formed on alluvial and part-colluvial deposits, as well as igneous, sedimentary and metamorphic rocks (McKenzie et al., 2004). They are characterised by a strong texture contrast between topsoil and subsoil, with clayey, sodic (ESP of over 6% in the upper 0.2 m of the B

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Horizon) and often highly dispersive subsoils (Isbell 2002) (**Table 3-5**). The relatively impermeable subsoil which inhibits plant root penetration, hard-setting topsoils and susceptibility to tunnel and gully erosion all pose significant management issues.

Sodosols comprise 545ha (5%) of the project area. Where exposed in road cuttings and creek banks, some Sodosols showed evidence of deep erosion and various stages of rilling and gullying. The subsoils (B Horizon) of Sodosols are susceptible to collapse and transport, and readily disperse under sustained water application.

Figure 3-3 presents a soil profile description for a Sodosol (Site 49). These Sodic Duplex and Gradational Brown Loams have a strong textural contrast between the A and B Horizons (**Table 3-6**).

■ **Table 3-5 Sodosol Representative Description and Management (Site 49)**

Soil	Sodosol	
AMG Reference	0601753E, 7610328N	
Site No	49	
Landform Element	Upper slope	
Landform Pattern	Flat / gently undulating plains	
Slope %	0%	
Microrelief	Nil	
Drainage	Good surface / poor subsoil	
Surface Condition	Gravelly	
Land Condition	Extensive erosion ($\leq 50\%$ of sample area)	
Land Use	Grazing	
Major Vegetation Form and Type	Ironbark, brigalow, spear grass, bohenia	
Sample for analysis	INSERT	
General Comments	Erosion was present in around 50% of the land surrounding the sample point	
Recommended Topsoil Stripping Depth	200mm if required for rehabilitation	
Land Suitability Summary:	Cropping: 5 Grazing: 4	
Preferred Rehabilitation Application	Use of this soil should be avoided in rehabilitation due to high erosion potential	

■ **Table 3-6 Sodosol: Particle Size Distribution (Site 49)**

Depth	Silt %	Clay %	Sand %	Gravel %	Unified Soil Classification
INSERT					



■ **Figure 3-3 Sodosol: Profile (Site 49)**

Major Chemical and Physical characteristics are summarised in **Table 3-7**. The following summary comments apply to Sodosol soil found within the project area:

- To be completed after additional soil sampling
- The soil profile display a characteristic texture contrast between the A and B horizons. The upper B horizon contains mottles which may indicate waterlogging due to hardsetting of the dispersive B horizon. This boundary may also act as a barrier to crop root penetration.

■ **Table 3-7 Sodosol: Soil Chemistry (Site 49)**

Analyte	Unit	Soil Sufficiency (Baker and Eldershaw, 1993)	> 100 mm	>200 - <300 mm	>800 - <900 mm	Comment
pH Value	pH Unit					
Electrical Conductivity	mS/cm	<0.8				

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Analyte	Unit	Soil Sufficiency (Baker and Eldershaw, 1993)	> 100 mm	>200 - <300 mm	>800 - <900 mm	Comment
Sulfate as SO ₄ 2-	mg/kg	8				
Chloride	mg/kg	800				
ExchCalcium	meq/100g	2				
ExchMagnesium	meq/100g	2				
Exch Potassium	meq/100g	0.2				
Exch Sodium	meq/100g					
CEC	meq/100g	>5				
ESP		<6%				
Ca/Mg ratio		<0.5				
Bicarbonate Alkalinity as CaCO ₃	mg/kg					
Boron	mg/kg	>1-4				
Cobalt	mg/kg					
Copper	mg/kg	0.4				
Iron	mg/kg					
Manganese	mg/kg					
Molybdenum	mg/kg	5				
Zinc	mg/kg	0.8				
Bicarbonate Extractable P	mg/kg					
Nitrite + Nitrate as N (Sol.)	mg/kg					
Total Kjeldahl Nitrogen as N	mg/kg					
Total Nitrogen as N	mg/kg	1500mg/kg				
Total Phosphorus as P	mg/kg	200mg/kg				
Organic Matter	%	>1.5%				



3.3. Dermosol

Dermosols lack a strong texture contrast between the A and B horizons, are not calcareous throughout, and have moderately to strongly structured B2 horizons. The B2 horizons are usually clayey and do not have a free-iron oxide content greater than 5%. In arid zones, Dermosols mainly occur on low angle pediments with low shrublands, extending from mesas with ferricrete in varying degrees of denundation, to surrounding Vertosol plains (**Table 3-8**).

Dermosols cover 2355ha (20%) of the Project area.

Figure 3-4 presents a soil profile description for a Dermosol (Site 28). These Red, Brown Light to Medium Clays are well structured and poorly drained (**Table 3-9**).

■ **Table 3-8 Dermosol: Representative Description and Management (Site 28)**

Soil	Brown Dermosol	
AMG Reference	595477E, 7612063N	
Site No	28	
Landform Element	Gently undulating	
Landform Pattern	Bottom of slope (1-2%)	
Slope %	1%	
Microrelief	Nil	
Drainage	Imperfect/poor	
Surface Condition	Hardpacked, non-cracking clay	
Land Condition	Good, small shrubs, grassland, some Ironbark	
Land Use	Grazing	
Major Vegetation Form and Type	Extensively cleared leaving small shrubs, Grassland, Some Ironbark	
Sample for analysis	0-100 mm, 200-300 mm, 700-800 mm	
General Comments	Low fertility, suitable for pasture	
Recommended Topsoil Stripping Depth	< 200mm on Dermosols with high sodicity at shallow depth. Otherwise Dermosols can be stripped to base of topsoil	
Land Suitability Summary:	Cropping: Class 4 Grazing: Class 4	
Preferred Rehabilitation Application	Only suitable for flat to gentle slopes (<3%) to avoid excessive erosion due to dispersive erosion potential. Soil suitable for grazing on native pastures	

	A1 0-100mm. Light Clay, 7.5YR 4/4, Weak, Weakly Pedal /Apedal, consistence 2, imperfect drainage, no inclusions, clear, even boundary
	B21 100-400mm. Medium Clay, 7.5Yr 4/4, ≤ 2% White mottles, Weak, Strongly Pedal, Coherent, poor drainage, consistence 2, clear, even boundary
	B22 400+ mm. Medium Clay, 7.5YR 3/3, White / Black mottles, Firm / Very Firm, Strongly Pedal, Coherent, consistence 3/4, poor drainage, base of horizon not encountered.

■ **Figure 3-4 Dermosol: Profile (Site 28)**

■ **Table 3-9 Dermsol: Particle Size Distribution (Site 28)**

Depth	Silt %	Clay %	Sand %	Gravel %	Unified Soil Classification
>0 - <100 mm	15	37	46	2	Light Clay
>700 - <800 mm	11	47	41	1	Medium Clay

Major Chemical and Physical characteristics are summarised in **Table 3-10**. The following summary comments apply to Sodosol soil found within the project area:

- Low overall fertility;
- Becoming sodic and dispersive below 200mm;
- Desirable pH range; and



- Soil has poor structure at surface (low organic matter, apedal) and becomes dispersive below 200mm. Other Dermosols tested were dispersive below 700mm.

■ **Table 3-10 Dermosol: Soil Chemistry (Site 28)**

Analyte	Unit	Soil Sufficiency (Baker and Eldershaw, 1993)	> 100 mm	>200 - <300 mm	>700 - <800 mm	Comment
pH Value	pH Unit		7.3	7.8	7.2	Neutral
Electrical Conductivity	mS/cm	<0.8	0.15	0.049	0.025	low
Sulfate as SO ₄ 2-	mg/kg	8	50	10	<10	High at surface, low at depth
Chloride	mg/kg	800	40	20	20	low
Exch Calcium	meq/100g	2	6.4	8.1	3.8	Adequate
Exch Magnesium	meq/100g	2	5.4	9.9	3.6	moderate
Exch Potassium	meq/100g	0.2	2.4	<0.1	<0.1	high in surface, low at depth
Exch Sodium	meq/100g		0.8	2.2	0.7	Sodic
CEC	meq/100g	>5	15.1	20.3	8.1	low
ESP		<6%	5%	11%	9%	Dispersive below 200mm
Ca/Mg ratio		<0.5	1.2	0.8	1.1	
Bicarbonate Alkalinity as CaCO ₃	mg/kg		152	254	127	
Boron	mg/kg	>1-4	<50			
Cobalt	mg/kg		58			
Copper	mg/kg	0.4	36			Very high
Iron	mg/kg		61000			
Manganese	mg/kg		1560			Very high
Molybdenum	mg/kg	5	<2			
Zinc	mg/kg	0.8	50			Very high
Bicarbonate Extractable P	mg/kg		<2			Very Low
Nitrite + Nitrate as N (Sol.)	mg/kg		35.3			
Total Kjeldahl Nitrogen as N	mg/kg		760			
Total Nitrogen as N	mg/kg	1500mg/kg	800			low
Total Phosphorus as P	mg/kg	200mg/kg	198			low
Organic Matter	%	>1.5%	1.4			

3.4. Kandosol

Kandosols are found on extensive, level to gently undulating plains and on mesas, often in association with ferricrete deposits. Parent materials are quartz-rich, often being sedimentary rocks, and their alteration products, and derived alluvium. They are often very deep (>3 m) and clay-rich

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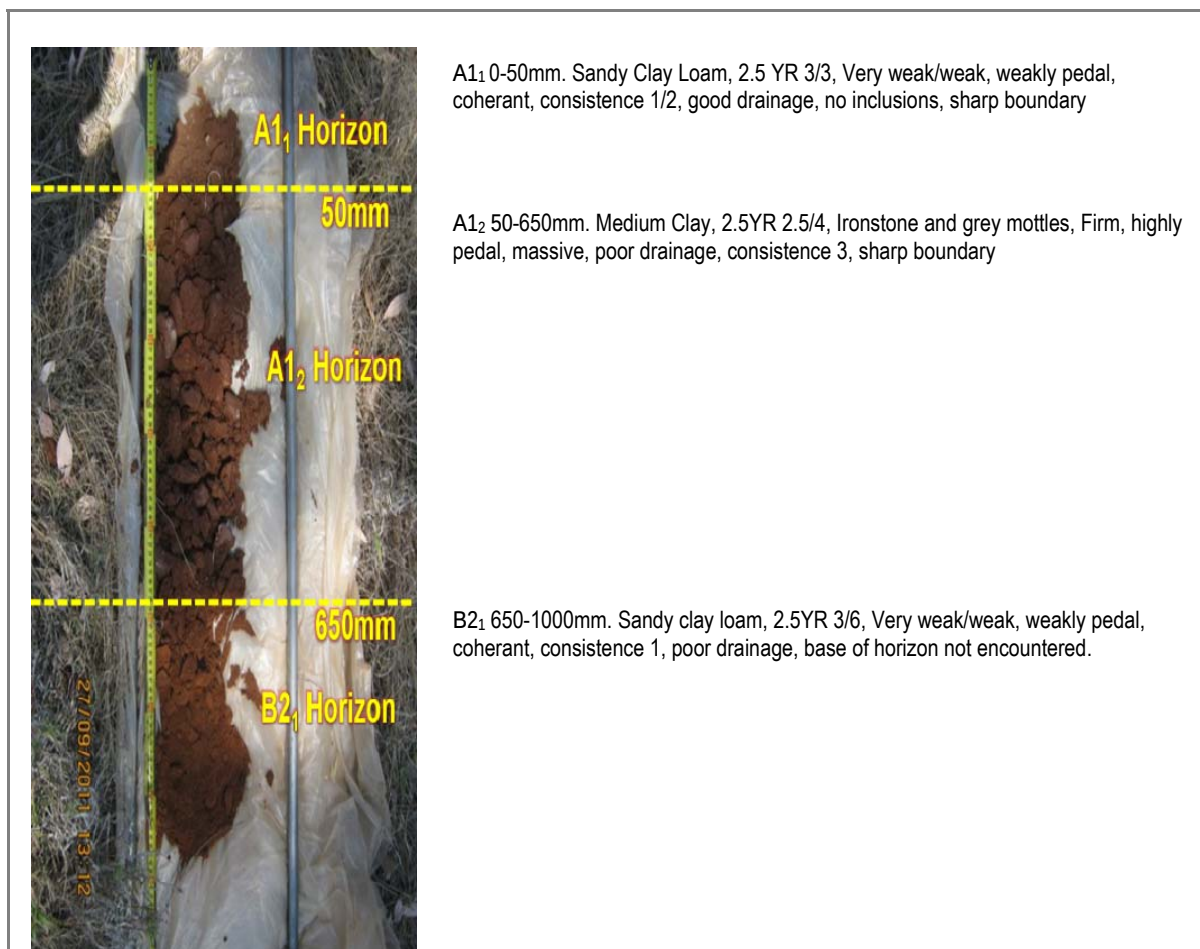
and only relatively small areas of Kandosols are used for extensive agriculture in Australia (mainly in western Australia and New South Wales). The majority of Kandosols are used for sparse grazing of sheep and cattle on native pastures growing on low fertility soils (McKenzie et al., 2004) (**Table 3-11**).

Kandosols comprise 4,299ha (37%) of the Project area.

Figure 3-5 presents a soil profile description for a Kandosol (Site 69). These Red Sandy Loams are well structured and tend to be poorly drained at depth (**Table 3-12**).

■ **Table 3-11 Kandosol: Representative Description and Management (Site 69)**

Soil	Kandosol	
AMG Reference	0595767E, 7617473N	
Site No	69	
Landform Element	Top of rise	
Landform Pattern	Gently undulating plain	
Slope %	1%	
Microrelief	Nil	
Drainage	Good at surface / poor at depth	
Surface Condition	Hardpacked	
Land Condition	Good, some vegetation clearance	
Land Use	Grazing	
Major Vegetation Form and Type	Extensively cleared Poplar Box, Morton Bay Ash	
Sample for analysis	0-50 mm, 200-300 mm, 800-900 mm	
General Comments	In general this soil is a good pasture soil however it's low to moderate fertility makes it unsuitable for cropping	
Recommended Topsoil Stripping Depth	Can be stripped to B horizon boundary which is maximum of 1500mm however generally is less than 400mm depth	
Land Suitability Summary:	Cropping: Class 3 Grazing: Class 2	
Preferred Rehabilitation Application	Can be used on steeper slopes due to good soil structure. May be possible for grazing on improved pastures provided further soil testing shows moderate fertility levels	



■ **Figure 3-5 Kandosol: Profile (Site 69)**

■ **Table 3-12 Kandosol: Particle Size Distribution (Site 69)**

Depth	Silt %	Clay %	Sand %	Gravel %	Unified Soil Classification
>200-<300	12	54	32	2	Medium Clay

Major soil chemical and physical characteristics are described in **Table 3-13**. The following summary comments apply to Kandosol soil found within the project area:

- Moderate overall fertility (high levels of nitrogen, adequate phosphorus and metals, low sulphate at surface and low/moderate CEC);
- Good soil structure; and
- Desirable pH range.



■ **Table 3-13 Kandosol: Soil Chemistry (Site 69)**

Analyte	Unit	Soil Sufficiency (Baker and Eldershaw, 1993)	>0 - <50 mm	>200 - <300 mm	>800 - <900 mm	Comment
pH Value	pH Unit		6.7	7.5	7.5	neutral
Electrical Conductivity	mS/cm	<0.8	0.034	0.014	0.026	low
Sulfate as SO ₄ 2-	mg/kg	8	<10	<10	30	low at surface, high at depth
Chloride	mg/kg	800	20	<10	10	very low
Exch Calcium	meq/100g	2	10.6	13.7	17	Moderate
Exch Magnesium	meq/100g	2	6.4	11.1	12.6	Moderate
Exch Potassium	meq/100g	0.2	0.3	<0.1	<0.1	Very low
Exch Sodium	meq/100g		<0.1	0.4	1.4	non sodic
CEC	meq/100g	>5	17.4	25.3	31	low to moderate
ESP		<6%	0	2%	5%	non dispersive
Ca/Mg ratio		<0.5	1.7	1.2	1.3	no physical problems indicated
Bicarbonate Alkalinity as CaCO ₃	mg/kg		114	63	51	
Boron	mg/kg	>1-4	<50			
Cobalt	mg/kg		58			
Copper	mg/kg	0.4	26			Very high
Iron	mg/kg		76700			
Manganese	mg/kg		1170			Very high
Molybdenum	mg/kg	5	<2			
Zinc	mg/kg	0.8	28			Very High
Bicarbonate Extractable P	mg/kg		80			Very High
Nitrite + Nitrate as N (Sol.)	mg/kg		1.7			
Total Kjeldahl Nitrogen as N	mg/kg		1640			
Total Nitrogen as N	mg/kg	1500mg/kg	1640			not limiting
Total Phosphorus as P	mg/kg	200mg/kg	400			High
Organic Matter	%	>1.5%	3.6			

4. Agricultural Land Suitability

Land use suitability of the project area in reference to broadscale rain-fed cropping and grazing has been assessed in accordance with Attachment 2 of Land Suitability Assessment Techniques in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME, 1995).

4.1. Existing Land Use Patterns

The majority of the project area is used for cattle grazing on buffel and native grasses which were in good condition at the time of survey. Vegetation within the project area comprises natural bush of Poplar Box, Bloodwood, Ironbark, Acacia, Wattle, and Brigalow.

The project area has low mean annual rainfall of between 500-800mm/year (BOM 2007) and rainfall can be unreliable and long droughts are common. Such unreliable and insufficient rainfall presents a significant limitation to sustained cropping in this area. No cropping was observed during the survey.

4.2. Methodology

The methodology used to identify agricultural suitability in this survey follows guidelines established by Land Resources Branch (1989), which is the basis for land suitability Assessment (DME, 1995). Land suitability assessments for each soil type have been undertaken for cropping and grazing land uses.

Land suitability classification is based on specific land uses assessed using the classes shown in **Table 4-1** (based on Shields and Williams, 1991 and DME, 1995).

■ Table 4-1 Land Suitability Classes

Class	Suitability Description
Class 1	Suitable land with negligible limitations and is highly productive requiring only simple management practices
Class 2	Suitable land with minor limitations which either reduce production or require more than simple management practices to sustain the use
Class 3	Suitable land with moderate limitations – Land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use
Class 4	Marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.
Class 5	Unsuitable land with extreme limitations that precludes its use.



The land suitability classification identifies the types and severity of limiting factors for each land use on the different soil types present. **Appendix D** presents graphs used for analysis for determination of land suitability for cropping and grazing.

Land suitability class is determined by the highest ranking limiting factor or a combination of a number of factors. The soils have been assessed against the following limiting factors defined by DME (1995) which determine crop and grazing suitability class:

- Plant available water capacity;
- Nutrient deficiency;
- Salinity;
- Soil physical factors;
- Erosion;
- Workability;
- Microrelief;
- Flooding;
- Wetness;
- Topography; and
- Rockiness.

Normally, only the most severe two or three limiting factors would determine suitability and the remainder become irrelevant.

4.2.1. Plant Available Water Capacity

Plant available water capacity (PAWC) is a significant soil property in this locality as cropping is based on fallow storage of moisture in the soil profile. PAWC is the moisture stored in the soil profile that is available to the plant and is classically defined as the moisture present between field capacity and permanent wilting point (15 bar). **Table 4-2** shows the criteria which DME (1995) proposed for assessment of the moisture availability limitation for crops in this region

■ **Table 4-2 PAWC: Land Suitability for Cropping / Grazing (DME, 1995)**

Limiting Factor	1	2	3	4	5
Moisture	PAWC >125 mm	PAWC 100-125 mm	PAWC 75-100 mm	PAWC 50-75 mm	PAWC <50 mm

Soil water storage assessment for Land Suitability Assessment was based on estimated PAWC derived from the following surrogate values:

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- **PAWC $\geq$ 150 mm** – alkaline to neutral pH throughout, Chloride anion (Cl-) <600 ppm (mg/kg) within 90 cm of surface and Exchangeable sodium percentage (ESP) < 15 within 90 cm of surface.
- **PAWC 125 – 150 mm** - alkaline to neutral pH throughout, Cl- <600 ppm (mg/kg) within 90 cm of surface and ESP < 15 within 90 cm of surface, > 15 cm to salt bulge with EC $\geq$ 900 ppm (1343 ppm).
- **PAWC 75 –125 mm** - alkaline to neutral pH throughout, Cl- <600 ppm (mg/kg) within 90 cm of surface and ESP < 15 within 90 cm of surface, > 15 cm to salt bulge with EC $\geq$ 900 ppm (1343 ppm), Duplex soils with subsoil becoming sodic (ESP 6-14) within 60 cm of surface but not strongly sodic (ESP $\geq$ 15) within 90 cm of surface.
- **PAWC $\leq$ 50 - $\leq$ 75 mm** - alkaline to neutral pH throughout, Cl- <600 ppm (mg/kg) within 90 cm of surface and ESP < 15 within 90 cm of surface, Duplex soils with subsoil becoming sodic (ESP 6-14) within 60 cm of surface but not strongly sodic (ESP $\geq$ 15) within 45 cm of surface.

Effective rooting depth is defined as the depth to which approximately 90% of plant roots will extract water. It is normally limited either by the presence of underlying rock or other hard materials or by chemical or physical attributes within the subsoil that restrict root growth (QDPI, 1990). Field morphology observations and chemical data used included soil texture and barriers to root growth such as high sodium, gravel, poor soil structure, high electrical conductivity and chloride.

4.2.2. Nutrient Deficiency

Shields and Williams (1991) states that soil nutrient deficiency has not been recognised as a major problem for crop production on traditionally cultivated soils in the Central Highlands. The levels of nutrient deficiency found in this survey are similarly not considered severe.

4.2.3. Salinity

This refers to the reduction in dry matter yield as a result of soluble salt (usually influenced by chloride concentration and measured by electrical conductivity) in the soil profile. It also contributes to reduced water availability limitation.

4.2.4. Soil Physical factors

This limitation deals with conditions which determine sufficient seed contact with moist soil to prevent desiccation prior to germination and establishment. One such condition applies to clay soils which have narrow moisture content suitable for cultivation, as they are susceptible to compaction and smearing when wetter than the plastic limit. Trafficability is also limited by high clay content and moisture retention on the clay soils. It is only a minor limitation here. With a grazing use,

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physical factors refer more to restrictions in the establishment and vigour of pastures as a result of soil surface condition and are typically related to size of surface aggregates which affects tendencies to seal and hardset. Overall within the survey area, the extensive development of Buffel and Spear Grass indicates that soil physical factors are generally not limiting to pasture establishment.

4.2.5. Erosion

The risk of soil loss from water erosion magnifies with increased slope gradient combined with water velocity when land is devoid of vegetation. Erosion was noted at 16 of the 98 sample locations and on all four soil types. Erosion was most severe on Sodosols in the northeast of the Project area and these soils will have a high risk of erosion if exposed. Elsewhere erosion was noted within creek systems and adjacent dirt tracks where water runoff from the track has cut into adjacent land.

Slope limits for determining erosion risk and suitability class according to DME (1995) are provided in **Table 4-3**.

■ **Table 4-3 Erosion Limitations for Cattle grazing – Effects of Slope (DME, 1995)**

Land Suitability Class	1	2	3	4	5
Cracking Clays	<3% slope	Slopes 3-6%	Slopes 6-9%	Slopes 9-15%	
Sodic rigid soils	<1% slope	Slopes 1-3%	Slopes 3-6%	Slopes 6-12%	>45%
Non-sodic rigid soils	<3% slope	Slopes 3-12%	Slopes 12-20%	Slopes 20-45%	

4.2.6. Workability, Flooding and Wetness

Drainage conditions of the soil column were noted during the soil survey (**Appendix A**). There was little evidence of poor drainage and water logging suggesting that flooding, workability and wetness would add little discernable weighting to overall land suitability.

4.2.7. Microrelief and Rockiness

Microrelief and rockiness was not noted in the Project area (refer to **Appendix A** – soil logs). Microrelief refers to relief up to a few metres about the plane of the land surface (McDonald et al. 1984b). Melonholing caused by the shrinking/swelling properties of clay rich Vertosols can present a limitation to cropping due to an uneven cultivation surface and impeded trafficability of machinery.



4.2.8. Topography

Topography is assessed in terms of slope and micro-relief. Slope may limit the effective and safe use of machinery and contribute to erosion hazard. Topography has been assessed by desktop using a 1 m contour digital elevation model for the site.

4.3. Results

Table 4-4 summarises the analytic criteria used to assign a class number presented in **Table 4-1**. DME (1995) presents thresholds for each of the identified analytic criteria. Table 4-6 summarises land suitability analysis determined from laboratory analysis (refer to **Appendix D** for graphical representation of laboratory analysis relevant to determination of land suitability for cropping and grazing).

Summary of findings here – are the soils suitable for cropping and grazing?

■ **Table 4-4 Land Suitability Class Criteria**

Limiting Factor	Diagnostic Criteria		Comment
Plant available water capacity	Cropping	- pH; - Cl⁻ anion concentration;	Table 2.3 from DME (1995)
	Grazing	- ESP; and - EC.	
Nutrient deficiency	Cropping	- Bicarbonate P; and - Exchangeable K	Table 2.2 and Table 2.3 from DME (1995)
	Grazing	Bicarbonate P.	
Salinity	Cropping	EC; and	
	Grazing	Cl⁻ anion concentration.	
Soil physical factors	Cropping	Soil texture; and	
	Grazing	Ped size.	
Erosion	Cropping	Sodicity; and	
	Grazing	Slope.	
Workability	Cropping	- Soil texture; and - Ped size.	
	Grazing	Not applicable / no criteria.	
Susceptibility to flooding	Cropping	Flood return period.	
	Grazing		
Microrelief	Cropping	Presence / absence and size of meloholes.	
	Grazing		
Wetness	Cropping	Geomorphology; and	
	Grazing	ESP.	
Topography	Cropping	Presence / Absence of gullies.	
	Grazing		
Rockiness	Cropping	Boulder, Cobbles, Gravel %	
	Grazing		

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4.3.1. Plant available water capacity

PAWC suitability range estimates for observed soil orders in this survey area are shown in **Table 4-5** summarised based on soil order. Land suitability class ratings for each site subjected to laboratory analysis is presented in **Table 4-6**.

■ **Table 4-5 Estimated Plant Rooting Depth, PAWC and Land Suitability Class**

Soil Order	Concept	Estimated Effective Rooting Depth (mm)	PAWC (mm)	Limitation Level
Vertosol	Soils with high clay content, and when dry, crack to a considerable depth	200->1000	450-125	1-2
Dermosol	Texture contrast soils with moderately to strongly structured usually clayey B2 horizons.	700->1000	100-> 125	2-3
Kandosol	Very deep (>1 m) and clay-rich	>1000	>125	1
Sodosol	INSERT	INSERT	INSERT	INSERT

4.3.2. Nutrient deficiency

The Vertosols in the Project area generally had high levels of nutrients with one exception, WW60 which contained low levels of phosphorus and nitrogen. The Dermosols generally had low fertility levels in particular low levels of phosphorus and nitrogen. The Kandosols had variable levels of nutrients with limitations between 1 and 4 for grazing however these soils generally had moderate to good levels of fertility for cropping purposes with limitation levels between 1 and 2.

Comment on Sodosol

Table 4-6 presents land suitability ratings for cropping and grazing derived from laboratory analysis.

4.3.3. Salinity

Increasing salinity in the soil profile (below 200 mm) was evidenced in some Vertosols and Dermosols (WW6, WW9 and WW15 - **Figure A 4 (b, c, d)**, **Figure A 1 (b, c, d)** and **Figure A 10 (b, c, d)**) respectively) in the central part of the Project area and this attribute has been incorporated into effective rooting depth estimations which directly affects PAWC and hence suitability. However, the remaining four Vertosol sample locations had low salt contents. In addition one Dermosol sample WW13 contained marginally high chloride content at 700mm depth (**Figure A 11 (c)**).

Comment on Sodosol



Refer to **Appendix D** for EC profiles from laboratory analysis. **Table 4-6** presents land suitability ratings for cropping and grazing derived from laboratory analysis.

4.3.4. Soil Physical Factors

As discussed in **Section 4.2.4** there were no identified limiting soil physical factors with the project area. **Table 4-6** presents land suitability ratings for cropping and grazing derived from laboratory analysis.

4.3.5. Erosion

Based on these slope limits presented in **Table 4-3**, none of the sample locations have any limitation with regard to water erosion however laboratory results show that some Vertosols and Dermosols in the Project area are sodic and are susceptible to erosion via dispersion as discussed in **Section 8.1**. The Sodosols also present a high erosion risk due to likely high sodium content relative to total cation exchange capacity.

Comment on Sodosol

Table 4-6 presents land suitability ratings for cropping and grazing derived from laboratory analysis.

4.3.6. Workability, Flooding and Wetness

There was little evidence of poor drainage and water logging suggesting that flooding, workability and wetness would add little discernable weighting to overall land suitability.

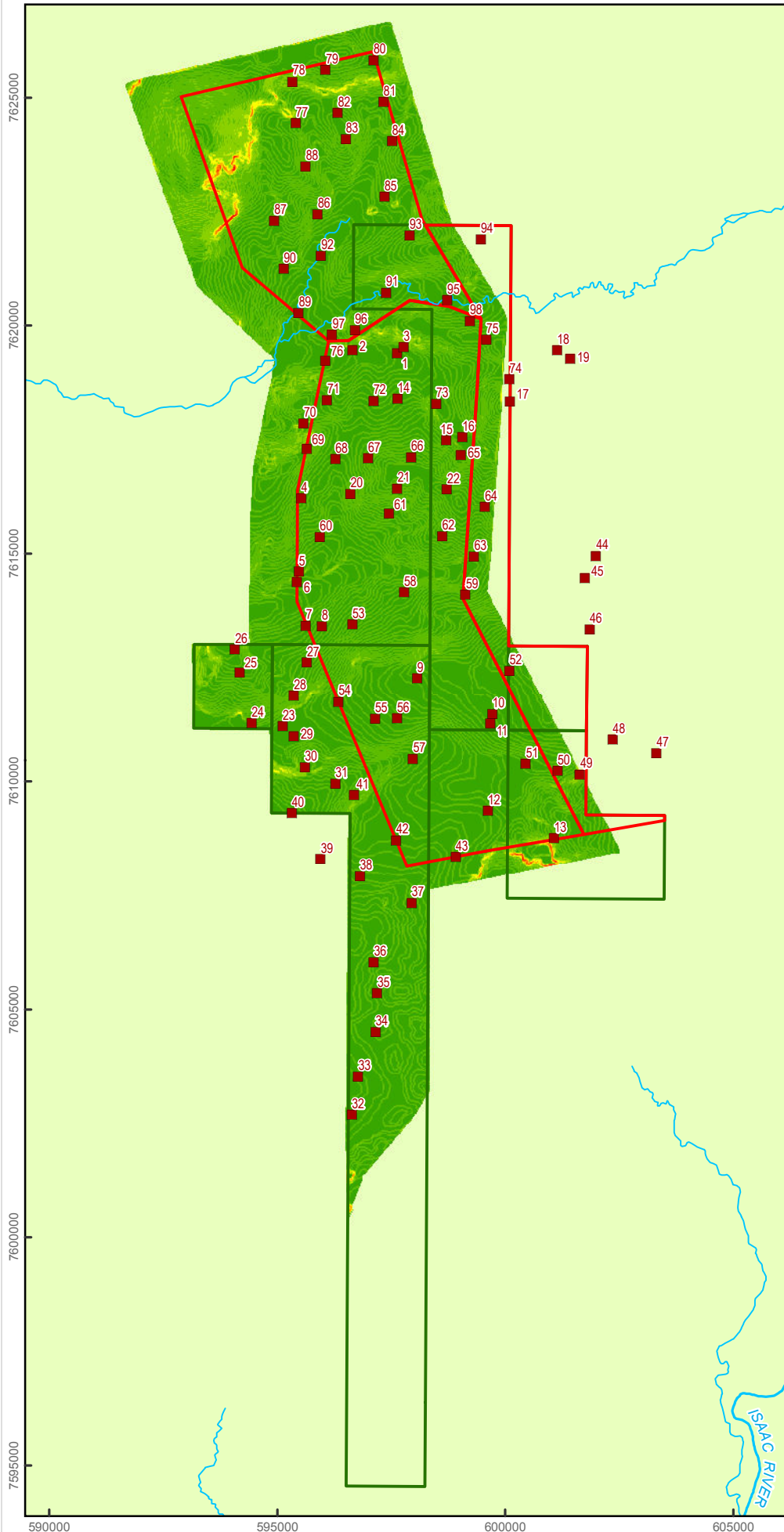
4.3.7. Microrelief and Rockiness

Micro-relief was not found to be a limiting factor during the field survey (refer to **Appendix A**).

4.3.8. Topography

The site consists of level plains and gently undulating plains and rises with slope across the majority of the site between 1-2%. Steeper slopes up to 11% exist in the far north of the site on Kandosols and on the southeast part of the site on Dermosols. These steeper slopes will present a limitation to cropping in these areas but are suitable for grazing. The map showing slope in the Project area is provided in **Figure 4-1**.

SLOPE



LEGEND

- Sample Locations
- Minor Watercourse
- Major Watercourse
- ▭ Mining Lease
- ▭ Exploration Permit Coal

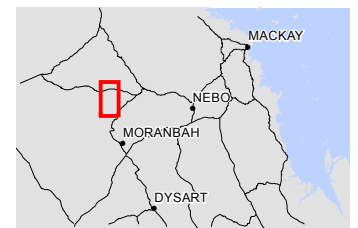
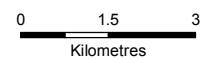
Slope (by percent rise)

- 0 - 1%
- 1 - 3%
- 3 - 5%
- 5 - 7%
- 7 - 10%
- 10 - 13%
- 13 - 17%
- 17 - 21%
- 21 - 28%

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FIGURE 4

■ **Table 4-6 Land Suitability Assessment: Cropping and Grazing**

Soil	Site	Sample Depth (mm)	PAWC (m)	Nutrient Deficiency (n)	pH (1:5)	Salinity (s)	Physical Factors (p)	Erosion (e)	Workability (k)	Microrelief (g)	Flooding (f)	Wetness (w)	Topo	Rock (g)	Ranking Cropping	Ranking Grazing
Vertosol	15	0-100	4 (<75 mm) ESP	1	1	1	2	2	3	1	2		1	1	4(m) 3(k)	4(m) 3(k)
		300-400		-	3	2	2	2	3	1	2	1	-	-	4(m) 3(k)	4 4(m) 3(k)(pH)
		900-1000		-	3	4	2	2	3	1	2		-	-	4(m) 4(s)	4(m) 4(s)
	22	0-100	4 (<75 mm) ESP	1	2	1	2	1	1	1	1	1	1	1	4 (m)	4 4(m) 2(pH)
	9	0-100	1	1	1	1	1	1	2	1	2		1	1	2(k) (f)	2(k) (f)
		200-300		-	1	1	1	1	2	1	2	1	-	-	2(k) (f)	2 2(k) (f)
		800-900		-	1	1	1	1	2	1	2		-	-	2(k) (f)	2(k) (f)
	6	0-100	4 (<75 mm) ESP	1	2	2	2	1	1	1	2		1	1	4(m) 2(s)	4(m) 2(pH) (s)
		200-300		-	3	2	2	1	1	1	2	1	-	-	4(m) 2(s)	4 4(m) 2(pH) (s)
		800-900		-	3	3	2	1	1	1	2		-	-	4(m) 2(s)	4(m) 2(pH) (s)
	75	0-50	1	1	2	1	2	1	2	1	2		1	1	2(p) (k) (f)	2(pH) (p) (k) (f)
		400-500		-	3	1	2	1	2	1	2	1	-	-	2(p) (k) (f)	2 3(pH) (p) (k) (f)
		900-1000		-	4	2	2	1	2	1	2		-	-	2(p) (k) (f)	4(pH) (p) (k) (f)
	94	0-50	1	1	2	1	2	1	2	1	2		1	1	2(p) (k) (f)	2(pH) (p) (k) (f)
		200-300		-	3	1	2	1	2	1	2	1	-	-	2(p) (k) (f)	2 3(pH) (p) (k) (f)
		600-700		-	3	1	2	1	2	1	2		-	-	2(p) (k) (f)	3(pH) (p) (k) (f)

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Wards Well: Soil Survey

Soil	Site	Sample Depth (mm)	PAWC (m)	Nutrient Deficiency (n)	pH (1:5)	Salinity (s)	Physical Factors (p)	Erosion (e)	Workability (k)	Microrelief (g)	Flooding (f)	Wetness (w)	Topo	Rock (g)	Ranking Cropping	Ranking Grazing
		0-20		4	2	1	3	1	3		1	1	1	1	4(n) 3(p) 3(k)	4(n) 3(p) 3(k)
	60	20-300	1	-	2	1	3	1	3	1	1	1	-	-	3(p) 3(k)	4 3(p) 3(k)
		700-800		-	3	1	3	1	3		1	1	-	-	3(p) 3(k)	3(p) 3(k) 3(pH)
		0-100		2	2	2	1	3	2		2	1	1	1	2(n) (s) (k) (f) 3(e)	2(n) (pH) (s) (k) (f) 3(e)
	28	200-300	1	4	2	1	1	3	2	1	2	1	-	-	2(n) (s) (k) (f) 3(e) 4(n)	2(n) (pH) (s) (k) (f) 3(e) 4(n)
		700-800		4	2	1	1	3	2		2	1	-	-	2(n) (s) (k) (f) 3(e) 4(n)	2(n) (pH) (s) (k) (f) 3(e) 4(n)
Dermosol		0-100		2	2	1	4	1	2		1	1	1	1	2(n) 4(m) (p)	2(n) (pH) 4(m) (p)
	36	200-300	4 (<75 mm) ESP	4	4	2	4	1	2	1	1	1	-	-	2(k) 4(m) (n) (p)	2(k) 4(m) (n) (pH) (p)
		700-800		4	4	3	4	1	2		1	1	-	-	2(k) 4(m) (n) (p)	2(k) 4(m) (n) (pH) (p)
	10	0-100	1	2	1	1	2	1	1	1	1	1	1	1	2(n) (p)	2(n) (p)
		500-600		4	1	1	2	1	1	-	1	1	-	-	4(n) (p)	4(n) (p)
		0-50		1	1	1	1	2	1	1	2	1	2	1	3(m) 2(e) (f)	3(m) 2(e) (f)
	13	200-300	3 (75-125 mm) ESP, EC, Cl	-	1	1	1	2	1	-	2	1	-	-	3(m) 2(e) (f)	3(m) 2(e) (f)
		700-800		-	3	3	1	2	1	-	2	1	-	-	3(m) 2(e) (f) (s)	3(m) 2(e) (f) (pH) (s)
		1000-1100			1	1	1	2	1	-	2	1	-	-	3(m) 2(e) (f) (s)	3(m) 2(e) (f) (pH) (s)

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Wards Well: Soil Survey

Soil	Site	Sample Depth (mm)	PAWC (m)	Nutrient Deficiency (n)	pH (1:5)	Salinity (s)	Physical Factors (p)	Erosion (e)	Workability (k)	Microrelief (g)	Flooding (f)	Wetness (w)	Topo	Rock (g)	Ranking Cropping	Ranking Grazing
	47	0-100	1	2	2	1	3	2	1	1	1	1	1	1	3(p) 2(n) (p) (e)	3 3(p) 2(n) (pH) (p) (e) 3
Kandosol	69	0-50	4 (<75 mm) ESP	1	2	1	2	1	2	1	1	1	1	1	4(m) 2(p) (k)	4(m) 2(pH) (p) (k)
		200-300		-	2	1	2	1	2	-	1	1	-	-	4(m) 2(p) (k)	4(m) 2(pH) (p) (k)
		800-900		-	2	1	2	1	2	-	1	1	-	-	4(m) 2(p) (k)	4(m) 2(pH) (p) (k)
	23	0-100	4 (<75 mm) ESP	2	1	2	1	1	2	1	1	1	1	1	4(m) 2(s) (k)	4(m) 2(s) (k)
		300-400		-	1	1	1	1	2	-	1	1	-	-	4(m) 2 (k)	4(m) 2 (k)
		900-1000		-	2	1	1	1	2	-	1	1	-	-	4(m) 2 (k)	4(m) 2 (k)
	38	0-50	4 (<75 mm) ESP	2	1	1	2	1	1	1	1	1	1	1	4(m) 2(p)	4(m) 2(p) (pH)
		500-600		-	2	1	2	1	1	-	1	1	-	-	4(m) 2(p)	4(m) 2(p) (pH)
	44	0-100	4 (<75 mm) ESP	1	1	1	3	1	2	1	1	1	1	1	4(m) 3(p) 2(k)	4(m) 3(p) 2(k)
		100-200		-	1	1	3	1	2	-	1	1	-	-	4(m) 3(p) 2(k)	4(m) 3(p) 2(k)
		500-600		-	1	1	3	1	2	-	1	1	-	-	4(m) 3(p) 2(k)	4(m) 3(p) 2(k)
INSERT Sodosol																

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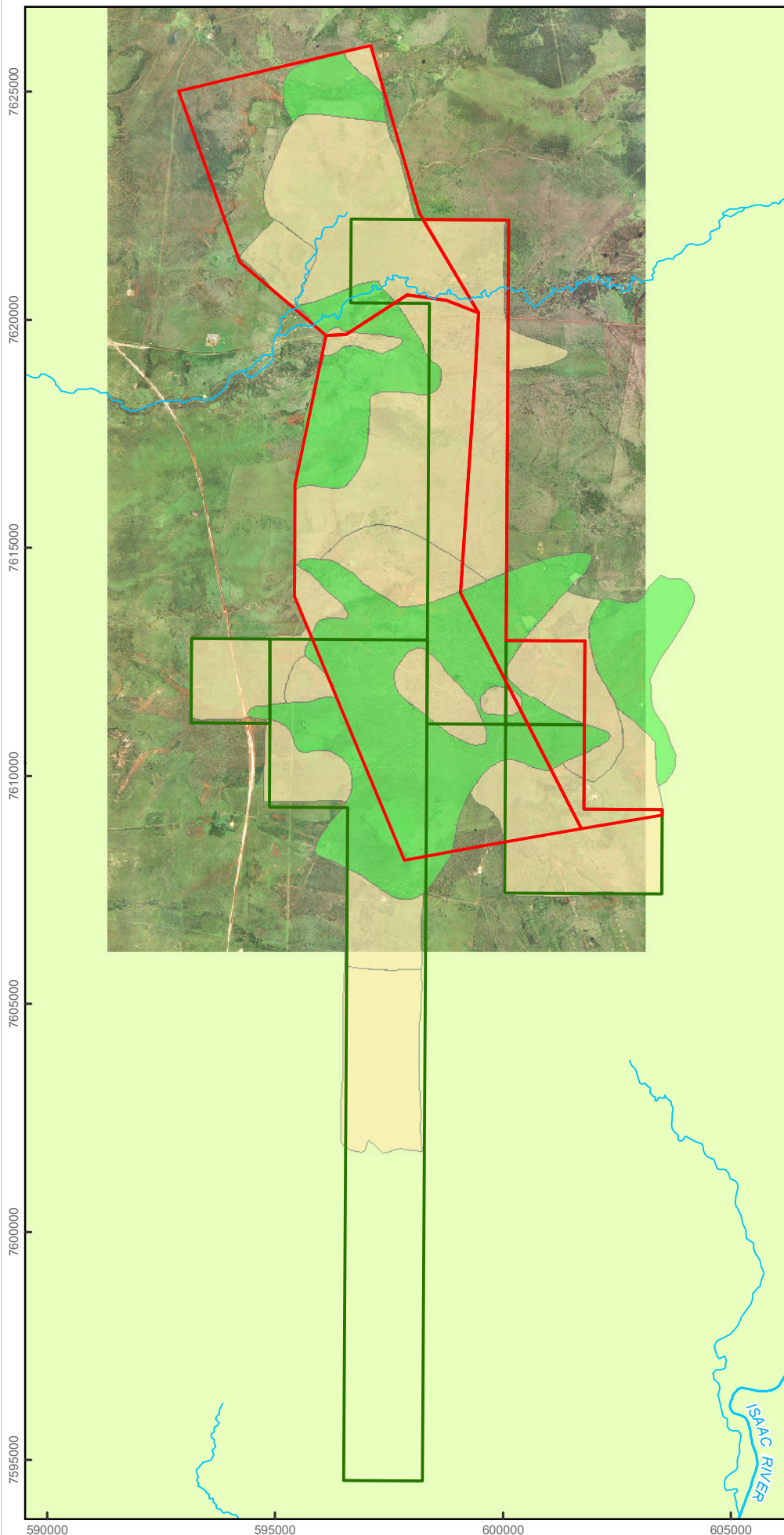
4.3.9. Pre-mining Land Suitability for Cropping and Grazing

The pre-mining land suitability classification for cropping and grazing of the project area, in accordance with the DERM requirements (DME, 1995) is shown in **Figure 4-2** for cropping and **Figure 4-3** for grazing. **Table 4-7** summarises the pre-mining assessment.

■ **Table 4-7 Pre-mining Land Suitability Classes**

Land Class	Description	Pre-mining Area (ha)	
1	Not present in the project area	0	
2	Vertosols - Soils with high clay content, and when dry, crack to a considerable depth		
	<i>Suitable land with minor limitations which either reduce production or require more than simple management practices to sustain the use</i>	INSERT	
3	Dermosol - Texture contrast soils with moderately to strongly structured usually clayey B2 horizons.		
	<i>Suitable land with moderate limitations – Land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use</i>	INSERT	
4	Vertosol – as above	Vertosol	INSERT
	Dermosol – as above	Dermosol	INSERT
	Kandosol - Very deep (>1 m) and clay-rich		
	<i>Marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.</i>	Kandosol	INSERT
5	Not present in project area	0	
TOTAL		INSERT	

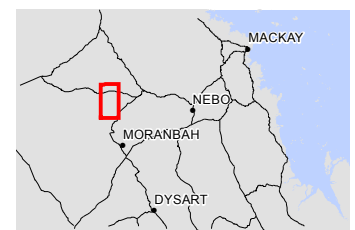
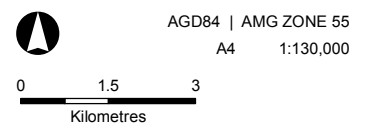
LAND SUITABLE FOR CROPPING



LEGEND

- Minor Watercourse
- Major Watercourse
- Mining Lease
- Exploration Permit Coal
- Land Suitable for Cropping**
 - 3 - Cropping land with moderate limitations (Kandasols)
 - 4 - Marginal cropping land (Dermosols, Sodosols, Vertosols)

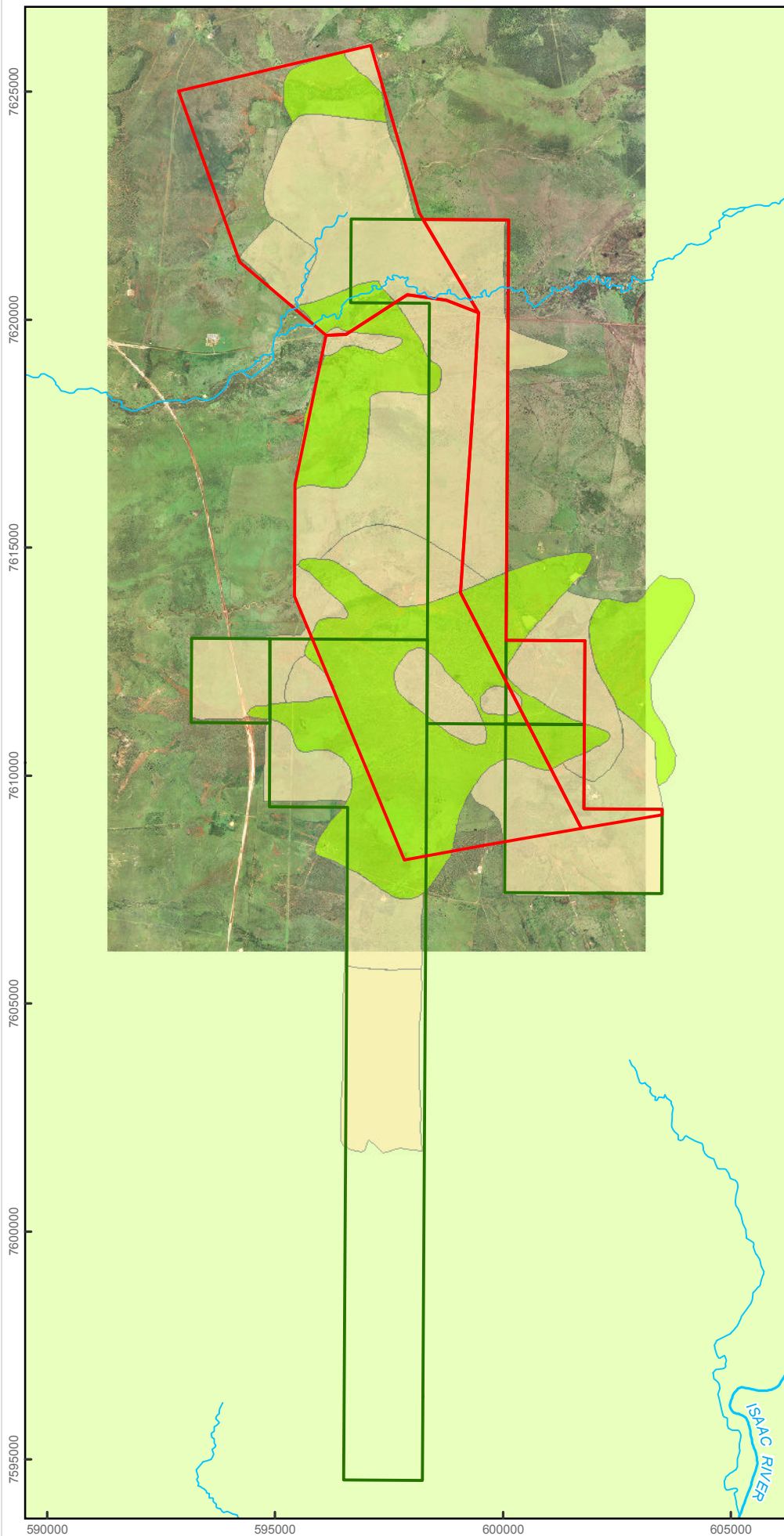
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FIGURE 6

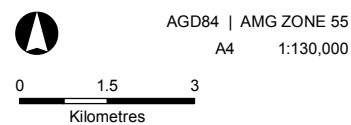
LAND SUITABLE FOR GRAZING



LEGEND

- Minor Watercourse
- Major Watercourse
- Mining Lease
- Exploration Permit Coal
- Land Suitable for Grazing**
 - 2 - Suitable grazing land with minor limitations (Kandasols)
 - 3 - Suitable grazing land with moderate limitations (Dermosols, Sodosols, Vertosols)

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**WARDS WELL MINE PROJECT - EIS
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FIGURE 7

5. Good Quality Agricultural Land

5.1. Method

The project area was also assessed against the Agricultural Land Class (ALC) system, which is used to identify potential Good Quality Agricultural Land (GQAL) in accordance with the *Guidelines for the identification of Good Quality Agricultural Land* (DPI / DLGP, 1993). Agricultural land is defined as land used for crop or animal production, but excluding intensive animal uses (i.e. feedlots and piggeries). GQAL is land which is capable of sustainable use for agriculture, with a reasonable level of inputs, and without causing degradation of land or other natural resources.

The DPI / DLGP (1993) guidelines have been introduced to provide local authorities and development proponents with a system to identify areas of good quality agricultural land for planning and project approval purposes. Descriptions of the agricultural land classes are provided in **Table 5-1**.

■ **Table 5-1 Scheme for Classifying Agricultural Land (DPI / DLGP, 1993)**

Class	Name	Description
A	Arable land (Crop land)	Land that is suitable for current and potential crops with limitations to production which range from none to moderate level.
B	Limited arable land (Limited crop land)	Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and / or agronomic improvements may be required before the land is considered suitable for cropping.
C	Pastoral land	Land that is only suitable for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.
	C1	Land suitable for improved pastures. In some circumstances may be considered as good quality agricultural land.
	C2	Land suitable for native pastures.
	C3	Land suitable for limited grazing of native pastures.
D	Non-agricultural land	Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and / or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rocky outcrops or poor drainage.

The ALC classification system combines land suitability system assessments for a number of specific land utilisation types into a single land classification (refer to **Section 4** for land suitability assessment). The correlation between ALC and land suitability is summarised in **Table 5-2**.



■ **Table 5-2 Land Suitability Ranking and Agricultural Land Class Correlation**

Land Suitability Ranking	Description	ALC
1	Suitable land with negligible limitations and is highly productive requiring only simple management practices	A
2	Suitable land with minor limitations which either reduce production or require more than simple management practices to sustain the use	A
3	Suitable land with moderate limitations – Land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use	A
4	Marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.	B or C1 and C2
5	Unsuitable land with extreme limitations that precludes its use.	C3 or D

5.2. Results

In the local area, the Department of Primary Industries and Fisheries (DPI&F) consider Class A Land in all areas to be good quality agricultural land. In addition, the DPI&F considers that some areas of Class B marginal crop land (where agricultural land is scarce) and better quality Class C1 (land suitable for improved pastures where pastoral industries predominate) may also be considered to be good quality agricultural land.

The existing GQAL mapping for the project area is summarised in **Table 5-3**. Existing broadscale mapping for the project area shows that the project area falls within A, C1, C2 and C3 categories with no indication of Class B or Class D. It is accepted that the mapping scale used to identify these areas was quite small and proponents of major projects are required to investigate GQAL at a higher mapping intensity. Accordingly, this survey within the project area has identified **INSERT text based on revised mapping** (Figure 5-1 and Table 5-4).

Overall the project will impact only minor areas of GQAL Class A and of Class C1 land as underground mining requiring limited surface disturbance is proposed.



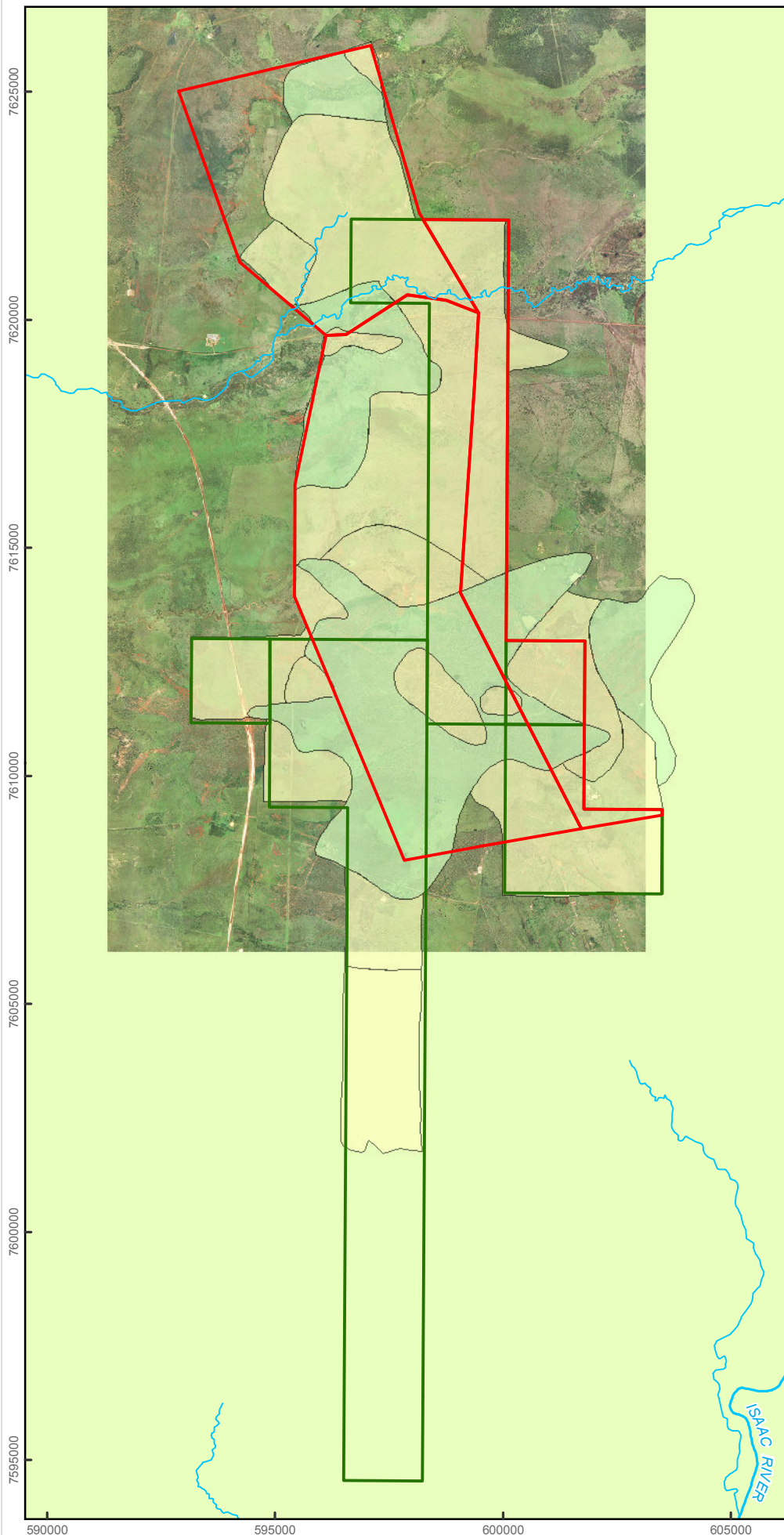
■ **Table 5-3 Existing and Revised Land Class Areas**

Class	Existing DERM Mapping (ha)		Revised Mapping (ha)	
A – Crop Land	5,850		INSERT	
B – Limited Crop Land	None		INSERT	
C – Pasture Land	C1	1,338	C1	0
	C2	4,172	C2	INSERT
	C3	646	C3	0
D – Non-agricultural Land	None		INSERT	

■ **Table 5-4 ALC and GQAL**

Australian Soil Classification	Cropping land Suitability Rating	Grazing Land Suitability rating	Equivalent ALC	GQAL	Area (ha)
Vertosol	4	4	C2	No	INSERT
	2	2	A	Yes	INSERT
	2	4	A	Yes	INSERT
	2	3	A	Yes	INSERT
Dermosol	4	4	C2	No	INSERT
	3	3	A-B	Yes - marginal	INSERT
Kandosol	4	4	C2	No	INSERT
Sodosol	INSERT	INSERT	INSERT	INSERT	INSERT

REVISED GOOD QUALITY AGRICULTURAL LAND CLASSIFICATIONS



LEGEND

- Minor Watercourse
- Major Watercourse
- Mining Lease
- Exploration Permit Coal

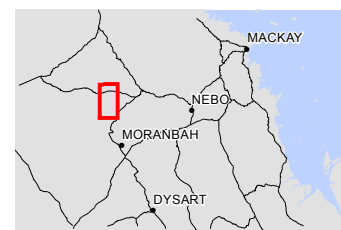
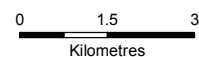
Revised GQAL

- C1 - Grazing on improved pastures
- C3 - Limited grazing on native pastures

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SOILS AND LAND SUITABILITY BASELINE SURVEY**

FIGURE 8

6. Strategic Cropping Land

This section discusses the land use suitability of the Project area in terms Strategic Cropping Land (SCL).

6.1. Method

DERM have proposed criteria for identifying strategic cropping land in the document *Protecting Queensland's strategic cropping land - Proposed criteria for identifying strategic cropping land* (DERM 2011). The criteria were developed to reliably and consistently identify Queensland's best cropping land—land that is suitable for a range of crops in most seasons.

This document is currently under public consultation and the outcomes of the review may affect the assessment made in this section. The criteria relevant for the Project area are described in **Table 6-1**.

■ **Table 6-1 Summary of Criteria for Identifying SCL (DERM, 2011)**

Criteria	Criteria and Thresholds – Western Cropping Land
Slope	≤3%
Rockiness	≤20% for rocks >60 mm diameter
Gildi microrelief	<50% of land surface being gilgai microrelief of >500 mm in depth
Soil depth	≥600 mm
Soil wetness	Has favourable drainage (no waterlogged layers within 300 mm of the ground surface).
Soil pH	For non-rigid soils, the soil at 300 mm and 600 mm soil depth must be greater than pH 5.0. For rigid soils, the soil at 300 mm and 600 mm soil depth must be within the range of pH 5.1 to pH 8.9, inclusive.
Salinity	Chloride content <800 mg/kg within 600 mm of the soil surface
Soil water storage	≥100 mm to a soil depth or soil physico-chemical limitation of ≤1000 mm

Slope for the sample locations has been computed using a 90 m Digital Elevation Model.

Rockiness and Gilgai microrelief were not encountered at any sample locations.

Soil water storage assessment was based on estimated PAWC according to soil texture class (measured in mm per cm of soil) as defined by CSIRO (2008) as shown in **Table 6-2**. PAWC estimated from the Land Suitability assessment was used as cross check to the DERM (2011) criteria.

■ **Table 6-2 Criteria for Estimating PAWC (DERM, 2011)**

Texture Class	Estimated PAWC (mm water / cm soil)
Sand	0.5
Sandy Loam to Clay	0.8 – 1.2
Heavy Clay	1.5 – 2.0

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6.2. Results

Figure 6-1 shows potential mapped SCL within the existing project area.

Comparison of the field investigation results with SCL assessment guidelines identified 7 of the 16 sites (with laboratory results) to be Strategic Cropping Land. **Table 6-3** shows a comparison of the 16 laboratory soil samples with the criteria and indicates whether the criteria were met along with the qualification as SCL. The letter P indicates a pass and F indicates a fail of the criteria. Individual sample SCL assessments are presented as **Appendix E**.

■ **Table 6-3 Summary Assessment of SCL**

ID	Assessment	ASC
9	P	Vertosol
15	F	
22	P	
6	F	
75	P - marginal	
94	F	Dermosol
60	P	
28	P	
36	F	
10	P	
13	F	Kandosol
47	P	
69	F	
23	F	
44	F	
38	F	INSERT Sodosol

Discussion comparing and contrasting the LS and SCL rating here. They don't agree / why not?
 Reclassification?



■ **Figure 6-1 Mapped potential SCL**



7. Post Mine Land Suitability

A key determining factor of post-mine land suitability is the configuration of coal seams in regards to depth of overburden removal required. As overburden increases in volume by about 30% after excavation, the depth of overburden to be removed is a very significant factor in height and gradients of post-mining landforms. In addition, factors influencing changes in land suitability include changed physical, chemical and biological properties of soil, changes in slope and slope length and changes in soil depth and the quality of the underlying spoil.

All sites which are not disturbed by mining activities will remain the same agricultural suitability as the pre-mining class. The main parameter determining post mining agricultural suitability, as with land capability, is steepness of slope and quality of material used as top dressing in rehabilitation. The majority of disturbance associated with mining will be related to underground subsidence. Subsidence will not likely impact post-mining land suitability and access. The majority of the disturbed post-mining landform consists of slopes of 10 degrees and will be covered in low to moderate quality top dressing. These factors should result in an agricultural suitability class 5. The flatter slopes should result in rehabilitation class 4 lands. The steep high walls and voids should also be class 5.

The exact location and nature of mine infrastructure has not been decided yet. The mine industrial area (MIA) will be constructed on flat ground with minimum surface preparation prior to construction. It is not expected that the agricultural and suitability class in the MIA will be altered post closure.

A return to previous uses such as grazing is feasible provided conservative spoil placement designs are implemented and sound topsoil stripping and management practices are undertaken.

The most important rehabilitation outcomes in the region are aimed at ensuring: a beneficial post-mining landuse; stable landforms; and the preservation of downstream water quality.

The following possible post-mining land use options exist:

- **Rain fed Cropping** - It is considered unlikely that any areas would be suitable for sustainable rain fed cropping mainly due to rainfall and soil limitations.
- **Cattle Grazing** - A return to grazing is feasible beneath most rehabilitated infrastructure areas as well as rehabilitated mine and spoil areas. Limits to grazing use are likely on elevated features such as rejects dumps and tailings dams; however these structures will make up a very small percentage of the total mining and operational areas.
- **Bushland Use** - Many mines in the Bowen Basin have a stated aim of native bushland use at completion of rehabilitation after mining has ceased. Given the climatic limitations in the

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region, this is a feasible option for final use of the project site. Extensive clearing for grazing purposes has occurred over the majority of the project site, hence a reversion to a bushland scenario will offer some support for improving biodiversity values in the area. A return to bushland for some mine domains such as on reject dumps is therefore an appropriate option and in line with sustainable development concepts.



8. Erosion Potential and Control

This section discusses the erosion potential of the soils following site clearance and provides erosion control management guidance to minimise the risk of soil degradation and impacts to downstream watercourses.

8.1. Soil Erosion Potential – Sodic Soils

The presence of excessive amounts of exchangeable sodium (relative to the other exchangeable cations) reverses the process of aggregation and causes soil aggregates to disperse into their constituent individual soil particles. This is known as deflocculation and occurs in sodic soils.

Sodicity or Exchangeable Sodium Percentage (ESP) is a measure of the proportion of sodium ions present in a soil; it is expressed as a percentage as:

$$ESP = \frac{\text{Exchanable Sodium}}{\text{Cation Exchange Capacity}} \quad Q1$$

Sodicity has a significant effect on the physical properties of a soil. At high sodicity, soils have a tendency to lose aggregation and to develop clay dispersion, impermeability, surface crusting and poor aeration.

When ESP values are medium to high (6 to > 15) and Mg/Ca ratio >1, there is a greater susceptibility to dispersion (Baker 1991). Non-saline soils ($EC_{1:5} < 400 \mu S/cm$) which are sodic are also more likely to disperse. However in general, soil ESP exceeding 6% warrant consideration as potentially dispersible soils which will influence surface structure and water movement.

The results of the field work show that several sample locations are likely to contain soils that are susceptible to erosion by dispersion which are shown in **Table 8-1** and ESP according to depth at all sample locations is presented for each sample location in **Appendix D**.

From **Table 8-1** the following summary statements can be made with respect to erosion potential:

- **Vertosols** – Moderate to high erosion potential of subsoil below 300 mm depth;
- **Dermosols** – Moderate dispersion potential below 200 mm depth. High erosion potential below 700 mm depth;
- **Kandosols** – Low to moderate erosion potential of subsoil below 500 mm; and
- Sodosols – **INSERT**

Land preparation for mining activities will involve vegetation clearance and topsoil stripping exposing these areas of dispersive subsoil which could potentially lead to surface crusting and soil

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loss through dispersion, sheet wash erosion and gullyng (even on gentle gradients where topsoil is thin). In some cases, the sodic layer is close to the soil surface, therefore it is important to identify topsoil stripping depth and avoid mixing of topsoil and subsoil which could degrade agricultural land. Some sodic soils may also be prone to tunnel erosion in which the subsoil material is suspended in water percolating through it, gradually removing soil and forming a pipe or tunnel. These tunnels eventually collapse and form a gully that can advance rapidly even on gentle slopes. Once exposed, preventing further degradation of subsoil is expensive and success rates are low.

■ **Table 8-1 Erosion Susceptibility**

Soil	Site	Sample Depth (mm)	EC	Exchangeable Sodium	CEC	ESP (approximate)	Exchangeable Calcium	Exchangeable Magnesium	Mg:Ca Ratio	Emerson Aggregate Rating	Susceptibility to Erosion
		Units	µS / cm	meq / 100 g	meq / 100 g	%	meq / 100 g	meq / 100 g	-	-	
Vertosol	15	0-100	0.58	0.7	54.5	1.3	33.2	20	0.6	5	Moderately erosion potential at depth > 900 mm
		300-400	0.278	7	60.6	11.5	30.2	23.2	0.76	-	
		900-1000	0.989	11.4	61.5	18.5	24.8	25.1	1.01	6	
	22	0-100	0.062	<0.1	82.8	<0.12	69.3	12.7	0.18	5	No erosion potential
	9	0-100	0.031	0.8	23.1	3.5	7.8	13.9	1.8	5	Erosion potential below 200 mm
		200-300	0.134	1.7	23.2	7.3	7.2	13.9	1.9	-	
		800-900	0.631	4.4	25	17.6	5.8	14.6	2.5	6	
	6	0-100	0.107	0.2	57	0.4	37.3	17.4	0.5	5	Moderate erosion potential at depth > 800 mm
		200-300	0.137	2.4	64.8	3.7	37.2	24.7	0.7	5	
		800-900	0.659	8.4	72.4	11.6	33.7	30.2	0.9		
	75	0-50	0.041	0.3	75.4	0.4	47	27.4	0.6	5	No erosion potential
		400-500	0.052	3.1	81.6	3.8	47.5	30.9	0.7	-	
		900-1000	0.097	2.8	55.3	5.1	31.3	21.2	0.7	5	
	94	0-50	0.073	<0.1	85	<0.11	66.7	17	0.3	5	No erosion potential
		200-300	0.083	0.2	89.9	0.2	73.4	15.9	0.2	-	
		600-700	0.07	0.3	60.6	0.5	50.1	10.1	0.2	4	
	60	0-20	0.042	0.1	67.2	0.1	42.6	23.4	0.5	5	No erosion potential
		20-300	0.02	0.6	70.4	0.9	45.7	23.9	0.5	-	
		700-800	0.087	0.7	86.8	0.8	61.1	25	0.4	5	
Dermosol	28	0-100	0.15	0.8	15.1	5.3	6.4	5.4	0.8	3	Erosion potential at
		200-300	0.049	2.2	20.3	10.8	8.1	9.9	1.2	-	

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Wards Well: Soil Survey

Soil	Site	Sample Depth (mm)	EC	Exchangeable Sodium	CEC	ESP (approximate)	Exchangeable Calcium	Exchangeable Magnesium	Mg:Ca Ratio	Emerson Aggregate Rating	Susceptibility to Erosion
		Units	µS / cm	meq / 100 g	meq / 100 g	%	meq / 100 g	meq / 100 g	-	-	
		700-800	0.025	0.7	8.1	8.6	3.8	3.6	0.9	3	depth > 200 mm
	36	0-100	0.028	0.8	17.4	4.6	9.2	7.1	0.8	5	Erosion potential at depth > 700 mm
		200-300	0.199	1.6	33.6	4.8	21.8	10	0.5	-	
		700-800	0.345	5.6	35	16.0	15	14.4	1.0	3	
	10	0-100	0.008	<0.1	2.4	<4.1	1.8	0.5	0.3	5	No erosion potential
		500-600	0.009	<0.1	2.1	<4.8	1.3	0.7	0.5	6	
	13	0-50	0.055	<0.1	22.4	<0.45	15.4	5.8	0.4	5	No erosion potential
		200-300	0.09	0.8	28.1	2.8	18	8.6	0.5	5	
		700-800	0.672	7	48.6	14.4	26.5	14.7	0.6	-	
		1000-1100	0.007	<0.1	1.8	<5.55	1	0.7	0.7	-	
	47	0-100	0.012	0.3	15.7	1.9	8.8	6.5	0.7	5	No erosion potential
Kandosol	69	0-50	0.034	<0.1	17.4	<0.57	10.6	6.4	0.6	3	No erosion potential
		200-300	0.014	0.4	25.3	1.6	13.7	11.1	0.8	-	
		800-900	0.026	1.4	31	4.5	17	12.6	0.7	3	
	23	0-100	0.142	0.2	3.9	5.1	2.3	1	0.4	5	Low erosion potential at depth > 500 mm
		300-400	0.045	<0.1	3.2	<3.1	1.8	1	0.6	-	
		900-1000	0.026	0.1	3.2	3.1	1.4	1.5	1.1	6	
	38	0-50	0.03	<0.1	5.6	<1.8	3.2	1.8	0.6	3	Low erosion potential at depth > 500 mm
		500-600	0.02	0.1	3	3.3	1.4	1.3	0.9	5	
	44	0-100	0.077	0.2	3.7	5.4	1.9	1.3	0.7	5	Low erosion potential at depth > 500 mm
		100-200	0.008	<0.1	2.8	<3.6	1.5	1.2	0.8	6	
		500-600	0.005	<0.1	3	<3.3	0.8	2.1	2.6		

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Wards Well: Soil Survey

Soil	Site	Sample Depth (mm)	EC	Exchangeable Sodium	CEC	ESP (approximate)	Exchangeable Calcium	Exchangeable Magnesium	Mg:Ca Ratio	Emerson Aggregate Rating	Susceptibility to Erosion
		Units	µS / cm	meq / 100 g	meq / 100 g	%	meq / 100 g	meq / 100 g	-	-	
INSERT Sodosol											

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8.2. Hillslope Erosion

In addition to soil dispersion associated with sodic soils, sections of the project area are likely to be susceptible to hillslope erosion. Sheet and rill erosion rates on hillslopes are largely a function of soil type, rainfall intensity, land cover and slope.

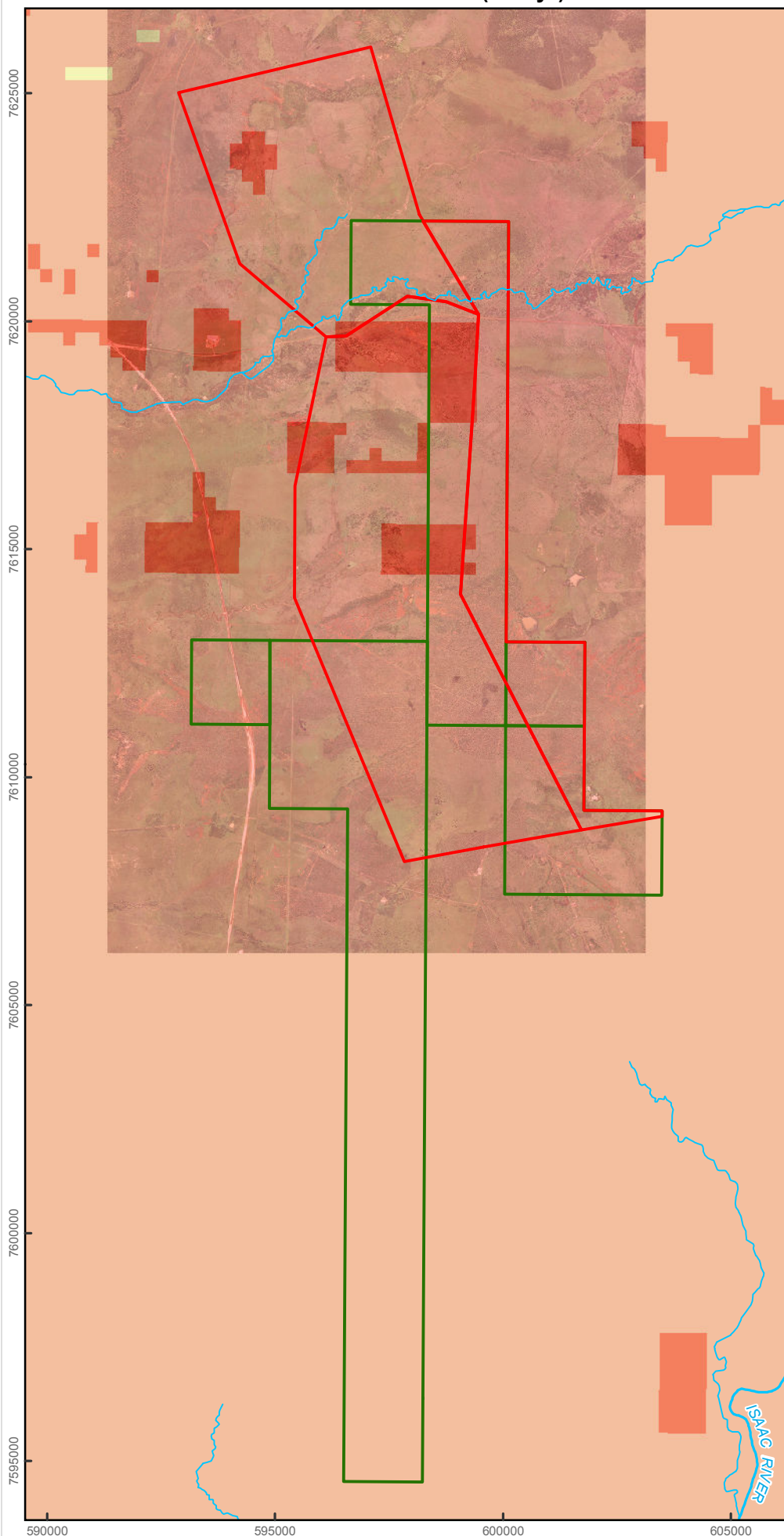
A hillslope erosion map of Australia showing erosion values in tonnes per hectare per year (t/ha/yr) has been produced as a product of the *Water-borne erosion and sediment transport project* conducted by the *National Land and Water Resources Audit* (NLWRA), 2001. The methodology used to produce this map is detailed in Appendix F. Figure 8-1 shows estimated erosion ratings for the project area based on NLWRA (2001) model. Erosion ratings (as used in Australian Agriculture Assessment 2001 reporting) are categorised as High (>10 t/ha/yr), Medium (between 0.5 and 10 t/ha/yr) and Low (<0.5 t/ha/yr). Figure 8-1 shows that the majority of the project area falls within the medium erosion potential category:

- **Low (<0.5 t/ha/yr) = 0 ha**
- **Medium (0.5 and 10 t/ha/yr) = 11,079.8 ha**
- **High (>10 t/ha/yr) = 926.7 ha**

Potential impacts from the project on current land use are considered as follows:

- Dispersion of topsoil through loss of organic matter, increased sodium to calcium ratios (if dust-suppression water is dominated by sodium), and mechanical degradation of soil aggregates (through traffic movement on topsoils);
- Reduced moisture retention (through reduction in pore space from soil compaction) especially in subsoils;
- Reduced infiltration through compaction of subsoils, dispersed topsoil leading to hard setting and decreased water availability;
- Increased root penetration resistance (through compaction of subsoils) and therefore decreased plant water availability;
- Increased erosion levels through dispersion of topsoil and reduced infiltration through subsoils;
- Loss of topsoil (and resultant loss in fertility) through stripping, storage and replacement; and
- Increased penetration resistance through surface crusting (dispersion of topsoil).

PREDICTED HILLSLOPE EROSION RATE (t/ha/yr)



LEGEND

- Minor Watercourse
- Major Watercourse

Mining Lease

Exploration Permit Coal

Predicted Hillslope Erosion (t/ha/yr)

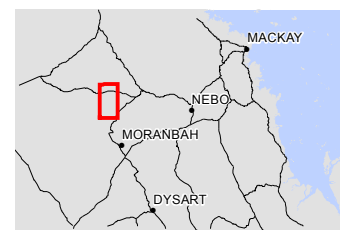
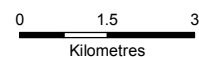
- Low: 0 - 0.5
- Medium: 0.5 - 10
- High: 10 - 100

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FIGURE 9



8.3. Erosion Control

Erosion control measures should be incorporated into an Erosion and Sediment Control Plan to be implemented through the life of the project. Erosion controls specific to areas of the proposed mine are summarised in **Table 8-2**. Training will be provided for all staff with responsibility for topsoil stripping, stockpile and management and mine rehabilitation.

The design parameters for the construction of erosion control work such as rock armoured or grass lined waterways will be in accordance with sound engineering and soil conservation earthworks principles. A number of variables should be taken into consideration such as time of concentration, rainfall intensity, soil erosivity, gradient, scour velocities and flow estimations.

Prior to clearing, the limits of disturbance will be marked by pegs placed at intervals on each side of the disturbed area. All operations will be planned to ensure that there is no damage to any trees outside the area being cleared.

Land disturbance will be minimised by clearing the smallest practical area of land ahead of rehabilitation and coal recovery activities and leaving this disturbed for the shortest possible time. Disturbed areas should be stabilised as quickly as practical and progressive revegetation should be undertaken and erosion and sediment control measures employed, that are consistent with the practices described in the Technical Guidelines for Environmental Management for Exploration and Mining in Queensland (DME, 1995).

■ **Table 8-2 Erosion Control for Mining Activities**

Area	Control Measures
Areas cleared of vegetation	■ Restrict clearing to areas essential for the works; ■ Windrow vegetation debris along the contour; ■ Minimise length of time soil is exposed; ■ Divert run-off from undisturbed areas away from the works; and ■ Direct run-off from cleared areas to sediment dam.
Exposed subsoils	■ Minimise length of time subsoil is exposed; and ■ Direct run-off from exposed areas to sediment dam/
Spoil dumps	■ Direct all run-off from dumps to sediment dams; ■ Avoid placement of sodic waste material on final external batters; ■ Control surface drainage to minimise the formation of active gullies; ■ Use soil and rock mulching to armour long slopes; and ■ Direct run-off from rehabilitated areas to sediment dams.
Topsoil stockpiles	■ Revegetate stockpile as soon as possible; ■ If stockpile to be retained for a period of more than 6 months, the stockpile will be deep ripped and revegetated with application of an appropriate fertiliser; ■ Stockpiles located in areas away from drainage lines or windy areas in order to minimise the risk of soil and wind erosion; ■ Dispersive soils (particularly Sodosols) will be stockpiled separately (if to be used in rehabilitation); ■ Topsoil stockpiles to have an embankment grade of approximately 1V:4H (to limit the potential for erosion of the outer pile face);

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Area	Control Measures
Residual Voids	■ Construction of stockpiles with a "rough" surface condition to reduce erosion hazard, improve drainage and promote revegetation; and ■ Construction of stockpiles by dozers rather than scrapers to minimise structural degradation. ■ Progressive backfilling during operations; ■ Regrade treatments for erosion and geotechnically unstable voids; ■ Use of rock mulch to control erosion; and ■ Apply seed and fertiliser as necessary to ensure rapid re-establishment of pasture and native trees.
Dams, Banks and Creek Crossings	■ Leave useful water storages to support grazing use; ■ Rehabilitate any dam not required post mining by: ■ Regrading embankments; ■ Capping any residual saline material; ■ Replace topsoil; ■ Rip on the contour; and ■ Seed.
Infrastructure	■ Provide protection in drains (e.g. Rip rap, grass) where water velocity may cause scouring; ■ Confine traffic to maintained tracks and roads; ■ Install sediment traps, silt fences, hay bales where necessary to control sediment; and ■ Rehabilitate disturbed areas around construction sites promptly.
Access Roads	■ Surface drainage will be optimised and stabilised; ■ Cross-fall drainage structures and mitre drainage will be implemented for the entire length of the roads; ■ Crowning may be necessary on steeper sections of the roads; ■ Outfall drainage will be constructed where roads traverses small fill batter areas, and in-fall drainage where roads traverse larger fill batter areas; ■ Road runoff will be intercepted at regular intervals to reduce runoff velocity in each mitre drain. Drain spacing will not exceed 50 metre; and ■ Mitre drains will be constructed so that water from the internal haul road is directed to the in-pit sediment control structures or the out-of-pit sediment basins.

8.3.1. Rehabilitation of Eroded Areas

Once extraction works are completed, the land surface will be constructed in accordance with the proposed final landform levels and progressively rehabilitated.

Streams will be restored with adequate controls to minimise the erosion within the restored section of creek, and controls to prevent the migration of any erosion upstream or downstream. Rock-lined channels will be constructed to form the channel surface. Key design elements of channel establishment works will include:

- The channel will be designed to convey the 100-ARI storm event, assuming that the catchment is partially vegetated;
- The channels will be generally trapezoidal in shape with 3:1 (H:V) bank batters and a base width of two metres;
- Natural curves and meanders will be used instead of straight lines to reflect natural stream characteristics;



- The channel will be rock-lined with rip rap and will include the placement of adequately sized rocks above a filter layer of suitable geotextile; and
- Soil will be packed between rocks to allow sedges and grasses to be established within the channel for long-term channel stabilisation.

9. Topsoil Management

This section discusses the selective handling of spoil and topsoil cover material with measures proposed to achieve successful in site rehabilitation outcomes.

9.1. Topsoil Stripping Management

All areas which may be programmed for disturbance may require stripping of topsoil for reuse in rehabilitation programs. Specific recommendations for topsoil stripping are summarised in **Table 9-1**. A map of topsoil stripping depths across the site is presented as **Figure 9-1**.

■ **Table 9-1 Topsoil Stripping Guide**

Soil	Soil Concept	Recommendations
Vertosol	Soils with high clay content, and when dry, crack to a considerable depth	Typical : 200mm Maximum Depth : 800-900 mm Max. Stockpile Height: 3 m. Depth to the salt bulge and dispersive soil is variable in these soils. In general they can be stripped to 200mm depth however could as deep as 800-900 mm depending on depth to salt profile (refer to Table 8-1).
Dermosol	Texture contrast soils with moderately to strongly structured usually clayey B2 horizons.	Typical : 200 mm Maximum Depth : 1000 mm Max. Stockpile Height: 3 m Some Dermosols have dispersive subsoils at variable depths. It is important not to strip below the topsoil layer within these soils to avoid mixing of of the dispersive subsoil.
Kandosol	Very deep (>3 m) clay-rich soils	Typical : 500mm Maximum Depth :1000 mm Max. Stockpile Height: 3 m Kandosols can be stripped to the base of the topsoil horizon
Sodosol	Texture contrast soils, with clayey sodic subsoils and dispersive properties	Typical : 100 mm Maximum Depth : 1000 mm Max. Stockpile Height: 3m These soils occupy a small portion of the site - it is recommended that stripping of this soil be avoided in favour of deeper stripping on other better soils if possible

The basic principle in determining useable depths of topsoil for rehabilitation is its quality in comparison to the spoil requiring rehabilitation and as such the quality of topsoil must exceed that of the spoil. While this may seem obvious, there are situations where additional problems have been created with the inappropriate use of topsoil. In addition, spoil can be expected to improve with years of exposure, leaching and plant colonisation and in some cases may provide better coverage than very poor topsoil after an appropriate time-span.



■ **Figure 9-1 Topsoil Stripping Depth**

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Often, Brigalow soils in Central Queensland (Bourne and Tuck 1993) are sodic and saline at depth. The Vertosols at Wards Well soils tend to display such tendencies with the depth to the salt accumulation layer (or salt bulge) variable but usually within the subsoil below 800mm however in certain areas it is within the topsoil below 200mm. Such topsoil/subsoil is therefore not recommended for reuse in rehabilitation, not only because of salt but also the associated sodic conditions predisposing coarse hard setting behaviour.

Overall, the area includes considerable reserves of topsoil that may be used in mine rehabilitation programs. As a guide, all topsoil used in rehabilitation should be applied to a thickness of at least 250 mm. This provides sufficient depth for ripping, should follow-up maintenance work be required. Soils placed to 150 mm or less can be significantly contaminated by spoil when a single pass of deep ripping occurs.

Suitable topsoil should be stripped for use in the rehabilitation program prior to mining disturbance. The topsoil should either be stockpiled until suitable re-contoured areas are available, or respread immediately across the area to be rehabilitated. In the project area, the topsoil resources present should be more than adequate for the rehabilitation of the spoil dumps and other disturbed areas. It should be noted that when mine development occurs, small topsoil test pits should be dug at close spacing e.g. say on a 100 m grid to better determine the stripping depth in advance of the box cut. This will provide the dozer operators with an understanding of the actual depth of stripping required in the particular area.

Stockpiling of topsoil will be necessary initially as most rehabilitation is normally unavailable until after a period of time. Stockpiles will be managed so that:

- Soil types with significantly different properties will be stockpiled separately;
- Locations are recorded using gps and data recorded relating to the soil type and volume on a database
- Managed by the mine operator; and
- Stockpile surfaces are ripped and seeded (if natural revegetation does not provide adequate cover).

9.2. Topsoil Stripping and Stockpile Management

Soil stripping and stockpiling is important for soil and water management at a mine during both the operational and rehabilitation phases. The stockpiles need to be managed to minimise erosion and loss of valuable topsoil for rehabilitation, and also to ensure the topsoil is maintained in a condition which supports the most rapid stabilisation of the site during rehabilitation.

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The following measures should be adopted for soil stripping and stockpiling:

- Soils should be stripped in a slightly moist condition (neither too dry nor wet) thus reducing dust generation and deterioration in topsoil quality;
- Topsoil should be stockpiled only when disturbed areas are not available for immediate rehabilitation; and
- Soil stockpiles should be constructed to minimise the stockpile area in a discrete three metre-high (maximum) pile, with a working face battered down at 30 degrees.

9.3. Topsoil Application During Rehabilitation

The following measures should be considered when applying topsoil during rehabilitation:

- Soil will be re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation, is returned to the surface. Topsoil will be spread to a minimum depth of 100 mm on 3:1 or steeper slopes and to a minimum depth of 50 mm on flatter slopes. Re-spreading on the contour will aid runoff control and increase moisture retention for subsequent plant growth.
- Handle topsoil at an optimum moisture content to reduce damage to soil structure – this will provide a higher standard of revegetation and lower maintenance requirements.
- Re-spread topsoil in the reverse sequence to its removal so that the organic layer, containing any seed or vegetation, is returned to the surface.
- Spread topsoil at a minimum depth of 250 mm.
- Spread topsoil along the contour of re-graded spoil by dumping at the top of slopes and grading downwards and across the contour – thus aiding runoff control, minimising erosion and increasing moisture retention.
- Level topsoil to an even surface and avoid a compacted or over-smooth finish
- Incorporate topsoil into the overburden or waste rock by contour cultivation with a tined implement in preparation for sowing – this will leave the soil surface in a roughened condition creating a ‘key’ between the soil and the spoil.
- Stop any vehicle traffic entering the area once topsoil is spread.
- Re-spread topsoil will be levelled to achieve an even surface, while avoiding a compacted or an over-smooth finish.
- Gypsum and/or lime may be applied to the final surface using broadcasting machinery immediately prior to sowing. The ameliorants will be incorporated to a nominal depth of 300 mm.



Site preparation will be undertaken to ensure rapid establishment and growth of vegetation. Topsoil will be spread along the contour of regraded overburden to minimise erosion by dumping at the top of slopes and grading downwards and across the contour.

Once the topsoil is spread, vehicle traffic will be prevented from entering the area. If necessary, some areas will remain without topsoil after final regrading, although these areas will then be sown to fulfil the revegetation objectives.

After topsoil spreading, all topsoiled areas will be contour-ripped to an indicative depth of 400 to 500 mm to create a 'key' between the soil and replaced overburden. To minimise erosion, ripping will be undertaken on the contour. Contour banks will be constructed where ripping in the above manner is insufficient to prevent erosion. Rip lines and contour banks will be directed to the closest watercourse.

A sterile cover crop (oats and/or Japanese millet) may be applied to assist with initial soil stabilisation and used in different ratios according to the season.

9.4. Reuse of Competent Spoil

The management and re-use of the topsoil (and subsoil identified as suitable for rehabilitation purposes) - otherwise called competent spoil - for rehabilitation purposes is to be undertaken in accordance with the *Code of Environmental Compliance - Mining Lease Projects* (DERM., January 2001) conditions as follow:

Competent spoil should be stripped and stockpiled separately during clearing. When the topsoil and associated subsoils have been identified as suitable for re-use for rehabilitation purposes, the topsoil should also be stripped and stockpiled separately.

- Competent spoil is to be removed and stockpiled prior to carrying out any mining activity.
- The mixing and erosion of competent spoil with overburden stockpiles should be prevented or minimised.
- Competent spoil and overburden are to be stored in separate stockpiles.
- Silt fencing or bunding is to be installed around the stockpiles
- A temporary cover crop or grass is to be established and maintained on the competent spoil stockpiles
- Competent spoil should be stored in stockpiles no more than 2 m high to retain seed germination potential.
- Where practical the competent spoil stockpiles should be re-used within 12 months of storage.



- The placement of competent spoil needs to be assessed based on the landscape position the topsoil was stripped from (Vertosols in lower slope areas and where water accumulation may occur, Dermosols in lower to medium slope areas, Chromosols in steeper slope areas).
- A competent spoil register should be developed to record the origin, stockpile locations and volumes and future placement areas details.



10. Conclusion

This study has identified and mapped the broad soil types and characterised topsoils and subsoils material within the project area. Based on existing literature and findings of the field survey and review of the analytical data, the study area contains a number of different soils derived from sedimentary and alluvial parents.

Some of the subsoils are alkaline and sodic and therefore dispersive. They will require specific management techniques to control the erosion potential following the commencement of the stripping activities and during the mine life cycle until rehabilitation is undertaken.

The topsoil and subsoils also has some limitations in regards to use as growth medium, including pH, sodicity and moisture holding capacity.

Rehabilitation planning should take into consideration these soils characteristics as the soils deemed competent spoil are to form the substrate for future re-vegetation programs.

Selection of re-vegetation strategies should be trial tested and adjusted to enable the selection of a sustainable re-vegetation program of the disturbed areas.

It is anticipated that topsoil and subsoils (the competent spoil) will be available for use in rehabilitation is appropriately handled during stripping and stockpiling operations. Depth limitations exist in some soils, and slope gradient may impact the stripping activities on steeper slopes.

Based on the literature review and field survey results the following settings have been confirmed for the study area:

- Land Suitability for Cropping
- Land Suitability for Grazing
- GQAL
- SCL

Large portions of the disturbed areas and spoil piles are therefore anticipated to be rehabilitated to either:

- Class 3 beef cattle grazing
- Class 4 cropping
- Nature conservation areas

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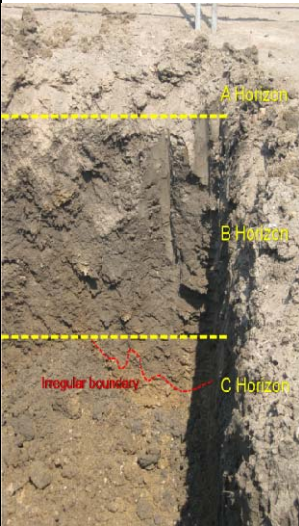


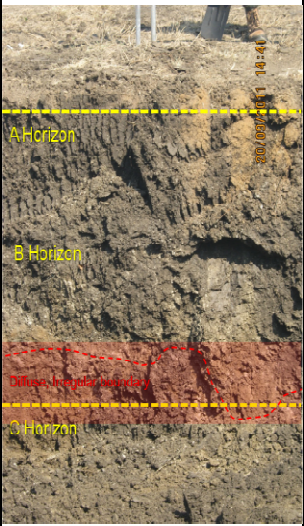
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Appendix A Soil Logs

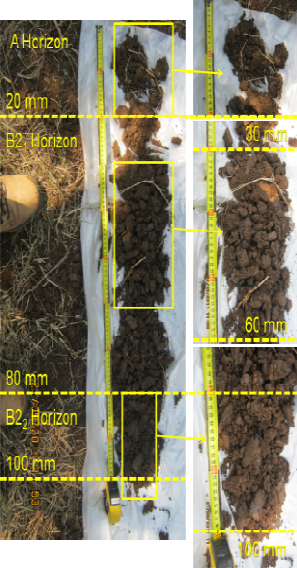
Project: Wards Well		Date: 20/9/2011			Location: 1 (DB02) Observation Type: P			Coordinates: 0597742, 7619573				
Job Number QE9811												
Natural Vegetation: Popular Box, mixed Woodland						Land Use: Grazing						
												
Topography: Flat (< 0.5%)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Restricted				
Remarks:				ASC Mapped: Vertosol				ASC Ground Truth: Dermosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	SiCL	Not recorded	10YR 3/4	None		Cracking coarse self mulching (coarse angular)	Weak, Coherent	2	Not recorded	Gradual, Even	A _{1p}	No sample
20-1400	SiMC	Not recorded	10YR 3/1	None		-	Strong, Coherent	2	Not recorded	Clear, Irregular	B ₂₁	No sample
1400-1500	LC	Not recorded	7.5YR 5/3	> 50% soft CaCO ₃		-	Not recorded	3, CaCO ₃ = 1	Not recorded	Base of horizon not encountered	B ₃	No sample

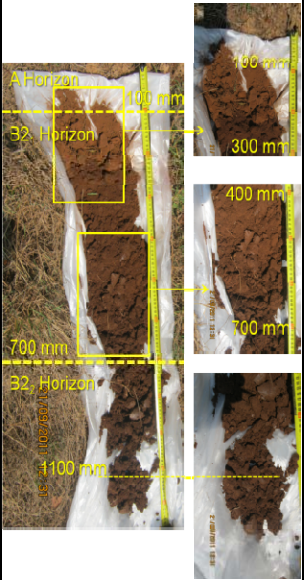
Project: Wards Well		Date: 20/9/2011		Location: 1 (DB01) Observation Type: P			Coordinates: 0596764, 7619633					
Job Number QE9811												
Natural Vegetation: Popular Box, mixed Woodland							Land Use: Grazing					
												
Topography: Flat (< 0.5%)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Restricted					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Dermosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	SiCL	Not recorded	10YR 3/4	None		Cracking coarse self mulching (coarse angular)	Strong, Coherent	2	Not recorded	Gradual, Even	A _{1p}	No sample
20-1400	SiMC	Not recorded	10YR 3/1	None		-	Strong, Coherent	2	Not recorded	Diffuse, Irregular	B ₂₁	No sample
1400-1500	LC	Not recorded	7.5YR 5/3	> 50% soft CaCO ₃		-	Not recorded	3, CaCO ₃ = 1	Not recorded	Base of horizon not encountered	B ₃	No sample

[illegible]

[illegible]

[illegible]

Project: Wards Well		Date: 21/9/2011		Location: 6 Observation Type: A			Coordinates: 0595544, 7614553					
Job Number QE9811												
Natural Vegetation: Buffel grass, Brigalow							Land Use: Gazing					
												
Topography: ≤ 1% old flood plain			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Well drained clay				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-200	MC	Not recorded	10YR 3/3	Nil		Cracking clay, fine grain, self mulching	Not Coherent, Mulch	2	Not recorded	Clear, Even	A1	0-10 mm
200-800	MC	Not recorded	10YR 4/2	≤ 2% Manganese nodules		-	Weak, Coherent	2	Not recorded	Gradual, Even	B2 ₁	20-30 mm
800-1000+	MC	Not recorded	7.5YR 3/4	≤ 2% Manganese nodules and soft lime nodules		-	Weak, Coherent	2	Not recorded	Gradual, Even	B2 ₂	80-90 mm

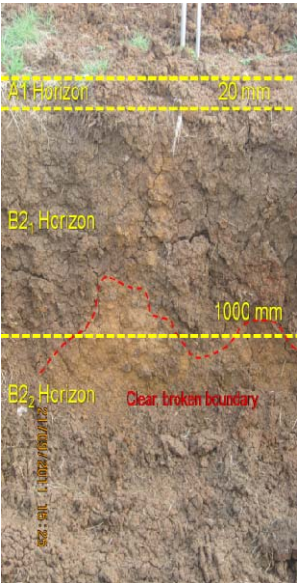
Project: Wards Well		Date: 21/9/2011		Location: 7 Observation Type: A			Coordinates: 595743,7613598					
Job Number QE9811												
Natural Vegetation: Grass, SL Ironbark, Bloodwood, Eucalypt Poplar Box							Land Use: Grazing					
												
Topography: Crest, low broad ridge ($\leq 1\%$)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Well drained					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SiC	Not recorded	5YR 3/4	Nil		Firm hardsetting, weak cracking	Very Firm, Coherent, Massive	4	Not recorded	Clear, Even	A1	No sample
100-700	MC	Not recorded	2.5YR 4/4	Nil		-	Firm, Coherent, Massive	3	Not recorded	Gradual, Even	B2 ₁	No sample
700-1000+	MC	$\leq 5\%$	2.5Yr 3/4	Manganese nodules and trace carbonate		-	Firm, Coherent, Massive	3	Not recorded	Base of horizon not encountered	B2 ₂	No sample

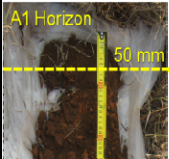
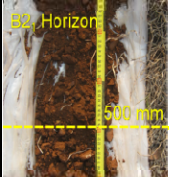
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Project: Wards Well		Date: 21/9/2011		Location: 10 Observation Type: A		Coordinates: 0599832, 7611654						
Job Number QE9811												
Natural Vegetation: Spear Grass, Acacia (various), Very few Ironbak, Mixed redland earth vegetation						Land Use: Grazing						
												
Topography: ≤ 1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Very well drained					
Remarks:				ASC Mapped: Kandosol			ASC Ground Truth: Brown Dermosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-350	SL	Nil	7.5YR 3/3	Nil		Sand, firm	Loose, Not Coherent	1	Not recorded	Gradual, Even	A ₁	0-100
350-1000+	SCL	Nil	7.5YR 4/4	Some mottles		-	Loose, Not Coherent	1	Not recorded	Gradual Even	A ₁ ₂	500-600
1000-1100+	SCL	Nil	5YR 5/5	Nil		-	Loose, Weakly Coherent, Massive	1	Not recorded	Base of horizon not encountered	A ₁ ₃	1000-1100

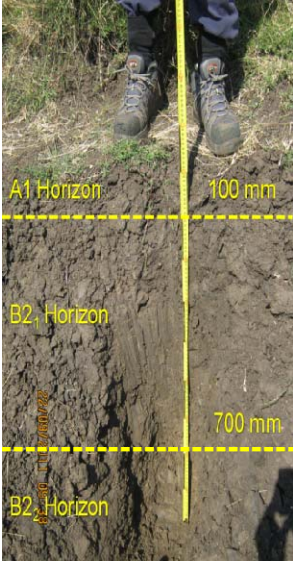
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Project: Wards Well		Date: 21/9/2011		Location: 12		Observation Type: P		Coordinates: 599737, 7609528				
Job Number QE9811												
Natural Vegetation: Brigalow, regrowth, Dandelion						Land Use: Grazing						
												
Topography: ≤ 1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Imperfect				
Remarks: Hard cracking, flat alluvial plain				ASC Mapped: Kandosol				ASC Ground Truth: Demosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	MC / HC	Nil	10YR 4/3	Nil		Self mulching, crtracking clay	Weakly Coherent, Surface mulch	2	Not recorded	Clear, Even	A1 _p	No sample
20-1000	MC / HC	Nil	10Yr 4/4	Nil		-	Weak, Coherent, Highly pedal	2	Not recorded	Clear, Broken	B2 ₁	No sample
1000+	MC / HC	Nil	7.5YR 4/6	Some grey mottles present		-	Firm, Coherent, Highly pedal	3	Not recorded	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 21/9/2011		Location: 13 Observation Type: A		Coordinates: 601185, 7608926						
Job Number QE9811												
Natural Vegetation: Brigalow, Black butt								Land Use: Grazing				
Topography: ≤ 1%				Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor			
Remarks: Hard soil, normal Gilgai landsurface, sample location in depression						ASC Mapped: Kandosol			ASC Ground Truth: Brown Dermosol			
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	SL	Nil	10YR 4/3	Nil	 	Firm, crusting, non-cracking	Loose / Weak, Apedal	2	Not recorded	Gradual	A1	0-500 mm, 200-300 mm
50-500	SL	Nil	10YR 3/3	Manganese nodules and yellow mottling	 		Loose / Weak, Weakly pedal	1	Not recorded	Gradual	B2 ₁	700-800 mm
500+	MC / HC	Nil	5YR 4/3	Ironstone and Manganese nodules	 		Loose / Weak, Weakly pedal	2	Poor	Gradual	B2 ₂	1000-1100mm

Project: Wards Well		Date: 22/9/2011		Location: 14			Observation Type: A			Coordinates: 0597754, 761859			
Job Number QE9811													
Natural Vegetation: Buffel grass, Acacia, Mt Coolabah (scattered). bohenia. Brigalow on uphill margin							Land Use: Grazing						
													
Topography: ≤ 1%, Top of alluvial plain				Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Imperfect, poorly drained clay				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-50	MC	Nil	10YR 3/1	Nil		Coarse, self-mulching, hard setting	Weak, Coherent, Highly pedal	2	Not recorded	Gradual, Even	A1	No sample	
50-200	MC	1-3%	10YR 3/1	Carbonate nodules (white and red)		-	Weak, Coherent, Highly pedal	2	Not recorded	Gradual, Even	B2 ₁	No sample	
200-1000+	MC	Nil	10YR 3/1	Mottling and carbonate nodules		-	Sub-angular, blocky	4	Not recorded	Base of horizon not encountered	B2 ₂	No sample	

Project: Wards Well		Date: 22/9/2011		Location: 15 Observation Type: A			Coordinates: 598820, 7617662					
Job Number QE9811												
Natural Vegetation: Medium density Ironbark, Acacia, Buffel grass, Brigalow							Land Use: Grazing					
												
Topography: Not recorded			Surface Rock % (> 60mm dia):		Erosion: Nil			Drainage: Nil				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SiC	Nil	7.5YR 3/2	Nil		Surface cracking, self-mulching, fine angular	Very Firm, Highly Pedal	4	Not recorded	Diffuse, Even	A1	0-100 mm
100-800	LC / MC	Nil	7.5YR 3/2	Some carbamate nodules		-	Very Firm, Highly Pedal	4	Not recorded	Clear, Even	B2 ₁	300-400 mm
800-1000+	MC	Nil	5YR 3/4	Some carbonate nodules		-	Very Firm, Highly Pedal	4	Not recorded	Base of horizon not encountered	B2 ₂	900-1000 mm

Project: Wards Well		Date: 22/9/2011		Location: 16 Observation Type: P			Coordinates: 599176,7617728					
Job Number QE9811												
Natural Vegetation: Buffel grass, Acacia, River Gum							Land Use: Grazing					
												
Topography: Undulating (1-2%)			Surface Rock % (> 60mm dia): Nil		Erosion: Visible signs of erosion			Drainage: Well drained				
Remarks: Creek bed					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	LC	Nil	7.5YR 2.5/1			No cracking, self-mulching crust	Weak, Weakly Pedal, Coherent	1	Not recorded	Gradual, Clear	A1	No sample
100-700	MC	≤ 30%	7.5YR 2.5/1	5-10 mm diameter gravel, some mottles		-	Weak, Weakly Pedal, Coherent	1	Not recorded	Gradual, Clear	B2 ₁	No sample
700-1000+	MC	≤ 30%	7.5YR 3/1	5-10 mm diameter gravel, some mottles		-	Weak, Weakly Pedal, Coherent	1	Not recorded	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 22/9/2011		Location: 17 Observation Type: A		Coordinates: 600217,7618517						
Job Number QE9811												
Natural Vegetation: Open Poplar box Woodlands						Land Use: Grazing						
												
Topography: ≤ 1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Imperfect					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC	Nil	5YR 3/2	Carbonate nodules		Self mulching	Weak, Highly Pedal, Coherent	2	Not recorded	Gradual	A1	No sample
50-100	MC	Nil	5YR 3/2	Nil		-	Firm, Highly Pedal, Coherent	3	Not recorded	Gradual	B2 ₁	No sample
100-1000	MC	Nil	10YR 4/4	Nil		-	Very Firm, Highly Pedal, Coherent	4	Not recorded	Base of horizon not encountered	B2 ₂	No sample

[illegible]

[illegible]

Project: Wards Well	Date: 22/9/2011	Location: 20	Observation Type: P	Coordinates: 596723, 7616485
Job Number: QE9811				

Natural Vegetation: Acacia and Grassland



Land Use: Grazing

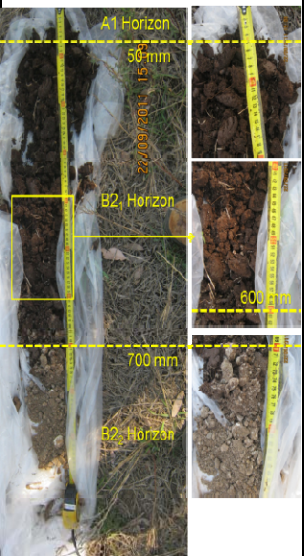


Topography: 1-2%	Surface Rock % (> 60mm dia): Nil	Erosion: Nil	Drainage: Well drained clay
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Remarks:	ASC Mapped: Vertosol	ASC Ground Truth: Vertosol
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Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	7.5YR 3/1	Nil		Self-mulching crust	Weak, Highly Pedal, Coherent	2	Not recorded	Gradual, Even	A1 _p	No sample
50-1000+	HC	≤ 5% Gravel	10YR 3/2	Nil		-	Very Firm, Weakly Pedal / Massive, Coherent	4	Not recorded	Base of horoizon not encountered	B2 ₁	No sample

[illegible]

Project: Wards Well		Date: 22/9/2011		Location: 22 Observation Type: A				Coordinates: 598838, 7616587				
Job Number QE9811												
Natural Vegetation: Popular Box, Buffel Grass								Land Use: Grazing				
												
Topography: Flat / Table top			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Restricted / Poor				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC	Nil	7.5YR 3/3	Nil		Self-mulching cracking clay	Very Weak, Weakly pedal / Apedal,	1	Restricted	Gradual, Even	A1	0-100 mm
50-700	MC	Nil	7.5YR 2.5/2	Carbonate nodules, White mottling		Weak, Stronger then weakly pedal, Coherent	2	Poor	Clear, Even	B2 ₁	200-400 mm	
700-1000+	SLC	Nil	10YR 4/4	Distinct white / yellow / red mottling		Very Firm, Strongly Pedal, Coherent	4	Poor	Clear, Even	B2 ₂	800-900 mm	

Project: Wards Well		Date: 23/9/2011		Location: 23 Observation Type: A			Coordinates: 0595233, 7611393					
Job Number QE9811												
Natural Vegetation: Iron Bark, Spear Grass							Land Use: Grazing					
												
Topography: Close to top of slope (1-2%)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Restricted				
Remarks:				ASC Mapped: Kandosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-250	SL	Nil	5YR 4/4	Nil		Hard-setting	Very Weak, Apedal	1	Not recorded	Clear Even	A1	0-100 mm
250-900	FSCL	≤ 5%	5YR 3/4	Drak gray / black mottles		-	Very Weak, Apedal / Weakly Coherent	1	Not recorded	Gradual Even	B2 ₁	300-400 mm
900-1000+	FSCL	≤ 80%	5YR 3/4	Nil		-	Very Weak, Apedal / Weakly Coherent	1	Not recorded	Base of horizon not encountered	B2 ₂	900-1000 mm

Project: Wards Well		Date: 23/9/2011		Location: 24 Observation Type: A			Coordinates: 594552,7611459					
Job Number QE9811												
Natural Vegetation: Spear Grass, Ironbark							Land Use: Grazing / Railway easment					
												
Topography: Close to top of slope (1-2%)			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Restricted				
Remarks:					ASC Mapped: Kandosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-300	SL	Nil	2.5YR 4/6	Nil		Hard packed, hard-setting	Very Weak, Apedal	1	Well	Gradual, Even	A1 _{1P}	No sample
300-900	LC	Nil	5YR 3/6	Nil		-	Very Weak, Apedal / Weakly Coherent	1	Poor	Gradual, Even	B2 ₁	No sample
900+	FSCL	≤ 5%	2.5YR 2.5/4	Some mottling present		-	Very Weak, Apedal / Weakly Coherent	1	Poor	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 23/9/2011		Location: 25 Observation Type: A			Coordinates: 594285, 7612574					
Job Number QE9811												
Natural Vegetation: Spear Grass, Bohenia, Acacia (cleared)							Land Use: Grazing					
												
Topography: Old Alluvial Plain (1-2%)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poorly drained					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	LC / MC	Nil	10YR 2/2	Slight red / yellow mottling		Self-mulching	Firm, Strongly Pedal, Coherent	3	Not recorded	Clear, Even	A1	No sample
20-80	MC	Nil	10YR 3/2	Red mottles, White and orange nodules		-	Firm, Strongly Pedal, Coherent	3	Not recorded	Clear, Even	B2 ₁	No sample
850-1000	MC	Nil	7.5YR 3/2	Red mottles, White and orange nodules		-	Weak, Strongly Pedal, Coherent	2	Not recorded	Base of horizon not encountered	B2 ₂	No sample

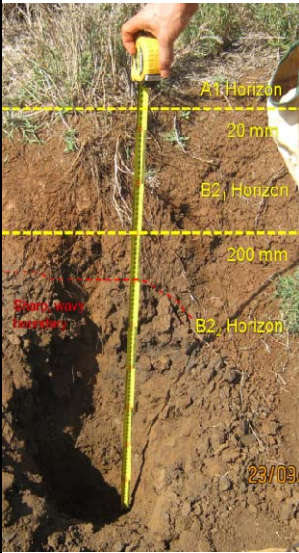
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Project: Wards Well		Date: 23/9/2011		Location: 28 Observation Type: A			Coordinates: 595477, 7612063					
Job Number QE9811												
Natural Vegetation: Small shrubs, Grassland, Some Ironbark							Land Use: Grazing					
												
Topography: Bottom of slope (1-2%)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Restricted					
Remarks: Area has been previously cleared				ASC Mapped: Kandasol			ASC Ground Truth: Brown Dermosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	LC	Nil	7.5YR 4/4	Nil		Hardpacked, non-cracking clay	Weak, Weakly Pedal /Apedal	1	imperfect	Clear, Even	A1	0-100 mm
100-400	MC	Nil	7.5Yr 4/4	White mottles		-	Weak, Strongly Pedal, Coherent	2	poor	Clear, Even	B2 ₁	200-300 mm
400+	MC	Nil	7.5YR 3/3	White / Black mottles		-	Firm / Very Firm, Strongly Pedal, Coherent	3 / 4	poor	Base of horizon not encountered	B2 ₂	700-800 mm

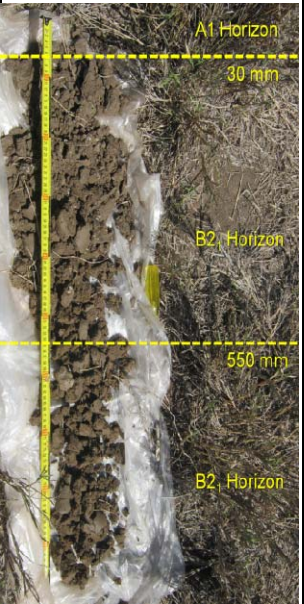
Project: Wards Well		Date: 23/9/2011		Location: 29 Observation Type: A				Coordinates: 0595478, 7611172				
Job Number QE9811												
Natural Vegetation: Ironbark, Acacia, Bohenia, Buffel grass, some Popular box								Land Use: Grazing				
												
Topography: ≤ 1% (Table top)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Imperfect / Well				
Remarks:				ASC Mapped: Kandosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	SCL	Nil	5YR 3/3	Nil		Hard setting	Very Weak, Weakly Pedal / Apedal	1	Not recorded	Gradual, Clear	A1	No sample
50-400	SCL	Nil	5YR 3/4	Ironstone and orange / red mottles		-	Very Weak / Weak, Weakly Pedal, Slightly Coherent	2	Not recorded	Gradual, Clear	B2 ₁	No sample
400-1000+	LC / MC	Nil	2.5YR 2.5/4	Ironstone and orange / red mottles		-	Weak, Stronger than Weakly Pedal, Mildly Coherent	2	Not recorded	Base of horizon not encountered	B2 ₂	No sample

[illegible]

Project: Wards Well		Date: 23/9/2011		Location: 31 Observation Type: P			Coordinates: 0596389, 7610125					
Job Number QE9811												
Natural Vegetation: Buffel Grass, Acacia, Brigalow							Land Use: Grazing					
												
Topography: Creek bed ($\leq 1\%$)			Surface Rock % (> 60mm dia): Nil		Erosion: Approx 10% of area eroded			Drainage: Restricted				
Remarks:					ASC Mapped: Kandosol			ASC Ground Truth: Dermosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	SCL	Nil	10YR 4/4	Nil		Hard-setting clay	Weak / Very Weak, Weakly pedal, Coherent	1	Well drained	Clear, Even	A1	No sample
20-200	LC	Nil	10YR 3/6	Nil		-	Weak, Weakly pedal, Coherent	2	Well drained	Sharp, Wavy	B2 ₁	No sample
200-1000+	HC	Nil	10YR 3/3	Ironstone		-	Very Firm, Weakly Pedal / Massive, Coherent	4	Well drained	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 24/9/2011		Location: 32 Observation Type: A				Coordinates: 0596753, 7602859				
Job Number QE9811												
Natural Vegetation: Cleared Speargrass, Brigalow regrowth, Acacia							Land Use: Grazing					
												
Topography: Flat, Melonholes throughout			Surface Rock % (> 60mm dia): Nil		Erosion: ≤ 5% of site			Drainage: Well drained				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Grey Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	LC	Nil	10YR 3/2	Nil		Self-mulching cracking black clay	Very firm, Highly pedal, Coherent	4	Imperfect	Sharp, Even	A1	No sample
150-450	MC	Nil	10YR 3/3	Oange / red mottles		-	Very firm, Highly pedal, Coherent	4	Imperfect	Sharp, Even	B2 ₁	No sample
450-1000+	MC	Nil	10YR 3/4	Carbonate nodules, Ironstone		-	Very firm, Highly pedal, Coherent	4	Imperfect	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 27/9/2011		Location: 33 Observation Type: A		Coordinates: 596891, 7603704						
Job Number QE9811												
Natural Vegetation: Cleared vegetation, Spear Grass						Land Use: Grazing						
												
Topography: Flat ($\leq 1\%$), Melonholes present		Surface Rock % (> 60mm dia): Nil		Erosion: Evidence of erosion ($\leq 5\%$)			Drainage: Well drained					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	LC / MC	Nil	10YR 3/2	Nil		Self-mulching cracking clay	Very firm, Highly Pedal, Coherent	4	Not recorded	Diffuse, Even	A1	No sample
150-550	MC	Nil	10YR 3/3	Orange / red mottles		-	Very firm, Highly Pedal, Coherent	4	Not recorded	Diffuse, Even	B2 ₁	No sample
550-1000+	MC	Nil	10YR 3/4	Carbonate nodules, Ironstone. Red / orange mottles		-	Very firm, Highly Pedal, Coherent	4	Not recorded	base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 24/9/2011		Location: 34 Observation Type: A			Coordinates: 597267, 7604679					
Job Number QE9811												
Natural Vegetation: Cleared, Buffel Grass, regrowth of Acacia							Land Use: Nil					
												
Topography: Flat undulating, Melon holes			Surface Rock % (> 60mm dia): Nil		Erosion: ≤ 5%			Drainage: Imperfect				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-30	MC	Nil	10YR 3/2	Nil		Self-mulching cracking clay	Very Firm, Highly Pedal, Coherent	4	Not recorded	Diffuse, Even	A1	No sample
50-550	MC	Nil	10YR 4/2	Carbonate nodules, Red mottles		-	Firm, Highly Pedal, Coherent	3	Not recorded	Diffuse, Even	B2 ₁	No sample
550+	MC	Nil	10YR 4/2	Tree roots intercepted		-	Weak, Highly Pedal, Coherent	2	Not recorded	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 24/9/2011		Location: 35			Observation Type: A			Coordinates: 597310, 7605530			
Job Number QE9811													
Natural Vegetation: Buffel Grass,							Land Use: Grazing						
													
Topography: Melonholes ($\leq 1\%$)			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Imperfect					
Remarks: Sample from within melonhole					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-250	LC	Nil	10YR 4/1	Nil		self-mulching, craking clay	Firm, Highly Pedal, Coherent	3	Imperfect	Gradual, Even	A1	No sample	
250-600	MC	Nil	10YR 4/2	White / Brown / Orange / Red mottles			Very Firm, Highly Pedal, Coherent	4	Imperfect	Clear, Even	B2 ₁	No sample	
600-1000+	MC	Nil	10YR 5/2	Orange / Brown mottles			Very Firm, Highly Pedal, Coherent	4	Imperfect	Base of horizon not encountered	B2 ₂	No sample	

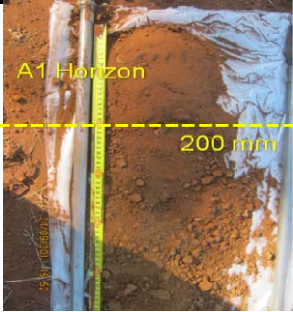
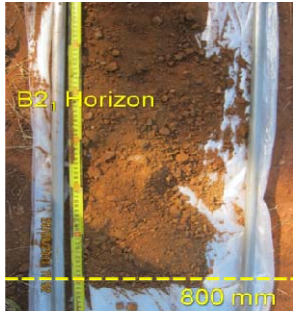
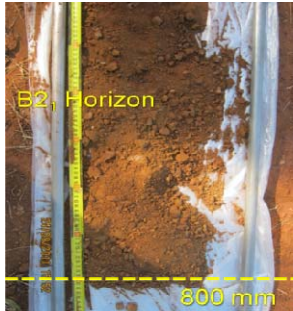
Project: Wards Well		Date: 24/9/2011		Location: 36		Observation Type: A		Coordinates: 0597230, 7606211				
Job Number QE9811												
Natural Vegetation: Cleared Buffel Grass, Popular box on edge of site						Land Use: Grazing						
												
Topography: Near top ridge line ($\leq 1\%$)		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Restricted				
Remarks:				ASC Mapped: Vertosol				ASC Ground Truth: Brown Dermosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SCL	Nil	7.5YR 3/2	Nil		Hard-setting	Firm, Highly Pedal, Coherent	4	Not recorded	Diffuse, Even	A1	0-100 mm
100-400	LC / MC	Nil	7.5Yr 3/2	Carbonate nodules, Ironstone		-	Firm, Highly Pedal, Coherent	4	Not recorded	Gradual, Even	B2 ₁	200-300 mm
400-1000+	MC	Nil	7.5YR 4/3	Carbonate nodules		-	Firm, Highly Pedal, Coherent	3	Not recorded	Base of horizon not encountered	B2 ₂	700-800 mm

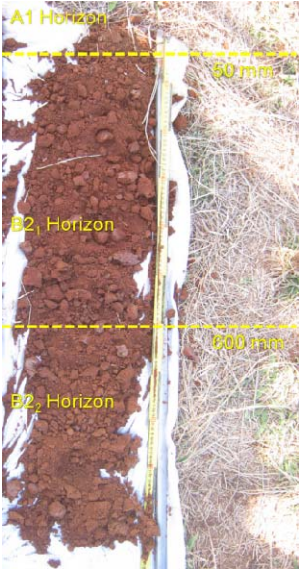
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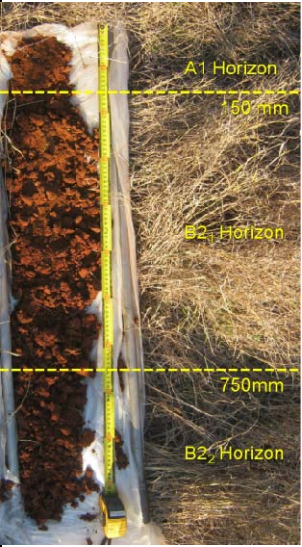
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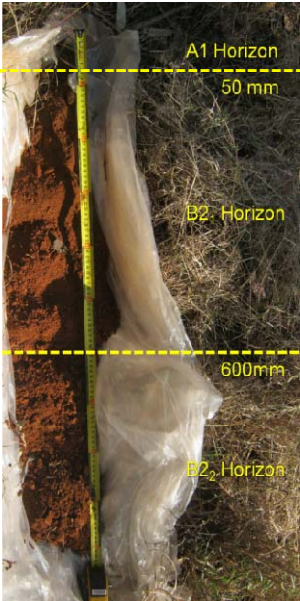
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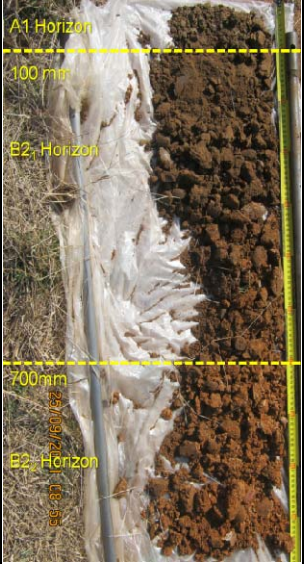
Project: Wards Well		Date: 41		Location: 41 Observation Type: A				Coordinates: 596794, 7609884					
Job Number QE9811													
Natural Vegetation: Ironbar, Buffel Grass 								Land Use: 					
Topography: 1-2%, Midslope		Surface Rock % (> 60mm dia): ≤ 1%		Erosion: ≤ 5%				Drainage: Not recorded					
Remarks:				ASC Mapped: Kandosol				ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-200	SL	≤ 5%	2.5YR 4/4	Small Gravel (1-2 mm), ≤ 5%		Sandy	Very Weak, Apedal	1	Well drained	Diffuse, Even	A1	No sample	
200-800	SL	≤ 5%	2.5YR 4/6	Medium Gravel (1-2 mm), ≤ 5%		-	Weak, Weakly Pedal, Coherent	2	Well drained	Sharp, Even	B2 ₁	No sample	
800+	LC	≤ 50% Horizon contain Samprolite (country rock) and is considered to be a transition layer	5YR 5/6	Medium - Large Gravel (1-2 mm), ≤ 50%		-	Very Strong, Strongly Pedal, Coherent	6	Well drained	-	B3	No sample	

Project: Wards Well		Date: 24/9/2011		Location: 42 Observation Type: A				Coordinates: 0897721, 7608886				
Job Number QE9811												
Natural Vegetation: Cleared, Buffel Grass, Regrowth, Bohenia								Land Use: Grazing				
												
Topography: Flat		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Restricted				
Remarks:				ASC Mapped: Kandosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	SCL	Nil	5YR 3/4	Nil		Firm, hardset sand	Weak, Weakly Pedal, Coherent	2	Not recorded	Diffuse, Even	A1	No sample
50-600	LC	Nil	2.5YR 3/4	Ironstone		Weak / Firm, Stronger then Weakly Pedal, Coherent	2	Not recorded	Diffuse, Even	B2 ₁	No sample	
600+	MC	Nil	4YR 3/4	Black mottles		Weak / Firm, Stronger then Weakly Pedal, Coherent	2	Not recorded	Base of horizon not encountered	B2 ₂	No sample	

Project: Wards Well		Date: 24/9/2011		Location: 43 Observation Type: A			Coordinates: 599031, 7608521					
Job Number QE9811												
Natural Vegetation: Ironbark, Spear Grass							Land Use: Grazing					
Topography: ≤1%			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: No recorded				
Remarks:					ASC Mapped: Kandosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	SL	Nil	2.5YR 3/3	Nil		Firm sand	Very Weak, Weakly Pedal, Coherent	1	Well drained	Gradual, Even	A1	No sample
150-750	SCL	Nil	5YR 3/4	Nil		-	Weak, Stronger than Weakly Pedal, Coherent	2	Imperfect	Diffuse, Even	B2 ₁	No sample
750+	MC	Nil	2.5YR 3/4	Yellow mottles		-	Weak / Firm, Highly Pedal, Coherent	2 / 3	Poor drainage	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 25/9/2011		Location: 44 Observation Type: A			Coordinates: 0602107, 7615125					
Job Number QE9811												
Natural Vegetation: Spear Grass, Bottle tree, Bohenia, Ironbark, Brigalow							Land Use: Grazing					
												
Topography: Flat, ≤ 1%, top of ridge			Surface Rock % (> 60mm dia): ≤ 10%		Erosion: Nil			Drainage: Poorly drained				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SL	20-30%	10YR 3/6	Nil	 A1 Horizon 100mm B2 Horizon 200mm B22 Horizon 25/09/2011 07:53	Gravely, hard-setting	Loose / Very Weak, Apedal	0 / 1	Not recorded	Clear, Even	A1	0-100 mm
100-200	SL	30%	10YR 4/4	Nil		-	Very Weak, Weakly Pedal	1	Not recorded	Clear, Even	B2 ₁	100-200 mm
200-800	SCL	80%	10YR 4/6	Yellow mottles		-	Weak, Highly Pedal, Coherent	1 / 2	Not recorded	Base of Horizon not encountered	B2 ₂	500-600 mm

Project: Wards Well		Date: 25/9/2011		Location: 45		Observation Type: A		Coordinates: 601862, 7614637				
Job Number QE9811												
Natural Vegetation: Brigalow, Ironbark, Prickly Pear, Spear Grass, Acacia						Land Use: Grazing						
												
Topography: ≤ 5%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Not recorded				
Remarks:				ASC Mapped: Vertosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	SCL	≤ 5%	7.5YR 3/3	Nil		Sandy, Firm, Small gravel (2 - 5 mm) ≤ 5%	Very Weak, Apedal	1	Not recorded	Gradual, Even	A1	No sample
50-600	LC	≤ 2% Ironstone	7.5YR 3/4	Ironstone		-	Weak, Weakly Pedal, Coherent	2	Not recorded	Gradual, Even	B2 ₁	No sample
600-1000+	LC	≤ 5% Gravel	2.5YR 3/4	Gravel		-	Weak, Stronger than Weakly Pedal, Coherent	2	Not recorded	Base of horizon not encountered	B2 ₂	No sample

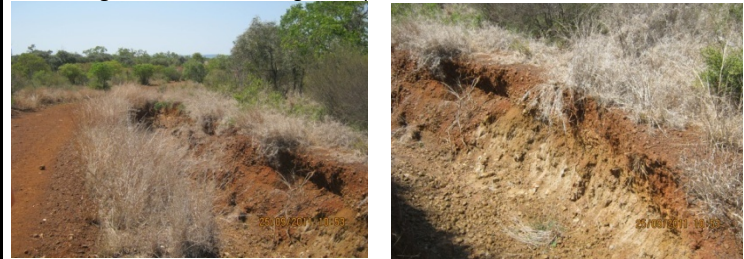
Project: Wards Well		Date: 25/9/2011		Location: 46 Observation Type: A			Coordinates: 0601972, 7613518					
Job Number QE9811												
Natural Vegetation: Brigalow, Spear Grass, some Ironbark							Land Use: Grazing					
												
Topography: Flat (old aluvial flood plain)			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor				
Remarks:					ASC Mapped: Kandosol			ASC Ground Truth: Sodosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	LC	≤ 10%	10YR 3/2	Nil		hard-setting	Firm, Hghly Pedal, Coherent	3	Not recorded	Diffuse, Even	A1	No sample
100-700	MC	≤ 5% Ironstone	10YR 2/2	Ironstone		-	Very Firm, Highly Pedal, Coherent	4	Not recorded	Gradual, Even	B2 ₁	No sample
700-1000+	MC	Nil	7.5YR 6/8	Orange / red / white mottles, Carbonate nodules		-	Very Firm, Highly Pedal, Coherent	4	Not recorded	Base of horizon not encountered	B2 ₂	No sample

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Project: Wards Well	Date: 25/09/11	Location: 49	Observation Type: E	Coordinates: 0601753, 7610328
Job Number QE9811				

Natural Vegetation: Ironbark, brigalow, spear, bohenia

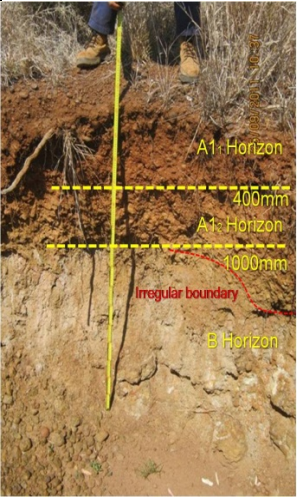


Land Use: Grazing



Topography: 1% near top	Surface Rock % (> 60mm dia): 50%	Erosion: Extensive (≤ 50% of sample area)	Drainage: Poor
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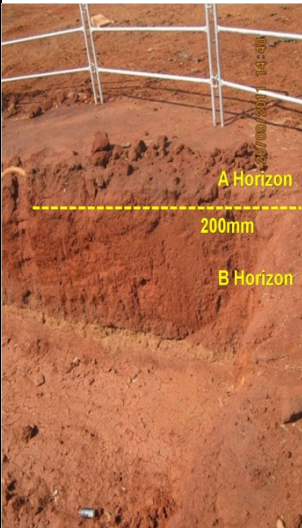
Remarks: Taken in erosion channel of gravel ridge	ASC Mapped: Kandosol	ASC Ground Truth: Sodosol
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Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-400	LC	80%	2.5YR 3/4	Nil		Hard gravel	Weak, Weakly Pedal, Coherent	2	Good	Clear, Even	A1 ₁	No sample
400-1000	LC	80%	7.5YR 4/6	Nil		-	Weak, Weakly Pedal, Coherent	2	Good	Clear, Irregular	A1 ₂	No sample
>1000	MC / HC	Nil	10YR 5/3	Grey / orange mottles		-	Weak, Weakly Pedal, Coherent	2	Poor	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 25/9/2011		Location: 50 Observation Type: A			Coordinates: 601263, 7610410					
Job Number QE9811												
Natural Vegetation: Buffell grass, ironbark, poplar box							Land Use:					
												
Topography: 1-2% mid slope			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded				
Remarks: Similar to 27 & 24					ASC Mapped: Kandosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SiC	1-5%	7.5YR 3/4	Nil		sandy-hard	Loose, Apedal	0	Not recorded	Gradual, Even	A ₁	No sample
100-600	LC	Nil	7.5YR 3/4	Nil		-	Loose, Apedal	0	Not recorded	Gradual, Even	B ₂ ₁	No sample
600-1000+	MC	Nil	7.5YR 4/4	Ironstone		-	Weak, weakly pedal	2	Not recorded	Base of horizon not encountered	B ₂ ₂	No sample

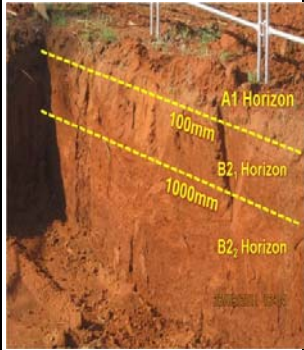
Project: Wards Well		Date: 25/9/2011		Location: 51 Observation Type: A				Coordinates: 0600568, 7610562				
Job Number QE9811												
Natural Vegetation: Buffell grass, ironbark						Land Use:						
												
Topography: Flat		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Good				
Remarks: Similar to 38, 39, 48				ASC Mapped: Kandosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-200	SiC	Nil	7.5 YR 25/2	Nil		Hard packed	Very weak, Weakly pedal	1	Not recorded	Clear, Sharp	A1	No sample
>200	LC	Nil	5YR 3/3	Ironstone		-	Very weak, Weakly pedal	1	Not recorded	Base of horizon not encountered	B ₂ ₁	No sample

Project: Wards Well		Date: 25/9/2011		Location: 52 Observation Type: A				Coordinates: 600207, 7612608				
Job Number QE9811												
Natural Vegetation: Ironbark, Moreton bay Ash								Land Use:				
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Good				
Remarks: Tree roots up to 400mm				ASC Mapped: Kandosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	SiC	Nil	7.5 YR 3/3	Nil		Hard packed	Very weak, Weakly pedal, Coherent	1	Not recorded	Gradual	A1	No sample
150-550	LC	Nil	10YR 3/3	Orange mottles			Very weak, Weakly pedal, Coherent	1	Not recorded	Sharp	B2 ₁	No sample
550- >1000	LC	≤ 50% 0-15 mm	10YR 3/6	Ironstone			Weak, Weakly pedal	1	Not recorded	Base of horizon not encountered	B2 ₂	No sample

Project: Wards Well		Date: 26/9/2011		Location: 53 Observation Type: P			Coordinates: 596761, 7613627					
Job Number QE9811												
Natural Vegetation: Ironbark, Eucalyptus, Morton Bay Ash							Land Use:					
												
Topography: <1% flat		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded					
Remarks: Drill pad				ASC Mapped: Vertosol			ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-200	SCL	0-1%	2.5YR 3/4	Ironstone		Hard packed	Very weak, Weakly pedal, Coherent	1	Good	Diffuse	A1 _p	No sample
200 - >1000	LC/MC	Nil	2.5YR 2.5/4	Ironstone		Coherent / Massive	Weak, Weakly pedal, Coherent	2	Good	Diffuse	B2 ₁	No sample

Project: Wards Well		Date: 26/9/2011		Location: 54 Observation Type: A			Coordinates: 596761, 7613627					
Job Number QE9811												
Natural Vegetation: Ironbark, Bohenia, Buffell, Morton Bay Ash							Land Use: Grazing					
												
Topography: <1% near top of rise			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Good				
Remarks: Brown surface					ASC Mapped: Kandosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-450	MC	Nil	10YR 2/2	Nil		Hard packed	Weak, Non-pedal	2	Not Recorded	Gradual	A1	No sample
450-1000+	SCL	10-20%	7.5YR 3/3	Ironstone		-	Very weak, weakly pedal	1	Not Recorded	Base of horizon not encountered	B2 ₁	No sample

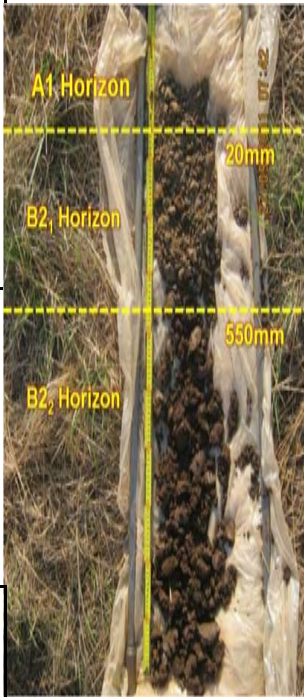
Project: Wards Well		Date: 26/9/2011		Location: 55 Observation Type: A			Coordinates: 597258, 7611552					
Job Number QE9811												
Natural Vegetation: Ironbark, Speargrass, Morton Bay Ash							Land Use: Grazing					
												
Topography: <1% flat		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded					
Remarks:				ASC Mapped: Kandosol			ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	SL	Nil	7.5YR 3/4	Nil		Sandy Firm	Very weak, Apedal, Coherent	1	Good	Gradual	A1	No sample
150 - >1000	SCL	Nil	7.5YR 3/4	Black / orange mottles at 950mm		-	Weak, Weakly pedal, Coherent	1 / 2	Not Recorded	Base of horizon not encountered	B ₂ ₁	No sample

Project: Wards Well		Date: 26/9/2011		Location: 56 Observation Type: P			Coordinates: 0597741, 7611566					
Job Number QE9811												
Natural Vegetation: Ironbark, Speargrass, Morton Bay Ash							Land Use: Grazing					
												
Topography: Flat possible tabletop			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor				
Remarks: Located on drill pad					ASC Mapped: Kandosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SCL	Nil	5YR 3/3	Nil		Hard packed	Very weak, Apedal, Coherent	1	Poor	Gradual	A1 _p	No sample
100 - >1000	LC	Nil	2.5YR 3/4	Some Ironstone		-	Very weak, Highly pedal	1	Poor	Base of horizon not encountered	B2 ₁	No sample
>1000	LC	20%									B2 ₂	No sample

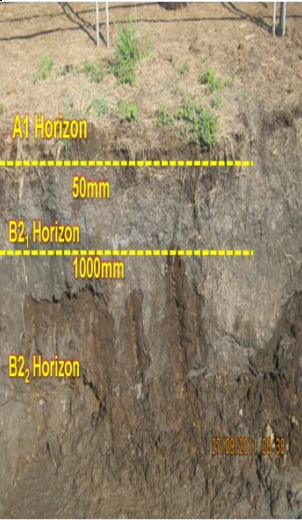
Project: Wards Well		Date: 26/9/2011		Location: 57 Observation Type: A			Coordinates: 0598090, 7610680					
Job Number QE9811												
Natural Vegetation: Buffel Grass, Ironbark							Land Use: Grazing					
												
Topography: <1%			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Good				
Remarks:					ASC Mapped: Kandosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-300	LC	Nil	5YR 3/3	Nil		Hard packed	Very weak, Weakly pedal	1	Not recorded	Gradual	A1	No sample
300-1000	LC/MC	Nil	5YR 3/4	Ironstone		-	Very weak, Weakly pedal	1	Not recorded	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 26/9/2011		Location: 58 Observation Type: A			Coordinates: 597898, 7614327					
Job Number QE9811												
Natural Vegetation: Buffel Grass, Ironbark							Land Use: Creek, grazing					
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Heavily eroded (90% of land)				Drainage: Good				
Remarks: Location is in creekbank, dry and heavily eroded (at 180cm surface is brittle/rocky				ASC Mapped: Vertosol				ASC Ground Truth: Demosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-200	LC/MC	Nil	7.5YR 2.5/3	Nil		Non cracking	Very weak, Weakly pedal, Coherent	1	Not recorded	Gradual, Clear	A1 _p	No sample
200-700	MC	<5%	5YR 3/3	Ironstone		-	Very firm, Highly pedal, Coherent	4	Not recorded	Not recorded	B2 ₁	No sample
700 - >1000	MC	50% is 5-15mm	7.5YR 2.5/3	Ironstone			Very firm, Highly pedal. Transition layer from B to C. Profile predominately B	4	Not recorded	Base of horizon not encountered	B2 ₃	No sample

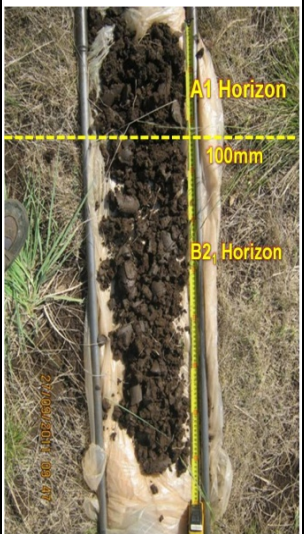
Project: Wards Well		Date: 26/9/2011			Location: 59 Observation Type: A			Coordinates: 599246, 7614274				
Job Number QE9811												
Natural Vegetation: Dense mature Brigalow, Buffel Grass								Land Use: grazing				
												
Topography: <1% flat		Surface Rock % (> 60mm dia): 5-10%			Erosion: Nil to slight			Drainage: Good				
Remarks: No livestock, some kangaroos					ASC Mapped: Vertosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SCL	1-5%	5YR 4/4	Nil		Not recorded	Very weak, Weakly pedal, Coherent	1	Good	Gradual	A1	No sample
100- >1000	LC	Nil	7.5YR 4/4	White mottles		-	Weak, Weakly pedal, Coherent	2	Poor	Gradual	B2 ₁	No sample

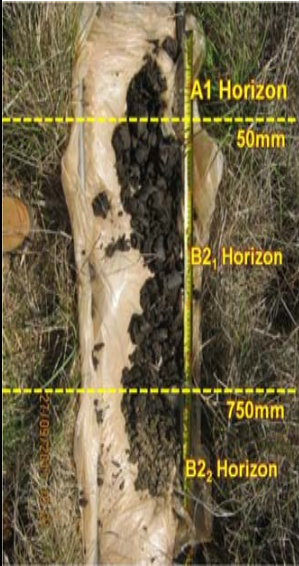
Project: Wards Well		Date: 27/9/2011			Location: 60			Observation Type: A			Coordinates: 0596050, 7615539		
Job Number QE9811													
Natural Vegetation: Cleared in places, Buffel Grass, Brigalow								Land Use: grazing					
													
Topography: <1% paleo channel			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor					
Remarks: Sample location is next to proposed drill pad					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-20	LC	Nil	7.5YR	Nil		Self Mulching	Very firm, Highly pedal	4	Not recorded	Sharp	A1	0-20 mm	
20-550	MC	Nil	7.5YR 3/4	Nil		-	Firm, Highly pedal	3	Poor	Sharp	B2 ₁	20-300 mm	
550-1000	SiC	40%	7.5YR 3/3	White/grey mottles and some yellow mottles		-	Very weak, Highly pedal	1	Good	Base of horizon not encountered	B2 ₂	700-800 mm	

Project: Wards Well		Date: 27/9/2011		Location: 61			Observation Type: A			Coordinates: 597565, 7616055		
Job Number QE9811												
Natural Vegetation: Bohemia, Brigalow, Buffel Grass							Land Use:					
												
Topography: < 1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Poor				
Remarks: Alluvial floodplain, wet clay at 20mm				ASC Mapped: Vertosol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	LC	Nil	7.5YR 4/4	Nil		Self Mulching	Firm, Highly pedal	1 / 2	Good	Gradual	A1	No sample
20- >1000	MC	1-2% 15mm	7.5YR 3/4	Orange / white mottles		-	Firm, Highly pedal	2	Poor	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 27/9/2011			Location: 62			Observation Type: A			Coordinates: 0598732, 7615564		
Job Number QE9811													
Natural Vegetation: Morton Bay Ash, Buffel Grass								Land Use: grazing					
													
Topography: <1%		Surface Rock % (> 60mm dia): Nil			Erosion: Nil			Drainage: Not recorded					
Remarks: Sample location is next to proposed drill pad					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-50	LC	Nil	7.5YR 4/4	Nil		Self Mulching	Very weak, Weakly pedal	1	Good	Not recorded	A1 _p	No sample	
50-1000	MC	≤ 5%	7.5YR 3/3	Black / orange mottling		-	Weak / firm, Weakly pedal	2 / 3	Poor	Sharp	B2 ₁	No sample	
>1000	SCL	≤ 40%	10YR 5/4	Yellow /orange mottles	-	Very weak / Weak, Weakly pedal	1 / 2	Not recorded	Base of horizon not encountered	B2 ₂	No sample		

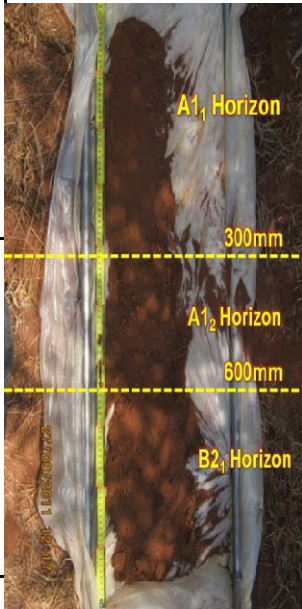
[illegible]

Project: Wards Well		Date: 27/9/2011		Location: 64			Observation Type: A			Coordinates: 0599669, 7616198			
Job Number QE9811													
Natural Vegetation: Buffel Grass, Morten Bay Grass							Land Use: Grazing						
													
Topography: On top of ridge		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor						
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Vertosol						
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-100	MC	Nil	10YR 3/4	Nil		Self Mulching	Very firm, highly pedal	4	Poor	Gradual, Even	A1	No sample	
100 - >1000	MC / HC	Nil	10YR 3/3	Orange/brown and white mottling		-	Very firm, highly pedal	4	Poor	Base of horizon not encountered	B2 ₁	No sample	

Project: Wards Well		Date: 27/9/2011		Location: 65		Observation Type: A		Coordinates: 599143, 7617345				
Job Number QE9811												
Natural Vegetation: Vegetation clearing leaving Buffel Grass						Land Use: Grazing						
												
Topography: 1-2% bottom of slope		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Poor				
Remarks: Stiff Clay, auger difficult to advance, tree roots to 500mm				ASC Mapped: Vertosol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	7.5 YR 3/2	Nil		Self Mulching	Firm, Highly pedal, Coherent	3	Poor	Gradual	A1	No sample
50-750	MC / HC	Nil	10YR 3/2	Fine Ironstone (≥ 2 mm)		-	Firm/Very firm, Highly pedal, Coherent	3 / 4	Poor	Gradual	B2 ₁	No sample
750- >1000	SiC	40 -50%	7.5YR 3/3	White/grey mottling at 750			Very Weak, Stronger then Weakly Pedal, Coherent	1		sharp	B2 ₂	

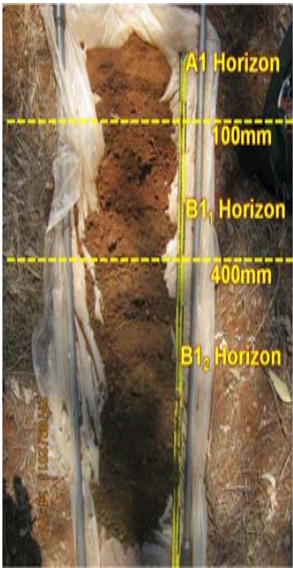
Project: Wards Well		Date: 27/9/2011		Location: 66			Observation Type: A			Coordinates: 0598053, 7617293		
Job Number QE9811												
Natural Vegetation: Brigalow, Bohemia, Acacia, Morton Bay Ash							Land Use: Grazing					
												
Topography: 1% near top		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	10 YR 3/2	Nil		Self Mulching, cracking	Very firm, highly pedal	4	Not recorded	Sharp	A1	No sample
50-950	MC	Nil	10YR 3/2	Fine Ironstone gravel (≥ 2 mm)		-	Very firm, highly pedal	4	Not recorded	Sharp	B2 ₁	No sample
950- >1000	SiC	50%	10YR 4/3	White/grey mottling		-	Very weak, weakly pedal	1	Not recorded	Base of horizon not encountered	B2 ₂	No sample

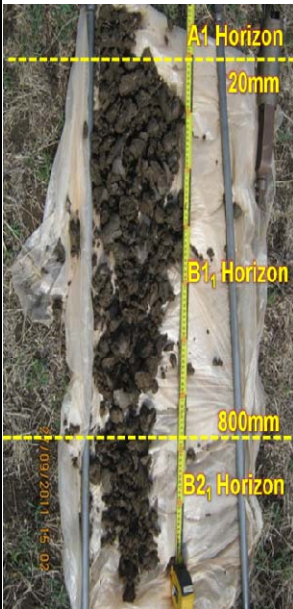
Project: Wards Well		Date: 27/9/2011		Location: 67			Observation Type: A			Coordinates: 0598053, 7617293		
Job Number QE9811												
Natural Vegetation: Cleared, vegetation Buffel grass, acacia							Land Use: Grazing					
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Poor				
Remarks: Large cracks in surface layer				ASC Mapped: Vertosol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	10YR 3/3	Nil		Self Mulching, cracking	Very firm, highly pedal, massive	4	Poor	Gradual	A1	No sample
50-1000	MC	Nil	10YR 3/3	Orange/black mottles		-	Very firm, highly pedal, massive	4	Poor	Base of horizon not encountered	B2 ₁	No sample

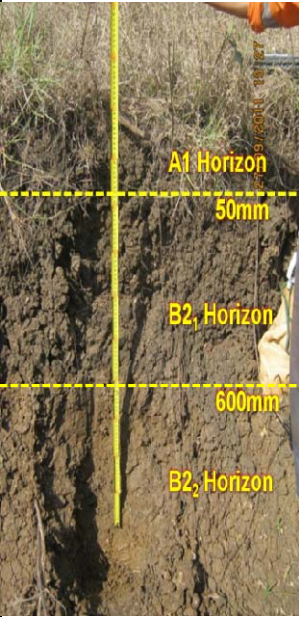
Project: Wards Well		Date: 27/9/2011			Location: 68			Observation Type: A			Coordinates: 0596388, 7617258		
Job Number: QE9811													
Natural Vegetation: Brigalow, Buffel Grass, 1 Poplar Box								Land Use: Grazing					
													
Topography: 1% mid slope			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Good					
Remarks: 600-1000 is hard digging					ASC Mapped: Vertosol			ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-300	SCL	Nil	2.5 YR 2.5/4	Nil		Hard packed	Firm, weakly pedal	3	Not recorded	Gradual	A ₁	No sample	
300-600	SCL	5%	2.5YR 3/4	Nil		-	Weak, weakly pedal	2	Not recorded	Dradual	A _{1.5}	No sample	
600-1000	SCL	Nil	2.5YR 2.5/4	Nil		-	Weak, weakly pedal	2	Not recorded	Base of horizon not encountered	B _{2.1}	No sample	

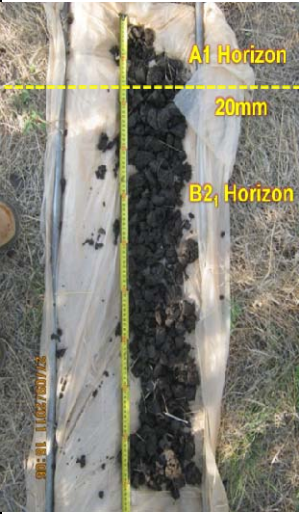
Project: Wards Well		Date: 27/9/2011		Location: 69			Observation Type: A			Coordinates: 0595767, 7617473			
Job Number QE9811													
Natural Vegetation: Poplar Box, Morton Bay Ash								Land Use: Grazing					
													
Topography: Top of Peak			Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Not recorded				
Remarks: 600-1000 is hard digging					ASC Mapped: Vertosol				ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-50	SCL	Nil	2.5 YR 3/3	Nil		Hard packed	Very weak/weak, weakly pedal, coherent	1 / 2	Good	Sharp	A1 ₁	0-50 mm	
50-650	MC	Nil	2.5YR 2.5/4	Ironstone and grey mottles		-	Firm, highly pedal, massive	3	Poor	Sharp	A1 ₂	200-300 mm	
650-100	SCL	Nil	2.5YR 3/6	Nil		-	Very weak/weak, weakly pedal, coherent	1	Not recorded	Base of horizon not encountered	B1 ₁	800-900 mm	

Project: Wards Well		Date: 27/9/2011		Location: 70 Observation Type: A			Coordinates: 0595691, 7618036					
Job Number QE9811												
Natural Vegetation: Some spear Acacia							Land Use: None					
												
Topography: Top of rocky ridge			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Nil				
Remarks: Bore terminated at 100mm due to refusal on hard clay					ASC Mapped: Vertosol			ASC Ground Truth: Kandosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SCL	Nil	2.5 YR 2.5/4	Black and yellow mottles		Rocky outcrops	Very firm	4	Poor	Sharp	A1 ₁	No sample

Project: Wards Well		Date: 27/9/2011			Location: 71 Observation Type: A			Coordinates: 0596210, 7618561				
Job Number QE9811												
Natural Vegetation: Buffel Grass, Brigalow, Poplar Box, Eucalypt							Land Use: Grazing					
												
Topography: Flat		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Good					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	LC	Nil	2.5 YR 3/3	Nil		Self mulching	Weak, Apedal	2	Not recorded	Gradual	A1 ₁	No sample
100-400	SC	5%	5YR 3/3	Ironstone		-	Very weak, weakly pedal	1	Not recorded	Sharp	B1 ₁	No sample
400-1000	SCL	50%	7.5YR 2.5/2	Many ironstone gravels		-	Very weak, weakly pedal	1	Not recorded	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 27/9/2011		Location: 72 Observation Type: A		Coordinates: 0597226, 7618527						
Job Number: QE9811												
Natural Vegetation: Cleared vegetation with some Bohemia, Brigalow						Land Use: Grazing						
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil		Drainage: Not recorded						
Remarks: Hard digging				ASC Mapped: Vertosol		ASC Ground Truth: Vertosol						
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	LC	Nil	10 YR 3/3	Nil		Hard cracking clay, self mulching	Weak, weakly pedal	2	Good	Gradual	A1 ₁	No sample
20-800	MC / HC	1%	10YR 3/3	Black and white mottles (ironstone)		-	Very firm, strongly pedal	4	Poor	Gradual	B2 ₁	No sample
800- >1000	MC / HC	Nil	10YR 3/6	Yellow/orange mottles and ironstone		-	Very firm, strongly pedal	4	Poor	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 27/9/2011		Location: 73				Observation Type: A				Coordinates: 0598601, 7618470			
Job Number QE9811															
Natural Vegetation: Spear grass, Blue Gum								Land Use: Grazing							
															
Topography: Creek bed				Surface Rock % (> 60mm dia): Nil		Erosion: 20%				Drainage: Not recorded					
Remarks: Creek bank				ASC Mapped: Vertosol				ASC Ground Truth: Vertosol							
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample			
0-50	LC	Nil	10YR 3/1	Nil		Self mulching	Loose	0	Not recorded	Gradual	A1 _{1p}	No sample			
50-600	LC / MC	5%	10YR 3/2	White mottles between 150-200mm			Very Firm, Strongly Pedal, Coherent	4	Not recorded	Abrupt	B2 ₁	No sample			
600- >1000	LC / MC	5%	10YR 4/3	Ironstone			Weak, weakly pedal, massive	2	Poor	Base of horizon not encountered	B2 ₂	No sample			

Project: Wards Well		Date: 27/9/2011		Location: 74 Observation Type: A			Coordinates: 0600207, 7619004					
Job Number QE9811												
Natural Vegetation: Bufffel (cleared) , Bohemia, Brigalow							Land Use: Grazing					
												
Topography: 1% near bottom of slope			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Near creek bottom of slope				
Remarks: Hard digging					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	LC	Nil	10YR 3/3	Nil		Self mulching, hard cracking clays	Weak, Weakly pedal, Massive	2	Good	Gradual	A ₁	No sample
20-1000	MC	1%	10YR 3/3	Black and white mottles			Very firm, strongly pedal, Massive	4	Poor	Abrupt	B ₂ ₁	No sample

Project: Wards Well		Date: 27/9/2011			Location: 75			Observation Type: A			Coordinates: 0599700, 7619872		
Job Number QE9811													
Natural Vegetation: Morton Bay Ash, Poplar Box, Brigalow								Land Use: Grazing					
													
Topography: 1% top of ridge (tabletop)		Surface Rock % (> 60mm dia): Nil			Erosion: Nil			Drainage:					
Remarks: Hard digging					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-50	LC	Nil	10YR 4/1	Nil		Self mulching, hard cracking clay	Weak / firm, highly pedal, massive	2-3	Poor	Gradual	A ₁	0-50 mm	
50-750	MC	Nil	10YR 4/1	white mottles				Very firm, highly pedal, massive	4	Poor	Sharp	B ₂	400-500 mm
750 - >1000	LC/MC	Nil	Not recorded	white/grey mottles				Fine, sub-angular, r3	No recorded	Base of horizon not encountered	B ₂	900-1000 mm	

[illegible]

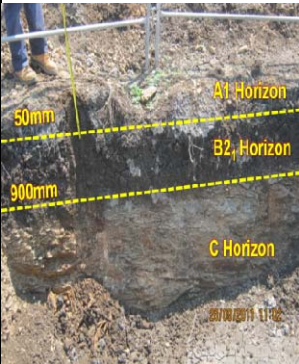
Project: Wards Well		Date: 28/9/2011		Location: 77			Observation Type: A		Coordinates: 0595518, 7624627				
Job Number QE9811													
Natural Vegetation: Buffel Grass, Briglow							Land Use: Grazing						
													
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Good					
Remarks:				ASC Mapped: Kandasol				ASC Ground Truth: Kandasol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-250	SL	10%	5YR 3/4	Nil		Sandy, firm, non-cracking	Very weak, weakly pedal, massive	1	Good	Sharp	A ₁	No sample	
250- >1000	SCL	Nil	5YR 3/4	White/black mottles, yellow mottles at 300mm		-	Very weak, weakly pedal, massive	1	Good	Gradual	B ₂	No sample	

Project: Wards Well		Date: 28/9/2011		Location: 78			Observation Type: A			Coordinates: 0595448, 7625536			
Job Number: QE9811													
Natural Vegetation: Ironbark, Buffel Grass							Land Use: Grazing						
													
Topography: Top of ridge		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Good						
Remarks: Coarse fraction is black/red when broken				ASC Mapped: Kandasol			ASC Ground Truth: Kandasol						
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-100	SCL	20%	7.5YR 3/3	Nil		Self mulching	Very weak, weakly pedal	1	Not recorded	Gradual	A ₁	No sample	
100-800	SCL	50%	7.5YR 4/4	Nil		-	Very weak, weakly pedal	1	Good	Gradual	B ₂ ₁	No sample	
800 - >1000	SCL	60%	10YR 4/6	Nil		-	Very weak, weakly pedal	1	Not recorded	Base of horizon not encountered	B ₂ ₂	No sample	

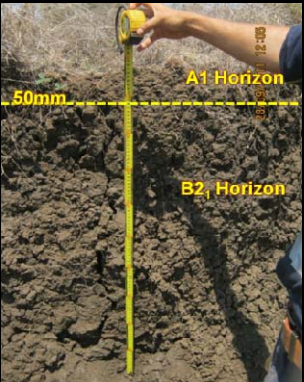
Project: Wards Well		Date: 28/9/2011		Location: 79 Observation Type: A			Coordinates: 0596176, 7625794					
Job Number QE9811												
Natural Vegetation: Ironbark							Land Use: Grazing					
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded					
Remarks: Coarse fraction is black/red when broken				ASC Mapped: Kandosol			ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	SL	Nil	5YR 3/3	Nil		Hard packed sandy	Very weak, non-pedal	1	Good	Gradual	A1 ₁	No sample
150-950	SCL	Nil	2.5YR 4/4	Nil		-	Very weak, weakly pedal, massive	1	Good	Sharp	B2 ₁	No sample
950- >1000	SCL	Nil	5YR 4/4	Ironstone		-	Very weak, weakly pedal, massive	1	Poor	Base of horizon not encountered	B2 ₂	No sample

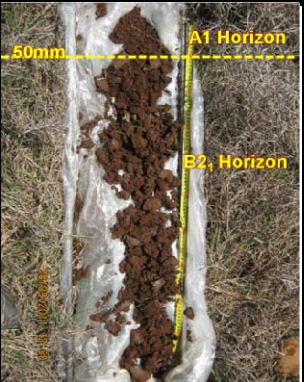
Project: Wards Well		Date: 28/9/2011		Location: 80 Observation Type: P				Coordinates: 0597227, 7626006				
Job Number QE9811												
Natural Vegetation: Buffel grass, Ironbark								Land Use: Grazing				
												
Topography: Top of ridge		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Not recorded				
Remarks:				ASC Mapped: Kandasol				ASC Ground Truth: Sodosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-100	SL	Nil	10YR 3/3	Nil		Hard packed fine gravel	Very weak, non pedal, massive	2	Good	Gradual	A1 _{1p}	No sample
100-750	SCL	Nil	10YR 4/6	Ironstone		-	Weak, weakly pedal, massive	2	Poor	Sharp, Irregular	B2 ₁	No sample
750 - >1000	MC/HC	Nil	10YR 5/4	Grey mottles		-	Very firm, weakly pedal, massive	4	Poor	Base of horizon not encountered	B2 ₂	No sample

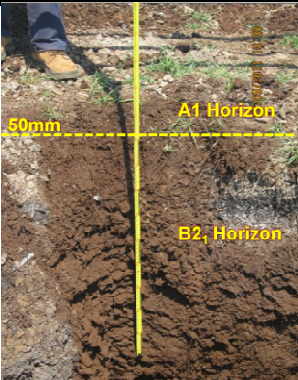
Project: Wards Well		Date: 28/9/2011		Location: 81 Observation Type: P			Coordinates: 0597444, 7625089					
Job Number QE9811												
Natural Vegetation: Buffel grass, Brigalow, Poplar Box							Land Use: Grazing					
												
Topography: Flat former alluvial floodplain			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Poor				
Remarks:					ASC Mapped: Kandasol			ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	10YR 3/3	Nil		Hard cracking	Firm, Weakly pedal, Massive	3	Good	Gradual	A1 ₁	No sample
50-700	MC	Nil	10YR 3/2	Ironstone		-	Firm, Weakly pedal, Massive	3	Poor	Sharp	B2 ₁	No sample
700- >1000	SL	Nil	10YR 4/3	White, grey, orange mottles		-	Very weak, Apedal	1	Good	Base of horizon not encountered	B2 ₂	No sample

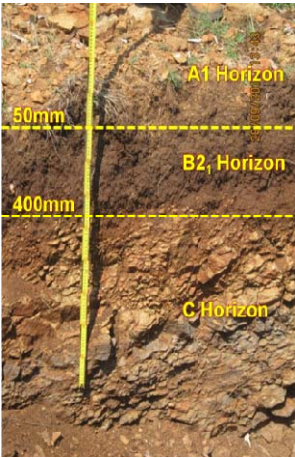
Project: Wards Well		Date: 28/9/2011		Location: 82			Observation Type: P			Coordinates: 0596439, 7624851		
Job Number: QE9811												
Natural Vegetation: Cleared vegetation, some Morton Bay Ash, Brigalow and Poplar Box								Land Use: Grazing				
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Poor				
Remarks:				ASC Mapped: Kandasol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC/MC	Nil	10YR 2/2	Nil		Self mulching	Weak	2	Good	Gradual	A1 _{1p}	No sample
50-900	MC	Nil	10YR 3/3	Ironstone		-	Weak	2	Poor	Sharp	B2 ₁	No sample
900-1000	SC	Massive	10YR 4/3	White, grey, orange mottles		-	Massive, Rock	1	Poor	Base of horizon not encountered	C	No sample

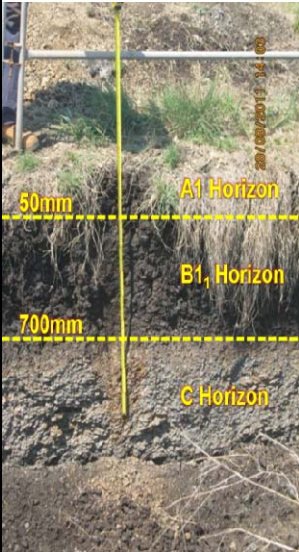
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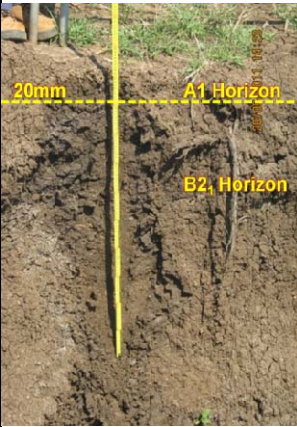
Project: Wards Well		Date: 28/9/2011		Location: 84 Observation Type: E			Coordinates:					
Job Number QE9811												
Natural Vegetation: Cleared vegetation, some Morton Bay Ash, Brigalow and Poplar Box							Land Use: Grazing					
												
Topography: Low lying creek bed			Surface Rock % (> 60mm dia): Nil		Erosion: 20%			Drainage: Not recorded				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	SC	10%	10YR 3/2	Nil		Self mulching	Weak, highly pedal, massive	2	Good	Sharp	A1 _{1p}	No sample
50 - >1000	MC	Nil	10YR 3/3	Ironstone		-	Very firm, highly pedal, massive	4	Poor	Base of horizon not encountered	B2 ₁	No sample

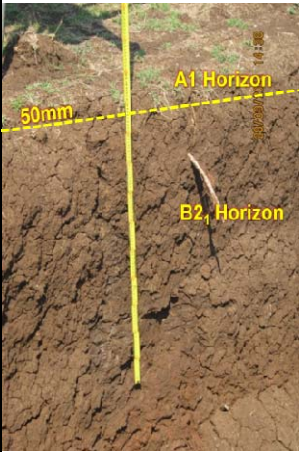
Project: Wards Well		Date: 28/9/2011		Location: 85		Observation Type: A		Coordinates: 0597468, 7623012				
Job Number: QE9811												
Natural Vegetation: Cleared. Buffel Grass, ironbark, Bohemia, Poplar Box								Land Use: Grazing				
												
Topography: 1% new top of range		Surface Rock % (> 60mm dia): Nil		Erosion: 20%			Drainage: Good					
Remarks:				ASC Mapped: Vertosol			ASC Ground Truth: Brown Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC	Nil	5YR 3/4	Nil		Self mulching	Firm, weakly pedal	3	Not recorded	Gradual	A1 ₁	No sample
50 - >1000	MC	Nil	5YR 3/4	Ironstone		-	Weak, highly pedal	2	Not recorded	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 28/9/2011		Location: 86 Observation Type: P			Coordinates: 0595998, 7622629					
Job Number QE9811												
Natural Vegetation: Cleared Poplar Box							Land Use: Grazing					
												
Topography: 1-2%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Not recorded				
Remarks:				ASC Mapped: Vertosol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC	Nil	7.5YR 3/3	Nil		Hard cracking clay	Weak, strongly pedal	2	Not recorded	Gradual	A1 _{1p}	No sample
50 - >1000	MC	5-10%	7.5YR 3/4	Ironstone and orange/brown mottles		-	Very firm, highly pedal	4	Not recorded		B2 ₁	No sample

Project: Wards Well		Date: 28/9/2011		Location: 87			Observation Type: P			Coordinates: 0595048, 7622481			
Job Number QE9811													
Natural Vegetation: Brigalow, Poplar Box (dead)							Land Use: Grazing						
													
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded						
Remarks: Dead trees				ASC Mapped: Vertosol			ASC Ground Truth: Dermosol						
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-20	SC	1%	7.5YR 2.5/3	White mottles		Non-cracking clay	Very firm, massive	4	Good	Sharp	A _{1p}	No sample	
20-400	LC/MC	0%	7.5YR 3/3	Ironstone		-	Weak/firm	2-3	Poor	Sharp	B ₂₁	No sample	
400 - >1000	Rock	100%		Massive Rock		-	Massive	4	Poor	Base of horizon not encountered	C	No sample	

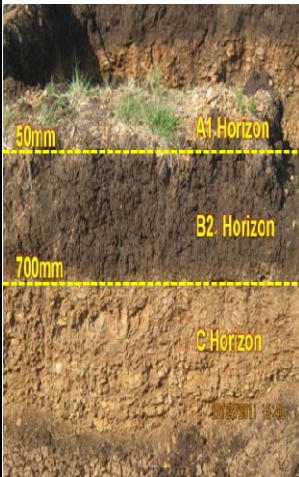
Project: Wards Well		Date: 28/9/2011		Location: 88 Observation Type: P		Coordinates: 0595737, 7623676						
Job Number QE9811												
Natural Vegetation: Cleared						Land Use: Grazing						
												
Topography:		Surface Rock % (> 60mm dia): Nil		Erosion: Nil		Drainage: Not recorded						
Remarks:				ASC Mapped: Vertosol		ASC Ground Truth: Dermosol						
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	HC	1%	10YR 4/2	Nil		Very hard cracking clay	Very firm, highly pedal, massive	4	Good	Sharp	A1 _{1p}	No sample
50-700	MC	0%	10YR 3/2	White mottles			firm, highly pedal, massive	3	Poor	Sharp	B2 ₁	No sample
700 - >1000	Hard rock layer	100%	Not recorded	Yellow/grey			Massive	4	Poor	Base of horizon not encountered	C	No sample

Project: Wards Well		Date: 28/9/2011		Location: 89 Observation Type: P			Coordinates: 0595582, 7620461					
Job Number QE9811												
Natural Vegetation: Eucalypts							Land Use: Grazing					
												
Topography: <1% high area between creeks		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded					
Remarks: Between creeks				ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	LC/MC	1%	10YR 3/3	Nil		Self mulching, roots	Firm/very firm, strongly pedal, massive	3-4	Good	Gradual	A1 _{1p}	No sample
20- >1000	LC/MC	Nil	10YR 4/3	Grey mottles with roots and Ironstone		-	Firm, strongly pedal, massive	3	Poor	Base of horizon not encountered	B2 ₁	No sample

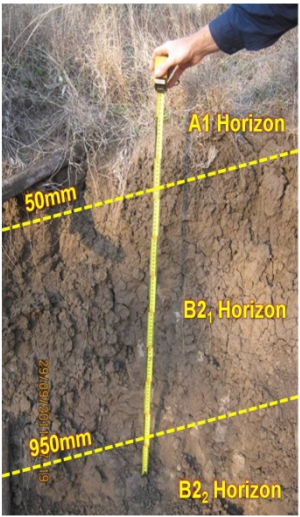
Project: Wards Well		Date: 28/9/2011		Location: 90		Observation Type: P		Coordinates: 0595253, 7621429				
Job Number QE9811												
Natural Vegetation: Ironbark, Poplar Box, Brigalow, Mountain Coolabah						Land Use: Grazing						
												
Topography: <1% high area between creeks		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Not recorded					
Remarks: Good grass cover				ASC Mapped: Vertosol			ASC Ground Truth: Dermosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	10YR 3/3	Nil		Cracking clay, sel-mulching	Firm / very firm, strongly pedal	3-4	Good	Gradual	A1 _{1p}	No sample
50-1050	LC	Nil	10YR 3/4	Red mottles and Ironstone		-	Firm, strongly pedal	3	Poor	Base of horizon not encountered	B2 ₁	No sample

Project: Wards Well		Date: 28/9/2011		Location: 91			Observation Type: P			Coordinates: 0597501, 7620905			
Job Number: QE9811													
Natural Vegetation: Poplar Box, brigalow, Eucalypts, Acacias							Land Use: Grazing						
													
Topography: Creek bed			Surface Rock % (> 60mm dia): Nil		Erosion: 20-30%			Drainage: Not recorded					
Remarks: Dry creekbed					ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-50	LC	Nil	10YR 4/2	Nil		Hard cracking clay	Firm, strongly pedal, massive	3	Well	Sharp	A _{1p}	No sample	
50-900	LC/MC	Nil	10YR 4/2	Carbonate, Ironstone, brown maroon gravel				Weak, strongly pedal, massive	2	Poor	Sharp	B ₂ ₁	No sample
900 - >1000	MC	Nil	10YR 4/3	Grey gravel, carbonate				Very weak/weak, strongly pedal, massive	1-2		Base of horizon not encountered	B ₂ ₁	No sample

Project: Wards Well		Date: 28/9/2011		Location: 92 Observation Type: P			Coordinates: 0596076, 7621714					
Job Number QE9811												
Natural Vegetation: Sparse Eucalypts							Land Use: Grazing					
												
Topography: Creek bank			Surface Rock % (> 60mm dia): Nil		Erosion: 10-20%			Drainage:				
Remarks: Dry creekbed					ASC Mapped: Vertosol			ASC Ground Truth: Dermosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	MC	Nil	10YR 4/3	Ironstone		Self mulching	Very firm, strongly pedal, massive	4	Well	Sharp	A ₁	No sample
50-1000	MC	Nil	10YR 3/3	Carbonate		-	Weak/firm, strongly pedal, massive	2-3	Poor	Sharp	B ₂	No sample
1000-1050	White rocks	60/70%	10YR 4/3	Grey gravel, carbonate		-	Weak, Massive	3-4	Not recorded	Base of horizon not encountered	C	No sample

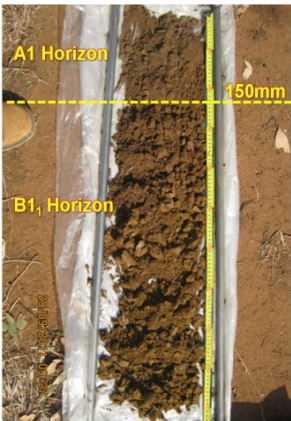
Project: Wards Well		Date: 28/9/2011		Location: 93			Observation Type:			Coordinates: 598022, 7622167		
Job Number QE9811												
Natural Vegetation: vegetaion cleared, some Poplar box							Land Use: Grazing					
												
Topography: 1-2%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage:					
Remarks: Dry creekbed				ASC Mapped: Vertosol			ASC Ground Truth: Vertosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC	Nil	10YR 3/4	Nil		Self mulching	Weak/firm, strongly pedal, massive	2 / 3	Well	Sharp	A1 _{1p}	No sample
50-700	MC	Nil	10YR 3/3	Orange gravel		-	Weak, strongly pedal, massive	2	Poor	Sharp	B2 ₁	No sample
700- >1000	Rocks	60/70%	10YR 4/3			-	Weak, Massive	3 / 4	None	Base of horizon not encountered	C	No sample

Project: Wards Well		Date: 28/9/2011		Location: 94			Observation Type: A			Coordinates: 0599580, 7622074			
Job Number QE9811													
Natural Vegetation: Morton Bay Ash							Land Use: Grazing						
													
Topography: 1-2%			Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage:				
Remarks: Long grass up to 1.2m					ASC Mapped: Vertosol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-50	LC	Nil	10YR 3/2	Nil		Self mulching	Weak, strongly pedal	2	Good	Sharp	A ₁	0-50 mm	
50-400	MC	Nil	10YR 3/1	Carbonate				Very firm, strongly pedal	4	Poor	Sharp	B ₂ ₁	200-300 mm
400->1000	SL	Nil	10YR 4/1	Carbonate at 400mm				Very weak, non pedal	1	Good	Base of horizon not encountered	B ₂ ₂	600-700 mm

Project: Wards Well		Date: 29/9/2011		Location: 95 Observation Type: E			Coordinates: 0598841, 7620747					
Job Number QE9811												
Natural Vegetation: Brigalow, Blue Gum, Buffel and Spear Grass, some Ironbark							Land Use: Grazing					
												
Topography: 1-2% in creek bed		Surface Rock % (> 60mm dia): Nil		Erosion: 20%				Drainage: Good				
Remarks: In creek bed				ASC Mapped: Vertosol				ASC Ground Truth: Vertosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-50	LC	Nil	10YR 3/2	Carbonate gravels		Self mulching crust	Very firm, strongly pedal	4	Not recorded	Sharp	A ₁	No sample
50-950	LC	Nil	10YR 3/3	Carbonate gravels		-	Very firm, strongly pedal	4	Not recorded	Gradual	B ₂ ₁	No sample
950- >1000	MC	Nil	10YR 4/2	Ironstone gravels		-	Firm, strongly pedal	3	Not recorded	Base of horizon not encountered	B ₂ ₂	No sample

Project: Wards Well		Date: 29/9/2011		Location: 96			Observation Type: E			Coordinates: 0596817, 7620084			
Job Number QE9811													
Natural Vegetation: Brigalow, Spear Grass							Land Use: Grazing						
													
Topography: 1% near top of ridge			Surface Rock % (> 60mm dia): 5%		Erosion: Nil			Drainage: Good					
Remarks: Located on rocky ridge, auger hit hard rock twice					ASC Mapped: Vertosol			ASC Ground Truth: Kandosol					
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample	
0-150	SL	50%	7.5YR 3/4	Black and yellow gravels		Hard packed gravel	Very weak, non pedal	1	Good	Sharp	A ₁	No sample	
150-250	SI	50%	5YR 4/4	Ironstone gravel			Very weak, non pedal	1	Good	Sharp	B ₂	No sample	
250+	Rock									Poor		B ₂	No sample

Project: Wards Well		Date: 29/9/2011		Location: 97 Observation Type: A			Coordinates: 0596317, 7619984					
Job Number QE9811												
Natural Vegetation: Poplar Box, Buffel Grass							Land Use: Grazing					
												
Topography: 1% near bottom of slope			Surface Rock % (> 60mm dia): Nil		Erosion: Nil			Drainage: Nil				
Remarks:					ASC Mapped: Vertosol			ASC Ground Truth: Dermosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-20	LC-MC	Nil	5YR 3/4	Nil		Firm cracking surface	Very firm, strongly pedal, massive	4	Good	Sharp	A ₁	No sample
20-350	MC	Nil	5YR 4/6	Ironstone & carbonate gravels		-	Weak/firm, strongly pedal	2-3	Poor	Sharp	B ₂ ₁	No sample
350-600	Sandy clay	70%	5YR 4/6	Carbonate		-	Very weak, weakly pedal	1	Good	Base of horizon not encountered	B ₂ ₂	No sample

Project: Wards Well		Date: 29/9/2011		Location: 98 Observation Type: A			Coordinates: 0599337, 7620288					
Job Number QE9811												
Natural Vegetation: Poplar Box							Land Use: Grazing					
												
Topography: <1%		Surface Rock % (> 60mm dia): Nil		Erosion: Nil				Drainage: Not recorded				
Remarks:				ASC Mapped: Vertosol				ASC Ground Truth: Dermosol				
Depth (mm)	Texture	Coarse Fraction	Munsell Colour	Inclusion	Photograph	Surface Soil Con.	Pedality	Consistence	Drainage	Boundaries	Horizons	Sample
0-150	SL	Nil	10YR 4/3	Nil		Sandy firm	Very weak, weakly pedal	1	Good	Sharp	A1 ₁	No sample
150- >1000	LC	Nil	7.5YR 5/6	Ironstone & orange gravels		-	Fine, strongly pedal, massive	3	Poor	Base of horizon not encountered	B2 ₁	No sample



Appendix B Tabulated Laboratory Results

QEO9811 400 Wards Well - Land Resources				WW6	WW6	WW6	WW9	WW9	WW9	WW10	WW10	WW13	WW13	WW13	WW13	WW15	WW15	WW15	WW22	WW23	WW23	WW23	WW28	WW28	WW28	WW36	WW36	WW36
Analyte	Units	Soil Sufficiency Criteria	LOR																									
				0-100	200-300	800-900	0-100	200-300	800-900	0-100	500-600	0-50	200-300	700-800	1000-1100	0-100	300-400	900-1000	0-100	0-100	300-400	900-1000	0-100	200-300	700-800	0-100	200-300	700-800
Vertosol							Vertosol			Dermosol		Dermosol				Vertosol			Vertosol	Kandosol			Dermosol			Dermosol		
Inorganics																												
pH Value	pH Unit	6-7.5	0.1	7.8	8.6	8.6	5.8	5.2	4.5	6.5	6.4	7.3	8	8.8	5.8	7.6	8.8	8.3	7.8	6.1	6.2	6.6	7.3	7.8	7.2	6.9	9	9.9
Electrical Conductivity @ 25°C	mS/cm	<0.8	1	0.107	0.137	0.659	0.031	0.134	0.631	0.008	0.009	0.055	0.09	0.672	0.007	0.058	0.278	0.989	0.062	0.142	0.045	0.026	0.15	0.049	0.025	0.028	0.199	0.345
Moisture Content (dried @ 103°C)	%		1	18.4	18.5	20.1	7.2	12.3	17.7	6.1	7.1	8.6	13.5	15.2	9.7	15.6	18.9	20.1	20.4	3.6	7.2	7.6	3.9	13.6	12.2	4.5	7.3	8.8
Sulfate as SO4 2-	mg/kg	8mg/kg	10	20	<10	120	10	40	<10	<10	<10	<10	<10	140	<10	10	70	530	<10	20	30	10	50	10	<10	<10	20	30
Chloride	mg/kg	800	10	<10	<10	1000	10	2350	1240	<10	<10	<10	<10	890	<10	30	200	1630	20	80	20	20	40	20	20	10	10	<10
Soil Classification based on Particle Size																												
Clay (<2 µm)	%	Ideal is Clay <40% and C. Sand <40%	1		68				69	21		46		60	23	74		82	80		33		37		47	36		32
Silt (2-60 µm)	%		1		12				23	6		29		19	7	17		12	13		9		15		11	6		8
Sand (0.06-2.00 mm)	%		1		12				8	73		21		13	70	9		6	7		55		46		41	57		60
Gravel (>2mm)	%		1		8				<1	<1		4		8	<1	<1		<1	<1		3		2		1	1		<1
Cobbles (>6cm)	%		1		<1				<1	<1		<1		<1	<1	<1		<1	<1		<1		<1		<1	<1		<1
Soluble Major Cations																												
Calcium	mg/kg		10	50	20	40	<10	<10	20	<10	<10	30	20	30	<10	10	<10	50	60	40	<10	<10	<10	<10	<10	<10	10	<10
Magnesium	mg/kg		10	20	<10	30	<10	<10	40	<10	<10	<10	<10	30	<10	<10	<10	40	<10	20	<10	<10	<10	<10	<10	<10	<10	<10
Sodium	mg/kg		10	20	170	760	20	120	600	<10	<10	10	70	760	<10	50	320	1160	<10	30	10	20	80	40	20	30	210	360
Potassium	mg/kg	500	10	40	<10	<10	<10	<10	<10	<10	<10	30	<10	<10	<10	<10	<10	<10	<10	60	20	<10	110	<10	<10	<10	<10	<10
Exchangeable Cations																												
Exchangeable Calcium	meq/100g		0.1	37.3	37.2	33.7	7.8	7.2	5.8	1.8	1.3	15.4	18	26.5	1	33.2	30.2	24.8	69.3	2.3	1.8	1.4	6.4	8.1	3.8	9.2	21.8	15
Exchangeable Calcium	meq. %	65-80%		65%	57%	47%	34%	31%	23%	75%	62%	69%	64%	55%	56%	61%	50%	40%	84%	59%	56%	44%	42%	40%	47%	53%	65%	43%
Exchangeable Magnesium	meq/100g		0.1	17.4	24.7	30.2	13.9	13.9	14.6	0.5	0.7	5.8	8.6	14.7	0.7	20	23.2	25.1	12.7	1	1	1.5	5.4	9.9	3.6	7.1	10	14.4
Exchangeable Magnesium	meq. %	10-15%		31%	38%	42%	60%	60%	58%	21%	33%	26%	31%	30%	39%	37%	38%	41%	15%	26%	31%	47%	36%	49%	44%	41%	30%	41%
Exchangeable Potassium	meq/100g		0.1	2.2	0.5	0.1	0.6	0.5	<0.1	0.1	<0.1	1.1	0.7	0.4	<0.1	0.5	0.1	0.2	0.8	0.5	0.3	0.1	2.4	<0.1	<0.1	0.3	<0.1	<0.1
Exchangeable Potassium	meq. %	1-5%		4%	1%	0.1%	3%	2%	<0.1	4%	<0.1	5%	2%	1%	<0.1	1%	0.2%	0.3%	1%	13%	9%	3%	16%	<0.1	<0.1	2%	<0.1	<0.1
Exchangeable Sodium	meq/100g		0.1	0.2	2.4	8.4	0.8	1.7	4.4	<0.1	<0.1	<0.1	0.8	7	<0.1	0.7	7	11.4	<0.1	0.2	<0.1	0.1	0.8	2.2	0.7	0.8	1.6	5.6
Exchangeable Sodium	meq. %	0-1%		0%	4%	12%	3%	7%	18%	<0.1	<0.1	<0.1	3%	14%	<0.1	1%	12%	19%	<0.1	5%	<0.1	3%	5%	11%	9%	5%	5%	16%
Cation Exchange Capacity	meq/100g	>5	0.1	57	64.8	72.4	23.1	23.2	25	2.4	2.1	22.4	28.1	48.6	1.8	54.5	60.6	61.5	82.8	3.9	3.2	3.2	15.1	20.3	8.1	17.4	33.6	35
ESP				0%	4%	12%	3%	7%	18%	0	0	0	3%	14%	0	1%	12%	19%	0	5%	0	3%	5%	11%	9%	5%	5%	16%
Alkalinity																												
Total Alkalinity as CaCO3	mg/kg		1	254	470	444	63	38	<1	51	38	203	368	558	51	178	432	140	216	51	25	51	152	254	127	102	558	1130
Bicarbonate Alkalinity as CaCO3	mg/kg		1	254	470	444	63	38	<1	51	38	203	368	507	51	178	381	140	216	51	25	51	152	254	127	102	456	419
Carbonate Alkalinity as CaCO3	mg/kg		1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	51	<1	<1	51	<1	<1	<1	<1	<1	<1	<1	<1	<1	102	711
Total Metals																												
Boron	mg/kg	>1-4	50	<50			<50			<50		<50				<50			<50	<50			<50			<50		
Cobalt	mg/kg		2	66			20			5		24				66			33	14		58			7			
Copper	mg/kg	0.4	5	38			16			<5		28				35			39	9		36			8			
Iron	mg/kg		50	69600			28800			12000		81500				57000			53800	37600			61000			13500		
Manganese	mg/kg		5	1290			182			202		820				732			1160	548			1560			376		
Molybdenum	mg/kg	5	2	<2			<2			<2		<2				<2			<2	<2			<2			<2		
Zinc	mg/kg	0.8																										

Salintiy impedement to rooting depth

Soil nutrient deficiency

Dispersive soil

QEO9811 400 Wards Well - Land Resources				WW38	WW38	WW44	WW44	WW44	WW47	WW60	WW60	WW60	WW69	WW69	WW69	WW75	WW75	WW75	WW94	WW94	WW94
Analyte	Units	Soil Sufficiency Criteria	LOR																		
				0-50	500-600	0-100	100-200	500-600	0-100	0-20	20-300	700-800	0-50	200-300	800-900	0-50	400-500	900-1000	0-50	200-300	600-700
				Kandosol		Kandosol			Dermoso	Vertosol			Kandosol			Vertosol			Vertosol		
Inorganics																					
pH Value	pH Unit	6-7.5	0.1	6.5	7.1	6.3	6.4	6.2	6.6	7.2	7.6	8.7	6.7	7.5	7.5	7.4	8.7	9	7.6	8.4	8.9
Electrical Conductivity @ 25°C	mS/cm	<0.8	1	0.03	0.02	0.077	0.008	0.005	0.012	0.042	0.02	0.087	0.034	0.014	0.026	0.041	0.052	0.097	0.073	0.083	0.07
Moisture Content (dried @ 103°C)	%		1	8.6	3.7	2.6	6.2	9.3	12	13.3	26.4	17.5	8.5	17.1	14.7	15.6	26.4	14.1	10	25.4	10.6
Sulfate as SO4 2-	mg/kg	8mg/kg	10	<10	<10	30	<10	<10	<10	<10	<10	<10	<10	<10	30	20	10	20	<10	<10	<10
Chloride	mg/kg	800	10	20	20	80	<10	<10	<10	10	<10	<10	20	<10	10	10	<10	20	<10	<10	<10
Soil Classification based on Particle Size																					
Clay (<2 µm)	%	Ideal is Clay <40% and C. Sand <40%	1		35	28		21	53	70		26		54		70	75		70		19
Silt (2-60 µm)	%		1		7	9		17	17	22		22		12		22	16		23		41
Sand (0.06-2.00 mm)	%		1		54	52		18	28	8		19		32		8	9		7		21
Gravel (>2mm)	%		1		4	11		44	2	<1		33		2		<1	<1		<1		19
Cobbles (>6cm)	%		1		<1	<1		<1	<1	<1		<1		<1		<1	<1		<1		<1
Soluble Major Cations																					
Calcium	mg/kg		10	<10	<10	10	<10	<10	<10	20	<10	40	10	<10	<10	20	<10	<10	60	90	50
Magnesium	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	<10	<10	10	10	10
Sodium	mg/kg		10	<10	20	40	<10	<10	10	<10	20	50	<10	20	30	20	80	140	<10	10	30
Potassium	mg/kg	500	10	30	<10	20	<10	<10	<10	10	<10	<10	10	<10	<10	<10	<10	<10	10	<10	<10
Exchangeable Cations																					
Exchangeable Calcium	meq/100g		0.1	3.2	1.4	1.9	1.5	0.8	8.8	42.6	45.7	61.1	10.6	13.7	17	47	47.5	31.3	66.7	73.4	50.1
Exchangeable Calcium	meq. %	65-80%		57%	47%	51%	54%	27%	56%	63%	65%	70%	61%	54%	55%	62%	58%	57%	78%	82%	83%
Exchangeable Magnesium	meq/100g		0.1	1.8	1.3	1.3	1.2	2.1	6.5	23.4	23.9	25	6.4	11.1	12.6	27.4	30.9	21.2	17	15.9	10.1
Exchangeable Magnesium	meq. %	10-15%		32%	43%	35%	43%	70%	41%	35%	34%	29%	37%	44%	41%	36%	38%	38%	20%	18%	17%
Exchangeable Potassium	meq/100g		0.1	0.6	0.2	0.2	<0.1	<0.1	0.1	1.1	0.2	<0.1	0.3	<0.1	<0.1	0.6	0.1	<0.1	1.1	0.3	<0.1
Exchangeable Potassium	meq. %	1-5%		11%	7%	5%	<0.1	<0.1	1%	2%	0.3%	<0.1	2%	<0.1	<0.1	1%	0.1%	<0.1	1%	0.3%	<0.1
Exchangeable Sodium	meq/100g		0.1	<0.1	0.1	0.2	<0.1	<0.1	0.3	0.1	0.6	0.7	<0.1	0.4	1.4	0.3	3.1	2.8	<0.1	0.2	0.3
Exchangeable Sodium	meq. %	0-1%		<0.1	3%	5%	<0.1	<0.1	2%	0%	1%	1%	<0.1	2%	5%	0%	4%	5%	<0.1	0%	0%
Cation Exchange Capacity	meq/100g	>5	0.1	5.6	3	3.7	2.8	3	15.7	67.2	70.4	86.8	17.4	25.3	31	75.4	81.6	55.3	85	89.9	60.6
ESP				0	3%	5%	0	0	2%	0%	1%	1%	0	2%	5%	0%	4%	5%	0	0%	0%
Alkalinity																					
Total Alkalinity as CaCO3	mg/kg		1	63	76	63	25	38	51	140	216	306	114	63	51	140	228	317	228	254	317
Bicarbonate Alkalinity as CaCO3	mg/kg		1	63	76	63	25	38	51	140	216	306	114	63	51	140	228	266	228	254	292
Carbonate Alkalinity as CaCO3	mg/kg		1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	51	<1	<1	25
Total Metals																					
Boron	mg/kg	>1-4	50	<50		<50			<50	<50			<50			<50			<50		
Cobalt	mg/kg		2	6		32			52	183			58			46			40		
Copper	mg/kg	0.4	5	7		13			34	60			26			26			36		
Iron	mg/kg		50	21500		48800			71600	57200			76700			42300			53000		
Manganese	mg/kg		5	513		1010			1180	2660			1170			732			1100		
Molybdenum	mg/kg	5	2	<2		<2			<2	<2			<2			<2			<2		
Zinc	mg/kg	0.8	5	<5		11			35	194			28			60			65		
Nutrients																					
Bicarbonate Extractable P	mg/kg			8		12			<2	2			80			13			39		
Nitrite + Nitrate as N (Sol.)	mg/kg		0.1	1.3		0.2			0.4	2.3			1.7			2.9			4.3		
Total Kjeldahl Nitrogen as N	mg/kg		20	740		260			630	1230			1640			1120			1210		
Total Nitrogen as N	mg/kg	1500mg/kg	20	740		260			630	1230			1640			1120			1210		
Total Phosphorus as P	mg/kg	200mg/kg	2	188		224			280	202			400			135			311		
Organic Matter	%	>1.5%	0.5	2.1		1.2			2.4	2.3			3.6			2.5			2.2		

Salintiy impedement to rooting depth

Soil nutrient deficiency

Dispersive soil



Appendix C ALS Laboratory Documents

Sinclair Knight Merz Pty Ltd
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CHAIN OF CUSTODY &

LAB: Aust. Lab. Services Pty Ltd (ALS)
ADDRESS: 32 Shand Street Stafford
PHONE: 07 3243 7222
FAX:

1 of 2

PROJECT #		PROJECT NAME		METHOD CODE & ANALYSIS REQUIRED										PRELIM. RESULTS BY:													
QEO9811.400		Wards Well - Land Resources												☐ VERBAL ☐ FAX ☒ EMAIL													
SAMPLE COLLECTOR'S NAME				LAB JOB #												FINAL REPORT BY:											
Angus Thompson / Timothy Rohde																SEND TO EMAIL ADDRESS(ES): Sampler: trohde @skm.com.au Proj Mgr: rjanssen @skm.com.au											
SAMPLE ID		DEPTH (metres)		LAB #		MATRIX				PRESERVATION METHOD				SAMPLING DATE		No. OF CONTAINERS		LAB QUOTE REF:									
						WATER SOIL AIR SLUDGE				ICE ACID-IFIED OTHER NONE								SKM ORDER No:									
																		COMMENTS (see below)									
																		(1) (2) (3)									
WW6		0-10		1		x								21-Sep-11		1		x x x									
WW6		20-30		1		x								21-Sep-11		1		x x x									
WW6		80-90		1		x								21-Sep-11		1		x x x									
WW9		0-100		1		x								21-Sep-11		1		x x x									
WW9		200-300		1		x								21-Sep-11		1		x x x									
WW9		800-900		1		x								21-Sep-11		1		x x x									
WW10		0-100		1		x								21-Sep-11		1		x x x									
WW10		500-600		1		x								21-Sep-11		1		x x x									
WW10		1000-1100		1		x								21-Sep-11		1		x x x									
WW13		0-50		1		x								21-Sep-11		1		x x x									
WW13		20-30		1		x								21-Sep-11		1		x x x									
WW13		70-80		1		x								21-Sep-11		1		x x x									
WW15		0-10		1		x								22-Sep-11		1		x x x									
WW15		30-40		1		x								22-Sep-11		1		x x x									
WW15		90-100		1		x								22-Sep-11		1		x x x									
WW22		0-100		1		x								22-Sep-11		1		x x x									
WW22		200-400		1		x								22-Sep-11		1		x x x									
WW22		800-900		1		x								22-Sep-11		1		x x x									
WW23		0-100		1		x								23-Sep-11		1		x x x									
WW23		300-400		1		x								23-Sep-11		1		x x x									
WW23		900-1000		1		x								23-Sep-11		1		x x x									
WW28		0-100		1		x								23-Sep-11		1		x x x									
WW28		200-300		1		x								23-Sep-11		1		x x x									
WW28		700-800		1		x								23-Sep-11		1		x x x									
TOTALS						0 24 0 0										24		24 24 24 24 24 24 24 16 13 8 8 8									
Relinquished by (SIGN/PRINT):				Date		Time		Received by (SIGN/PRINT):				Date		Time		Custody				Additional Comments/Instructions:							
Tim Rohde of SKM				17/10				Matt McCabe of ALS				17/10/11		15:20		Seals Intact? Yes No				Please send copies of all correspondence to -rjanssen@globalskm.com							
Relinquished by (SIGN/PRINT):				Date		Time		Received by (SIGN/PRINT):				Date		Time		Sample Receipt				Please Send Invoice to rjanssen@globalskm.com							
																Temp. °C											



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LAB: Aust. Lab. Services Pty Ltd (ALS)
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Page 2 of 3

PROJECT #		PROJECT NAME		METHOD CODE & ANALYSIS REQUIRED																		PRELIM. RESULTS BY:								
QEO9811.400		Words Well - Land Resources																				☐ VERBAL ☐ FAX ☒ EMAIL								
SAMPLE COLLECTOR'S NAME			LAB JOB #																					FINAL REPORT BY:						
Angus Thompson / Timothy Rohde																								SEND TO EMAIL ADDRESS(ES): Sampler: trohde@skm.com.au Proj Mgr: rjanssen@skm.com.au						
SAMPLE ID	DEPTH (metres)	LAB #	MATRIX				PRESERVATION METHOD				SAMPLING DATE	No. OF CONTAINERS	Moisture (EA055)	1:5 Soil Water Extract (EN/34)	Conductivity (EA010)	pH 1:5 (EA002)	Ca, Mg, Na, K (NT-1S)	Chloride and Sulfate (NT-2S)	Alkalinity (ED037)	CEC and Ex. Cation (ED007)	Emerson Class (holders)	PSD (with hydrometer)	Total N and Total P (NT-11S)	OM (EP004)	Total Metals by ICP/MS (B, Cu, Co, Fe, Mn, Mo, Zn) (EG0057)	LAB QUOTE REF:	SKM ORDER No:	COMMENTS (see below)		
			WATER	SOIL	AIR	SLUDGE	ICE	ACIDIFIED	OTHER	NONE																		(1)	(2)	(3)
25	WW36	0-100		x						24-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
26	WW36	200-300		x						24-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
27	WW36	700-800		x						24-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
28	WW38	0-50		x						24-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
29	WW38	500-600		x						24-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
Intentionally blank																														
30	WW44	0-100		x						25-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
31	WW44	100-200		x						25-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
32	WW44	500-600		x						25-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
33	WW47	0-100		x						26-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
34	WW47	450-1000		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
Intentionally blank																														
35	WW60	0-20		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
36	WW60	20-300		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
37	WW60	700-800		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
38	WW69	0-50		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
39	WW69	200-300		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
40	WW69	800-900		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
41	WW75	0-50		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
42	WW75	400-500		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
43	WW75	900-1000		x						27-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
44	WW94	0-50		x						28-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
45	WW94	200-300		x						29-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
46	WW94	600-700		x						30-Sep-11	1	x	x	x	x	x	x	x	x	x	x	x	x	x						
TOTALS			0	22	0	0						22	22	22	22	22	22	22	22	16	14	8	8	8						
SIGN/PRINT:			Date		Time		Received by (SIGN/PRINT):					Date		Time		Custody		Seals Intact?		Yes / No		Additional Comments/Instructions:								
of SKM			17/10				of															Please send copies of all correspondence to - rjanssen@globalskm.com Please send invoice to rjanssen@globalskm.com								
SIGN/PRINT:			Date		Time		Received by (SIGN/PRINT):					Date		Time		Sample Receipt		Temp.		°C										
							of																							

Ph: +61 3 9248 3100
 Fax: +61 3 9248 3364

CHAIN OF CUSTODY &

LAB: Aust. Lab. Services Pty Ltd (ALS)
ADDRESS: 32 Shand Street Stafford
PHONE: 07 3243 7222
FAX:

Page 3 of 3

[illegible]



Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)
Comprehensive Report

Work Order : EB1121537

Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Brisbane
Contact	: R JANSSEN	Contact	: Dean Sullivan
Address	: P O BOX 312 FLINDERS LANE MELBOURNE VIC AUSTRALIA 8009	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: rjanssen@globalskm.com	E-mail	: dean.sullivan@alsglobal.com
Telephone	: +61 03 8668 3000	Telephone	: +61 7 3243 7144
Facsimile	: +61 03 8668 3001	Facsimile	: +61 7 3243 7218
Project	: QEO9811 400 Wards Well - Land Resources	Page	: 1 of 5
Order number	: ----		
C-O-C number	: ----	Quote number	: ES2010SINKNI0337 (EN/003/10)
Site	: ----		
Sampler	: A Thompson/T Rohde	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 17-OCT-2011	Issue Date	: 19-OCT-2011 13:25
Client Requested Due Date	: 26-OCT-2011	Scheduled Reporting Date	: 26-OCT-2011

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 24,24.1,24.3,24°C
No. of coolers/boxes	: 4 MEDIUM	No. of samples received	: 64
Security Seal	: Intact.	No. of samples analysed	: 43

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Breaches in recommended extraction / analysis holding times have occurred.**
- **Please be advised that samples WW22-200-400; WW22-800-900 and WW47-450-100 were not received.**
- **Emerson Aggregate analysis will be subcontracted to Golder Associates.**
- **The recommended extraction time for organic carbon/matter; sulphate; pH; Conductivity; chloride; moisture on soil samples is 7 days from the date of sampling.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Matt Goodwin.
- Analytical work for this work order will be conducted at ALS Brisbane and ALS Newcastle.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.



Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- No sample container / preservation non-compliance exist.

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	(On Hold) SOIL No analysis requested	SOIL - EA002 pH (1:5)	SOIL - EA010 (solids): Electrical Conductivity (1:5) Electrical Conductivity (1:5)	SOIL - EA150H Particle Sizing by Hydrometer	SOIL - ED007 CEC / Exchangeable Cations (ED007)	SOIL - ED037 Alkalinity in Soil	SOIL - EG005T (solids) Total Metals by ICP-AES	SOIL - EME-SOL (Subcontracted) Emerson Aggregate Testing on soil samples
EB1121537-001	21-SEP-2011 15:00	WW6 0-10		✓	✓		✓	✓	✓	✓
EB1121537-002	21-SEP-2011 15:00	WW6 20-30		✓	✓	✓	✓	✓		✓
EB1121537-003	21-SEP-2011 15:00	WW6 80-90		✓	✓		✓	✓		
EB1121537-004	21-SEP-2011 15:00	WW9 0-100		✓	✓		✓	✓	✓	✓
EB1121537-005	21-SEP-2011 15:00	WW9 200-300		✓	✓		✓	✓		
EB1121537-006	21-SEP-2011 15:00	WW9 800-900		✓	✓	✓	✓	✓		✓
EB1121537-007	21-SEP-2011 15:00	WW10 0-100		✓	✓	✓	✓	✓	✓	✓
EB1121537-008	21-SEP-2011 15:00	WW10 500-600		✓	✓		✓	✓		
EB1121537-009	21-SEP-2011 15:00	WW13 1000-1100		✓	✓	✓	✓	✓		✓
EB1121537-010	21-SEP-2011 15:00	WW13 0-50		✓	✓	✓	✓	✓	✓	✓
EB1121537-011	21-SEP-2011 15:00	WW13 20-30		✓	✓		✓	✓		
EB1121537-012	21-SEP-2011 15:00	WW13 70-80		✓	✓	✓	✓	✓		✓
EB1121537-013	22-SEP-2011 15:00	WW15 0-10		✓	✓	✓	✓	✓	✓	✓
EB1121537-014	22-SEP-2011 15:00	WW15 30-40		✓	✓		✓	✓		
EB1121537-015	22-SEP-2011 15:00	WW15 90-100		✓	✓	✓	✓	✓		✓
EB1121537-016	22-SEP-2011 15:00	WW22 0-100		✓	✓	✓	✓	✓	✓	✓
EB1121537-019	23-SEP-2011 15:00	WW23 0-100		✓	✓		✓	✓	✓	✓
EB1121537-020	23-SEP-2011 15:00	WW23 300-400		✓	✓	✓	✓	✓		
EB1121537-021	23-SEP-2011 15:00	WW23 900-1000		✓	✓		✓	✓		✓
EB1121537-022	23-SEP-2011 15:00	WW28 0-100		✓	✓	✓	✓	✓	✓	✓
EB1121537-023	23-SEP-2011 15:00	WW28 200-300		✓	✓		✓	✓		
EB1121537-024	23-SEP-2011 15:00	WW28 700-800		✓	✓	✓	✓	✓		✓
EB1121537-025	24-SEP-2011 15:00	WW36 0-100		✓	✓	✓	✓	✓	✓	✓
EB1121537-026	24-SEP-2011 15:00	WW36 200-300		✓	✓		✓	✓		
EB1121537-027	24-SEP-2011 15:00	WW36 700-800		✓	✓	✓	✓	✓		✓
EB1121537-028	24-SEP-2011 15:00	WW38 0-50		✓	✓		✓	✓	✓	✓
EB1121537-029	24-SEP-2011 15:00	WW38 500-600		✓	✓	✓	✓	✓		✓
EB1121537-030	25-SEP-2011 15:00	WW44 0-100		✓	✓	✓	✓	✓	✓	✓
EB1121537-031	25-SEP-2011 15:00	WW44 100-200		✓	✓		✓	✓		
EB1121537-032	25-SEP-2011 15:00	WW44 500-600		✓	✓	✓	✓	✓		✓
EB1121537-033	26-SEP-2011 15:00	WW47 0-100		✓	✓	✓	✓	✓	✓	✓
EB1121537-035	27-SEP-2011 15:00	WW60 0-20		✓	✓	✓	✓	✓	✓	✓
EB1121537-036	27-SEP-2011 15:00	WW60 20-300		✓	✓		✓	✓		
EB1121537-037	27-SEP-2011 15:00	WW60 700-800		✓	✓	✓	✓	✓		✓



			(On Hold) SOIL No analysis requested	SOIL - EA002 pH (1:5)	SOIL - EA010 (solids): Electrical Conductivity (1:5) Electrical Conductivity (1:5)	SOIL - EA150H Particle Sizing by Hydrometer	SOIL - ED007 CEC / Exchangeable Cations (ED007)	SOIL - ED037 Alkalinity in Soil	SOIL - EG005T (solids) Total Metals by ICP-AES	SOIL - EME-SOL (Subcontracted) Emerson Aggregate Testing on soil samples
EB1121537-038	27-SEP-2011 15:00	WW69 0-50		✓	✓		✓	✓	✓	✓
EB1121537-039	27-SEP-2011 15:00	WW69 200-300		✓	✓	✓	✓	✓		
EB1121537-040	27-SEP-2011 15:00	WW69 800-900		✓	✓		✓	✓		✓
EB1121537-041	27-SEP-2011 15:00	WW75 0-50		✓	✓	✓	✓	✓	✓	✓
EB1121537-042	27-SEP-2011 15:00	WW75 400-500		✓	✓	✓	✓	✓		
EB1121537-043	27-SEP-2011 15:00	WW75 900-1000		✓	✓		✓	✓		✓
EB1121537-044	28-SEP-2011 15:00	WW94 0-50		✓	✓	✓	✓	✓	✓	✓
EB1121537-045	29-SEP-2011 15:00	WW94 200-300		✓	✓		✓	✓		
EB1121537-046	30-SEP-2011 15:00	WW94 600-700		✓	✓	✓	✓	✓		✓
EB1121537-047	[17-OCT-2011]	WW18 80-900	✓							
EB1121537-048	[17-OCT-2011]	WW18	✓							
EB1121537-049	[17-OCT-2011]	WW18 20-40	✓							
EB1121537-050	[17-OCT-2011]	WW32 20-100	✓							
EB1121537-051	[17-OCT-2011]	WW32 70-80	✓							
EB1121537-052	[17-OCT-2011]	WW32 0-10	✓							
EB1121537-053	[17-OCT-2011]	WW52 30-40	✓							
EB1121537-054	[17-OCT-2011]	WW52 0-10	✓							
EB1121537-055	[17-OCT-2011]	WW52 70-80	✓							
EB1121537-056	[17-OCT-2011]	WW35 30-40	✓							
EB1121537-057	[17-OCT-2011]	WW35 80-90	✓							
EB1121537-058	[17-OCT-2011]	WW35 0-10	✓							
EB1121537-059	[17-OCT-2011]	WW4 200-300	✓							
EB1121537-060	[17-OCT-2011]	WW4 700-800	✓							
EB1121537-061	[17-OCT-2011]	WW4 0-100	✓							
EB1121537-062	[17-OCT-2011]	WW78 0-100	✓							
EB1121537-063	[17-OCT-2011]	WW78 300-400	✓							
EB1121537-064	[17-OCT-2011]	WW78 900-1000	✓							
EB1121537-066	[17-OCT-2011]	WW22 200-1000	✓							
EB1121537-067	[17-OCT-2011]	WW22 300-400	✓							
EB1121537-068	[17-OCT-2011]	WW22 600-700	✓							



Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - EP004 Organic Matter in Soil (Walkley Black)	SOIL - NT-11S Total N + Total P	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S Major Anions (Cl, SO4)
EB1121537-001	21-SEP-2011 15:00	WW6 0-10	✓	✓	✓	✓
EB1121537-002	21-SEP-2011 15:00	WW6 20-30			✓	✓
EB1121537-003	21-SEP-2011 15:00	WW6 80-90			✓	✓
EB1121537-004	21-SEP-2011 15:00	WW9 0-100	✓	✓	✓	✓
EB1121537-005	21-SEP-2011 15:00	WW9 200-300			✓	✓
EB1121537-006	21-SEP-2011 15:00	WW9 800-900			✓	✓
EB1121537-007	21-SEP-2011 15:00	WW10 0-100	✓	✓	✓	✓
EB1121537-008	21-SEP-2011 15:00	WW10 500-600			✓	✓
EB1121537-009	21-SEP-2011 15:00	WW13 1000-1100			✓	✓
EB1121537-010	21-SEP-2011 15:00	WW13 0-50	✓	✓	✓	✓
EB1121537-011	21-SEP-2011 15:00	WW13 20-30			✓	✓
EB1121537-012	21-SEP-2011 15:00	WW13 70-80			✓	✓
EB1121537-013	22-SEP-2011 15:00	WW15 0-10	✓	✓	✓	✓
EB1121537-014	22-SEP-2011 15:00	WW15 30-40			✓	✓
EB1121537-015	22-SEP-2011 15:00	WW15 90-100			✓	✓
EB1121537-016	22-SEP-2011 15:00	WW22 0-100	✓	✓	✓	✓
EB1121537-019	23-SEP-2011 15:00	WW23 0-100	✓	✓	✓	✓
EB1121537-020	23-SEP-2011 15:00	WW23 300-400			✓	✓
EB1121537-021	23-SEP-2011 15:00	WW23 900-1000			✓	✓
EB1121537-022	23-SEP-2011 15:00	WW28 0-100	✓	✓	✓	✓
EB1121537-023	23-SEP-2011 15:00	WW28 200-300			✓	✓
EB1121537-024	23-SEP-2011 15:00	WW28 700-800			✓	✓
EB1121537-025	24-SEP-2011 15:00	WW36 0-100	✓	✓	✓	✓
EB1121537-026	24-SEP-2011 15:00	WW36 200-300			✓	✓
EB1121537-027	24-SEP-2011 15:00	WW36 700-800			✓	✓
EB1121537-028	24-SEP-2011 15:00	WW38 0-50	✓	✓	✓	✓
EB1121537-029	24-SEP-2011 15:00	WW38 500-600			✓	✓
EB1121537-030	25-SEP-2011 15:00	WW44 0-100	✓	✓	✓	✓
EB1121537-031	25-SEP-2011 15:00	WW44 100-200			✓	✓
EB1121537-032	25-SEP-2011 15:00	WW44 500-600			✓	✓
EB1121537-033	26-SEP-2011 15:00	WW47 0-100	✓	✓	✓	✓
EB1121537-035	27-SEP-2011 15:00	WW60 0-20	✓	✓	✓	✓
EB1121537-036	27-SEP-2011 15:00	WW60 20-300			✓	✓
EB1121537-037	27-SEP-2011 15:00	WW60 700-800			✓	✓
EB1121537-038	27-SEP-2011 15:00	WW69 0-50	✓	✓	✓	✓
EB1121537-039	27-SEP-2011 15:00	WW69 200-300			✓	✓
EB1121537-040	27-SEP-2011 15:00	WW69 800-900			✓	✓
EB1121537-041	27-SEP-2011 15:00	WW75 0-50	✓	✓	✓	✓
EB1121537-042	27-SEP-2011 15:00	WW75 400-500			✓	✓
EB1121537-043	27-SEP-2011 15:00	WW75 900-1000			✓	✓
EB1121537-044	28-SEP-2011 15:00	WW94 0-50	✓	✓	✓	✓



			SOIL - EP004 Organic Matter in Soil (Walkley Black)	SOIL - NT-11S Total N + Total P	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S Major Anions (Cl, SO4)
EB1121537-045	29-SEP-2011 15:00	WW94 200-300			✓	✓
EB1121537-046	30-SEP-2011 15:00	WW94 600-700			✓	✓

Requested Deliverables

MR TIMOTHY ROHDE

- *AU Certificate of Analysis - NATA (COA)	Email	trohde@skm.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	trohde@skm.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	trohde@skm.com.au
- A4 - AU Sample Receipt Notification - Environmental (SRN)	Email	trohde@skm.com.au
- Attachment - Report (SUBCO)	Email	trohde@skm.com.au
- Chain of Custody (CoC) (COC)	Email	trohde@skm.com.au
- EDI Format - ENMRG (ENMRG)	Email	trohde@skm.com.au
- EDI Format - ESDAT (ESDAT)	Email	trohde@skm.com.au
- EDI Format - XTab (XTAB)	Email	trohde@skm.com.au

R JANSSEN

- *AU Certificate of Analysis - NATA (COA)	Email	rjanssen@globalskm.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	rjanssen@globalskm.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	rjanssen@globalskm.com
- A4 - AU Sample Receipt Notification - Environmental (SRN)	Email	rjanssen@globalskm.com
- A4 - AU Tax Invoice (INV)	Email	rjanssen@globalskm.com
- Attachment - Report (SUBCO)	Email	rjanssen@globalskm.com
- Chain of Custody (CoC) (COC)	Email	rjanssen@globalskm.com
- EDI Format - ENMRG (ENMRG)	Email	rjanssen@globalskm.com
- EDI Format - ESDAT (ESDAT)	Email	rjanssen@globalskm.com
- EDI Format - XTab (XTAB)	Email	rjanssen@globalskm.com



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1121537	Page	: 1 of 20
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Brisbane
Contact	: MR TIMOTHY ROHDE	Contact	: Dean Sullivan
Address	: P O BOX 312 FLINDERS LANE MELBOURNE VIC AUSTRALIA 8009	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: trohde@skm.com.au	E-mail	: dean.sullivan@alsglobal.com
Telephone	: +61 03 8668 3000	Telephone	: +61 7 3243 7144
Facsimile	: +61 03 8668 3001	Facsimile	: +61 7 3243 7218
Project	: QEO9811 400 Wards Well - Land Resources	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 17-OCT-2011
C-O-C number	: ----	Issue Date	: 26-OCT-2011
Sampler	: A Thompson/T Rohde	No. of samples received	: 64
Site	: ----	No. of samples analysed	: 43
Quote number	: EN/003/10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dianne Blane	Laboratory Supervisor	Newcastle
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

Environmental Division Brisbane
Part of the **ALS Laboratory Group**

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A Campbell Brothers Limited Company



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG005T (Total Metals): Sample EB1121537-030 (WW44 0-100) shows poor duplicate result due to sample heterogeneity. Confirmed by visual confirmation.**



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				WW6 0-10	WW6 20-30	WW6 80-90	WW9 0-100	WW9 200-300
				21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-001	EB1121537-002	EB1121537-003	EB1121537-004	EB1121537-005
EA150: Particle Sizing								
+75µm	----	1	%	----	18	----	----	----
+150µm	----	1	%	----	17	----	----	----
+300µm	----	1	%	----	15	----	----	----
+425µm	----	1	%	----	13	----	----	----
+600µm	----	1	%	----	12	----	----	----
+1180µm	----	1	%	----	10	----	----	----
+2.36mm	----	1	%	----	8	----	----	----
+4.75mm	----	1	%	----	6	----	----	----
+9.5mm	----	1	%	----	<1	----	----	----
+19.0mm	----	1	%	----	<1	----	----	----
+37.5mm	----	1	%	----	<1	----	----	----
+75.0mm	----	1	%	----	<1	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.8	8.6	8.6	5.8	5.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	107	137	659	31	134
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	18.4	18.5	20.1	7.2	12.3
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	68	----	----	----
Silt (2-60 µm)	----	1	%	----	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	----	12	----	----	----
Gravel (>2mm)	----	1	%	----	8	----	----	----
Cobbles (>6cm)	----	1	%	----	<1	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	37.3	37.2	33.7	7.8	7.2
Exchangeable Magnesium	----	0.1	meq/100g	17.4	24.7	30.2	13.9	13.9
Exchangeable Potassium	----	0.1	meq/100g	2.2	0.5	0.1	0.6	0.5
Exchangeable Sodium	----	0.1	meq/100g	0.2	2.4	8.4	0.8	1.7
Cation Exchange Capacity	----	0.1	meq/100g	57.0	64.8	72.4	23.1	23.2
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	254	470	444	63	38
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	254	470	444	63	38
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	<1	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	<10	120	10	40



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW6 0-10	WW6 20-30	WW6 80-90	WW9 0-100	WW9 200-300
				21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-001	EB1121537-002	EB1121537-003	EB1121537-004	EB1121537-005
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	1000	10	2350
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	50	20	40	<10	<10
Magnesium	7439-95-4	10	mg/kg	20	<10	30	<10	<10
Sodium	7440-23-5	10	mg/kg	20	170	760	20	120
Potassium	7440-09-7	10	mg/kg	40	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	<50	----	----	<50	----
Cobalt	7440-48-4	2	mg/kg	66	----	----	20	----
Copper	7440-50-8	5	mg/kg	38	----	----	16	----
Iron	7439-89-6	50	mg/kg	69600	----	----	28800	----
Manganese	7439-96-5	5	mg/kg	1290	----	----	182	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	<2	----
Zinc	7440-66-6	5	mg/kg	76	----	----	19	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	19.8	----	----	4.1	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	2630	----	----	770	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	2650	----	----	770	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	494	----	----	164	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	5.1	----	----	2.2	----



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW9 800-900	WW10 0-100	WW10 500-600	WW13 1000-1100	WW13 0-50
				21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00
				EB1121537-006	EB1121537-007	EB1121537-008	EB1121537-009	EB1121537-010
EA150: Particle Sizing								
+75µm	----	1	%	7	70	----	67	22
+150µm	----	1	%	5	58	----	52	8
+300µm	----	1	%	3	34	----	30	6
+425µm	----	1	%	2	18	----	19	6
+600µm	----	1	%	<1	8	----	13	5
+1180µm	----	1	%	<1	2	----	5	4
+2.36mm	----	1	%	<1	<1	----	<1	4
+4.75mm	----	1	%	<1	<1	----	<1	4
+9.5mm	----	1	%	<1	<1	----	<1	4
+19.0mm	----	1	%	<1	<1	----	<1	<1
+37.5mm	----	1	%	<1	<1	----	<1	<1
+75.0mm	----	1	%	<1	<1	----	<1	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	4.5	6.5	6.4	5.8	7.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	631	8	9	7	55
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	17.7	6.1	7.1	9.7	8.6
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	69	21	----	23	46
Silt (2-60 µm)	----	1	%	23	6	----	7	29
Sand (0.06-2.00 mm)	----	1	%	8	73	----	70	21
Gravel (>2mm)	----	1	%	<1	<1	----	<1	4
Cobbles (>6cm)	----	1	%	<1	<1	----	<1	<1
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	5.8	1.8	1.3	1.0	15.4
Exchangeable Magnesium	----	0.1	meq/100g	14.6	0.5	0.7	0.7	5.8
Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.1	<0.1	<0.1	1.1
Exchangeable Sodium	----	0.1	meq/100g	4.4	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	25.0	2.4	2.1	1.8	22.4
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	<1	51	38	51	203
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	<1	51	38	51	203
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	<1	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW9 800-900	WW10 0-100	WW10 500-600	WW13 1000-1100	WW13 0-50
				21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00
<i>Compound</i>	<i>CAS Number</i>	<i>LOR</i>	<i>Unit</i>	EB1121537-006	EB1121537-007	EB1121537-008	EB1121537-009	EB1121537-010
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	1240	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	20	<10	<10	<10	30
Magnesium	7439-95-4	10	mg/kg	40	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	600	<10	<10	<10	10
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	30
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	----	<50	----	----	<50
Cobalt	7440-48-4	2	mg/kg	----	5	----	----	24
Copper	7440-50-8	5	mg/kg	----	<5	----	----	28
Iron	7439-89-6	50	mg/kg	----	12000	----	----	81500
Manganese	7439-96-5	5	mg/kg	----	202	----	----	820
Molybdenum	7439-98-7	2	mg/kg	----	<2	----	----	<2
Zinc	7440-66-6	5	mg/kg	----	<5	----	----	34
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	0.2	----	----	1.6
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	180	----	----	1170
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	----	180	----	----	1170
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	53	----	----	477
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	<0.5	----	----	2.8



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW13 20-30	WW13 70-80	WW15 0-10	WW15 30-40	WW15 90-100
				21-SEP-2011 15:00	21-SEP-2011 15:00	22-SEP-2011 15:00	22-SEP-2011 15:00	22-SEP-2011 15:00
				EB1121537-011	EB1121537-012	EB1121537-013	EB1121537-014	EB1121537-015
EA150: Particle Sizing								
+75µm	----	1	%	----	20	8	----	5
+150µm	----	1	%	----	18	5	----	3
+300µm	----	1	%	----	15	3	----	1
+425µm	----	1	%	----	13	2	----	<1
+600µm	----	1	%	----	12	1	----	<1
+1180µm	----	1	%	----	10	<1	----	<1
+2.36mm	----	1	%	----	8	<1	----	<1
+4.75mm	----	1	%	----	5	<1	----	<1
+9.5mm	----	1	%	----	<1	<1	----	<1
+19.0mm	----	1	%	----	<1	<1	----	<1
+37.5mm	----	1	%	----	<1	<1	----	<1
+75.0mm	----	1	%	----	<1	<1	----	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.0	8.8	7.6	8.8	8.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	90	672	58	278	989
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	13.5	15.2	15.6	18.9	20.1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	60	74	----	82
Silt (2-60 µm)	----	1	%	----	19	17	----	12
Sand (0.06-2.00 mm)	----	1	%	----	13	9	----	6
Gravel (>2mm)	----	1	%	----	8	<1	----	<1
Cobbles (>6cm)	----	1	%	----	<1	<1	----	<1
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	18.0	26.5	33.2	30.2	24.8
Exchangeable Magnesium	----	0.1	meq/100g	8.6	14.7	20.0	23.2	25.1
Exchangeable Potassium	----	0.1	meq/100g	0.7	0.4	0.5	0.1	0.2
Exchangeable Sodium	----	0.1	meq/100g	0.8	7.0	0.7	7.0	11.4
Cation Exchange Capacity	----	0.1	meq/100g	28.1	48.6	54.5	60.6	61.5
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	368	558	178	432	140
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	368	507	178	381	140
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	51	<1	51	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	140	10	70	530



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW13 20-30	WW13 70-80	WW15 0-10	WW15 30-40	WW15 90-100
				21-SEP-2011 15:00	21-SEP-2011 15:00	22-SEP-2011 15:00	22-SEP-2011 15:00	22-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-011	EB1121537-012	EB1121537-013	EB1121537-014	EB1121537-015
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	890	30	200	1630
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	20	30	10	<10	50
Magnesium	7439-95-4	10	mg/kg	<10	30	<10	<10	40
Sodium	7440-23-5	10	mg/kg	70	760	50	320	1160
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	----	----	<50	----	----
Cobalt	7440-48-4	2	mg/kg	----	----	66	----	----
Copper	7440-50-8	5	mg/kg	----	----	35	----	----
Iron	7439-89-6	50	mg/kg	----	----	57000	----	----
Manganese	7439-96-5	5	mg/kg	----	----	732	----	----
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	----	----	42	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	----	3.1	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	----	1010	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	----	----	1010	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	----	209	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	3.0	----	----



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				WW22 0-100	WW23 0-100	WW23 300-400	WW23 900-1000	WW28 0-100
				22-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-016	EB1121537-019	EB1121537-020	EB1121537-021	EB1121537-022
EA150: Particle Sizing								
+75µm	----	1	%	6	----	55	----	45
+150µm	----	1	%	4	----	43	----	38
+300µm	----	1	%	2	----	29	----	26
+425µm	----	1	%	<1	----	22	----	18
+600µm	----	1	%	<1	----	18	----	13
+1180µm	----	1	%	<1	----	12	----	7
+2.36mm	----	1	%	<1	----	3	----	2
+4.75mm	----	1	%	<1	----	<1	----	<1
+9.5mm	----	1	%	<1	----	<1	----	<1
+19.0mm	----	1	%	<1	----	<1	----	<1
+37.5mm	----	1	%	<1	----	<1	----	<1
+75.0mm	----	1	%	<1	----	<1	----	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.8	6.1	6.2	6.6	7.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	62	142	45	26	150
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	20.4	3.6	7.2	7.6	3.9
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	80	----	33	----	37
Silt (2-60 µm)	----	1	%	13	----	9	----	15
Sand (0.06-2.00 mm)	----	1	%	7	----	55	----	46
Gravel (>2mm)	----	1	%	<1	----	3	----	2
Cobbles (>6cm)	----	1	%	<1	----	<1	----	<1
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	69.3	2.3	1.8	1.4	6.4
Exchangeable Magnesium	----	0.1	meq/100g	12.7	1.0	1.0	1.5	5.4
Exchangeable Potassium	----	0.1	meq/100g	0.8	0.5	0.3	0.1	2.4
Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.2	<0.1	0.1	0.8
Cation Exchange Capacity	----	0.1	meq/100g	82.8	3.9	3.2	3.2	15.1
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	216	51	25	51	152
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	216	51	25	51	152
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	<1	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	20	30	10	50



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW22 0-100	WW23 0-100	WW23 300-400	WW23 900-1000	WW28 0-100
				22-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-016	EB1121537-019	EB1121537-020	EB1121537-021	EB1121537-022
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	20	80	20	20	40
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	60	40	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	20	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	<10	30	10	20	80
Potassium	7440-09-7	10	mg/kg	<10	60	20	<10	110
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	<50	<50	----	----	<50
Cobalt	7440-48-4	2	mg/kg	33	14	----	----	58
Copper	7440-50-8	5	mg/kg	39	9	----	----	36
Iron	7439-89-6	50	mg/kg	53800	37600	----	----	61000
Manganese	7439-96-5	5	mg/kg	1160	548	----	----	1560
Molybdenum	7439-98-7	2	mg/kg	<2	<2	----	----	<2
Zinc	7440-66-6	5	mg/kg	52	7	----	----	50
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	4.8	42.9	----	----	35.3
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	1820	240	----	----	760
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	1820	280	----	----	800
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	222	114	----	----	198
EP004: Organic Matter								
Organic Matter	----	0.5	%	3.9	<0.5	----	----	1.4



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW28 200-300	WW28 700-800	WW36 0-100	WW36 200-300	WW36 700-800
				23-SEP-2011 15:00	23-SEP-2011 15:00	24-SEP-2011 15:00	24-SEP-2011 15:00	24-SEP-2011 15:00
				EB1121537-023	EB1121537-024	EB1121537-025	EB1121537-026	EB1121537-027
EA150: Particle Sizing								
+75µm	----	1	%	----	41	53	----	57
+150µm	----	1	%	----	35	40	----	44
+300µm	----	1	%	----	25	21	----	23
+425µm	----	1	%	----	18	12	----	12
+600µm	----	1	%	----	13	7	----	6
+1180µm	----	1	%	----	6	3	----	2
+2.36mm	----	1	%	----	2	<1	----	<1
+4.75mm	----	1	%	----	<1	<1	----	<1
+9.5mm	----	1	%	----	<1	<1	----	<1
+19.0mm	----	1	%	----	<1	<1	----	<1
+37.5mm	----	1	%	----	<1	<1	----	<1
+75.0mm	----	1	%	----	<1	<1	----	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.8	7.2	6.9	9.0	9.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	49	25	28	199	345
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	13.6	12.2	4.5	7.3	8.8
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	47	36	----	32
Silt (2-60 µm)	----	1	%	----	11	6	----	8
Sand (0.06-2.00 mm)	----	1	%	----	41	57	----	60
Gravel (>2mm)	----	1	%	----	1	1	----	<1
Cobbles (>6cm)	----	1	%	----	<1	<1	----	<1
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	8.1	3.8	9.2	21.8	15.0
Exchangeable Magnesium	----	0.1	meq/100g	9.9	3.6	7.1	10.0	14.4
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.3	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	2.2	0.7	0.8	1.6	5.6
Cation Exchange Capacity	----	0.1	meq/100g	20.3	8.1	17.4	33.6	35.0
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	254	127	102	558	1130
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	254	127	102	456	419
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	102	711
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	<10	<10	20	30



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW28 200-300	WW28 700-800	WW36 0-100	WW36 200-300	WW36 700-800
				23-SEP-2011 15:00	23-SEP-2011 15:00	24-SEP-2011 15:00	24-SEP-2011 15:00	24-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-023	EB1121537-024	EB1121537-025	EB1121537-026	EB1121537-027
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	20	20	10	10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	40	20	30	210	360
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	----	----	<50	----	----
Cobalt	7440-48-4	2	mg/kg	----	----	7	----	----
Copper	7440-50-8	5	mg/kg	----	----	8	----	----
Iron	7439-89-6	50	mg/kg	----	----	13500	----	----
Manganese	7439-96-5	5	mg/kg	----	----	376	----	----
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	----	----	8	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	----	1.1	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	----	420	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	----	----	420	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	----	93	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	1.9	----	----



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW38 0-50	WW38 500-600	WW44 0-100	WW44 100-200	WW44 500-600
				24-SEP-2011 15:00	24-SEP-2011 15:00	25-SEP-2011 15:00	25-SEP-2011 15:00	25-SEP-2011 15:00
				EB1121537-028	EB1121537-029	EB1121537-030	EB1121537-031	EB1121537-032
EA150: Particle Sizing								
+75µm	----	1	%	----	54	62	----	61
+150µm	----	1	%	----	41	52	----	60
+300µm	----	1	%	----	26	37	----	57
+425µm	----	1	%	----	18	29	----	56
+600µm	----	1	%	----	14	24	----	55
+1180µm	----	1	%	----	9	19	----	52
+2.36mm	----	1	%	----	4	11	----	44
+4.75mm	----	1	%	----	<1	3	----	24
+9.5mm	----	1	%	----	<1	<1	----	<1
+19.0mm	----	1	%	----	<1	<1	----	<1
+37.5mm	----	1	%	----	<1	<1	----	<1
+75.0mm	----	1	%	----	<1	<1	----	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.5	7.1	6.3	6.4	6.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	30	20	77	8	5
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	8.6	3.7	2.6	6.2	9.3
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	35	28	----	21
Silt (2-60 µm)	----	1	%	----	7	9	----	17
Sand (0.06-2.00 mm)	----	1	%	----	54	52	----	18
Gravel (>2mm)	----	1	%	----	4	11	----	44
Cobbles (>6cm)	----	1	%	----	<1	<1	----	<1
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	3.2	1.4	1.9	1.5	0.8
Exchangeable Magnesium	----	0.1	meq/100g	1.8	1.3	1.3	1.2	2.1
Exchangeable Potassium	----	0.1	meq/100g	0.6	0.2	0.2	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.1	0.2	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	5.6	3.0	3.7	2.8	3.0
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	63	76	63	25	38
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	63	76	63	25	38
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	<1	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	30	<10	<10



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW38 0-50	WW38 500-600	WW44 0-100	WW44 100-200	WW44 500-600
				24-SEP-2011 15:00	24-SEP-2011 15:00	25-SEP-2011 15:00	25-SEP-2011 15:00	25-SEP-2011 15:00
				EB1121537-028	EB1121537-029	EB1121537-030	EB1121537-031	EB1121537-032
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	20	20	80	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	<10	20	40	<10	<10
Potassium	7440-09-7	10	mg/kg	30	<10	20	<10	<10
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	<50	----	<50	----	----
Cobalt	7440-48-4	2	mg/kg	6	----	32	----	----
Copper	7440-50-8	5	mg/kg	7	----	13	----	----
Iron	7439-89-6	50	mg/kg	21500	----	48800	----	----
Manganese	7439-96-5	5	mg/kg	513	----	1010	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	<5	----	11	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	1.3	----	0.2	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	740	----	260	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	740	----	260	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	188	----	224	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	2.1	----	1.2	----	----



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW47 0-100	WW60 0-20	WW60 20-300	WW60 700-800	WW69 0-50
				26-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00
				EB1121537-033	EB1121537-035	EB1121537-036	EB1121537-037	EB1121537-038
EA150: Particle Sizing								
+75µm	----	1	%	29	8	----	50	----
+150µm	----	1	%	24	6	----	49	----
+300µm	----	1	%	16	4	----	48	----
+425µm	----	1	%	12	3	----	47	----
+600µm	----	1	%	8	2	----	45	----
+1180µm	----	1	%	5	2	----	41	----
+2.36mm	----	1	%	2	<1	----	33	----
+4.75mm	----	1	%	<1	<1	----	22	----
+9.5mm	----	1	%	<1	<1	----	8	----
+19.0mm	----	1	%	<1	<1	----	<1	----
+37.5mm	----	1	%	<1	<1	----	<1	----
+75.0mm	----	1	%	<1	<1	----	<1	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.6	7.2	7.6	8.7	6.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	12	42	20	87	34
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	12.0	13.3	26.4	17.5	8.5
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	53	70	----	26	----
Silt (2-60 µm)	----	1	%	17	22	----	22	----
Sand (0.06-2.00 mm)	----	1	%	28	8	----	19	----
Gravel (>2mm)	----	1	%	2	<1	----	33	----
Cobbles (>6cm)	----	1	%	<1	<1	----	<1	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	8.8	42.6	45.7	61.1	10.6
Exchangeable Magnesium	----	0.1	meq/100g	6.5	23.4	23.9	25.0	6.4
Exchangeable Potassium	----	0.1	meq/100g	0.1	1.1	0.2	<0.1	0.3
Exchangeable Sodium	----	0.1	meq/100g	0.3	0.1	0.6	0.7	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	15.7	67.2	70.4	86.8	17.4
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	51	140	216	306	114
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	51	140	216	306	114
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	<1	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW47 0-100	WW60 0-20	WW60 20-300	WW60 700-800	WW69 0-50
				26-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00
<i>Compound</i>	<i>CAS Number</i>	<i>LOR</i>	<i>Unit</i>	EB1121537-033	EB1121537-035	EB1121537-036	EB1121537-037	EB1121537-038
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	10	<10	<10	20
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	20	<10	40	10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	20	<10
Sodium	7440-23-5	10	mg/kg	10	<10	20	50	<10
Potassium	7440-09-7	10	mg/kg	<10	10	<10	<10	10
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	<50	<50	----	----	<50
Cobalt	7440-48-4	2	mg/kg	52	183	----	----	58
Copper	7440-50-8	5	mg/kg	34	60	----	----	26
Iron	7439-89-6	50	mg/kg	71600	57200	----	----	76700
Manganese	7439-96-5	5	mg/kg	1180	2660	----	----	1170
Molybdenum	7439-98-7	2	mg/kg	<2	<2	----	----	<2
Zinc	7440-66-6	5	mg/kg	35	194	----	----	28
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.4	2.3	----	----	1.7
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	630	1230	----	----	1640
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	630	1230	----	----	1640
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	280	202	----	----	400
EP004: Organic Matter								
Organic Matter	----	0.5	%	2.4	2.3	----	----	3.6



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	WW69 200-300	WW69 800-900	WW75 0-50	WW75 400-500	WW75 900-1000
				27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00
				EB1121537-039	EB1121537-040	EB1121537-041	EB1121537-042	EB1121537-043
EA150: Particle Sizing								
+75µm	----	1	%	33	----	6	6	----
+150µm	----	1	%	29	----	4	3	----
+300µm	----	1	%	21	----	2	2	----
+425µm	----	1	%	16	----	1	1	----
+600µm	----	1	%	12	----	<1	<1	----
+1180µm	----	1	%	6	----	<1	<1	----
+2.36mm	----	1	%	2	----	<1	<1	----
+4.75mm	----	1	%	<1	----	<1	<1	----
+9.5mm	----	1	%	<1	----	<1	<1	----
+19.0mm	----	1	%	<1	----	<1	<1	----
+37.5mm	----	1	%	<1	----	<1	<1	----
+75.0mm	----	1	%	<1	----	<1	<1	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.5	7.5	7.4	8.7	9.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	14	26	41	52	97
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	17.1	14.7	15.6	26.4	14.1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	54	----	70	75	----
Silt (2-60 µm)	----	1	%	12	----	22	16	----
Sand (0.06-2.00 mm)	----	1	%	32	----	8	9	----
Gravel (>2mm)	----	1	%	2	----	<1	<1	----
Cobbles (>6cm)	----	1	%	<1	----	<1	<1	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	13.7	17.0	47.0	47.5	31.3
Exchangeable Magnesium	----	0.1	meq/100g	11.1	12.6	27.4	30.9	21.2
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.6	0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.4	1.4	0.3	3.1	2.8
Cation Exchange Capacity	----	0.1	meq/100g	25.3	31.0	75.4	81.6	55.3
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	63	51	140	228	317
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	63	51	140	228	266
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	<1	<1	51
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	30	20	10	20



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW69 200-300	WW69 800-900	WW75 0-50	WW75 400-500	WW75 900-1000
				27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1121537-039	EB1121537-040	EB1121537-041	EB1121537-042	EB1121537-043
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	10	10	<10	20
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	20	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	20	30	20	80	140
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	----	----	<50	----	----
Cobalt	7440-48-4	2	mg/kg	----	----	46	----	----
Copper	7440-50-8	5	mg/kg	----	----	26	----	----
Iron	7439-89-6	50	mg/kg	----	----	42300	----	----
Manganese	7439-96-5	5	mg/kg	----	----	732	----	----
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	----	----	60	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	----	2.9	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	----	1120	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	----	----	1120	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	----	135	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	2.5	----	----



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				WW94 0-50	WW94 200-300	WW94 600-700	----	----
				28-SEP-2011 15:00	29-SEP-2011 15:00	30-SEP-2011 15:00	----	----
Compound	CAS Number	LOR	Unit	EB1121537-044	EB1121537-045	EB1121537-046	----	----
EA150: Particle Sizing								
+75µm	----	1	%	4	----	36	----	----
+150µm	----	1	%	2	----	34	----	----
+300µm	----	1	%	1	----	32	----	----
+425µm	----	1	%	<1	----	32	----	----
+600µm	----	1	%	<1	----	30	----	----
+1180µm	----	1	%	<1	----	26	----	----
+2.36mm	----	1	%	<1	----	19	----	----
+4.75mm	----	1	%	<1	----	8	----	----
+9.5mm	----	1	%	<1	----	<1	----	----
+19.0mm	----	1	%	<1	----	<1	----	----
+37.5mm	----	1	%	<1	----	<1	----	----
+75.0mm	----	1	%	<1	----	<1	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.6	8.4	8.9	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	73	83	70	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	10.0	25.4	10.6	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	70	----	19	----	----
Silt (2-60 µm)	----	1	%	23	----	41	----	----
Sand (0.06-2.00 mm)	----	1	%	7	----	21	----	----
Gravel (>2mm)	----	1	%	<1	----	19	----	----
Cobbles (>6cm)	----	1	%	<1	----	<1	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	66.7	73.4	50.1	----	----
Exchangeable Magnesium	----	0.1	meq/100g	17.0	15.9	10.1	----	----
Exchangeable Potassium	----	0.1	meq/100g	1.1	0.3	<0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.2	0.3	----	----
Cation Exchange Capacity	----	0.1	meq/100g	85.0	89.9	60.6	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	228	254	317	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	228	254	292	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	25	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	----	----



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				WW94 0-50	WW94 200-300	WW94 600-700	----	----
				28-SEP-2011 15:00	29-SEP-2011 15:00	30-SEP-2011 15:00	----	----
Compound	CAS Number	LOR	Unit	EB1121537-044	EB1121537-045	EB1121537-046	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	60	90	50	----	----
Magnesium	7439-95-4	10	mg/kg	10	10	10	----	----
Sodium	7440-23-5	10	mg/kg	<10	10	30	----	----
Potassium	7440-09-7	10	mg/kg	10	<10	<10	----	----
EG005T: Total Metals by ICP-AES								
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	40	----	----	----	----
Copper	7440-50-8	5	mg/kg	36	----	----	----	----
Iron	7439-89-6	50	mg/kg	53000	----	----	----	----
Manganese	7439-96-5	5	mg/kg	1100	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	----	----
Zinc	7440-66-6	5	mg/kg	65	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	4.3	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	1210	----	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	1210	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	311	----	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	2.2	----	----	----	----

Certificate of Analysis

ALS Laboratory Group Pty Ltd
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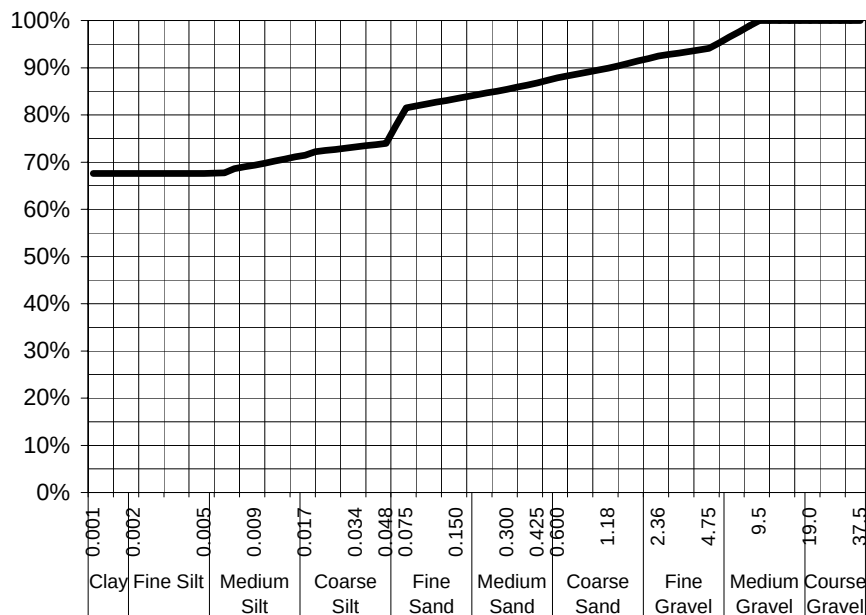
ALS Environmental

Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-002 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW6 20-30
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	94%
2.36	92%
1.18	90%
0.600	88%
0.425	87%
0.300	85%
0.150	83%
0.075	82%
Particle Size (microns)	
48	74%
34	73%
17	71%
9	69%
5	68%
3	68%
1	68%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

NATA Accreditation: 825 **Site:** Newcastle

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Dianne Blane

Laboratory Supervisor, Newcastle
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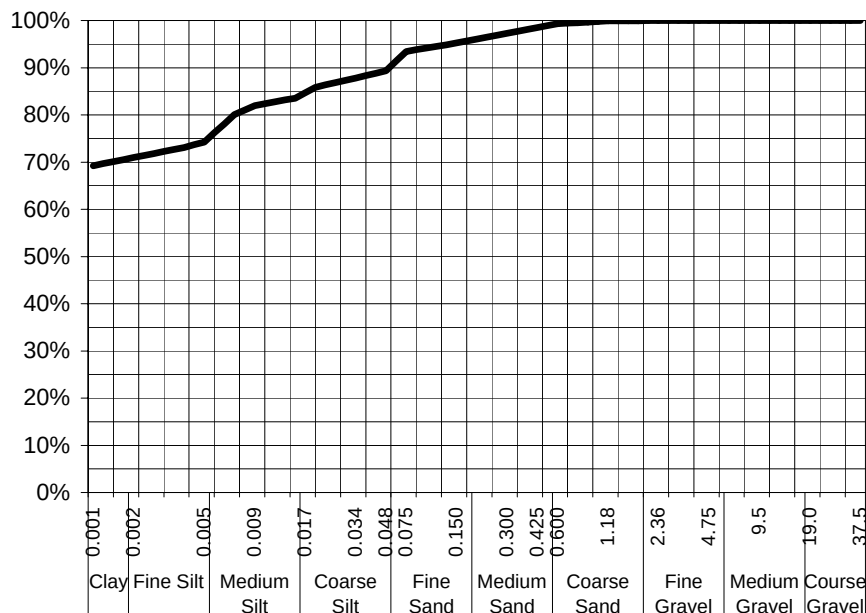
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-006 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW9 800-900
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	99%
0.300	97%
0.150	95%
0.075	93%
Particle Size (microns)	
48	89%
34	88%
17	85%
9	82%
5	74%
3	73%
1	69%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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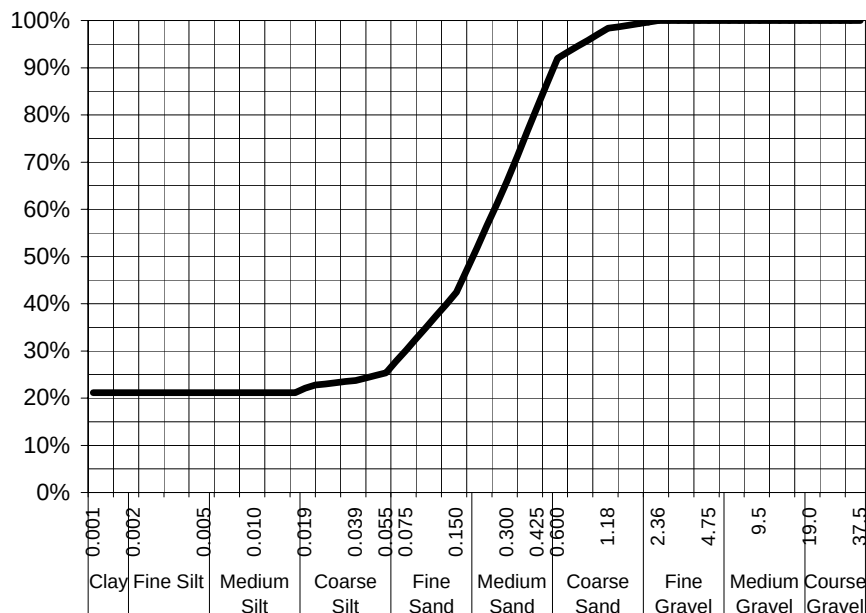
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-007 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW10 0-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	98%
0.600	92%
0.425	82%
0.300	66%
0.150	42%
0.075	30%
Particle Size (microns)	
55	25%
39	24%
19	22%
10	21%
5	21%
4	21%
1	21%

Samples analysed as received.

Median Particle Size (mm)	0.150
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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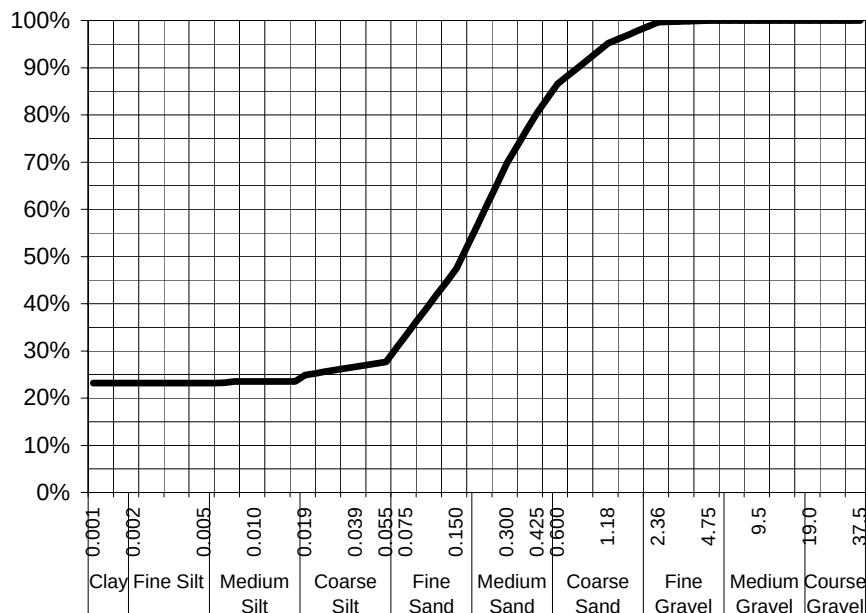
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-009 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW13 1000-1100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	95%
0.600	87%
0.425	81%
0.300	70%
0.150	47%
0.075	33%
Particle Size (microns)	
55	28%
39	27%
19	25%
10	24%
5	23%
4	23%
1	23%

Samples analysed as received.

Median Particle Size (mm)	0.150
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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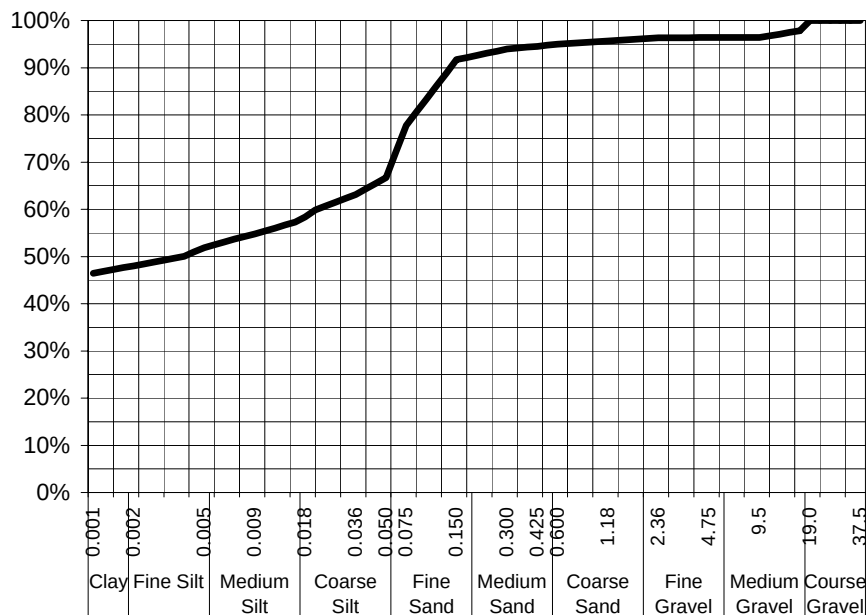
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-010 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW13 0-50
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	96%
4.75	96%
2.36	96%
1.18	96%
0.600	95%
0.425	95%
0.300	94%
0.150	92%
0.075	78%
Particle Size (microns)	
50	67%
36	63%
18	58%
9	55%
5	52%
3	50%
1	46%

Samples analysed as received.

Median Particle Size (mm)	0.004
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt, fine sand and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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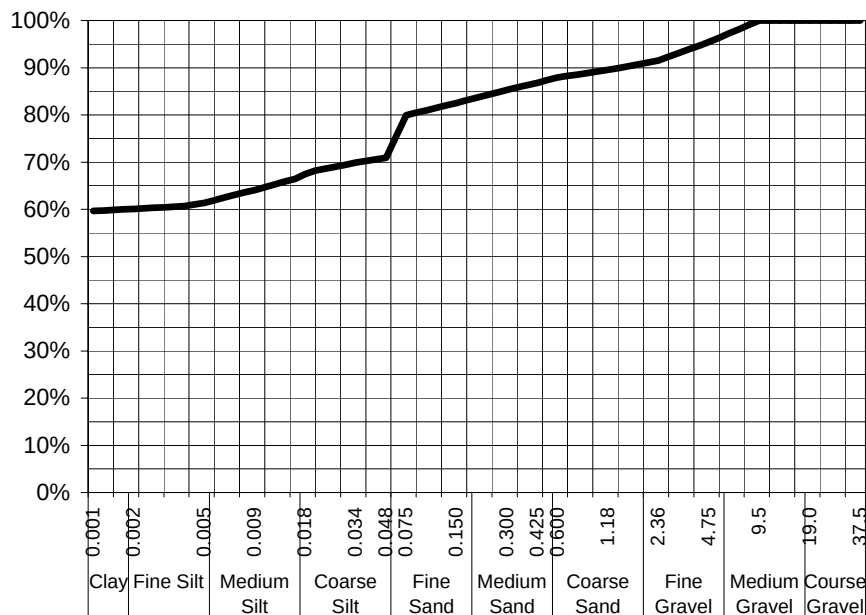
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COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-012 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW13 70-80
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	95%
2.36	92%
1.18	90%
0.600	88%
0.425	87%
0.300	85%
0.150	83%
0.075	80%
Particle Size (microns)	
48	71%
34	70%
18	67%
9	64%
5	61%
3	61%
1	60%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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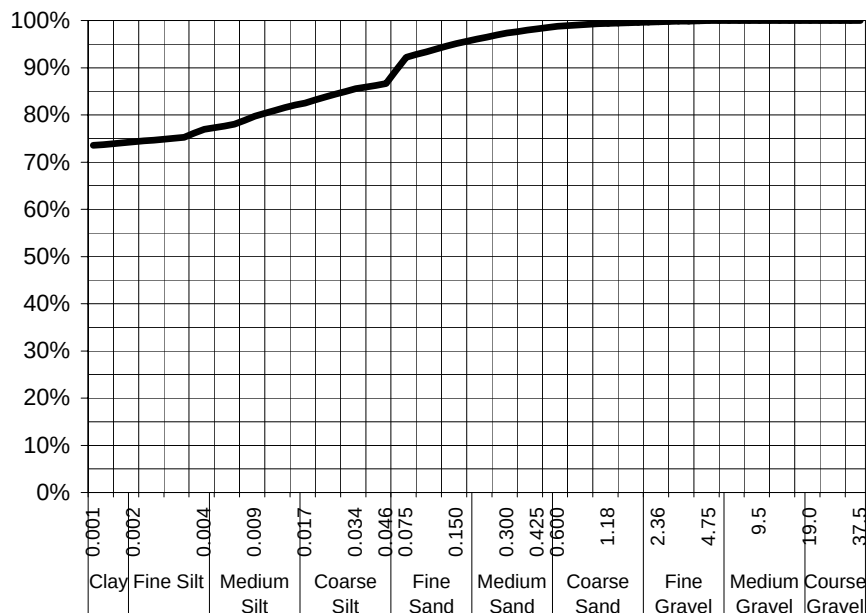
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-013 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW15 0-10
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	99%
0.425	98%
0.300	97%
0.150	95%
0.075	92%
Particle Size (microns)	
46	87%
34	86%
17	82%
9	80%
4	77%
3	75%
1	74%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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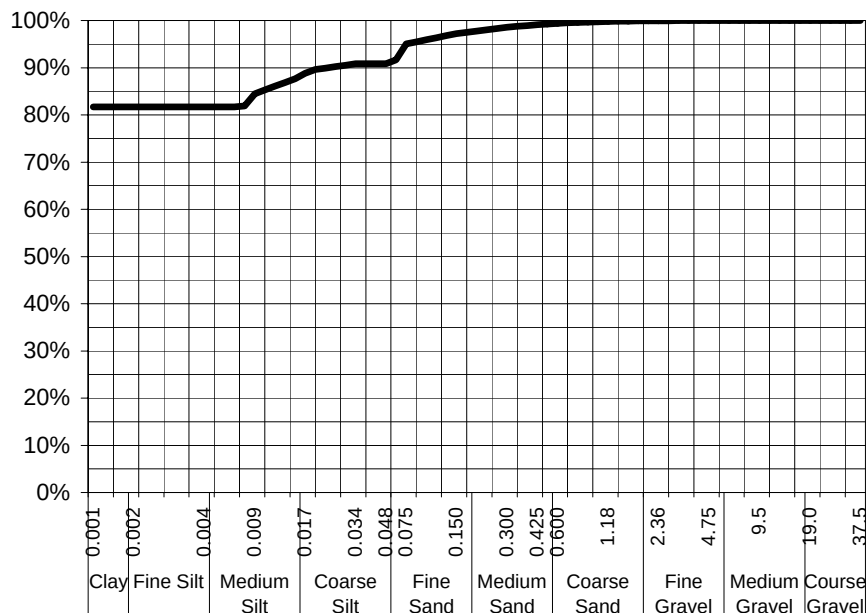
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-015 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW15 90-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	99%
0.300	99%
0.150	97%
0.075	95%
Particle Size (microns)	
48	91%
34	91%
17	89%
9	84%
4	82%
3	82%
1	82%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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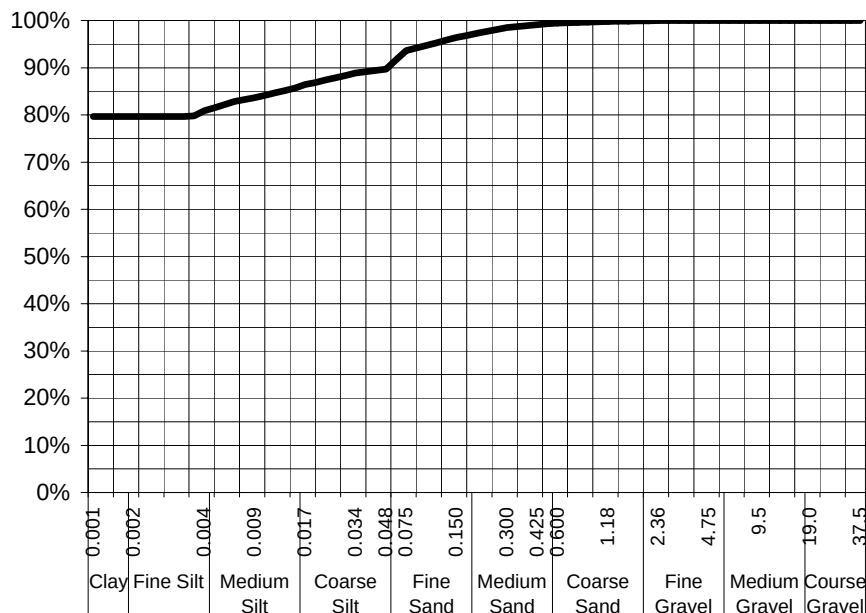
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-016 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW22 0-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	99%
0.300	99%
0.150	96%
0.075	94%
Particle Size (microns)	
48	90%
34	89%
17	86%
9	84%
4	81%
3	80%
1	80%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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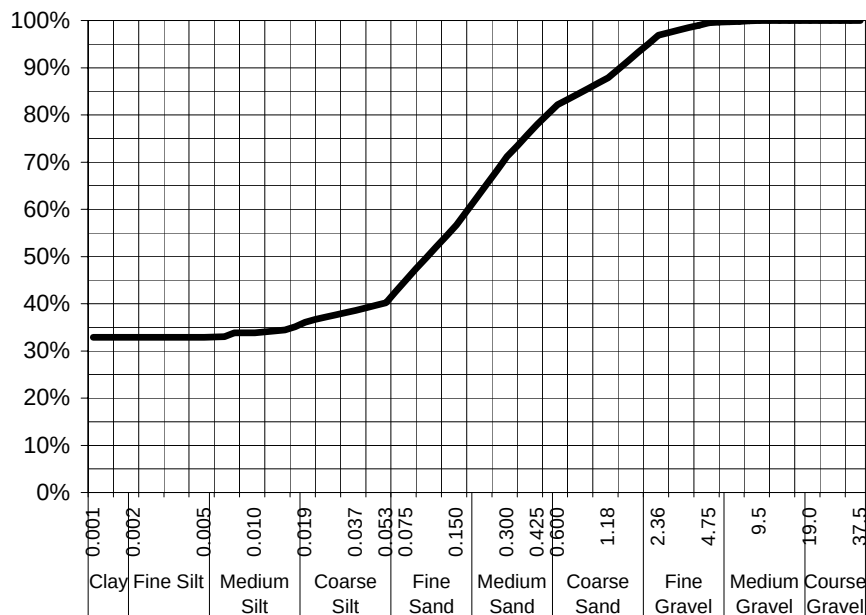
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-020 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW23 300-400
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	97%
1.18	88%
0.600	82%
0.425	78%
0.300	71%
0.150	57%
0.075	45%
Particle Size (microns)	
53	40%
37	39%
19	36%
10	34%
5	33%
3	33%
1	33%

Samples analysed as received.

Median Particle Size (mm)	0.075
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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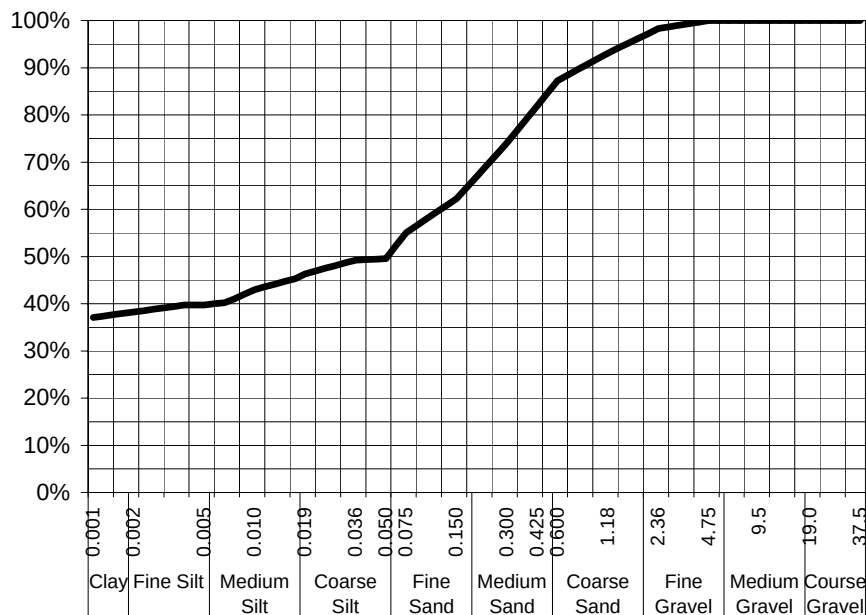
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-022 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW28 0-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	98%
1.18	93%
0.600	87%
0.425	82%
0.300	74%
0.150	62%
0.075	55%
Particle Size (microns)	
50	50%
36	49%
19	46%
10	43%
5	40%
3	40%
1	37%

Samples analysed as received.

Median Particle Size (mm)	0.050
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand, silty clay and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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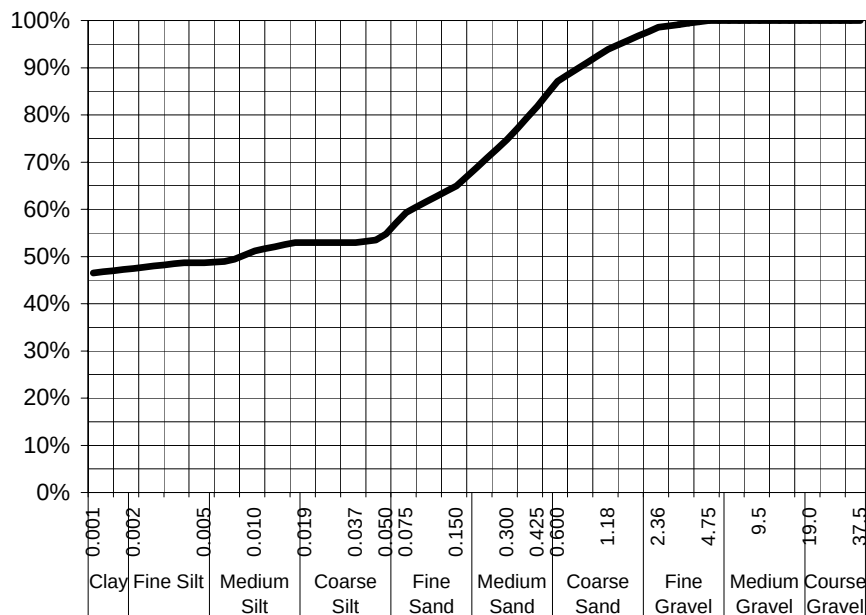
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-024 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW28 700-800
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	99%
1.18	94%
0.600	87%
0.425	82%
0.300	75%
0.150	65%
0.075	59%
Particle Size (microns)	
50	55%
37	53%
19	53%
10	51%
5	49%
3	49%
1	47%

Samples analysed as received.

Median Particle Size (mm)	0.008
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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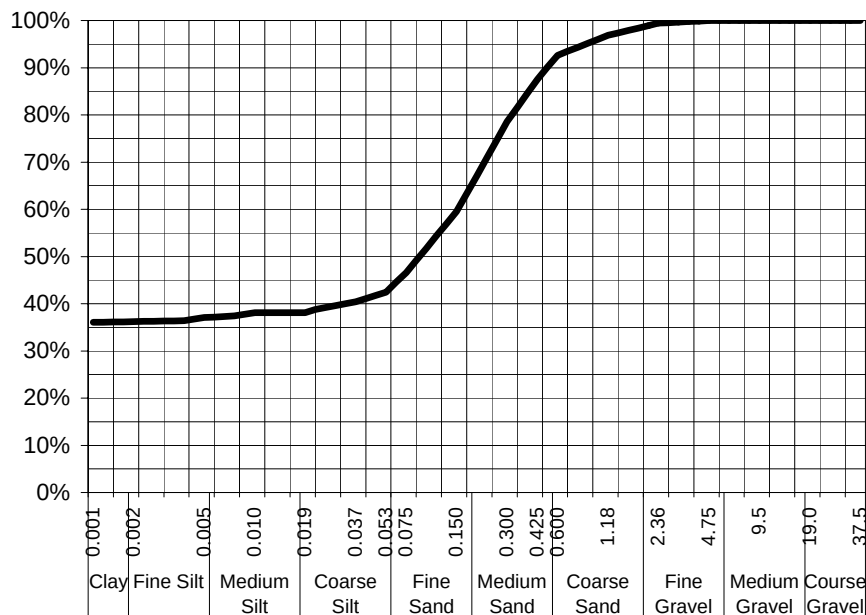
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-025 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW36 0-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	99%
1.18	97%
0.600	93%
0.425	88%
0.300	79%
0.150	60%
0.075	47%
Particle Size (microns)	
53	42%
37	40%
19	38%
10	38%
5	37%
3	36%
1	36%

Samples analysed as received.

Median Particle Size (mm)	0.075
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand, clay and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

NATA Accreditation: 825 **Site:** Newcastle

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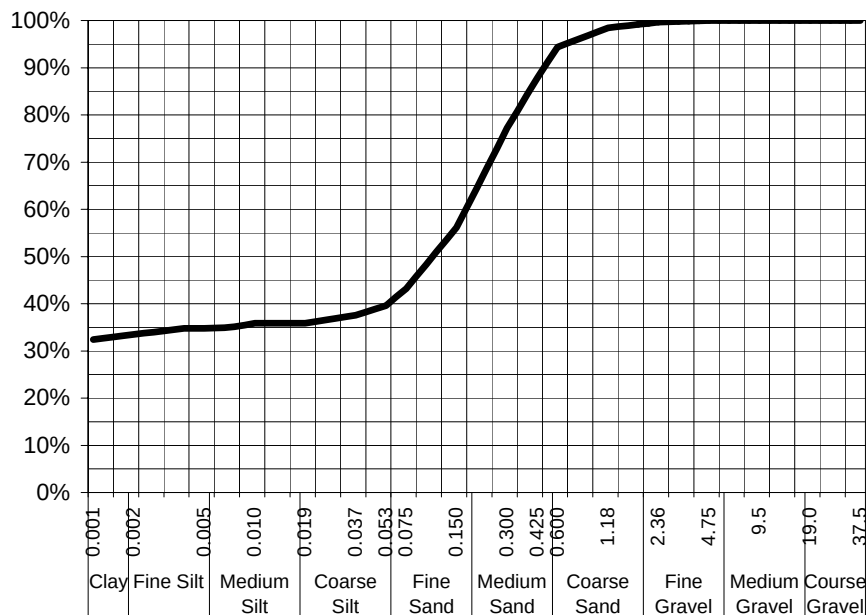
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-027 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW36 700-800
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	98%
0.600	94%
0.425	88%
0.300	77%
0.150	56%
0.075	43%
Particle Size (microns)	
53	40%
37	38%
19	36%
10	36%
5	35%
3	35%
1	32%

Samples analysed as received.

Median Particle Size (mm)	0.075
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

NATA Accreditation: 825 **Site:** Newcastle

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Dianne Blane

Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

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samples.newcastle@alsenviro.com

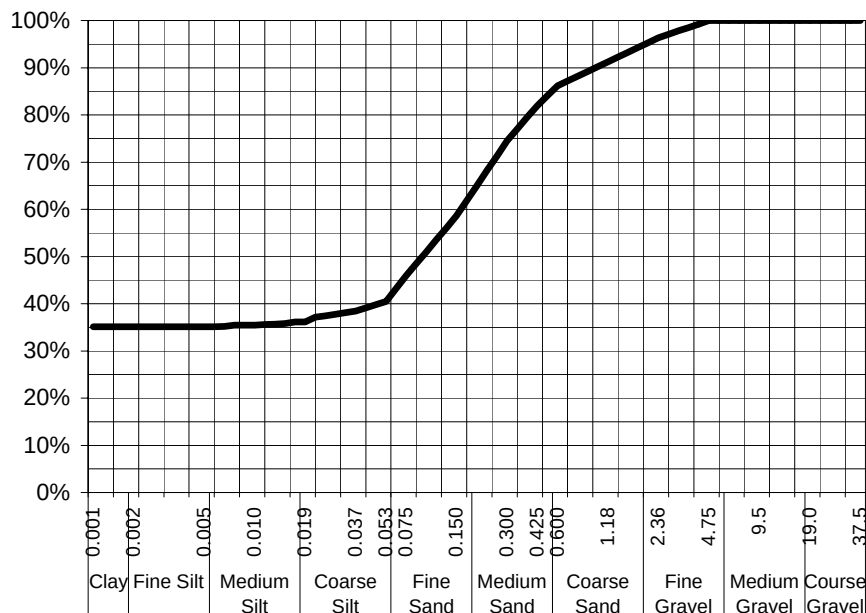
ALS Environmental

Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-029 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW38 500-600
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	96%
1.18	91%
0.600	86%
0.425	82%
0.300	75%
0.150	59%
0.075	46%
Particle Size (microns)	
53	40%
37	38%
19	36%
10	35%
5	35%
3	35%
1	35%

Samples analysed as received.

Median Particle Size (mm)	0.075
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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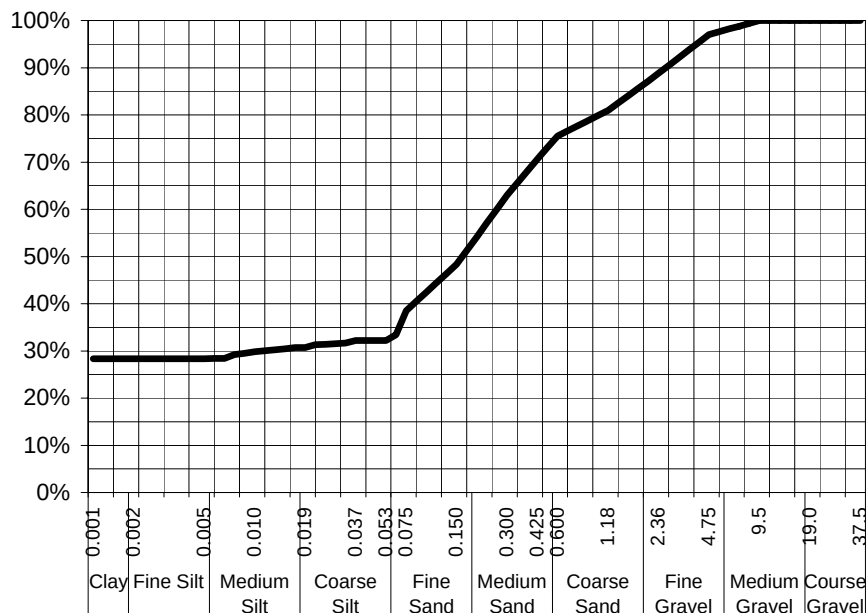
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-030 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW44 0-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	97%
2.36	89%
1.18	81%
0.600	76%
0.425	71%
0.300	63%
0.150	48%
0.075	39%
Particle Size (microns)	
53	32%
37	32%
19	31%
10	30%
5	28%
4	28%
1	28%

Samples analysed as received.

Median Particle Size (mm)	0.150
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and clay

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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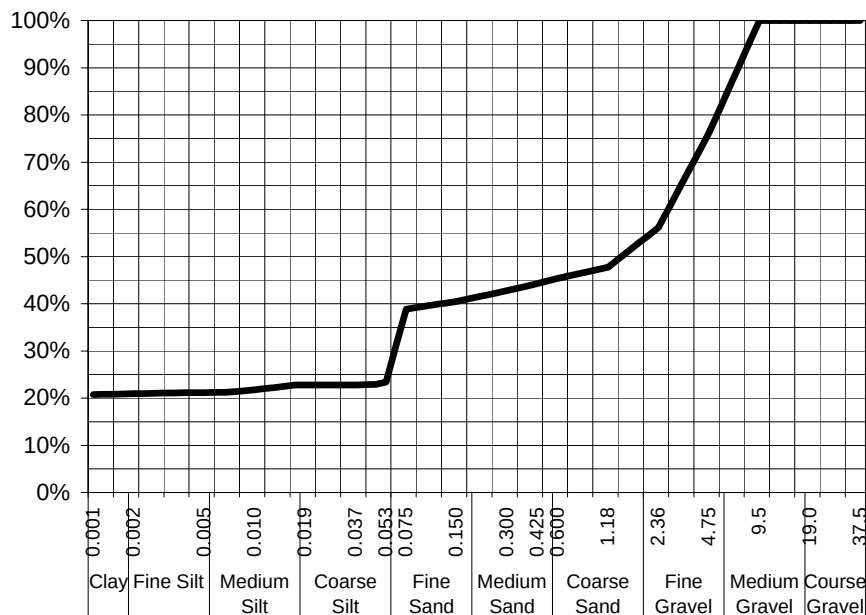
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-032 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW44 500-600
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	76%
2.36	56%
1.18	48%
0.600	45%
0.425	44%
0.300	43%
0.150	40%
0.075	39%
Particle Size (microns)	
53	23%
37	23%
19	23%
10	22%
5	21%
3	21%
1	21%

Samples analysed as received.

Median Particle Size (mm)	1.180
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Gravel, silty clay and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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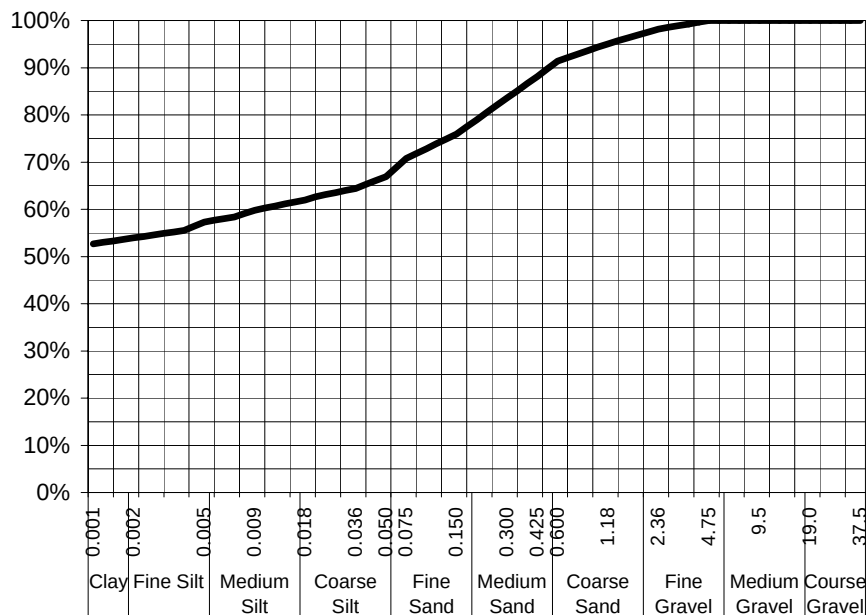
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-033 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW47 0-100
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	98%
1.18	95%
0.600	91%
0.425	88%
0.300	84%
0.150	76%
0.075	71%
Particle Size (microns)	
50	67%
36	64%
18	62%
9	60%
5	57%
3	56%
1	53%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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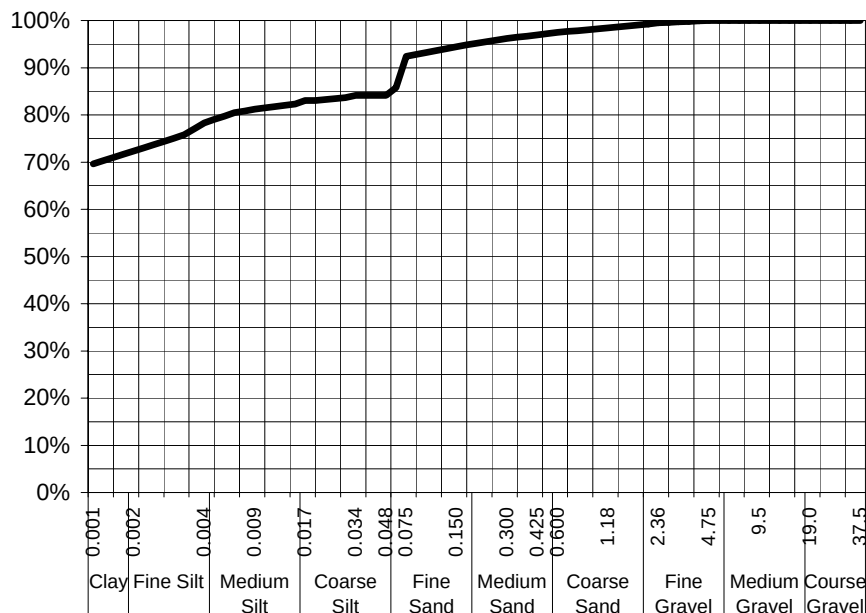
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fax 02 4968 0349
samples.newcastle@alsenviro.com

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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-035 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW60 0-20
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	98%
0.600	97%
0.425	97%
0.300	96%
0.150	94%
0.075	92%
Particle Size (microns)	
48	84%
34	84%
17	83%
9	81%
4	78%
3	76%
1	70%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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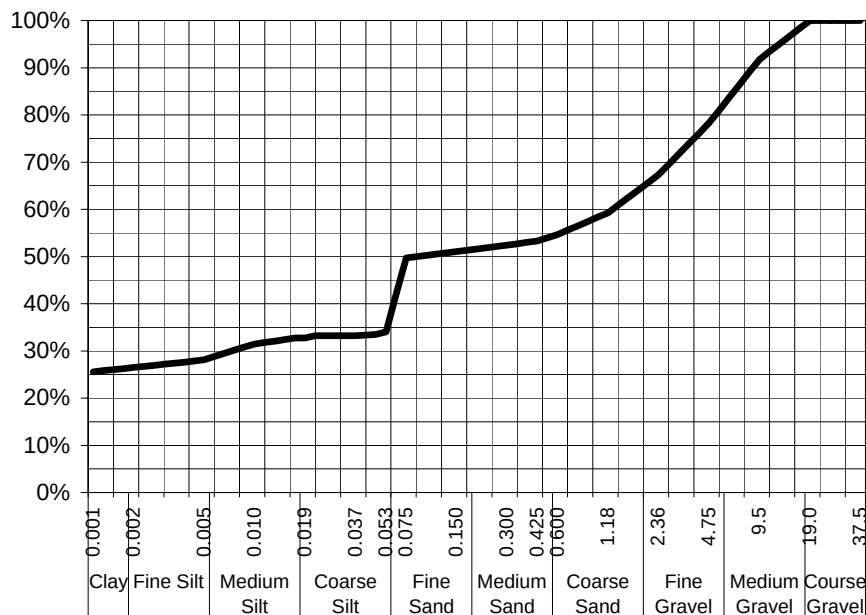
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-037 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW60 700-800
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	92%
4.75	78%
2.36	67%
1.18	59%
0.600	55%
0.425	53%
0.300	52%
0.150	51%
0.075	50%
Particle Size (microns)	
53	34%
37	33%
19	33%
10	31%
5	28%
3	28%
1	26%

Samples analysed as received.

Median Particle Size (mm)	0.075
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt, gravel and coarse sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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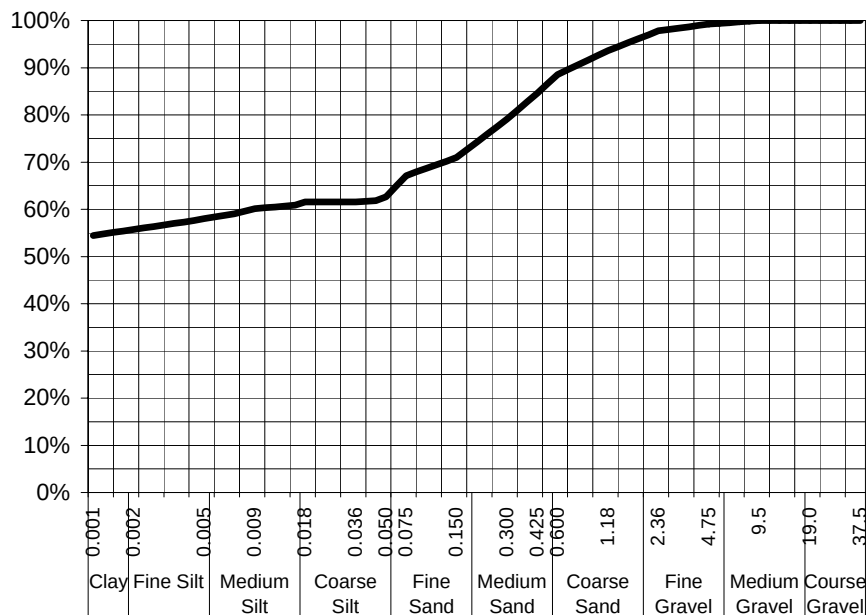
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fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental
Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-039 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW69 200-300
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	99%
2.36	98%
1.18	94%
0.600	89%
0.425	85%
0.300	79%
0.150	71%
0.075	67%
Particle Size (microns)	
50	63%
36	62%
18	62%
9	60%
5	58%
3	57%
1	54%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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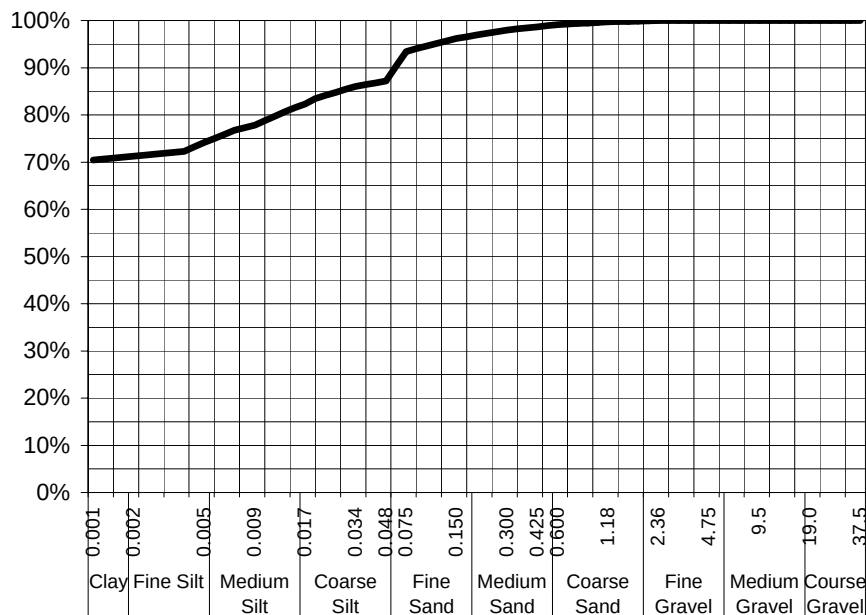
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-041 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW75 0-50
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	99%
0.300	98%
0.150	96%
0.075	93%
Particle Size (microns)	
48	87%
34	86%
17	82%
9	78%
5	74%
3	72%
1	70%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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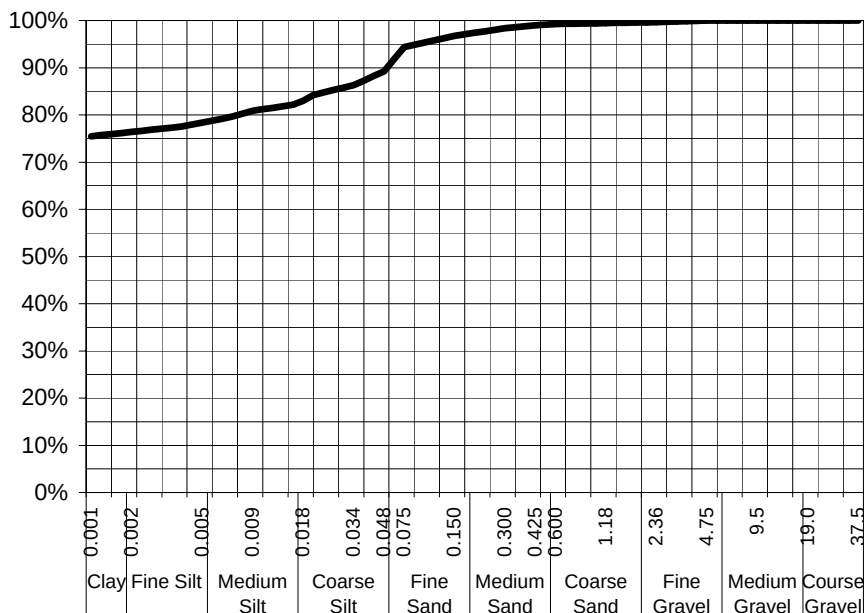
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-042 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW75 400-500
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	99%
0.425	99%
0.300	98%
0.150	97%
0.075	94%
Particle Size (microns)	
48	89%
34	86%
18	83%
9	81%
5	78%
3	78%
1	75%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

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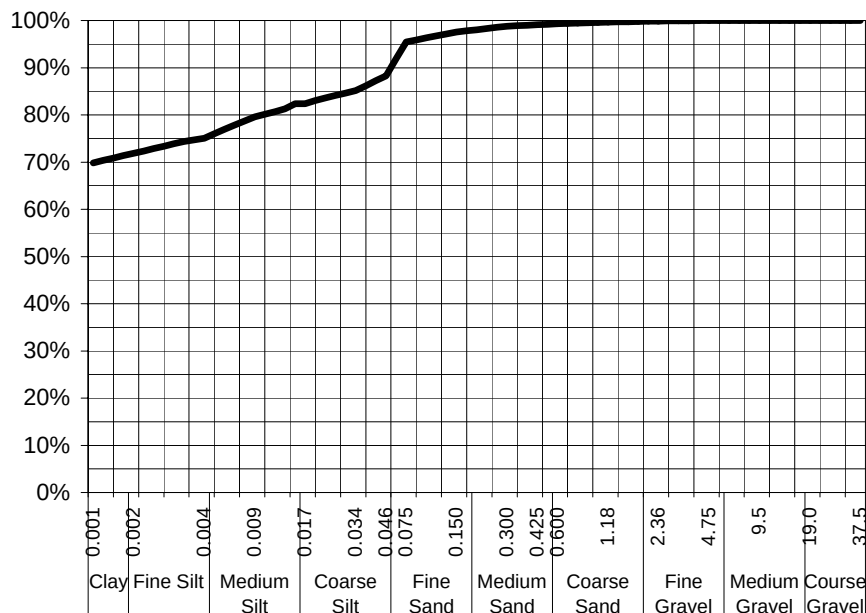
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Newcastle, NSW



CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-044 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW94 0-50
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	99%
0.300	99%
0.150	98%
0.075	95%
Particle Size (microns)	
46	88%
34	85%
17	82%
9	80%
4	75%
3	74%
1	70%

Samples analysed as received.

Median Particle Size (mm)	#N/A
---------------------------	------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Clay silt and vegetation

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

NATA Accreditation: 825 **Site:** Newcastle

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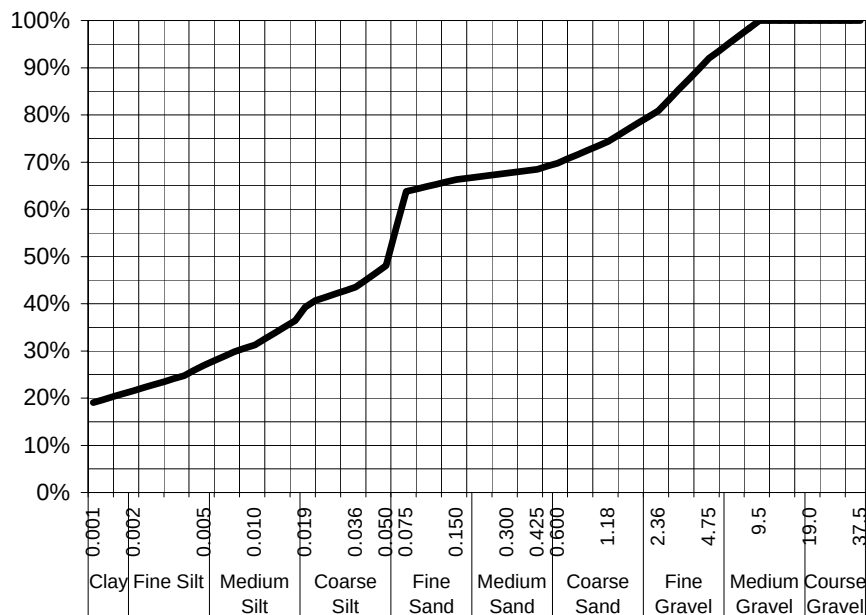
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CLIENT: Timothy Rohde **DATE REPORTED:** 26-Oct-2011
COMPANY: Sinclair Knight Merz **DATE RECEIVED:** 17-Oct-2011
ADDRESS: P O Box 312 Flinders Lane **REPORT NO:** EB1121537-046 / PSD
Melbourne, Vic Australia 8009
PROJECT: QEO9811 400 Wards Well - **SAMPLE ID:** WW94 600-700
Land Resources

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	92%
2.36	81%
1.18	74%
0.600	70%
0.425	68%
0.300	68%
0.150	66%
0.075	64%
Particle Size (microns)	
50	48%
36	44%
19	39%
10	31%
5	27%
4	25%
1	19%

Samples analysed as received.

Median Particle Size (mm)	0.050
---------------------------	-------

Sample Comments:

Analysed: 20-Oct-11

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silt clay, coarse sand and gravel

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density 2.65 g/cm³ Assumed

NATA Accreditation: 825 **Site:** Newcastle

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Laboratory Supervisor, Newcastle
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Environmental Division

QUALITY CONTROL REPORT

Work Order	: EB1121537	Page	: 1 of 10
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Brisbane
Contact	: MR TIMOTHY ROHDE	Contact	: Dean Sullivan
Address	: P O BOX 312 FLINDERS LANE MELBOURNE VIC AUSTRALIA 8009	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: trohde@skm.com.au	E-mail	: dean.sullivan@alsglobal.com
Telephone	: +61 03 8668 3000	Telephone	: +61 7 3243 7144
Facsimile	: +61 03 8668 3001	Facsimile	: +61 7 3243 7218
Project	: QEO9811 400 Wards Well - Land Resources	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 17-OCT-2011
C-O-C number	: ----	Issue Date	: 26-OCT-2011
Sampler	: A Thompson/T Rohde	No. of samples received	: 64
Order number	: ----	No. of samples analysed	: 43
Quote number	: EN/003/10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dianne Blane	Laboratory Supervisor	Newcastle
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

Environmental Division Brisbane

Part of the **ALS Laboratory Group**

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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA002 : pH (Soils) (QC Lot: 2005966)									
EB1121537-001	WW6 0-10	EA002: pH Value	----	0.1	pH Unit	7.8	7.8	0.0	0% - 20%
EB1121537-028	WW38 0-50	EA002: pH Value	----	0.1	pH Unit	6.5	6.5	0.0	0% - 20%
EA002 : pH (Soils) (QC Lot: 2005976)									
EB1121537-038	WW69 0-50	EA002: pH Value	----	0.1	pH Unit	6.7	6.8	0.0	0% - 20%
EA002 : pH (Soils) (QC Lot: 2005984)									
EB1121537-002	WW6 20-30	EA002: pH Value	----	0.1	pH Unit	8.6	8.6	0.0	0% - 20%
EB1121537-015	WW15 90-100	EA002: pH Value	----	0.1	pH Unit	8.3	8.2	0.0	0% - 20%
EA002 : pH (Soils) (QC Lot: 2006001)									
EB1121537-037	WW60 700-800	EA002: pH Value	----	0.1	pH Unit	8.7	8.7	0.0	0% - 20%
EA010: Conductivity (QC Lot: 2005968)									
EB1121537-001	WW6 0-10	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	107	110	2.8	0% - 20%
EB1121537-028	WW38 0-50	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	30	26	14.3	0% - 20%
EA010: Conductivity (QC Lot: 2005978)									
EB1121537-038	WW69 0-50	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	34	33	3.0	0% - 20%
EA010: Conductivity (QC Lot: 2005986)									
EB1121537-002	WW6 20-30	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	137	136	0.7	0% - 20%
EB1121537-015	WW15 90-100	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	989	1010	2.1	0% - 20%
EA010: Conductivity (QC Lot: 2006003)									
EB1121537-037	WW60 700-800	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	87	83	4.7	0% - 20%
EA055: Moisture Content (QC Lot: 2006028)									
EB1121537-004	WW9 0-100	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	7.2	7.0	3.7	No Limit
EB1121537-011	WW13 20-30	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	13.5	14.4	6.5	0% - 50%
EA055: Moisture Content (QC Lot: 2006029)									
EB1121537-026	WW36 200-300	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	7.3	7.1	3.9	No Limit
EB1121537-033	WW47 0-100	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	12.0	12.1	0.0	0% - 50%
ED007: Exchangeable Cations (QC Lot: 2006014)									
EB1121537-001	WW6 0-10	ED007: Exchangeable Calcium	----	0.1	meq/100g	37.3	36.3	2.5	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	17.4	17.5	0.9	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	2.2	2.2	0.0	0% - 20%
		ED007: Exchangeable Sodium	----	0.1	meq/100g	0.2	0.2	0.0	No Limit
EB1121537-009	WW13 1000-1100	ED007: Exchangeable Calcium	----	0.1	meq/100g	1.0	1.0	0.0	0% - 50%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	0.7	0.7	0.0	No Limit
		ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED007: Exchangeable Cations (QC Lot: 2006015)									
EB1121537-023	WW28 200-300	ED007: Exchangeable Calcium	----	0.1	meq/100g	8.1	8.8	8.0	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	9.9	10.8	8.7	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	2.2	2.4	7.1	0% - 20%
EB1121537-031	WW44 100-200	ED007: Exchangeable Calcium	----	0.1	meq/100g	1.5	1.5	0.0	0% - 50%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	1.2	1.2	0.0	0% - 50%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
ED007: Exchangeable Cations (QC Lot: 2006016)									
EB1121537-044	WW94 0-50	ED007: Exchangeable Calcium	----	0.1	meq/100g	66.7	65.5	1.8	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	17.0	17.0	0.0	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	1.1	1.1	0.0	0% - 50%
		ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
ED037: Alkalinity (QC Lot: 2005970)									
EB1121537-001	WW6 0-10	ED037: Total Alkalinity as CaCO3	----	1	meq/kg	254	254	0.0	0% - 20%
EB1121537-028	WW38 0-50	ED037: Total Alkalinity as CaCO3	----	1	meq/kg	63	63	0.0	0% - 20%
ED037: Alkalinity (QC Lot: 2005980)									
EB1121537-038	WW69 0-50	ED037: Total Alkalinity as CaCO3	----	1	meq/kg	114	114	0.0	0% - 20%
ED037: Alkalinity (QC Lot: 2005988)									
EB1121537-002	WW6 20-30	ED037: Total Alkalinity as CaCO3	----	1	meq/kg	470	470	0.0	0% - 20%
EB1121537-015	WW15 90-100	ED037: Total Alkalinity as CaCO3	----	1	meq/kg	140	140	0.0	0% - 20%
ED037: Alkalinity (QC Lot: 2006005)									
EB1121537-037	WW60 700-800	ED037: Total Alkalinity as CaCO3	----	1	meq/kg	306	306	0.0	0% - 20%
ED040S: Soluble Major Anions (QC Lot: 2005967)									
EB1121537-001	WW6 0-10	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	20	0.0	No Limit
EB1121537-028	WW38 0-50	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	0.0	No Limit
ED040S: Soluble Major Anions (QC Lot: 2005977)									
EB1121537-038	WW69 0-50	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	0.0	No Limit
ED040S: Soluble Major Anions (QC Lot: 2005985)									
EB1121537-002	WW6 20-30	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	0.0	No Limit
EB1121537-015	WW15 90-100	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	530	570	7.4	0% - 20%
ED040S: Soluble Major Anions (QC Lot: 2006002)									
EB1121537-037	WW60 700-800	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	0.0	No Limit
ED045G: Chloride Discrete analyser (QC Lot: 2005972)									
EB1121537-001	WW6 0-10	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.0	No Limit
EB1121537-028	WW38 0-50	ED045G: Chloride	16887-00-6	10	mg/kg	20	20	0.0	No Limit
ED045G: Chloride Discrete analyser (QC Lot: 2005982)									
EB1121537-038	WW69 0-50	ED045G: Chloride	16887-00-6	10	mg/kg	20	20	0.0	No Limit

Page : 5 of 10
 Work Order : EB1121537
 Client : SINCLAIR KNIGHT MERZ
 Project : QEO9811 400 Wards Well - Land Resources



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED045G: Chloride Discrete analyser (QC Lot: 2005989)									
EB1121537-002	WW6 20-30	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.0	No Limit
EB1121537-015	WW15 90-100	ED045G: Chloride	16887-00-6	10	mg/kg	1630	1620	0.9	0% - 20%
ED045G: Chloride Discrete analyser (QC Lot: 2006006)									
EB1121537-037	WW60 700-800	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.0	No Limit
ED093S: Soluble Major Cations (QC Lot: 2005969)									
EB1121537-001	WW6 0-10	ED093S: Calcium	7440-70-2	10	mg/kg	50	60	0.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	20	20	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	20	30	0.0	No Limit
		ED093S: Potassium	7440-09-7	10	mg/kg	40	30	0.0	No Limit
EB1121537-028	WW38 0-50	ED093S: Calcium	7440-70-2	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Potassium	7440-09-7	10	mg/kg	30	30	0.0	No Limit
ED093S: Soluble Major Cations (QC Lot: 2005979)									
EB1121537-038	WW69 0-50	ED093S: Calcium	7440-70-2	10	mg/kg	10	10	0.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Potassium	7440-09-7	10	mg/kg	10	10	0.0	No Limit
ED093S: Soluble Major Cations (QC Lot: 2005987)									
EB1121537-002	WW6 20-30	ED093S: Calcium	7440-70-2	10	mg/kg	20	<10	0.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	170	160	0.0	0% - 50%
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.0	No Limit
EB1121537-015	WW15 90-100	ED093S: Calcium	7440-70-2	10	mg/kg	50	60	20.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	40	40	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	1160	1200	3.8	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.0	No Limit
ED093S: Soluble Major Cations (QC Lot: 2006004)									
EB1121537-037	WW60 700-800	ED093S: Calcium	7440-70-2	10	mg/kg	40	40	0.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	20	20	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	50	40	0.0	No Limit
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.0	No Limit
EG005T: Total Metals by ICP-AES (QC Lot: 2005948)									
EB1121537-001	WW6 0-10	EG005T: Cobalt	7440-48-4	2	mg/kg	66	58	12.8	0% - 20%
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	38	33	14.4	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	1290	1130	13.0	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	76	63	18.5	0% - 50%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG005T: Total Metals by ICP-AES (QC Lot: 2005948) - continued									
EB1121537-001	WW6 0-10	EG005T: Iron	7439-89-6	50	mg/kg	69600	63600	9.0	0% - 20%
EB1121537-030	WW44 0-100	EG005T: Cobalt	7440-48-4	2	mg/kg	32	29	10.4	0% - 50%
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	13	15	11.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	1010	1270	# 22.4	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	11	13	15.6	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
		EG005T: Iron	7439-89-6	50	mg/kg	48800	48500	0.6	0% - 20%
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2005971)									
EB1121537-001	WW6 0-10	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	19.8	20.0	1.2	0% - 20%
EB1121537-028	WW38 0-50	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	1.3	1.2	9.4	0% - 50%
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2005981)									
EB1121537-038	WW69 0-50	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	1.7	1.4	15.8	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2006017)									
EB1121537-001	WW6 0-10	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	2630	2160	19.4	0% - 20%
EB1121537-030	WW44 0-100	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	260	220	13.9	0% - 50%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2006018)									
EB1121537-001	WW6 0-10	EK067G: Total Phosphorus as P	----	2	mg/kg	494	528	6.5	0% - 20%
EB1121537-030	WW44 0-100	EK067G: Total Phosphorus as P	----	2	mg/kg	224	221	1.5	0% - 20%
EP004: Organic Matter (QC Lot: 2007396)									
EB1121434-001	Anonymous	EP004: Organic Matter	----	0.5	%	<0.5	<0.5	0.0	No Limit
EB1121532-001	Anonymous	EP004: Organic Matter	----	0.5	%	2.8	2.6	10.0	No Limit
EP004: Organic Matter (QC Lot: 2007397)									
EB1121537-030	WW44 0-100	EP004: Organic Matter	----	0.5	%	1.2	1.1	0.0	No Limit



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EA002 : pH (Soils) (QCLot: 2005966)								
EA002: pH Value	----	0.1	pH Unit	----	5.2 pH Unit	100	97	103
EA002 : pH (Soils) (QCLot: 2005976)								
EA002: pH Value	----	0.1	pH Unit	----	5.2 pH Unit	100	97	103
EA002 : pH (Soils) (QCLot: 2005984)								
EA002: pH Value	----	0.1	pH Unit	----	5.2 pH Unit	99.8	97	103
EA002 : pH (Soils) (QCLot: 2006001)								
EA002: pH Value	----	0.1	pH Unit	----	5.2 pH Unit	100	97	103
EA010: Conductivity (QCLot: 2005968)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	196 µS/cm	99.5	85	115
EA010: Conductivity (QCLot: 2005978)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	196 µS/cm	95.4	85	115
EA010: Conductivity (QCLot: 2005986)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	196 µS/cm	90.3	85	115
EA010: Conductivity (QCLot: 2006003)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	196 µS/cm	92.3	85	115
ED007: Exchangeable Cations (QCLot: 2006014)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.5	1.39 meq/100g	94.6	70	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.5	0.79 meq/100g	94.5	70	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.5	0.18 meq/100g	74.8	70	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.5	0.41 meq/100g	90.9	70	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	----	2.71 meq/100g	94.8	70	130
ED007: Exchangeable Cations (QCLot: 2006015)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.5	1.39 meq/100g	96.3	70	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.5	0.79 meq/100g	91.0	70	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.5	0.18 meq/100g	71.8	70	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.5	0.41 meq/100g	86.8	70	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	----	2.71 meq/100g	93.8	70	130
ED007: Exchangeable Cations (QCLot: 2006016)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.5	1.39 meq/100g	93.0	70	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.5	0.79 meq/100g	91.5	70	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.5	0.18 meq/100g	78.5	70	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.5	0.41 meq/100g	87.2	70	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	----	2.71 meq/100g	92.8	70	130



Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
ED037: Alkalinity (QCLot: 2005970)								
ED037: Total Alkalinity as CaCO3	----	1	meq/kg	<1	200 meq/kg	95.0	85	115
ED037: Alkalinity (QCLot: 2005980)								
ED037: Total Alkalinity as CaCO3	----	1	meq/kg	<1	200 meq/kg	95.0	85	115
ED037: Alkalinity (QCLot: 2005988)								
ED037: Total Alkalinity as CaCO3	----	1	meq/kg	<1	200 meq/kg	95.0	85	115
ED037: Alkalinity (QCLot: 2006005)								
ED037: Total Alkalinity as CaCO3	----	1	meq/kg	<1	200 meq/kg	95.0	85	115
ED040S: Soluble Major Anions (QCLot: 2005967)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	238 mg/kg	94.5	77	125
ED040S: Soluble Major Anions (QCLot: 2005977)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	238 mg/kg	99.1	77	125
ED040S: Soluble Major Anions (QCLot: 2005985)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	238 mg/kg	93.2	77	125
ED040S: Soluble Major Anions (QCLot: 2006002)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	238 mg/kg	92.4	77	125
ED045G: Chloride Discrete analyser (QCLot: 2005972)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	5000 mg/kg	99.9	81	125
ED045G: Chloride Discrete analyser (QCLot: 2005982)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	5000 mg/kg	# 11000	81	125
ED045G: Chloride Discrete analyser (QCLot: 2005989)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	5000 mg/kg	110	81	125
ED045G: Chloride Discrete analyser (QCLot: 2006006)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	5000 mg/kg	111	81	125
ED093S: Soluble Major Cations (QCLot: 2005969)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----
ED093S: Sodium	7440-23-5	10	mg/kg	<10	----	----	----	----
ED093S: Potassium	7440-09-7	10	mg/kg	<10	----	----	----	----
ED093S: Soluble Major Cations (QCLot: 2005979)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----
ED093S: Sodium	7440-23-5	10	mg/kg	<10	----	----	----	----
ED093S: Potassium	7440-09-7	10	mg/kg	<10	----	----	----	----
ED093S: Soluble Major Cations (QCLot: 2005987)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----



Sub-Matrix: **SOIL**

Method: Compound				Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
CAS Number	LOR	Unit						
ED093S: Soluble Major Cations (QCLot: 2005987) - continued								
ED093S: Sodium	7440-23-5	10	mg/kg	<10	----	----	----	----
ED093S: Potassium	7440-09-7	10	mg/kg	<10	----	----	----	----
ED093S: Soluble Major Cations (QCLot: 2006004)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----
ED093S: Sodium	7440-23-5	10	mg/kg	<10	----	----	----	----
ED093S: Potassium	7440-09-7	10	mg/kg	<10	----	----	----	----
EG005T: Total Metals by ICP-AES (QCLot: 2005948)								
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	24.49 mg/kg	94.1	87	125
EG005T: Copper	7440-50-8	5	mg/kg	<5	54.68 mg/kg	95.3	89	125
EG005T: Iron	7439-89-6	50	mg/kg	<50	15500 mg/kg	129	79	130
EG005T: Manganese	7439-96-5	5	mg/kg	<5	135.6 mg/kg	90.4	88	120
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	8.06 mg/kg	109	78.8	121.2
EG005T: Zinc	7440-66-6	5	mg/kg	<5	103.88 mg/kg	95.2	86	124
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2005971)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	104	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2005981)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.68 mg/kg	98.3	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2006017)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	534 mg/kg	78.1	70	118
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2006018)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	75 mg/kg	106	70	130
EP004: Organic Matter (QCLot: 2007396)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	97.4	85	115
EP004: Organic Matter (QCLot: 2007397)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	97.4	85	115



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: SOIL

Sub-Matrix: SOIL				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)		Recovery Limits (%)
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 2005948)							
EB1121537-004	WW9 0-100	EG005T: Cobalt	7440-48-4	50 mg/kg	89.8	70	130
		EG005T: Copper	7440-50-8	50 mg/kg	93.8	70	130
		EG005T: Manganese	7439-96-5	50 mg/kg	96.3	70	130
		EG005T: Zinc	7440-66-6	50 mg/kg	92.6	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2005971)							
EB1121537-004	WW9 0-100	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.0 mg/kg	111	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2006017)							
EB1121537-004	WW9 0-100	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	107	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2006018)							
EB1121537-004	WW9 0-100	EK067G: Total Phosphorus as P	----	100 mg/kg	93.8	70	130



Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1121537	Page	: 1 of 25
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Brisbane
Contact	: MR TIMOTHY ROHDE	Contact	: Dean Sullivan
Address	: P O BOX 312 FLINDERS LANE MELBOURNE VIC AUSTRALIA 8009	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: trohde@skm.com.au	E-mail	: dean.sullivan@alsglobal.com
Telephone	: +61 03 8668 3000	Telephone	: +61 7 3243 7144
Facsimile	: +61 03 8668 3001	Facsimile	: +61 7 3243 7218
Project	: QEO9811 400 Wards Well - Land Resources	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 17-OCT-2011
C-O-C number	: ----	Issue Date	: 26-OCT-2011
Sampler	: A Thompson/T Rohde		
Order number	: ----	No. of samples received	: 64
Quote number	: EN/003/10	No. of samples analysed	: 43

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

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Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: SOIL

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA002 : pH (Soils)								
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	28-SEP-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	21-OCT-2011	28-SEP-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	29-SEP-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	22-SEP-2011	21-OCT-2011	29-SEP-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	30-SEP-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	23-SEP-2011	21-OCT-2011	30-SEP-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	01-OCT-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	21-OCT-2011	01-OCT-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	02-OCT-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	25-SEP-2011	21-OCT-2011	02-OCT-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	03-OCT-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	04-OCT-2011	✖	25-OCT-2011	19-OCT-2011	✖

Page : 3 of 25
 Work Order : EB1121537
 Client : SINCLAIR KNIGHT MERZ
 Project : QEO9811 400 Wards Well - Land Resources



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA002 : pH (Soils) - Continued								
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	27-SEP-2011	21-OCT-2011	04-OCT-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	05-OCT-2011	✖	25-OCT-2011	19-OCT-2011	✖
Snap Lock Bag WW94 - 200-300		29-SEP-2011	21-OCT-2011	06-OCT-2011	✖	25-OCT-2011	21-OCT-2011	✖
Snap Lock Bag WW94 - 600-700		30-SEP-2011	21-OCT-2011	07-OCT-2011	✖	25-OCT-2011	21-OCT-2011	✖



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method			Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)				Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity									
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	28-SEP-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	21-OCT-2011	28-SEP-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	29-SEP-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	22-SEP-2011	21-OCT-2011	29-SEP-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	30-SEP-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	23-SEP-2011	21-OCT-2011	30-SEP-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	01-OCT-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	21-OCT-2011	01-OCT-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	02-OCT-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	25-SEP-2011	21-OCT-2011	02-OCT-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	03-OCT-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	04-OCT-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	27-SEP-2011	21-OCT-2011	04-OCT-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	05-OCT-2011	✖	25-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW94 - 200-300		29-SEP-2011	21-OCT-2011	06-OCT-2011	✖	25-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW94 - 600-700		30-SEP-2011	21-OCT-2011	07-OCT-2011	✖	25-OCT-2011	18-NOV-2011	✔	



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA055: Moisture Content								
Snap Lock Bag WW6 - 0-10, WW6 - 80-90, WW9 - 200-300, WW10 - 0-100, WW13 - 1000-1100, WW13 - 20-30,	WW6 - 20-30, WW9 - 0-100, WW9 - 800-900, WW10 - 500-600, WW13 - 0-50, WW13 - 70-80	21-SEP-2011	----	----	----	19-OCT-2011	05-OCT-2011	✖
Snap Lock Bag WW15 - 0-10, WW15 - 90-100,	WW15 - 30-40, WW22 - 0-100	22-SEP-2011	----	----	----	19-OCT-2011	06-OCT-2011	✖
Snap Lock Bag WW23 - 0-100, WW23 - 900-1000, WW28 - 200-300,	WW23 - 300-400, WW28 - 0-100, WW28 - 700-800	23-SEP-2011	----	----	----	19-OCT-2011	07-OCT-2011	✖
Snap Lock Bag WW36 - 0-100, WW36 - 700-800, WW38 - 500-600	WW36 - 200-300, WW38 - 0-50,	24-SEP-2011	----	----	----	19-OCT-2011	08-OCT-2011	✖
Snap Lock Bag WW44 - 0-100, WW44 - 500-600	WW44 - 100-200,	25-SEP-2011	----	----	----	19-OCT-2011	09-OCT-2011	✖
Snap Lock Bag WW47 - 0-100		26-SEP-2011	----	----	----	19-OCT-2011	10-OCT-2011	✖
Snap Lock Bag WW60 - 0-20, WW60 - 700-800, WW69 - 200-300, WW75 - 0-50, WW75 - 900-1000	WW60 - 20-300, WW69 - 0-50, WW69 - 800-900, WW75 - 400-500,	27-SEP-2011	----	----	----	19-OCT-2011	11-OCT-2011	✖
Snap Lock Bag WW94 - 0-50		28-SEP-2011	----	----	----	19-OCT-2011	12-OCT-2011	✖
Snap Lock Bag WW94 - 200-300		29-SEP-2011	----	----	----	19-OCT-2011	13-OCT-2011	✖
Snap Lock Bag WW94 - 600-700		30-SEP-2011	----	----	----	19-OCT-2011	14-OCT-2011	✖



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA150: Particle Sizing								
Snap Lock Bag WW6 - 20-30, WW10 - 0-100, WW13 - 0-50,	WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	---	19-MAR-2012	----	24-OCT-2011	19-MAR-2012	✔
Snap Lock Bag WW15 - 0-10, WW22 - 0-100	WW15 - 90-100,	22-SEP-2011	---	20-MAR-2012	----	24-OCT-2011	20-MAR-2012	✔
Snap Lock Bag WW23 - 300-400, WW28 - 700-800	WW28 - 0-100,	23-SEP-2011	---	21-MAR-2012	----	24-OCT-2011	21-MAR-2012	✔
Snap Lock Bag WW36 - 0-100, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	---	22-MAR-2012	----	24-OCT-2011	22-MAR-2012	✔
Snap Lock Bag WW44 - 0-100,	WW44 - 500-600	25-SEP-2011	---	23-MAR-2012	----	24-OCT-2011	23-MAR-2012	✔
Snap Lock Bag WW47 - 0-100		26-SEP-2011	---	24-MAR-2012	----	24-OCT-2011	24-MAR-2012	✔
Snap Lock Bag WW60 - 0-20, WW69 - 200-300, WW75 - 400-500	WW60 - 700-800, WW75 - 0-50,	27-SEP-2011	---	25-MAR-2012	----	24-OCT-2011	25-MAR-2012	✔
Snap Lock Bag WW94 - 0-50		28-SEP-2011	---	26-MAR-2012	----	24-OCT-2011	26-MAR-2012	✔
Snap Lock Bag WW94 - 600-700		30-SEP-2011	---	28-MAR-2012	----	24-OCT-2011	28-MAR-2012	✔



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA150: Soil Classification based on Particle Size								
Snap Lock Bag WW6 - 20-30, WW10 - 0-100, WW13 - 0-50,	WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	---	19-MAR-2012	----	24-OCT-2011	19-MAR-2012	✔
Snap Lock Bag WW15 - 0-10, WW22 - 0-100	WW15 - 90-100,	22-SEP-2011	---	20-MAR-2012	----	24-OCT-2011	20-MAR-2012	✔
Snap Lock Bag WW23 - 300-400, WW28 - 700-800	WW28 - 0-100,	23-SEP-2011	---	21-MAR-2012	----	24-OCT-2011	21-MAR-2012	✔
Snap Lock Bag WW36 - 0-100, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	---	22-MAR-2012	----	24-OCT-2011	22-MAR-2012	✔
Snap Lock Bag WW44 - 0-100,	WW44 - 500-600	25-SEP-2011	---	23-MAR-2012	----	24-OCT-2011	23-MAR-2012	✔
Snap Lock Bag WW47 - 0-100		26-SEP-2011	---	24-MAR-2012	----	24-OCT-2011	24-MAR-2012	✔
Snap Lock Bag WW60 - 0-20, WW69 - 200-300, WW75 - 400-500	WW60 - 700-800, WW75 - 0-50,	27-SEP-2011	---	25-MAR-2012	----	24-OCT-2011	25-MAR-2012	✔
Snap Lock Bag WW94 - 0-50		28-SEP-2011	---	26-MAR-2012	----	24-OCT-2011	26-MAR-2012	✔
Snap Lock Bag WW94 - 600-700		30-SEP-2011	---	28-MAR-2012	----	24-OCT-2011	28-MAR-2012	✔



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED007: Exchangeable Cations								
Soil Glass Jar - Unpreserved WW6 - 0-10, WW6 - 80-90, WW9 - 200-300, WW10 - 0-100, WW13 - 1000-1100, WW13 - 20-30,	WW6 - 20-30, WW9 - 0-100, WW9 - 800-900, WW10 - 500-600, WW13 - 0-50, WW13 - 70-80	21-SEP-2011	21-OCT-2011	19-MAR-2012	✔	21-OCT-2011	19-MAR-2012	✔
Soil Glass Jar - Unpreserved WW15 - 0-10, WW15 - 90-100,	WW15 - 30-40, WW22 - 0-100	22-SEP-2011	21-OCT-2011	20-MAR-2012	✔	21-OCT-2011	20-MAR-2012	✔
Soil Glass Jar - Unpreserved WW23 - 0-100, WW23 - 900-1000, WW28 - 200-300,	WW23 - 300-400, WW28 - 0-100, WW28 - 700-800	23-SEP-2011	21-OCT-2011	21-MAR-2012	✔	21-OCT-2011	21-MAR-2012	✔
Soil Glass Jar - Unpreserved WW36 - 0-100, WW36 - 700-800, WW38 - 500-600	WW36 - 200-300, WW38 - 0-50,	24-SEP-2011	21-OCT-2011	22-MAR-2012	✔	21-OCT-2011	22-MAR-2012	✔
Soil Glass Jar - Unpreserved WW44 - 0-100, WW44 - 500-600	WW44 - 100-200,	25-SEP-2011	21-OCT-2011	23-MAR-2012	✔	21-OCT-2011	23-MAR-2012	✔
Soil Glass Jar - Unpreserved WW47 - 0-100		26-SEP-2011	21-OCT-2011	24-MAR-2012	✔	21-OCT-2011	24-MAR-2012	✔
Soil Glass Jar - Unpreserved WW60 - 0-20, WW60 - 700-800, WW69 - 200-300, WW75 - 0-50, WW75 - 900-1000	WW60 - 20-300, WW69 - 0-50, WW69 - 800-900, WW75 - 400-500,	27-SEP-2011	21-OCT-2011	25-MAR-2012	✔	21-OCT-2011	25-MAR-2012	✔
Soil Glass Jar - Unpreserved WW94 - 0-50		28-SEP-2011	21-OCT-2011	26-MAR-2012	✔	21-OCT-2011	26-MAR-2012	✔
Soil Glass Jar - Unpreserved WW94 - 200-300		29-SEP-2011	21-OCT-2011	27-MAR-2012	✔	21-OCT-2011	27-MAR-2012	✔
Soil Glass Jar - Unpreserved WW94 - 600-700		30-SEP-2011	21-OCT-2011	28-MAR-2012	✔	21-OCT-2011	28-MAR-2012	✔



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method			Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)				Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037: Alkalinity									
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	19-MAR-2012	✔	26-OCT-2011	19-MAR-2012	✔	
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	21-OCT-2011	19-MAR-2012	✔	26-OCT-2011	19-MAR-2012	✔	
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	20-MAR-2012	✔	26-OCT-2011	20-MAR-2012	✔	
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	22-SEP-2011	21-OCT-2011	20-MAR-2012	✔	26-OCT-2011	20-MAR-2012	✔	
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	21-MAR-2012	✔	26-OCT-2011	21-MAR-2012	✔	
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	23-SEP-2011	21-OCT-2011	21-MAR-2012	✔	26-OCT-2011	21-MAR-2012	✔	
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	22-MAR-2012	✔	26-OCT-2011	22-MAR-2012	✔	
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	21-OCT-2011	22-MAR-2012	✔	26-OCT-2011	22-MAR-2012	✔	
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	23-MAR-2012	✔	26-OCT-2011	23-MAR-2012	✔	
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	25-SEP-2011	21-OCT-2011	23-MAR-2012	✔	26-OCT-2011	23-MAR-2012	✔	
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	24-MAR-2012	✔	26-OCT-2011	24-MAR-2012	✔	
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	25-MAR-2012	✔	26-OCT-2011	25-MAR-2012	✔	
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	27-SEP-2011	21-OCT-2011	25-MAR-2012	✔	26-OCT-2011	25-MAR-2012	✔	
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	26-MAR-2012	✔	26-OCT-2011	26-MAR-2012	✔	
Snap Lock Bag WW94 - 200-300		29-SEP-2011	21-OCT-2011	27-MAR-2012	✔	26-OCT-2011	27-MAR-2012	✔	
Snap Lock Bag WW94 - 600-700		30-SEP-2011	21-OCT-2011	28-MAR-2012	✔	26-OCT-2011	28-MAR-2012	✔	



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED040S : Soluble Sulfate by ICPAES								
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	28-SEP-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	21-OCT-2011	28-SEP-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	29-SEP-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	22-SEP-2011	21-OCT-2011	29-SEP-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	30-SEP-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	23-SEP-2011	21-OCT-2011	30-SEP-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	01-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	21-OCT-2011	01-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	02-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	25-SEP-2011	21-OCT-2011	02-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	03-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	04-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	27-SEP-2011	21-OCT-2011	04-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	05-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔
Snap Lock Bag WW94 - 200-300		29-SEP-2011	21-OCT-2011	06-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔
Snap Lock Bag WW94 - 600-700		30-SEP-2011	21-OCT-2011	07-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔



Matrix: SOIL

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED045G: Chloride Discrete analyser									
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	28-SEP-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	21-OCT-2011	28-SEP-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	29-SEP-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	22-SEP-2011	21-OCT-2011	29-SEP-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	30-SEP-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	23-SEP-2011	21-OCT-2011	30-SEP-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	01-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	21-OCT-2011	01-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	02-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	25-SEP-2011	21-OCT-2011	02-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	03-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	04-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	27-SEP-2011	21-OCT-2011	04-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	05-OCT-2011	✖	26-OCT-2011	16-NOV-2011	✔	
Snap Lock Bag WW94 - 200-300		29-SEP-2011	21-OCT-2011	06-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔	
Snap Lock Bag WW94 - 600-700		30-SEP-2011	21-OCT-2011	07-OCT-2011	✖	26-OCT-2011	18-NOV-2011	✔	



Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED093S: Soluble Major Cations									
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	19-MAR-2012	✓	26-OCT-2011	19-MAR-2012	✓	
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-SEP-2011	21-OCT-2011	19-MAR-2012	✓	26-OCT-2011	19-MAR-2012	✓	
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	20-MAR-2012	✓	26-OCT-2011	20-MAR-2012	✓	
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	22-SEP-2011	21-OCT-2011	20-MAR-2012	✓	26-OCT-2011	20-MAR-2012	✓	
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	21-MAR-2012	✓	26-OCT-2011	21-MAR-2012	✓	
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	23-SEP-2011	21-OCT-2011	21-MAR-2012	✓	26-OCT-2011	21-MAR-2012	✓	
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	22-MAR-2012	✓	26-OCT-2011	22-MAR-2012	✓	
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	24-SEP-2011	21-OCT-2011	22-MAR-2012	✓	26-OCT-2011	22-MAR-2012	✓	
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	23-MAR-2012	✓	26-OCT-2011	23-MAR-2012	✓	
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	25-SEP-2011	21-OCT-2011	23-MAR-2012	✓	26-OCT-2011	23-MAR-2012	✓	
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	24-MAR-2012	✓	26-OCT-2011	24-MAR-2012	✓	
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	25-MAR-2012	✓	26-OCT-2011	25-MAR-2012	✓	
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	27-SEP-2011	21-OCT-2011	25-MAR-2012	✓	26-OCT-2011	25-MAR-2012	✓	
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	26-MAR-2012	✓	26-OCT-2011	26-MAR-2012	✓	
Snap Lock Bag WW94 - 200-300		29-SEP-2011	21-OCT-2011	27-MAR-2012	✓	26-OCT-2011	27-MAR-2012	✓	
Snap Lock Bag WW94 - 600-700		30-SEP-2011	21-OCT-2011	28-MAR-2012	✓	26-OCT-2011	28-MAR-2012	✓	



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG005T: Total Metals by ICP-AES								
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	21-OCT-2011	19-MAR-2012	✔	22-OCT-2011	19-MAR-2012	✔
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	21-OCT-2011	20-MAR-2012	✔	22-OCT-2011	20-MAR-2012	✔
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	21-OCT-2011	21-MAR-2012	✔	22-OCT-2011	21-MAR-2012	✔
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	21-OCT-2011	22-MAR-2012	✔	22-OCT-2011	22-MAR-2012	✔
Snap Lock Bag WW44 - 0-100		25-SEP-2011	21-OCT-2011	23-MAR-2012	✔	22-OCT-2011	23-MAR-2012	✔
Snap Lock Bag WW47 - 0-100		26-SEP-2011	21-OCT-2011	24-MAR-2012	✔	22-OCT-2011	24-MAR-2012	✔
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	21-OCT-2011	25-MAR-2012	✔	22-OCT-2011	25-MAR-2012	✔
Snap Lock Bag WW94 - 0-50		28-SEP-2011	21-OCT-2011	26-MAR-2012	✔	22-OCT-2011	26-MAR-2012	✔
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	19-OCT-2011	19-MAR-2012	✔	26-OCT-2011	19-MAR-2012	✔
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	19-OCT-2011	20-MAR-2012	✔	26-OCT-2011	20-MAR-2012	✔
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	19-OCT-2011	21-MAR-2012	✔	26-OCT-2011	21-MAR-2012	✔
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	19-OCT-2011	22-MAR-2012	✔	26-OCT-2011	22-MAR-2012	✔
Snap Lock Bag WW44 - 0-100		25-SEP-2011	19-OCT-2011	23-MAR-2012	✔	26-OCT-2011	23-MAR-2012	✔
Snap Lock Bag WW47 - 0-100		26-SEP-2011	19-OCT-2011	24-MAR-2012	✔	26-OCT-2011	24-MAR-2012	✔
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	19-OCT-2011	25-MAR-2012	✔	26-OCT-2011	25-MAR-2012	✔
Snap Lock Bag WW94 - 0-50		28-SEP-2011	19-OCT-2011	26-MAR-2012	✔	26-OCT-2011	26-MAR-2012	✔



Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method			Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)				Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	21-OCT-2011	19-MAR-2012	✓	21-OCT-2011	19-MAR-2012	✓	
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	21-OCT-2011	20-MAR-2012	✓	21-OCT-2011	20-MAR-2012	✓	
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	21-OCT-2011	21-MAR-2012	✓	21-OCT-2011	21-MAR-2012	✓	
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	21-OCT-2011	22-MAR-2012	✓	21-OCT-2011	22-MAR-2012	✓	
Snap Lock Bag WW44 - 0-100		25-SEP-2011	21-OCT-2011	23-MAR-2012	✓	21-OCT-2011	23-MAR-2012	✓	
Snap Lock Bag WW47 - 0-100		26-SEP-2011	21-OCT-2011	24-MAR-2012	✓	21-OCT-2011	24-MAR-2012	✓	
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	21-OCT-2011	25-MAR-2012	✓	21-OCT-2011	25-MAR-2012	✓	
Snap Lock Bag WW94 - 0-50		28-SEP-2011	21-OCT-2011	26-MAR-2012	✓	21-OCT-2011	26-MAR-2012	✓	
EK067G: Total Phosphorus as P by Discrete Analyser									
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	21-OCT-2011	19-MAR-2012	✓	21-OCT-2011	19-MAR-2012	✓	
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	21-OCT-2011	20-MAR-2012	✓	21-OCT-2011	20-MAR-2012	✓	
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	21-OCT-2011	21-MAR-2012	✓	21-OCT-2011	21-MAR-2012	✓	
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	21-OCT-2011	22-MAR-2012	✓	21-OCT-2011	22-MAR-2012	✓	
Snap Lock Bag WW44 - 0-100		25-SEP-2011	21-OCT-2011	23-MAR-2012	✓	21-OCT-2011	23-MAR-2012	✓	
Snap Lock Bag WW47 - 0-100		26-SEP-2011	21-OCT-2011	24-MAR-2012	✓	21-OCT-2011	24-MAR-2012	✓	
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	21-OCT-2011	25-MAR-2012	✓	21-OCT-2011	25-MAR-2012	✓	
Snap Lock Bag WW94 - 0-50		28-SEP-2011	21-OCT-2011	26-MAR-2012	✓	21-OCT-2011	26-MAR-2012	✓	



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP004: Organic Matter								
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	21-SEP-2011	25-OCT-2011	28-SEP-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	22-SEP-2011	25-OCT-2011	29-SEP-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	23-SEP-2011	25-OCT-2011	30-SEP-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	24-SEP-2011	25-OCT-2011	01-OCT-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW44 - 0-100		25-SEP-2011	25-OCT-2011	02-OCT-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW47 - 0-100		26-SEP-2011	25-OCT-2011	03-OCT-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	27-SEP-2011	25-OCT-2011	04-OCT-2011	✖	25-OCT-2011	22-NOV-2011	✔
Snap Lock Bag WW94 - 0-50		28-SEP-2011	25-OCT-2011	05-OCT-2011	✖	25-OCT-2011	22-NOV-2011	✔



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity in Soil	ED037	6	43	14.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Cations - soluble by ICP-AES	ED093S	6	43	14.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride Soluble By Discrete Analyser	ED045G	6	43	14.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Electrical Conductivity (1:5)	EA010	6	43	14.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	5	43	11.6	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Soluble	ED040S	6	43	14.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	4	40	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	3	16	18.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Organic Matter	EP004	3	29	10.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH (1:5)	EA002	6	43	14.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus By Discrete Analyser	EK067G	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Alkalinity in Soil	ED037	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride Soluble By Discrete Analyser	ED045G	8	43	18.6	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Electrical Conductivity (1:5)	EA010	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	3	43	7.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Soluble	ED040S	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	16	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Organic Matter	EP004	2	29	6.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH (1:5)	EA002	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus By Discrete Analyser	EK067G	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Alkalinity in Soil	ED037	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Cations - soluble by ICP-AES	ED093S	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride Soluble By Discrete Analyser	ED045G	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Electrical Conductivity (1:5)	EA010	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	3	43	7.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Soluble	ED040S	4	43	9.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	16	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Organic Matter	EP004	2	29	6.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Page : 17 of 25
 Work Order : EB1121537
 Client : SINCLAIR KNIGHT MERZ
 Project : QEO9811 400 Wards Well - Land Resources



Matrix: **SOIL** Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Method Blanks (MB) - Continued							
Total Phosphorus By Discrete Analyser	EK067G	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	15	6.7	5.0	✓	ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	16	6.3	5.0	✓	ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	16	6.3	5.0	✓	ALS QCS3 requirement
Total Phosphorus By Discrete Analyser	EK067G	1	16	6.3	5.0	✓	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	(APHA 21st ed., 4500H+) pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 103)
Electrical Conductivity (1:5)	EA010	SOIL	(APHA 21st ed., 2510) Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 104)
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Particle Size Analysis (Sieving)	EA150	SOIL	Particle Size Analysis by Sieving according to AS1289.3.6.1 - 1995
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Exchangeable Cations	ED007	SOIL	Rayment & Higginson (1992) Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM (1999) Schedule B(3) (Method 301)
Alkalinity in Soil	ED037	SOIL	APHA 21st ed., 2320 B Alkalinity is determined and reported on a 1:5 soil/water leach.
Major Anions - Soluble	ED040S	SOIL	In-house. Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Chloride Soluble By Discrete Analyser	ED045G	SOIL	The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition 4500-Cl- E.
Cations - soluble by ICP-AES	ED093S	SOIL	APHA 21st ed., 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)
Total Metals by ICP-AES	EG005T	SOIL	(APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	APHA 21st ed., 4500 NO3- F. Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by Cadmium Reduction, and direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	APHA 21st ed., 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	APHA 21st ed., 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrogen, each determined separately as N.
Total Phosphorus By Discrete Analyser	EK067G	SOIL	APHA 21st ed., 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Emerson Aggregate Testing	EME-SOL	SOIL	Emerson Aggregate Testing per AS1289.3.8.1 performed by Subcontractor Laboratory.
Organic Matter	EP004	SOIL	AS1289.4.1.1 - 1997., Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (1999) Schedule B(3) (Method 105)
Preparation Methods	Method	Matrix	Method Descriptions
Exchangeable Cations Preparation Method	ED007PR	SOIL	Rayment & Higginson (1992) method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
TKN/TP Digestion	EK061/EK067	SOIL	APHA 21st ed., 4500 Norg- D; APHA 21st ed., 4500 P - H. Macro Kjeldahl digestion.

Page : 19 of 25
 Work Order : EB1121537
 Client : SINCLAIR KNIGHT MERZ
 Project : QEO9811 400 Wards Well - Land Resources



Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)
Organic Matter	EP004-PR	SOIL	AS1289.4.1.1 - 1997., Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (1999) Schedule B(3) (Method 105)



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG005T: Total Metals by ICP-AES	EB1121537-030	WW44 0-100	Manganese	7439-96-5	22.4 %	0-20%	RPD exceeds LOR based limits
Laboratory Control Spike (LCS) Recoveries							
ED045G: Chloride Discrete analyser	2371166-001	----	Chloride	16887-00-6	11000 %	81-125%	Recovery greater than upper control limit
ED045G: Chloride Discrete analyser	2371166-023	----	Chloride	16887-00-6	1.0 %	81-125%	Recovery less than lower control limit

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Matrix Spike outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA002 : pH (Soils)							
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	19-OCT-2011	28-SEP-2011	21	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-OCT-2011	28-SEP-2011	23	25-OCT-2011	21-OCT-2011	4
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	19-OCT-2011	29-SEP-2011	20	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	21-OCT-2011	29-SEP-2011	22	25-OCT-2011	21-OCT-2011	4
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	19-OCT-2011	30-SEP-2011	19	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	21-OCT-2011	30-SEP-2011	21	25-OCT-2011	21-OCT-2011	4



Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA002 : pH (Soils) - Analysis Holding Time Compliance							
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	19-OCT-2011	01-OCT-2011	18	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	21-OCT-2011	01-OCT-2011	20	25-OCT-2011	21-OCT-2011	4
Snap Lock Bag WW44 - 0-100		19-OCT-2011	02-OCT-2011	17	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	21-OCT-2011	02-OCT-2011	19	25-OCT-2011	21-OCT-2011	4
Snap Lock Bag WW47 - 0-100		19-OCT-2011	03-OCT-2011	16	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	19-OCT-2011	04-OCT-2011	15	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	21-OCT-2011	04-OCT-2011	17	25-OCT-2011	21-OCT-2011	4
Snap Lock Bag WW94 - 0-50		19-OCT-2011	05-OCT-2011	14	25-OCT-2011	19-OCT-2011	6
Snap Lock Bag WW94 - 200-300		21-OCT-2011	06-OCT-2011	15	25-OCT-2011	21-OCT-2011	4
Snap Lock Bag WW94 - 600-700		21-OCT-2011	07-OCT-2011	14	25-OCT-2011	21-OCT-2011	4
EA010: Conductivity							
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	19-OCT-2011	28-SEP-2011	21	----	----	----
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-OCT-2011	28-SEP-2011	23	----	----	----
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	19-OCT-2011	29-SEP-2011	20	----	----	----
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	21-OCT-2011	29-SEP-2011	22	----	----	----
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	19-OCT-2011	30-SEP-2011	19	----	----	----
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	21-OCT-2011	30-SEP-2011	21	----	----	----



Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA010: Conductivity - Analysis Holding Time Compliance							
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	19-OCT-2011	01-OCT-2011	18	----	----	----
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	21-OCT-2011	01-OCT-2011	20	----	----	----
Snap Lock Bag WW44 - 0-100		19-OCT-2011	02-OCT-2011	17	----	----	----
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	21-OCT-2011	02-OCT-2011	19	----	----	----
Snap Lock Bag WW47 - 0-100		19-OCT-2011	03-OCT-2011	16	----	----	----
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	19-OCT-2011	04-OCT-2011	15	----	----	----
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	21-OCT-2011	04-OCT-2011	17	----	----	----
Snap Lock Bag WW94 - 0-50		19-OCT-2011	05-OCT-2011	14	----	----	----
Snap Lock Bag WW94 - 200-300		21-OCT-2011	06-OCT-2011	15	----	----	----
Snap Lock Bag WW94 - 600-700		21-OCT-2011	07-OCT-2011	14	----	----	----
EA055: Moisture Content							
Snap Lock Bag WW6 - 0-10, WW6 - 80-90, WW9 - 200-300, WW10 - 0-100, WW13 - 1000-1100, WW13 - 20-30,	WW6 - 20-30, WW9 - 0-100, WW9 - 800-900, WW10 - 500-600, WW13 - 0-50, WW13 - 70-80	----	----	----	19-OCT-2011	05-OCT-2011	14
Snap Lock Bag WW15 - 0-10, WW15 - 90-100,	WW15 - 30-40, WW22 - 0-100	----	----	----	19-OCT-2011	06-OCT-2011	13
Snap Lock Bag WW23 - 0-100, WW23 - 900-1000, WW28 - 200-300,	WW23 - 300-400, WW28 - 0-100, WW28 - 700-800	----	----	----	19-OCT-2011	07-OCT-2011	12
Snap Lock Bag WW36 - 0-100, WW36 - 700-800, WW38 - 500-600	WW36 - 200-300, WW38 - 0-50,	----	----	----	19-OCT-2011	08-OCT-2011	11



Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA055: Moisture Content - Analysis Holding Time Compliance							
Snap Lock Bag WW44 - 0-100, WW44 - 500-600	WW44 - 100-200,	----	----	----	19-OCT-2011	09-OCT-2011	10
Snap Lock Bag WW47 - 0-100		----	----	----	19-OCT-2011	10-OCT-2011	9
Snap Lock Bag WW60 - 0-20, WW60 - 700-800, WW69 - 200-300, WW75 - 0-50, WW75 - 900-1000	WW60 - 20-300, WW69 - 0-50, WW69 - 800-900, WW75 - 400-500,	----	----	----	19-OCT-2011	11-OCT-2011	8
Snap Lock Bag WW94 - 0-50		----	----	----	19-OCT-2011	12-OCT-2011	7
Snap Lock Bag WW94 - 200-300		----	----	----	19-OCT-2011	13-OCT-2011	6
Snap Lock Bag WW94 - 600-700		----	----	----	19-OCT-2011	14-OCT-2011	5
ED040S : Soluble Sulfate by ICPAES							
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	19-OCT-2011	28-SEP-2011	21	----	----	----
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-OCT-2011	28-SEP-2011	23	----	----	----
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	19-OCT-2011	29-SEP-2011	20	----	----	----
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	21-OCT-2011	29-SEP-2011	22	----	----	----
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	19-OCT-2011	30-SEP-2011	19	----	----	----
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	21-OCT-2011	30-SEP-2011	21	----	----	----
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	19-OCT-2011	01-OCT-2011	18	----	----	----
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	21-OCT-2011	01-OCT-2011	20	----	----	----
Snap Lock Bag WW44 - 0-100		19-OCT-2011	02-OCT-2011	17	----	----	----



Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
ED040S : Soluble Sulfate by ICPAES - Analysis Holding Time Compliance							
Snap Lock Bag WW44 - 100-200,	WW44 - 500-600	21-OCT-2011	02-OCT-2011	19	----	----	----
Snap Lock Bag WW47 - 0-100		19-OCT-2011	03-OCT-2011	16	----	----	----
Snap Lock Bag WW60 - 0-20, WW75 - 0-50	WW69 - 0-50,	19-OCT-2011	04-OCT-2011	15	----	----	----
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500,	WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	21-OCT-2011	04-OCT-2011	17	----	----	----
Snap Lock Bag WW94 - 0-50		19-OCT-2011	05-OCT-2011	14	----	----	----
Snap Lock Bag WW94 - 200-300		21-OCT-2011	06-OCT-2011	15	----	----	----
Snap Lock Bag WW94 - 600-700		21-OCT-2011	07-OCT-2011	14	----	----	----
ED045G: Chloride Discrete analyser							
Snap Lock Bag WW6 - 0-10, WW10 - 0-100,	WW9 - 0-100, WW13 - 0-50	19-OCT-2011	28-SEP-2011	21	----	----	----
Snap Lock Bag WW6 - 20-30, WW9 - 200-300, WW10 - 500-600, WW13 - 20-30,	WW6 - 80-90, WW9 - 800-900, WW13 - 1000-1100, WW13 - 70-80	21-OCT-2011	28-SEP-2011	23	----	----	----
Snap Lock Bag WW15 - 0-10,	WW22 - 0-100	19-OCT-2011	29-SEP-2011	20	----	----	----
Snap Lock Bag WW15 - 30-40,	WW15 - 90-100	21-OCT-2011	29-SEP-2011	22	----	----	----
Snap Lock Bag WW23 - 0-100,	WW28 - 0-100	19-OCT-2011	30-SEP-2011	19	----	----	----
Snap Lock Bag WW23 - 300-400, WW28 - 200-300,	WW23 - 900-1000, WW28 - 700-800	21-OCT-2011	30-SEP-2011	21	----	----	----
Snap Lock Bag WW36 - 0-100,	WW38 - 0-50	19-OCT-2011	01-OCT-2011	18	----	----	----
Snap Lock Bag WW36 - 200-300, WW38 - 500-600	WW36 - 700-800,	21-OCT-2011	01-OCT-2011	20	----	----	----
Snap Lock Bag WW44 - 0-100		19-OCT-2011	02-OCT-2011	17	----	----	----



Matrix: **SOIL**

Method Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
ED045G: Chloride Discrete analyser - Analysis Holding Time Compliance						
Snap Lock Bag WW44 - 100-200, WW44 - 500-600	21-OCT-2011	02-OCT-2011	19	----	----	----
Snap Lock Bag WW47 - 0-100	19-OCT-2011	03-OCT-2011	16	----	----	----
Snap Lock Bag WW60 - 0-20, WW75 - 0-50 WW69 - 0-50,	19-OCT-2011	04-OCT-2011	15	----	----	----
Snap Lock Bag WW60 - 20-300, WW69 - 200-300, WW75 - 400-500, WW60 - 700-800, WW69 - 800-900, WW75 - 900-1000	21-OCT-2011	04-OCT-2011	17	----	----	----
Snap Lock Bag WW94 - 0-50	19-OCT-2011	05-OCT-2011	14	----	----	----
Snap Lock Bag WW94 - 200-300	21-OCT-2011	06-OCT-2011	15	----	----	----
Snap Lock Bag WW94 - 600-700	21-OCT-2011	07-OCT-2011	14	----	----	----
EP004: Organic Matter						
Snap Lock Bag WW6 - 0-10, WW10 - 0-100, WW9 - 0-100, WW13 - 0-50	25-OCT-2011	28-SEP-2011	27	----	----	----
Snap Lock Bag WW15 - 0-10, WW22 - 0-100	25-OCT-2011	29-SEP-2011	26	----	----	----
Snap Lock Bag WW23 - 0-100, WW28 - 0-100	25-OCT-2011	30-SEP-2011	25	----	----	----
Snap Lock Bag WW36 - 0-100, WW38 - 0-50	25-OCT-2011	01-OCT-2011	24	----	----	----
Snap Lock Bag WW44 - 0-100	25-OCT-2011	02-OCT-2011	23	----	----	----
Snap Lock Bag WW47 - 0-100	25-OCT-2011	03-OCT-2011	22	----	----	----
Snap Lock Bag WW60 - 0-20, WW75 - 0-50 WW69 - 0-50,	25-OCT-2011	04-OCT-2011	21	----	----	----
Snap Lock Bag WW94 - 0-50	25-OCT-2011	05-OCT-2011	20	----	----	----

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

Craig Bryant

From: Hutchinson, Andrew (SKM) <AHutchinson@globalskm.com>
Sent: Monday, 7 November 2011 11:52 AM
To: Dean Sullivan
Cc: Bryn Stephens; Matthew Goodwin; Samples Brisbane; Rohde, Timothy (SKM)
Subject: RE: Additional Sampling Wards Well EB1121537
Attachments: image001.jpg

Dean

Yeah sorry I had changed some of the sample labels in my spreadsheet to make them all in mm (as some were in cm).

So to confirm, ALS sample numbers for EK080 Bicarbonate Extractable P are:

1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 30, 33, 35, 38, 41, 44

→
Cheers

Andy

From: Dean Sullivan [mailto:Dean.Sullivan@alsglobal.com]
Sent: Monday, 7 November 2011 10:56 AM
To: Hutchinson, Andrew (SKM)
Cc: Rohde, Timothy (SKM)
Subject: RE: Additional Sampling Wards Well

Hi Andy,

Just to clarify:

These samples IDs line up with ALS IDs – 4, 7, 16, 19, 22, 25, 28, 30, 33, 35, 38, 41, 44; and sample 1 do you mean WW6 – 0-10 and sample 10 is it WW13 – 0-500?

Cheers,

How was your customer experience? Please send us your feedback

Dean Sullivan
BUSINESS DEVELOPMENT OFFICER
ALS | Environmental

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FAX +61 7 3243 7218

Winner of the inaugural CARE Award 2011 – Sustainable Technology & Innovation:
Reduction in Sample Volumes – Improving quality, safety, efficiency and sustainability in environmental practices

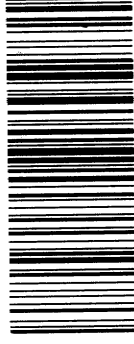


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Environmental Division
Brisbane
Work Order

EB1123397



Telephone : + 61-7-3243 7222



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1123397	Page	: 1 of 6
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Brisbane
Contact	: MR ANDREW HUTCHINSON	Contact	: Dean Sullivan
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: ahutchinson@globalskm.com	E-mail	: dean.sullivan@alsglobal.com
Telephone	: +61 08 8424 3800	Telephone	: +61 7 3243 7144
Facsimile	: +61 08 8424 3810	Facsimile	: +61 7 3243 7218
Project	: QEO9811 400 Wards Well-Land Resources	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 07-NOV-2011
C-O-C number	: ----	Issue Date	: 14-NOV-2011
Sampler	: A.Thompson/T.Rohde	No. of samples received	: 16
Site	: ----	No. of samples analysed	: 16
Quote number	: EN/003/10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

Environmental Division Brisbane
Part of the **ALS Laboratory Group**

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A Campbell Brothers Limited Company



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				WW6 0-10	WW9 0-100	WW10 0-100	WW13 0-50	WW15 0-10
				21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	21-SEP-2011 15:00	22-SEP-2011 15:00
Compound	CAS Number	LOR	Unit	EB1123397-001	EB1123397-002	EB1123397-003	EB1123397-004	EB1123397-005
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	2	mg/kg	42	12	<2	55	34



Analytical Results

Sub-Matrix: SOIL

				Client sample ID	WW22 0-100	WW23 0-100	WW28 0-100	WW36 0-100	WW38 0-50
				Client sampling date / time	22-SEP-2011 15:00	23-SEP-2011 15:00	23-SEP-2011 15:00	24-SEP-2011 15:00	24-SEP-2011 15:00
Compound	CAS Number	LOR	Unit		EB1123397-006	EB1123397-007	EB1123397-008	EB1123397-009	EB1123397-010
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	2	mg/kg		16	5	<2	<2	8



Analytical Results

Sub-Matrix: SOIL

				Client sample ID	WW44 0-100	WW47 0-100	WW60 0-20	WW69 0-50	WW75 0-50
				Client sampling date / time	25-SEP-2011 15:00	26-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00	27-SEP-2011 15:00
Compound	CAS Number	LOR	Unit		EB1123397-011	EB1123397-012	EB1123397-013	EB1123397-014	EB1123397-015
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	2	mg/kg		12	<2	2	80	13



Analytical Results

Sub-Matrix: SOIL

				Client sample ID	WW94 0-50	----	----	----	----
				Client sampling date / time	28-SEP-2011 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1123397-016	----	----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	2	mg/kg		39	----	----	----	----



Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1123397	Page	: 1 of 5
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Brisbane
Contact	: MR ANDREW HUTCHINSON	Contact	: Dean Sullivan
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: ahutchinson@globalskm.com	E-mail	: dean.sullivan@alsglobal.com
Telephone	: +61 08 8424 3800	Telephone	: +61 7 3243 7144
Facsimile	: +61 08 8424 3810	Facsimile	: +61 7 3243 7218
Project	: QEO9811 400 Wards Well-Land Resources	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 07-NOV-2011
C-O-C number	: ----	Issue Date	: 14-NOV-2011
Sampler	: A.Thompson/T.Rohde		
Order number	: ----		
Quote number	: EN/003/10	No. of samples received	: 16
		No. of samples analysed	: 16

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Environmental Division Brisbane

Part of the **ALS Laboratory Group**

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Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Soil Glass Jar - Unpreserved WW6 0-10, WW10 0-100,	WW9 0-100, WW13 0-50	21-SEP-2011	----	----	----	11-NOV-2011	19-MAR-2012	✓
Soil Glass Jar - Unpreserved WW15 0-10,	WW22 0-100	22-SEP-2011	----	----	----	11-NOV-2011	20-MAR-2012	✓
Soil Glass Jar - Unpreserved WW23 0-100,	WW28 0-100	23-SEP-2011	----	----	----	11-NOV-2011	21-MAR-2012	✓
Soil Glass Jar - Unpreserved WW36 0-100,	WW38 0-50	24-SEP-2011	----	----	----	11-NOV-2011	22-MAR-2012	✓
Soil Glass Jar - Unpreserved WW44 0-100		25-SEP-2011	----	----	----	11-NOV-2011	23-MAR-2012	✓
Soil Glass Jar - Unpreserved WW47 0-100		26-SEP-2011	----	----	----	11-NOV-2011	24-MAR-2012	✓
Soil Glass Jar - Unpreserved WW60 0-20, WW75 0-50	WW69 0-50,	27-SEP-2011	----	----	----	11-NOV-2011	25-MAR-2012	✓
Soil Glass Jar - Unpreserved WW94 0-50		28-SEP-2011	----	----	----	11-NOV-2011	26-MAR-2012	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL** Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Bicarbonate Extractable P (Colwell)	EK080	2	17	11.8	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Bicarbonate Extractable P (Colwell)	EK080	1	17	5.9	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Bicarbonate Extractable P (Colwell)	EK080	SOIL	Rayment & Higginson (1992) Method 9B1 Phosphorus is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by FIA.



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.
- For all matrices, no Matrix Spike outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.



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TEST RESULTS

Client :	ALS Environmental Brisbane	Report No. :	R11625
Address :	32 Shand Street, Stafford	Job No. :	117634002/4
Project :	Delivered Samples	Date Received :	20/10/2011
Batch No. :	EB1121537	Sampled by :	Client

EMERSON CLASSIFICATION

Reg'n No.	Sample No.	Sample ID	Description	Emerson Classification Number
11305725	1	WW6 0-10 21/09/2011	(CH) Silty CLAY, dark brown	5
11305726	2	WW6 20-30 21/09/2011	(CH) Silty CLAY, dark brown	5
11305727	4	WW9 0-100 21/09/2011	(CH) Silty CLAY, dark brown	5
11305728	6	WW9 800-900 21/09/2011	(CH) Silty CLAY, dark brown	6
11305729	7	WW10 0-100 21/09/2011	(CI) Silty CLAY, dark brown	5
11305730	9	WW10 1000-1100 21/09/2011	(CI) Silty CLAY, brown	6
11305731	10	WW13 0-50 21/09/2011	(CI) Silty CLAY, dark brown	5
11305732	12	WW13 70-80 21/09/2011	(CH) Silty CLAY, dark brown	5
11305733	13	WW15 0-10 22/09/2011	(CH) Silty CLAY, dark brown	5
11305734	15	WW15 90-100 22/09/2011	(CH) Silty CLAY, dark brown	6
11305735	16	WW22 0-100 22/09/2011	(CH) Silty CLAY, dark brown	5
11305736	19	WW23 0-100 23/09/2011	(CI) Silty CLAY, brown	5
11305737	21	WW23 900-1000 23/09/2011	(CI) Silty CLAY, brown	6
11305738	22	WW28 0-100 23/09/2011	(CI) Silty CLAY, dark brown	3
11305739	24	WW28 700-800 23/09/2011	(CI) Silty CLAY, dark brown	3
11305740	25	WW36 0-100 24/09/2011	(CI) Silty CLAY, dark brown	5
11305741	27	WW36 700-800 24/09/2011	(CH) Silty CLAY, brown	3
11305742	28	WW38 0-50 24/09/2011	(CI) Silty CLAY, brown	3
11305743	29	WW38 500-600 24/09/2011	(CH) Silty CLAY, red brown	5
11305744	30	WW44 0-100 25/09/2011	(CI) Silty CLAY, brown	5
11305745	32	WW44 500-600 25/09/2011	(CH) Silty CLAY, red brown	6
11305746	33	WW47 0-100 26/09/2011	(CI) Silty CLAY, dark brown	5
11305747	35	WW60 0-20 27/09/2011	(CI) Silty CLAY, dark brown	5
11305748	37	WW60 700-800 27/09/2011	(CI) Silty CLAY, dark brown	5
11305749	38	WW69 0-50 27/09/2011	(CI) Silty CLAY, dark brown	3
11305750	40	WW69 800-900 27/09/2011	(CI) Silty CLAY, brown	3
11305751	41	WW75 0-50 27/09/2011	(CI) Silty CLAY, brown	5
11305752	43	WW75 900-1000 27/09/2011	(CI) Silty CLAY, dark brown	5
11305753	44	WW94 0-50 28/09/2011	(CI) Silty CLAY, dark brown	5
11305754	46	WW94 600-700 30/09/2011	(CI) Silty CLAY, dark brown	4

Remarks : Deionised water at 20 °C used in Emerson Class test.

Test Procedure : AS 1289 3.8.1

Prepared by *MF*

Checked by *46*

This document is issued in accordance with NATA's accreditation requirements.

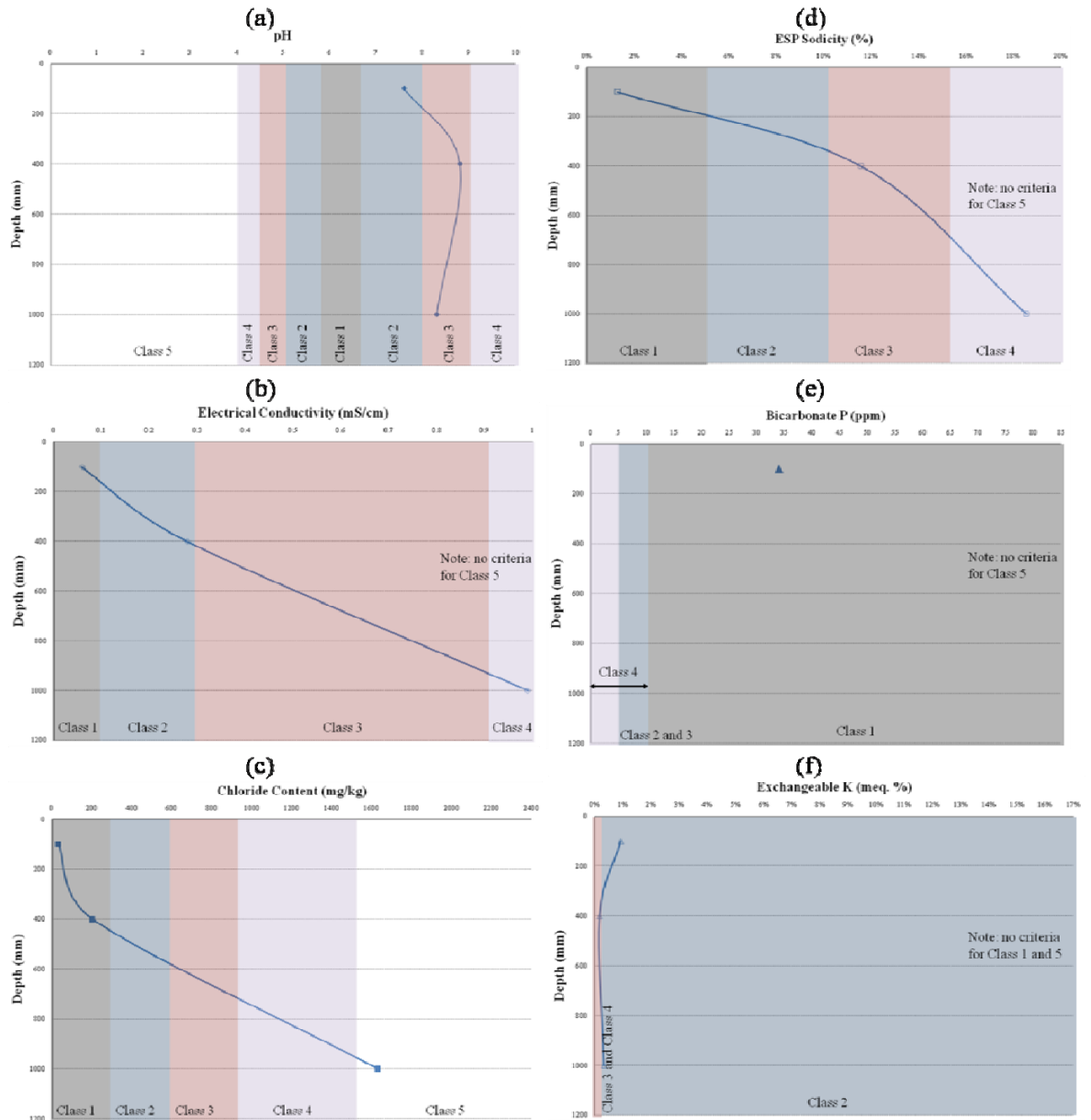


Nick Farrer
Approved Signatory

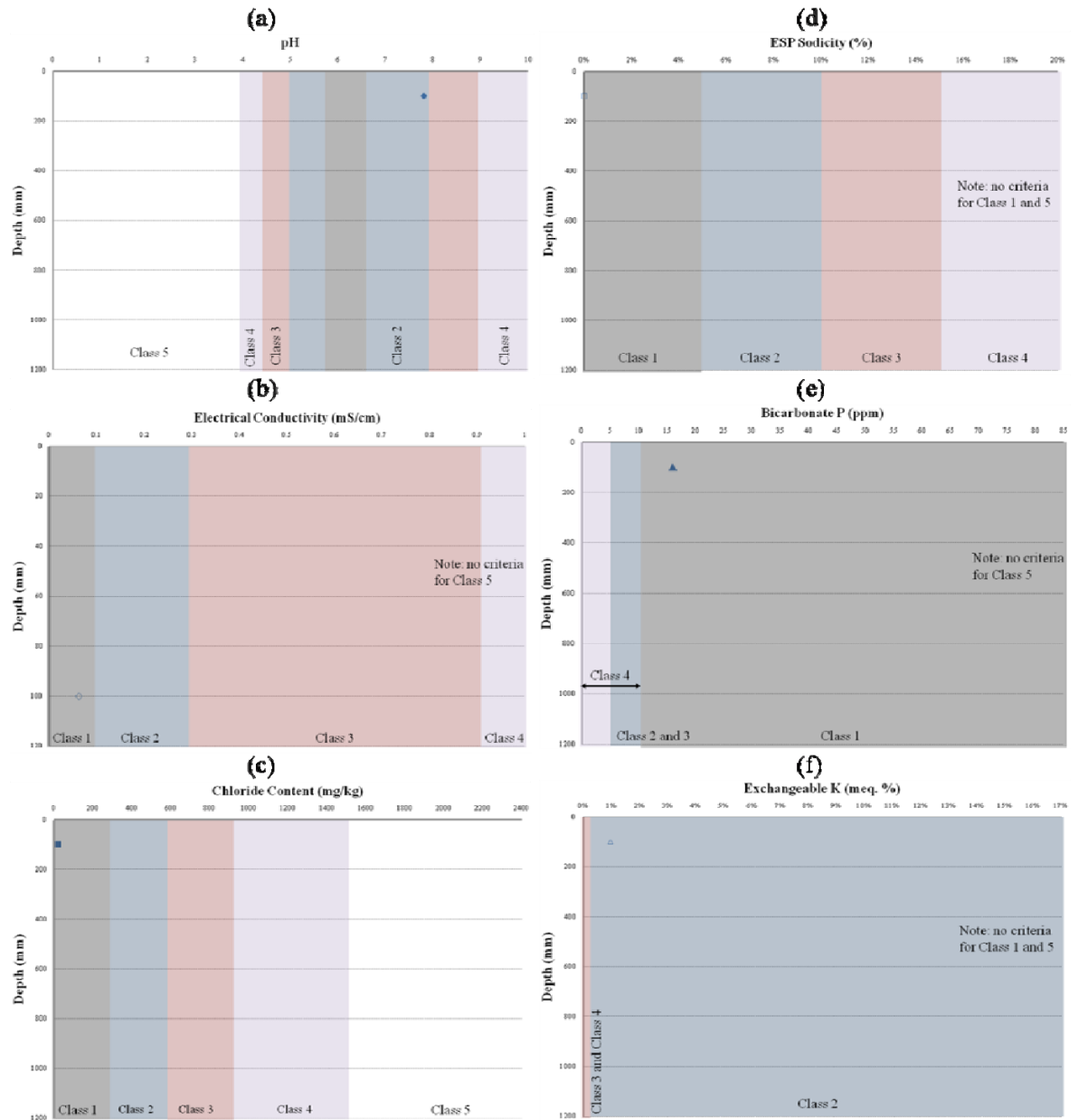
Nhm 28/10/11
Senior Technical Officer
NATA Accred. No. : 1961



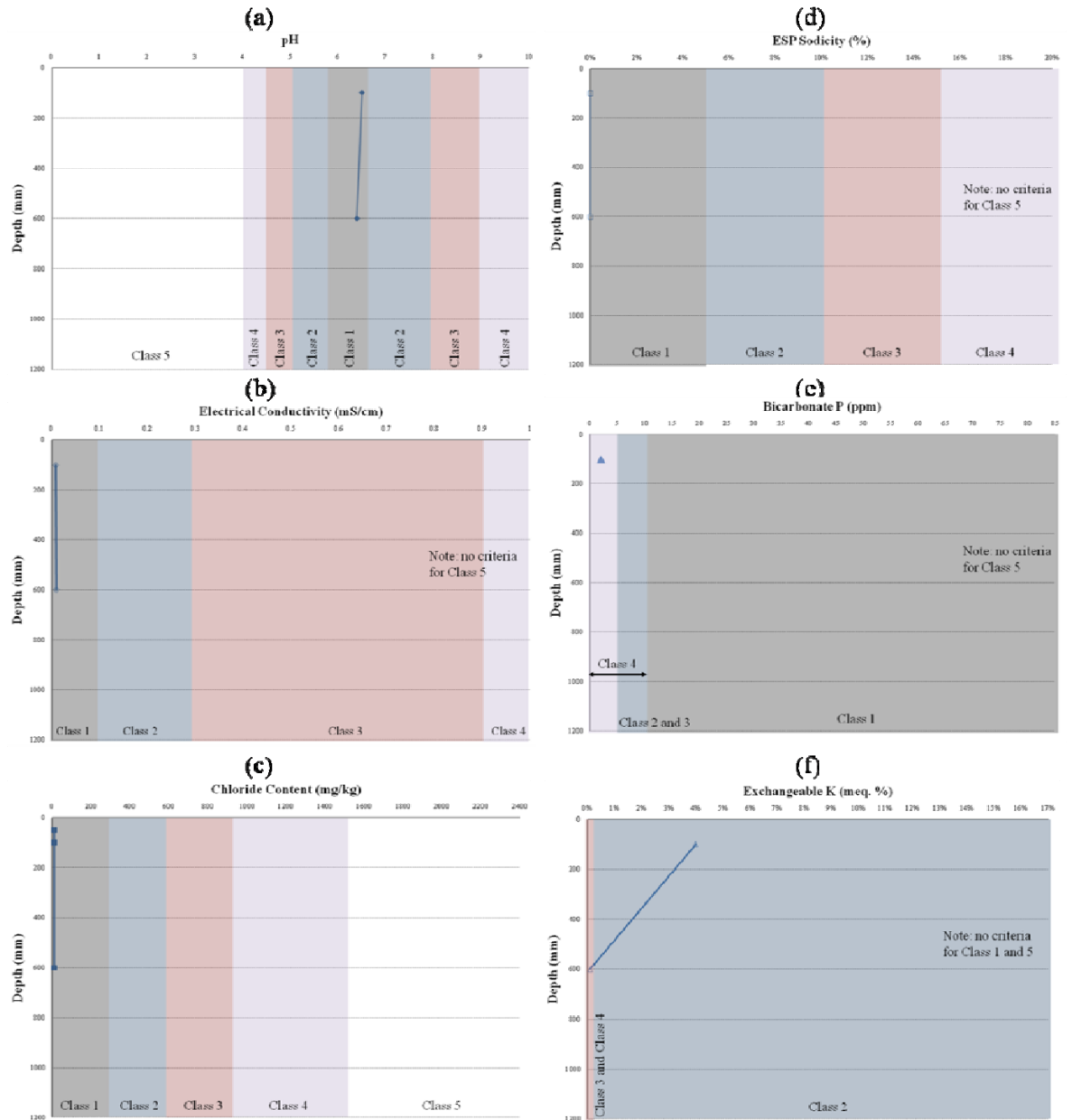
Appendix D Land Suitability Assessment



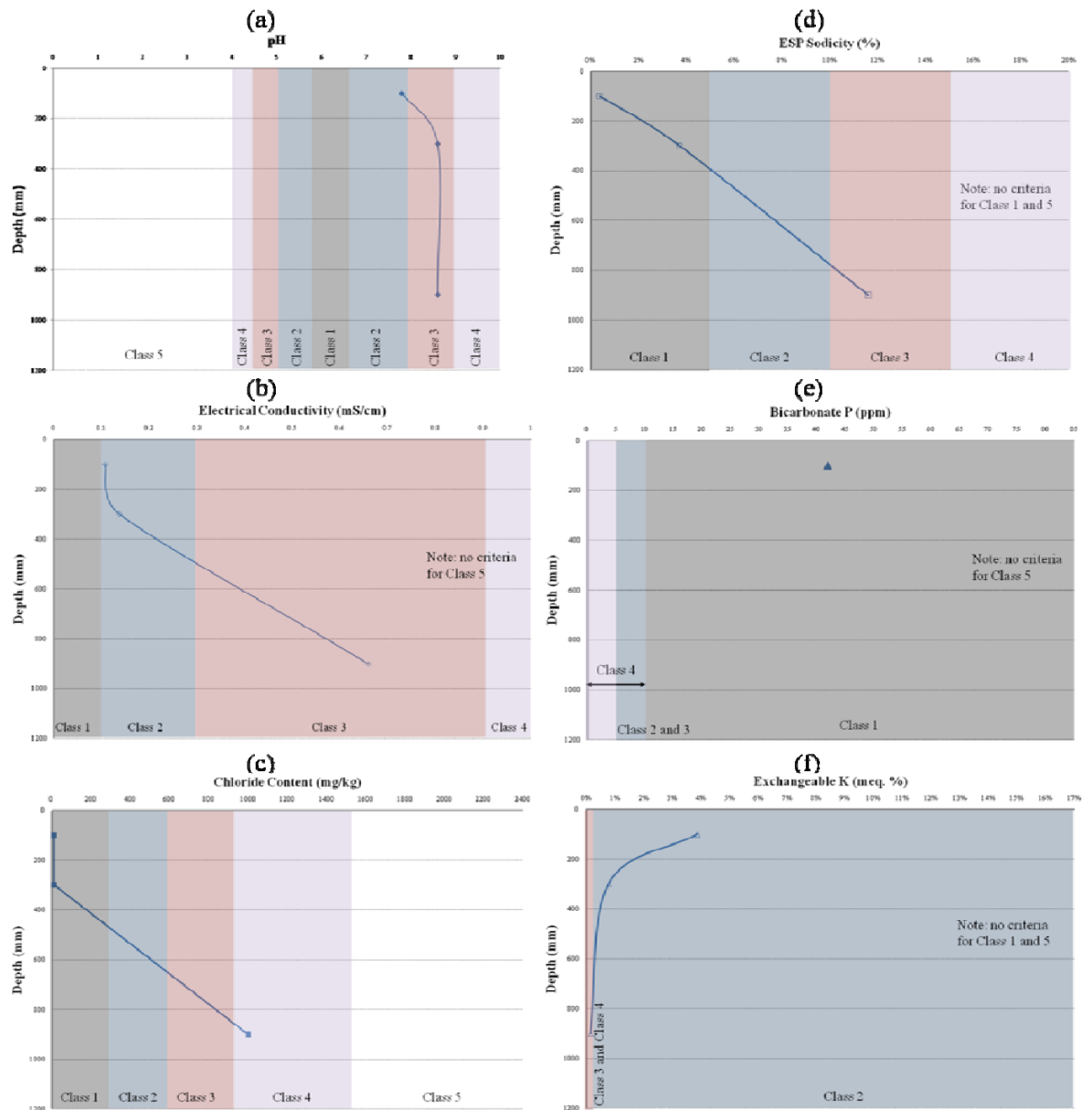
■ Figure A 1 Vertosol: Site 15 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K



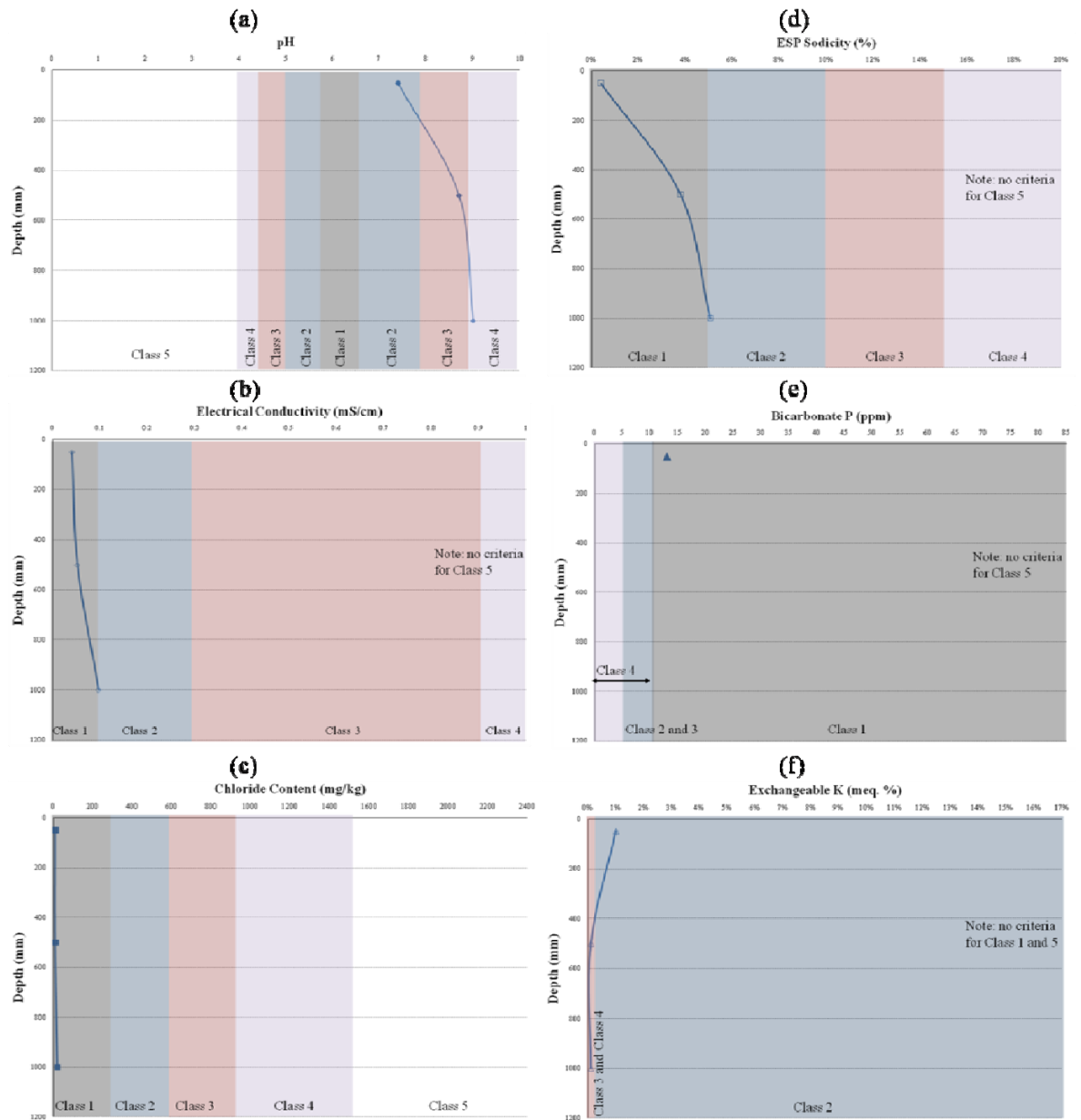
■ Figure A 2 Vertosol: Site 22 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP, (e) Bicarbonate P, and (f) Exchangeable K



■ Figure A 3 Vertosol: Site 9 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP, (e) Bicarbonate P, and (f) Exchangeable K

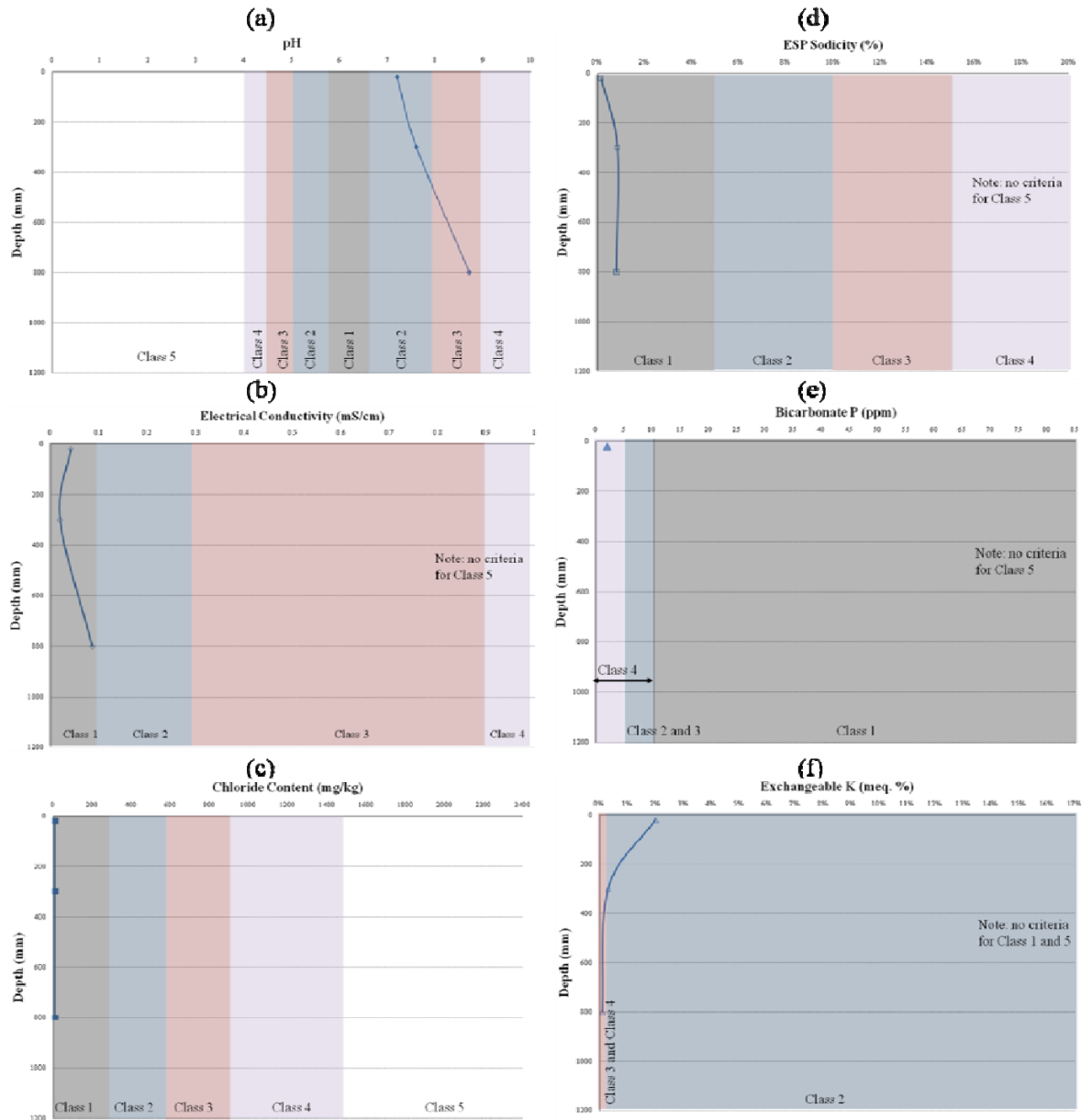


■ Figure A 4 Vertosol Site 6 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP, (e) Bicarbonate P, and (f) Exchangeable K

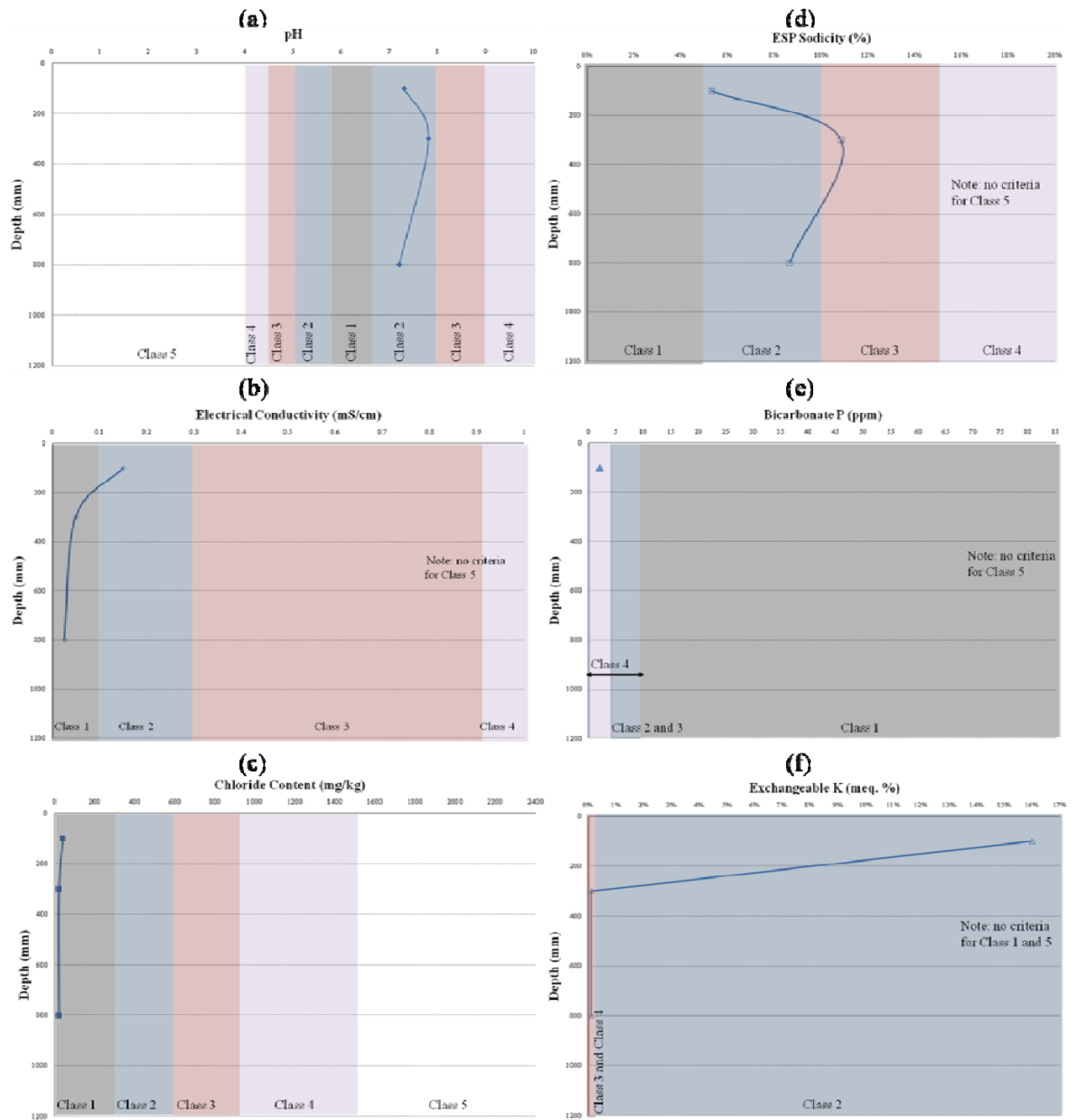


■ **Figure A 5 Vertosol: Site 75 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K**

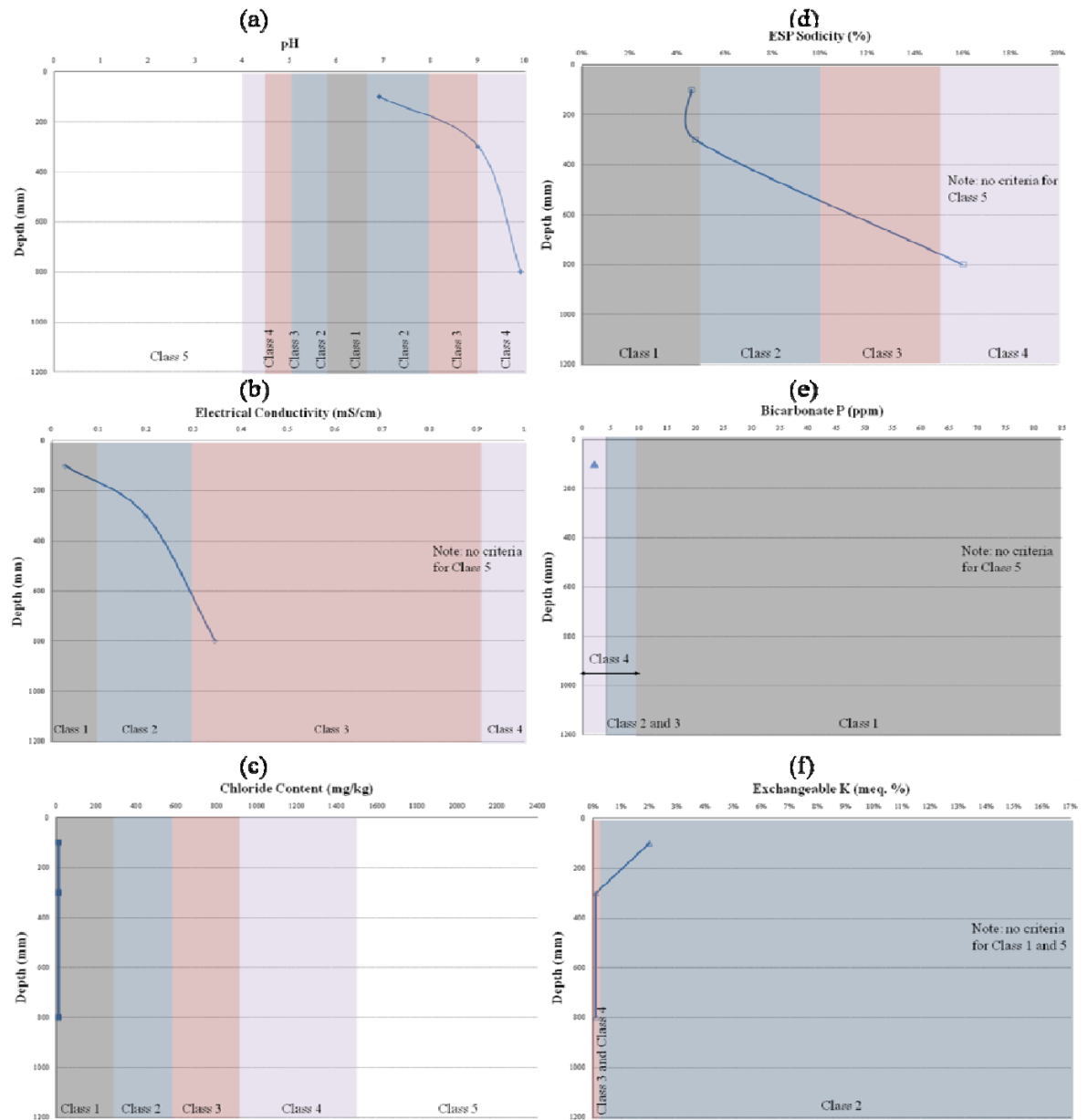




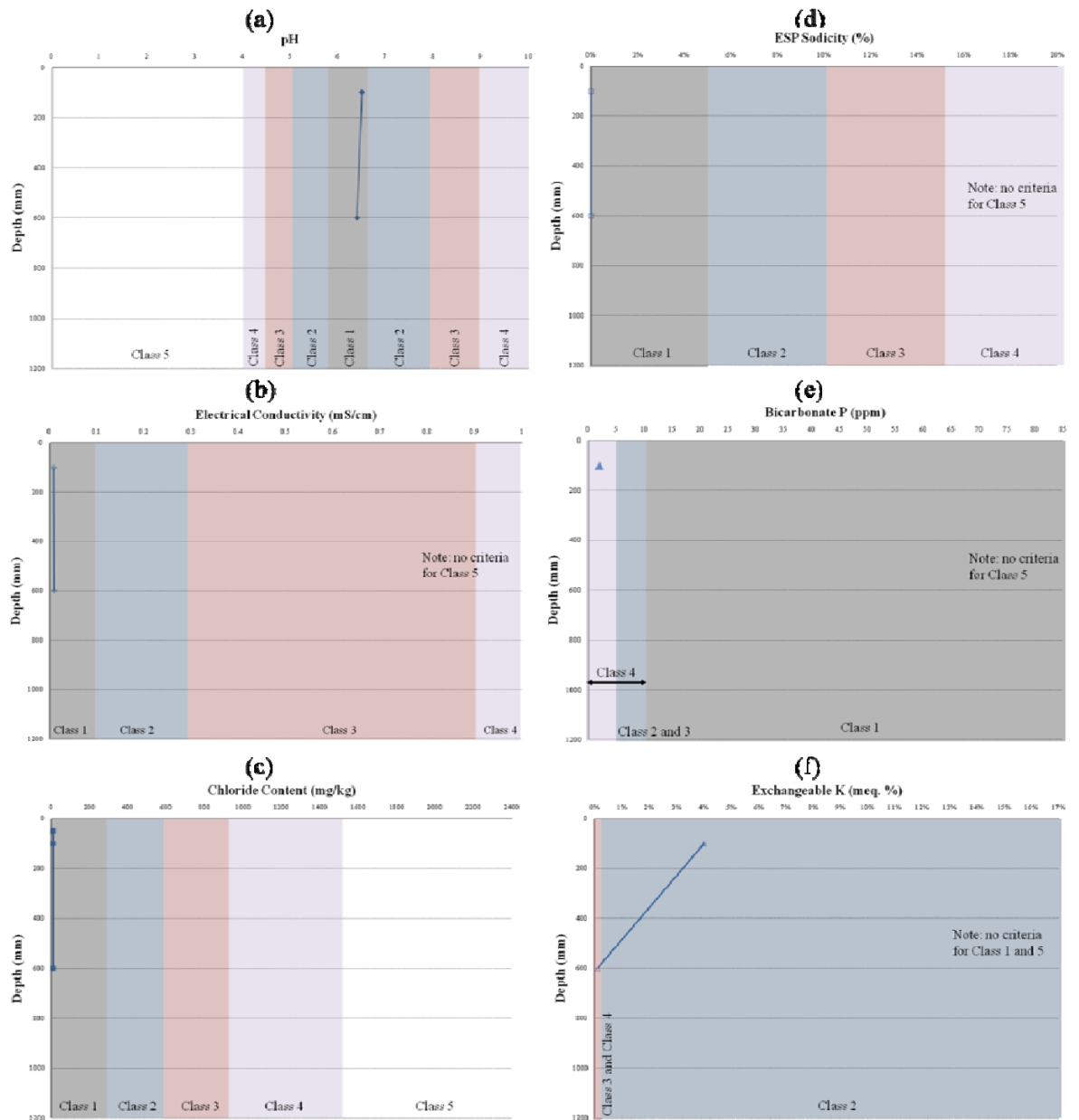
■ **Figure A 7 Vertosol: Site 60 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K(a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K**



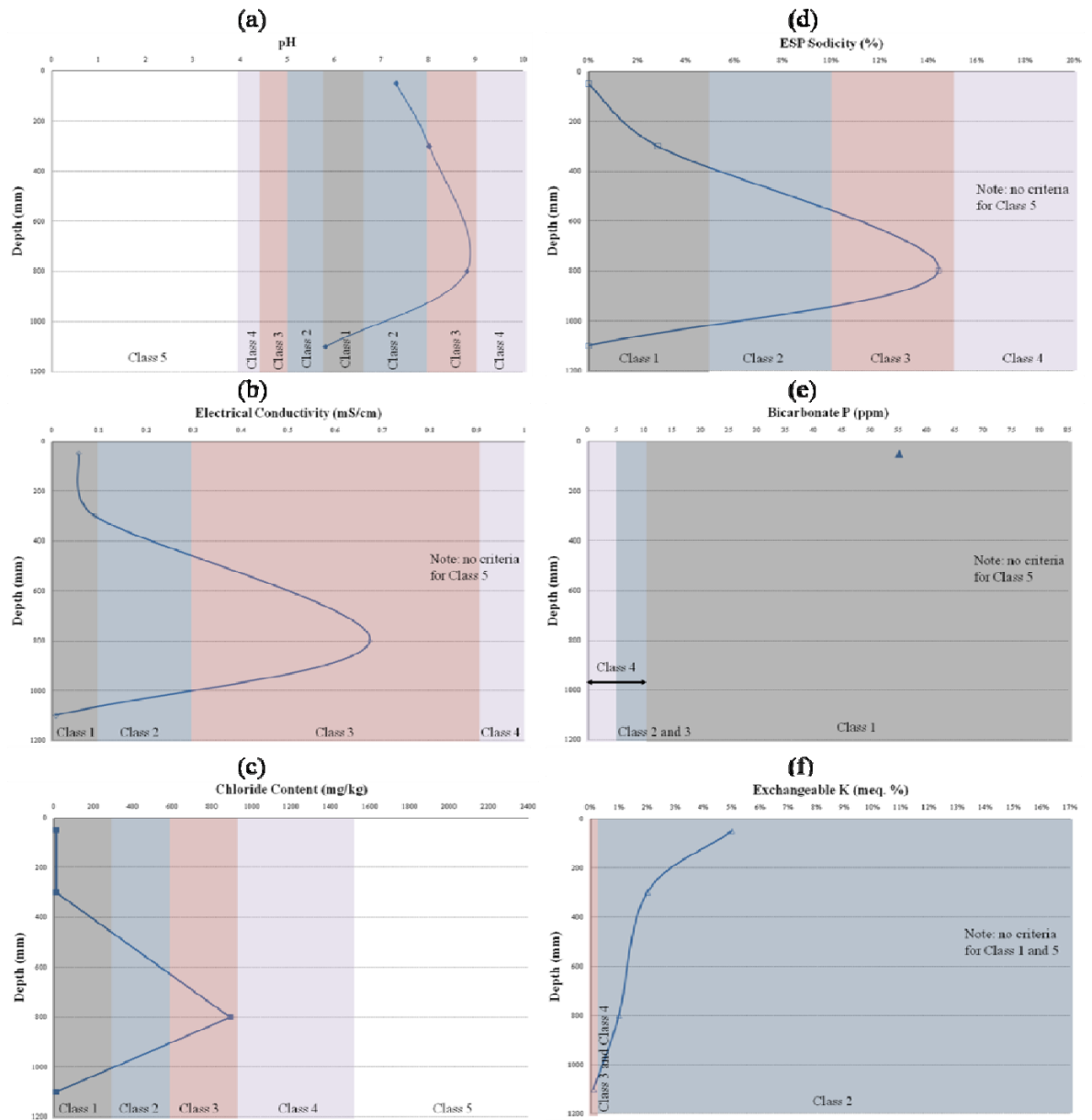
■ Figure A 8 Dermosol: Site 28 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP, (e) Bicarbonate P, and (f) Exchangeable K



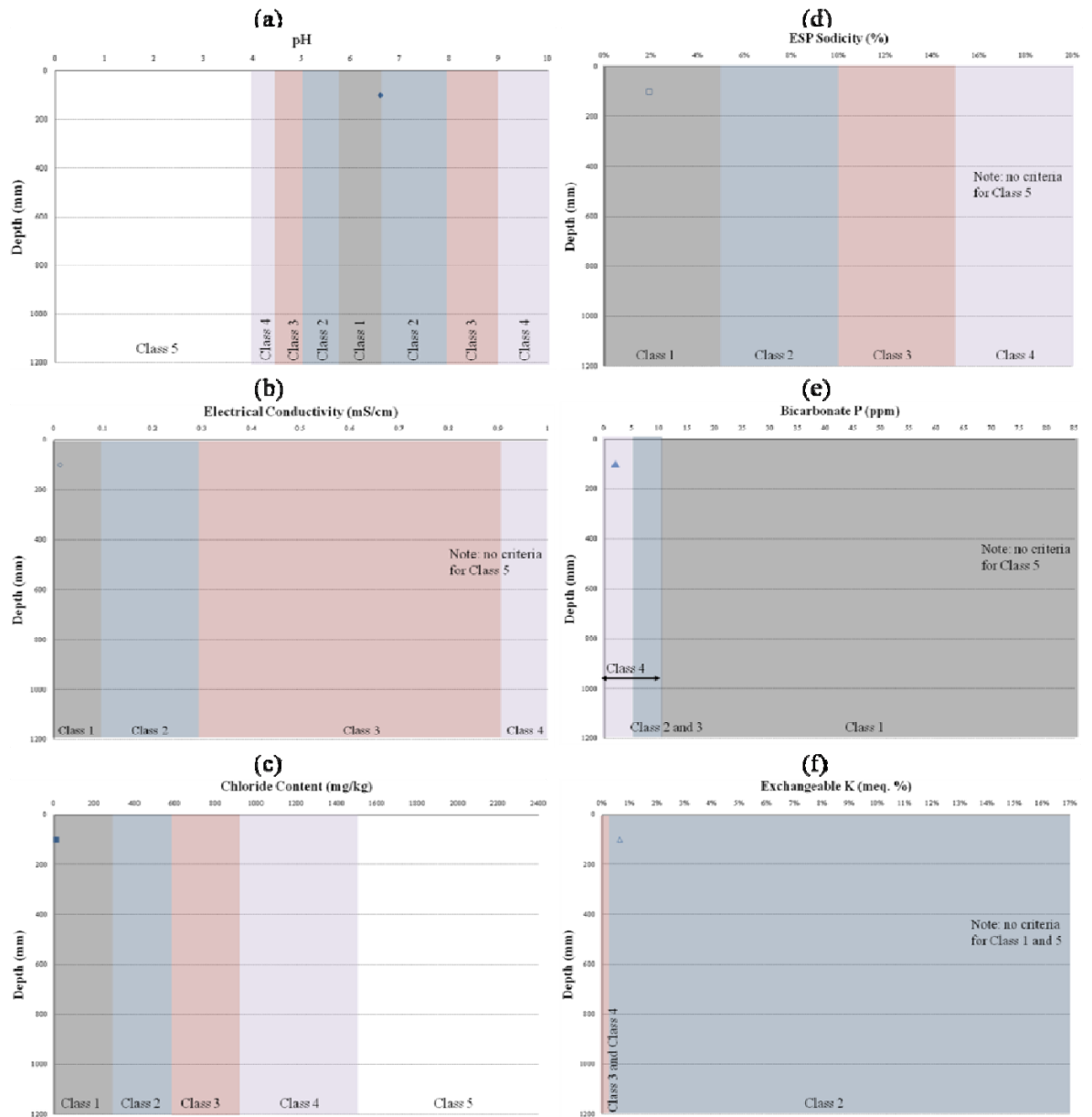
■ **Figure A 9 Dermosol: Site 36 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K**



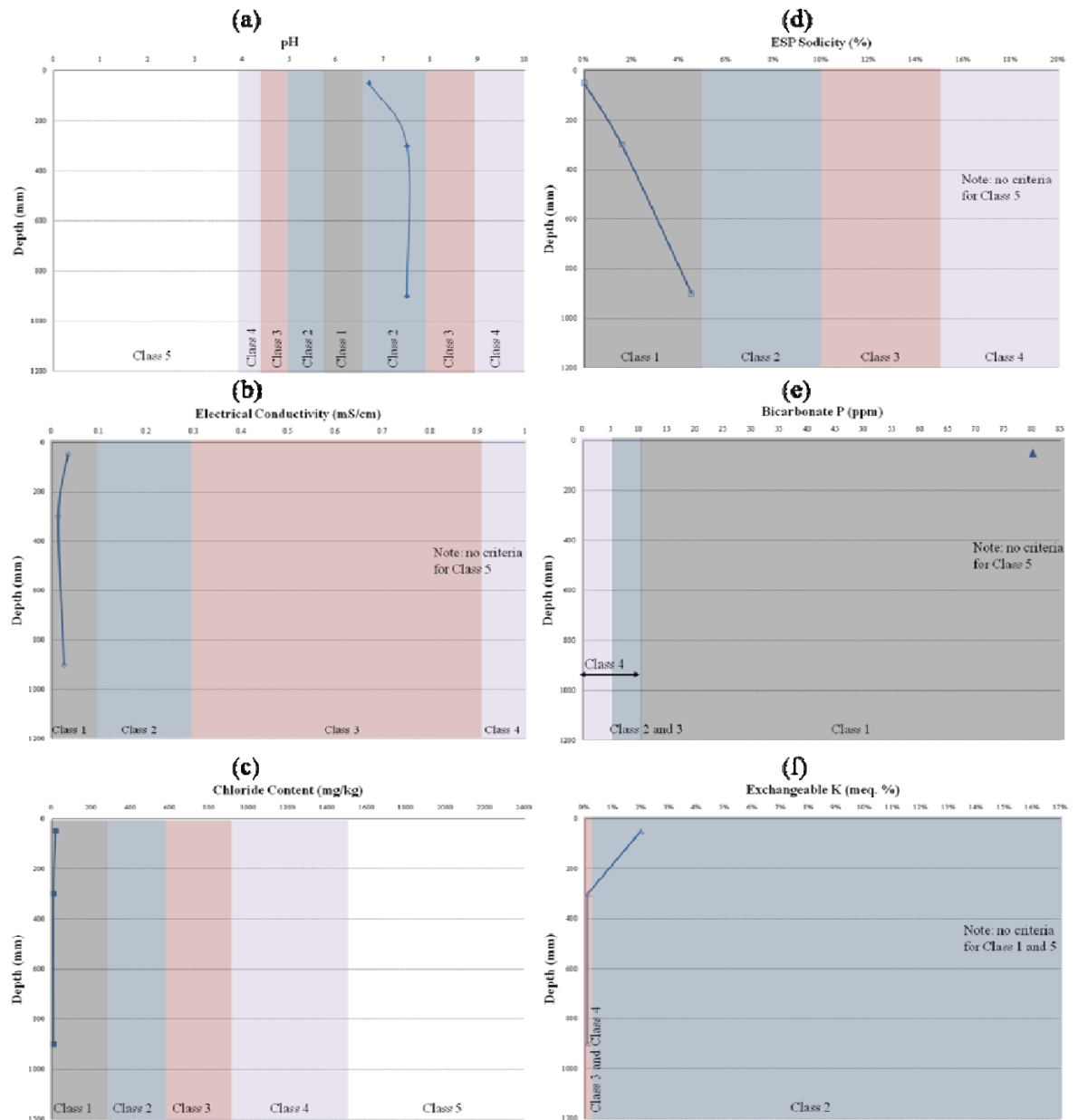
■ Figure A 10 Dermosol: Site 10 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K



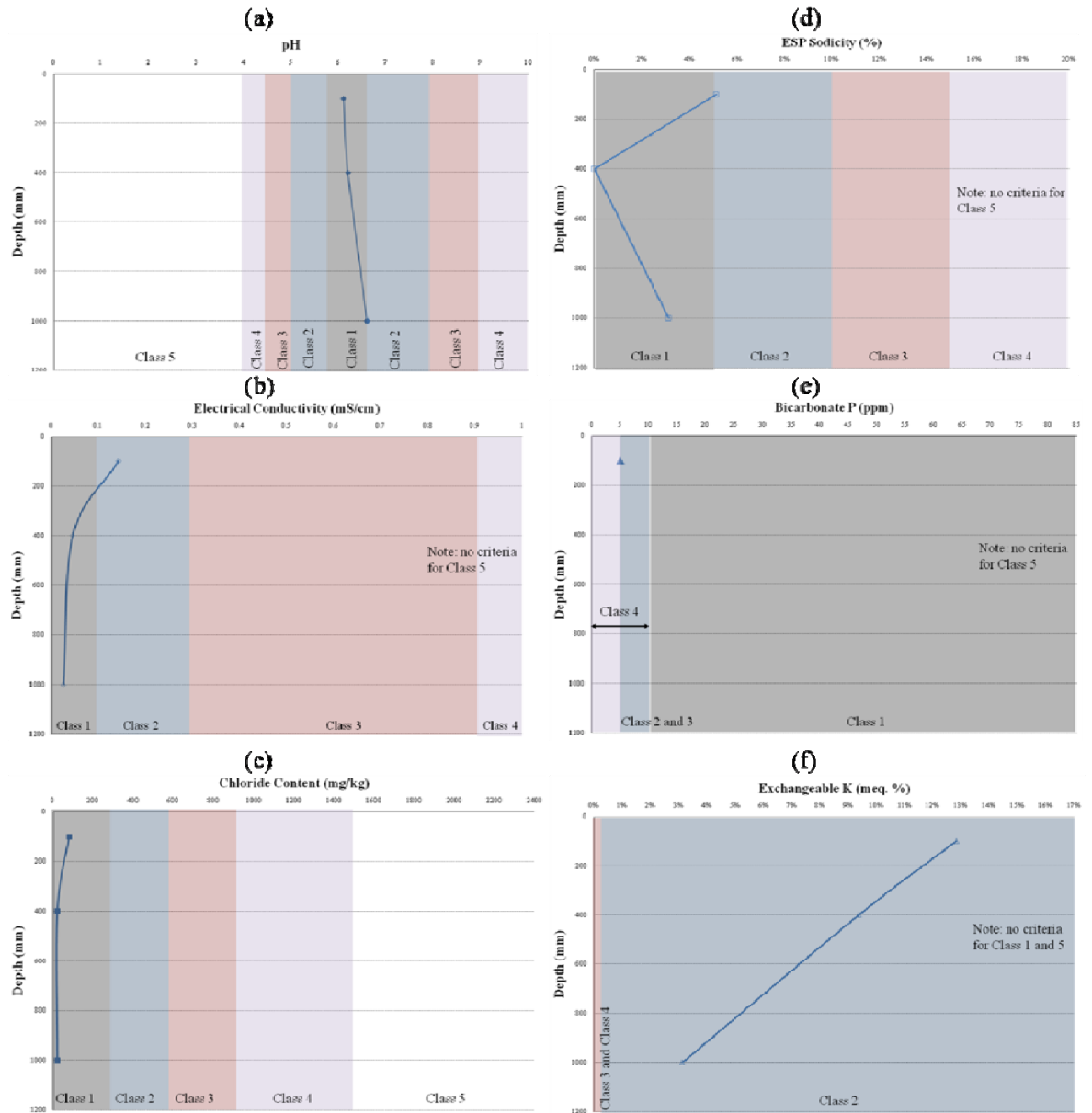
■ Figure A 11 Dermosol: Site 13 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K



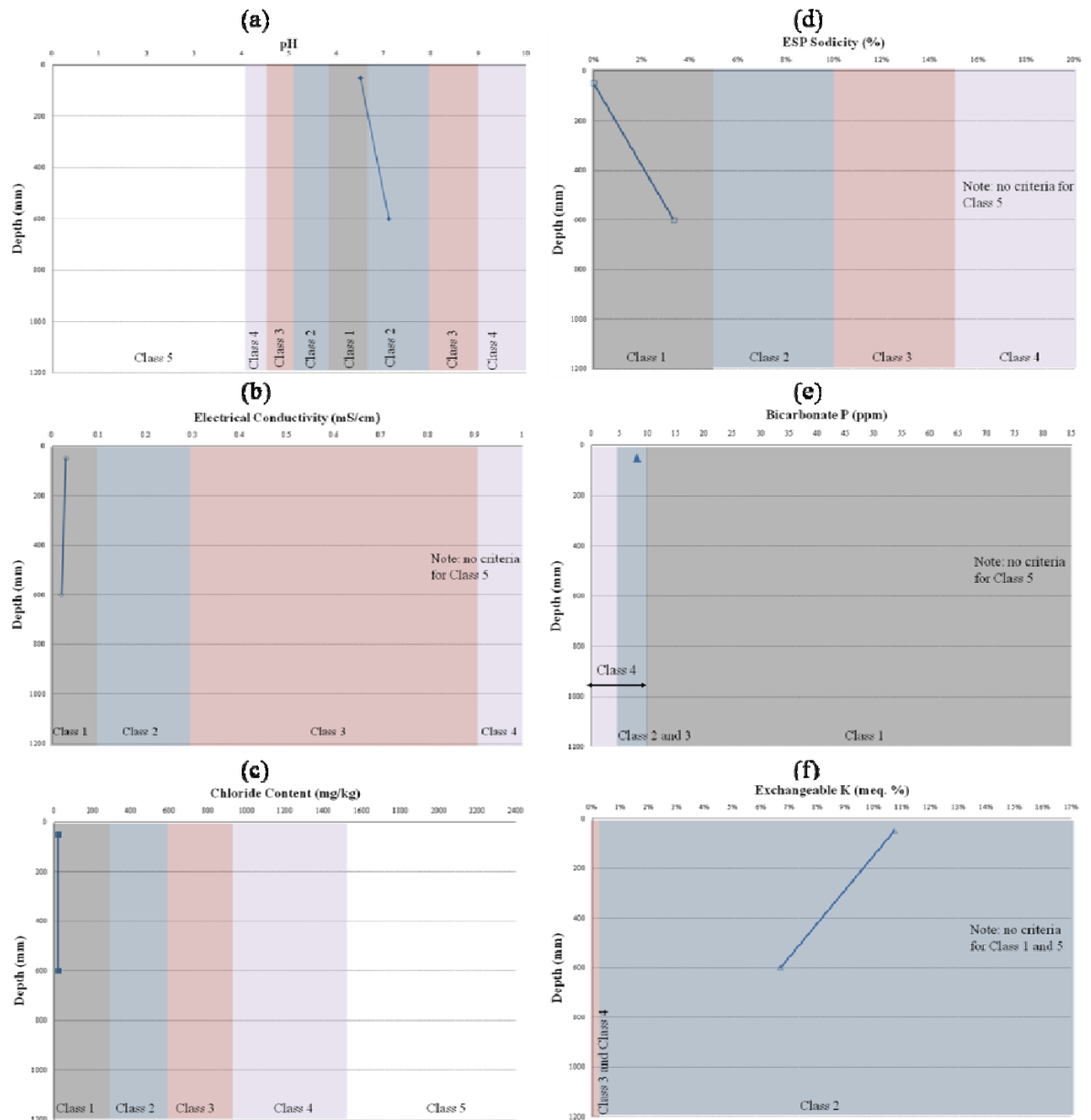
■ Figure A 12 Dermosol: Site 47 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K



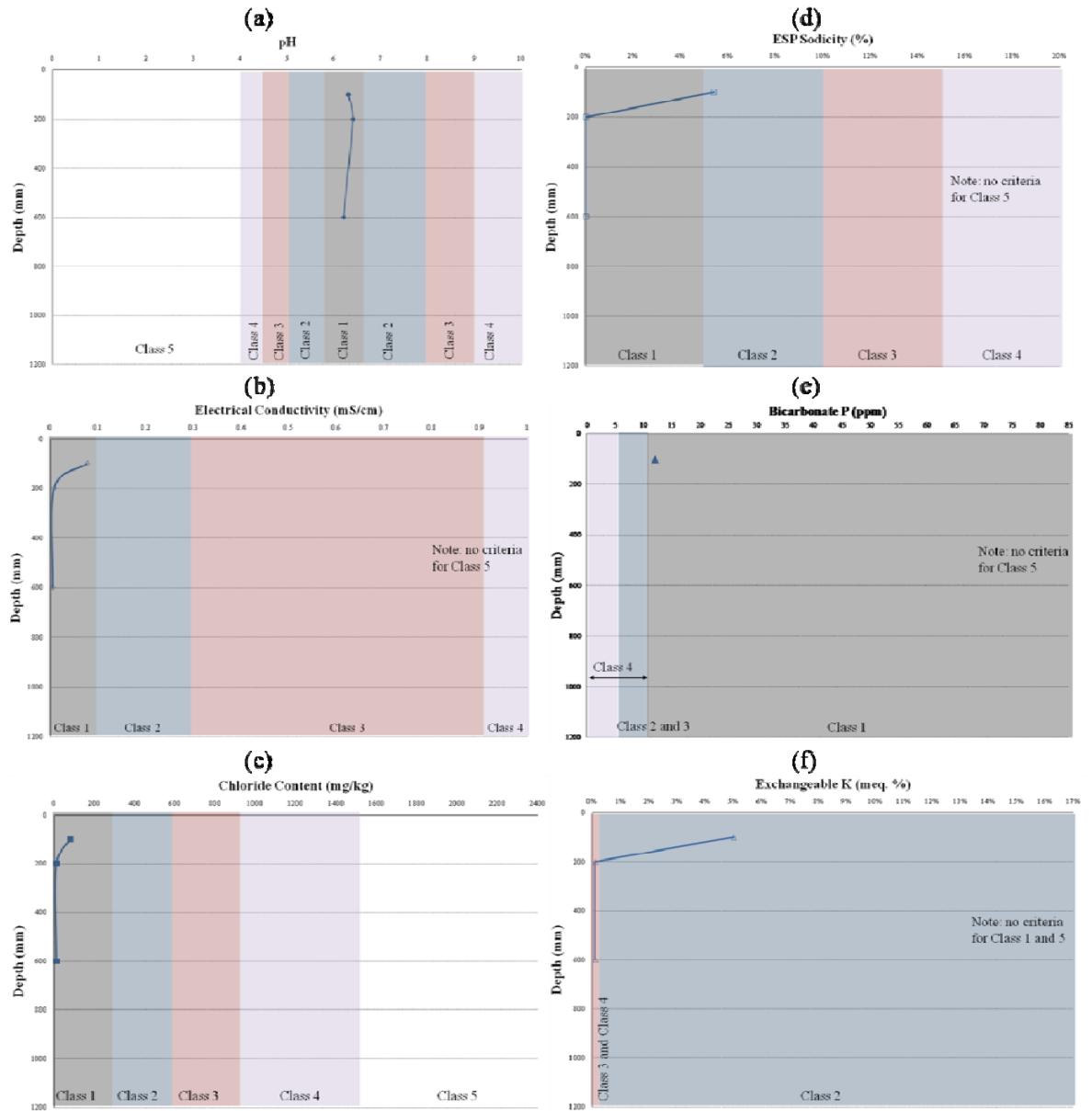
■ **Figure A 13 Kandosol: Site 69 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K**



■ Figure A 14 Kandosol: Site 23 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K



■ **Figure A 15 Kandosol: Site 38 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP. (e) Bicarbonate P, and (f) Exchangeable K**



■ Figure A 16 Kandosol: Site 44 (a) pH, (b) Electrical conductivity, (c) Chloride content, (d) ESP, (e) Bicarbonate P, and (f) Exchangeable K



Appendix E Strategic Cropping Land Assessment

PART A - Site and Soil Data			
Site	6		
Land use / Cover	Grazing / Buffel grass, Brigalow		
Location Coordinates	0595544, 7614553		
Soil Classification	Vertosol		
Soil map unit name	Vertosol		
Soil correlation	May Downs - Dark self mulching deep clay (≥ 90 cm) and Teviot – Dark self mulching moderately deep to deep clay soils.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Microrelief	< 50% of land surface being gilgai microreliefs of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P (marginal)
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 1000 mm based on SCL Guidelines. However surrogate analysis from LS assessment estimated ≤ 75 mm / 10 cm with an ESP limitation

PART A - Site and Soil Data			
Site	9		
Land use / Cover	Grazing / Poplar Box, Open woodland		
Location Coordinates	598188, 7612435		
Soil Classification	Vertosol		
Soil map unit name	Kandosol		
Soil correlation	May Downs - Dark self mulching deep clay (≥ 90 cm) and Teviot – Dark self mulching moderately deep to deep clay soils.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	10		
Land use / Cover	Grazing / Grass, Acacia (various), Very few Ironbark		
Location Coordinates	0599832, 7611654		
Soil Classification	Red Dermosol		
Soil map unit name	Kandosol		
Soil correlation	Kinnoul - shallow uniform medium to fine textured soils, alkaline subsoils		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	13		
Land use / Cover	Grazing / Brigalow, Blackbutt		
Location Coordinates	601185, 7608926		
Soil Classification	Red Dermosol		
Soil map unit name	Kandosol		
Soil correlation	Kinnoul - shallow uniform medium to fine textured soils, alkaline subsoils		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P - 800 mm to chemical impedance
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P - marginal
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P - marginal
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 1000 mm based on SCL Guidelines. However surrogtae analysis from LS assessment estimated ≤ 75 mm / 10 cm with an ESP, EC and Cl limitation

PART A - Site and Soil Data			
Site	15		
Land use / Cover	Grazing / Medium density Ironbark, Acacia, Buffel grass, Brigalow		
Location Coordinates	598820, 7617662		
Soil Classification	Vertosol		
Soil map unit name	Vertosol		
Soil correlation	May Downs - Dark self mulching deep clay (≥ 90 cm) and Teviot – Dark self mulching moderately deep to deep clay soils.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P (marginal)
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 1000 mm based on SCL Guidelines. However surrogae analysis from LS assessment estimated ≤ 75 mm / 10 cm with an ESP limitation

PART A - Site and Soil Data			
Site	22		
Land use / Cover	Grazing / Medium density Ironbark, Acacia, Buffel grass, Brigalow		
Location Coordinates	598838, 7616587		
Soil Classification	Vertosol		
Soil map unit name	Vertosol		
Soil correlation	May Downs - Dark self mulching deep clay (≥ 90 cm) and Teviot – Dark self mulching moderately deep to deep clay soils.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Microrelief	< 50% of land surface being gilgai microreliefs of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	23		
Land use / Cover	Grazing / Ironbark, Spear grass		
Location Coordinates	0595233, 7611393		
Soil Classification	Kandosol		
Soil map unit name	Kandosol		
Soil correlation	Dunrobin – Deep loamy red earths.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Microrelief	< 50% of land surface being gilgai microreliefs of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 800 mm based on SCL Guidelines

PART A - Site and Soil Data			
Site	28		
Land use / Cover	Grazing / Small shrubs, Grassland, Some Ironbark		
Location Coordinates	595477, 7612063		
Soil Classification	Red Dermosol		
Soil map unit name	Kandosol		
Soil correlation	Kinnoul - shallow uniform medium to fine textured soils, alkaline subsoils		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	36		
Land use / Cover	Grazing / Small shrubs, Grassland, Some Ironbark		
Location Coordinates	0597230, 7606211		
Soil Classification	Red Dermosol		
Soil map unit name	Vertosol		
Soil correlation	Kinnoul - shallow uniform medium to fine textured soils, alkaline subsoils		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	F
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 1000 mm based on SCL Guidelines. However surrogtae analysis from LS assessment estimated ≤ 75 mm / 10 cm with an ESP limitation

PART A - Site and Soil Data			
Site	38		
Land use / Cover	Grazing / Poplar box, Morton Bay ash		
Location Coordinates	0396927, 7608097		
Soil Classification	Kandosol		
Soil map unit name	Kandosol		
Soil correlation	Dunrobin – Deep loamy red earths.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Microrelief	< 50% of land surface being gilgai microreliefs of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 800 mm based on SCL Guidelines

PART A - Site and Soil Data			
Site	44		
Land use / Cover	Grazing / Ironbark, Spear Grass, Brigalow		
Location Coordinates	0602107, 7615125		
Soil Classification	Kandosol		
Soil map unit name	Kandosol		
Soil correlation	Dunrobin – Deep loamy red earths.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Microrelief	< 50% of land surface being gilgai microreliefs of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 800 mm based on SCL Guidelines

PART A - Site and Soil Data			
Site	47		
Land use / Cover	Grazing / Small shrubs, Grassland, Some Ironbark		
Location Coordinates	603431, 7610795		
Soil Classification	Red Dermosol		
Soil map unit name	Kandosol		
Soil correlation	Kinnoul - shallow uniform medium to fine textured soils, alkaline subsoils		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	60		
Land use / Cover	Grazing / Cleared Buffel grass, Brigalow		
Location Coordinates	0596050, 7615539		
Soil Classification	Vertosol		
Soil map unit name	Vertosol		
Soil correlation	May Downs - Dark self mulching deep clay (≥ 90 cm) and Teviot – Dark self mulching moderately deep to deep clay soils.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P- 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	69		
Land use / Cover	Grazing / Poplar box, Morton Bay ash		
Location Coordinates	0595767, 7617473		
Soil Classification	Kandosol		
Soil map unit name	Vertosol		
Soil correlation	Dunrobin – Deep loamy red earths.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A.		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	F - 800 mm based on SCL Guidleines

PART A - Site and Soil Data			
Site	75		
Land use / Cover	Grazing / Moreton Bay ash, Poplar box, Brigalow		
Location Coordinates	0599700, 7619872		
Soil Classification	Vertosol		
Soil map unit name	Vertosol		
Soil correlation	May Downs - Dark self mulching deep clay (≥ 90 cm) and Teviot – Dark self mulching moderately deep to deep clay soils.		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	0-1% (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Mircrorelief	< 50% of land surface being gilgi microrelies of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	P
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P (marginal)
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis

PART A - Site and Soil Data			
Site	94		
Land use / Cover	Grazing / Long grass up to 1.2 m		
Location Coordinates	0599580, 7622074		
Soil Classification	Shallow Vertosol		
Soil map unit name	Vertosol		
Soil correlation	Arcturus – Dark self-mulching moderately shallow clays (60-90 cm).		
Surface rock	Nil		
Gilgai microrelief	Nil		
Slope and landform	Not recorded (see Figure 4-1)		
Surface condition			
Soil profile description	see Appendix A. Soil depth - 400 mm		
Part B - SCL Assessment			
SCL Zone	Western Cropping Zone		
SCL status as shown on trigger map			
SCL Criteria	Threshold Assessed	Assessment Method	Pass (P) or Fail (F)
1 - Slope	≤ 3%	Slope modelling from 10m DEM contour data	P
2 - Rockiness	≤ 20% for rocks > 60 mm diameter	Field Assessment	P
3 - Gilgai Microrelief	< 50% of land surface being gilgai microreliefs of > 500 mm in depth	Field Assessment	P
4 - Soil depth	≥ 600 mm	Field Assessment	F
5 - Soil wetness	Has favourable drainage		P
6 - Soil pH	at 300mm and 600 mm: 5 (rigid) 5.1 (non-rigid) to 5 (rigid) 8.9 (non-rigid)	Refer to Appendix D	P
7 - Salinity	Chloride content <800 mg/kg within 600 mm of soil surface	Refer to Appendix D	P
8 - Soil water storage	≥ 100 mm to a soil depth or soil physico-chemical limitation of ≤ 1000 mm	Refer to Section 4.2.1 and Table 4-2	P - 1000 mm from SCL Guidelines, 150 mm / 10 cm from LS analysis



Appendix F Hillslope Erosion



The hillslope erosion map was derived using an amended version of the universal soil loss equation (USLE): $\text{Erosion} = K \times R \times C \times S \times L$ tonnes/ha/year.

The results were truncated to values less than 100 t/ha/year to eliminate those non-realistically high erosion rates due to artefacts of 9" digital elevation model (DEM). The individual factors are described in Lu et al 2001 and are summarised as follows:

- K is soil erodibility and is derived from modelled soil data provided by ASRIS project.
- R is rainfall erosivity derived from point data supplied by DNR Queensland.
- C is the cover factor based on,
 - seasonal rainfall derived from QDNR data.
 - ABARES Landuse data at 0.01 deg cell size
 - AVHRR derived NDVI data at 0.05 deg cell size
- S is the slope factor derived by modelling high resolution 20 to 50 m cell DEM and extending this data to cover the river basins containing intensive agriculture.
- L is the slope length factor, derived by modelling high resolution 20 to 50 m cell DEM and extending this data to cover the river basins containing intensive agriculture. Outside this area the L factor was set to 1

APPENDIX 6
SMC WARDS WELL PRCP COMMUNITY CONSULTATION PLAN AND STAKEHOLDER REGISTER



Progressive Rehabilitation and Closure Plan Wards Well

Community Consultation Plan

February 2021

Contents

Definitions	3
Introduction	4
1. Consultation requirements	7
Consultation as part of PRC plan development	7
Consultation on Wards Well PRC Plan	8
Community consultation register	8
PRC plan implementation community consultation plan	9
2. Consultation approach	9
Stakeholder analysis	9
Use of existing engagement mechanisms	12
Iterative consultation process	13
Social value	14
3. Consultation program	14
Objectives and outcomes	14
Consultation methods and frequency	15
4. Information to be released for community consultation	19
5. How stakeholder feedback will be considered	20
6. PRC Plan consultation plan review	20

Definitions

Consultation	Community consultation is a key component of the PRC plan and is intended to ensure that anyone impacted by proposed rehabilitation and closure activities at the site has an opportunity to provide input to the planning process (PRC plan Guideline, DES, 2019).
CCP	Community consultation plan, required to be submitted with the PRC plan
LoA	Life of Asset
EP Act	Environmental Protection Act 1994 (Qld)
EIS	Environmental Impact Statement – primary approval document for major projects under the State Development and Public Organisations Act 1971 and EP Act
DES	Department of Environment and Science, DES is responsible for assessing PRC plans and schedules.
DNRME	Department of Natural Resource Mining Energy
MERFP Act	Mineral and Energy Resources (Financial Provisioning) Act 2018 (Qld)
NUMA	Non-use management area - means an area of land the subject of a PRC plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC plan carried out on the land have ended. Land is in a stable condition if— (a) the land is safe and structurally stable; and (b) there is no environmental harm being caused by anything on or in the land; and (c) the land can sustain a post-mining land use
PMLU	Post-mining land use – means the purpose for which the land will be used after all relevant activities for the PRC plan carried out on the land have ended
PRC plan	Progressive rehabilitation and closure plan PRC plans must include a detailed description of how and where mining activities will be carried out, how consultation was undertaken and considered in development of a PRC plan, and any risks of not being able to rehabilitate the land to a stable condition.
PIE	Public Interest Evaluation - The MERFP Act introduces requirements for a PIE to be carried out for any EA applications that include a NUMA in a PRC plan schedule.

Wards Well	Wards Well Project
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Introduction

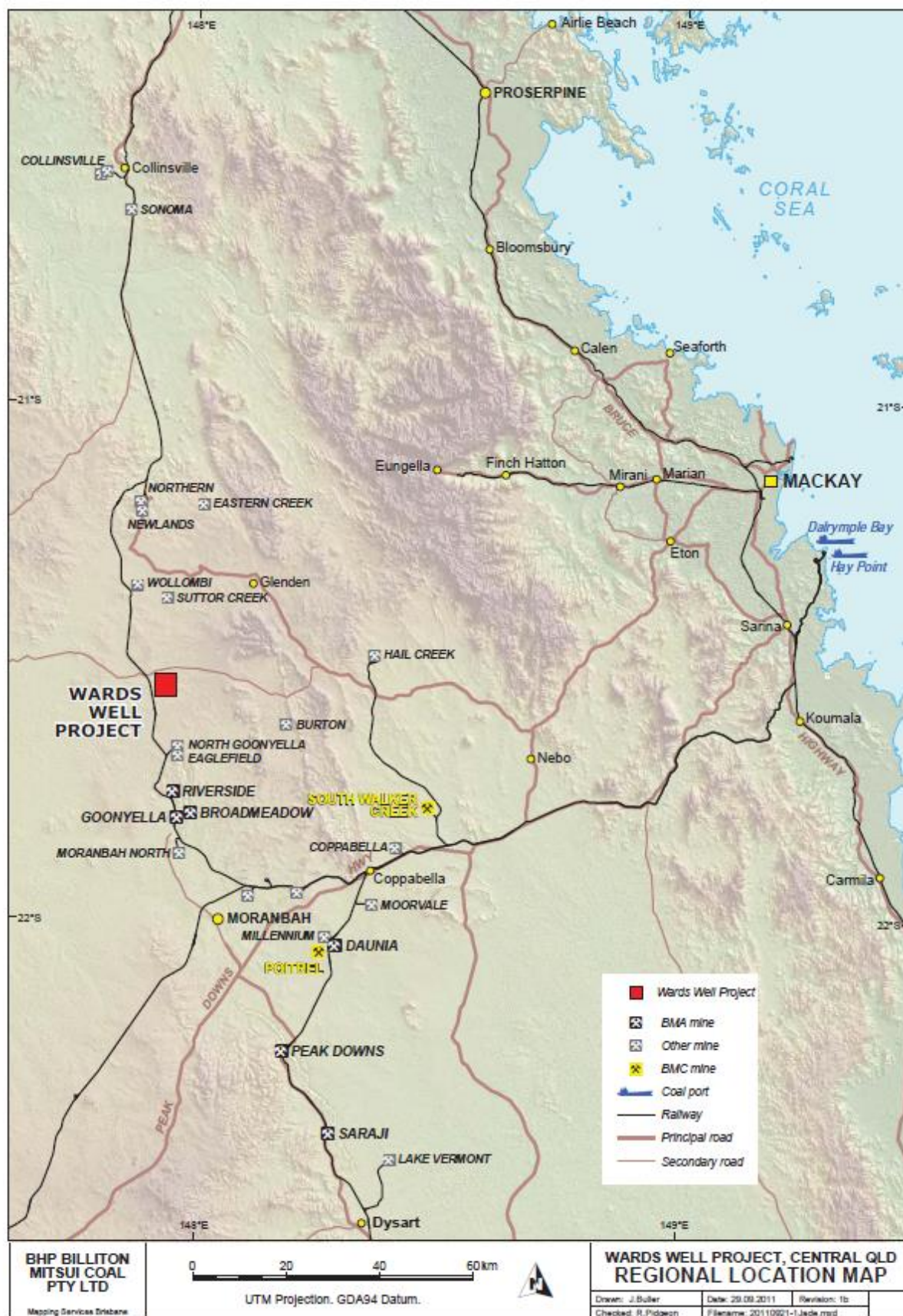
This section describes the Community Consultation Plan (CCP) to be delivered as part of the Wards Well Project (Wards Well) Progressive Rehabilitation and Closure plan (PRC plan) to address the requirements of the *Guideline - PRC Plans* (DES, 2019). It includes:

- consultation requirements for PRC planning;
- the objectives and desired outcomes for stakeholder engagement in PRC planning for Wards Well;
- the consultation process and program including proposed frequency of consultation;
- information to be released for community consultation; and
- how community feedback will be considered in PRC plan updates.

An amendment to Wards Well's Environmental Authority (EA) will be required to enable further exploration at Wards Well as discussed in Section 1 below. The EA amendment is anticipated to be approved by the end of 2022, requiring amendments to the PRC plan and accompanying CCP. The term of this current CCP is therefore assumed as two years (2021-2022).

Figure 1 shows the location of Wards Well in regard to nearby communities and coal mines, and **Figure 2** shows the currently proposed disturbance area within the four mining leases in context with landholdings and Traditional Ownership.

Figure 1: Wards Well Location



February 2021



1. Consultation requirements

Consultation as part of PRC plan development

DES has produced a *Guideline - Progressive rehabilitation and closure plans* (DES, 2019) which provides that ‘community consultation is a key component of the PRC plan and is intended to ensure that anyone impacted by proposed rehabilitation and closure activities at the site has an opportunity to provide input to the planning process’. The guideline requires that the applicant must attempt to consult all relevant members of the community, noting that ‘the community may include, but are not limited to:

- affected landholders (such as underlying and adjoining land holders, and holders of land necessary for access to the land to which the proposed PRC plan relates);
- Traditional Owners;
- local government; and
- local community groups’ (*Ibid.*).

The *Guideline - PRC plans* requirements are:

- consultation should occur prior to any PRCP schedule amendments that are likely to impact the community;
- the consultation register should be updated when this consultation is undertaken;
- in developing the proposed PRC plan, the community should at least be engaged on:
 - the plan for the mine;
 - Post-mining land uses (PMLUs) or non-use management areas (NUMAs);
 - areas of disturbance;
 - rehabilitation and management methods;
 - progressive rehabilitation and closure timeframes; and
- ongoing community consultation should continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community.

The *Guideline – PRC plans* also provides that community consultation carried out through different processes (such as an EIS) may be used to address the requirements in section 126C(1)(c) of the EP Act which provides that a PRC Plan must include details of the consultation undertaken by the applicant in developing the proposed PRC plan, and details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan. If there are no land outcomes identified in a land outcome document or previous consultation cannot be demonstrated, the applicant is required to comply with the requirements above as if it was a new application.

Each PRC plan is required to detail how stakeholders have been consulted in the Plan’s development and the outcomes of that consultation i.e. how stakeholder inputs have informed the outcomes stated in the PRC plan.

EP Act Section 755B provides that the notification stage under chapter 5, part 4 does not apply for the assessment of the proposed PRCP schedule if either of the following matters is satisfied in relation to land the subject of a proposed PRCP schedule— (a) the outcome for land under a land outcome document is the same as, or substantially similar to, the PMLU or NUMA stated for the area under the proposed PRCP schedule; or (b) for an area of land stated in a land outcome document that could be a proposed NUMA under the PRCP schedule—the schedule proposes a PMLU for all or part of the land. As the proposed PMLU is the same as the outcome specified in the Wards Well EA, notification is not expected to be required.

Consultation on Wards Well PRC Plan

Land within the Wards Well MLs was acquired in 2007. Further acquisition of land under compensation agreements was undertaken in 2011-2012. Engagement with the affected landowners was undertaken to develop compensation, leasing and agistment agreements. This included advice that:

- in the near term, exploration activities were the only activities planned;
- an underground mine was proposed for some time in the future; and
- until land was required for exploration or mining, it would be available for grazing within the terms of the agistment agreements and leases.

In essence, the outcome of consultation during the acquisition processes was that landowners and cattle would be excluded from affected areas whilst land disturbance was occurring, and the land would then be rehabilitated and the landform returned to a state suitable for grazing. The existing use for grazing (managed under agistment agreements and leases) has been discussed with directly affected landholders as part of regular meetings between the Land Management team and these stakeholders.

An EIS has not been prepared for Wards Well, so there has been no public consultation regarding land use or land management.

Consultation undertaken as part of PRC plan preparation for Wards Well included:

- meeting with Isaac Regional Council (IRC) about Wards Well's approved activities, PRC planning process and PMLUs, provision of a presentation for Council's information, and an invitation for further discussion with Council about their involvement in future PRC plan consultations;
- writing to the three landholders that own or lease land within the MLs to provide a project update and information about the approved activities and PMLUs under Wards Well's EA, inviting feedback and discussing ongoing engagement regarding the form of IRC's involvement in future PRC planning consultations;
- writing to Widi People who are the Traditional Owners of land within ML1790 and ML70495 to provide an update on Wards Well and information on approved activities and PMLUs within the MLs, with a future meeting with Widi People planned to focus on the Wards Well PRC plan;
- writing to utility owners and the owners of overlapping tenures (mining and gas exploration) within the Wards Well MLs to advise that a PRC plan was being prepared and forecast further engagement in future stages of Wards Well's development; and
- writing to other interested stakeholders including adjacent landholders, the Jangga People (who are the Traditional Owners of land to the east of the MLs), IRC, and government representatives to advise that a PRC plan was being prepared, provide information about Wards Well, progressive rehabilitation and approved PMLUs, and invite stakeholders to contact BHP's Communities team if they would like to discuss the PRC plan or obtain more information..

Community consultation register

A community consultation register has been provided as part of the PRC plan in compliance with section 126C(1)(c)(iii) of the EP Act and includes:

- identification of each community member/stakeholder;
- previous engagements with the community;
- consultation date(s);
- description of consultation type ;

- information provided to the community;
- issues raised/discussed by the community;
- how issues have been considered;
- decisions/ outcomes of engagement; and
- commitments made by BHP.

The community consultation register will be a live instrument for recording future consultation on Wards Well's PRC plan.

PRC plan implementation community consultation plan

The *Guideline - PRC plans* notes that ongoing community consultation is expected to continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community. Consultation is required prior to any PRC plan schedule amendments that are likely to impact the community, and the consultation register needs to be updated when this consultation is undertaken.

In order to comply with section 126C(1)(c)(iv) of the EP Act, the PRC plan must include a community consultation plan (CCP) detailing how ongoing consultation will be carried out in relation to the rehabilitation to be carried out under the PRC plan. The community consultation plan must include details of:

- the objectives for community consultation;
- how the community will be engaged;
- proposed consultation frequency;
- what information will be released for community consultation; and
- how feedback/comments will be considered.

2. Consultation approach

Stakeholder analysis

BHP is committed to consultation in PRC planning with affected and interested stakeholders, who are identified in Table 1. Affected stakeholders were determined in accordance with the International Council for Mining and Metals (ICMM) Community Development Toolkit (ICMM, 2012) guiding questions and include stakeholders who:

- reside within the project area;
- have cultural or historical ties to the area;
- may be socially or economically impacted by closure or rehabilitation;
- will benefit from closure; or
- will be responsible for implementing measures to mitigate negative impacts.

Affected stakeholders who will be consulted during the PRC plan implementation period include:

- landowners and lessees within the MLs;
- Traditional owners - Widi People and Jangga People;
- adjacent private landholders;
- Isaac Regional Council;

- utility owners – Powerlink, Aurizon, Sunwater, Department of Transport and Main Roads (DTMR); and
- owners of overlapping tenures - Arrow Energy Holdings and Anglo American plc.

Other interested stakeholders include those who will be responsible for making decisions, whose co-operation or influence would be beneficial, who might have resources to contribute, or who support or oppose the changes that PRC planning may bring (ICMM, 2012). As Wards Well's currently approved activities do not require a workforce or engagement with local suppliers, and do not result in social impacts for local communities, community members, community groups and businesses have been considered as interested stakeholders for the purpose of this PRC plan.

Table 1 identifies affected and interested stakeholders including issues which are of interest with respect to PRC planning.

Table 1: Wards Well Stakeholders

Stakeholders	Details	Issues of interest
Affected stakeholders		
Traditional owners - Widi People	The Widi People (whose claim was recognised by the NNTT in 2015) are the Traditional Owners of land to the east of Wards Well, with a small area of land within ML 1790 and ML70495 within the Widi People's claim area.	• Cultural heritage impacts • Impacts on Native Title • Potential for impacts on the cultural landscape or connections to Country • Post-mining land use and landform / land scape • Environmental management /stewardship • Employment and business opportunities in exploration, environmental management and monitoring, rehabilitation
Affected landowners and lessees	BHP-Mitsubishi Coal (BMC) has agreements with three landholders within the Wards Well MLs including two landowners and the lessees of land owned by BMC. Land within the MLs is used for grazing. Compensation Agreements are in place for properties within the MLs.	• Access to land owned by BHP whilst not required for mining purposes • Future access to and ownership of lands • Compensation for impacts on land use • Water access – water allocations, water pipelines • Environmental management /stewardship • Post-mining land use and landform/land scape • Rehabilitation
Utility owners • Powerlink • Aurizon • Sunwater • DTMR	Utility owners with assets within Wards Well MLs include Powerlink (electricity transmission), Sunwater (Burdekin water supply pipeline and Eungella water pipelines), Aurizon (rail infrastructure) and DTMR (Suttor Development Road and an unformed road). BHP engages with utility owners as required, i.e. through issue-specific or transactional engagement. Implementation of the PRC plan will require update to agreements with utility owners.	• Impact on assets/asset value • Remediation of impacts on assets • Service disruptions and mitigations • Crossing/interface agreements
Owners of overlapping tenures • Arrow Energy • Anglo American	Arrow Energy and Anglo American have overlapping tenures with the Wards Well MLs (for coal seam gas production and coal production respectively). Relationships with overlapping	• Any impacts on the use or availability of land within overlapping tenures • Water access • Access to land owned by BHP whilst not required for mining purposes • Crossing/interface agreements

Stakeholders	Details	Issues of interest
	tenures owners are managed as part of statutory and commercial processes.	
Adjacent private landholders	To the east and west of Wards Well MLs, BHP owns land which is used as a buffer to manage the potential for conflicting land uses. Peabody's North Goonyella mine adjoins the southern boundary of the mining lease. Land owned by private landholders is located to the west and east. Land uses on adjacent land holdings include grazing and mining,	• Environmental management /stewardship • Post-mining land use and landform/land scape • Access to land owned by BHP whilst not required for mining purposes • Rehabilitation schedule • Future access to and ownership of lands
Local Government • Isaac Regional Council	Isaac Regional Council is the local government and planning authority for the Isaac LGA which encompasses some 58, 000 km2 and 17 distinct and diverse communities.	• Local job opportunities • Economic and community sustainability and transformation (towards post-mining) • Environmental stewardship • Effects of on Council services and infrastructure e.g. changes to infrastructure agreements, water supply or road maintenance • Mine rehabilitation progress • Management of closure impacts on employment and businesses • Accordance of BHP rehabilitation plans with local and regional planning goals
Interested stakeholders		
Other nearby landholders	Several landholders are located within 5-6 km. BHP has established relationships with landholders to the south and east of Wards Well.	• Post-mining land use and landform/land scape • Access to land owned by BHP • Rehabilitation schedule • Future access to and ownership of lands
Jangga People	The Jangga People (whose claim was recognised in 2012) are the Traditional Owners of land to the west of Wards Well's MLs.	• Potential for impacts on the cultural landscape or connections to Country • Post-mining land use and landform / land scape • Employment and business opportunities in exploration, environmental management and monitoring, rehabilitation
BHP employees and contractors	Wards Well does not have an established on-site workforce. Exploration and land management functions are performed by contractors. Other BHP personnel will be interested in closure planning if they perceive that it may affect their employment security.	• Job opportunities • Loss of jobs with closure • Closure planning in context with other mining industry changes e.g. technology advances, autonomous haulage • Workers' conditions • Sustainability of communities that are dependent on mining
Unions	Unions with members who are employed by BHP include the Construction, Forestry, Mining and Energy Union (CFMEU), the Australian Manufacturing Workers' Union (AMWU) and the Electrical Trades Union (ETU). BHP maintains relationships with unions with respect to enterprise bargaining agreements, working conditions and workplace health and safety.	

Stakeholders	Details	Issues of interest
Businesses	BHP's Local Buying Program is delivered in a strategic partnership between BHP and C-RES, a cost neutral organisation. BHP and C-RES have an extensive network of small business suppliers, including Indigenous businesses.	• Opportunities to participate in supply chain (e.g. exploration, environmental management, rehabilitation) • Economic transformation (towards post-mining) • Economic and community sustainability • Loss of supply opportunities with closure
Community members and groups	BHP is strongly affiliated with the communities of Moranbah and Dysart (in the Isaac LGA) and Blackwater (in the Central Highlands LGA).	• Local job opportunities • Local business opportunities • Community and regional sustainability • Environmental management • Future use of mined land • With closure of an operation, loss of jobs and supply opportunities • Rehabilitation schedules
Queensland Government	State government representatives and agencies with an interest in PRC planning include: • Office of the Minister for Resources • Office of the Minister for Environment, Great Barrier Reef, Science and Youth Affairs • Member for Burdekin • Member for Gregory • Shadow Minister for Natural Resources, Mine and Energy • Department of Natural Resources, Mining and Energy (DNRME) - Deputy Director-General Georesources • DES – PRCP Team and Emerald Business Centre	• Legislative compliance • Resource development • Employment opportunities • Public interest • Environmental management • Financial assurance • Environmental risk identification and management • Future land use and landform • Company responses to stakeholder views
Federal Government	The Department of Agriculture Water and Environment (DAWE) is the lead agency for environmental protection at Commonwealth level.	

Use of existing engagement mechanisms

Communities and stakeholders within Isaac LGA will experience multiple demands for their participation in PRC planning over the next few years. To minimise additional demands on communities and stakeholders, BHP will utilise its existing stakeholder engagement mechanisms for PRC consultation wherever possible, as described in Table 2.

Table 2: Using existing BHP engagement mechanisms

Mechanism	Mechanism and frequency
Landholder meetings	BHP's Land Management team engage regularly with landholders within and near MLs. Engagement with Wards Well landholders has related to land access, agistment arrangements and leases Consultation with landowners within and adjacent to Wards Well will be conducted throughout the life of the PRC plan through regular meetings on site or in Moranbah.

Mechanism	Mechanism and frequency
IRC meetings	Twice yearly meetings are held with Isaac Regional Council, generally in March and September. The meetings have a fluid agenda which is subject to change based on key topics/issues at the time. BHP met with IRC in December 2020 to discuss Wards Well, PRC planning and Council's preferred options for engagement in PRC planning. PRC planning updates will be offered as an agenda item for bi-annual briefings. BHP will also offer site-specific and strategic engagement opportunities to IRC.
Traditional Owner meetings	Bi-monthly meetings are generally held with Barada Barna and Ghungalou People. The Indigenous Affairs and Cultural Heritage team is seeking to establish a similar routine with Widi People and Jangga People. The Indigenous Affairs and Cultural Heritage team and the Indigenous Business Specialist will be provided with information to support engagement with Traditional Owners.
Community Connect newsletter	This monthly newsletter is distributed to more than 20,000 letterboxes throughout the Bowen Basin and will include a status update on Wards Well and PRC planning, on an annual basis.
Coal Connect	This weekly electronic employee newsletter will provide a status update on Wards Well and PRC planning on an annual basis and prior to any application for EA amendments.
Moranbah Smart Transformation Advisory Committee (STAC)	The Moranbah STAC is one of two established by BHP as part of its Smart Transformations consultation (the other is the Dysart STAC.) The STACs were involved in developing the Smart Transformation Readiness Assessment and the Community Roadmap, which aim to assist Moranbah and Dysart in preparing for the Fourth Industrial Revolution. STACs generally meet monthly. There is an opportunity to seek feedback on closure planning issues from STAC members.
CSIRO Local Voices	This is a three-year engagement process which includes quarterly pulse surveys for registered participants. There is an opportunity to seek community feedback on closure planning issues through this forum.

Iterative consultation process

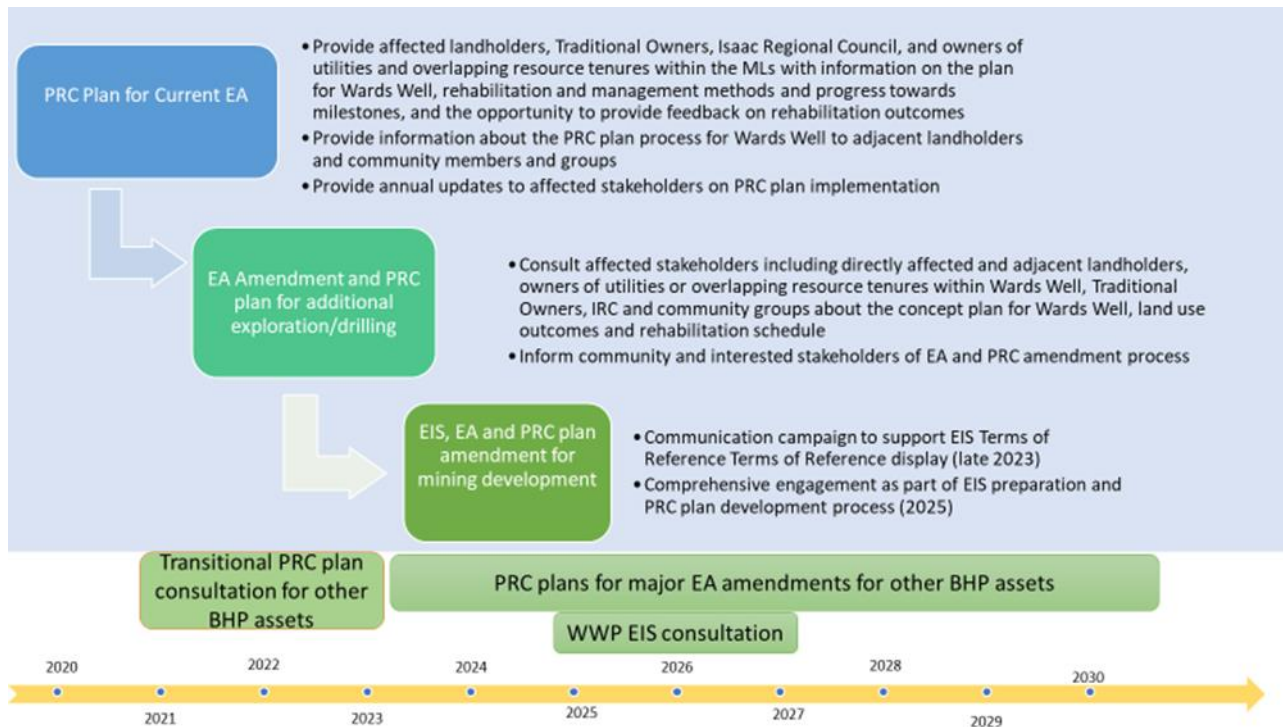
The scope of approved activities under the current Wards Well EAs is limited to exploration, and is time-limited, as the current EA requires a Major amendment in the short term to enable additional exploration and drilling at Wards Well. An application for an EA amendment to facilitate additional exploration is planned for lodgement in late 2021, and would require an accompanying consultation process, consultation register and PRC Plan.

Further EA and PRC plan amendments (expected to include an Environmental Impact Statement under the EPA Act 1994 or the SDPWO Act 1971) will be required to gain approval for mining. Development of Terms of Reference for an EIS is proposed to be finalised by 30 September 2023. This would require a communication strategy to develop community awareness of the proposed project and support stakeholders' informed involvement in the statutory consultation process. Following finalisation of the EIS Terms of Reference, BHP may proceed to the development of the EIS including a comprehensive engagement process.

Figure 3 shows a preliminary draft timeline for PRC plan consultation in line with the required EA amendments, forecasting consultation during the EA amendment process and a future EIS process. As consultation for other BHP assets' PRC plans will also be required during 2021 to 2023, future engagement for Wards Well PRC planning would be positioned, where possible, as part of a portfolio approach to consultation on PRC.

This CCP addresses consultation for the current EA and PRC plan implementation period, and for the commencement of the EA amendment process, anticipating that the CCP will be updated as part of updating the PRC plan for the EA amendment. Consultation as part of a PRC plan/EA amendment for mining development would be considered as part of the methodology for a future EIS.

Figure 3: Staged approach for Wards Well PRC consultation – indicative timeline



Social value

Social value is the positive contribution BHP makes to the environment and society – our workforce, partners, customers, economies and communities. Open and transparent engagement and cooperation with key stakeholders generates social value, which is a precondition to shareholder value. A social value approach goes beyond consultation and social investment, and encourages collective impact, local activation and stakeholder empowerment. The PRC planning process provides BHP with a unique opportunity to demonstrate a commitment to social value and proactively identify opportunities for genuine engagement, co-design and/or partnership with stakeholders to achieve long-term positive social, environmental and economic outcomes post-mining.

Opportunities to catalyse social value will be a focus of future consultation with stakeholders. This includes:

- the opportunity to work industry partners to develop a shared analysis and where possible alignment on PRC plans;
- the opportunity to support landholders' aspirations for future use of rehabilitated land;
- cooperation with Indigenous businesses to develop their capacity to undertake land management and rehabilitation works; and
- cooperation with Council on strategic planning outcomes and economic transformation initiatives.

3. Consultation program

Objectives and outcomes

Consultation as part of implementing the current Wards Well PRC plan will be informed by the objectives and desired outcomes shown in **Table 3**.

Table 3: PRC plan engagement objectives and outcomes

Engagement Objectives	Engagement Outcomes
Develop strong and cooperative stakeholder relationships with affected stakeholders to enable their informed consideration of PRC plans and identification of shared value and/or beneficial future land uses	Affected stakeholders have access to detailed information on plans for Wards Well and regular opportunities to provide input and feedback on Wards Well's rehabilitation methods, schedule and outcomes as they progress
Demonstrate transparency regarding BHP's PRC intentions and timeframes to local communities	A wide range of stakeholders within Isaac LGA communities have access to information about PRC planning and implementation for Wards Well and have opportunities to provide feedback on rehabilitation and closure outcomes
Incorporate community objectives and aspirations for land use and landform planning post-mining in future plans for Wards Well	BHP engagement with IRC and local communities identifies strategic objectives and opportunities for social value which are considered in Wards Well's future PRC plans

BHP will monitor progress against these objectives as part of annual PRC plan monitoring and reporting processes.

Consultation methods and frequency

Table 4 outlines the engagement program for consultation as part of Wards Well PRC plan implementation. As previously noted, an EA amendment will be required to enable further exploration at Wards Well, requiring amendments to the PRC plan and accompanying CCP, so this consultation program will be implemented as part of that process.

Table 4: Consultation program for PRC Plan implementation

Engagement objective		
Develop strong and cooperative stakeholder relationships with affected stakeholders to enable their informed consideration of PRC plans and identification of shared value and/or beneficial future land uses		
Stakeholders	Consultation method	Frequency
- Landowners and lessees within the MLs - Traditional owners - Widi People and Jangga People - Adjacent private landholders - Isaac Regional Council - Utility owners – Powerlink, Aurizon, Sunwater, DTMR - Owners of overlapping tenures - Arrow Energy, Anglo American	Advise affected stakeholders in writing when the PRC plan is approved and provide a copy of the PRC plan for their information	One-off
	Provide information in writing to all affected stakeholders on PRC plan progress, and invite affected stakeholders' feedback on: - the approved PMLU e.g. rehabilitation methods which would optimises future grazing opportunities, or water storage - areas where land disturbance through approved exploration activities are proposed i.e. any particular values in certain areas - rehabilitation methods, schedule and progress towards milestones	Initially on commencement of rehabilitation; subsequent consultation to be defined thereafter
	Meet with directly affected and adjacent landholders, Widi People and Jangga People to provide an update on the Wards Well concept plan, communicate progress with rehabilitation against the PRC plan schedule, and discuss any other items of interest e.g. particular values pertaining to disturbed areas, or shared value initiatives	Ongoing engagement process
	As part of biannual meetings with IRC (or as determined with Council), provide an update on the status of Wards Well's EA (approved activities and PMLUs), the PRC plan and concept plan (as progressed), and progress with rehabilitation against the PRC plan schedule, and forecast upcoming PRC plan consultations for other BHP assets	Bi-annual
	Notify affected stakeholders in writing when an EA amendment application for further exploration has commenced, providing information on the scope and location of the activities for which the amendment is sought, seeking feedback on the proposed updated rehabilitation schedule, disturbance footprint and proposed PMLUs to be included in the PRC plan/amendment accompanying the EA amendment application, and advising on how to access information about the EA amendment notification process	One-off
	Meet with Widi People and Jangga People to provide an update on Wards Well and proposed disturbance areas/activities for which an EA amendment is sought. With Widi People, this will include consultation on cultural heritage management requirements, rehabilitation species, methods and timeframes. This consultation may also identify Traditional Owners' interest in and capacity for involvement in rehabilitation works.	Ongoing engagement process – meetings as agreed
	Meet with DTMR to develop an Infrastructure Plan and update/develop a crossing agreement with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process	Meetings as required
	Through correspondence and/or meetings, cooperate with Powerlink, Sunwater and Aurizon to develop interface agreements where required, with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process	One off process

Engagement objective			Demonstrate transparency regarding BHP's PRC intentions and timeframes to local communities
Stakeholders	Consultation method	Frequency	
Moranbah and Glenden community members and groups	Using Community Connect (BHP's monthly community newsletter) and community forums such as interagency meetings, partnership meetings and community and business networks, provide community updates on PRC planning (Wards Well-specific and portfolio wide) and advise community members of progress towards the Wards Well EA amendment for further exploration	Ongoing engagement process	
	Via Smart Transformations Advisory Committee members, CSIRO Local Voices pulse surveys and/or PRC plan-specific workshops or focus groups, seek the involvement of community members and groups in articulating community aspirations for rehabilitation of BHP mines, PMLUs and economic transformation	One-off process	
BHP employees, contractors and unions	Via Coal Connect (a weekly email newsletter to personnel), provide regular updates on PRC planning (Wards Well-specific and portfolio wide) and updates on the Wards Well concept planning process	Ongoing engagement process	
Young people	Share accessible information (e.g. on-line or printed learning resources) with Moranbah and Glenden schools and community organisations (e.g. Moranbah Youth and Community Centre and Youth Advisory Committee) to enable young people to understand mine planning and rehabilitation planning and implementation	One-off	
Local businesses and BHP suppliers	Via the Moranbah Traders Association and C-RES, provide updates on PRC planning (Wards Well-specific and portfolio wide), including rehabilitation plans and progress, approved PMLUs and potential future supply opportunities	One-off	
Elected representatives and Government agencies	Provide updates via letter and/or meeting on PRC planning to: - Office of the Minister for Resources (Queensland) - Office of the Minister for Environment, Great Barrier Reef, Science and Youth Affairs (Queensland) - Shadow Minister for Resources - Shadow Minister for Environment, Great Barrier Reef, Science and Youth Affairs Resources - Member for Burdekin (Queensland Parliament) - Member for Gregory (Queensland Parliament) - Member for Capricornia (Australian Parliament) - DES PRCP Team and Emerald Business Centre - Director, Coal Hub, Department of Resources - Deputy Director-General Georesources, Department of Resources - Assistant Secretary Assessments and Governance Branch, DAWE	As requested, or as agreed with individual representatives /agencies	

Engagement objective			Incorporate community objectives and aspirations for land use and landform planning post-mining in future plans for Wards Well
Stakeholders	Consultation method		Frequency
Traditional Owners and Indigenous businesses, C-RES	Meet with Traditional Owners and Indigenous businesses to understand business capabilities and communicate the pipeline of opportunities relating to rehabilitation work and land management (portfolio-wide)		One-off process
	In cooperation with Traditional Owners including Widi People, Jangga People and other First Nations within Isaac LGA, plan and implement an Indigenous business capability development program to match rehabilitation opportunities, if this is required		One-off process
Isaac Regional Council	Meet with IRC to understand Council's strategic analysis and planning for Isaac LGA and the Wards Well project area as relevant, to identify objectives to be considered as part of future PRC planning for Wards Well		Annually, or as agreed with Council
	Share the results of BHP research and industry partnership projects relevant to rehabilitation with Council		One-off, or as agreed with Council
	Participate in Council-led initiatives which aim to harness social value from mine closure and rehabilitation planning, and/or work towards from economic transformation		As invited
Local businesses and BHP suppliers	Via C-RES, share information on local supply opportunities relevant to rehabilitation implementation and hold a workshop/s for interested businesses to identify and develop local capabilities for involvement in rehabilitation work		One-off process

4. Information to be released for community consultation

Whilst many stakeholders in the Isaac LGA and broader Mackay-Isaac-Whitsunday Region are well-educated about mining operations, there is less understanding of planning for Life of Mine, rehabilitation and closure planning. The CCP recognises the following social context:

- talk of closure planning will lead to community concerns, requiring careful and consistent messaging;
- Wards Well's status (in the exploration phase, with no production expected in the short to medium term) may make it difficult for stakeholders to understand impacts and opportunities relating to rehabilitation. The iterative nature of PRC plans will need to be emphasised, e.g. this PRC plan is for the currently approved activities, and EA amendment would be required to undertake further exploration, construction and operational works, which will require PRC plan amendments for these works and associated infrastructure;
- PRC plan consultations by a range of companies for a variety of assets will represent considerable cumulative demands on stakeholders, and a coordinated, strategic approach will be required to manage consultation fatigue; and
- community members are becoming increasingly aware of climate change and the impacts of resource activities and energy policies on the environment, so community and stakeholder expectations with regards to mine rehabilitation need to be understood.

Information to be released for community consultation will include:

- the rationale and scope for PRC planning;
- the approved activities and PMLUs for Wards Well;
- on-site activities to date;
- the extent of approved mining leases for Wards Well;
- the scope of the Wards Well PRC exploration plan and mining plan (when available);
- areas of disturbance e.g. indicative exploration plan and box cut location under the current ML;
- proposed rehabilitation methods, schedule and milestones;
- the proposed rehabilitation schedule and activities at Wards Well;
- requirements for EA amendments and accompanying PRC plan revision; and
- opportunities for stakeholder engagement in engagement as part of the PRC plan's implementation.

Communication tools will include:

- a holding statement for general enquiries;
- frequently asked questions and answers (FAQs) and a PRC planning fact sheet available to support engagement activities;
- face to face and virtual meetings; and
- updates and fact sheets about PRC planning for BHP assets through Community Connect, Coal Connect and C-RES.

5. How stakeholder feedback will be considered

As noted in the *Guideline – PRC plans*, in addition to the annual return requirements that relate to EAs, if a PRCP schedule applies for the activities, the annual return must also include an evaluation of the effectiveness of the PRCP schedule, including the environmental management carried out under the schedule, for the year to which the annual return relates.

BHP will monitor the progress and outcomes of progressive rehabilitation activities and report on progress against milestones to demonstrate how successful rehabilitation has been in achieving progress towards the rehabilitation milestones and approved PMLU, and to inform corrective action where required, which will be reported a part of annual returns.

Information about rehabilitation progress will be delivered as part of the consultation methods detailed in Table 4, and any feedback will be considered in PRC plan implementation and updates.

The PRC Plan Consultation Register will be updated as community consultation activities outlined in Table 4 are completed. All stakeholder feedback recorded in the Consultation Register will be considered in framing and detailing future PRC plan amendments for Wards Well. This may include feedback on e.g.:

- flora species selection;
- rehabilitation methods to protect cultural heritage and achieve optimal use for grazing;
- disturbance to areas of specific sensitivity or value;
- the rehabilitation schedule;
- water management e.g. availability for beneficial use; and/or
- development of business capacity programs to equip local and Indigenous businesses for rehabilitation works.

BHP has sought Isaac Regional Council's views on consultation options to involve Council in future PRC plan consultation for both Wards Well EA amendments and other BHP assets, and will utilise Council's preferred options to seek inputs on e.g. rehabilitation outcomes and business capability program development.

BHP will also consider any community submissions made as part of the future EA amendment process in finalising the PRC plan for further exploration.

6. PRC Plan consultation plan review

Review of the PRC plan will be undertaken as part of the annual rehabilitation auditing process and in response to community feedback. This will include monitoring progress towards the desired outcomes for consultation.

The first transitional PRC plan for Wards Well is likely to be superseded by a PRC plan amendment to support an EA amendment for further exploration and drilling. Consultation will be undertaken with affected stakeholders as outlined in Table 4, and the results of this consultation considered in revising and updating the PRC plan to accompany the EA amendment application.

Terms of reference for an EIS to enable future mining development for Wards Well are required to be developed by September 2023. The Terms of Reference will refer to the PRC plan and requirements for its development. If BHP decides to develop Wards Well as a coal mine, a comprehensive and inclusive community and stakeholder engagement process will be undertaken as part of the EIS. This will include a specific focus on progressive rehabilitation and closure planning to enable stakeholders to inform the PRC plan to be prepared for mine operations.

Wards Well PRC Plan Community Consultation Register										
Stakeholder Details				PRC Plan Development Engagement				Engagement Outcomes		
Stakeholder Group	Stakeholder Title	Property/ Organisation	Previous engagement	Consultation type	Consultation date	Information provided	Issues raised/discussed	How issues were considered	Decisions/outcomes of engagement	BHP commitments
Affected landholders	Owner	Lenton Downs	Land within the WWVP MLs was acquired in 2007. Further acquisition of land under compensation agreements was undertaken in 2011-2012. Engagement with the affected landowners was undertaken to develop compensation, leasing and agistment agreements. BHP engages with landholders regularly on lease and land use issues.	Letter, via email	19/01/21	PRC plan requirements Wards Well status Activities approved under Wards Well EA Location in relation to landholdings (map) Disturbance area (Map) Rehabilitation requirements and key steps Approved PMLUs Divestment review process for BMC assets Requirement to seek EA amendment to undertake further exploration activities and mining, involving stakeholder consultation	No feedback or enquiries were received. BHP's regular engagements with landowners indicate that their issues of interest include land access under current land access and lease agreements, the Denham Park lease, and access to BHP land for grazing use whilst is not required for mining.	Stakeholder did not raise any issues. Landowners' interest in use of the land for grazing was considered in framing PMLUs.	Land within the MLs will continue to be available for grazing under existing agreements between BHP and landholders. Landholders and cattle will be excluded from affected areas whilst land disturbance for exploration (and in the future potentially for mining) is occurring. As disturbed land becomes available, it will be rehabilitated to a state suitable for grazing.	BHP will advise affected landholders when it applies for an EA amendment for WW, provide information on the scope and location of the activities for which the amendment is sought, and seek landholders' input on the rehabilitation schedule and proposed PMLUs to be included in the PRC plan/amendment accompanying the EA amendment application.
	Owner	Lancewood	As above	Letter, via email	19/01/21	As above	As above.	As above.	As above	As above
	Lessee	Also lessee for Denham Park DubiniBoomerang Pastoral Epsom Pastoral	As above	Letter, via email	19/01/21	As above	As above	As above.	As above	As above
Adjacent landholders	Owner	Bilyana Holding	BHP engages with adjacent landholders on an as-needed basis e.g. seeking interest in use of BHP-owned land and water issues (TBC) Liaison regarding land access and road use	Letter, via email	19/01/21	As above	As above.	As above.	As above	BHP will advise adjacent landholders when it applies for an EA amendment for WW, and provide information and consultation opportunities as for affected landholders.
	Geology & Resources Administration Support Manager	Peabody Energy Australia	BHP is involved in a partnership project between University of Queensland, International Council for Mining and Metals (ICMM), Anglo American and Peabody. The project aims to establish an understanding committed and future potential post-mining land outcomes, long-term community priorities, projects and planning constraints and opportunities surrounding the Moranbah township, and investigate collaborative opportunities for beneficial use of post-closure mine assets surrounding the Moranbah township.	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	The Community Consultation Plan (CCP) provided with the WW PRC plan addresses future engagement with Peabody Energy Australia.	BHP will advise Peabody Energy Australia of the schedule for preparation of further PRC plan iterations when this is known.
Tenement holders within ML	Manager Tenure	Anglo American plc	Commercial discussions regarding land tenure As above. BHP and Anglo American are working together as part of partnership to understand committed and future potential post-mining land outcomes, community priorities, planning constraints and opportunities, and the potential for collaborative opportunities for beneficial use of post-closure mine assets surrounding the Moranbah township.	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	The CCP provided with the WW PRC plan addresses future engagement with Anglo American plc.	BHP will consult with Anglo American regarding their interests in land within the WW MLs as part of preparing its development plan for further exploration.
	Manager Overlapping Tenure	Arrow Energy Holdings Pty. Ltd.	Commercial discussions regarding land tenure	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	The CCP provided with the WW PRC plan addresses future engagement with Arrow Energy Holdings.	BHP will consult with Arrow Energy Holdings regarding their interests in land within the WW MLs as part of preparing its development plan for further exploration.
Utility owners within ML	District Director, Mackay Whitsunday District	DTMR	Correspondence regarding Infrastructure Plan required prior to any work on the ML.	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	DTMR require an infrastructure plan prior to any work on the ML which has been identified in the PRC Plan CCP.	BHP will work with DTMR to develop an Infrastructure Plan and update/develop a crossing agreement with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process.
	Property Projects Coordinator	Powerlink	Correspondence, issue-specific	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	The Community Consultation Plan provided with the WW PRC plan addresses future engagement with Powerlink.	BHP will work with Powerlink to develop/ update a crossing agreement if required, with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process.
	Commercial Advisor	Sunwater	Correspondence, issue-specific	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	The Community Consultation Plan provided with the WW PRC plan addresses future engagement with Sunwater.	BHP will work with Sunwater to develop/ update a crossing agreement if required, with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process.
	Senior Advisor Community Engagement	Aurizon	Correspondence, issue-specific	Letter, via email	19/01/21	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	The CCP provided with the WW PRC plan addresses future engagement with Aurizon.	BHP will work with Aurizon to develop/ update a crossing agreement if required, with terms and conditions tailored to the planned exploration/ mining activity as part of a future EA amendment application process.
Traditional owners within ML	Legal Representative	Widi People Of The Nebo Estate #1	Consultation regarding South Walker Mine clearing and cooperation between Widi People and BHP.	Letter, via email	5-Feb-21	PRC plan requirements Wards Well MLs and proposed disturbance footprint in relation to native title areas (maps) Status of Wards Well Activities approved under Wards Well EA Rehabilitation requirements and key steps Approved PMLUs Divestment review process for BMC assets Requirement to seek EA amendment to undertake further exploration activities and mining, involving stakeholder consultation	No feedback or enquiries were received. BHP's regular engagements with Traditional Owners indicate interest in the protection of environmental values associated with land to be mined.	Stakeholder did not raise any issues. BHP is considering the potential for involvement of Indigenous businesses in future mine rehabilitation works.	Traditional owners interest in environmental management is addressed in the PRC Plan Community Consultation Plan.	BHP will notify Widi People when it is seeking an EA amendment for further exploration and meet with Widi People to provide an update on WW and proposed disturbance areas/activities for which the EA amendment is sought. This will include consultation on rehabilitation species, methods and timeframes. BHP's Indigenous business specialists will work with Traditional Owners and Indigenous businesses to understand capabilities and the pipeline of opportunities which relate to rehabilitation work and land management, and plan for capability development to match rehabilitation opportunities if this is required.
Traditional owners east of ML	Jangga Operations	Jangga People	Nil to date - no BHP assets within Jangga People's country	Letter, via email	8-Feb-21	As above	As above.	Stakeholder did not raise any issues. BHP is considering the potential for involvement of Indigenous businesses in future mine rehabilitation works.	N/A	Should BHP propose to seek an MDL / EA within EPCs that overlap or are near Jangga People's country, BHP will notify Jangga People, initiate cultural heritage management protocols, meet with Jangga People to provide an update on WW and proposed disturbance areas/activities for which the ML/EA amendment is sought, and encourage their involvement in the EA notification process. BHP's Indigenous Business Specialist will work with Jangga businesses to understand capabilities and the pipeline of opportunities which relate to rehabilitation work and land management, and plan for capability development to match rehabilitation opportunities if this is required.
Local Government	Mayor	Isaac Regional Council	Bi-annual meetings with Council	Letter, via email	Meeting - 3/12/2020 Letter - 19/12/20	BHP's approach to progressive rehabilitation and closure (PRC) planning Legislative requirements for closure planning Wards Well Project update BHP's PRC planning pipeline Council engagement in BHP's PRC planning Wards Well PRC consultation - preliminary timeframe IRC's strategic analysis and planning for Isaac LGA and Wards Well project area as relevant	Council engagement in PRC planning for BHP assets Cumulative consultation demands of PRC planning with various companies and multiple assets for some companies such as BHP Council is considering its options for engaging with companies preparing PRC plans and will take a strategic approach, with seamless consultation as the goal. Council will develop readiness of Council planning documents, with the corporate planning process re-commencing in Q1 2021. Both Isaac LGA plans and Mackay-Isaac Whitsunday regional plans may be relevant. The visions developed by the Moranbah and Dysart STACs in relation to those two towns will also be relevant. Key principal is cooperation to get the best outcome for communities, industry and Council. Interest in rehabilitation noted. No specific comments on PMLUs or rehabilitation plans. Executive Assistant to Mayor and CEO nominated as key contact for coordination of IRC-BHP engagement on PRC planning	BHP recognises the cumulative demands for Council involvement in PRC Plan engagement. Future engagement processes for BHP's PRC plans will include a strategic approach to consultation with Council, to minimise demands on Council's time and maximise the value derived from consultation with Council.	The CCP program will consider Council's preferred options for engagement as part of subsequent reviews of the CCP. Future engagement with Council will include discussion of rehabilitation methods and milestones.	BHP will engage with IRC to understand Council's strategic analysis and planning for Isaac LGA and the Wards Well project area as relevant. BHP will share the results of its research and industry partnership projects relevant to rehabilitation with Council at bi-annual meetings between Council and BHP. BHP will work with Council and other stakeholders in future PRC plan consultations to identify and implement social value opportunities.
	Division 1 Councillor	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Division 2 Councillor (Dysart)	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Division 3 Councillor (Moranbah)	Isaac Regional Council	As above.	Meeting invitation, letter via email and presentation provided	Meeting - 3/12/2020 Letter - 19/12/20					
	Division 4 Councillor (Moranbah)	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Deputy Mayor/Division 5 Councillor	Isaac Regional Council	As above.	Meeting invitation, letter via email and presentation provided	Meeting - 3/12/2020 Letter - 19/12/20					
	Division 6 Councillor	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Division 7 Councillor	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Division 8 Councillor	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	CEO	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Galilee Basin and Bowen Basin Project Manager	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Director Engineering and Infrastructure	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
	Exec. Assistant to Mayor and CEO	Isaac Regional Council	As above.	Meeting and provision of presentation, letter via email	Meeting - 3/12/2020 Letter - 19/12/20					
State Government	Manager, Environmental Services & Regulation Manager, Environmental Services Coal and Central Queensland Compliance	DES	Meetings and correspondence to identify and agree rehabilitation criteria and PMLU as part of EA application process	Pre-lodgement meeting	44218	Provision of draft PRC Plan and discussion of requirements	All issues noted and minuted.	DES feedback was considered in the development of the PRC Plan including the Community Consultation Plan	As noted and minuted.	BHP will comply with the legislative and regulatory requirements for PRC Plans.
	Director Coal Hub, Rockhampton	Department of Resources (formerly DNRME)	Meetings on an as-needed basis	Letter, via email	18/12/2020	Acknowledgement of letter, request to keep the Department informed.	No feedback or enquiries were received.	The PRC Plan's Community Consultation Plan includes provision of annual updates to Department of Resources	N/A	BHP will provide annual updates on PRC planning to the Director Coal Hub, Rockhampton.
	Deputy Director-General Georesources	Department of Resources (formerly DNRME)	Meeting and correspondence regarding resource development commitments	Letter via email	18/12/2020	As above	No feedback or enquiries were received.	The PRC Plan's Community Consultation Plan includes provision of annual updates to Department of Resources	N/A	BHP will provide annual updates on PRC planning to the Deputy Director General.
Federal Government	Assistant Secretary Assessments and Governance Branch	DAWE	Monthly meetings with Director and team, additional meetings as required	Meeting	2/02/2021	No issues raised in relation to PRC plans in regular briefings to date. BHP's portfolio in the Bowen Basin New requirements for mine rehabilitation MERFP Act requirements Transition notice for BMC's Wards Well Project issued BHP's environmental management approach - progressive rehabilitation Wards Well overview Divestment options review Contacts for further information	No feedback or enquiries were received. DAWE does not require regular updates on the WW PRC Plan.	Stakeholder did not raise any issues.	N/A	BHP will provide updates on PRC planning for future assets to the Secretary's office.
Community Groups	President	Moranbah Traders Association, Manager, Moranbah Community Workers Club, Member, Moranbah Smart Transformations Advisory Committee (STAC)	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	BHP will provide regular community updates on PRC planning and seek the involvement of community members and groups in understanding community aspirations for rehabilitation, post mining land use and economic transformation.
	Principal	Moranbah State School, Member Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	As above
	Local business owner and Board member C-Res	C-Res, Member Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	BHP will involve businesses in identifying social value as part of the PRC planning process. This will include identifying local capacity for involvement in rehabilitation work. BHP will also participate in initiatives led by the business community which aim to harness social value from mine closure and rehabilitation planning, and/or work towards from economic transformation.
	C-Res Coordinator	C-Res, Member Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	As above
	Local business owner	Member, Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	As above
	Coordinator	4RFM Community Radio, Member Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	BHP will liaise with 4RFM to provide community updates on closure planning and consultation opportunities. BHP will provide regular community updates on PRC planning and seek the involvement of community members and groups in understanding community aspirations for rehabilitation, post mining land use and economic transformation.
	DON Moranbah Hospital	Queensland Health, Member Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	BHP will involve its internal stakeholders in PRC planning processes to build capacity for community engagement on PRC planning issues.
	Goomyella Riverside Mine GM, Member	BHP, Member, Moranbah STAC	Moranbah STAC meetings	Letter, via email	24/12/2020	As above	No feedback or enquiries were received.	Stakeholder did not raise any issues.	N/A	

APPENDIX 7- NOT USED

APPENDIX 8

BHP (10 FEBRUARY 2021): PRELIMINARY SITE INVESTIGATION WARDS WELL MINE



Preliminary Site Investigation Wards Well Mine

10 February 2021



Contents

Preliminary Site Investigation – Wards Well	1	
1 Introduction	1	
1.1 Objective		1
1.2 Trigger Status		1
1.3 Assessment of Site Contamination NEPM		1
2 Scope of Work	2	
3 Site Context	3	
3.1 Site Identification		3
3.2 Local Government Authority and Zoning		4
3.3 Site Infrastructure		6
3.4 Queensland Contaminated Land Registers		6
4 Site History	7	
4.1 Summary of Previous Investigations		7
4.2 Historical Aerial Imagery		12
4.3 Historical Registered Owners		15
4.4 Licenses and Notices		16
4.4.1 Environmental Authority		16
4.4.2 Transitional PRC Plan		18
4.4.3 Enforcement Register		18
5 Environmental Setting	18	
5.1 Topography and Surface Water		18
5.2 Geology		21
5.2.1 Regional setting		21
5.2.2 Depositional Setting		21
5.3 Acid Sulphate Soils		21
5.4 Hydrogeology		21
5.4.1 Registered Groundwater Bores		22
5.5 Ecosystems and Vegetation		23
5.5.1 State Environmental Reports		23
5.5.2 Protected Matters		29
5.6 Water Quality Environmental Values and Objectives		30
5.6.1 Environmental Values		30
5.6.2 Water Quality Objectives		35
5.7 Flood Risks		36
5.8 Surrounding Land Uses/Activities		38
5.9 Site Waste Management		40

5.10	Earthworks	40
5.11	Water Resource Use	40
5.12	Other Databases	41
6	Site Inspection	42
6.1	Anecdotal Information	43
7	Conceptual Site Model	43
7.1	Source	43
7.2	Potential Receptors	44
7.3	Potential Exposure Routes	44
7.4	Potentially Complete Exposure Pathways	44
8	Conclusions and Recommendations	44
8.1	Conclusions	44
8.2	Recommendations	45
9	References	46

Appendices

Appendix A: Survey Plans

Appendix B: Contaminated Land Register Searches

Appendix C: Groundwater Monitoring Results

Appendix D: Aerial Images

Appendix E: Disturbance Area Images

Appendix F: Lotsearch Report

Appendix G: Golder (2020) Hydrogeological Conceptual Model

Appendix H: Ecosystem Search Results

Appendix I: Field Photographs

Appendix J: Isaac Regional Council Zoning and Overlay Maps

Appendix K: Dial Before You Dig Search Results

Preliminary Site Investigation – Wards Well

1 Introduction

This Preliminary Site Investigation (PSI) has been prepared to inform the development of the transitional Progressive Rehabilitation and Closure Plan (PRC Plan) for the Wards Well mine. The Wards Well mining leases at the time of this investigation were operated under the Environmental Authority (EA) number: EPPR00668513 (date effective 25 January 2018).

The mining leases, which form the boundary of this investigation, are summarised in Table 1 below.

Table 1: Wards Well Mining Leases

Mining Lease	Name
ML4752	Lancewood
ML1790	Wards Well
ML70443	Wards Well East
ML70495	Wards Well Southeast

The Wards Well mine is located within the northern region of the Bowen Basin approximately 30 kilometres (km) south of Glenden and approximately 150 km southwest of Mackay in Central Queensland. It is located immediately to the north of the existing North Goonyella Mine and approximately 45km to the north of Moranbah. The Suttor Development Road runs east-west through the Project area and is located on the northern boundary of ML1790 and southern boundary of ML4752.

Extractive mining operations had not commenced at the time of this investigation. Exploration drilling activities had occurred within the investigation area since the 1970s.

1.1 Objective

The objective of the investigation was to inform the development of the transitional PRC Plan through the identification of baseline potential contamination risks to the proposed post mining land use.

1.2 Trigger Status

This investigation has been undertaken voluntarily as part of the development of the transitional PRC Plan for the BHP mine. The investigation was not subject to an administering authority 'show cause' notice at the time of investigation.

1.3 Assessment of Site Contamination NEPM

This site investigation has been undertaken with reference to the EP Act (1994) and the National Environment Protection Measure (Assessment of Site Contamination) Measure (ASC NEPM), noting the objective of the investigation in relation to informing the PRC Plan development and that this investigation was limited to the area covered by the mining lease and not the legal property boundaries.

The relevant sections of the following schedules from the ASC NEPM were utilised and followed as part of this investigation.

- Schedule A – Recommended General Process for the Assessment of Site Contamination.
- Schedule B1 – Guideline on Investigation Levels for Soil and Groundwater.
- Schedule B2 – Guideline on Site Characterisation (applicable sections as listed below).

- 2.0 Stages of investigation
- 2.1 Preliminary site investigation
- 3.0 Preliminary investigations
- 3.1 Site identification
- 3.2 Current and proposed use
- 3.3 Site history
- 3.4 Environmental setting
- 3.5 Local geology and hydrogeology
- 3.6 Site inspection
- 4.0 Conceptual site models
- 14.0 Report presentation

2 Scope of Work

This report consists of a PSI that has been prepared with reference to the following:

- National Environment Protection Council (1999) National Environment Protection (Assessment of Site Contamination) Measure (rev: 2013) (ASC NEPM).
- Queensland Government (1994) Environmental Protection Act.
- Standards Australia (AS4482.1:2005) Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil.
- Queensland Government (2019) Queensland Auditor Handbook for Contaminated Land – Module 6: Content requirements for contaminated land investigations documents, certifications and audit reports.

In accordance with the ASC NEPM, the PSI was primarily undertaken to identify:

- Potential sources of contamination and determine potential contaminants of concern;
- Areas of potential contamination;
- Potential human and ecological receptors; and
- Potentially affected media (soil, sediment, groundwater, surface water).

To achieve the above, the following scope of work was undertaken.

- Records review including review of the following where it was publicly available or held by BHP:
 - historical aerial photographs;
 - current and historical title records;
 - site layout plans and previous investigation reports and other data;
 - licences and notices;
 - council overlay maps;
 - flood maps;
 - unexploded ordnance maps;
 - service plans (“dial before you dig” search);
 - State groundwater database;
 - Environmental Management Register (EMR) and Contaminated Land Register (CLR);

- ecological databases identifying potentially sensitive receptors such as ecosystems, wetlands, vegetation types and species;
- environmental values and water quality objectives for the area in which the investigation area is located; and
- publicly available topographic, geological and hydrogeological maps.
- Inspection of the investigation area to assess for potential visible evidence of contamination, any activities or process that may result in contamination of the investigation area, surrounding land uses that have a potential for contamination of the investigation area and to validate where practical the information obtained from the records review.
- Development of a contaminated land Conceptual Site Model.

3 Site Context

3.1 Site Identification

The Wards Well mine area covered by this investigation is shown in Figure 1.

Table 2 summarises the mining leases and legal properties covered by this investigation.

Table 2: Mining Leases and Legal Properties

Mining Lease	ML4752		ML1790		ML70443		ML70495
Lease Name	Lancewood		Wards Well		Wards Well East		Wards Well Southeast
Latitude	21°29'31.74"S		21°34'16.61"S		21°32'40.38"S		21°35'49.20"S
Longitude	147°55'38.78"E		147°56'36.13"E		147°57'48.71"E		147°58'41.30"E
Permit Status	Granted		Granted		Granted		Granted
Grant Date	1978		1978		2017		2017
ML Holder	BHP Billiton Mitsui Coal Pty Ltd		BHP Billiton Mitsui Coal Pty Ltd		BHP Billiton Mitsui Coal Pty Ltd		BHP Billiton Mitsui Coal Pty Ltd
Area (ha)	2363		4392		867.6		489.6
Legal Properties	Lot 2 on SP256592	Lot 8 on GV807254	Lot 2 on SP214117	Lot 11 on SP262530	Lot 8 on GV807254	Lot 2 on SP214117	Lot 2 on SP214117
Property Ownership Type	Freehold	Land Lease	Land Lease	Freehold	Land Lease	Land Lease	Land Lease
Property Current Registered Owner	B.J. and J.M. Pini	V.A. and M.E. Mason	BHP Billiton Mitsui Coal Pty Ltd	BHP Billiton Mitsui Coal Pty Ltd	V.A. and M.E. Mason	BHP Billiton Mitsui Coal Pty Ltd	BHP Billiton Mitsui Coal Pty Ltd

Figure 1 illustrates the Wards Well Project mining leases and **Appendix A** contains survey plans for each of the legal properties intersected by the mining leases.

3.2 Local Government Authority and Zoning

The investigation area is located within the local government area of the Isaac Regional Council. The council, at the time of preparation of this report, was in the process of developing a new planning scheme for the region. Under the Draft Isaac Regional Council Planning Scheme Zoning Rural Areas, the area in which the site is located is proposed to be zoned as “Rural”. It should be noted, the Planning Act does not apply to development in mining tenements authorised under the Mineral Resources Act 1989, other than for administering Integrated Development Assessment System (IDAS) for the Heritage Act, in relation to a Queensland heritage place.

A review of the Isaac Regional Council overlay maps covering the area of the investigation did not identify the following within the investigation area.

- Flood hazards;
- Heritage Areas;
- High ecological value waters or water resource catchments; and
- Acid sulfate soils.

Copies of the council overlays are contained in **Appendix J**.

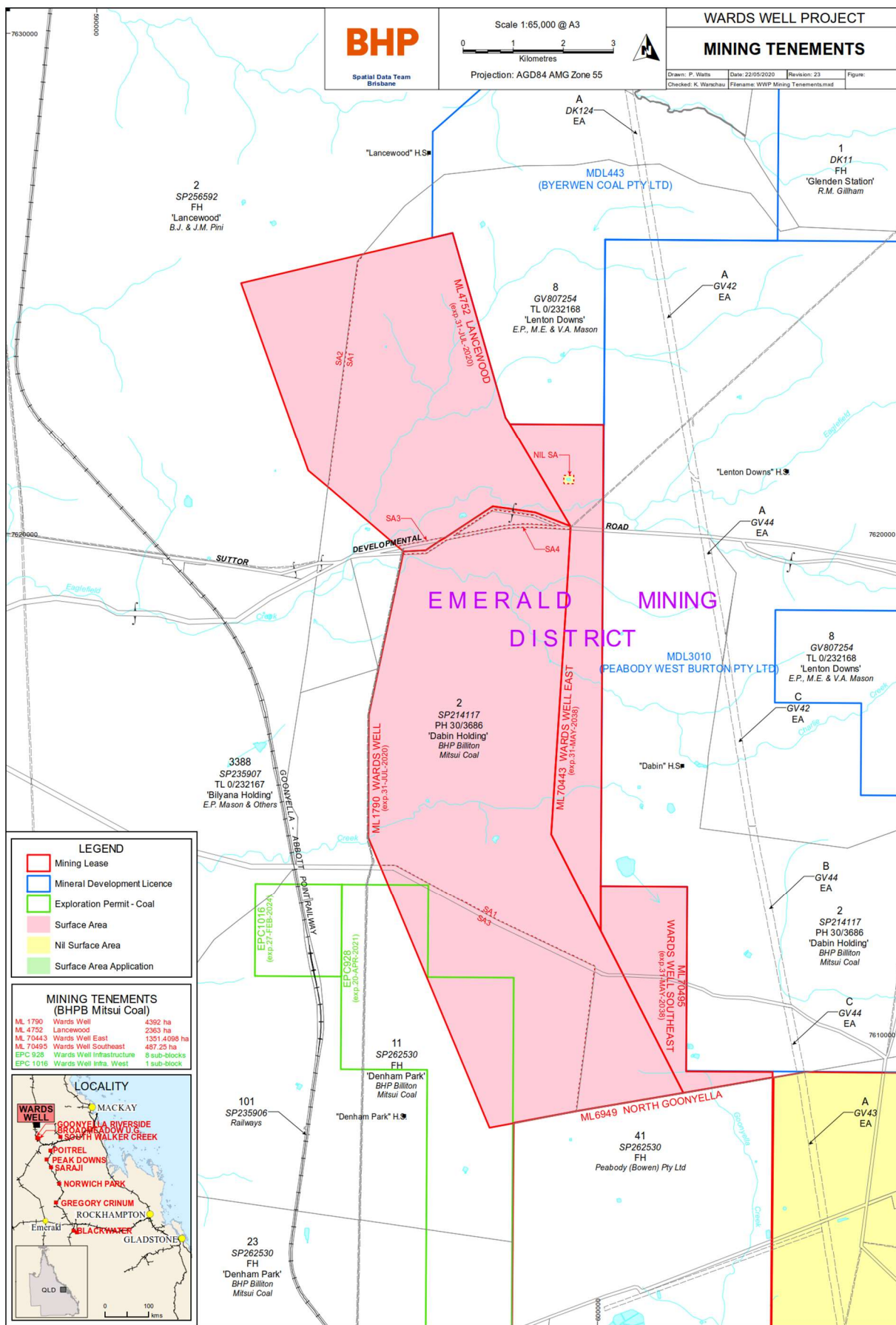


Figure 1: Wards Well Mining Tenements

3.3 Site Infrastructure

The investigation area has been subject to agricultural (grazing) and exploration activities. No commercial extraction of coal had occurred prior to this investigation. Therefore, infrastructure on site was limited to:

- Suttor Development Road (public road);
- Groundwater extraction bores for stock watering and associated water pumping infrastructure;
- Access tracks and roads;
- Fences; and
- Agricultural small water storage dams, tanks and troughs.

No homesteads, septic systems, workshops, chemical storage, cattle dips, farm dumps or other infrastructure, considered to present a significant risk of contamination, was observed within the mining leases that formed the investigation area. It should be noted that these activities were observed surrounding the investigation area generally in the proximity of the homesteads.

A dial before you dig search for the investigation area was undertaken to assess for potential services and other in-ground infrastructure that has the potential to cause contamination. The dial before you dig search results identified a Sunwater water pipeline that runs along the western boundary of ML1790 and through the investigation area along the alignment of the Suttor Development Road. The Isaac Regional Council and Ergon Energy dial before you dig searches did not identify any assets within the searched area. A copy of the dial before you dig search results are contained in **Appendix K**.

3.4 Queensland Contaminated Land Registers

A search of the Environmental Management Register (EMR) and the Contaminated Land Register (CLR) was undertaken on 6 January 2021. The search responses are contained in **Appendix B**. The results of the contaminated land searches are summarised in Table 3.

Table 3: Contaminated Land Register Search Results

Property	EMR	CLR	Comments
Lot 2 SP256592	Not Listed	Not Listed	Property includes the Lancewood Homestead site and other associated infrastructure areas to the north of the investigation area.
Lot 2 SP214117	Not Listed	Not Listed	Property includes the Dabin Homestead site to the east of the investigation area.
Lot 8 GV807254	Listed on the EMR for Livestock Dip or Spray Race.	Not Listed	Cattle dip is believed to be located within the proximity of the Lenton Downs Homestead approximately 3.6km to the east of ML70443.
Lot 11 SP262530	Not Listed	Not Listed	Property includes the Denham Park Homestead site to the west of the investigation area.

4 Site History

4.1 Summary of Previous Investigations

Preliminary Approval Studies

In 2012 studies were commenced to support future approvals for development at Wards Well, however the project was placed on hold and the studies were not completed. A summary of these preliminary assessments is provided below for background information only.

Groundwater

The findings of the preliminary hydrogeology assessment included the following:

- During 2011 the static water level on site ranged from 7.5 to 41.4m below ground level (296.6 to 314.9 mRL). The potentiometric groundwater surface is generally a subdued reflection of the surface topography and indicates a general groundwater flow direction to the west. The hydraulic gradient ranged from 1 in 250 to 1 in 400.
- An assessment of the “environmental value” of groundwater for the Project area in 2012, included:
 - Aquatic Ecosystems - There were no known permanent surface water bodies that are reliant on groundwater flows, present within the mining lease. All of the creeks that flow through the Project area were ephemeral systems that were not fed by a permanent discharge from underlying aquifers.
 - The depth to the saturated zone was between 10m and 40 m below surface and was considered unlikely that vegetation was dependent on this deep groundwater.
 - Recreational Use -This category of environmental value was not considered relevant to the groundwater regime of the area.
 - Drinking Water - The groundwater was rarely suitable for human consumption, and there was no known reliance on groundwater for drinking water in the area.
 - Agricultural Use - The groundwater was generally suitable for stock and this was the most common use of groundwater in the region surrounding the Project.
 - Industrial Use - There were no industrial users of groundwater within the Project area.
- The coal seam permeability values at Wards Well ranged from 1×10^{-3} m/day to 1×10^{-6} m/day, with values in the range of 2×10^{-5} m/day, 4×10^{-4} m/day the most common. These permeability values were considered relatively low in comparison to typical coal seam permeability values for the Bowen Basin.
- The primary environmental value of the groundwater from the aquifers within the Project area was deemed to be for agricultural use only. Available groundwater results were compared to ANZECC (2000) Guidelines for livestock watering and all the results were within the stock watering investigation levels.
- The Wards Well Project is partially located within the Isaac River sub-basin, which is contained within the Fitzroy Basin. However, due to insufficient data points close to the Project area, a specific chemistry zone has not been established for the area of interest.

Geochemical

The findings of the preliminary hydrogeology assessment included the following:

Potential coal rejects

- Potential coal rejects, whether from ROM coal from G0 seam or from coal seam spoil/rejects encountered during construction of the access portals, were expected to generate highly alkaline, low-salinity run-off/seepage following surface exposure.
- The total sulfur concentration of all samples was generally very low (75th percentile = 0.07%; 90th percentile = 0.13%), however some samples contained low sulfide concentrations that could potentially generate weak acidity.

- Selected samples were classified as potentially acid forming (PAF), with a 'Low Capacity' to generate significant acid, however most samples, and therefore the bulk material, was expected to be non-acid forming (NAF). 'PAF' rejects are conservatively expected to comprise less than 10% of all reject material.
- Total metal and metalloid concentrations in potential coal reject samples were low – below the applied health-based investigation levels for soils. One potential coal reject sample exceeded the applied 'background' concentration for manganese.
- The multi-element results indicate that some potential coal reject materials may produce leachate containing elevated concentrations of some soluble elements (mainly molybdenum and selenium).

Access portal spoil

- Spoil from access portals was expected to generate highly alkaline, low-salinity run-off/seepage following surface exposure.
- The total sulfur and sulfide concentration of all spoil samples assessed was very low, and all samples assessed were classified as NAF.
- Total metal and metalloid concentrations in spoil samples were low – below the applied health-based investigation levels for soils. Some spoil samples had concentrations of manganese, cobalt and zinc that exceeded the applied 'background' level for these metals.
- The multi-element results indicate that some spoil materials may produce leachate containing elevated concentrations of some soluble elements (mainly molybdenum and occasionally selenium).

Coal

- Coal mined from the Project (ROM coal) is expected to generate pH-neutral to mildly alkaline, low-salinity run-off/seepage following surface exposure.
- The total sulfur concentration of the samples tested was low (less than 0.5%) and one coal sample contained low concentrations of sulfide sulfur – sufficient to classify this single sample as PAF-Low Capacity.
- All except one sample was classified as NAF, therefore the bulk coal material is expected to be NAF. The acid forming nature of the single PAF-Low Capacity sample is currently uncertain, but ROM coal would not be expected to generate significant acidity due to low sulfide concentrations.
- Total metal and metalloid concentrations in coal samples were low – below the applied health-based investigation levels for soils.
- The multi-element results indicate that coal materials, overall, are not expected to produce leachate containing soluble elements in significant concentrations.

Routine Groundwater Monitoring Results

Groundwater monitoring has been undertaken by BHP within the investigation area since 2011. A summary of the monitoring wells is contained in Table 4 and the location of the monitoring wells are shown on Figure 2.

Table 4: Summary of BHP Wards Well Monitoring Wells

Bore ID	Installation Type	Easting	Northing	Surface Elevation (m AHD)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Screened Geology
MB03	Open Standpipe	597925	7621997	317.4	267.7	255.7	Basalt
MB03A	Open Standpipe	598676	7621619	324.2	188.2	176.2	Basalt
MB04	Open Standpipe	598774	7621734	325.8	186.8	177.8	Basalt
MB05R	Open Standpipe	596747	7619460	303.3	170.3	164.3	Basalt
MB06	Open Standpipe	597605	7615403	314.6	235.1	229.1	Basalt (weathered)
MB07	Open Standpipe	596666	7613468	311.9	248.9	242.9	Basalt
MB08	Open Standpipe	599625	7611359	335.9	267.9	264.9	Basalt
MB09	Open Standpipe	597636	7609407	323.3	274.3	271.3	Basalt
MB10	Open Standpipe	600074	7620778	320.7	218.7	203.7	Basalt
MB11	Open Standpipe	599910	7620190	319.7	204.7	198.7	Basalt
MB12	Open Standpipe	599965	7616688	322.4	291.4	288.4	Basalt
MB13	Open Standpipe	598576	7621731	325.7	198.7	180.7	Basalt (weathered)
MB14	Open Standpipe	598109	7622195	317.4	247.4	235.4	Basalt
MB15	Open Standpipe	596584	7619218	303.3	173.3	164.3	Basalt
MB16	Open Standpipe	596421	7619394	303.3	185.3	173.3	Basalt
MB17R	Open Standpipe	596622	7613320	312.7	247.7	244.7	Basalt
MB18R	Open Standpipe	596791	7613519	312.7	222.7	216.7	Tertiary Sediments (Sand)
MB18R2	Open Standpipe	596807	7613530	312.7	234.7	228.7	Basalt (weathered)
PB01	Pumping Bore	598598	7621734	325.8	225.2	187.1	Basalt
PB02	Pumping Bore	596751	7619460	303	187.6	157.6	Basalt (weathered)
PB03	Pumping Bore	596679	7613457	311.9	236.7	230.7	Tertiary Sediments
VWP01_S1	Vibrating Wire Piezometer	598583	7621733	325.8	-9.2	-9.2	Overburden
VWP01_S2					-30.2	-30.2	Goonyella
P01_S3					-142.2	-142.2	Goonyella
VWP01_S4					-208.2	-208.2	Goonyella
VWP02_S1	Vibrating Wire Piezometer	596657	7619458	303	103	103	Overburden
VWP02_S2					90	90	Goonyella
VWP02_S3					73	73	Interburden
VWP02_S4					57.5	57.5	Goonyella
VWP03_S1	Vibrating Wire Piezometer	596669	7613458	311.84	146.84	146.84	Interburden
VWP03_S2					105.84	105.84	Goonyella
VWP03_S3					79.84	79.84	Goonyella
VWP03_S4					47.84	47.84	Goonyella

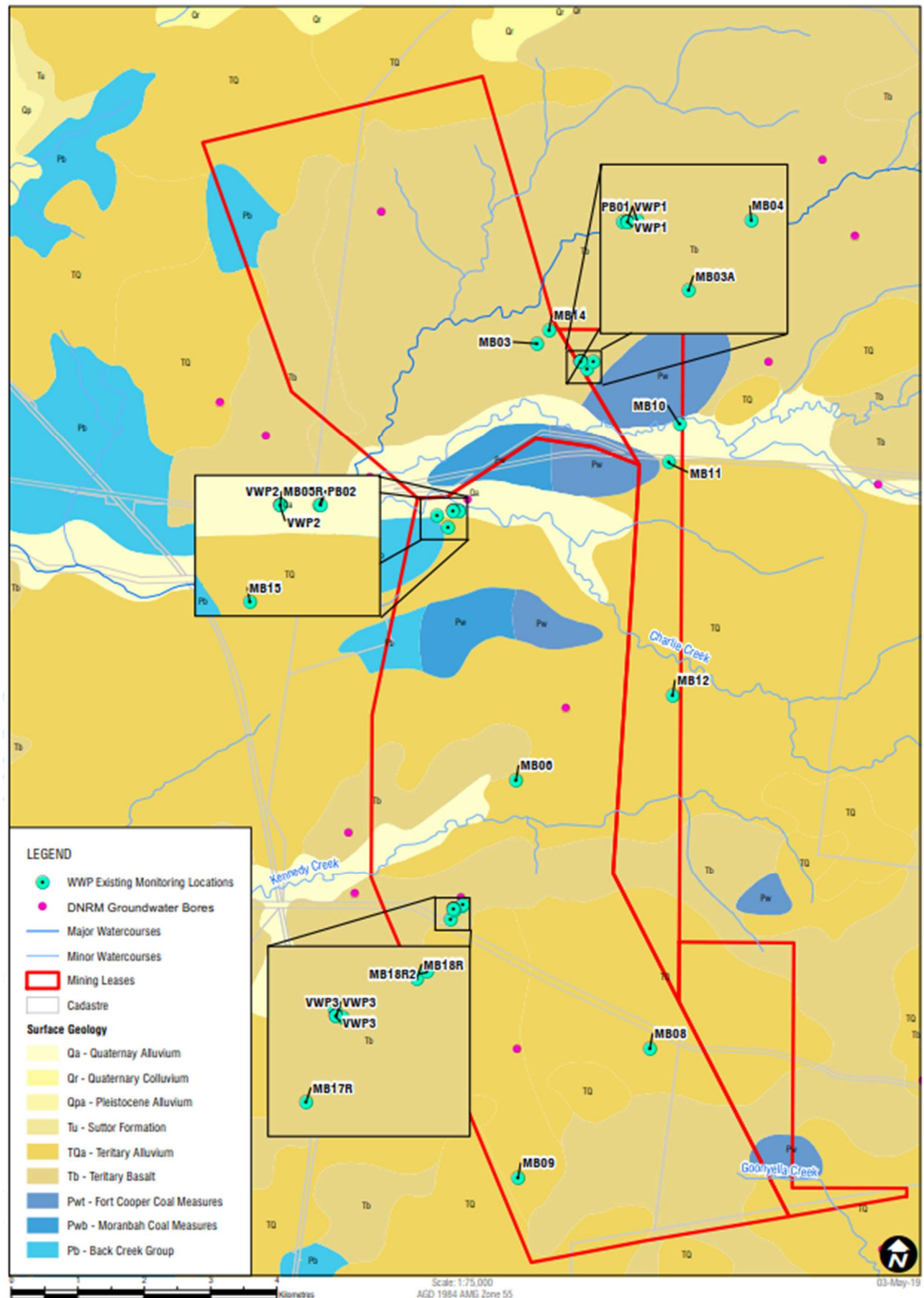


Figure 2: Wards Well Groundwater Monitoring Well Network

A summary of the water monitoring results is contained in **Appendix C**.

Samples collected from the groundwater monitoring bores (wells with the prefix MB) have been selectively analysed in accordance with the Environmental Authority conditions for the following:

- pH/electrical conductivity
- Anions/Cations
- Metals – Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium (III+VI), Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Phosphorus, Potassium, Selenium, Silver, Strontium, Titanium, Uranium, Vanadium and Zinc.
- Total Recoverable Hydrocarbons.
- Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene.
- Nutrients – Ammonia, Nitrate, Nitrite, Nitrogen (Total), Kjeldahl Nitrogen Total and Phosphorus.

All of the groundwater monitoring bores from which samples were collected and analysed, are located within Tertiary aquifers, which are utilised for stock watering within the investigation area. Vibrating Wire Piezometer (bores with the prefix VW), which were installed within the Permian aquifers were utilised for assessment of water levels and have not formed part of the groundwater sampling and analysis program.

As mining operations had not commenced, the groundwater analytical results collected from all of the monitoring bores were considered representative of pre-mining conditions. As such, the statistical assessment of the data has utilised all monitoring bores to provide an indication of overall groundwater quality and suitability within the Tertiary hosted aquifers. A summary of significant results is contained in Table 5.

Table 5: Summary of Significant Tertiary Aquifer Analytical Results

Analyte	Maximum Concentration	Mean Concentration	80 th Percentile	Guidelines exceeded by 80 th Percentile
Chloride	1,400mg/L	697mg/L	1,092mg/L	ADWG ANZECC (2000) Recreation
Sodium	1,000mg/L	411mg/L	530mg/L	ADWG ANZECC (2000) Recreation
Boron	1.1mg/L	0.259mg/L	0.45mg/L	ANZECC (2000) 95%
Selenium	0.017mg/L	0.004mg/L	0.01mg/L	ADWG ANZECC (2000) Recreation
Sulphate	174mg/L	22.826mg/L	35.6mg/L	-
Zinc	0.26mg/kg	0.017mg/L	0.026mg/L	ANZECC (2000) 95%
Total Dissolved Solids	4,310mg/L	1,584mg/L	2,470mg/L	ADWG

Notes:

Outliers removed via visual review of the results. Detection limit assumed for results below laboratory method detection limit.
 ADWG = National health and Medical Research Council (2011) Australian Drinking Water Guidelines
 ANZECC (2000) = Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000) Australian and New Zealand guidelines for fresh and marine water quality

A preliminary review of the analytical data against the Water Quality Objectives (WQO) (see Section 5.6 for evaluation of WQOs) identified the following significant results.

- The groundwater contained within the Tertiary aquifers is sodium chloride dominated with an average and 80th Percentile concentrations exceeding the WQOs associated with the ADWG and the ANZECC (2000) Recreational guidelines. The 80th percentile concentration of selenium within the Tertiary aquifer was also found to exceed the ADWG and the ANZECC (2000) Recreational guidelines.
- The 80th Percentile concentrations of boron and zinc were above the ANZECC (2000) 95% level of species protection.
- Total Recoverable Hydrocarbons were not detected above the laboratory detection limits within the available from 2012 to 2017. The single round of monitoring for benzene, toluene, ethylbenzene, xylene, polycyclic aromatic hydrocarbons and phenols in 2012, also did not identify detectable levels within groundwater.
- With the exception of maximum result for Total Dissolved Solids, the average and 80th Percentile results were all below the established ANZECC (2000) Livestock guidelines.

Therefore, the groundwater is unlikely to be suitable for beneficial use for drinking water, other domestic purposes or recreational use without prior treatment. However, the analytical results generally indicate the tertiary aquifer was suitable for use of cattle stock watering.

It should be noted the quality of groundwater within the Permian hosted aquifers have not been assessed. However, the salinity of the Permian aquifers are expected to be higher than the overlying Tertiary aquifers.

4.2 Historical Aerial Imagery

A review of publically accessible aerial imagery available on State of Queensland, Department of Natural Resources, QImagery was undertaken for evidence of potentially contaminating activities or processes that may have occurred within the investigation area or on immediately surrounding areas. A copy of the reviewed aerial images are contained in **Appendix D** and the summary of the review is contained in the table below.

Table 6: Summary of Aerial Image Review

Queensland Globe Imagery 2016-2020

Review of the Queensland Globe satellite imagery was undertaken. Images of identified notable anthropogenic type disturbances within the investigation area are reproduced in **Appendix E** and summarised below.

ML1790

Disturbance Area 01 - Western boundary of ML1790 approx. 3.2 km south of Suttor Development Road – two areas of disturbance with material handling visible. Materials of different colours indicate potential for material from external sources stored on site. (**Appendix I, Photograph 14**)

Disturbance Area 02 – Central western portion of ML1790 approximately 3.2km south of Suttor Development Road. Stock watering/mustering point.

Disturbance Area 03 – Central ML1790, approx. 5km south of Suttor Creek Development Road. Stock water/mustering point. (**Appendix I, Photograph 15**)

Disturbance Area 04 – Central eastern portion of ML1790, approximately 2.7km to the south of Suttor Development Road. Stock watering and mustering point. (**Appendix I, Photograph 16**)

Disturbance Area 05 – Northern portion of ML1790 immediately to the south of Suttor Development Road. Cleared area with a connecting track to the road to the north. No visible use. (**Appendix I, Photograph 17**)

Disturbance Area 06 – Central portion of ML1790, approx. 6km to the south of Suttor Development Road. Area of exposed earth, possibly natural, no apparent use. (**Appendix I, Photograph 18**)

Disturbance Area 07 – Southern portion of ML1790. Cleared square areas and access tracks. Possible exploration drill pads. No apparent use at the time of image.

Disturbance Area 08 – Southern portion of ML1790, approx. 9.5km to the south of Suttor Development Road. Stock watering point and dams.

Disturbance Area 09 – Southern Portion of ML1790, approx. 10.5km to the south of Suttor Development Road. Possible drill pad and access track prior to drilling with mud pits excavated.

Disturbance Area 10 – Immediately to the south of Suttor development road. Area of erosion. (**Appendix I, Photograph 19**)

Disturbance Area 11 – Western boundary of ML1790 approx. 5.2km to the south of Suttor Development Road. The rectangular area of disturbance appears to have been subject to earthworks. (**Appendix I, Photograph 20**)

ML4752

Disturbance Area 01 – crosses eastern boundary with ML70443 to the north of Suttor Development Road. Possible borrow pit with visible stockpiling of earthen materials and earthworks. No visible earthmoving equipment within images. (**Appendix I, Photograph 11**)

Disturbance Area 02 – southern boundary of ML4752. Possible stock water dam, which contained water. (**Appendix I, Photograph 12**)

Disturbance Area 03 – Stock watering point with turkey nest dam. (**Appendix I, Photograph 13**)

ML70443

Disturbance Area 01 – crosses western boundary with ML4752 to the north of Suttor Development Road. Possible borrow pit with visible stockpiling of earthen materials and earthworks. No visible earthmoving equipment within images. (**Appendix I, Photograph 11**)

Disturbance Area 02 – southern portion of ML70443 on eastern boundary. Series of three small farm dams that appeared silted up.

ML70495

No areas of notable disturbance were observed on ML70495.

Surrounding Areas

To the north of ML4752 is the Lancewood Homestead and other associated agricultural infrastructure including dams, holding yards and sheds and access tracks. The observed infrastructure is between 1km and 1.5km to the north of the mining lease.

Approximately 1.5km to the east and up gradient of ML70443 is the Burton Downs Homestead and other agricultural supporting infrastructure including sheds, dams, stock holding yards, cattle dip and feed storage yards.

To the east of the southern portion of ML70443 and to the north of ML70495 on Kennedy Creek and tributaries there are three agricultural water dams.

Within 2km to the east of ML70495, five agricultural water supply dams are visible.

To the south of ML1790 and ML70495 and down gradient of investigation area are mining leases and land disturbances associated with the North Goonyella mining operations.

Approximately 1.5km to the south west of ML1790 is the Denham Park homestead and associated agricultural type infrastructure including sheds, water tanks, holding yards and cattle dip. To the south of the homestead was an unsealed airstrip.

The Newlands System rail line runs north south approximately 1.5km at its closest point to the west and down gradient of the investigation area.

Immediately to the west of ML1790 is a cleared and rehabilitated water supply infrastructure corridor with above ground infrastructure yards intermittently along the corridor.

QSat (2017) 240cm Planet 1:9,000

Both on-site and off-site land uses were consistent with those described for the Queensland Globe Imagery.

Harrybrandt (2007) 1:40,000

(note does not cover northern portion of ML4752)

The aerial images show the investigation area with increased vegetation cover and higher water levels within the dams.

ML4752 – ML70443

Disturbance Area 01 – The disturbance area associated with the possible borrow pit is smaller than observed within the 2017 images and more concentrated on ML4752.

With the exception of the above the on and off-site observations were consistent with the 2017 images.

Hillalong (2005) 1:40,000

(note does not cover areas to the south of Suttor Development Road)

Both on-site and off-site land uses were consistent with those described above for the Queensland Globe imagery and Harrybrandt (2007) images.

Harrybrandt (2000) 1:40,000

(note does not cover northern portion of ML4752)

Both on-site and off-site land uses were consistent with Harrybrandt (2007) images.

Hillalong (2000) 1:40,000

(note does not cover areas to the south of Suttor Development Road)

Both on-site and off-site land uses were consistent with the Hillalong 2005 images.

Harrybrandt (1987) 1:25,000

(note does not cover northern portion of ML4752)

ML1790 Disturbance Areas 01, 05, 07, 09, 10 and 11 and ML4752 Disturbance Area 02, mining disturbances immediately to the south, the Newlands System rail line and the water supply infrastructure corridor with above ground infrastructure yards to the west were not observed within the 1987 imagery. The site and immediately surrounding area appeared to be generally used for stock and possibly timber harvesting.

Hillalong (1985) 1:24,800

(note does not cover areas to the south of Suttor Development Road)

Both on-site and off-site land uses were consistent with the Hillalong 2000 images.

Harrybrandt (1979) 1:25,000

(note does not cover northern portion of ML4752)

ML4752 – ML70443 Disturbance Area 01, borrow pit, was not observed within the 1979 imagery. With the exception of this disturbance area Both on-site and off-site land uses were consistent with those described above.

Hillalong (1977) 1:24,900

(note does not cover areas to the south of Suttor Development Road)

Both on-site and off-site land uses were consistent with the Hillalong 1985 images. The area of the site and surrounding land uses were utilised for stock grazing.

Byerwen (1971) 1:23,900

(note does not cover areas to the south of Suttor Development Road)

Both on-site and off-site land uses were consistent with the Hillalong 1977 images. The area of the site and surrounding land uses were utilised for stock grazing.

Hillalong (1969) 1:25,900

(note does not cover areas to the south of Suttor Development Road)

Both on-site and off-site land uses were consistent with the Byerwen 1971 images. The area of the site and surrounding land uses were utilised for stock grazing.

Burton Downs (1969) 1:25,900

Both on-site and off-site land uses were consistent with the Harybrandt 1979 images with the exception of additional areas containing trees which appeared consistent with open woodlands. The predominant land use remained stock grazing.

Burton Downs (1957) 1:40,500

(note western extent of the leases not covered by images)

Both on-site and off-site land uses were consistent with the Burton Downs 1969 images. The predominant land use remained stock grazing.

4.3 Historical Registered Owners

A review of historical registered owners has been undertaken to identify owners/lessee that are known to undertake activities with a high potential to cause contamination. A copy of the historical title search results is contained in **Appendix F**. Table 7 below summarises the historical owners for properties, which are intersected by the Wards Well mining leases.

Table 7: Summary of Registered Owners

Year	Registered Owner	Comments
Lot 2 on SP 256592		
Pre 1981	Crown Title	
1981	Ronald Francis Camm & Tolma Rose Camm	Grazing Homestead Perpetual Lease 4106 Mackay District
2005	Benjamin Joseph Pini & Julie Maree Pini	2012 Lease to Minumbra Lancewood Pty Ltd – Lease B SP 245741, expires 01.08.2017, also 3 x 5 year options 2017 Title Granted to Benjamin Joseph Pini & Julie Maree Pini
Lot 2 on SP214117		
Pre 1961	Crown Title	
1961	George Francis Gordon	Lease of Pastoral Holding Dabin Holding Term 30 years from 30.07.1961 Now Rolling Term Lease extended to 30.06.2046

Year	Registered Owner	Comments
1969	Boomerang Holding Pty Ltd & Epson Pastoral Company Pty Ltd	
2007	BHP Mitsui Coal Pty Ltd	
Lot 11 on SP262530		
Pre 1978	Crown Title	
1978	Douglas Victor Kemp & Rhonda Ann Kemp	Grazing Homestead Freeholding Lease 30/3977 Mackay District Term of 40 years from 01.10.1978 Title grant 2007
2010	BHP Mitsui Coal Pty Ltd	
Lot 8 on GV807254		
Pre 1964	Crown Title	
1964	Richard James Fallis	Lease of Preferential Holding Term of 30 years from 01.10.1964
Date not listed	Edward Peter Mason Peter Mason Mora Ellen Mason Valda Ann Mason	
2019	Andrew David Busch Duncan Smith (Personal Representative of Mora Ellen Mason) Valda Ann Mason	
2019	Valda Ann Mason	Term expiring 11.02.2038

The review of the historical titles indicates the investigation area has been leased and utilised for grazing activities.

Historical lease conditions contained on the titles required the management of Prickly Pear and Harissa Cactus and the clearing and maintenance of cleared areas. BHP are the current owners of the lease on Lot 2 on SP214117 and registered freehold owners of Lot 11 on SP262530.

4.4 Licenses and Notices

4.4.1 Environmental Authority

Environmental Authority EPPR00668513 (EA), held by BHP Billiton Mitsui Coal Pty Ltd is held for the mining leases forming the investigation area. The EA includes the following environmentally relevant activities:

- Resource Activity, Ancillary 08 - Chemical Storage 1: Storing a total of 50t or more of chemicals of dangerous goods class 1 or class 2, division 2.3 under subsection (1)(a).
- Resource Activity, Schedule 2A, 10: Investigating the potential development of a mineral resource by large bulk sampling or constructing an exploratory shaft, adit or open pit.

- Resource Activity, Ancillary 63 - Sewage Treatment, 1: Operating sewage treatment works, other than no release works, with a total daily peak design capacity of, more than 100 but not more than 1500EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme.
- Resource Activity, Schedule 2A, 09: A mining activity involving drilling, costeaning, pitting or carrying out geological surveys causing significant disturbance.

Note the above environmentally relevant activities are as per the EA at the time of preparation of this investigation. Changes to the Environmental Protection Regulation have occurred since the EA was issued. Schedule 2A is now Schedule 3.

At the time of investigation the bulk sampling and exploratory shafts had not been undertaken and therefore, related environmental relevant activities of chemical storage and sewage treatment had not been undertaken. Only drilling and geotechnical surveys had been undertaken, although “*significant disturbance*” as described with the definition of Resource Activity, Schedule 2A, 09 was not identified.

In addition to the above BHP environmental authority, the following summaries all environmental authorities that are applicable to the investigation area.

Table 8: Summary of Onsite Environmental Authorities

Permit Number	Holder	Activity
EPPR00930713	QUARRICO PRODUCTS PTY LTD	ERA 16 - Extraction and Screening, 1 ERA 16 - Extraction and Screening, 2 ERA 16 - Extraction and Screening, 3
EPPG00699613	CH4 PTY LTD	Non-Scheduled, Petroleum Activity, Authority to Prospect - ATP
EPPG03219115	ARROW CSG (ATP 364) PTY LTD	Schedule 3, 08
EPPR00668513	BHP BILLITON MITSUI COAL PTY LTD	Ancillary 08 - Chemical Storage, 1 Ancillary 63 - Sewage Treatment, 1 Schedule 3, 09 Schedule 3, 10
EPVX00409013	BHP BILLITON MITSUI COAL PTY LTD	Non-Scheduled, Mining Activity, Exploration Permit Coal - EPC
EPVX00551613	Byerwen Coal Pty Ltd	Non-Scheduled, Mining Activity, Exploration Permit Coal - EPC
EPSX00377413	Byerwen Coal Pty Ltd	Non-Scheduled, Mining Activity, Exploration Permit Mineral - EPM
EPVX00409013	BHP BILLITON MITSUI COAL PTY LTD	Non-Scheduled, Mining Activity, Exploration Permit Coal - EPC
EPSX00259113	BHP BILLITON MITSUI COAL PTY LTD	Non-Scheduled, Mining Activity, Exploration Permit Coal - EPC

In addition to the onsite environmental authorities, mining related permits and authorities are present to the north and south of the investigation area and are held by Peabody Pty Ltd and Byerwen Coal Pty Ltd.

4.4.2 Transitional PRC Plan

A Progressive Rehabilitation and Closure (PRC) Plan Transitional Notice issued by the Department of Environment and Science had been provided to BHP Billiton Mitsui Coal Pty Ltd as the Environmental Authority holder for ML1790, ML70495, ML70443 and ML4752. The notice requires the holder of environmental authority EPPR00668513 to submit a proposed PRC Plan that meets the requirements of Section 126C and 126D of the Environmental Protection Act (1994) to the administering authority by 26 February 2021.

4.4.3 Enforcement Register

A review of the Queensland Government enforcement register indicated the investigation area and immediately surrounding land did not have any recorded enforcement notices.

5 Environmental Setting

5.1 Topography and Surface Water

The investigation area generally slopes gently towards the southwest and supports two shallow valleys, associated with non-perennial Eaglefield and Kennedy Creeks. On the eastern side of the lease, ground surface elevations range from RL 320 m to RL 340 m falling to the southwest to approximately RL 310 m to RL 330 m. Within the footprint of the lease, the highest ground elevations lie within the northwestern corner of ML4752 (about RL 380 m) with the lowest on the western boundary of the investigation area (about RL 310 m).

Eaglefield, Kennedy and Charlie creeks and their minor tributaries, drain the portion of the Project area located in the Burdekin Basin. The creek systems discharge the investigation area to the west flowing towards the Suttor River, which is part of the Burdekin system. In each case the water courses are non-perennial.

The south eastern portion of the investigation area which is located in the Fitzroy Basin forms the headwaters of Goonyella Creek, which drains the investigation area to the south east towards the Isaac River.

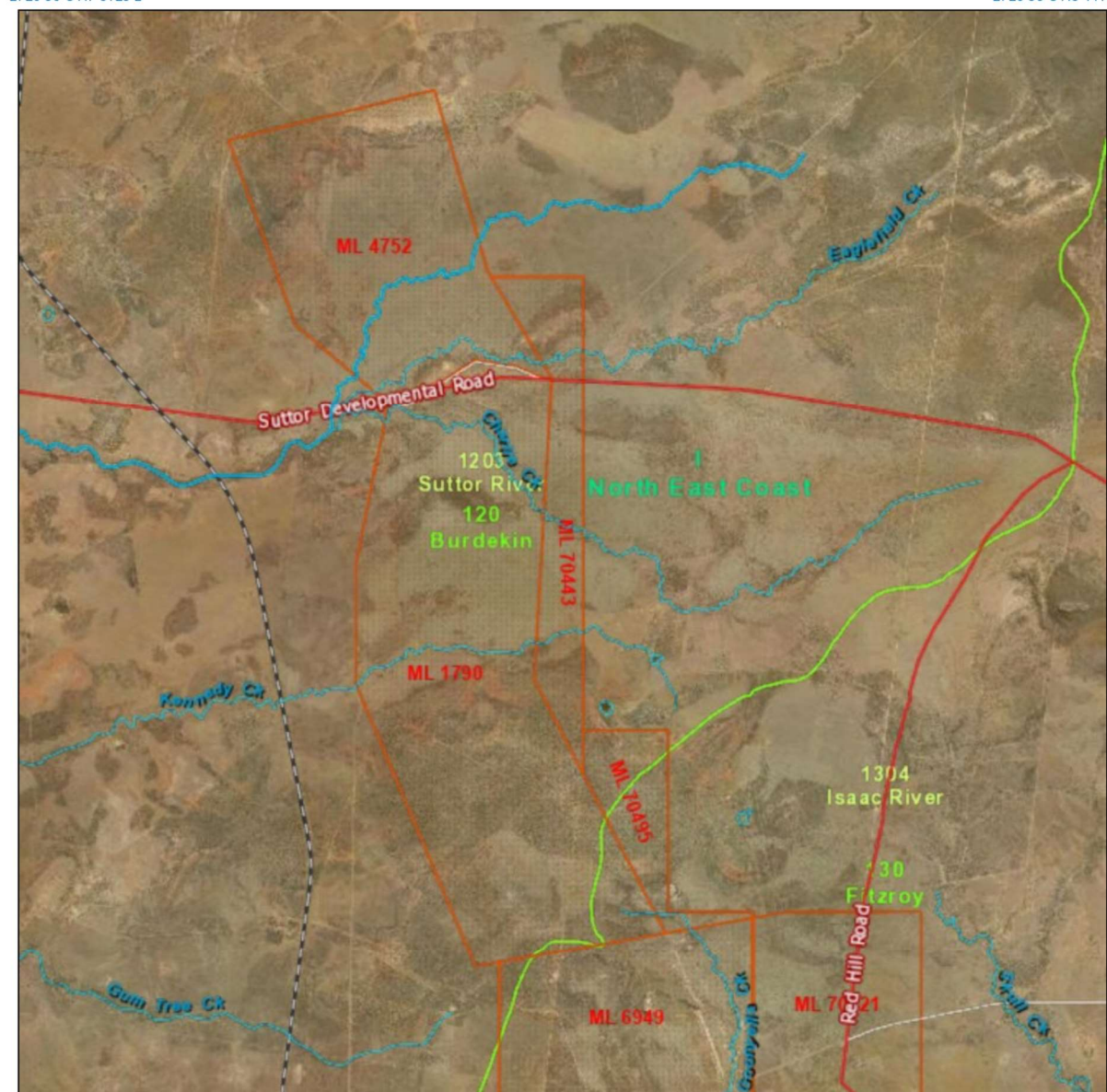
The location of the surface water features are shown on Figure 3 and are summarised in Table 9.

Wards Well PRCP

Local Hydrology and Fluvial Networks

21°26'59"S 147°51'23"E

21°26'59"S 148°4'14"E



21°38'56"S 147°51'23"E

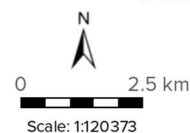
21°38'56"S 148°4'14"E

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**Queensland
Government**

Department of Natural Resources, Mines and Energy

Figure 3: Surface Water Features

Table 9: Surface Water Features

Water Course	Perenniality	Hierarchy	Stream Order	Comment
Burdekin Basin				
Eaglefield Creek	Non-perennial	Minor	3	Runs east to west across ML4752 and ML70443 to the north of Suttor Creek Development Road. Immediately to the west of the investigation area the classification changes to a hierarchy of Major and Stream order of 4. (Appendix I, Photograph 1 and Photograph 2)
Charlie Creek	Non-perennial	Minor	2	Runs south east to north west across ML70443 and ML1790 to the south of Suttor Development Road. Drains into Eaglefield Creek to the west of ML1790. (Appendix I, Photograph 4)
Kennedy Creek	Non-perennial	Minor	2	Runs east to west across ML70433 and ML1790. Two minor first order streams drain into the creek from the south. Drains into Eaglefield Creek approximately 10km to the west of the investigation area. (Appendix I, Photograph 3)
Un-named	Non-perennial	Minor	1	Runs east west across ML70443 to the south of Suttor Development Road and drains into Charlie Creek on ML1790.
Un-named	Non-perennial	Minor-Major	1-2-3	Multiple un-named drainage lines draining the norther portion of ML4752 and to the north east of the investigation area. Generally runs from north east to south west across ML4752 to the north of Suttor Development Road. Drains into Eaglefield Creek to the west of ML4752
Lake Dalrymple/Burdekin Falls Dam	-	-	-	Located approximately 130km to the north west of the site.
Man-made dams	-	-	-	Numerous small farm water supply dams are present within and immediately surrounding the investigation area.
Fitzroy Basin				
Goonyella Creek	Non-perennial	Minor	1	Source located in the south eastern corner of ML1790, running to the south east along the southern boundary of ML70495 before turning south and draining into the Isaac River.
Burton Gorge Dam	Permanent	-	-	Located on the Isaac River approximately 15km to the east of the investigation area.
Man-made dams				Numerous small farm water supply dams are present within and immediately surrounding the investigation area.

Source Department of Natural Resources (2016), Queensland Globe.

5.2 Geology

The geological setting of the site is summarised within the Golder (2020) Wards Well Mine - Progressive Rehabilitation and Closure Plan - Hydrogeological Conceptual Model report (**Appendix G**).

5.2.1 Regional setting

The Wards Well site is located on the Collinsville Shelf, near the western reaches of the Bowen Basin in Central Queensland. The Collinsville Shelf has a shallow, easterly dip between 2 to 5 degrees with localised steepening. The Bowen Basin is part of a connected group of Permian-Triassic basins spanning across eastern Australia.

5.2.2 Depositional Setting

The depositional setting of the project area comprises Quaternary alluvial and poorly consolidated sediments and basalt flows of the Tertiary Sutor Formation unconformably overlying Permian age strata.

Quaternary Sediments

The Quaternary sediments consist of sand, clay and silt of varying content associated with creeks and drainage channels. The deposits are irregular in thickness and lensoidal in nature.

Tertiary Strata

The Tertiary strata comprise four major basalt flows intercalated with pyroclastic ash flow and ash fall tuffs, volcanic breccias, clays, muds, lignites and unconsolidated fine to coarse grained sand and gravels.

Permian Strata

The underlying Permian strata comprises the Fort Cooper Coal Measures (FCCM) and Moranbah Coal Measures (MCM), which dip to the east. The FCCM unconformably underlies the Tertiary sediments and is typically massive, coarse grained sandstone, fine to medium grained sandstone, dark grey siltstone, carbonaceous shale and mudstone and coal seams with tuffaceous claystone bands. The MCM conformably underlies the FCCM and comprises low ash coal seams, laminated claystones, siltstones, interbedded siltstones/sandstones and massive sandstones.

Geological Structures

Two main fault sets have been identified at the project site during previous site investigations: normal faults striking east-west with a vertical displacement of approximately five to ten metres, and thrust faults striking north-south with approximately three metre upthrust to the east.

5.3 Acid Sulphate Soils

A review of the Atlas of Australian Acid Sulfate Soils indicates the investigation area is located in an area designated as having “*extremely low probability of occurrence*”.

5.4 Hydrogeology

The hydrogeological setting for the investigation area is described in Golder Associates (2020) Wards Well Mine – Progressive Rehabilitation and Closure Plan – Hydrogeological Conceptual Model.

The area in which the Wards Well site is located is underlain by three main hydro-stratigraphic units.

Quaternary alluvium – alluvial sediments associated with river systems and sediments associated with floodplains and alluvial flats. The alluvium is classed as a porous aquifer with groundwater occurring within the pore spaces. The typical aquifer thickness is between 15m and 25m with hydraulic conductivities ranging depending on clay content between 1×10^{-3} and 20m/day and a general groundwater flow direction following the topographic profile.

Tertiary Strata – comprising of vesicular basalt flows which follow Tertiary palaeochannels within the Permian basement material. The aquifer is a secondary porosity aquifer with groundwater contained within fractures. Typical aquifer levels are between 6m and 60m below ground surface with variable hydraulic conductivities due to the heterogeneity of the material between 0.1 and 2.4m/day and a general groundwater flow direction from north east to south west. This is the primary aquifer utilised within the region with Total Dissolved Solids typically ranging between 480mg/L and 2900mg/L.

Permian Strata – comprising of siltstone, sandstone, calcareous and carbonaceous shale and coal. The depth of the aquifer is expected to vary between 7 and 42m below ground surface. The hydraulic conductivity of the overburden material (typically ranging from 1×10^{-3} m/day to 1×10^{-4} m/day) varies from the coal seams (typically ranging from 1×10^{-3} m/day to 1×10^{-6} m/day). Groundwater within this strata can generally be expected to have higher levels of salinity.

5.4.1 Registered Groundwater Bores

A search of the Department of Natural Resources Mines and Energy's (DNRME) groundwater bore data base was undertaken for information on hydrogeological conditions beneath the site and to provide an understanding of the groundwater use within the investigation area.

Table 10: Summary of Registered Bores

Bore ID	Installation Date	Depth (m)	Bottom Lithology	Use	Status
ML4752					
141166	2011	146	Basalt	-	Existing
85415	1990	48.7	Basalt	-	Existing
162051	2011	100	Siltstone	-	Existing
162050	2011	70	Basalt	Mine Monitoring	Existing
162064	2011	148.6	Basalt	Mine Monitoring	Existing
162054	2011	153	Basalt	Mine Monitoring	Existing
ML1790					
182311	-	117.1	-	-	Existing
162060	2011	88	Basalt/clay	Mine Monitoring	Existing
162052	2011	163	Sandstone	Mine Monitoring	Existing
162063	2011	107	Siltstone	Mine Monitoring	Existing
162065	2011	145.4	Basalt	Mine Monitoring	Existing
162053	2011	160	Basalt	Mine Monitoring	Existing

Bore ID	Installation Date	Depth (m)	Bottom Lithology	Use	Status
162059	2011	148.8	Sandstone	Mine Monitoring	Existing
162061	2011	76.7	Clay	Mine Monitoring	Existing
141160	2011	154.6	Sandstone	Sub-artesian Monitoring	Existing
141162	2011	95	Basalt/clay	Sub-artesian Monitoring	Existing
141163	2011	113	Siltstone	Sub-artesian Monitoring	Existing
162058	2011	89	Sandstone	Mine Monitoring	Existing
ML70443					
162057	2011	146	Siltstone/coal	Mine Monitoring	Existing
162062	2011	52.6	Claystone	Mine Monitoring	Existing
162056	2011	137	Clay	Mine Monitoring	Existing
162055	2011	161	Sandstone/siltstone	Mine Monitoring	Existing
ML70495 – No registered bores within lease					

The registered bores on site were predominantly listed for the purpose of groundwater monitoring. However, it should be noted that inspection of the investigation area identified five bores that appear to be unregistered and utilised for stock watering.

5.5 Ecosystems and Vegetation

5.5.1 State Environmental Reports

Searches of the Queensland Government's Environmental Reports and the Commonwealth Government's Protected Matters database were completed to identify potential ecological receptors. The search results for the Queensland Government Environmental reports are contained in **Appendix H** and summarised in

Table 11.

Table 11: Ecosystem and Vegetation Search Results

ML4752 - Lancewood

Report	Identified Aspect	Area Covered	Comments
MSES	Threatened (endangered or vulnerable) wildlife and vegetation	2060.95ha (86.9%)	Vulnerable: - Denisonia maculata - Ornamental snake. - Dichanthium queenslandicum.
	Regulated Vegetation – endangered of concern Category B remnant	1388.83ha (58.6%)	
	Regulated Vegetation – Essential habitat	1929.07ha (81.3%)	
	Regulated Vegetation – Intersecting a watercourse	16.2km	
Regional Ecosystems	Endangered	75.24 (3.17%)	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces. Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks
	Of Concern	1,273.72ha (53.71%)	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines. Dichanthium sericeum grassland on Cainozoic igneous rocks.
	Not of Concern at present	842.55ha (35.53%)	Eucalyptus populnea +/- E. melanophloia +/- Corymbia Eucalyptus orgadophila Eucalyptus crebra
Biodiversity and Conservation Values	Aquatic conservation significance (riverine)- Medium	2,371.68ha (100%)	
	Threatened species	-	Denisonia maculate - ornamental snake Dichanthium queenslandicum Digitaria porrecta
	Priority Species		Capparis shanesiana
Groundwater Dependent Ecosystems (GDEs)	High potential GDEs	-	Aquatic and Terrestrial GDEs Associated with drainage lines.
Inflow Dependent Ecosystems	Rankings from low to high likelihood.	-	Aquatic and Terrestrial Inflow Dependent Ecosystems
Wetlands	No Wetland Protection Areas within ML4752		

ML1790 – Wards Well

Report	Identified Aspect	Area Covered	Comments
MSES	Threatened (endangered or vulnerable) wildlife and vegetation	2992.7ha (68.3%)	Vulnerable: - Denisonia maculata - Ornamental snake. - Dichanthium queenslandicum. - Geophaps scripta scripta squatter pigeon (southern subspecies)
	Special least of concern animals	191.16ha (4.4%)	Tachyglossus aculeatus short-beaked echidna
	Regulated Vegetation – endangered of concern Category B remnant	1655.9ha (37.8%)	
	Regulated Vegetation – Endangered/of concern Category C (regrowth)	131.36ha (3%)	
	Regulated Vegetation – Category R (GBR riverine regrowth)	1.23ha (<0.1%)	
	Regulated Vegetation – Essential habitat	3131.03 ha (81.3%)	
	Regulated Vegetation – Intersecting a watercourse	12.9km	
Regional Ecosystems	Endangered	236.64 (5.4%)	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces. Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks
	Of Concern	1,307.97ha (29.87%)	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines. Eucalyptus coolabah woodland on alluvial plains Dichanthium sericeum grassland on Cainozoic igneous rocks.
	Not of Concern at present	1627.48ha (37.16%)	Eucalyptus populnea +/- E. melanophloia +/- Corymbia Eucalyptus orgadophila Eucalyptus melanophloia +/- E. orgadophila Eucalyptus crebra
Biodiversity and Conservation Values	Aquatic conservation significance (riverine)- Medium	4379.28ha (100%)	
	Threatened species		Denisonia maculate - ornamental snake Dichanthium queenslandicum Digitaria porrecta Geophaps scripta scripta - squatter pigeon (southern subspecies)
	Priority Species		Capparis shanesiana Gehyra catenata Lagorchestes conspicillatus Spectacled Hare-wallaby Paradelma orientalis Brigalow Scaly-foot Pyrrholaemus sagittatus Speckled Warbler
Groundwater Dependent Ecosystems (GDEs)	High potential GDEs	-	Aquatic and Terrestrial GDEs Associated with drainage lines.
Inflow Dependent Ecosystems	Rankings from low to high likelihood.	-	Aquatic and Terrestrial Inflow Dependent Ecosystems
Wetlands	No Wetland Protection Areas within ML1790		

ML70443 – Wards Well East

Report	Identified Aspect	Area Covered	Comments
MSES	Threatened (endangered or vulnerable) wildlife and vegetation	591.04ha (68%)	Vulnerable: • Denisonia maculata - Ornamental snake. • Dichanthium queenslandicum.
	Regulated Vegetation – endangered of concern Category B remnant	535.15ha (61.6%)	
	Regulated Vegetation – Endangered/of concern Category C (regrowth)	3.27ha (0.4%)	
	Regulated Vegetation – Category R (GBR riverine regrowth)	0.92ha (0.1%)	
	Regulated Vegetation – Essential habitat	634.18ha (73%)	
	Regulated Vegetation – Intersecting a watercourse	4.6km	
Regional Ecosystems	Endangered	57.7 (6.64%)	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces.
	Of Concern	454.44ha (52.29%)	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines. Dichanthium sericeum grassland on Cainozoic igneous rocks.
	Not of Concern at present	238.15ha (27.4%)	Eucalyptus populnea +/- E. melanophloia +/- Corymbia Eucalyptus orgadophila
Biodiversity and Conservation Values	Aquatic conservation significance (riverine)- Medium	969.08ha (100%)	
	Threatened species		Dichanthium queenslandicum Digitaria porrecta
	Priority Species		Gehyra catenata Lagorchestes conspicillatus Spectacled Hare-wallaby Pyrrholaemus sagittatus Speckled Warbler
Groundwater Dependent Ecosystems (GDEs)	High potential GDEs	-	Aquatic and Terrestrial GDEs Associated with drainage lines.
Inflow Dependent Ecosystems	Rankings from low to high likelihood.	-	Aquatic and Terrestrial Inflow Dependent Ecosystems
Wetlands	No Wetland Protection Areas within ML70443		

MI70495 – Wards Well South East

Report	Identified Aspect	Area Covered	Comments
MSES	Threatened (endangered or vulnerable) wildlife and vegetation	245.5ha (50.1%)	Vulnerable: • Denisonia maculata - Ornamental snake.
	Regulated Vegetation – endangered of concern Category B remnant	30.86ha (6.3%)	
	Regulated Vegetation – Endangered/of concern Category C (regrowth)	16.96ha (3.5%)	
	Regulated Vegetation – Essential habitat	247.84ha (50.6%)	
	Regulated Vegetation – Intersecting a watercourse	1.3km	
Regional Ecosystems	Endangered	61.5 (12.56%)	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces. Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks
	Of Concern	3.76ha (0.77%)	Dichanthium sericeum grassland on Cainozoic igneous rocks.
	Not of Concern at present	342.24ha (69.88%)	Eucalyptus populnea +/- E. melanophloia +/- Corymbia Eucalyptus orgadophila
Biodiversity and Conservation Values	Aquatic conservation significance (riverine)	High aquatic conservation significance – 30.05ha (6.14%) Medium aquatic conservation significance – 459.73ha (93.86%)	
	Threatened species		Dichanthium queenslandicum Geophaps scripta scripta - squatter pigeon (southern subspecies)
	Priority Species		Gehyra catenata Lagorchestes conspicillatus Spectacled Hare-wallaby Pyrrholaemus sagittatus Speckled Warbler
Groundwater Dependent Ecosystems (GDEs)	Not located within ML70495		
Inflow Dependent Ecosystems	Not located within ML70495	-	
Wetlands	No Wetland Protection Areas within ML70495		

A review of the Queensland Environmental Reports identified the presence of endangered ecosystems, of concern ecosystems, essential habitat, inflow dependent ecosystems and groundwater dependent ecosystems within the investigation area. These ecosystems were identified as supporting endangered, vulnerable and threatened species. Therefore, the investigation area supports potentially sensitive ecological receptors.

5.5.2 Protected Matters

A search of the Environment Protection and Biodiversity and Conservation Act (1999) Protected Matters database was undertaken to identify potentially sensitive receptors within proximity of the investigation area. The Protected Matters search results are contained in **Appendix H** and the results are summarised in Table 12.

Table 12: Protected Matters Search Results

Category	No	Presence	Description	Status
Threatened Ecological Communities	4	Known to Occur	Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered
		Likely to occur	Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered
			Poplar Box Grassy Woodland on Alluvial Plains	Endangered
			Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered
Threatened Species	20	Known to occur	Geophaps scripta scripta - Squatter Pigeon (southern)	Vulnerable
			Ornamental Snake - Denisonia maculata	Vulnerable
		Likely to occur	Erythroriorchis radiatus - Red Goshawk	Vulnerable
			Neochmia ruficauda ruficauda - Star Finch (eastern), Star Finch (southern)	Endangered
			Dasyurus hallucatus - Northern Quoll	Endangered
			Macroderma gigas - Ghost Bat	Vulnerable
			Dichanthium queenslandicum - King Blue-grass	Endangered
			Dichanthium setosum - bluegrass	Vulnerable
		May occur	Calidris ferruginea - Curlew Sandpiper	Critically Endangered
			Falco hypoleucos - Grey Falcon	Vulnerable

The review of the Protected Matters database indicates that endangered ecological communities and endangered and vulnerable species are either known, likely or may occur within the investigation area. Therefore, the investigation area potential contains sensitive ecological receptors.

5.6 Water Quality Environmental Values and Objectives

The investigation area straddles the boundary between the Burdekin and Fitzroy Basins. The entirety of mining leases ML4752 and ML70443 are located in the Burdekin Basin, while the south eastern corner of ML1790 and the southern half of ML70495 are located in the Fitzroy Basin.

The declared underground water area 'Highlands Underground Water Area' protrudes into the south western portion of ML1790.

The location of the proposed box cut and associated exploration activities under the EA (number: EPPR00668513) are located on ML4752 located in the Burdekin Basin.

Figure 4, illustrates the location of the mining leases and water basins.

The water quality environmental values and objectives for the investigation area are documented in the following:

- NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan 2016, NQ Dry Tropics, Townsville.
- Queensland Government (2011) Environmental Protection (Water) Policy (2009) Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (Part).

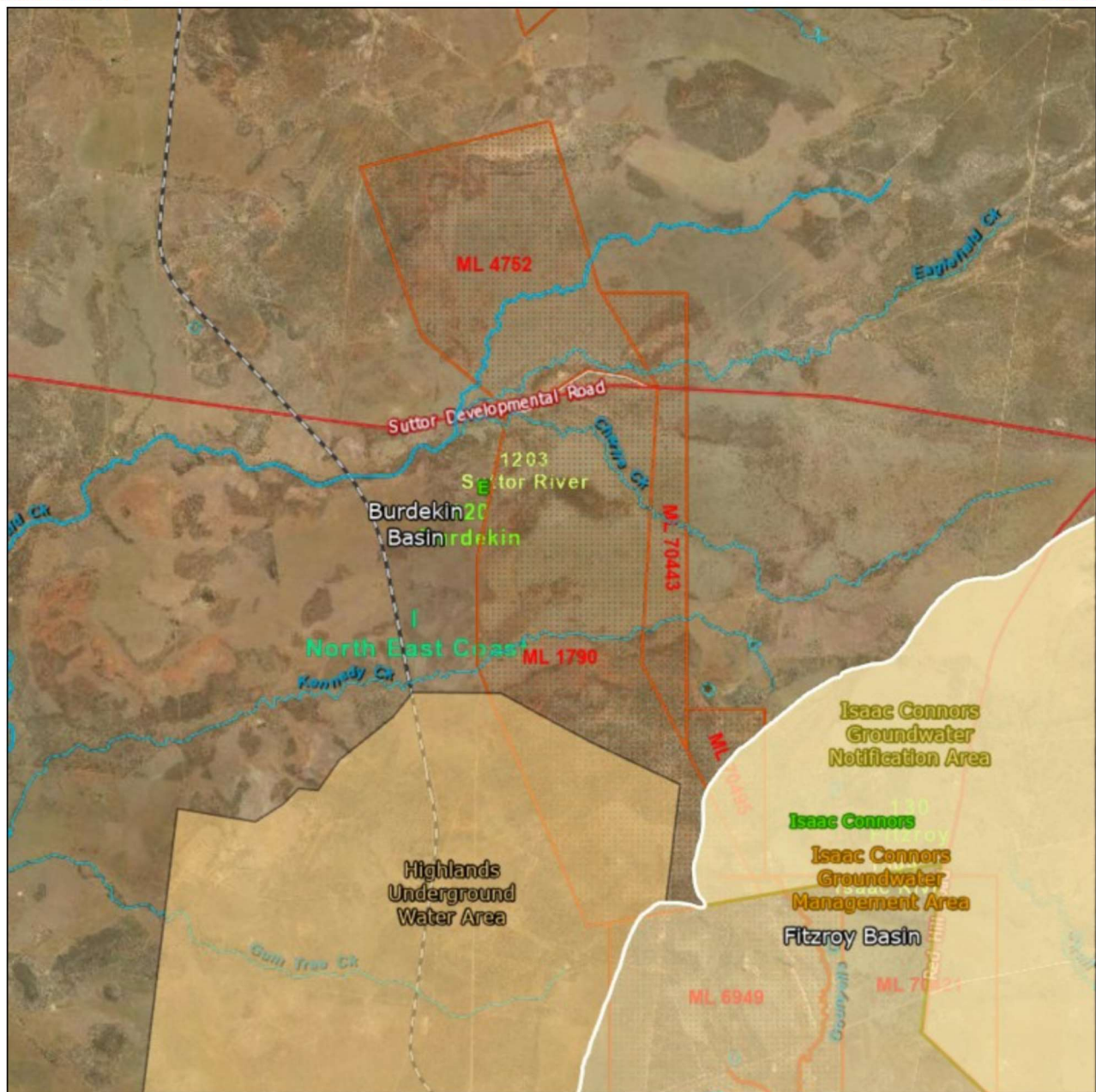
The portion of the investigation area that is located within the Burdekin Basin is contained within the Upper Suttor River catchment. The portion of the site located in the Fitzroy Basin is located within the Isaac River Sub-basin, the Isaac Northern Rivers catchment and the Isaac Connors Water Management Area. Groundwater within this area falls within the Isaac Connors Groundwater Management Area.

5.6.1 Environmental Values

The environmental values identified under the Environmental Protection (Water and Wetland Biodiversity) Policy (2019), applicable to surface water and groundwater for the catchments in which the site is located, are summarised in the Table 13 below. An evaluation of the environmental values relevance to the site is provided in Table 14.

21°26'30"S 147°49'19"E

21°26'30"S 148°3'19"E



21°39'31"S 147°49'19"E

21°39'31"S 148°3'19"E

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Figure 4: Water Basins

Table 13: Environmental Values

Basin	Catchment	Aquatic Ecosystems	Irrigation	Farm Use	Stock Watering	Aquaculture	Human Consumption	Primary Recreation	Secondary Recreation	Visual Recreation	Raw Drinking Water	Industrial Use	Cultural and Spiritual
Burdekin (Draft)	Upper Suttor River – Surface Waters	✓			✓		✓	✓	✓	✓	✓	✓	✓
	Upper Suttor River - Groundwaters		✓	✓	✓						✓	✓	
Fitzroy	Isaac Northern Tributaries – Surface Waters	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Isaac Groundwaters	✓	✓	✓	✓			✓			✓		✓

Note the Environmental values provided within the NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan 2016 are draft only.

Table 14: Evaluation of Identified Environmental Values

Environmental Value	Surface Water		Groundwater	
	Evaluation	Beneficial Use	Evaluation	Beneficial Use
Aquatic Ecosystems	The drainage lines within and immediately surrounding the investigation area were Non-perennial. However, downstream of the investigation area are regionally significant waterways including the Isaac River and Suttor River.	✓	Where groundwater interacts with surface water ecosystems there is potential for groundwater to impact aquatic ecosystems. It is noted that Aquatic Ecosystems are not an identified Environmental Value for the Upper Suttor River catchment.	✓
Irrigation	The investigation area is located in a rural area predominantly utilised for grazing. However, downstream of the investigation area use of surface water for irrigation is considered likely. It is noted that irrigation is not considered an Environmental Value for the Upper Suttor River.	✓	The investigation area is located in a rural area and there are a number of water supply bores within and surrounding the investigation area.	✓
Farm Use	The investigation area is located in a rural area. It is noted that farm use is not considered an Environmental Value for the Upper Suttor River.	✓	The investigation area is located in a rural area and there are a number of water supply bores within and surrounding the investigation area. It is noted that farm use is not an identified Environmental Value for the Upper Suttor River catchment.	✓
Stock Watering	The investigation area is located in a rural area predominantly utilised for grazing.	✓	The investigation area is located in a rural area and there are a number of water supply bores within and surrounding the investigation area.	✓
Aquiculture	Not considered to be an Environmental Value for the catchments in which the investigation area is located	✗	Not an identified environmental value.	✗
Human Consumer	The non-perennial surface water streams within and immediately surrounding the site drain towards permanent water bodies including the Burton Gorge Dam and the Lake Dalrymple/Burdekin Falls Dam which are used for fishing and other activities.	✓	Not an identified environmental value.	✗

Environmental Value	Surface Water		Groundwater	
	Evaluation	Beneficial Use	Evaluation	Beneficial Use
Primary Recreation	Surface waters downstream of the investigation area can be utilised for primary recreation.	✓	Primary recreation is identified as a potential environmental value for the Isaac Groundwater. Groundwater extraction in the area could include primary recreational use such as swimming pools.	✓
Secondary Recreation	Surface waters downstream of the investigation area can be utilised for secondary recreation.	✓	Not an identified environmental value.	✗
Visual Recreation	The rivers and streams are associated with recreational areas and therefore visual recreation is applicable to the site.	✓	Not an identified environmental value.	✗
Raw Drinking Water	The non-perennial surface water streams within and immediately surrounding the site drain towards Burton Gorge Dam and the Lake Dalrymple/Burdekin Falls Dam.	✓	The investigation area is located in a rural area and there are a number of water supply bores within and surrounding the investigation area. However, due to salinity of the groundwater it is likely that groundwater would require treatment prior to potable use.	✓
Industrial Use	A number of mining and industrial activates are located downstream of the site that could potentially utilise surface waters.	✓	A number of mining and rural related industrial activates within the catchments. There are also a number of groundwater supply bores within the catchments. It is noted that Industrial Use is not an identified groundwater environmental value within the Isaac catchment.	✓
Cultural and Spiritual	The waterways within the region have a demonstrated connection with indigenous Australians	✓	Groundwater has the potential to influence groundwater dependant ecosystems and cultural and spiritual values. It is noted that Cultural and Spiritual values were not identified as an Environmental Value for the Upper Sutor River groundwater.	✓

5.6.2 Water Quality Objectives

Fitzroy Basin

The portion of the investigation area that is located within the Fitzroy Basin has a management intent of 'moderately disturbed'.

Catchment specific surface water quality objectives that have been derived for the Upper Isaac River catchment waters include the following:

- ammonia Nitrogen (N): <20 micrograms per litre (µg/L)
- oxidised N: <60 µg/L
- organic N: <420 µg/L
- total nitrogen: <500 µg/L
- filterable reactive phosphorus (FRP): <20 µg/L
- total phosphorus: <50 µg/L
- chlorophyll a: <5.0 µg/La
- dissolved oxygen: 85%–110% saturation
- turbidity: <50 NTU
- suspended solids: <55 mg/Lb
- pH: 6.5–8.5 b
- conductivity (EC) baseflow: <720 µS/cm
- conductivity (EC) high flow: <250 µS/cm
- sulfate: <25 mg/L
- Macroinvertebrates:
 - Taxa richness (composite): 12–21
 - Taxa richness (edge habitat): 23–33
 - PET taxa richness (composite): 2–5
 - PET taxa richness (edge habitat): 2–5
 - SIGNAL index (composite): 3.33–3.85
 - SIGNAL index (edge habitat): 3.31–4.20
 - % tolerant taxa (composite): 25–50%
 - % tolerant taxa (edge habitat): 44–56%

Water quality for objectives for human use environmental values applicable to the portion of the investigation area located in the Fitzroy Basin are summarised in Table 3 of the Queensland Government (2011) Isaac River Sub-basin Environmental Values and Water Quality Objectives, and were derived from the following:

- Australian Drinking Water Guidelines (NHMRC, 2011)
- Australia New Zealand Food Standards Code (Australian Government)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000)
- Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

The portion of the investigation area located within the Fitzroy Basin is not covered by an established groundwater 'chemistry zone' due to insufficient data available to establish groundwater quality objectives. The objectives for groundwater include:

- Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters.
- Where groundwaters are in good condition the intent is to maintain existing water quality (20th, 50th and 80th percentiles).

Burdekin Basin

Draft water quality objectives are provided within the, NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan, noting that in accordance with the national framework, the Reef Long term Sustainability Plan, and EPP Water, locally relevant water quality guidelines were under development for the Burdekin at the time of this investigation and the objectives provided were in draft only.

Draft Burdekin Basin surface water quality objectives that are provided for upland streams, include the following:

- Turbidity (NTU) 25
- Ammonia-N ($\mu\text{g/L}$) 10
- NOx-N ($\mu\text{g/L}$) 15
- Organic N ($\mu\text{g/L}$) 225
- Total N ($\mu\text{g/L}$) 250
- FRP ($\mu\text{g/L}$) 15
- Total P ($\mu\text{g/L}$) 30
- Ametryn ($\mu\text{g/L}$) Proposed 0.02
- Atrazine ($\mu\text{g/L}$) Current 0.7, Proposed 3.7
- Diuron ($\mu\text{g/L}$) 0.2
- Hexazinone ($\mu\text{g/L}$) Current 75, Proposed 0.2
- Imidacloprid ($\mu\text{g/L}$) Proposed 0.03
- Tebuthiuron ($\mu\text{g/L}$) Current 0.02 Proposed 4.3
- 2,4-D ($\mu\text{g/L}$) 140

Water quality for objectives for human use environmental values applicable to surface and groundwaters in the Burdekin Basin are summarised in Table 4.4 of the NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan, and include the following:

- Australian Drinking Water Guidelines (NHMRC, 2011)
- Australia New Zealand Food Standards Code (Australian Government)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000)
- Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

5.7 Flood Risks

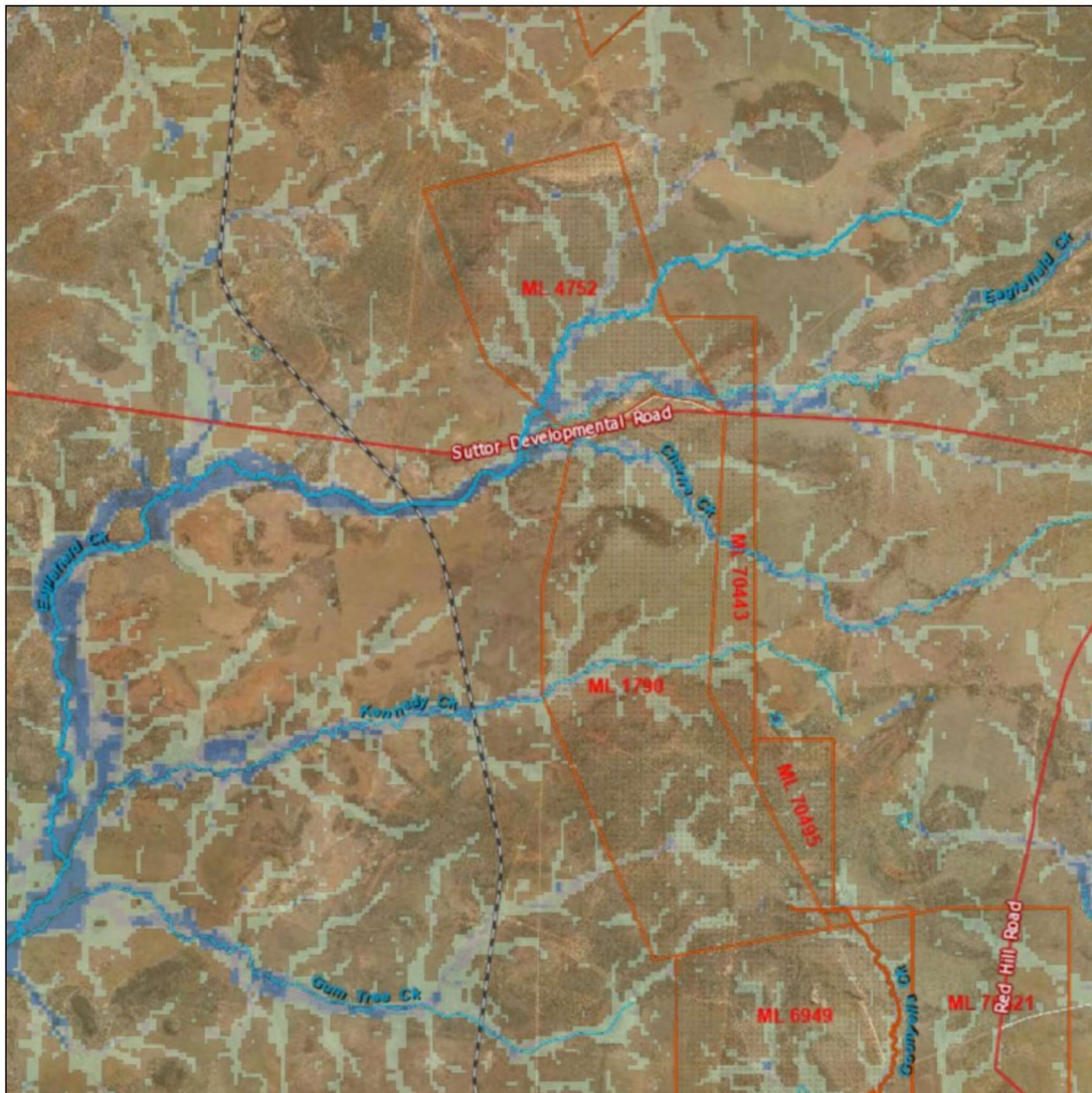
A review of the 1% Annual Exceedance Probability (AEP) flood map indicates that at the Wards Well mining leases flood events are predominately concentrated immediately around the creeks. As the investigation area is located towards the top of the catchment and upstream catchment areas were primarily utilised for grazing, the potential for contamination of the site from flood waters is considered low.

Wards Well

1% AEP Flood Level

21°26'14"S 147°48'33"E

21°26'14"S 148°2'25"E



21°39'8"S 147°48'33"E

21°39'8"S 148°2'25"E

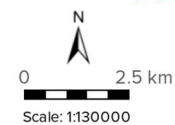
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Figure 5: 1% Annual Exceedance Probability Flood Map

5.8 Surrounding Land Uses/Activities

Land uses immediately to the north east and west of the investigation area are predominantly utilised for grazing. Immediately to the south is the North Goonyella Mine (ML6949 held by Peabody Bowen Pty Ltd) and Red Hill Mine (ML70421 held by BHP). A summary of the observed land uses are summarised in Table 15.

Table 15: Summary of Surrounding Land Uses

Direction	Activity	Description
North	Homesteads	Lancewood Homestead - Approximately 1.6km to the north of ML4752. The homestead site includes a number of buildings (residential and agricultural type sheds) water tanks, stock yards, hardstand storage areas/waste disposal and water dams. Approximately 3.5 km to the south west and 1.3km to the north of ML4752 are stockyards, water dams and a possible cattle dip. The homestead and cattle yards are located on the northern side of a ridge line with surface drainage from the area draining to the north west and away from the investigation area. Talwood Homestead – Approximately 7km to the north west of ML4752. The homestead site includes two buildings (residential and small shed). The homestead is located on the northern side of a ridge line with surface drainage from the area draining to the north west and away from the investigation area.
	Grazing	Satellite images indicate the area utilised for grazing includes wooded and cleared areas with access track to homesteads and farm access.
	Mining	Suttor Creek and Wollombi mining operations are located to the north of the site with surface disturbances located approximately 6km and 10km from the northern boundary of ML4752. The southern tip of the ML4761, on which these mines are located, is approximately 2km to the north of ML4752. Surface drainage from the disturbed areas of these mining leases is to the west and away from the investigation area.
	Rail	The Newlands System rail line is located approximately 4km to the north west of the investigation area.
East	Homesteads	Lenton Downs Homestead – Approximately 3.6km to the east of ML70443 to the north of Suttor Development Road. Large homestead site with multiple residential and agricultural support type structures, dams, stockyards, cattle dip, hardstand areas solid waste disposal areas. The homestead site is located on the southern side of Eaglefield Creek, which flows approximately 4.6km to the west before entering ML70443. Dabin Homestead – Approximately 2.9km to the east of ML70443 to the south of Suttor Development Road. Multiple residential and agricultural buildings, stock yards, cattle dip, dams and solid waste disposal area. The homestead is located to the south of Charlie Creek, which flows to the north west for approximately 3.5km before entering ML70443.
	Easement	A power supply easement runs north-south approximately 1.5km to the east at its closest point of the investigation area.
	Grazing	Grazing areas to the east of the investigation area are predominantly cleared and support numerous dams and unsealed access tracks.

West	Homesteads	Denham Park Homestead – Approximately 1.4km to the west of the southern end of ML1790. The homestead site supports a residential type building, numerous agricultural buildings, stock yards, possible cattle dip, water storage, hard stand areas and an airstrip to the south.
	Easement	Sunwater Ltd and Eungella Water Pipeline Pty Ltd water supply easements run north south to the west of ML1790 (on the western boundary to the north of Kennedy Creek up to Suttor Development Road). The water supply easements also run along the northern side of Suttor Development Road through ML1790 and ML4752 before heading to the north east through ML70443.
	Rail	The Newlands System rail line runs north south past the investigation area (located approximately 1.5km to the west of the investigation area at closest point).
	Grazing	Grazing areas to the west of the investigation area are a mixture of cleared and wooded areas and support numerous dams and unsealed access tracks.
	Other	Approximately 2km to the west of ML4752 is an area (covering approximately 10.6ha) formally believed to be utilised as a Queensland Rail construction camp. Over 75 buildings were visible in the imagery taken before their removal. The site also supported what appeared to be a waste water treatment system and pond. A majority of the buildings have been removed and the area was not operational at the time of investigation. Aerial images indicates the facility was constructed post 2005 and demolished prior to 2017. The area is located down gradient of the investigation area.
South	Mining	North Goonyella underground mine - Immediately to the south of ML1790 is the Peabody operated mine on ML70495. The mining lease supports numerous disturbance areas including tailings dams waste dumps, water storage dams, coal handling areas, rail siding, industrial areas and other surface disturbance areas. This mine is located down gradient of the investigation area. Red Hill mining lease is located to the south east of the investigation area. Surface areas of the Red Hill lease adjacent to the investigation area are utilised for grazing. The Red Hill lease is down gradient of the investigation area.

Due to the topography of the area, land uses to the north, south and west are down gradient of the investigation area, and any surface contamination present within these areas is unlikely to cause contamination of the investigation area. To the east and up-gradient of investigation area are Dabin Homestead and Lenton Downs Homestead. Both of these homesteads include activities that have the potential to cause land contamination and are located adjacent to creeks (Eaglefield and Charlie creeks) that run to the west and through the investigation area). From the homesteads to the eastern boundary of the investigation area (ML70443) the creek alignments are at least 3.5km. Contamination sources from homestead sites are not expected to have migrated through the ephemeral creeks and result in contamination at concentrations that could cause environmental harm within the investigation area.

5.9 Site Waste Management

Wastes generation within the investigation area are limited to wastes resulting from the use of the land for grazing and exploration activities.

Grazing activities within the investigation area include open paddocks and watering points. Other grazing related activities, including workshops, cattle dips, homesteads and other infrastructure/activities are located outside of the investigation area, and wastes generated by these activities are also managed outside of the investigation area.

Exploration drilling activities generate liquid and solid wastes that are removed from the ground as drill cuttings and drilling fluids/groundwater. The mining leases ML1790 and ML4752 were granted in 1978 and exploration drilling is anticipated to have occurred since the early 1970's. Records of historical drilling practices and drilling fluid additives were not identified as part of this investigation. Recent exploration drilling practices include the establishment of drill pads with pits for the collection of cuttings and liquid wastes. The drill pads are rehabilitated upon completion of the exploration drilling including the covering of pits containing drilling wastes. Inspection of the investigation area did not identify any evidence of visible contamination in historical exploration drilling sites.

5.10 Earthworks

At the time of this investigation the approved box cut and underground bulk sampling program had not been undertaken. Earthworks undertaken on site included the following:

- Quarry/borrow pit located on the boundary of ML4752 and ML70443 to the north of Suttor Development Road;
- Area on western boundary of ML1790, observed in satellite image with plant and material stockpiles (area revegetated at time of site inspection);
- Construction of small farm dams;
- Drilling of groundwater extraction/monitoring wells;
- Exploration drilling including: clearing of drill pads, excavation of drilling mud pits, drilling of exploration holes, rehabilitation of drill pads; and
- Construction of access tracks and fences.

Other than minor importation of crushed rock used on selected sections of access tracks, imported earthen materials and/or landfilling was not identified within the investigation areas.

The area of the quarry/borrow pit at the time of inspection, was not operational. The area was cleared and void of vegetation and the depth of excavation appeared to be less than 2m. It is assumed the material sourced from the quarry/borrow pit was utilised for maintenance of surrounding roads.

5.11 Water Resource Use

During the site inspection the following water resource uses were observed within the investigation area:

- Earth dam located approximately 400m to the north of Suttor Development Road on ML4752 utilised for stock watering;
- Earth dam located approximately 1km to the north of Suttor Development Road on ML70443 utilised for stock watering;
- Earth dam located on the western side of ML1790 approximately 5km to the south of Suttor Development Road utilised for stock watering;
- Earth dam located in the center of ML1790 approximately 6km to the south of Suttor Development Road utilised for stock watering;
- Groundwater extraction well with small turkey nest dams, southern portion of ML1790, approximately 9.25km to the south of Suttor Development Road utilised for stock watering.
- Groundwater extraction well with small turkeys nest dams, central ML1790, approximately 5.25km to the south of Suttor Development Road, utilised for stock watering.

- Groundwater extraction well with small turkeys nest dams, western side of ML1790, approximately 3.4km to the south of Suttor Development Road, utilised for stock watering.
- Groundwater extraction well with small turkeys nest dams, tanks and solar system, eastern side of ML1790, approximately 2.6km to the south of Suttor Development Road, utilised for stock watering.
- Groundwater extraction well with small turkeys nest dam, central ML4752, approximately 4km to the north of Suttor Development Road, utilised for stock watering.

Within 5km of the investigation area there were four homestead sites, stock watering points, and numerous farm dams. Although the homestead sites were not inspected, as they were outside of the investigation area, water for use within the homesteads are anticipated to be rainwater/imported water due to the salinity of the underlying aquifers.

As identified within Section 5.5, groundwater dependent ecosystems and inflow dependent ecosystems are present within the investigation area surrounding the ephemeral creeks/drainage lines. Environmental flows of groundwater and surface water are required to maintain these ecosystems.

To the south and north of the site, water resources are managed as part of the operational mine sites. Mine affected water is collected, reused for processing and other operational uses and where required discharged under Environmental Authority conditions.

Within the portion of the investigation area located in the Burdekin Basin, surface water flows and basalt aquifer flows are in a westerly direction. Immediately downstream of the investigation area are rural grazing properties, consistent with the land uses on site. Surface water flows through the natural ephemeral drainage lines (Eaglefield, Charlie and Kennedy creeks) are directed to the west and into Eaglefield Creek, Suttor River, Lake Dalrymple water supply dam and into the Burdekin River. Environmental Values for this catchment are provided within Section 5.6.1.

The south east portion of the investigation area that forms part of the Fitzroy Basin drains in a south easterly direction through Goonyella Creek. Goonyella Creek drains into the Isaac River, which in turn drains into the Fitzroy River. Environmental Values for this catchment are provided within Section 5.6.1.

5.12 Other Databases

A search of the following databases was undertaken to identify potential contaminated land risks.

- Defence PFAS Investigation & Management Program - Investigation Sites
- Defence PFAS Investigation & Management Program - Management Sites
- Airservices Australia National PFAS Management Program
- Queensland Fire and Emergency Services PFAS Investigation Sites
- Defence 3 Year Regional Contamination Investigation Program
- National Waste Management Facilities Database
- National Liquid Fuel Facilities
- UBD Business Directories

A copy of the search results is contained within **Appendix F**.

The above searches did not identify any records within or immediately surrounding the investigation area.

6 Site Inspection

An inspection of the investigation area was undertaken 10-11 December 2020. The inspection was undertaken by vehicle and on foot targeting those areas where anthropogenic disturbances were identified within the desk top investigations. The following observations were made during the site inspection.

- The entire investigation area was utilised for grazing. No mineral exploration works were being undertaken at the time of inspection.
- The borrow pit located on the boundary of ML4752 and ML70443 (ML4752 - ML70443 Disturbance Area 01) to the north of Sutter Development Road was not operational. No plant or equipment was present and no visible signs of contamination were identified. One settled stockpile of locally won earth was present on the eastern side of the borrow pit. The borrow pit area had not been rehabilitated and no vegetation had re-established within the disturbance area.
- A disused communications pole was present within a cleared area to the south of Sutter Development Road (ML1790 Disturbance Area 05). The size of the pad indicates the area may have been used for a road works or similar support compound. No visible signs of contamination were observed and only minor residual steel, wood, pipes and tyre debris remained within the cleared area.
- The former earthworks area on the western boundary of (ML 1790 Disturbance Area 01) had been rehabilitated and was covered with grass consistent with the surrounding land. Evidence of stockpiled/imported materials or contamination was not identified.
- All former exploration drill pads viewed had been rehabilitated. No evidence of contamination or drilling wastes were observed.
- All groundwater extraction bores identified, were utilised for stock watering and powered by windmills or solar. No cattle dips, landfilling, petroleum storage, or other potentially contaminating activities associated with grazing activities were identified within the investigation area. Some maintenance work/refurbishment of stock water groundwater extraction locations was apparent with replacement of bores, windmills, tanks, troughs and pipework. Disused equipment remained in the proximity of the bore.
- All surface water dams observed were either dry or held very little water. No evidence of contamination was observed at any of the dams.
- All creek lines crossed were dry at the time of inspection and were free of rubbish and anthropogenic materials. Eaglefield and Charlie creeks, which had homestead sites up gradient were inspected at the proximity of the eastern boundary of the investigation area. No evidence of waste disposal or contamination was observed.
- An area of erosion was observed within the north western portion of ML1790 (ML1790 – disturbance Area 10) to the south of Sutter Development Road. An inspection of the area did not identify any anthropogenic disturbances other than grazing and a farm access track/Sutter Development Road up gradient. The dispersive soils had eroded up to one metre in depth within an area with a slight slope towards Charlie Creek.
- The area of reduced vegetation in the center of ML1790 (ML1790 – Disturbance Area 06) had evidence of topsoil loss and a lack of groundcover vegetation. Aside from an agricultural dam located in the center of the area, no other anthropogenic activities were noted. A tributary of Kennedy Creek ran through the area and showed evidence of accelerated erosion.

Photographs showing the investigation area at the time of field inspection are contained in **Appendix I**.

The inspection of the investigation area did not identify any evidence that would indicate a significant potential for contamination within the investigation area.

Surrounding the investigation area, homestead sites include cattle dips, workshops, landfilling and other activities that have the potential to cause contamination. Mining operations to the south and north of the investigation area also have the potential to cause contamination. Due to the distance from the investigation area and the direction of surface water flows (on the northern, southern and westerns sides) these surrounding land uses are not anticipated to have caused contamination of the investigation area.

6.1 Anecdotal Information

Due to BHP Covid-19 restrictions, access to interview land managers during the site inspection was not available. Interviews were undertaken over the phone post the site inspection. Pertinent Information from the interviews are summarised below.

Mr David Write – Land Manager for Dabin Station (Lot 2 on SP214117) including the northern portion of ML1790 and ML70495 and ML70443 south of Sutter Development Road.

- Groundwater is extracted across the Dabin properties for use as stock water. Bores were estimated to be approximately 100 to 120m deep. The quality of the water was variable with a couple of bores producing reasonable water, however others were quiet brackish.
- A cattle dip is present within the yards located at the homestead (not within the mining leases). The dip had not been operated for at least 25 years.
- Waste disposal on site was in an area between the homestead and creek (not within the mining leases). No other waste disposal locations were known.
- No known areas of contamination or spills/releases of hazardous materials within the mining lease areas, noting the “gas people” had been doing drilling but had not informed Mr Wright of any contamination/incidents.
- Approximately 20 years ago during international beef export contamination concerns, a couple of dogs brought in from Toowoomba were used to assess for potential contamination around the holding yards. The assessment identified potential low level dieldrin impacts within the cattle holding yards and a separate area was set up to hold the cattle and prevent possible contamination of the beef (not in mining lease area).

Mr Andrew Dioth, the land manager for Lenton Downs, was unable to be contacted during the course of the investigation.

7 Conceptual Site Model

The Conceptual Site Model (CSM) has been based on the guidance provided in the ASC NEPM and has been developed to determine the presence of plausible complete exposure pathways from contamination sources to receptors such as humans and/or environmental values. For an identifiable risk to exist, a complete exposure pathway must be present, which requires each of the following to be present.

- The presence of substances that have the potential to cause harm (SOURCE).
- The presence of a receptor which may be harmed at an exposure point (RECEPTOR).
- The existence of a means of exposing a receptor to the source (EXPOSURE ROUTE).

Outlined below are descriptions of the source, receptors and exposure pathways associated with the investigation area and a summary of the potentially complete exposure pathways identified.

7.1 Source

At the time of site inspection, the investigation area was predominantly utilised for grazing with historical evidence of coal exploration activities (drilling and other surveys). Mining, bulk sampling or the excavation of box cuts had not been undertaken. The investigation did not identify sources of contamination within the investigation area that had the potential to cause environmental harm. Surrounding land uses included homesteads and associated infrastructure. Two of the homesteads (Dabin and Lenton Downs) were located upstream of the investigation area and undertook activities that had the potential to cause contamination. However, the distance to the investigation areas along the ephemeral creek alignments (at least 3.5km) would prevent potential sources of contamination impacting the investigation area.

Therefore, no sources of contamination have been identified for the investigation area at the time of this investigation.

7.2 Potential Receptors

Potential receptors identified include the following:

- on-site exploration/mining personnel;
- on-site land users/managers;
- on-site stock (cattle);
- off-site maintenance workers within easements;
- off-site land users industrial land users;
- off-site residential occupants;
- public users of roads and other public areas;
- terrestrial ecological receptors within the rural and industrial environments in proximity of the investigation area; and
- ecological ecosystems of the creeks and drainage lines both on site and down gradient.

7.3 Potential Exposure Routes

The main feasible transport mechanisms that have been identified for the mobilisation of contaminants include:

- surface water flows;
- groundwater;
- airborne particulates; and
- dermal contact with contaminated soil.

7.4 Potentially Complete Exposure Pathways

As no sources of contamination have been identified within the investigation area, no complete exposure pathways have been identified.

8 Conclusions and Recommendations

8.1 Conclusions

The investigation area covered by this PSI included the mining leases held under the Environmental Authority (EA): EPPR00668513 (date effective 25 January 2018). The mining leases included: ML4752; ML1790, ML70443; and ML70495. These mining leases covered part of the following legal properties:

- Lot 2 SP256592;
- Lot 2 SP214117;
- Lot 8 GV807254; and
- Lot 11 SP262530.

Based on the results of the PSI the following conclusions are drawn.

- Lot 8 on GV807254 was listed on the Queensland Environmental Management Register (EMR) for the notifiable Activity of Livestock Dip or Spray Race. All other properties at the time of investigation were not listed on the EMR. No Notifiable Activities were identified within the investigation area (including the portion of Lot 8 on GV807254 within the investigation area). However, homestead sites located outside of the mining leases and boundaries of the investigation area, may contain 'Notifiable Activities' associated with the use of the properties for grazing. None of the properties were listed on the Queensland Contaminated Land Register.

- Groundwater monitoring within the Tertiary hosted aquifers had been undertaken by BHP since 2011. As mining operations, other than exploration drilling and seismic works, have not been undertaken prior to this investigation, the groundwater analytical results are indicative of pre-mining conditions. A preliminary assessment of the groundwater results indicated that 80th percentile concentrations of chloride, sodium, boron, selenium, zinc and total dissolved solids were above selected Water Quality Objectives for the catchments. Anthropogenic sources of these contaminants were not identified and therefore the identified concentrations are anticipated to be representative of background conditions. The Tertiary aquifer results indicate that groundwater has limited potential for potable/domestic use and for release to sensitive ecosystems without prior treatment. The analytical results indicate the Tertiary aquifer is suitable for cattle stock watering.
- Registered groundwater monitoring wells on site are predominantly utilised for monitoring purposes. However inspection of the investigation area indicates that groundwater has been and is utilised for the purpose of stock watering.
- Investigations into the quality of the Permian hosted aquifers are limited, however based on regional data, groundwater hosted within the Permian is expected to have higher levels of salinity when compared to the overlying Tertiary aquifers.
- Review of historical imagery indicates the investigation area has been utilised for grazing purposes since at least 1957 with only minor disturbance areas predominantly associated with exploration drilling, farm dams, Suttor Development Road and a quarry/borrow pit. Review of the historical titles indicates that registered owners, other than BHP for Lot 2 SP214117 and Lot 11 SP262530, have been private citizens since the deed of grant was issued.
- The majority of the investigation area is located in the Burdekin Basin, which drains the investigation area to the west and into Eaglefield Creek followed by the Suttor River and the Burdekin River. The south eastern corner of the investigation area falls within the Fitzroy Basin, with the investigation area forming the headwaters of Goonyella Creek, which flows in a south easterly direction and into the Isaac River.
- Ecosystems on site include endangered (Semi-evergreen vine thicket, Brigalow, Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin Poplar Box Grassy Woodlands) and of concern ecosystems/ecological communities and may provide habitat for a variety of the endangered and vulnerable species.
- No visible evidence of contamination was observed during the site inspection and no 'Notifiable Activities' or other evidence indicating the presence of 'Prescribed Contaminated Land' (as defined by the EP Act (1994)) was identified within the investigation area. Surrounding land uses at homestead sites (outside of the investigation area) have the potential to have undertaken 'Notifiable Activities'. However the distance to the investigation area and in some cases the direction of overland flow would limit the potential for these activities to have impacted the investigation area.

8.2 Recommendations

Based on the results of the PSI, which did not identify a reasonable potential for the presence of 'Prescribed Contaminated Land' within the investigation area, no further contaminated land investigations are required to support the development of the PRC Plan.

9 References

- AEG (2012) Interim Draft Report on Wards Well Environmental Impact Study Groundwater Assessment
- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality
- Commonwealth Government (1999) *Environmental Protection and Biodiversity Conservation Act*
- Commonwealth Government (2019) Australia New Zealand Food Standards Code
- Ecological Australia (2017) Wards Well Coal Project Ecological Assessment Report
- Golder (2021) Wards Well Progressive Rehabilitation and Closure Plan – Hydrogeological Conceptual Model
- National Environment Protection Council (1999) National Environment Protection (Assessment of Site Contamination) Measure
- NHMRC (2008) Guidelines for Managing Risks in Recreational Water.
- NHMRC (2011) Australian Drinking Water Guidelines
- NQ Dry Tropics 2016, Burdekin Region Water Quality Improvement Plan (2016), NQ Dry Tropics, Townsville.
- Queensland Government (1994) Environmental Protection Act
- Queensland Government (2011) Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River)
- Queensland Government (2019) Environmental Protection (Water and Wetland Biodiversity) Policy
- Queensland Government (2019) Queensland Auditor Handbook for Contaminated Land – Module 6: Content requirements for contaminated land investigations documents, certifications and audit reports.
- RGS Environmental Pty Ltd/Terrenus Earth Sciences (2012) Draft Geochemical Assessment of Potential Coal Reject, Coal and Spoil Materials Wards Well Project
- Standards Australia (AS4482.1:2005) Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil.

APPENDIX 9 – NOT USED

APPENDIX 10
WARDS WELL PRCP RISK ASSESSMENT

Wards Well Risk Assessment
Progressive Rehabilitation and Closure Plan

Risk Event* (Unplanned/unwanted event)	Scenario #	Scenario	Causes (related to risk event)	Impact Description*	MFL Basis* (Absolute worst case scenario, with no controls in place)	Highest MFL Level	Mitigating Controls	Severity Impact Description* (taking into account the effectiveness of existing mitigating controls)	Highest Severity	Preventative Controls	Likelihood Basis* (chance of the impact at the severity which is being used in the calculation of the RRR, taking into account the effectiveness of existing preventative	Likelihood	Likelihood*	RRR
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	1	Landform failure (Boxcut backfilled and 0.6m elevation on remaining dump, driven by EA conditions)	1. Erosion instability 2. Geotechnical instability 3. Differential settlement 4. Insufficient surface cover to maintain PMLU 5. Flooding and/or extreme weather events	- Erosion - Sediment transport - Topsoil loss - Failure of vegetation - Slumping and settlement - Mass movement of landform - Exposure of less desirable materials in the dump or backfill	Erosion with differential settlement	2	- Monitoring of landform stability and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works. - Reshape of landform to fix differential settlement and erosion and revegetate areas.	Monitoring identifies any failure and limits the time before repairs are scheduled.	1	- Backfill box-cut in lifts to increase compaction during dumping - Prioritise placement of dispersive tertiary and weathered material in the void - Prioritise placement of less erosive Permian material on the outside of the backfill - Filling above natural surface to account for settlement and prevent possible flood impacts - Minimise height and slope gradients of landform structures - Landform structures reshaped and blended in with surrounding topography - Surface cover including vegetation to provide erosion resistance	With all controls in place including ongoing monitoring and maintenance would mean that landform failure on a large scale for this landform is unlikely	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	2	Alteration of hydrogeological conditions	1. Release of contaminants to groundwater. 2. Change in geological profiles and groundwater extraction resulting in changes to pre-mining groundwater depths. 3. Change in geological profiles and groundwater extraction resulting in alterations of groundwater flows. 4. Interconnection of groundwater aquifers of differing characteristics. 5. Change in groundwater recharge and discharge characteristics resulting in changes to the hydrogeological system.	- Groundwater chemistry altered rendering it not suitable for extraction and use within PMLU - Grazing - Degradation of stygofauna ecosystems - Groundwater dependant ecosystems - Groundwater quality not supporting the establishment/maintenance of Environmental Values and Water Quality Objectives for the basins in which the mine is located - Loss of groundwater aquifer volume and height i.e. depletion of the groundwater resource - Existing groundwater extraction bores become dry, depletion of Groundwater resource reducing availability for extraction/beneficial use - Excavation areas acting as a sink for shallower basalt/lower salinity aquifers and increasing groundwater flows into the Permian aquifers	Changes to the quality or height of groundwater aquifers that render water within the Tertiary aquifers unsuitable for stock watering and maintenance of ecosystems. If this occurred a Site Management Plan may be required to restrict groundwater extraction in the impacted area and existing groundwater bores may need to be relocated.	1	- Site operational procedures will include requirements for notification/reporting of and cleaning up of any spills. - Maintenance of all plant and equipment will be undertaken to prevent and rectify any loss of hazardous materials. - Any contamination caused by the approved activities will be investigated and remediated on-site or removed from site for disposal as appropriate. - Operational areas will be assessed at the completion of exploration activities for any releases of hazardous contaminants and any impacted areas remediated/appropriately managed. - Groundwater monitoring data collected during and post the approved exploration activities will be reviewed for evidence of groundwater impacts. If impacts to groundwater are identified, further investigations will be undertaken to determine appropriate remedial measures.	Localised degradation of groundwater quality or decrease in groundwater heights. Compartmentalised Tertiary aquifer will limit the lateral extent of the distribution. Carbon based contaminants would be expected to naturally degrade over time. No AMD risks identified. Water levels and electrical conductivity expected to reach new equilibrium relatively quickly with recharge from rainfall infiltration.	1	- All imported hazardous materials are to be stored and used in accordance with relevant standards and removed from site on completion of the exploration works. - At the completion of operations, all hazardous materials and infrastructure that have the potential to release contaminants to groundwater will be removed from site. - Box-cut void will be backfilled. - Geochemical risks associated with the material to be excavated are to be assessed prior to commencement of box cut excavation by suitably qualified persons and plans developed and implemented to manage any identified risks. - Groundwater and ecosystem monitoring to be undertaken in accordance with EA conditions. - Assessment of groundwater through development of conceptual models by suitably qualified persons to assess the potential for groundwater impacts associated with approved activities. Note that a very low risk (contamination, water level and quality change) of the proposed operations causing any long term permanent impacts has been identified (Golder 2020).	No AMD issues identified, relatively small box cut and underground bulk sampling excavation, backfill of excavation at completion and limited site operations that have the potential to cause contamination of the groundwater aquifer. Groundwater flow within backfill should be in a downward direction towards the Permian aquifer and therefore dominated by the water with similar properties to the Tertiary aquifer (see Golder 2020 Wards Well Mine - Progressive Rehabilitation and Closure Plan - Hydrogeological Conceptual Model). Therefore highly unlikely.	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	3	Alteration of surface water systems	1. Release of contaminants to surface water resources. 2. Changes to alignments and ecosystems of drainage lines and streams. 3. Changes to hydraulic flows. 4. Changes to flood patterns/distribution. 5. Alternation of surface water infiltration rates. 6. Surface water flows over unvegetated/disturbed soils.	- Surface water chemistry altered rendering it not suitable for PMLU - Grazing - Degradation of ecosystems and land uses connected to surface water flows and floodplains on and down gradient of the mine - Sedimentation of downstream surface water drainage lines resulting in changes to their hydraulic properties and impacting ecosystems - Surface water quality not supporting the establishment/maintenance of Environmental Values and Water Quality Objectives for the basins in which the mine is located - Accelerated erosion rates from surface water flows in disturbed areas and degraded ecosystems - Reduction in rehabilitation success rates due to reduced surface water quality - Alteration of soil properties associated with contaminants carried by surface waters, including erodability and geotechnical qualities	Changes to the quality and quantity of surface waters that render it not suitable for proposed final land use of grazing or results in degradation of ecosystems. If this occurred additional remediation, alteration of final landforms, or implementation of a Site Management Plan may be required.	2	- Surface water monitoring data collected during and post the approved exploration activities will be reviewed for evidence of water quality impacts. If impacts are identified, further investigations will be undertaken to determine appropriate remedial measures. - Site operational procedures will include requirements for notification/reporting of and cleaning up of any spills. - Maintenance of all plant and equipment will be undertaken to prevent and rectify any loss of hazardous materials. - Any loss of hazardous contaminants by the approved exploration activities that causes contaminated land/environmental harm will be investigated and remediated on-site or removed from site for disposal as appropriate. - Operational areas will be assessed at the completion of exploration activities for evidence of contaminated land and any impacted areas remediated/appropriately managed. - Sediment and erosion controls will be regularly inspected and maintained where required.	If surface water contamination was occurring likely to be from near surface materials which could be easily accessed and managed. Final landform only 0.6m above the pre-mining surface height. Disturbance areas not within any recognised drainage or creek lines.	1	- All imported hazardous materials and to be stored and used in accordance with relevant standards and removed from site on completion of the approved exploration works. - Box-cut void will be backfilled. - Surface water monitoring to be undertaken in accordance with EA conditions. - Separation of clean (stormwater dam) and mine-affected water (mine water dam) systems to prevent the release of contaminants/ sediments that have the potential to cause environmental harm. - Monitoring of surrounding ecosystems will be undertaken in accordance with EA conditions. - Rehabilitation of disturbed areas will be undertaken as soon as practical after the completion of operations.	No AMD issues identified, final landform only 0.6m above existing level, backfill of excavation at completion and limited site operations that have the potential to cause contamination and are to be removed at the completion of works. No alteration of surface water drainage lines or creeks required.	Unlikely	0.1	1

Risk Event* (Unplanned/unwanted event)	Scenario #	Scenario	Causes (related to risk event)	Impact Description*	MFL Basis* (Absolute worst case scenario, with no controls in place)	Highest MFL Level	Mitigating Controls	Severity Impact Description* (taking into account the effectiveness of existing mitigating controls)	Highest Severity	Preventative Controls	Likelihood Basis* (chance of the impact at the severity which is being used in the calculation of the RRR, taking into account the effectiveness of existing preventative	Likelihood	Likelihood*	RRR
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	4	Alteration of flood hydrology	1. Changes to drainage network hydraulics. 2. Artificial landforms reducing or increasing flood extent and changing velocities/flows. 3. Changes to vegetation cover and soil type which alter runoff and infiltration rates.	- Decrease in landform stability - Accelerated mobilisation of sediments and other hazardous contaminants off-site - Increasing/decreasing of flood extents, frequency and severity - Degradation of floodplain ecosystems - Degradation of ecosystems which were not previously subject to flooding due to water inundation - Infrastructure damage from increased flooding heights/velocities - Health and safety risks to on-site and off-site land users associated with increased flood heights, velocities and frequency	Alteration of flood dynamics that result in damage to the surrounding environment and infrastructure.	1	- Monitoring of landform stability and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works. - Where approved activities alter floodwater characteristics that cause damage to infrastructure within the proximity of the operations, the infrastructure will be repaired and appropriate mitigation measures assessed and implemented to minimise potential future occurrence.	The area containing the box cut and associated disturbances has less than a 0.2m modelled extreme flood height (DNRME).	1	- Box-cut void will be backfilled. - Assessment of flooding risks evaluated prior to commencement of operations. Note assessment has confirmed low risk. - Final landforms are to be located, designed and constructed to minimise impact to flooding regimes and to withstand reasonably assessed flooding risks. - Monitoring of surrounding ecosystems to be undertaken in accordance with EA conditions .	Extreme flood event only has the potential to introduce <0.2m of flood waters to the box cut disturbance area.	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	5	Insufficient, inadequate or inappropriate soil and capping material required for rehabilitation activities	1. Poor soil fertility 2. Unstable material (erosive, dispersive) 3. Weed infestation 4. Disturbance by fauna (movement, burrowing, etc.) 5. Incorrect placement depth and surface treatment 6. Incorrect soil characterisation and amelioration requirements 7. Insufficient topsoil 8. Inappropriate topsoil stockpiling and management	- Erosion - Sediment transport - Topsoil loss - Failure of vegetation (poor vegetation growth or incorrect vegetation affecting PMLU)	Total failure of vegetation in rehabilitation areas.	2	- Monitoring of landform stability and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works. - Repair erosion areas, retest soil and revegetate.	Monitoring identifies any failure and limits the time before repairs are scheduled.	1	- Initial topsoil survey, mapping and material balancing - Provide data into the mine plan to drive correct placement of materials - Review the topsoil material balance periodically during operations to ensure sufficient volumes for the rehabilitation needs. - Undertake rehabilitation planning and preparation in accordance with the specific requirements for soil, seed and management for a grazing PMLU - Management of topsoil stripping and application during rehabilitation. - Topsoil assessment by suitably qualified person to determine ameliorant and fertiliser requirements.	With all controls in place including ongoing monitoring and maintenance would mean that insufficient, inadequate or inappropriate soil for use on rehabilitation is unlikely	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	6	Insufficient identification and management of waste characterisation	1. Poor material characterisation 2. Geochemical not correctly defined 3. Inappropriate placement of adverse material 4. Poor landform execution 5. Inappropriate management strategy	- Release of contaminants to surface and groundwater. - Vegetation failure - Water cannot be used by end user (human and ecosystem) - Erosion	Significant quantities of carbonaceous material not identified leading to vegetation failure and impact to water.	2	- Monitoring of landform stability and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works. - Cover undesirable materials and redo rehabilitation.	Monitoring identifies any failure and limits the time before repairs are scheduled.	1	- Ongoing waste characterisation during operations - Prioritise tertiary, weathered and carbonaceous material in the box-cut void.	With all controls in place including ongoing monitoring and maintenance would mean that insufficient, inadequate or inappropriate soil for use on rehabilitation is unlikely	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	7	Failure of, or inadequate / inappropriate cover design	No cover design required for Wards Well as there is no environmental risk associated with any material remaining on-site.	N/A			N/A			N/A				
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	8	Inadequate and/or inappropriate revegetation	1. Unfavourable climatic conditions and/or weather events 2. Incorrect species mix 3. Poor seed quality 4. Weed contaminated seed 5. Poor quality topsoil or seed bed preparation 6. Erosion	- Exposed soils due to poor vegetation establishment and growth, resulting in enhanced erosion rates. - Increased weed establishment and growth. - Reduction in land capability of PMLU (grazing) - reduced availability of land for grazing (erosion), as well as inhibited growth of suitable fodder species - Need for ongoing corrective action - soil sampling and analysis, amelioration and re-vegetation.	Total failure of vegetation in rehabilitation areas.	2	- Monitoring of landform stability and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works. - Repair erosion areas, retest soil, review seed mix and revegetate.	Monitoring identifies any failure and limits the time before repairs are scheduled.	1	- Topsoil assessment by suitably qualified person to determine ameliorant and fertiliser requirements. - Management of seed selection and quality. - Plant at optimal time of year.	With all controls in place including ongoing monitoring and maintenance would mean that insufficient, inadequate or inappropriate soil for use on rehabilitation is unlikely	Unlikely	0.1	1

Risk Event* (Unplanned/unwanted event)	Scenario #	Scenario	Causes (related to risk event)	Impact Description*	MFL Basis* (Absolute worst case scenario, with no controls in place)	Highest MFL Level	Mitigating Controls	Severity Impact Description* (taking into account the effectiveness of existing mitigating controls)	Highest Severity	Preventative Controls	Likelihood Basis* (chance of the impact at the severity which is being used in the calculation of the RRR, taking into account the effectiveness of existing preventative	Likelihood	Likelihood*	RRR
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	9	Failure of TSF rehabilitation	Not applicable - no TSFs for Wards Well	N/A			N/A			N/A				
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	10	Stability failure of rehabilitated void	1. Erosion instability 2. Geotechnical instability (deterioration of geotechnical characteristics) 3. Geochemical instability (deterioration or changes) 4. Increase/decrease in predicted void water levels	- Changes to surface and groundwater flow patterns / distribution.	Erosion with differential settlement	2	- Monitoring of backfill settlement and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works.	Monitoring identifies any failure and limits the time before repairs are scheduled.	1	- Box-cut void to be backfilled .	With all controls in place including ongoing monitoring and maintenance would mean that insufficient, inadequate or inappropriate soil for use on rehabilitation is unlikely	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	11	Stability failure of underground mine workings	1. Geotechnical instability of remaining pillars 2. Surface cracking and/or sinkhole formation 3. Flooding of underground workings	- Surface subsidence that may affect functionality of the PMLU (grazing) - landform changes that could hinder/change safe access to areas by livestock. - Damage to existing flora and revegetated area damage due to changing surface conditions. - Increased potential for spontaneous combustion events within underground workings. - Changes to surface water infiltration rates, flow patterns and/or flood patterns/distribution that could affect local catchment and ecosystem integrity. - Changes to groundwater flow volumes and rates that could affect local catchment integrity.	Total collapse of underground workings causing significant subsidence	2	- Monitoring of subsidence and rehabilitation success to be undertaken post operations to confirm stability and identify requirements for rectification works. - Revegetate areas of vegetation die-back - Fill surface cracks to reduce both water and air access to underground workings (reducing water ingress and oxygen exposure for ignition of spontaneous combustion).		1	- Underground design to consider geotechnical issues and include stability analysis and subsidence modelling. - Undertake an assessment to determine the most appropriate, legislatively accepted seal requirements.	With all controls in place including ongoing monitoring and maintenance would mean that insufficient, inadequate or inappropriate soil for use on rehabilitation is unlikely	Unlikely	0.1	1
Stable condition (safe, stable, non-polluting and sustainable) for land described as a post-mining land (reference PMLU table E1 - 100% cattle grazing) use is not achieved	12	Deterioration of built infrastructure conditions	1. Potential soil contamination around mine industrial areas	- Reduced soil fertility to support PMLU land capability (grazing). - Potential contamination of surface water runoff affecting integrity of local catchments.		1	- Undertake a preliminary contaminated land assessment prior to the completion of the approved activities, identify if any areas require a further Detailed Site Investigation and remediation plan developed if required. - Conduct ongoing maintenance		1	- Clean up and remediate contamination during operational period. - Undertake PSI contaminated land assessment post mining to identify any areas requiring further DSI	With all controls in place including ongoing monitoring and maintenance would mean that deterioration of built infrastructure is unlikely	Unlikely	0.1	1

APPENDIX 11 - NOT USED



Environmental Authority Amendment Application Supporting Report

P-EA-100658735 and P-PRCP-100669070_V1

Centurion Coal Mine Pty Ltd.

Moranbah, Queensland 4744

Prepared by:

SLR Consulting Australia

SLR Project No.: 620.040594

13 September 2024

Revision: 2.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	11 September 2024	Eliza Blandthorn, Mavisha Nariansamy	Reine Byrne	Peter Smith
2.0	13 September 2024	Eliza Blandthorn, Mavisha Nariansamy	Reine Byrne	Peter Smith
	Click to enter a date.			
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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Centurion Coal Mine Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



Executive Summary

Centurion Coal Mine Pty Ltd has recently secured the rights to further explore resources under a portion of Mining Lease (ML) 1790 and ML 70495 located immediately adjacent to and directly north of the Centurion Coal Mine, an existing underground longwall mine located on ML 6949.

As a result, Centurion Coal Mine Pty Ltd proposes to undertake exploration activities which consist of a pilot coal seam gas (CSG) exploration and extraction programme (the Project) within ML 1790. Exploration and evaluation of CSG requires the implementation of a network of 13 vertical and 10 lateral wells, extending from the ground surface down to the Goonyella Middle coal seam. These wells will be connected to flare kits and be supported by other surface infrastructure for CSG processing, monitoring, and control.

To obtain authorisation for the Project activities, an amendment to the Environmental Authority (EA) P-EA-100658735 and Progressive Rehabilitation and Closure Plan (PRCP) P-PRCP-100669070_V1 is required. The proposed changes include:

- EA P-EA-100658735:
 - Condition 15 Schedule A.
 - Condition 7 Schedule F.
 - Condition 9 Schedule F.
 - Condition 22 Schedule F.
- PRCP P-PRCP-100669070_V1:
 - Section B - Figure 1.
 - Section C – (RA1) Rehabilitation area 1

Assessments air quality, greenhouse gas, noise and vibration, terrestrial ecology, aquatic ecology, groundwater, surface water, and waste management were undertaken to determine impacts. The impacts resulting from Project activities along with mitigation measures are presented in this Supporting Report.

Risk assessments have determined that the proposed Project activities pose a low risk of causing environmental harm/ nuisance beyond that authorised by the EA. This is attributed to the scale and location of the Project activities, and that these activities can be managed under the monitoring and compliance requirements of the existing EA and Centurion Coal Mine management practices that will be applied to the Project to minimise and/or prevent unauthorised harm to Environmental Values from the Project.

Based on the outcomes of the assessments undertaken, Centurion Coal Mine Pty Ltd consider that the approvals pathway is commensurate to a minor EA Amendment process.



Table of Contents

Basis of Report	i
Executive Summary	ii
Acronyms and Abbreviations	ix
1.0 Introduction	1
1.1 Objective of this Environmental Authority Amendment	1
1.2 Project Background	1
1.3 Project Objectives	1
1.4 Report Structure	2
2.0 Legislative Context	3
2.1 Mineral Resources Act 1989	3
2.2 Environmental Protection Act 1994	3
2.2.1 Amendment Threshold	4
2.2.2 Standard Criteria	5
2.2.3 Environmentally Relevant Activities	8
2.2.4 Environmental Protection (Air) Policy 2019	8
2.2.5 Environmental Protection (Noise) Policy 2019	8
2.2.6 Environmental Protection (Water and Wetland Biodiversity) Act 2019	9
2.3 Environment Protection and Biodiversity Conservation Act 1999	9
2.4 Water Act 2000	10
2.5 Regional Planning Interests Act 2014	10
3.0 Activities Subject of this EA Amendment	11
3.1 Location of the Project	11
3.2 Access Tracks	13
3.3 Coal Seam Gas Exploration	13
3.3.1 Drill Pad	13
3.3.2 Vertical Wells	14
3.3.3 Lateral Wells	14
3.3.4 Exploration Method	15
3.4 Water	18
3.5 Power	18
3.6 Amenities	18
3.7 Equipment	19
3.8 Workforce and Working Hours	20
3.9 Hours of Operation	20



3.10	Rehabilitation and Closure	20
3.11	Project Schedule	23
4.0	Proposed EA and PRCP Amendments	24
4.1	Environmental Authority	24
4.1.1	Condition 15 Schedule A	24
4.1.2	Condition 7 Schedule F	25
4.1.3	Condition 9 Schedule F	25
4.1.4	Condition 22 Schedule F	26
4.2	Progressive Rehabilitation and Closure Plan	28
4.2.1	Section B – Final site design and reference maps	28
4.2.2	Section C – Post-mining land uses	28
5.0	Assessment Methodology	30
5.1	Terminology	30
5.2	Methodology to Identify Environmental Impacts	30
5.2.1	Terrestrial and Aquatic Ecology	31
5.2.2	Groundwater Assessment	31
5.3	Risk Assessment Methodology	31
6.0	Environmental Assessments	33
6.1	Air Quality	34
6.1.1	Existing Environmental Values	34
6.1.2	Potential Impacts	39
6.1.3	Management Practices	40
6.1.4	Risk Assessment	41
6.2	Greenhouse Gas	42
6.2.1	Existing Environmental Values	42
6.2.2	Potential Impacts	45
6.2.3	Management Practices	47
6.2.4	Risk Assessment	47
6.3	Noise and Vibration	49
6.3.1	Existing Environment	49
6.3.2	Potential Impacts	52
6.3.3	Management Practices	58
6.3.4	Risk Assessment	58
6.4	Land Resources	59
6.4.1	Existing Environmental Values	59
6.4.2	Potential Impacts	70



6.4.3	Management Practices.....	72
6.4.4	Risk Assessment.....	72
6.5	Terrestrial Ecology	75
6.5.1	Existing Environmental Values	75
6.5.2	Summary of MSES.....	92
6.5.3	Potential Impacts.....	95
6.5.4	Management Practices.....	98
6.5.5	Risk Assessment.....	100
6.6	Aquatic Ecology	102
6.6.1	Existing Environmental Values	102
6.6.2	Summary of MSES.....	103
6.6.3	Potential Impacts.....	104
6.6.4	Management Practices.....	104
6.6.5	Risk Assessment.....	105
6.7	Groundwater	105
6.7.1	Existing Environmental Values	106
6.7.2	Proposed Activities.....	119
6.7.3	Prediction of Impacts.....	119
6.7.4	Risk Assessment.....	127
6.7.5	Limitations.....	132
6.8	Surface Water	133
6.8.1	Existing Environmental Values	133
6.8.2	Potential Impacts.....	136
6.8.3	Management Practices.....	136
6.8.4	Risk Assessment.....	136
6.9	Waste.....	138
6.9.1	Existing Environmental Values	138
6.9.2	Potential Impacts.....	138
6.9.3	Management Practices.....	143
6.9.4	Risk Assessment.....	144
7.0	Conclusion	146
8.0	References.....	147



Tables in Text

Table 1.1	Report structure	2
Table 2.1	Summary of minor EA amendment threshold criteria (Section 223)	4
Table 2.2	Assessment of standard criteria	5
Table 3.1	Drill pad disturbance area	13
Table 3.2	Equipment requirements	19
Table 4.1	EA P-EA-100658735 Condition A15.....	24
Table 4.2	EA P-EA-100658735 Condition F7.....	25
Table 4.3	EA P-EA-100658735 Condition F9.....	25
Table 4.4	EA P-EA-100658735 Condition F22.....	26
Table 4.5	PRCP P-PRCP-100669070_V1 Section B – Figure 1	28
Table 4.6	PRCP P-PRCP-100669070_V1 Section C – (RA1) Rehabilitation area 1.....	28
Table 5.1	Likelihood level	31
Table 5.2	Consequence rating	31
Table 5.3	Risk matrix	32
Table 5.4	Descriptions of risk rating	32
Table 6.1	Environmental values not subject to potential impacts	33
Table 6.2	Receptors Surrounding the Project	34
Table 6.3	Ambient Air Quality Objectives.....	36
Table 6.4	Estimates of background levels of pollutants.....	38
Table 6.5	Air quality risk assessment.....	41
Table 6.6	Rainfall and temperature climate statistics based on data obtained from the BoM MWTP monitoring station (1972-2012).....	42
Table 6.7	National Greenhouse Accounts Emission Factors (Scope 1).....	45
Table 6.8	Summary of GHG Emissions.....	47
Table 6.9	Greenhouse gas risk assessment	48
Table 6.10	Receptors Surrounding the Project	49
Table 6.11	Baseline noise monitoring results summary	51
Table 6.12	Modelled meteorological conditions	52
Table 6.13	Modelled scenarios and equipment SWL data – A-weighted.....	53
Table 6.14	Predicted worst-case new access track and drill pad construction noise levels.....	54
Table 6.15	Predicted worst-case CSG exploration drilling noise levels	56
Table 6.16	Predicted worst-case CSG well operational noise levels	57



Table 6.17	Noise and vibration risk assessment	58
Table 6.18	Surface geology lithological summary	59
Table 6.19	Soil order chemical properties summary	64
Table 6.20	Queensland suitability classes	67
Table 6.21	Land resources risk assessment	73
Table 6.22	Ground-truthed REs within the Project Area.....	75
Table 6.23	MSES regulated vegetation within the Project Area	94
Table 6.24	MSES protected wildlife habitat within the Project Area	95
Table 6.25	Direct impacts to remnant and mature regrowth REs within the Project Area ..	96
Table 6.26	Direct impacts to threatened flora and fauna habitat within the Project Area ...	96
Table 6.27	Groundwater Section 126A	105
Table 6.28	Hydraulic conductivity estimates from field testing	110
Table 6.29	Pumping stress periods used in model.....	122
Table 6.30	Model aquifer layering and hydraulic parameters	123
Table 6.31	Sensitivity analysis of interburden vertical conductivity.....	127
Table 6.32	Likelihood Categories.....	128
Table 6.33	Consequence Categories.....	128
Table 6.34	Risk Ranking Matrix	129
Table 6.35	Risk assessment summary	130
Table 6.36	Suttor River at Eaglefield: flow volume summary (ML)	134
Table 6.37	Surface water risk assessment	137
Table 6.38	Waste types anticipated from Project activities.....	139
Table 6.39	Waste risk assessment	144

Figures in Text

Figure 3.1	Project location	12
Figure 3.2	Proposed project layout	16
Figure 3.3	Proposed final site design	22
Figure 6.1	Location of sensitive air receptors.....	35
Figure 6.2	Location of DESI Moranbah Monitoring Stations.....	37
Figure 6.3	Location of assessed receptors.....	50
Figure 6.4	Surface geology	61
Figure 6.5	Atlas of Australian Soils	62
Figure 6.6	ASC of Project Areas (SKM, 2012)	65
Figure 6.7	ASC of Project Areas (DNRME and DES 2024)	66



Figure 6.8	Grazing land class suitability	68
Figure 6.9	Cropping land class suitability	69
Figure 6.10	Ground-truthed regional ecosystems	77
Figure 6.11	Threatened ecological communities	78
Figure 6.12	Dichanthium Queenslandicum records and habitat	80
Figure 6.13	<i>Digitaria porrecta</i> records and habitat	81
Figure 6.14	Koala records and habitat	85
Figure 6.15	Short-beaked echidna records and habitat.....	86
Figure 6.16	Squatter pigeon (southern) records and habitat	87
Figure 6.17	White-throated needletail habitat.....	88
Figure 6.18	Fork-tailed swift habitat	90
Figure 6.19	Oriental cuckoo habitat	91
Figure 6.21	Vertical well depth.....	107
Figure 6.22	Surface geology and monitoring network	111
Figure 6.23	Permian coal measures groundwater contours	114
Figure 6.24	Groundwater dependent ecosystem mapping and private bores.....	117
Figure 6.25	Predicted drawdown in coal seam.....	126
Figure 6.26	Regional drainage.....	135

Appendices

Appendix A Terrestrial Ecology and Aquatic Ecology Methodology to Identify Environmental Impacts

Appendix B MSES significant residual impact assessments



Acronyms and Abbreviations

ALD	Assessment level decision
AUSRIVAS	Australian River Assessment System
BAR	Bioacoustic records
CCM	Centurion Coal Mine
CEC	Cation exchange capacity
CH ₄	Methane
CONCAWE	The Conservation of Clean Air and Water Europe
CSG	Coal seam gas
dBa	Decibels A
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEHP	Department of the Environment and Heritage Protection
DES	Department of Environment and Science
DESI	Department of Environment, Science and Innovation
DEWHA	Department of the Environment, Water, Heritage and the Arts
DNRM	Department of Natural Resource Management
DNRME	Department of Natural Resources, Mines and Energy
DoR	Department of Resources
DotE	Department of the Environment
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
DSITI	Department of Science, Information Technology and Innovation
EA	Environmental authority
EIS	Environmental Impact Statement
EO Act	<i>Environmental Offsets Act 2014</i>
EO Regulation	Environmental Offsets Regulation 2014
EP Act	<i>Environmental Protection Act 1994</i>
EP Regulation	Environment Protection Regulation 2019
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EPP	Environmental Protection Policy
ERA	Environmentally Relevant Activities
ERC	Estimated Rehabilitation Cost
E2M	E2M Consulting Pty Ltd
GDE	Groundwater-dependent ecosystem
GHG	Greenhouse gas
GHG Act	<i>Greenhouse Gas Storage Act 2009</i>
GM	Goonyella Middle
ha	Hectares
HDPE	High density poly ethylene
Hydrobiology	Hydrobiology Pty Ltd
Hz	Hertz
ID	Identification
IESC	Independent Expert Scientific Committee
ISO	International Organisation for Standardisation
kL	kilolitre



km	kilometers
kpa	kilopascals
kV	kilovolt
L	litre
LIKT	Locally important koala tree
m	meters
mm	millimeters
mbGL	meters below ground level
MMC	Model Mining Conditions Guideline
MDL	Mineral development lease
ML	Mega litres
ML	Mining lease
MNES	Matters of national environmental significance
MR Act	<i>Mineral Resources Act 1989</i>
MSES	Matters of state environmental significance
NA	Not applicable
NC Act	<i>Nature Conservation Act 1992</i>
NEPM	National Environment Protection Measures
PET	Plecoptera, Ephemeroptera, and Trichoptera macroinvertebrates
PM	Particulate matter
PNC	EcoAccess Planning for Noise Control guideline
PPV	Peak particle velocity
PRCP	Progressive Rehabilitation and Closure Plan
RBL	Rating background levels
RE	Regional Ecosystem
RIDA	Regional Interests Development Approval
RPI Act	<i>Regional Planning Interests Act 2014</i>
SCADA	Supervisory Control and Data Acquisition
SEVT	Semi-evergreen vine thicket
SIGNAL	Stream Invertebrate Grade Number - Average Level
SIS	Surface-to-inseam
SLR	SLR Consulting Australia
SO	Stream order
SRI	Significant Residual Impact
SWL	Sound power level
SWL	Standing water level
t	tonnes
TEC	Threatened ecological communities
TEP	Transitional Environment Programs
TSP	Total suspended particulates
TSSC	Threatened Species Scientific Committee
VM Act	<i>Vegetation Management Act 1999</i>
W	Watts



1.0 Introduction

This section presents the background, objectives, and structure of this supporting report.

1.1 Objective of this Environmental Authority Amendment

Centurion Coal Mine Pty Ltd (a subsidiary of Peabody Energy Australia PCI PTY LTD) is seeking authorisation to undertake exploration activities which consist of a pilot coal seam gas (CSG) exploration and extraction programme on Mining Lease (ML) 1790.

To obtain authorisation for these activities, an amendment to the Environmental Authority (EA) P-EA-100658735 and Progressive Rehabilitation and Closure Plan (PRCP) P - PRCP - 100669070_V1 is required.

This report has been prepared to support an amendment to P-EA-100658735 and P- PRCP - 100669070_V1 under Section 226A of the *Environmental Protection Act 1994* (EP Act).

1.2 Project Background

Centurion Coal Mine Pty Ltd has recently secured the rights to further explore resources under a portion of ML 1790 and ML 70495 located immediately adjacent to and directly north of the Centurion Coal Mine (CCM), an existing underground longwall mine located on ML 6949.

As a result, Centurion Coal Mine Pty Ltd proposes to undertake the Project exploration activities on ML 1790. The activities and infrastructure associated with the pilot CSG exploration and extraction programme are the subject of this EA and PRCP Amendment and are henceforth referred to as 'the Project'.

1.3 Project Objectives

The objectives of the Project are:

- **Resource identification and characterisation:** Determine the presence, quantity, and quality of CSG within the Goonyella Middle (GM) coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity). As the exploration wells are brought online, the water and gas production are monitored and measured to determine the drawdown characteristics of the water and CSG within the GM coal seam.
- **Feasibility assessment:** There had been no historical testing on ML1790 to measure CSG drainage performance. This Project is required to understand more about the characteristics of the GM coal seam and the contained gas. This is required to develop management plans for the safe, environmentally conscience and economic extraction of CSG and coal from the ML1790. The drilling and sampling of the resource, and data gathering from the exploration works enables resource and groundwater models to be built and verified. From this the technical and economic analysis can be based on more reliable information to assess the feasibility of extracting the resource.
- **Impact and risk assessment:** Monitor and evaluate potential impacts associated with CSG exploration and extraction on environmental values (EVs); and refine mitigation measures to ensure the safety and success of the Project.



- **Regulatory compliance:** Ensure that exploration activities comply with, or exceed, local, state, and commonwealth regulations.

1.4 Report Structure

This Report is structured as shown in **Table 1.1**.

Table 1.1 Report structure

Chapter	Content
Chapter 1: Introduction (this chapter)	Objectives of the EA Amendment Application Supporting Report, project background, project objectives, and report structure.
Chapter 2: Legislation Context	Key legislation, policies and guidelines to this project.
Chapter 3: Activities Subject to this EA Amendment	Design information on each phase of the Project to inform the impact assessment process. Includes the project justification and alternatives assessment.
Chapter 4: Proposed EA Amendments	Conditions of EA P-EA-100658735 and PRCP P-PRCP-100669070_V1 that require amendment.
Chapter 5: Assessment Methodology	A description of the environmental assessment process and approach taken to determining the significance of impacts and appropriate mitigation.
Chapters 6: Environmental Assessment	An assessment of the Project's environmental impacts on air quality, greenhouse gases (GHG), noise and vibration, land resources, terrestrial ecology, aquatic ecology, surface water and groundwater resources, and waste management. Includes a description of relevant legislation, policies and guidelines adopted for this assessment, a description of baseline characteristics, identified mitigation measures to reduce or avoid significant impacts, and a summary of the residual (post-mitigation) effects.
Chapter 7: Conclusion	A summary of the EA Amendment Application Supporting Report findings.
Chapter 8: Reference	-



2.0 Legislative Context

This section summarises the key State and Commonwealth legislation, policies, and guidelines applicable to the Project.

2.1 Mineral Resources Act 1989

The Mineral Resources Act 1989 (MR Act) is administered by the Department of Resources (DoR) and provides for “the assessment, development and utilisation of mineral resources to the maximum extent practicable consistent with sound economic and land use management”.

The principal objectives of the MR Act are to:

- Encourage and facilitate prospecting and exploring for and mining of minerals.
- Enhance knowledge of the mineral resources of the State.
- Minimise land use conflict with respect to prospecting, exploring and mining.
- Encourage environmental responsibility in prospecting, exploring and mining.
- Ensure an appropriate financial return to the State from mining.
- Provide an administrative framework to expedite and regulate prospecting and exploring for and mining of minerals.
- Encourage responsible land care management in prospecting, exploring and mining.

The MR Act provides for the granting, conditioning and management of mining tenements, prospecting permits, exploration permits, mineral development licences, mining leases and mining claims.

A ML (with surface rights) under the MR Act is required to permit the conduct of mining and associated activities within the ML. The Project footprint is located within ML 1790, which authorise surface rights to access minerals and gaseous hydrocarbons in the Project Area.

2.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994 (EP Act)* was established “to protect Queensland’s environment, while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends”.

Resource activities carried out on mining tenure are approved via the grant of an EA under Chapter 5 of the EP Act. When deciding whether to grant or refuse an application for an EA or an amendment to an EA or deciding on the conditions of the EA, the Department of Environment, Science and Innovation (DESI), the administering authority, must consider certain matters set out in the EP Act.

The EP Act utilises several mechanisms to achieve its objectives. These include:

- EA assessment processes, including where applicable, an Environmental Impact Statement (EIS) process for resource projects.
- Licensing or approving all Environmentally Relevant Activities (ERAs).
- Major and minor EA Amendment provisions to EAs.
- Allowing for improvement through Transitional Environment Programs (TEPs).
- Issuing Environmental Protection Policies (EPPs).



- Regulating contaminated land.
- Creating a general environmental duty.

An EA Amendment is required where there is a proposed change to the nature and extent of authorised activities on an associated ML(s) and/or the conditions of the EA need to be amended. For the Project to proceed, an amendment to the existing EA Conditions is required.

2.2.1 Amendment Threshold

A minor amendment for an EA under Section 223 of the EP Act “means an amendment that is for an environmental authority a condition conversion; or a minor amendment (threshold)”. An assessment of the proposed EA Amendment for the Project against the minor amendment (threshold) criteria (as outlined in Section 223 of the EP Act) is presented in **Table 2.1**.

Table 2.1 Summary of minor EA amendment threshold criteria (Section 223)

Minor EA Amendment Threshold Criteria	This EA Amendment Application
The proposed amendment:	
a) is not a change to a condition identified in the authority as a standard condition, other than – i. a change that is a condition conversion. ii. a change that is not a condition conversion but that replaces a standard condition of the authority with a standard condition for the environmentally relevant activity to which the authority relates. iii. a change that will not result in a change to the impact of the relevant activity on an EV.	The Project is not a change to a standard condition.
b) does not significantly increase the level of environmental harm caused by the relevant activity	The Project does not significantly increase the level of environmental harm, as demonstrated under Section 6.0 .
c) does not change any rehabilitation objectives stated in the authority in a way likely to result in significantly different impacts on EVs than the impacts previously permitted under the authority	The Project does not result in any changes to the current rehabilitation objectives that would result in a significant impact on EV, as demonstrated under Section 6.0 .
d) does not significantly increase the scale or intensity of the relevant activity	The Project does not significantly increase the intensity of the relevant activities, as demonstrated under Section 6.0 .
e) does not relate to a new relevant resource tenure for the authority that is— i. a new mining lease ii. a new petroleum lease iii. new geothermal lease under the Geothermal Energy Act iv. a new GHG injection and storage lease under the GHG storage Act	The Project does not relate to a new resource tenure for the EA.



Minor EA Amendment Threshold Criteria	This EA Amendment Application
f) involves an addition to the surface area for the relevant activity of no more than 10% of the existing area	The Project will not change the existing surface area for the relevant activities by more than 10%, as demonstrated under Section 3.0 and Section 6.0 .
g) for an environmental authority for a petroleum activity— i. involves constructing a new pipeline that does not exceed 150km ii. involves extending an existing pipeline so that the extension does not exceed 10% of the existing length of the pipeline	Not Applicable.
h) if the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—seeks, in the amendment application under section 224, an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit.	The Project will adhere to the standard conditions for the relevant authority.

This assessment demonstrates that the proposed EA Amendment is not a major amendment, and it therefore should be considered a minor EA amendment for the purposes of the EP Act.

2.2.1.1 Assessment Level Decision

Within 10 business days after receiving an EA Amendment Application, DESI must make an Assessment Level Decision (ALD). The ALD process will determine whether the amendment application is a minor or major amendment (with or without an EIS).

2.2.1.2 Public Interest and Notification

Centurion Coal Mine Pty Ltd considers that the Project does not represent a significant impact to EVs to that currently approved under the EA P-EA-100658735. It is therefore reasonably considered unlikely that the Project (and accompanying EA amendment) will trigger minimal, if any, public interest.

2.2.2 Standard Criteria

The Standard Criteria, as defined in Schedule 4 of the EP Act, has been considered to assist in assessing the significance of the proposed amendment and to assist the DESI in the assessment of the proposed application as a minor amendment in accordance with Section 241 of the EP Act. Centurion Coal Mine Pty Ltd assessment against the Standard Criteria is outlined in Table 2.2.

Table 2.2 Assessment of standard criteria

EP Act Reference	Legislation Requirement	How Requirement is Addressed
Standard criteria (a)	The following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment—	(i) Peabody has evaluated the risk of potential environmental impact in line with the precautionary principle. These evaluations have formed the development of suitable environmental



EP Act Reference	Legislation Requirement	How Requirement is Addressed
	(i) the precautionary principle; (ii) intergenerational equity; (iii) conservation of biological diversity and ecological integrity	avoidance and mitigation measures, detailed in each Environmental Assessment provided in Section 6.0 for the technical disciplines. Peabody possesses the necessary technical expertise, financial backing, and resources to implement and sustain the suggested environmental mitigation measures for the Project. (ii) The Project will balance economic benefit with minimal environmental disturbance, beneficial infrastructure construction, and post-mining land use planning. It emphasises maintaining environmental value, reducing impact, and using existing infrastructure where possible. Intergenerational equity is addressed through long-term land use planning, community impact consideration, and environmental monitoring and mitigation measures. (iii) The Project will retain remnant vegetation, use existing infrastructure to limit clearing, and plan progressive rehabilitation. Mitigation measures include preserving riparian zones, minimising clearing, managing weeds, and rehabilitating with native species.
Standard criteria (b)	Any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development.	It is expected that the Project will be consistent with the Isaac Regional Planning Scheme Version 1.1, July 2024. Relevant standards include those set out under the <i>National Environment Protection Council (Queensland) Act 1994</i>. National Environment Protection Measures (NEPMs) outline national objectives for protecting and managing aspects of the environment. These NEPMs have been considered during the environmental assessment stage for the Project. The following EPPs are relevant to the Project and discussed in Section 2.2.4, 2.2.5, and 2.2.6.
Standard criteria (d)	Any relevant environmental impact study, assessment or report.	Peabody has conducted environmental assessments commensurate with a minor EA Amendment Application under the EP Act. These assessments have prioritised key factors such as air quality, GHG, noise and vibration, surface water and groundwater resources, terrestrial and aquatic ecology, GDEs, and waste management i.e., critical matters. They comprehensively address current environmental values, potential



EP Act Reference	Legislation Requirement	How Requirement is Addressed
		impacts, and strategies for avoiding, managing, mitigating, and rehabilitating these impacts.
Standard criteria (e)	The character, resilience and values of the receiving environment.	The ML 1790 and ML 70495 are situated amongst a coal mining region in the Bowen Basin where resource extraction, agriculture and livestock grazing are the predominant, co-existent land uses. The Project is located on an area that has been subject to previous drilling and exploration activities. As a result, the landscape has been highly modified. An assessment of environmental characteristics was conducted (Section 6.0) as part of this amendment application.
Standard criteria (f)	All submissions made by the applicant and submitters.	The Project and associated environmental studies will constitute Peabody's submission in support of the EA Amendment Application. Peabody will undertake an appropriate level of formal and non-formal key stakeholder consultation during the EA Amendment process in line with Peabody's existing stakeholder engagement principles and process. Peabody will respond to complaints and concerns from the public during the Project should they arise.
Standard criteria (g)	The best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows— (i) an environmental authority (ii) a transitional environmental program (iii) an environmental protection order (iv) a disposal permit (v) a development approval	P-EA-100658735 sets out suitable environmental management practice for the proposed activities and is not the subject of: (ii) a transitional environmental program (iii) an environmental protection order (iv) a disposal permit, or (v) a development approval.
Standard criteria (h)	The financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument	Approval of this EA Amendment will require an amendment to the current estimated rehabilitation cost (ERC) decision. This will be addressed following approval of the amendment application.
Standard criteria (i)	The public interest	Issues of community interest and concern will be addressed during the EA Amendment process. Peabody will continue to engage with the relevant key stakeholders in relation to the Project as an extension of its existing stakeholder engagement program. In addition, the Project does not represent a significant impact to EVs that is currently approved under the EA P-EA-100658735. It



EP Act Reference	Legislation Requirement	How Requirement is Addressed
		is therefore reasonably considered unlikely that the Project (and accompanying EA amendment) would trigger minimal, if any, public interest.
Standard criteria (j)	Any relevant site management plan	The existing CCM environmental management plans will be updated accordingly, stating the management strategies to prevent or minimise the potential for environmental harm from the Project. They will also set out a framework to manage environmental obligations set out in the EA.
Standard criteria (k)	Any relevant integrated environmental management system or proposed integrated environmental management system	The Project will operate in accordance with the existing CCM Environmental Management Framework and other related documentation.

2.2.3 Environmentally Relevant Activities

ERAs described under the *Environment Protection Regulation 2019* (Qld) (EP Regulation) and authorised to take place on ML 1790 and ML 70495 will continue to be undertaken under EA (P-EA-100658735).

The Project will not require the authorisation of any additional ERAs.

2.2.4 Environmental Protection (Air) Policy 2019

The purpose of the *Environmental Protection (Air) Policy 2019* (EPP(Air)) is to achieve the relevant objectives of the EP Act by:

- Identifying EVs to be enhanced or protected.
- Stating indicators and air quality objectives for enhancing or protecting the EVs.
- Providing a framework for making consistent, equitable and informed decisions about the air environment.

This EA Amendment outlines an air quality assessment in **Section 1.1**, inclusive of a summary of management and mitigation measures and risk assessment of impacts to the air shed and sensitive receptors.

2.2.5 Environmental Protection (Noise) Policy 2019

The purpose of the *Environmental Protection (Noise) Policy 2019* (EPP(Noise)) is to achieve the relevant objectives of the EP Act by:

- Identifying EVs to be enhanced or protected.
- Stating acoustic quality objectives for enhancing or protecting the EVs.
- Providing a framework for making consistent, equitable and informed decisions about the acoustic environment.

This EA Amendment outlines the noise and vibration assessment in **Section 0**, inclusive of a summary of management and mitigation measures and risk assessment of potential impacts to sensitive receptors.



2.2.6 Environmental Protection (Water and Wetland Biodiversity) Act 2019

The purpose of the *Environmental Protection (Water and Wetland Biodiversity) Act 2019* (EPP(WWB)) is to achieve the relevant objectives of the EP Act by:

- Identifying EVs for waters and wetlands.
- Identifying management goals for waters.
- Stating water quality guidelines and water quality objectives to enhance or protect the environment.
- Providing a framework for making consistent, equitable and informed decisions about waters.
- Monitoring and reporting on the condition of water.

This EA Amendment outlines the surface and groundwater assessment in **Section 6.7** and **Section 1.1**, inclusive of a summary of management practices and risk assessment of impacts to the relevant EVs.

2.3 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas. The EPBC Act identifies nine Matters of National Environmental Significance (MNES) categories:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).
- A water resource, in relation to coal seam gas development and large coal mining development.

An assessment and approval under the EPBC Act is required for any activity that has, or is likely to have, a significant impact on an MNES. Such an activity is deemed to be a 'controlled action'. It is an offence to undertake a 'controlled action' without the approval of the Commonwealth Environment Minister.

The Project is not anticipated to require approval under EPBC Act; refer to **Section 6.5** and **Appendix B** for further details. However, Centurion Coal Mine Pty Ltd is currently preparing a self-assessment to determine whether there are potential impacts to MNES. Should the self-assessment determine there is a significant impact on MNES, Centurion Coal Mine Pty Ltd will submit a referral to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) accordingly.



2.4 Water Act 2000

The *Water Act 2000* (Water Act) provides for the management of waters and watercourses and the construction, control and management of works that affect watercourses. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

Centurion Coal Mine Pty Ltd exercises underground water rights on ML 1790 and ML 70495 in accordance with the requirements of the Water Act.

Section 227AA of the EP Act describes the circumstances in which additional information on the exercise of underground water rights must be provided for an EA amendment application. Additional information must be provided where:

- The application relates to a site-specific EA for a resource project or activity that includes a resource tenure that is a mineral development licence, mining lease or petroleum lease.
- The proposed amendment involves changes to the exercise of underground water rights.

Section 227AA requires that an applicant must provide the information required by section 126A of the EP Act. Section 1.1.4 of the DESI Guideline ESR/2016/3275 '*Requirements for site-specific and amendment applications – underground water rights*' provides guidance on when information on the exercise of underground water rights is required. Amendment applications only need to include information relating to the changes to the proposed exercise of underground water rights which will occur, or are predicted to occur as a result of the proposed amendment to the EA.

The activities proposed as part of this EA amendment are partially located within the Highland Groundwater Underground Water Area. The Water Regulation 2016 outlines that the Highland Groundwater Underground Water Area does not require water entitlement, water permit or seasonal water assignment notice for stock or domestic purposes or a prescribed activity.

2.5 Regional Planning Interests Act 2014

The *Regional Planning Interests Act 2014* (RPI Act) regulates impacts from resource and other regulated activities on identified areas of regional interest. The RPI Act restricts the carrying out of resource activities in 'areas of regional interest' where the activity is not exempt from the provisions of the RPI Act, or a regional interests development approval (RIDA) has not been granted. The 'areas of regional interest' managed under the RPI Act are Priority Living Areas, Priority Agricultural Areas, Strategic Environmental Areas and Strategic Cropping Areas.

Under the RPI Act, approximately 153 ha of Strategic Cropping Land has been mapped within the Project Area. A compliance certificate (No. SCLRD2013/000151) has been issued for ML1790, ML4752, MLA70443, MLA70495 on 6 November 2013.



3.0 Activities Subject of this EA Amendment

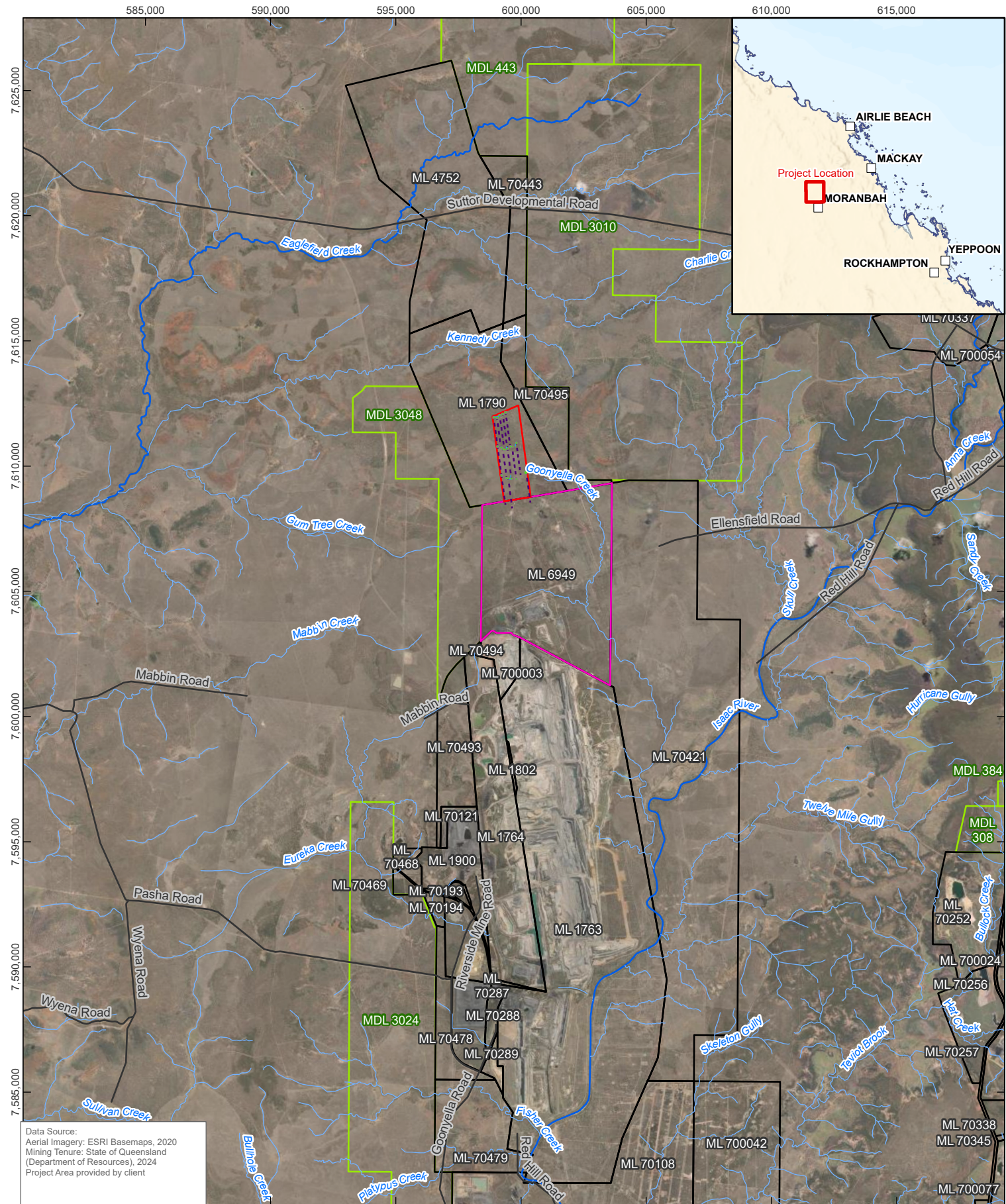
This section provides a description of the activities subject of this EA Amendment. **Section 4.0** provides details on the necessary amendments to the EA.

3.1 Location of the Project

The Project is located approximately 40 km north of Moranbah and is accessed from Moranbah via the Goonyella Road, the Red Hill Road and the North Goonyella Mine Access Road. Mackay is located approximately 140 km (and approximately 188 km by road), to the east and is accessed via the Peak Downs Highway, the Suttor Developmental Road, the Red Hill Road and the North Goonyella Mine Access Road.

The Project is located immediately adjacent to, and north of, the CCM (**Figure 3.1**).





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.040594.00001
Date Drawn: 11-Sep-2024
Drawn by: RB

LEGEND

- Road
- Lateral Well Length
- Project Area
- Drill Pad
- Centurion Coal Mine
- Access Track
- Mining Lease
- Mineral Development Licence

EA AMENDMENT P-EA-100658735

PROJECT LOCATION



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FIGURE 3.1

3.2 Access Tracks

A network of access tracks for light and heavy vehicles is present across ML 1790 and connects to the existing road network (i.e. North Goonyella Mine Access Road) (**Figure 3.1**) due to existing and historical activities within ML 1790. The existing access tracks will be used as much as possible to connect the proposed drill pads and minimise requirements for additional surface disturbance.

Where new access tracks are required due to the location of the drill pads, these will be constructed to allow for light and heavy vehicles. The new access tracks will be 5 m wide and will extend a cumulative 0.31 km, typically in an East-West direction (**Figure 3.2**).

The access tracks will be constructed as follows:

- Survey and demarcation of access track alignment and clearing boundaries.
- Removal of vegetation.
- Removal and stockpile of topsoil and unsuitable sub-soils.
- Preparation of access track base with sub-base material.
- Installation of traffic control infrastructure such as signage.

A 30 kL water cart will operate for dust suppression across working and trafficable areas. The access tracks will be maintained to ensure the safety of site personnel and to facilitate the effective transportation of equipment and personnel.

3.3 Coal Seam Gas Exploration

The program for exploration and evaluation of CSG has been designed as a network of gas extraction wells, extending from the ground surface down to the GM coal seam with lateral in-seam drainage to maximise the coverage of data acquisition from the exploration program. These wells will be supported by surface infrastructure for CSG processing, monitoring, and control.

Vertical wells are drilled from the surface directly downwards. The lateral wells are drilled near vertically from the surface and are then deviated through a tight radius bend to intercept the target coal seam parallel to the bedding planes (**Image 3.1**). The lateral wells are then directionally drilled through the GM coal seam to intercept its corresponding vertical well. The vertical wells are used for collecting and conveying the CSG and associated water to the surface from within the lateral well that passes through the GM coal seam.

3.3.1 Drill Pad

Each CSG well will be constructed and operated from within the boundaries of a drill pad. A total of nineteen (19) drill pads are proposed for the vertical and lateral wells. **Table 3.1** presents details of the drill pad disturbance area and **Figure 3.2** illustrates their locations.

Table 3.1 Drill pad disturbance area

Drill pads	No	Dimensions (m)	Disturbance area (ha)
Drill pad	19	80 X 80 m	12.65
Less existing approved disturbance			(0.85)
Total new disturbance			11.80



Drill pad construction methodology will be as follows:

- Permit to Disturb is required prior to any vegetation or groundcover removal.
- Survey and demarcation of access track alignment and clearing boundaries.
- Removal of vegetation.
- Removal and stockpile of topsoil and unsuitable sub-soils.
- Construction and installation of water management infrastructure, such as sumps, bunds and water tanks.
- Delivery and spread of gravel to ensure drill pad allows for all-weather access.

Figure 3.2 illustrates the proposed layout of vertical and lateral wells across the drill pads. Some drill pads will be dual propose and accommodate both vertical and lateral wells within them.

3.3.2 Vertical Wells

A total of thirteen (13) vertical wells will be drilled (**Figure 3.2**). Following development of the drill pads, construction methodology for the vertical wells is as follows:

- The initial step involves drilling a pilot hole (known as spudding). A larger diameter hole (12 ¾" diameter) is then drilled to a shallow depth (24 m) and a steel casing is installed to prevent the well from collapsing. The hole is then drilled to the target GM coal seam depth (290 - 570 m). Drilling fluid (mud) is used to lubricate the bit, control pressure, and carry cuttings to the surface. The cuttings will then be collected at the surface, where they will be disposed of in line with the CCM waste management procedure.
- Casing (such as steel, fibre glass or high-density polyethylene (HDPE)) is run into the hole to the total depth and cemented in place to prevent groundwater and gas from moving outside of the well and between geological layers. Perforations are made in the casing at the coal seam level to allow gas to flow into the well.
- The well is completed with necessary equipment for gas extraction. Initial production tests are conducted to evaluate the well's performance.
- During the extraction evaluation operation, the CSG from the vertical well will be connected via a low-pressure pipeline to a candle stick flare kit located within the disturbance footprint of the drill pad. The flare will enable combustion of all extracted methane gas to minimise the emission intensity of the evaluation operation.

3.3.3 Lateral Wells

Ten (10) lateral wells will be drilled into the GM coal seam (**Figure 3.2**). Following development of the drill pads, construction methodology for the lateral wells follows the same methodology as for vertical wells:

- A vertical section is drilled to a depth above the target GM coal seam (290 - 570m). Then, using directional drilling techniques, the wellbore is gradually deviated from the vertical to horizontal, forming a curve. This requires specialized downhole motors and tools. Once the curve is horizontal, it is drilled along the coal seam (1000-1900 m) for a specified distance to connect with the vertical well. The horizontal well maximizes exposure to the coal seam, enhancing gas recovery and the spatial extent of data acquisition.



- Casing (such as steel, fibre glass or HDPE) (7 7/8" diameter) is run into the well and cemented to isolate the gas-producing zones. Perforations are made in the casing at the coal seam level to allow gas to flow into the well.
- The horizontal well is completed with equipment designed for gas production, including perforating the casing along the horizontal section.

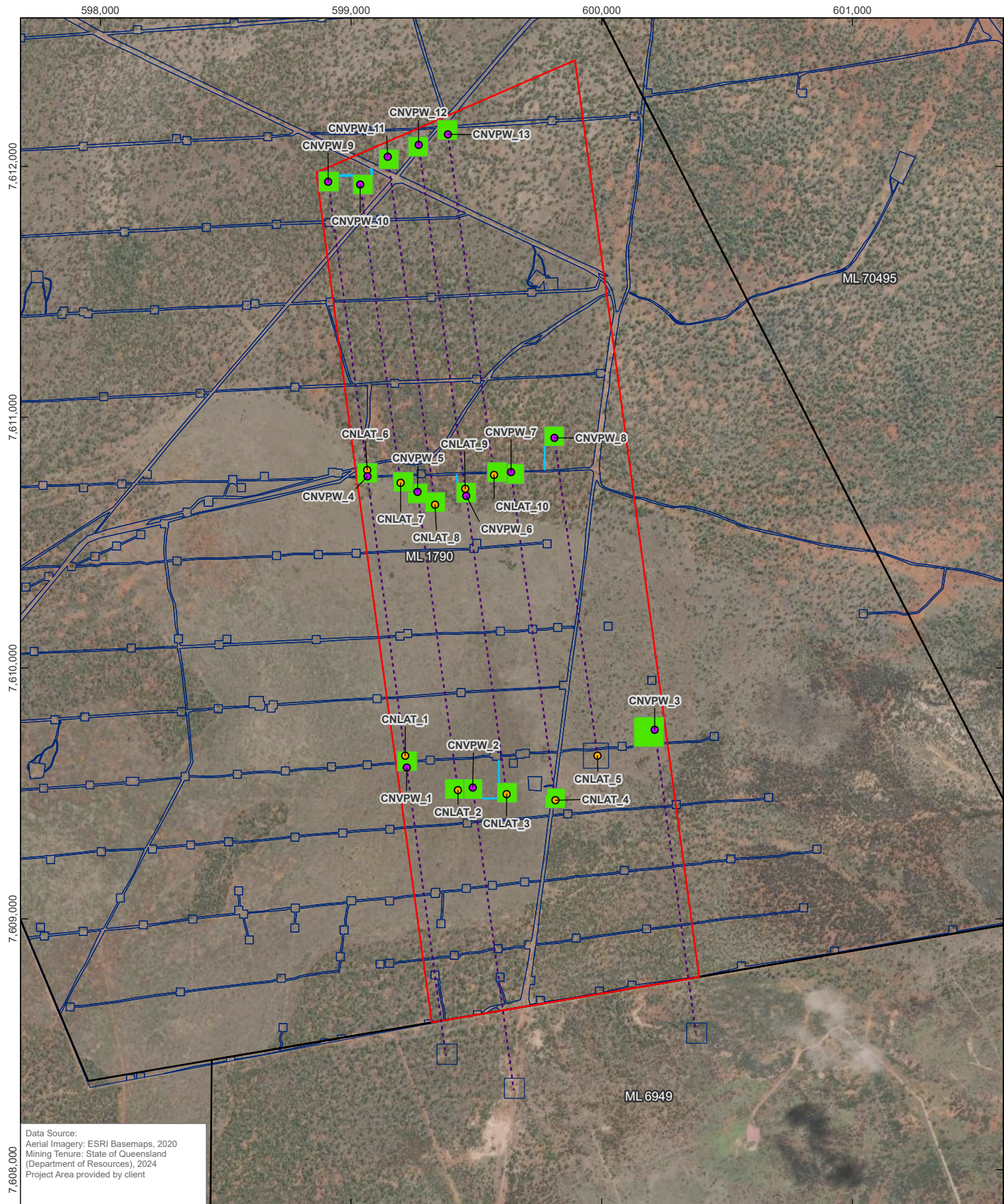
3.3.4 Exploration Method

Following drilling of the vertical and lateral wells and installation of the necessary extraction and monitoring equipment, CSG will be extracted as follows:

- Water in the GM coal seam (formation water) will be removed, reducing the pressure in the coal seam (~40 kpa/day). Pumps located at the base of the vertical wells, are operated to bring water to the surface.
- It is anticipated that depressurising of the coal seam will take up to 90 days. The water will pass through the well head to storage tanks and be carted off and added to the CCM mine water management system.
- The reduction in pressure within the coal seam allows CSG to be desorbed from the coal. The CSG will migrate through the coal's natural fractures (cleats) through the perforations made in the casing and into the well.
- The desorbed CSG will flow up the well to the surface, where it will be separated from any remaining water. The CSG will pass through a steel pipe before being flared. It is anticipated that the CSG will comprise >99% methane (CH₄) and will be flared 24 hours per day. Data logging will take place to record the amount of CSG produced from the wells. It is anticipated that CSG will be produced at a rate of 500 l/sec.
- Water and gas monitoring data collected during the evaluation will enable the development of decline curves which will better inform the gas-in-place, geological and hydrogeological models for the resource.

Image 3.1 and **Image 3.2** present examples of CSG well schematics.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:20,000 at A4

Project Number: 620.040594.00001

Date Drawn: 09-Sep-2024

Drawn by: RB

LEGEND

- Project Area
- Mining Lease
- Existing Approved Disturbance

- Lateral Well
- Vertical Well
- Lateral Well Length
- Drill Pad
- Access Track

EA AMENDMENT P-EA-100658735

PROPOSED PROJECT LAYOUT



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3.2

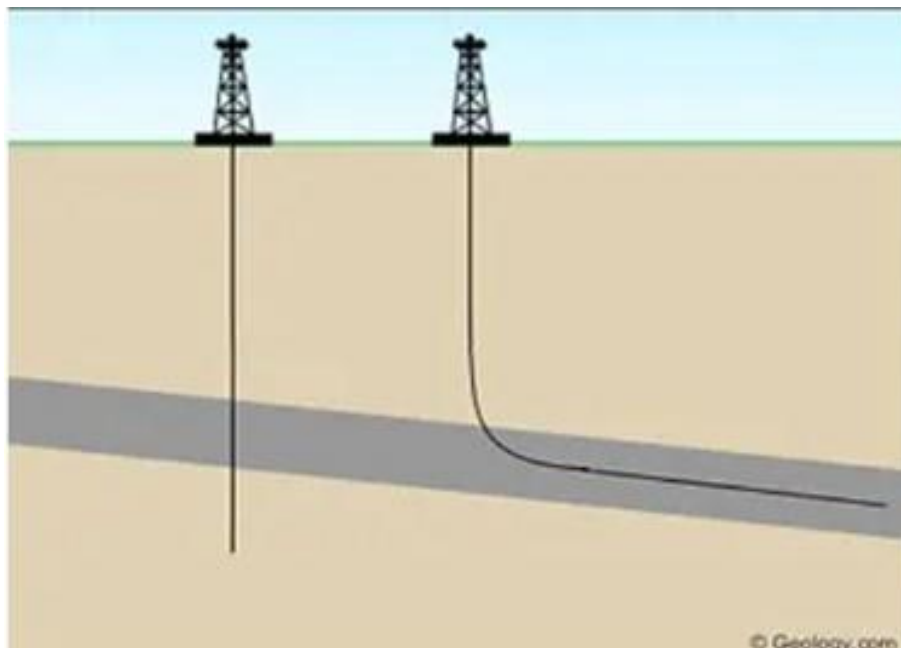


Image 3.1 Schematic of vertical and lateral wells



Image 3.2 Example of drill pad arrangement



3.4 Water

Construction water requirements will be supplied via water truck to the drill pad and well locations. Approximately 5,000 kL of water sourced from the CCM raw water dam is anticipated to be required for construction of the 19 drill pads and drilling of the 23 wells.

Water collected from the wells during operations will be pumped to holding tanks located on the relevant drill pads. Each holding tank is designed to hold a capacity of 20 kL of water / sufficient for one day of pumping during initial depressurising of the target coal seam. It is expected that water collected from the wells following depressurisation will reduce. From the holding tank, the water will be collected by a water truck and taken to CCM where it will be treated and integrated into the CCM mine water management system.

3.5 Power

The Project electricity requirements are for the drill pumps and well pumps. It is proposed that on-site generators are used to provide electricity for vertical drill pads. One 60 kV diesel generator is required per vertical drill pad, a total of thirteen (13) generators are required.

High-voltage connection to the electricity network will not be required.

3.6 Amenities

Typical drill pad site layouts are shown in **Image 3.3** and **Image 3.4**. The drill pad sites will include a mobile office and workshop which will be relocated as drilling progresses.

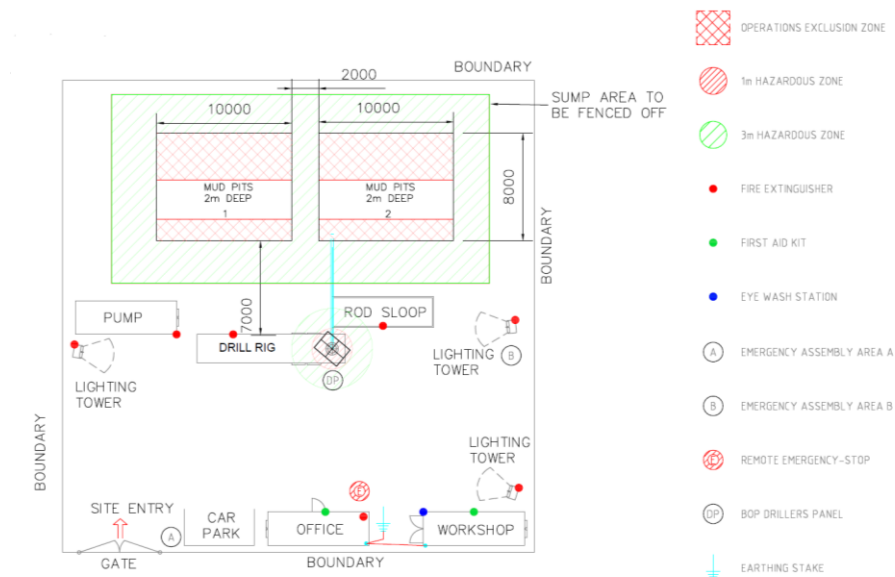


Image 3.3 Example of vertical well drill pad layout and amenities



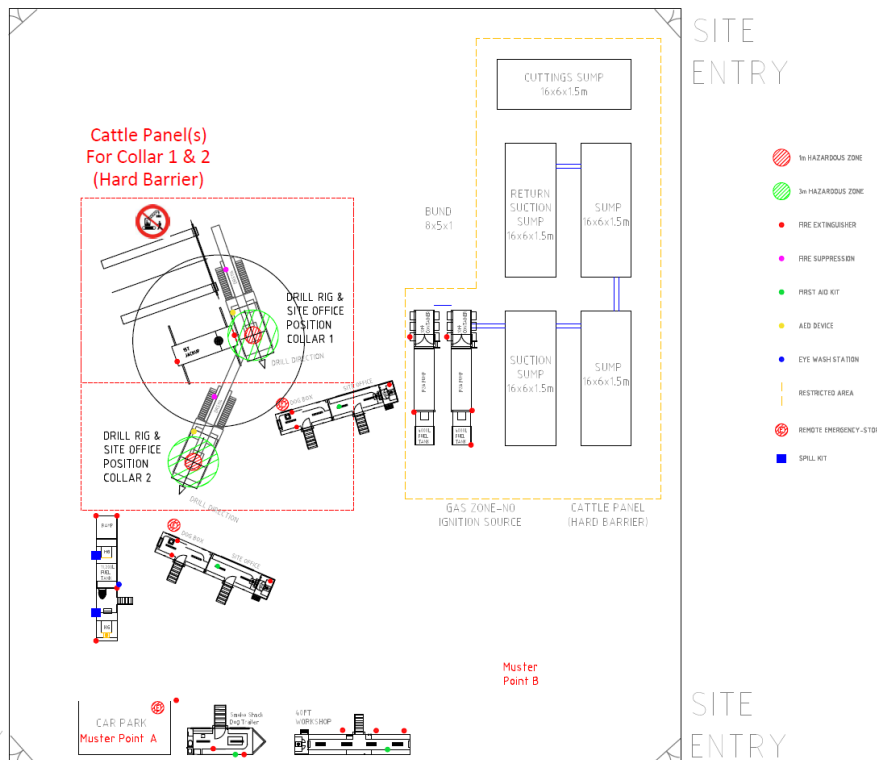


Image 3.4 example of lateral well drill pad layout and amenities

3.7 Equipment

Table 3.2 outlines the earth moving and drilling equipment (currently being utilised at the CCM) that will be used in the construction, maintenance and operation of the access tracks, drill pads and wells.

Table 3.2 Equipment requirements

Equipment Description
Earth moving
Dozer such as the Caterpillar D8T for primary excavation surface of drill pads and access tracks
Grader, such as Caterpillar Grader 150
Truck, such as Caterpillar 745 Articulated Truck
Vibratory soil compactor, such as Caterpillar Roller 256B
Vegetation slasher
Water
30kL water truck to provide construction water requirements and collect extracted well water
Power
60kV diesel generator to provide power to well and pump infrastructure
Drill rigs
1 SIS drill rig and 1 vertical drill rig



Equipment Description
Wellhead equipment
Wellhead assemblies to control the pressure and flow of CSG to the surface
Valves and fittings to control and direct the flow of CSG to the surface
Flares and venting systems for controlled burning of CSG
Pumps
Water pumps to remove water from the coal seam
Gas pumps for extracting CSG from the well
Mud pumps and systems for drilling fluid circulation
Gas Separation and processing equipment
Separators to separate CSG from water and other impurities
Measurement and monitoring devices
Flow meters to measure the amount of CSG being extracted
Pressure gauges to monitor pressure levels in the well
Gas analysers to analyse the composition and quality of the CSG
Safety and environmental control equipment
Blowout preventers (BOPs) to prevent uncontrolled release of CSG
Monitoring systems for detecting gas leaks and monitoring environmental compliance
Control and automation systems
SCADA systems for remote monitoring and control of gas production
Automation software for optimising gas extraction and processing

3.8 Workforce and Working Hours

Staffing has been estimated at 14 personnel during the construction of the Project. Construction staff will work a 12 -hour day / night shift 7 days / 7 nights roster.

During operation, the CSG drainage will be flared 24 hours per day. Staffing has been estimated at 2 personnel working 12-hour day / night shift 7 days / 7 nights roster (commencing 6:00am or 6:00pm).

Staff will transfer from CCM to the Project, and it is not envisaged that additional staff will be required.

The existing Centurion Village will provide accommodation for the Project workforce during the construction and operation phase. No additional worker accommodation will be required.

3.9 Hours of Operation

It is anticipated that the Project will operate 24 hours per day.

3.10 Rehabilitation and Closure

In accordance with the P-PRCP-100669070_V1, land will be rehabilitated to a stable condition which is defined as land that is:

- Safe and structurally stable.



- No environmental harm being caused by anything on or in the land.
- Can sustain a post-mining land use.

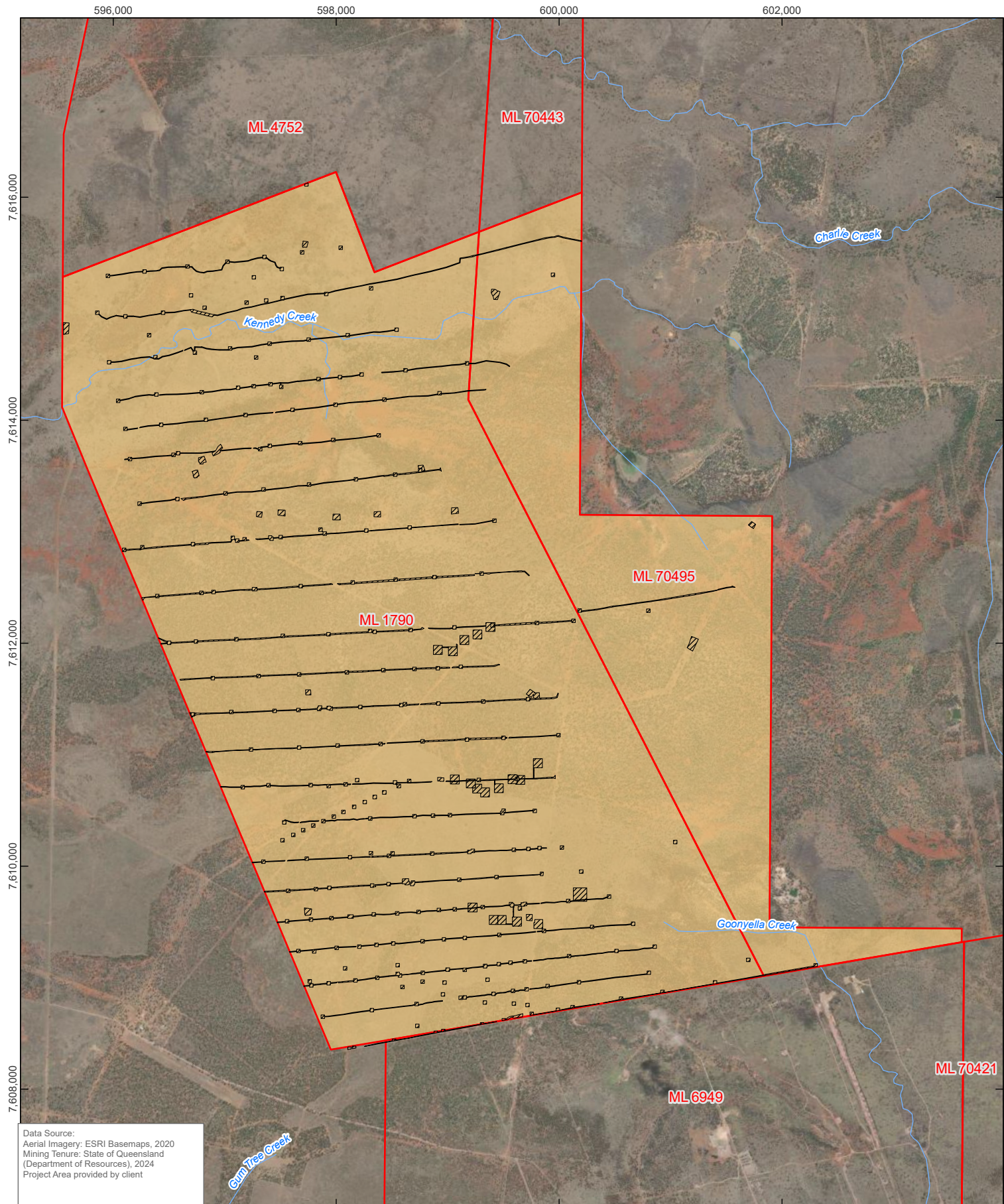
The access tracks and drill pads will be rehabilitated through the following methodologies:

- Windrows and drains will be pushed and deep ripped.
- Topsoil placement, amelioration and seeding with pasture grasses and trees.
- Where the access tracks and drill pads cross a watercourse, or there is an increased risk of sedimentation, rock armour will be applied.

The extent of rehabilitation activities will be subject to agreement with landholders who may choose to retain infrastructure deemed beneficial.

Figure 3.3 presents the proposed final site design to be included in the amended PRCP.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

	0 0.5 1 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:45,000 at A4
Project Number:	620.040594.00001
Date Drawn:	09-Sep-2024
Drawn by:	RB

LEGEND

-  Watercourse
-  Mining Lease
-  Maximum Disturbance Footprint
-  PMLU - Grazing

EA AMENDMENT P-EA-100658735

PROPOSED FINAL SITE DESIGN



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FIGURE 3.3

3.11 Project Schedule

One Surface to in-seam (SIS) drill rig will be used to drill the vertical and lateral wells. Vertical wells will be drilled first (approximately 10 days per well) followed by the connecting lateral wells (approximately 20 days per well). Once the wells have been drilled, the surface infrastructure will be installed (approximately 15 days per vertical well). It is anticipated that it may take up to 90 days to depressurise the wells followed by up to 18 months of gas flow.

To summarise, Project activities are:

- Clearing 12 ha of vegetation for drill pads (11.80 ha) and access tracks (0.20 ha).
- Developing 0.31 km of 5 m wide access track.
- Drilling, installing and operating thirteen (13) vertical wells and ten (10) lateral wells across 19 drill pads.
- Extracting the groundwater and CSG from the target GM coal seam.
- Closure and rehabilitation of the wells.



4.0 Proposed EA and PRCP Amendments

The following section details the conditions of EA P-EA-100658735 and PRCP P-PRCP-100669070_V1 that require amendment.

4.1 Environmental Authority

This section presents the proposed amendments to the following conditions:

- Condition 15 Schedule A.
- Condition 7 Schedule F.
- Condition 9 Schedule F.
- Condition 22 Schedule F.

4.1.1 Condition 15 Schedule A

Table 4.1 details the existing conditions of A15 and the proposed changes subject of this EA amendment.

Table 4.1 EA P-EA-100658735 Condition A15

Existing Condition				
The only mining activities to be carried out under this EA are the mining activities defined within the parameters of Table 1 (Mining Activities) and identified in Figure 1 attached to this EA.				
Proposed Condition				
No change to wording of condition. Table 1 and Figure 1 referenced in the condition is to be amended.				
Change				
Table 1 will be updated and replaced by				
Mine Domain	Mine Feature Domain	Location (GDA94)	Maximum Disturbance Area	Constraints
Exploration activities	Drill holes and pads	As per Figure 3.2	1400 metres squared per drill pad	Total disturbed area must not exceed 1.4 ha
			6400 metres squared per drill pad	Total disturbed area must not exceed 11.80 ha
	Historic holes and pads	As per Figure 3.2	3000 metres squared per drill pad	Quantity: 310 drill holes
Ancillary infrastructure	Roads and tracks	As per Figure 3.2		Scale and intensity

Figure 1 in EA P-EA-100658735 will be updated and replaced by Figure 3.2 of this report.



Existing Condition
Figure 3.2 reflects the following changes to the location and extent of activities for the Project outlined in Section 3 of this report. - Clearing 12 ha of vegetation for drill pads (11.80 ha) and 0.31 km of access tracks (0.20 ha). - Drilling, installing and operating thirteen (13) vertical wells and ten (10) lateral wells across 19 drill pads. - Closure and rehabilitation of the wells.
Justification
The proposed amendment ensures that the variation in activities aligns with the approved disturbance and activities outlined in Table 1 (Mining Activities) and Figure 1. The amendment incorporates the Project activities to determine the presence, quantity, and quality of CSG within the GM coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity).

4.1.2 Condition 7 Schedule F

Table 4.2 details the existing conditions of F7 and the proposed changes subject of this EA amendment.

Table 4.2 EA P-EA-100658735 Condition F7

Existing Condition
Exploration activities undertaken must be consistent with Figures 1 to 4 attached to this environmental authority.
Proposed Condition
No change to wording of condition. Figure 1 to 4 referenced in the condition is to be amended.
Change
Figure 1 to Figure 4 in EA P-EA-100658735 will be updated and replaced by Figure 3.1, Figure 3.2, Figure 6.10 through Figure 6.19 of this report. These figures illustrate the location of exploration and mineral development activities, mining leases, and proposed extent of impacts to Matters of State Environmental Significant (MSES) regulated vegetation and protected wildlife habitat.
Justification
The proposed amendment ensures that any necessary expansions or modifications to the exploration activities, as depicted in the updated figures, are within the scope of the EA.

4.1.3 Condition 9 Schedule F

Table 4.3 details the existing conditions of F9 and the proposed changes subject of this EA amendment.

Table 4.3 EA P-EA-100658735 Condition F9

Existing Condition
The operational area of individual drill sites must not exceed 1,400 square metres.
Proposed Condition
The operational area of individual drill sites must not exceed 6,400 square metres.
Change



Existing Condition
Condition F9 would be updated to refer to the drill pads in which the Project activities can be performed. Figure 1 in EA P-EA-100658735 will be updated and replaced by Figure 3.2 of this report. This figure illustrates the location of exploration and mineral development activities.
Justification
The proposed amendment ensures that the variation in activities aligns with the approved disturbance and activities outlined in Table 1 (Mining Activities) and Figures 1 to 4 . The amendment incorporates the Project activities to determine the presence, quantity, and quality of CSG within the GM coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity).

4.1.4 Condition 22 Schedule F

Table 4.4 details the existing conditions of F22 and the proposed changes subject of this EA amendment.

Table 4.4 EA P-EA-100658735 Condition F22

Existing Condition			
Impacts to matters of State environmental significant (MSES) as a result of carrying out exploration activities must only occur to the maximum extent stated in Table F1 – Authorised residual impacts to MSES’ and consistent with general exploration activities depicted in Figure 3 ‘Authorised impacts to MSES Regulated Vegetation’ and Figure 4 ‘Authorised impacts to MSES Protected Wildlife Habitat’.			
Proposed Condition			
No change to wording of condition. Table F1, Figure 3 and Figure 4 referenced in the condition is to be amended.			
Change			
Table F1 in EA P-EA-100658735 will be updated and replaced by:			
Prescribed Environmental Matters – Matter Of State Environmental Significance (MSES)	Location Of Impact	Offset Requirements Under Environmental Offsets Act 2014	Maximum Extent Of Impact (Ha)
Regulated vegetation – Endangered or Of Concern Regional Ecosystem			
Grassland Regional Ecosystem (11.8.11)	In accordance with Figure 6.10.	No	1.81
Sparse Regional Ecosystem (11.3.4, 11.4.2)	N/A	No	0
Dense / Mid Dense Regional Ecosystem (11.3.1, 11.9.5)	N/A	No	0
Regulated Vegetation – Located in the defined distance from the defining banks of a watercourse			



Existing Condition			
Grassland Regional Ecosystem (11.8.11)	N/A	No	0
Sparse Regional Ecosystem (11.3.4, 11.4.2)	N/A	No	0
Dense / Mid Dense Regional Ecosystem (11.3.1, 11.9.5)	N/A	No	0
Protected Wildlife Habitat – Essential habitat for an endangered or vulnerable animal or plant			
Dichanthium queenslandicum (King Blue Grass)	In accordance with Figure 6.10.	No	1.81
Protected Wildlife Habitat – A habitat for endangered or vulnerable wildlife or Special Least Concern animal			
Squatter Pigeon	In accordance with Figure 6.16	No	7.41
Grey Falcon	N/A	No	1.50
Fork Tailed Swift	In accordance with Figure 6.18	No	1.50
Koala	In accordance with Figure 6.14	No	7.15
Greater Glider	N/A	No	0.88
Short Beaked Echidna	In accordance with Figure 6.15	No	7.95
Ornamental Snake	N/A	No	6.54
Figure 3 and Figure 4 in EA P-EA-100658735 will be updated and replaced by Figure 6.10 through Figure 6.19 of this report. These figures illustrate the proposed extent of impacts to MSES regulated vegetation and protected wildlife habitat.			
Justification			
The completion of terrestrial and aquatic ecology field surveys across the Study Area have allowed for a more refined understanding of the categorisation of vegetation communities, presence of flora and fauna, and extent of habitat for these flora and fauna species. As such, the assessment of impacts to MSES from the Project are based on contemporary, ground-truthed ecological data. During the design stages of the Project, terrestrial and aquatic ecological values were considered and avoided where feasible and practical. This included the use of previously disturbed areas where possible, prioritised location of disturbance in non-remnant areas of vegetation affording limited habitat value, avoidance of TECs where possible, and where remnant vegetation was required for			



Existing Condition
clearing those area classified as No concern at present under the VM Act were prioritised over Of concern and Endangered REs. Though the Project will result in the direct clearing of habitat for MSES flora and fauna species, this amount comprises less than 1% of habitat for each species as mapped within the broader Study Area. In addition, the implementation of mitigation measures will further minimise potential impacts to the species. As such, an assessment against the SRI Guideline determined the Project is unlikely to result in a significant residual impact on any MSES (Refer to Appendix B).

4.2 Progressive Rehabilitation and Closure Plan

This section presents the proposed amendments to the following conditions:

- Section B – Figure 1
- Section C – (RA1) Rehabilitation area 1

4.2.1 Section B – Final site design and reference maps

Table 4.5 details the existing conditions of Section B – Final site design and reference maps and the proposed changes subject of this PRCP amendment.

Table 4.5 PRCP P-PRCP-100669070_V1 Section B – Figure 1

Existing Condition
Section B of the PRCP contains the final site design plans in Figure 1 .
Proposed Condition
No change to wording of condition. Figure 1 referenced in the PRCP is to be amended.
Change
Figure 1 in PRCP P-PRCP-100669070_V1 will be updated and replaced by Figure 3.3 of this report. Figure 3.3 reflects the following changes to the location and extent of activities for the Project activities.
• Clearing 12 ha of vegetation for drill pads (11.80 ha) and access tracks (0.20 ha) • Developing 0.31 km of 5 m wide access tracks • Drilling, installing and operating thirteen (13) vertical wells and ten (10) lateral wells across 19 drill pads, and • Closure and rehabilitation of the wells.
Justification
The amendment incorporates the Project activities to determine the presence, quantity, and quality of CSG within the GM coal seam and further assess the geological and petrophysical properties of the coal seam (i.e. permeability, porosity).

4.2.2 Section C – Post-mining land uses

Table 4.6 details the existing conditions of Section C – (RA1) Rehabilitation area 1 and the proposed changes subject of this PRCP amendment.

Table 4.6 PRCP P-PRCP-100669070_V1 Section C – (RA1) Rehabilitation area 1



Existing Condition						
Rehabilitation of the site must be undertaken as per Section C of PRCP P-PRCP-100669070_V1. Currently, 133 ha of the site is to be rehabilitated, with rehabilitation milestones to be reached within the timeframes indicated in the schedule below.						
Proposed Condition						
No change to wording of condition. Section C – Post-mining land use, (RA1) Rehabilitation area 1 referenced in the PRCP is to be amended.						
Change						
Post-mining land uses (PMLU)						
Rehabilitation area			RA1			
Relevant activities			Exploration - drilling and associated tracks			
Total rehabilitation area size (ha)			145			
Commencement of fire milestone : RM1			10/12/2021			
PMLU			Cattle grazing			
Date area is available	10/12/2021	10/12/2028				
Cumulative area available	19	145				
Milestone completed by	10/12/2026	10/12/2031	10/12/2036	10/12/2041	10/12/2046	
Milestone Reference	Cumulative area achieved (ha)					
RM1	19	145				
RM2	19	145				
RM3	19	145				
RM4	19	145				
RM5	19	145				
RM6			19	145		
RM7				19	145	
Justification						
Total rehabilitation area size in (RA1) Rehabilitation area 1 of PRCP P-PRCP-100669070_V1 is proposed to increase from 133 ha to 145 ha. The 145 ha reflects the additional 12 ha of disturbance involved with the aforementioned clearing of vegetation for drill pads (11.80 ha) and access tracks (0.20 ha) associated with the Project activities.						



5.0 Assessment Methodology

This section outlines the methodology used to assess the potential impacts the Project has on relevant EVs.

The following methodology was taken when assessing the impacts to the EVs:

- Characterisation of EVs.
- Identification of any potential relevant environmental impacts.
- Outline existing management practices.
- Risk assessment of potential impacts.

5.1 Terminology

In the context of this Report, the following terminology are used to define the spatial and operational parameters of the Project:

- **Project:** Refers to the planned development which is the subject of this Report. A project usually involves construction, operation, or changes to land use, that requires regulatory approval and has the potential to cause environmental impacts. A project includes all stages of its lifecycle, from design to construction, operation, and rehabilitation and closure.
- **Project Area:** The Project Area refers to the physical boundaries of the land, water resources, or other resources that will be directly affected by the proposed Project. This includes the location where construction, operations, and any other project-related activities will take place.
- **Study Area:** The Study Area is the broader geographic region that is considered through the impact assessment process. It includes the Project Area and surrounding areas that may be indirectly affected by the Project. The boundaries of the Study Area are often determined by the nature of the Project's potential impacts on EVs.
- **Project Activities:** Project activities encompass all actions or operations associated with the Project during construction, operation and rehabilitation that may have a direct or indirect impact on the environment. These activities are assessed to determine the impacts on EVs.
- **Disturbance Area:** The disturbance area refers to the specific portion of the Project or Study Area where physical or ecological disturbance will occur as a result of the Project Activities. It is usually a subset of the Project Area but might extend beyond it due to indirect impacts.

5.2 Methodology to Identify Environmental Impacts

To identify the potential impacts to the EVs desktop assessments were conducted. The nature of the Project Activities and the location of the Project resulted in further investigation into the potential impacts associated with ecology and groundwater. The specific methodology for the assessments of these EVs are detailed in the following sections.

Section 6.0 provides the results of such assessments.



5.2.1 Terrestrial and Aquatic Ecology

Refer to **Appendix A** for details of the terrestrial and aquatic ecology methodology, respectively.

5.2.2 Groundwater Assessment

Refer to **Section 6.7** of the groundwater methodology.

5.3 Risk Assessment Methodology

The EVs were assessed using an adapted version of the Risk Assessment Education Resource (Mining Safety and Health Advisory Committee 2023). This guideline was developed for conducting effective risk assessments and was designed in accordance with *ISO 31000:2018 – Risk Management*.

A likelihood and consequence rating were assigned to each potential impact, which resulted in an overall, risk rating. **Table 5.1** details the likelihood descriptors and **Table 5.2** outlines the level of consequence. The combination of likelihood and consequence resulted in a risk matrix (**Table 5.3**). A description of each risk rating is provided in **Table 5.4**.

Table 5.1 Likelihood level

Likelihood Level	Description
Almost certain (5)	Could occur several times a year Could be expected to occur during a project >80% likely to occur
Likely (4)	Could occur within one year Could easily occur during a project 60% - 80% likely to occur
Possible (3)	Could occur in a one to two-year period Occurred in a small number of projects 30% - 60% likely to occur
Unlikely (2)	Could occur in a two to five-year timeframe Known to have happened within the industry 5% - 30% likely to occur
Rare (1)	Could occur in more than five years' time Has not occurred but could Less than 5% likely to occur

Table 5.2 Consequence rating

Consequence	Description
Major (5)	Destruction of important habitat, species, or natural environment Significant impact to sensitive receptors Regulatory significant
High (4)	Extensive and measurable medium-term impact on habitat, species, or natural environment Extensive impact to sensitive receptors



Consequence	Description
Medium (3)	Localised medium-term impact on habitat, species, or natural environment Localised medium-term impact to sensitive receptors
Low (2)	Localised short-term impact on habitat, species, or natural environment Localised short-term impact on sensitive receptors
Minor (1)	Little to no discernible impact on habitat, species, or natural environment Little to no impact on sensitive receptors

Table 5.3 Risk matrix

Likelihood	Consequence				
	Minor (1)	Low (2)	Medium (3)	High (4)	Major (5)
Almost certain (5)	Medium	Significant	Significant	High	High
Likely (4)	Medium	Medium	Significant	High	High
Possible (3)	Low	Medium	Significant	Significant	High
Unlikely (2)	Low	Low	Medium	Significant	Significant
Rare (1)	Low	Low	Medium	Medium	Significant

Table 5.4 Descriptions of risk rating

Risk Level	Risk Measures
High	Immediate action required Identify and implement controls to manage risks Highest level of management needs to be involved
Significant	Immediate action required Identify and implement controls to manage risks Senior site management should be involved
Medium	Implement controls to manage risks Responsibility must be defined
Low	Implement controls as required Manage by routine processes



6.0 Environmental Assessments

The following sections provide the environmental assessments for:

- Section 1.1: Air quality.
- Section 6.2: Greenhouse gas.
- Section 6.3: Noise and vibration.
- Section 6.4: Land resources.
- Section 6.5: Terrestrial ecology.
- Section 6.6: Aquatic ecology.
- Section 6.7: Groundwater.
- Section 1.1: Surface water.
- Section 1.1: Waste.

The EVs for which no new or varied impacts are anticipated as a function of the Project activities are summarised in **Table 6.1**.

Table 6.1 Environmental values not subject to potential impacts

EV	Risk to EV	Details
Social	Not subject to potential impacts. No changes are predicted.	The Project activities will not change existing potential impacts. Any potential, relevant impacts to EVs will continue to be managed via current protocols and management plans.
Geochemistry	Not subject to potential impacts. No changes are predicted.	The Project activities will not change existing potential impacts. Any potential, relevant impacts to EVs will continue to be managed via current protocols and management plans.



6.1 Air Quality

This section presents the assessment of Project related air quality impacts to sensitive receptors.

6.1.1 Existing Environmental Values

6.1.1.1 Sensitive Receptor Locations

Potential sensitive receptors surrounding the Project Area are presented in **Table 6.2** and **Figure 6.1**. Sensitive receptors have been identified through desktop review of historical information (e.g. EIS, EA amendments etc) and an analysis of available aerial photographic images.

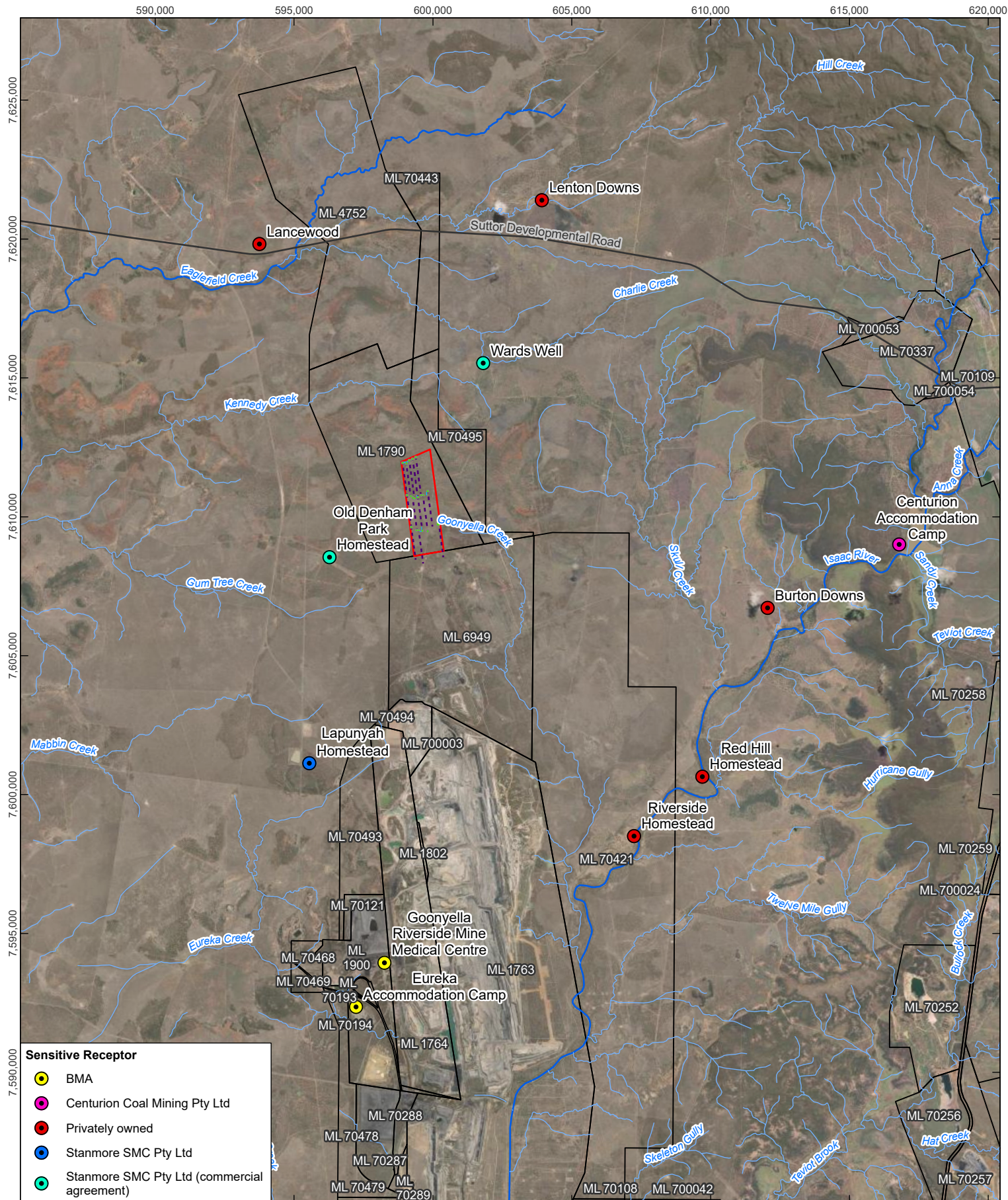
It is noted that the nearest privately owned receptor is Lancewood which is located approximately 9.4 km to the nearest drill pad. The closest receptor is Old Denham Park Homestead (3.1 km) which is owned by Stanmore SMC Pty Ltd and with which there is an agreement in place.

Table 6.2 Receptors Surrounding the Project

ID	Receptor Name	Easting (m)	Northing (m)	Approximate Distance to Closest Drill Pad (km)	Ownership/Agreement Status
1	Old Denham Park Homestead	596275	7608546	3.1	Stanmore SMC Pty Ltd (commercial agreement)
2	Wards Well	601809	7615534	4.1	Stanmore SMC Pty Ltd (commercial agreement)
3	Lancewood	593750	7619821	9.4	Privately owned
4	Lenton Downs	603922	7621398	10.2	Privately owned
5	Centurion Accommodation Camp	616790	7609005	16.5	Centurion Coal Mining Pty Ltd
6	Burton Downs	612051	7606721	12.2	Privately owned
7	Red Hill Homestead	609702	7600644	13.0	Privately owned
8	Riverside Homestead	607241	7598505	13.2	Privately owned
9	Goonyella Riverside Mine Medical Centre	598253	7593944	15.5	BMA
10	Eureka Accommodation Camp	597230	7592356	17.2	BMA
11	Lapunyah Homestead	595547	7601128	9.2	Stanmore SMC Pty Ltd

Note 1: GDA 2020 MGA Zone 55 projection.





- Sensitive Receptor**
- BMA
 - Centurion Coal Mining Pty Ltd
 - Privately owned
 - Stanmore SMC Pty Ltd
 - Stanmore SMC Pty Ltd (commercial agreement)

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:180,000 at A4
Project Number: 620.040594.00001
Date Drawn: 10-Sep-2024
Drawn by: RB

LEGEND

- Major Road
- Major Watercourse
- Minor Watercourse
- ▭ Project Area
- ▭ Mining Lease
- Lateral Well Length
- ▭ Drill Pad
- ▭ Access Track

EA AMENDMENT P-EA-100658735

LOCATION OF SENSITIVE RECEPTORS



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FIGURE 6.1

6.1.1.2 Air Quality Objectives

A summary of the Queensland EPP (Air) ambient air quality objectives that are relevant to the Project is provided in **Table 6.3**.

The pollutants are associated with the mechanical generation of dust (i.e. total suspended particulates (TSP), particulate matter with an aerodynamic diameter less than 10 microns (PM₁₀), and dust deposition) and the combustion of diesel fuels (particulate matter with an aerodynamic diameter less than 2.5 microns (PM_{2.5}), carbon monoxide, and nitrogen dioxide).

Table 6.3 Ambient Air Quality Objectives

Pollutant	Environmental Value	Averaging Period	Objectives	Allowable exceedances	Source
Carbon monoxide	Health and wellbeing	8 hours	11,000 µg/m ³	1 day each year	QLD EPP(Air)
Nitrogen dioxide	Health and wellbeing	1 hour	250 µg/m ³	1 day each year	QLD EPP(Air)
		1 year	62 µg/m ³	None	QLD EPP(Air)
	Health and diversity of ecosystems	1 year	33 µg/m ³	None	QLD EPP(Air)
PM ₁₀	Health and wellbeing	24 hour	50 µg/m ³	None	QLD EPP(Air)
		Annual	25 µg/m ³	None	QLD EPP(Air)
PM _{2.5}	Health and wellbeing	24 hour	25 µg/m ³	None	QLD EPP(Air)
		Annual	8 µg/m ³	None	QLD EPP(Air)
TSP	Health and wellbeing	Annual	90 µg/m ³	None	QLD EPP(Air)
Dust deposition	Nuisance	30 day	120 mg/m ² /day	None	QLD DESI

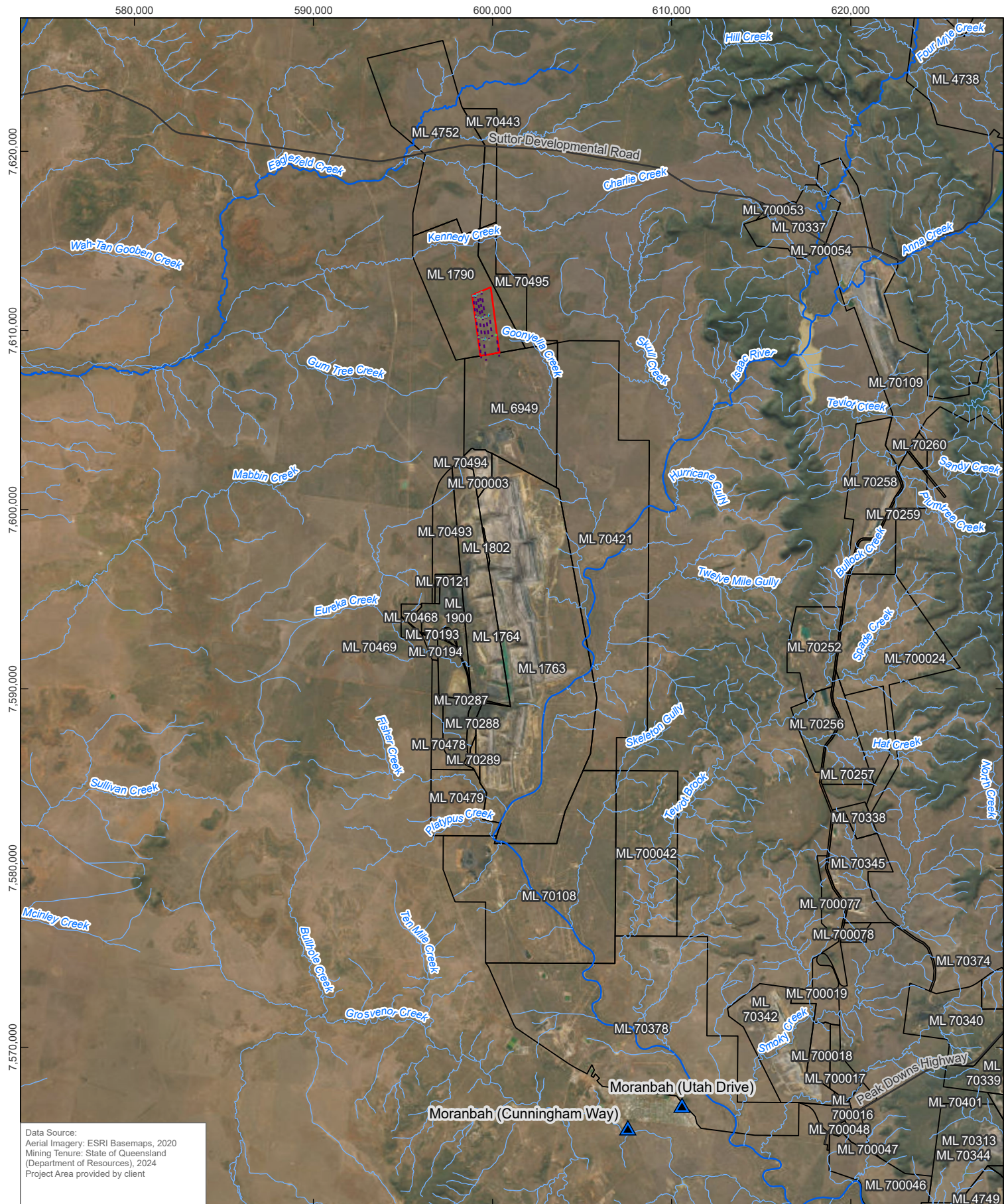
6.1.1.3 Air Quality Environment

The nearest ambient air monitoring stations operated by the DESI are the DESI Moranbah (Utah Drive) and DESI Moranbah (Cunningham Way) located approximately 40 km to the south-southeast of the Project (**Figure 6.2**).

The DESI monitoring station on Utah Drive has been in operation since 2011 with the Cunningham Way station operational since 2020. Both of the DESI stations record levels of PM₁₀ and PM_{2.5} as well as meteorological parameters such as wind speed and wind direction.

The DESI Moranbah monitoring stations are potentially influenced by a number of open cut mining operations within the airshed. When developing estimates of background levels of dust, it has been assumed that air quality recorded at the DESI Moranbah (Utah Drive) monitoring station is sufficiently representative of those in the vicinity of the Project.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:280,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

- DESI Moranbah Monitoring Station
- Lateral Well Length
- Major Road
- Drill Pad
- Major Watercourse
- Access Track
- Minor Watercourse
- Project Area
- Mining Lease

EA AMENDMENT P-EA-100658735

LOCATION OF AMBIENT AIR QUALITY MONITORING



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FIGURE 6.2

Pollutant gases included in the Queensland EPP (Air) such as carbon monoxide or nitrogen dioxide, that are associated with the combustion of diesel fuel, are not recorded at either of the two DESI Moranbah ambient air monitoring stations.

Thus estimates of background levels of these pollutants were based on data sets from other DESI operated monitoring stations.

Carbon monoxide and nitrogen dioxide are recorded at locations that are more representative of the urban and/or industrialised airshed as opposed to an airshed dominated by the influence of mining or mine-related operations and thus estimates developed from these data sets may over-estimate background pollutant levels in the vicinity of the Project.

A summary of estimates of background levels of pollutants is provided in **Table 6.4** with additional notes in relation to the data sets, included in the table.

Background estimates suggest that in general background ambient air quality is well below the relevant objective with the exception of the annual averages of PM₁₀ (96% of objective) and PM_{2.5} (85% of objective).

These high levels of dust as well as the frequently recorded exceedances of the 24 hour average concentration of PM₁₀ and PM_{2.5} at the DESI Moranbah monitoring stations, highlights the dusty background environment within the airshed that includes the Project.

Table 6.4 Estimates of background levels of pollutants

Pollutant	Environmental Value	Averaging Period	Objectives	Background Estimate	Percentage of Objective	Source
Carbon monoxide	Health and wellbeing	8 hours	11,000 µg/m ³	370 µg/m ³	3%	QLD ⁽⁴⁾
Nitrogen dioxide	Health and wellbeing	1 hour	250 µg/m ³	60.4 µg/m ³	24%	QLD ⁽⁵⁾
		1 year	62 µg/m ³	14.5 µg/m ³	23%	QLD ⁽⁵⁾
	Health and diversity of ecosystems	1 year	33 µg/m ³	14.5 µg/m ³	44%	QLD ⁽⁵⁾
PM ₁₀	Health and wellbeing	24 hour	50 µg/m ³	24.4 µg/m ³	49%	DESI ⁽²⁾
		Annual	25 µg/m ³	23.8 µg/m ³	96%	DESI ⁽²⁾
PM _{2.5}	Health and wellbeing	24 hour	25 µg/m ³	7.6 µg/m ³	30%	DESI ⁽²⁾
		Annual	8 µg/m ³	6.8 µg/m ³	85%	DESI ⁽²⁾
TSP	Health and wellbeing	Annual	90 µg/m ³	47.6 µg/m ³	53%	DESI ^(2,3)
Dust deposition	Nuisance	30 day	120 mg/m ² /day	47 mg/m ² /day	39%	AQMP ⁽¹⁾ (CMJV)
Notes:						
(1) AQMP (CMJV) – Air Quality Management Plan: Coppabella-Moorvale Joint Venture – Draft, dated 13 March 2023						
(2) DESI – Based on 2023 data from the DESI Moranbah (Utah Drive) monitoring station. Estimates for the 24 hour averages are conservatively based on the 90 th percentile of the data set. A total of five days exceeded the EPP(Air) objective of 50 for the 24 hour average concentration of PM ₁₀ . Four PM _{2.5} EPP(Air) exceedances days were recorded.						
(3) TSP is not collected at the DESI Moranbah monitoring stations. The estimate for the annual average is based on the assumption that 50% of TSP is in the form of PM ₁₀ .						



Pollutant	Environmental Value	Averaging Period	Objectives	Background Estimate	Percentage of Objective	Source
(4) QLD – Queensland Government’s Queensland air monitoring 2023 National Environment Protection (Ambient Air Quality) Measure. Estimate based on the maximum 90 th percentile 8 hour average concentration from the Boyne Island monitoring station over the period 2010 through 2023. Note that concentrations of carbon monoxide are only reported for the Boyne Island and Woolloongabba monitoring stations in 2023. Carbon monoxide ceased to be measured at the North Toowoomba monitoring station in 2010.						
(5) QLD – Queensland Government’s Queensland air monitoring 2023 National Environment Protection (Ambient Air Quality) Measure. Estimate based on the maximum 90 th percentile 1 hour average or annual average concentration of nitrogen dioxide from the South Gladstone monitoring station over the period 2010 through 2023.						

6.1.2 Potential Impacts

The following subsections detail the potential air quality impacts as a result of the Project activities described in **Section 3.0**.

A risk-based assessment of these potential impacts is detailed in **Table 6.5**

6.1.2.1 Construction of Access Tracks

Based on information provided in **Section 3.2**, the establishment of new access tracks to will involve the clearing of vegetation and the stockpiling of topsoil and sub-soils for the access track. Compacting of the access track will be undertaken using a roller. Gravel will be delivered by truck to the access track and spread using a grader to ensure all-weather access.

As a series of access tracks already exist across ML 1790, the construction of new access tracks will be limited to a disturbance footprint of approximately 0.20 ha.

The construction of the access tracks has the potential to create emissions of mechanically generated dust as well as emissions of particulates and gases through the combustion of diesel fuel by the dozer, grader, roller and trucks.

The construction of the access track is anticipated to be associated with a minimal risk of air quality impacts at receptor locations due to the significant distance to the nearest receptor.

6.1.2.2 Construction of Drill Pads

Based on information provided in **Section 3.3**, a total of 19 drill pads will be developed as part of the Project. The total combined footprint of all pads in areas that are not covered by existing disturbance approvals is 11.8 ha.

A dozer will be used to remove and stockpile topsoil and sub-soils from each of the pads. Compacting of the pad will be undertaken using a roller. Gravel will be delivered by truck to the drill pad and spread using a grader to ensure all-weather access. It is estimated that each drill pad will take 2-3 days to construct.

The construction of the drill pads has the potential to create emissions of mechanically generated dust as well as emissions of particulates and gases through the combustion of diesel fuel by the dozer, grader, roller and trucks.

The construction of the drill pads is anticipated to be associated with a minimal risk of air quality impacts at receptor locations due to the significant distance to the nearest receptor.

6.1.2.3 Drilling of Vertical and Lateral Wells

Based on information provided in **Section 3.3**, the 13 vertical wells will require approximately 10 days of drilling time. Lateral wells will each take approximately 20 days. One well will be



drilled at a time, thus cumulatively approximately 330 days of drilling will be required to complete the network.

Although the drilling of the wells is unlikely to generate significant levels of larger scale dust (i.e. TSP or PM₁₀) emissions of particulate (PM_{2.5}) and gases (e.g. carbon monoxide and oxides of nitrogen) will be associated with the combustion of diesel fuel by the drill rig.

As a single drill rig will be used at any one time, the risk of impacts due to emissions of particulate and gases associated with the combustion of diesel fuel are anticipated to be minimal at receptor locations due to the significant distance to the nearest receptor.

6.1.2.4 Vertical and Lateral Well Operation

Flaring

Based on information provided in **Section 3.3**, CSG will be extracted at a rate of approximately 500 l/sec per well or approximately 1,800 cubic metres per hour of CSG per well. It is anticipated that the destruction efficiency of the candlestick flare will be in excess of 95%.

The risk of adverse impacts associated with emission of pollutant gases included in the EPP (Air) due to the flaring of the CSG is anticipated to be minimal at receptor locations due to the significant distance to the nearest receptor.

Generators

As noted in **Section 3.5**, electricity will be required to operate the drill pumps and the well pumps.

A total of thirteen 60 kV diesel generators will be co-located with the vertical wells.

The risk of adverse impacts associated with emission of pollutant gases included in the EPP(Air) due to the combustion of diesel fuel is anticipated to be minimal at receptor locations due to the significant distance to the nearest receptor.

6.1.2.5 Closure and Rehabilitation

The risk of air quality impacts will reduce as the need for diesel fuel decreases.

The reduction in the disturbance footprint associated with rehabilitation will lead to a reduction in the risk of air quality impacts associated with the generation of dust either by the movement of equipment and/or wind generated dust during adverse conditions.

6.1.3 Management Practices

will be managed. Mitigation and management practices to reduce the potential impacts to the sensitive receptors as a result of the Project Activities include:

- Watering of unsealed areas whenever visible dust is being generated.
- Reducing speed limits.
- Minimising clearing of vegetation.
- Seeding of stockpiled material where appropriate.
- Utilising cleaner burning generators.
- Optimising engine performance based on emissions outcomes.
- Operating plant and equipment (including flares) in an emission's optimal manner.



- Monitoring meteorological conditions and pro-actively watering unsealed areas and stockpiles prior to and during, adverse meteorological conditions.

6.1.4 Risk Assessment

The potential air quality impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.5**.

The risk of air quality impacts is Low.

Table 6.5 Air quality risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Impact of emissions of dust and/or pollutants due to combustion of diesel at sensitive receptor locations during construction of access track and drill pads	Unlikely (2)	Low (2)	Low	Short duration of drill pad construction activities (i.e. 2-3 days each). Watering of disturbance areas will provide effective mitigation of dust. Significant distance to nearest receptor (i.e. greater than 3 km)
Impact of emissions of pollutants due to combustion of diesel at sensitive receptor locations during drilling	Unlikely (2)	Low (2)	Low	Drilling activities at each drill pad ranges from 10 to 30 days per pad. Significant distance to nearest receptor (i.e. greater than 3 km)
Impact of emissions of pollutants due to combustion of CSG at sensitive receptor locations during flaring	Unlikely (2)	Low (2)	Low	Flares distributed over a number of drill pads. High destruction efficiency of flares. Significant distance to nearest receptor (i.e. greater than 3 km)
Impact of emissions of pollutants due to combustion of diesel in generators during dewatering and CSG extraction	Unlikely (2)	Low (2)	Low	Individual generators distributed over a number of drill pads. Significant distance to nearest receptor (i.e. greater than 3 km)



6.2 Greenhouse Gas

Assessment of GHG impacts is pending and will be included in the final submission to DESI.

6.2.1 Existing Environmental Values

6.2.1.1 Climate and Meteorology

The Project is located in the sub-tropical region of Central Queensland and is characterised by hot, moist summers and dry winters.

The nearest monitoring station is located at the Moranbah Water Treatment Plant (MWTP), approximately 38 km south of the Project. The MWTP was operated by the Bureau of Meteorology for the period of 1972 to 2012.

Table 6.6 presents a summary of the long term monthly averaged data for:

- Daily maximum temperature
- Daily minimum temperate, and
- Rainfall, of particular note is the seasonal variability in rainfall totals with the majority of the rain occurring during the summer months of December, January and February.

Table 6.6 Rainfall and temperature climate statistics based on data obtained from the BoM MWTP monitoring station (1972-2012)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	33.9	33.1	32.2	29.6	26.5	23.7	23.6	25.5	29.3	32.3	33.1	33.9	29.7
Mean minimum temperature (°C)	21.9	21.8	20.2	17.6	14.2	11.1	9.8	11.1	14.1	17.6	19.4	21.1	16.7
Mean rainfall (mm)	103.8	100.7	55.4	36.4	34.5	22.1	18	25	9.1	35.7	69.3	103.9	613

Long term wind roses for 09:00 and 15:00 provide in Image 6.1 and Image 6.2 respectively, highlight the general light to moderate winds and predominately easterly and south-easterly winds experienced at this location.



Rose of Wind direction versus Wind speed in km/h (10 Jan 1986 to 26 Mar 2012)

Custom times selected, refer to attached note for details

MORANBAH WATER TREATMENT PLANT

Site No: 034038 • Opened Jan 1972 • Closed Apr 2012 • Latitude: -21.9947° • Longitude: 148.0308° • Elevation 260m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.

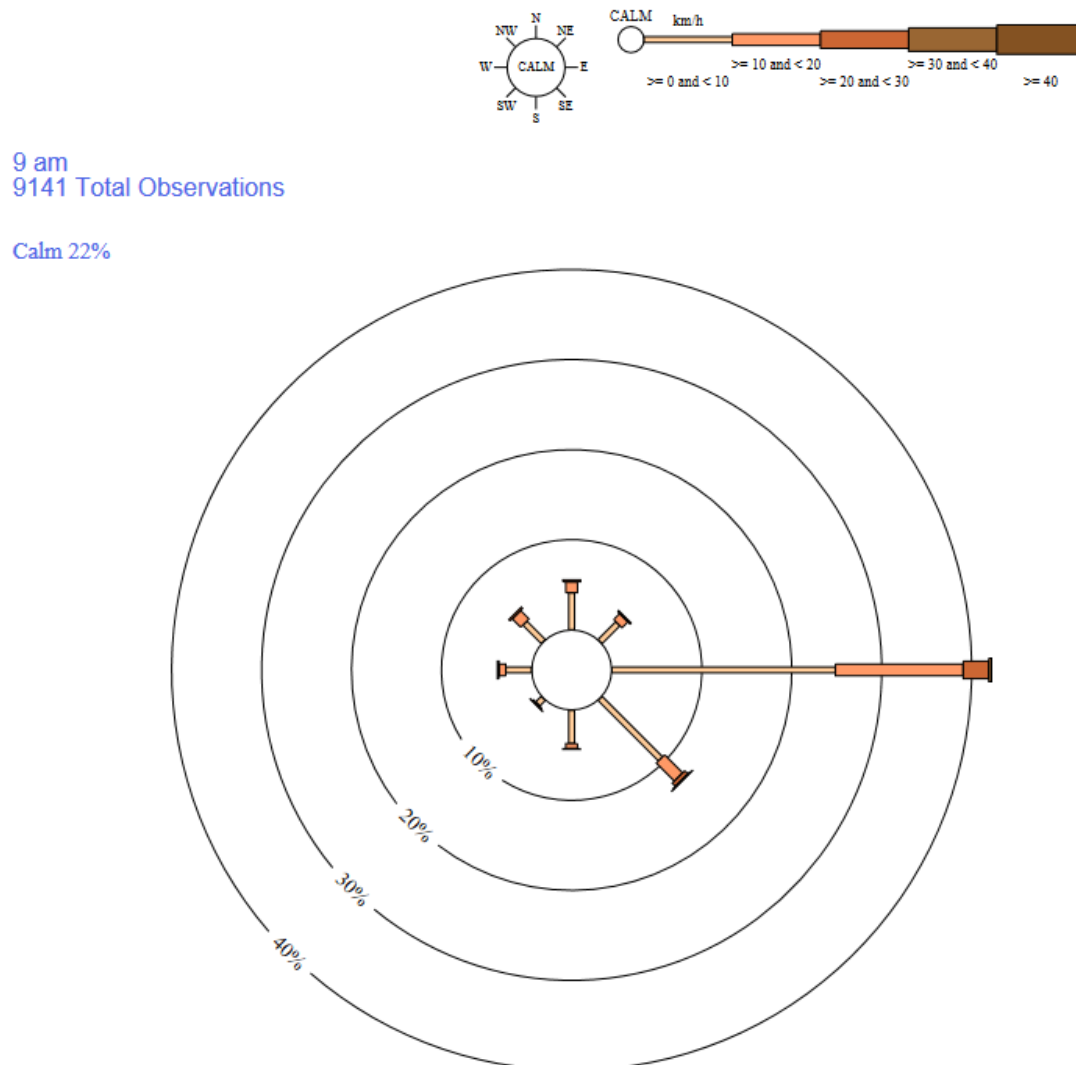


Image 6.1: Wind Rose based on data obtained at 09:00 at the MWTP (1986-2012)
(Source: BoM website
http://www.bom.gov.au/climate/averages/tables/cw_034038.shtml)



Rose of Wind direction versus Wind speed in km/h (10 Jan 1986 to 26 Mar 2012)

Custom times selected, refer to attached note for details

MORANBAH WATER TREATMENT PLANT

Site No: 034038 • Opened Jan 1972 • Closed Apr 2012 • Latitude: -21.9947° • Longitude: 148.0308° • Elevation 260m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.

3 pm
8922 Total Observations

Calm 16%

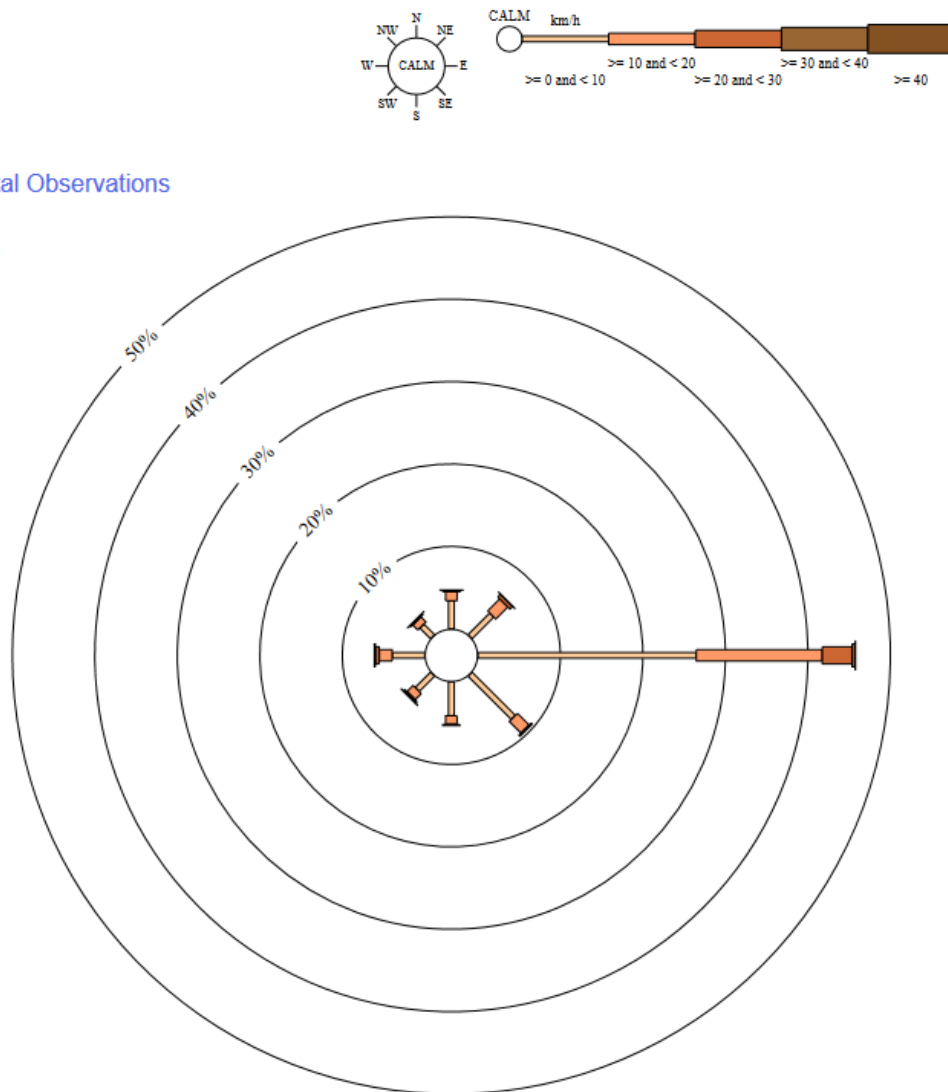


Image 6.2: Wind Rose based on data obtained at 15:00 at the MWTP (1986-2012)
(Source: BoM website
http://www.bom.gov.au/climate/averages/tables/cw_034038.shtml)

6.2.1.2 Greenhouse Gas Inventory

The 'National Greenhouse and Energy Reporting Act 2007' (NGER Act) provides a framework for the annual reporting of corporate greenhouse gas (GHG) emissions, energy consumption and production.



DCCEEWs 'Australian National Greenhouse Accounts Factors' (NGA Factors 2023) provides a methodology by which corporations estimate GHG emissions associated with their activities, including:

- GHG emissions are reported in units of carbon dioxide equivalent or CO₂-e
- GHG sources are classified as being either 'direct' or 'indirect'.
 - Direct emission sources (or Scope 1) are produced from sources within the boundary of an organisation and as a result of that organisation's activities
 - Indirect emissions are generated as a consequence of an organisation's activity, but which are physically produced by the activities of another organisation. There are two classes of indirect emissions: electricity (Scope 2) and other sources (Scope 3).
- It is noted that the NGER Act requires the reporting of Scope 1 and Scope 2 emissions, however the reporting of Scope 3 emissions is voluntary.

The focus of this GHG assessment is Scope 1 emissions. Scope 2 emissions are excluded as the Project electricity requirements will be locally generated using diesel generators and not consumed from the national grid. Further the Project will not produce a product, therefore there are no downstream Scope 3 emissions and upstream Scope 3 emissions have not been considered.

Table 6.7 presents the scope 1 NGA Factors considered in this assessment.

Table 6.7 National Greenhouse Accounts Emission Factors (Scope 1)

Emission Source	Energy Content ⁽³⁾	Emission Factor	Units ⁽²⁾	Source
Coal seam methane that is captured for combustion	0.0377 GJ/m ³	51.63	kg CO ₂ -e/GJ	NGA ⁽¹⁾
Combustion of diesel fuel	38.6 GJ/kL	70.20	kg CO ₂ -e/GJ	NGA ⁽¹⁾
Note: (1) NGA – Australian Government's Department of Climate Change, Energy, the Environment and Water's National Greenhouse Accounts Factors (2023) (2) kg CO ₂ -e/GJ – kilograms (KG) of carbon dioxide equivalent (CO ₂ -e) per gigajoule (GJ) (3) (a) GJ/m ³ – gigajoule (GJ) per cubic metre (m ³) (3) (b) GJ/kL – gigajoule (GJ) per kilolitre (kL)				

6.2.2 Potential Impacts

The following subsections detail the potential GHG impacts as a result of the activities described in **Section 3**. A risk-based assessment of these potential impacts is detailed in **Table 6.5**

6.2.2.1 Construction of Drill Pads and Access Tracks

Based on information provided in **Section 3.2**, a total of 19 drill pads (11.80 ha) and 0.2 ha of access tracks will be developed as part of the Project. Combustion of diesel fuel will be associated with activities undertaken by the dozer, articulated truck, roller and grader during the construction of the drill pads and access tracks.



Based on the NGA Factors provided in **Table 6.7** and estimates of diesel fuel usage, between 170 to 260 tonnes of CO₂-e emissions is estimated to be associated with the combustion of diesel fuel during the construction of the drill pads and access tracks.

6.2.2.2 Establishment of Vertical and Lateral Wells

Based on information provided in **Section 3.3**, the 13 vertical well will require approximately 10 days of drilling time. Lateral wells will each taking approximately 20 days. Thus in total, approximately 330 days of drilling will be undertaken to complete drilling of the network of vertical and lateral wells.

Based on the NGA Factors provided in **Table 6.7** and a drill rig diesel fuel consumption range of 75 to 110 litres per hour, approximately 1,600 to 2,400 tonnes of CO₂-e emissions is estimated to be associated with the drilling of the network of vertical and lateral wells.

6.2.2.3 Vertical and Lateral Wells Operation

Flaring

Based on information provided in **Section 3.3**, each of the 13 vertical wells will produce CSG at a rate of approximately 500 l/sec per well.

The flaring of CSG, as opposed the release of CSG directly to the atmosphere, has the benefit of significantly reducing the global warming potential (GWP) of the released gases into the atmosphere from that of (approximately 100%) methane with a GWP of 28 to that of carbon dioxide with a GWP of 1.

Based on the NGA Factors provided in **Table 6.7** and assuming that the CSG is flared for a period of 1½ and 2 years with all wells producing CSG at a rate of 500 l/sec for the duration, between 700,000 to 800,000 tonnes of CO₂-e emissions is estimated to be generated due to flaring over the life of the Project.

Generators

As noted in **Section 3.5**, electricity will be required to operate the drill pumps and the well pumps. A total of thirteen 60 kV diesel generators will be co-located with the vertical wells.

Based on the NGA Factors provided in **Table 6.7** and assuming that all diesel generators will operate for a period of 2 years at a diesel fuel consumption rate of between 8 to 14 litres per hour, between 5,000 to 8,700 tonnes of CO₂-e emissions are estimated to be associated with the operation of the generators over the life of the Project.

6.2.2.4 Summary of GHG Emission Estimates

Table 6.8 provides a summary of estimated Scope 1 GHG emission over the life of the Project, highlighting the flaring of CSG as the primary source of emissions. It is noted that CSG flaring will occur primarily during Year 2 of the Project.

It is also noted that it has conservatively been assumed that the CSG flow rate of 500 l/s will be sustained across all thirteen vertical wells throughout a 1½ to 2-year period. In practice, CSG flow rates will be both spatially and temporally variable.



Table 6.8 Summary of GHG Emissions

Project Phase	Source	Tonnes of CO2-e	Percentage of Total
Construction	Combustion of diesel in equipment during drill pad and access track construction	170 - 260	0.02 - 0.03
Construction	Combustion of diesel in drill rig during construction of vertical and lateral wells	1,600 - 2,400	0.23 - 0.30
Operation	Combustion of diesel in generators during operation of vertical and lateral wells	5,000 – 8,700	0.71 – 1.07
Operation	Flaring of CSG	700,00 – 800,000	98.6 – 99.0
Total		706,770 – 811,360	

6.2.2.5 Comparison with Australian Emissions

The latest Australian GHG emissions inventory (2021-2022) provided in the DCCEEW 'National Inventory Report 2022' (DCCEEW, 2024) indicates Australia's total GHG emissions (including land use, land use change and forestry activities) was 432.6 million tonnes (Mt) of CO2-e.

Most of the Project CO2-e emissions occur over the 2-year period associated with the flaring of CSG. The summary of emissions provided in **Table 6.8**.

suggests an annual Project-related contribution to GHG emissions in the range of approximately 0.35 Mt and 0.4 Mt of CO2-e per year. This represents between 0.08% and 0.09% of Australia's 2022 GHG emissions. Queensland's contribution to the 2022 national inventory was estimated to be 124.1 Mt of CO2-e. The Project's contribution represents 0.28% to 0.33% of Queensland's 2022 emissions.

6.2.3 Management Practices

The potential impacts will be managed through current practices. These methods are used to mitigate impacts of GHG emission, and include:

- Monitoring of diesel use
- Operating plant and equipment so as to minimise fuel usage
- Minimising the risk of fugitive emissions of CSG, and
- Ensuring flares are operating optimally.

6.2.4 Risk Assessment

The potential GHG impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.5**. The risk of greenhouse gas impacts is considered low.



Table 6.9 Greenhouse gas risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Fugitive emissions of GHG associated with the Project will contribute to climate change	Possible (3)	Minor (1)	Low	Although any contribution to GHG emissions may contribute to climate change in theory, it is unlikely that the scale of the contribution of fugitive emissions of GHG from the Project would result in a material change in climate outcomes. Nonetheless, all practicable strategies to reduce the risk of fugitive emissions of CSG throughout the life of the Project should be implemented.



6.3 Noise and Vibration

This section presents the assessment of Project related noise and vibration impacts to sensitive receptors.

6.3.1 Existing Environment

6.3.1.1 Sensitive Receptors

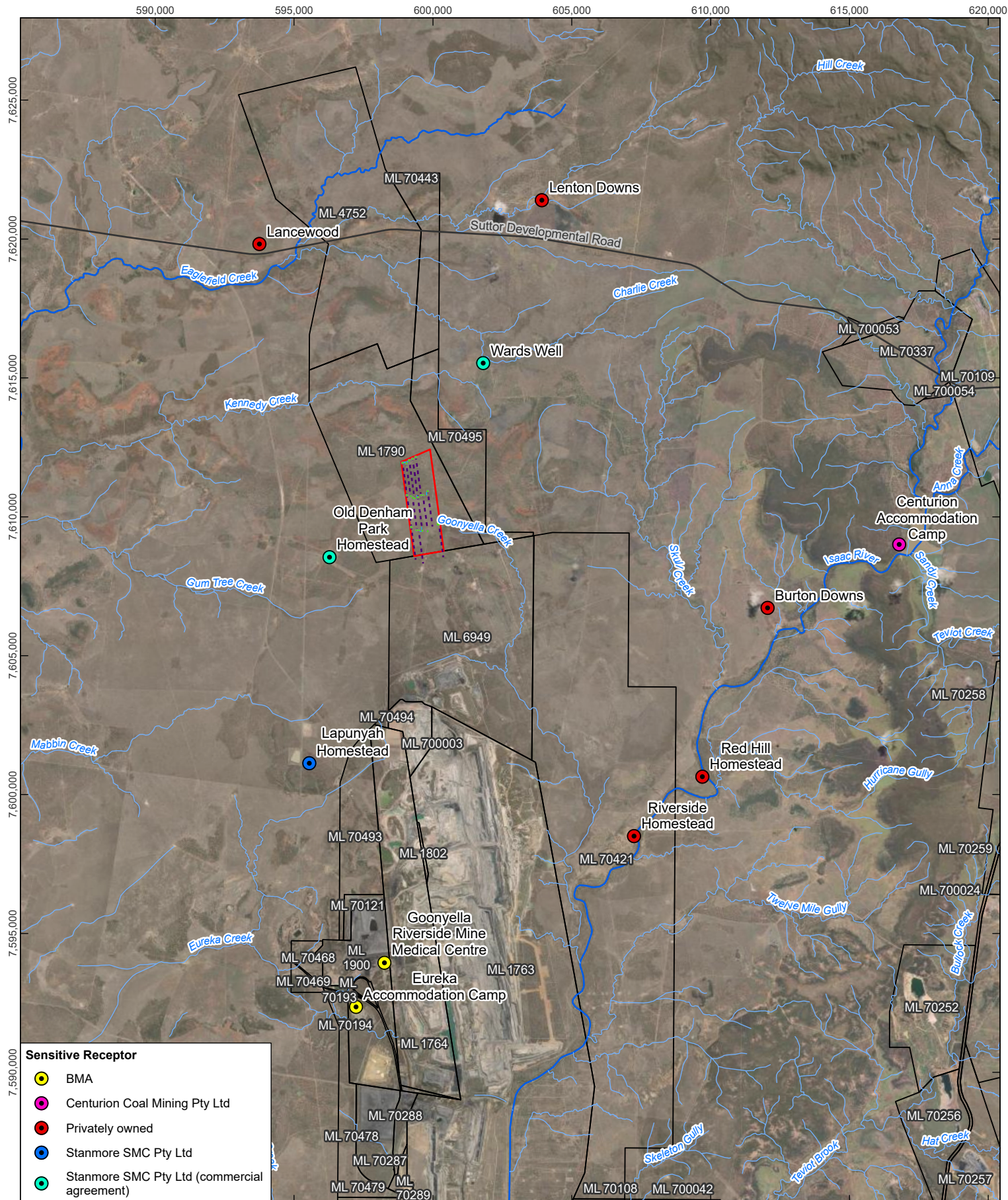
Potential sensitive receptors surrounding the Project Area, are presented in **Table 6.10** and **Figure 6.3**. Sensitive receptors have been identified through a desktop review of historical information (e.g. EIS, EA amendments, etc) and an analysis of available aerial photographic images.

Table 6.10 Receptors Surrounding the Project

ID	Receptor Name	Easting (m) ¹	Northing (m) ¹	Approximate Distance to Closest Drill Pad (km)	Ownership/Agreement Status
1	Old Denham Park Homestead	596275	7608546	3.1	Stanmore SMC Pty Ltd (commercial agreement)
2	Wards Well	601809	7615534	4.1	Stanmore SMC Pty Ltd (commercial agreement)
3	Lancewood	593750	7619821	9.4	Privately owned
4	Lenton Downs	603922	7621398	10.2	Privately owned
5	Centurion Accommodation Camp	616790	7609005	16.5	Centurion Coal Mining Pty Ltd
6	Burton Downs	612051	7606721	12.2	Privately owned
7	Red Hill Homestead	609702	7600644	13.0	Privately owned
8	Riverside Homestead	607241	7598505	13.2	Privately owned
9	Goonyella Riverside Mine Medical Centre	598253	7593944	15.5	BMA
10	Eureka Accommodation Camp	597230	7592356	17.2	BMA
11	Lapunyah Homestead	595547	7601128	9.2	Stanmore SMC Pty Ltd

Note 1: GDA 2020 MGA Zone 55 projection.





Sensitive Receptor

- BMA
- Centurion Coal Mining Pty Ltd
- Privately owned
- Stanmore SMC Pty Ltd
- Stanmore SMC Pty Ltd (commercial agreement)

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:180,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

- Major Road
- Major Watercourse
- Minor Watercourse
- ▭ Project Area
- ▭ Mining Lease
- Lateral Well Length
- ▭ Drill Pad
- ▭ Access Track

EA AMENDMENT P-EA-100658735

LOCATION OF SENSITIVE RECEPTORS



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6.3

6.3.1.2 Acoustic Environment

Historical noise monitoring results obtained from measurements completed by SLR have been used to inform the assessment criteria for the Project. The baseline noise levels are summarised in **Table 6.11** and have been conservatively applied to the assessment.

All items of acoustic instrumentation employed during the noise monitoring were set to A-weighted and 'Fast' response in accordance with the relevant Australian Standards and DESI's *Noise Measurement Manual* (EPA 2020). All items of acoustic instrumentation employed during the noise measurement surveys were designed to comply with AS/NZS IEC 61672.1-2019 *Electroacoustics-Sound level meters-Specifications* and carried current manufacturer calibration certificates.

Table 6.11 Baseline noise monitoring results summary

Monitoring Location	Description	Rating Background Level (dBA)		
		Day (7 am – 6 pm)	Evening (6 pm – 10 pm)	Night (10 pm – 7 am)
(ID 1) Old Denham Park Homestead	Noise logger located in south-eastern corner of front yard, approximately 15 m from the homestead	28	25	25
(ID 6) Burton Downs Homestead	Noise logger located in centre of front yard, approximately 100 m from the homestead (between homestead and working shed, next to fruit garden)	25	24	24
(ID 8) Riverside Homestead	Noise logger located in north-eastern corner of tennis court, approximately 40 m from the homestead	30	23	23
(ID 10) Eureka Accommodation Camp	Noise logger located ~200 m from Eureka Creek & ~500 m from Riverside Mine Road	36	39	36
(ID 11) Lapunyah Homestead	Noise logger located in south-eastern corner of front yard, approximately 20 m from the homestead	26	30	28

The following is noted from the existing baseline noise monitoring data:

- Excluding the Eureka Camp, Rating Background Levels (RBL) ranged from 25 dBA to 30 dBA during the daytime, and 23 dBA to 30 dBA during both the evening and night-time.
- The observed noise levels were typical of a rural environment with natural noise sources, such as birds, light wind in trees, insects, as well as mining noise contributions associated with the Goonyella Riverside Mine complex and CCM.
- RBLs at the Eureka Village ranged between 36 dBA to 39 dBA during the daytime, evening and night-time. The ambient noise environment at this location was largely controlled by local (i.e. camp-related) vehicle movements, mechanical plant noise from within the camp and noise from Goonyella Riverside Mine.

Of the above, the observation most relevant to this study is that background noise levels (in the context of the existing EA) were shown to be 30 dBA or lower during the day, evening and night-time assessment periods. This is expected to also be the case at other sensitive receptor locations listed in **Table 6.17**.



6.3.2 Potential Impacts

The following subsections detail the noise and vibration assessment methodology and potential impacts resulting from the activities described in **Section 3.0**.

6.3.2.1 Assessment Methodology

Modelling Parameters and Assumptions

A SoundPLAN (Version 8.2) computer noise model was developed to predict project noise levels at potentially impacted receptors. SoundPLAN is a computer model software package enabling calculation of environmental noise by combining a digitised ground map (topography), the location and acoustic sound power levels of potentially critical noise sources on site and the location of receivers for assessment purposes.

The Conservation of Clean Air and Water Europe (CONCAWE¹) industrial prediction algorithm has been used to model predicted noise levels from the Project. The statistical accuracy of environmental noise predictions using CONCAWE was investigated by Marsh (Applied Acoustics 15 – 1982). Marsh concluded that CONCAWE was accurate to ± 2 dBA in any one octave band between 63 hertz (Hz) and 4 kHz and ± 1 dBA overall.

In relation to the modelling of atmospheric conditions, DESI's *EcoAccess Planning for Noise Control* (PNC) guideline (retracted and currently undergoing review by DESI), provides guidance with respect to applying default atmospheric conditions for the assessment of mining operations. The default weather parameters recommended by the PNC guideline are summarised in **Table 6.12** and have been applied to the assessment of noise impacts from the Project.

Table 6.12 Modelled meteorological conditions

Parameter	Neutral Weather	Adverse Weather
Temperature	10oC	10oC
Humidity	70%	90%
Pasqual stability class	D	F (representative of temperature inversion)
Wind speed	0 m/s	2 m/s

Noise and Vibration Modelling Scenarios

The following provides an overview of the noise and vibration modelling completed to inform the assessment of the potential for noise and vibration impacts from the Project:

- New access track and drill pad construction:
 - The pre-drilling stage involving the development of the new access tracks and drill pads has been modelled based on the combined fleet of construction equipment listed in **Table 6.13** operating simultaneously. Noise from the new access tracks and drill pad construction activities have been modelled individually at every proposed access track and drill pad site with the highest (i.e. worst-case) noise level predicted at each receptor assessed against the noise criteria.

¹ Report no. 4/81 the propagation of noise from petroleum and petrochemical complexes to neighbouring communities



- Vibration modelling and assessment has been carried out for the 12t vibratory roller required for soil compaction as part of the earthmoving fleet.
- Drilling of vertical and lateral wells:
 - The modelling of well drilling noise has been conservatively based on the lateral well rig setup (spread) for all Project wells (i.e. both vertical and lateral wells), noting noise emission from the drilling of vertical wells will potentially be lower, given the smaller rig spread. Noise from the SIS drill rig have been modelled individually at every proposed drill site with the highest (i.e. worst-case) noise level predicted at each receptor assessed against the noise criteria. The modelled sound power level (SWL) data is summarised in **Table 6.13**.
 - No discernible sources of vibration are anticipated during this stage of the Project.
- Vertical and lateral well operation:
 - Modelling of worst-case operational noise from the Project has been based on the plant listed in **Table 6.13** all operating simultaneously at all proposed well sites. As can be seen by the significant difference in source SWLs, noise emission levels associated with this stage of the Project will be dominated by the vertical flare.
 - No discernible sources of vibration are anticipated during this stage of the Project.

Table 6.13 Modelled scenarios and equipment SWL data – A-weighted

Plant Item	Octave Band Centre Frequency (Hz)								Total SWL	Source Height
	63	125	250	500	1k	2k	4k	8k		
New access track and drill pad construction (note: fleet consists of one (1) of each item)										
Slasher	83	103	105	110	112	104	102	92	115	2.0 m
Dozer D8T	84	93	97	105	101	100	98	90	108	2.5 m
Vibratory roller (12t)	97	102	95	100	102	101	98	93	108	2.0 m
Water truck (30 kL)	84	90	95	100	100	99	95	85	106	2.5 m
Grader CAT 150	94	100	106	103	109	106	102	90	113	3.0 m
Well drilling (note: only one (1) rig proposed for well drilling)										
SIS drill rig	105	109	111	117	122	119	111	102	125	3.0 m
Well operation (note: well operational plant modelled at each well pad; other plant will also be required however the below represents the acoustically significant plant items required for the Project)										
Flare (500 L/sec)	95	106	113	118	116	115	111	108	123	6.0 m



Plant Item	Octave Band Centre Frequency (Hz)								Total SWL	Source Height
	63	125	250	500	1k	2k	4k	8k		
Well pumps	89	84	88	91	96	98	92	81	102	2.0 m
Generator 60kV diesel	78	85	86	83	85	85	79	65	92	1.5 m

6.3.2.2 New Access Tracks and Well Pad Development

Construction Noise

The predicted new access track and drill pad construction noise levels, under neutral and adverse weather conditions, are summarised in **Table 6.14**.

Construction of the new access tracks and drill pads is anticipated to occur during the hours of 6:00 am to 6:00 pm daily. As such, the EA noise limits for both the daytime period (i.e. 7:00 am to 6:00 pm) and night-time period (i.e. 6:00 am to 7:00 am) have been included for reference in **Table 6.14**.

Table 6.14 Predicted worst-case new access track and drill pad construction noise levels

Receptor	EA Noise Limit LA10,adj,10mins (dBA)		Predicted Construction Noise Level LA10,adj,10min (dBA)	
	6:00 am to 7:00 am	7:00 am to 6:00 pm	Adverse Weather	Neutral Weather
1 - Old Denham Park Homestead ¹	N/A	N/A	31	26
2 - Wards Well ¹	N/A	N/A	27	21
3 - Lancewood	33	35	14	<10
4 - Lenton Downs	33	35	13	<10
5 - Centurion Accommodation Camp	N/A	N/A	<10	<10
6 - Burton Downs	33	35	11	<10
7 - Red Hill Homestead	33	35	10	<10
8 - Riverside Homestead	33	35	10	<10
9 - Goonyella Riverside Mine Medical Centre ²	33	35	<10	<10
10 - Eureka Accommodation Camp ²	33	35	<10	<10
11 - Lapunyah Homestead ¹	33	35	15	<10
Note: Greyed cells indicate the receptor is either owned by CCM or a commercial agreement exists (i.e. non-sensitive receptors). Note 1: Receptor owned and operated by Stanmore SMC Pty Ltd. Note 2: Receptor owned and operated by BMA.				



From the noise modelling results presented in **Table 6.14**, the following is noted:

- Worst-case new access track and drill pad construction noise levels are predicted to comply with the EA noise limits at all sensitive receptors.
- The highest predicted noise level was 31 dBA LA10,adj,10mins at the Old Denham Park Homestead, which is noted to be owned by Stanmore SMC Pty Ltd with a commercial agreement in place between CCM and Stanmore.
- The highest predicted noise level at a privately-owned sensitive receptor was 14 dBA LA10,adj,10mins at Lancewood.

Construction Vibration

The current EA does not prescribe vibration limits, nor does it provide guidance in relation to the prevention of vibration impacts from activities occurring on ML 1790. Consequently, the potential for vibration impacts associated with the operation of the 12t vibratory roller (required as part of the earthworks fleet) has been assessed against the following criterion:

- Human comfort peak particle velocity (PPV) vibration limit of 5 mm/s, based on guidance from DESI's *Model Mining Conditions* Guideline (MMC).

It is noted the above criterion specifically refers to ground vibration from blasting, however it is considered that the vibration limits are relevant to the assessment of vibration from the Project vibratory compaction works, particularly given the temporary and short-term nature of these works. Notwithstanding this, vibration offset buffer distances to comply with the threshold of human perception (i.e. <0.15 mm/s²) have also been calculated and assessed for the Project.

Prediction of PPV vibration levels from the 12t roller has been based on the following methodology:

- Vibratory compaction – BS 5228-2:2009 Evaluation and measurement for vibration in buildings - Part 2 (plus 2014 Amendment), specifically Table E.1 'Empirical predictors for groundborne vibration arising from mechanized construction works'.

Vibratory compaction PPV vibration levels were calculated using the empirical formulae shown in **Image 6.3**.

Operation	Prediction question	Scaling factors (and probability of predicted value being exceeded)	Parameter range
Vibratory compaction (steady state)	$v_{res} = k_s \sqrt{n_d} \left[\frac{A}{x + L_d} \right]^{1.5}$	$k_s = 75$ (50%) $k_s = 143$ (33.3%) $k_s = 276$ (5%)	$1 \leq n_d \leq 2$ $0.4 \leq A \leq 1.72$ mm $2 \leq x \leq 110$ m
Vibratory compaction (start up and run down)	$v_{res} = k_t \sqrt{n_d} \left[\frac{A^{1.5}}{(x + L_d)^{1.3}} \right]$	$k_t = 65$ (50%) $k_t = 106$ (33.3%) $k_t = 177$ (5%)	$0.75 \leq L_d \leq 2.2$ m

Image 6.3 Empirical predictors for groundborne vibration from construction works

Source: Table E.1, Vibratory rolling – BS 5228-2:2009 Evaluation and measurement for vibration in buildings - Part 2 (plus 2014 Amendment)

² British Standard BS 5228-2:2009, *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*, states "Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV range of 0.14 mm/s to 0.3 mm/s".



Based on the formulae presented in **Image 6.3**, vibration offset buffer distances for the 12t roller have been calculated to inform the assessment:

- Approximately 30 m to comply with the 5 mm/s human comfort vibration limit.
- Approximately 480 m to be below the threshold of human perception (i.e. <0.15 mm/s).

Based on the above vibration offset buffer distances and the receptor to drill pad distances in Table 6.10 (i.e. 9.4 km to 13.2 km for privately-owned sensitive receptors), the risk of vibration-related impacts is negligible for any sensitive receptor during the vibratory compaction works.

6.3.2.3 Vertical and Lateral Well Drilling

The predicted vertical and lateral well drilling noise levels, under neutral and adverse weather conditions, are summarised in **Table 6.15** and are assessed against the daytime and night-time period noise limits.

Table 6.15 Predicted worst-case CSG exploration drilling noise levels

Receptor	EA Noise Limit LA10,adj,10mins (dBA)		Predicted Drilling Noise Level LA10,adj,10min (dBA)	
	6:00 am to 7:00 am	7:00 am to 6:00 pm	Adverse Weather	Neutral Weather
1 - Old Denham Park Homestead ¹	N/A	N/A	37	31
2 - Wards Well ¹	N/A	N/A	32	26
3 - Lancewood	33	35	17	10
4 - Lenton Downs	33	35	16	<10
5 - Centurion Accommodation Camp	N/A	N/A	<10	<10
6 - Burton Downs	33	35	13	<10
7 - Red Hill Homestead	33	35	12	<10
8 - Riverside Homestead	33	35	12	<10
9 - Goonyella Riverside Mine Medical Centre ²	33	35	11	<10
10 - Eureka Accommodation Camp ²	33	35	<10	<10
11 - Lapunyah Homestead ¹	33	35	17	10
Note: Greyed cells indicate the receptor is either owned by CCM or a commercial agreement exists (i.e. non-sensitive receptors). Note 1: Receptor owned and operated by Stanmore SMC Pty Ltd. Note 2: Receptor owned and operated by BMA.				

The noise prediction modelling results shown in **Table 6.14** and **Table 6.15** indicate the following:



- Worst-case drilling noise levels are predicted to comply with the EA noise limits at all sensitive receptors.
- The highest predicted noise level at a privately-owned sensitive receptor was 17 dBA LA10,adj,10mins at Lancewood.

6.3.2.4 Vertical and Lateral Well Operation

The predicted vertical and lateral well operational noise levels under neutral and adverse weather conditions, are summarised in **Table 6.16** and are assessed against the daytime and night-time period noise limits.

Table 6.16 Predicted worst-case CSG well operational noise levels

Receptor	EA Noise Limit LA10,adj,10mins (dBA)		Predicted CSG Well Noise Level LA10,adj,10min (dBA)	
	6:00 am to 7:00 am	7:00 am to 6:00 pm	Adverse Weather	Neutral Weather
1 - Old Denham Park Homestead 1	N/A	N/A	46	40
2 - Wards Well 1	N/A	N/A	41	34
3 - Lancewood	33	35	28	20
4 - Lenton Downs	33	35	26	19
5 - Centurion Accommodation Camp	N/A	N/A	<10	<10
6 - Burton Downs	33	35	24	17
7 - Red Hill Homestead	33	35	23	16
8 - Riverside Homestead	33	35	23	15
9 - Goonyella Riverside Mine Medical Centre 2	33	35	22	14
10 - Eureka Accommodation Camp 2	33	35	19	12
11 - Lapunyah Homestead 1	33	35	29	21
Note: Greyed cells indicate the receptor is either owned by Centurion Mine or a commercial agreement exists (i.e. non-sensitive receptors). Note 1: Receptor owned and operated by Stanmore SMC Pty Ltd. Note 2: Receptor owned and operated by BMA.				

The noise prediction modelling results shown in **Table 6.16** the following is noted:

- Worst-case CSG well operational noise levels are predicted to comply with the EA noise limits at all sensitive receptors.
- The highest predicted noise level at a privately-owned sensitive receptor was 28 dBA LA10,adj,10mins at Lancewood. The 6 m high vertical flares are the dominant source of noise during this stage of the Project.



6.3.3 Management Practices

The assessment of the potential for noise and vibration impacts to sensitive receptors has indicated that impacts would likely be avoided without the need for specific mitigation and management measures. Nonetheless, it is recommended that the following good practice measures are applied during the Project to assist with the control of noise and vibration levels:

- Use of the quietest available equipment to complete the earthworks, drilling and CSG flaring works.
- All plant and equipment should be operated in accordance with the manufacturer's instruction and regularly maintained in order to minimise noise emission levels.
- Lining pipe racks with rubber to dampen the metal-on-metal impact.
- Equipment should be shut down when not in use.
- Broadband "buzzer", not tonal "beeper", reversing alarms should be utilised on all mobile plant.

6.3.4 Risk Assessment

The potential noise and vibration impacts were assessed to provide an overall risk rating, which are presented in **Table 6.17**. The risk-based assessment has determined that noise and vibration impact to sensitive receptors surrounding the Project are low due to the scale and location of the Project activities.

Table 6.17 Noise and vibration risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Noise disturbance at sensitive receptors during new access track and drill pad construction works	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm
Vibration disturbance at sensitive receptors during vibratory compaction associated with new access track and drill pad construction works	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm
Noise disturbance at sensitive receptors during CSG exploration drilling works	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm
Noise disturbance at sensitive receptors during CSG flaring operations	Unlikely (2)	Low (2)	Low	Due to the minor scale and size of the Project activities, and the distance to the sensitive receptors, this potential impact poses a low risk of environmental harm



6.4 Land Resources

This section presents the assessment of Project related land resource impacts to environmental values.

6.4.1 Existing Environmental Values

6.4.1.1 Surface Geology

The Project is located within the Nogoa-Belyando region, which comprises of gently undulating Tertiary land surface that was depositional over extensive lowland areas (SKM 2012). **Table 6.18** translates lithologies (Department of Resources 2023) within the Project area, as illustrated in **Figure 6.4**.

Table 6.18 Surface geology lithological summary

Map Symbol	Legend	Lithological Summary	Age
TQr\>Pwt	TQr\>QLD>Fort Cooper Coal Measures (TQr\>Pwt)	Older residual soils, colluvium (ferruginous soils)	Late Tertiary - Quaternary
Pwt	Fort Cooper Coal Measures (Pwt)	Lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff, tuffaceous (cherty) mudstone	Late Permian
TQr\>Pb	TQr\>QLD>Back Creek Group (TQr\>Pb)	Older residual soils, colluvium (ferruginous)	Late Tertiary - Quaternary
TQa	TQa-(TQa)	Locally red-brown mottled, poorly consolidated sand, silt, clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected)	Late Tertiary - Quaternary
TQr>Tu	TQr-QLD>Suttor Formation (TQr>Tu)	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)	Late Tertiary - Quaternary
TQr>Tb	TQr-QLD>Tb-(TQr>Tb)	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)	Late Tertiary - Quaternary
TQr\>	TQr\>-(TQr\>)	Older residual soils, colluvium (ferruginous)	Late Tertiary - Quaternary
Tb	Tb-(Tb)	Mostly olivine basalt flows and some plugs; some areas of nephelinite, basanite etc	Tertiary

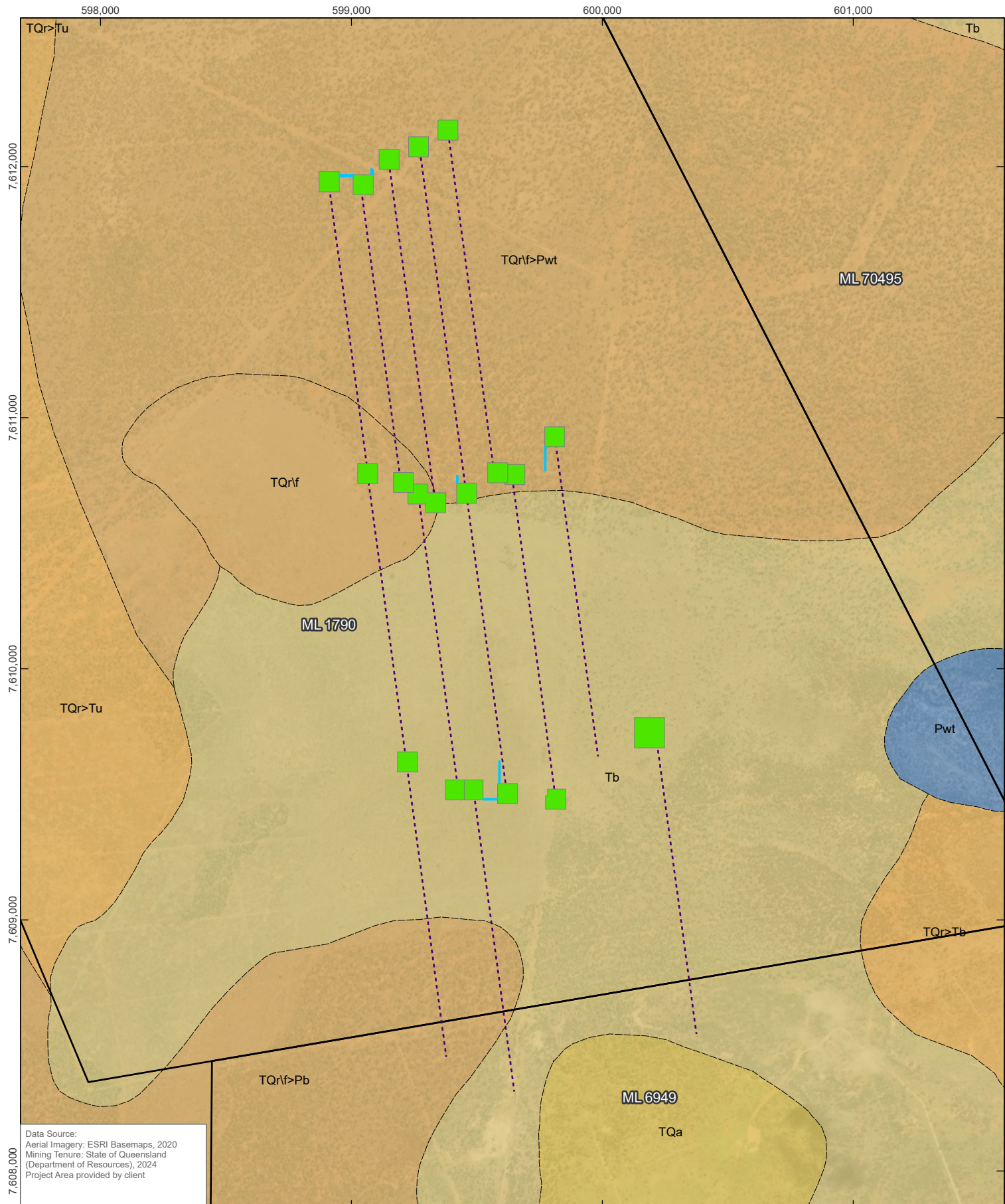


6.4.1.2 Soil Mapping Units

Within the disturbances areas of the Project, only one soil mapping unit (**Figure 6.4**) is identified utilising the Queensland Government Department of Resources (2018) database. It uses The Atlas of Australian Soils compiled by during the 1960's period to create a standardised Australian national description of soils.

The disturbance area is dominated by the unit My28 (**Figure 6.5**) and is described as gently undulating lands with broad ridge crests and low rises. Dominant soils are loamy or occasionally sandy red earths.





Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:20,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

LEGEND

- Lateral Well Length
- Drill Pad
- Access Track
- Mining Lease

Surface Geology

- Geological boundary approximate
- Fort Cooper Coal Measures (Pwt)
- TQa-QLD (TQa)
- TQr-QLD>Suttor Formation (TQr>Tu)
- TQr-QLD>Tb-QLD (TQr>Tb)

- TQr-f-QLD (TQr-f)
- TQr-f-QLD>Back Creek Group (TQr-f>Pb)
- TQr-f-QLD>Fort Cooper Coal Measures (TQr-f>Pwt)
- Tb-QLD (Tb)

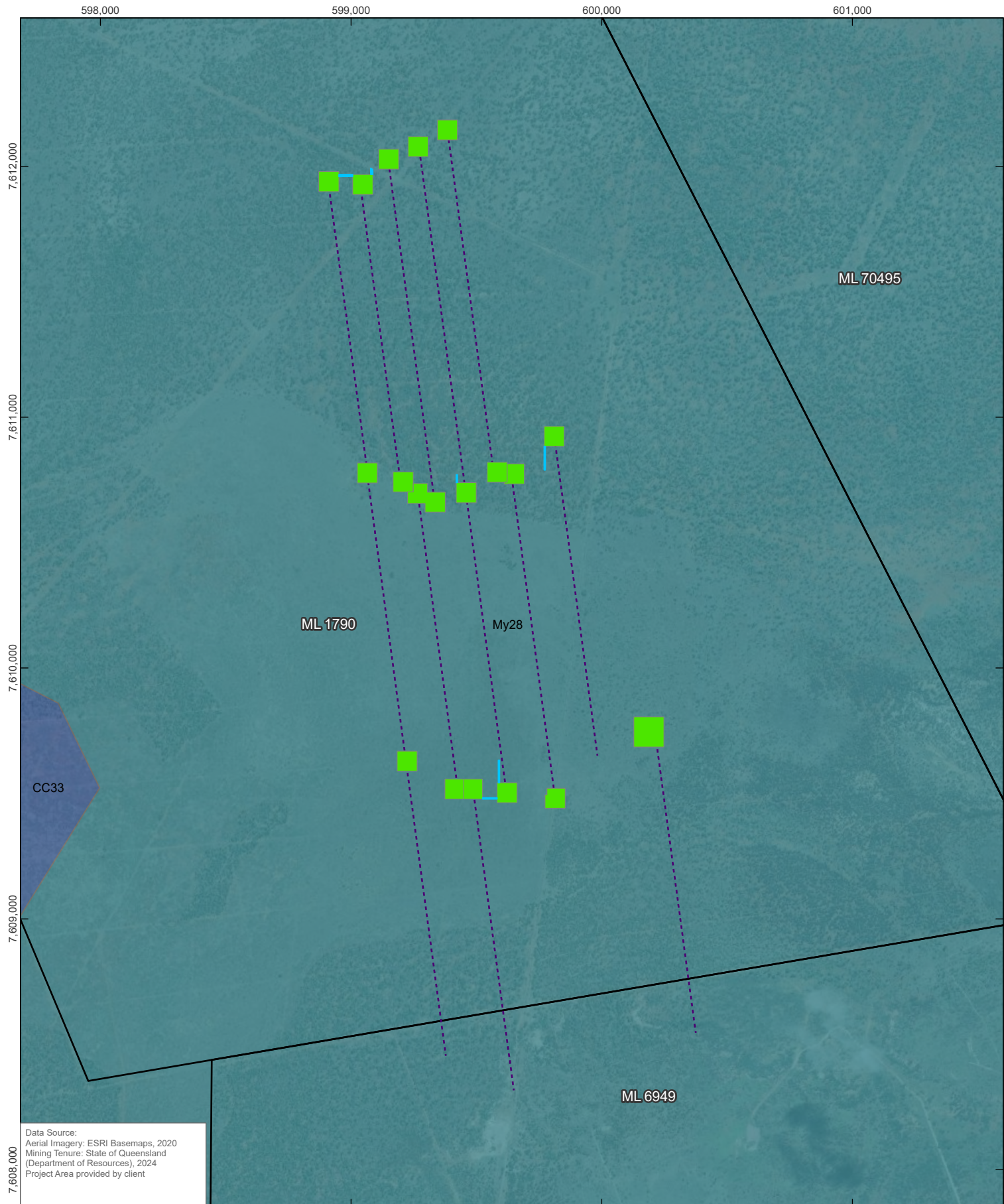
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SURFACE GEOLOGY



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FIGURE 6.4



Data Source:
 Aerial Imagery: ESRI Basemaps, 2020
 Mining Tenure: State of Queensland
 (Department of Resources), 2024
 Project Area provided by client

	0 0.3 0.5 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	620.040594.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

LEGEND

-  Lateral Well Length
-  Drill Pad
-  Access Track
-  Mining Lease

Atlas of Australian Soils

Map Unit

-  CC33
-  My28

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ATLAS OF AUSTRALIAN SOILS



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FIGURE 6.5

6.4.1.3 Soil Orders

Soil units for most of the Project Area was mapped by (2012) as part of the *Wards Well: Soil Survey*. completed detailed soil descriptions at 98 locations and 384 observation sites. A section of the disturbance area to the south of the Project Area was not classified by SKM (**Figure 6.6**). The broad scale regional soil mapping (DNRME and DES 2024) was accessed to determine the soil order (**Figure 6.7**). The major soil orders present on site are Vertosol, Dermosol and Kandosol. The dominant properties of each soil order are provided below.

Vertosol

The soil profile is predominantly clayey, with the surface soil typically consisting of light clay containing over 35% clay content. The subsoil varies from light to medium or heavy clay. Due to the characteristics of the clay minerals, these soils undergo significant shrinkage and swelling during wetting and drying cycles. When dry, they develop noticeable cracks that usually extend to the soil surface (VRO 2021).

On-site (SKM 2012), the observed Vertosols have a well-developed structure and high clay content, with most being utilized for grazing in the region. These cracking clays typically range from very dark brown to dark greyish black, consisting of medium to heavy clays. They are moderately to well-drained, generally alkaline, and become increasingly alkaline with depth.

Further observations include:

- Overall good fertility.
- Sodicity and salinity increase below 300 mm, restricting plant rooting depth and plant-available water capacity (PAWC) with probability of soils becoming epihypersodic³.
- Desirable pH levels.
- High levels of nitrates, phosphorus and metals.
- Well-structured surface soil (high organic matter and calcium relative to magnesium), though it may become dispersive below 300 mm.

Dermosol

Dermosols are characterized by a strong texture transition between the A and B horizons and are not uniformly calcareous. They feature moderately to strongly structured B2 horizons, which are typically clayey and contain less than 5% free iron oxides. In arid regions, Dermosols are commonly found on low-angle pediments with sparse shrublands.

Within the mining lease (SKM, 2012), Dermosols have been observed to have the following properties:

- Overall low fertility (low levels of phosphorus and nitrogen).
- Sodicity and dispersiveness increase below 200 mm.
- pH at desirable levels.

³ Extremely high levels of exchangeable sodium within the upper part of the soil profile. Soil with very high exchangeable sodium percentage (ESP), typically in the range of 15% or more, which is considered detrimental to soil health.



- Poor surface soil structure (low organic matter and apedal) with dispersiveness below 200 mm; other tested Dermosols showed dispersiveness below 700 mm.

Kandosol

Kandosols are non-texture contrast soils (with little or gradual increase in clay content with depth) that have massive (i.e. weakly to non-structured) subsoils (B horizons). They are found mainly in the upland areas, often in association with Dermosols, Chromosols and Kurosols. These soils can vary from stony hardsetting soils to deeper friable soils. Some may almost be texture contrast and have a bleached subsurface (A2) horizon (VRO 2021).

Kandosols are often found in conjunction with ferricrete deposits, within level to gently undulating plains. Their parent material usually consists of quartz-rich sedimentary rock. They are often greater than 3m deep and clay rich. The Kandosols within the Project area have been observed with the following (SKM 2012):

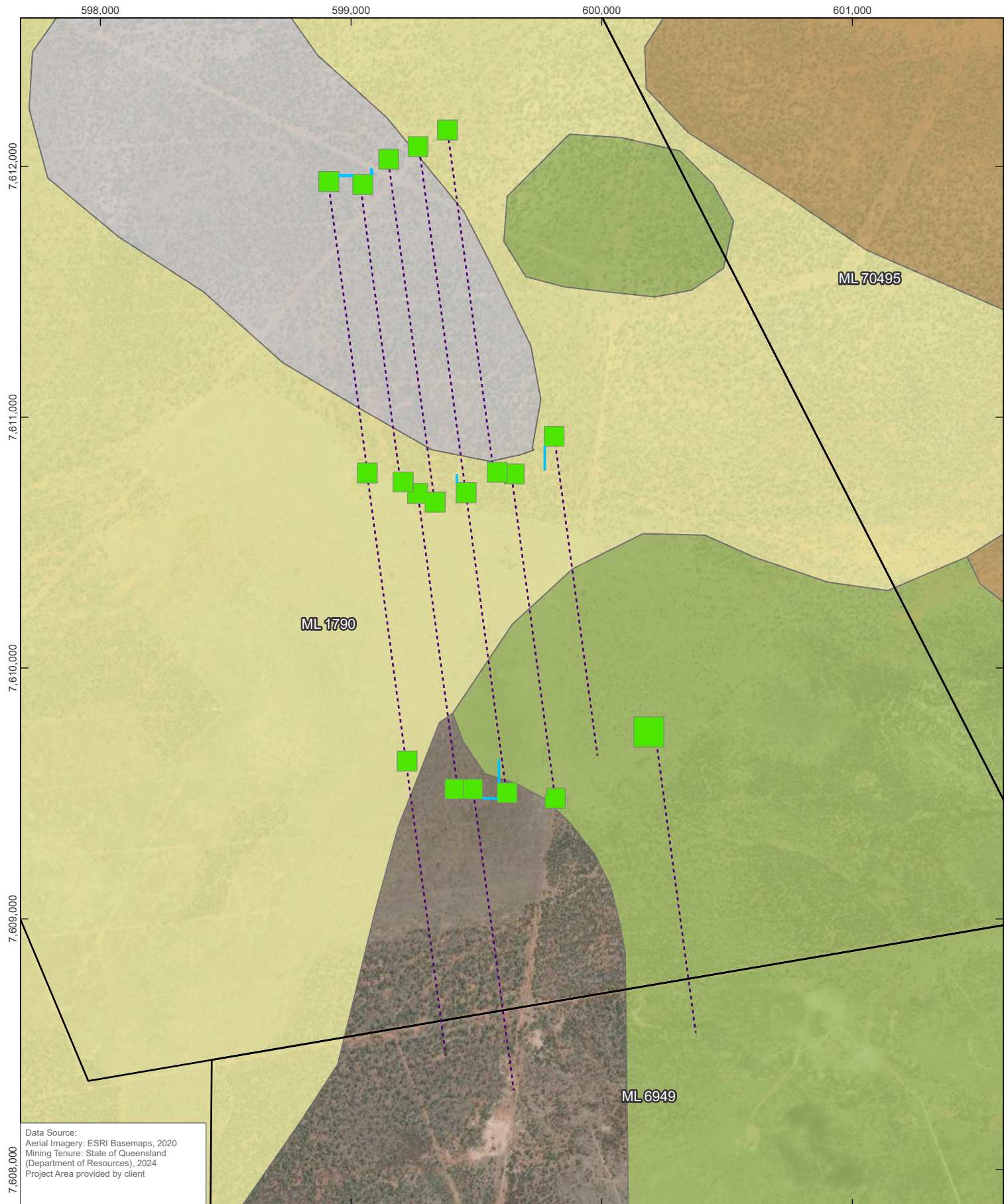
- pH is within desirable range.
- Good soil structure.
- Moderate overall fertility (high levels of nitrogen, adequate phosphorus and metals, low sulphate at surface and low to moderate cation exchange capacity (CEC)).

A summary of chemical properties (**Table 6.19**) of these soil orders have been extracted from Wards Well Mine (BHP, 2021). Further details of each soil order are presented in the following sections.

Table 6.19 Soil order chemical properties summary

Parameter	Unit	Vertosol	Dermosol	Kandosol
pH1:5 water	N/A	7.8 - 8.6	7.2 - 7.8	6.7 – 7.5
Electrical conductivity (1:5 water)	dS/m	0.1 - 0.66	0.025 - 0.15	0.014 – 0.034
Plant available water content	mm	125 - 450	100 - >125	>125
Organic carbon	%	5.1	1.4	3.6
Cation exchange capacity	cmol/kg	57 - 72.4	8.1 - 20.3	17.4 – 31
Exchangeable sodium percentage	%	0 - 12	5 – 11	0 – 5
Calcium to magnesium ratio	N/A	1.1 - 2.1	0.8 – 1.2	1.2 – 1.7
Productivity	-	Predominate soil type in the region. Soil properties sufficient to support grasses and native trees	Suitable for rehabilitation for cattle grazing on flat to gentle slopes	Suitable for rehabilitation of steeper slopes due to good soil structure





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:20,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

--- Lateral Well Length

■ Drill Pad

— Access Track

□ Mining Lease

Australian Soil Classification (SKM, 2012)

■ Dermosol

■ Kandasols

■ Sodosol

■ Vertosol

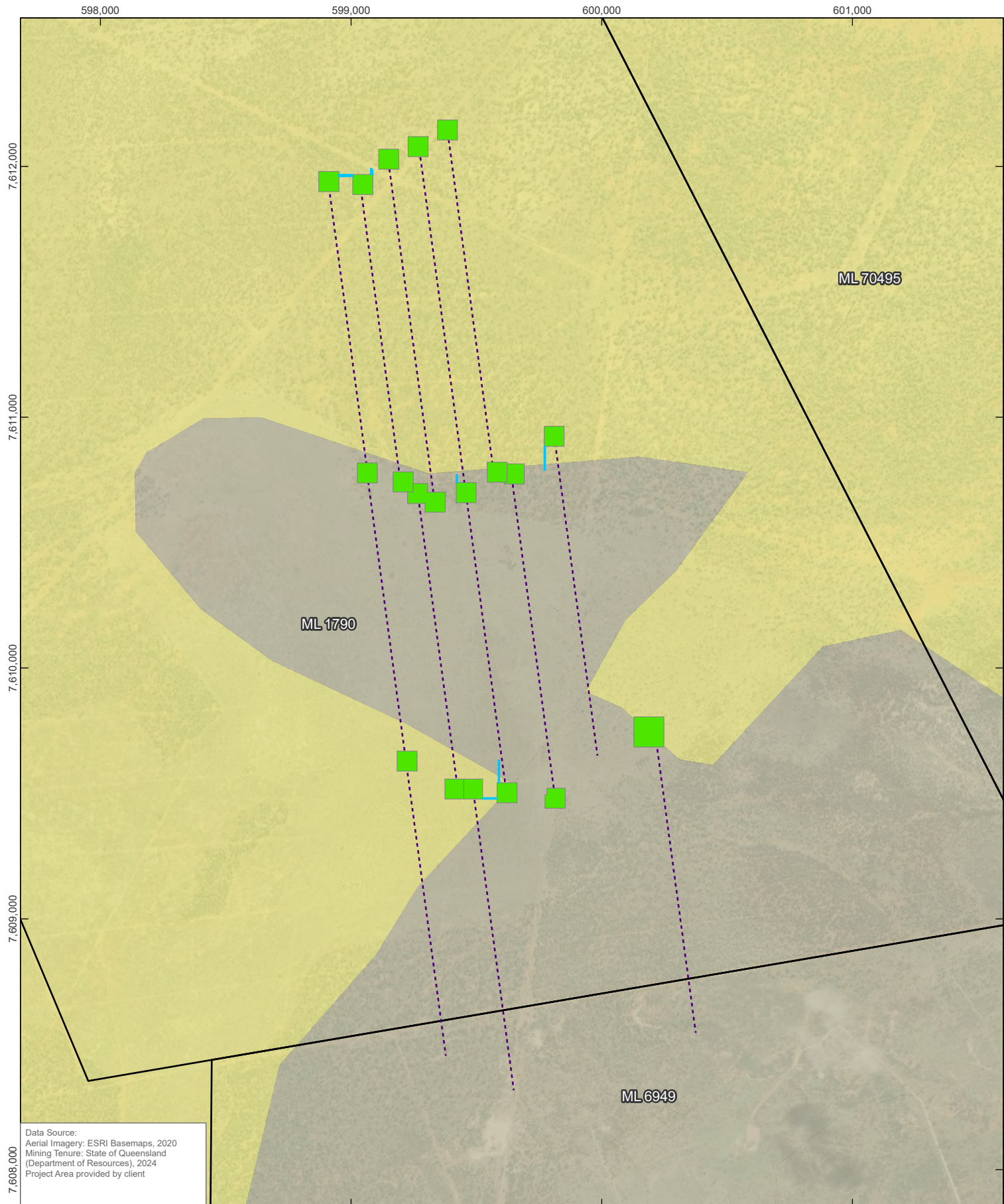
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**AUSTRALIAN SOIL
CLASSIFICATION OF PROJECT
AREAS (SKM, 2012)**



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FIGURE 6.6



 0 0.3 0.5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:20,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

LEGEND

-  Lateral Well Length
-  Drill Pad
-  Access Track
-  Mining Lease

Australian Soil Classification (DNRME and DES, 2024)

-  Kandosol
-  Vertosol

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**AUSTRALIAN SOIL
CLASSIFICATION OF PROJECT
AREAS (DNRME AND DES, 2024)**



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FIGURE 6.7

6.4.1.4 Land Use

Most of the Project Area is currently utilised for cattle grazing on buffel and native grasses, which were in good condition during the survey completed by (2012). The vegetation in the area includes natural bush consisting of Poplar Box, Bloodwood, Ironbark, Acacia, Wattle and Brigalow species. The environmental values of terrestrial ecology and vegetation are described in further detail in **Section 6.5** and **Section 6.6**.

6.4.1.5 Land Suitability

Five land suitability classes are defined for use in Queensland, with land suitability decreasing progressively from Class 1 to Class 5 (**Table 6.24**). These classes are used to describe an area of land in terms of suitability for a particular land use which allows optimum, sustainable production with current technology while minimising degradation to the land resource in the short, medium or long-term (Queensland Government 2013). Land suitability deals with land specific uses, which in this case are grazing and cropping.

An overall suitability class for each land use is then determined for each mapping unit on a scale of 1 to 5. This is usually determined by the most severe suitability subclass that applies in that particular mapping unit.

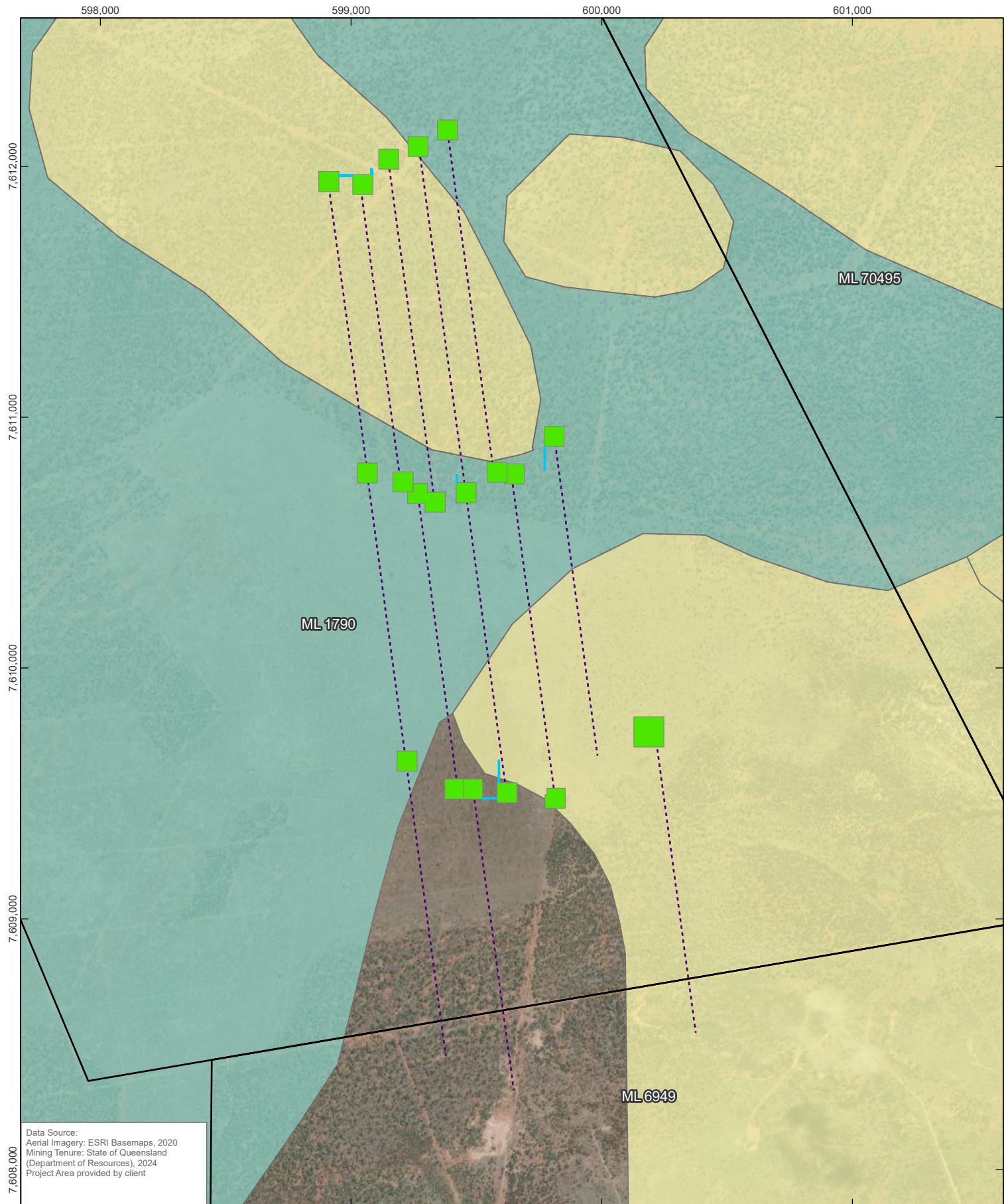
Land suitability for the Project Area was classified by (2012) using the Department of Minerals and Energy (1995) *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland* (1995) and the grazing and cropping guidelines in Shields and Williams (1991) *Land Resource Survey and Evaluation of the Kilcummin Area, Queensland*.

Vertosol and Dermosol were Class 3 for grazing and Class 4 for cropping and Kandosol Class 2 for grazing and Class 3 for cropping (**Figure 6.8** and **Figure 6.9**). The soil survey did not evaluate the full Project Area. The area between the Kandosols and Dermosols in the southern extend of the Project Area was not evaluated. Following a conservative approach, it is assumed that this area is classified as the higher of the two land suitability classes between which it is located.

Table 6.20 Queensland suitability classes

Class	Description
1	Highly productive land requiring only simple management practices to maintain economic production.
2	Land with limitations that either constrain production or require more than the simple management practices of class 1 land to maintain economic production.
3	Land with limitations that either further constrain production or require more than those management practices of class 2 land to maintain economic production.
4	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics or technology.
5	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:20,000 at A4

Project Number: 620.040594.00001

Date Drawn: 10-Sep-2024

Drawn by: RB

LEGEND

--- Lateral Well Length

■ Drill Pad

— Access Track

□ Mining Lease

Land Suitable for Grazing

■ 2 - Suitable grazing land with minor limitations (Kandasols)

■ 3 - Suitable grazing land with moderate limitations (Dermosols, Sodosols, Vertosols)

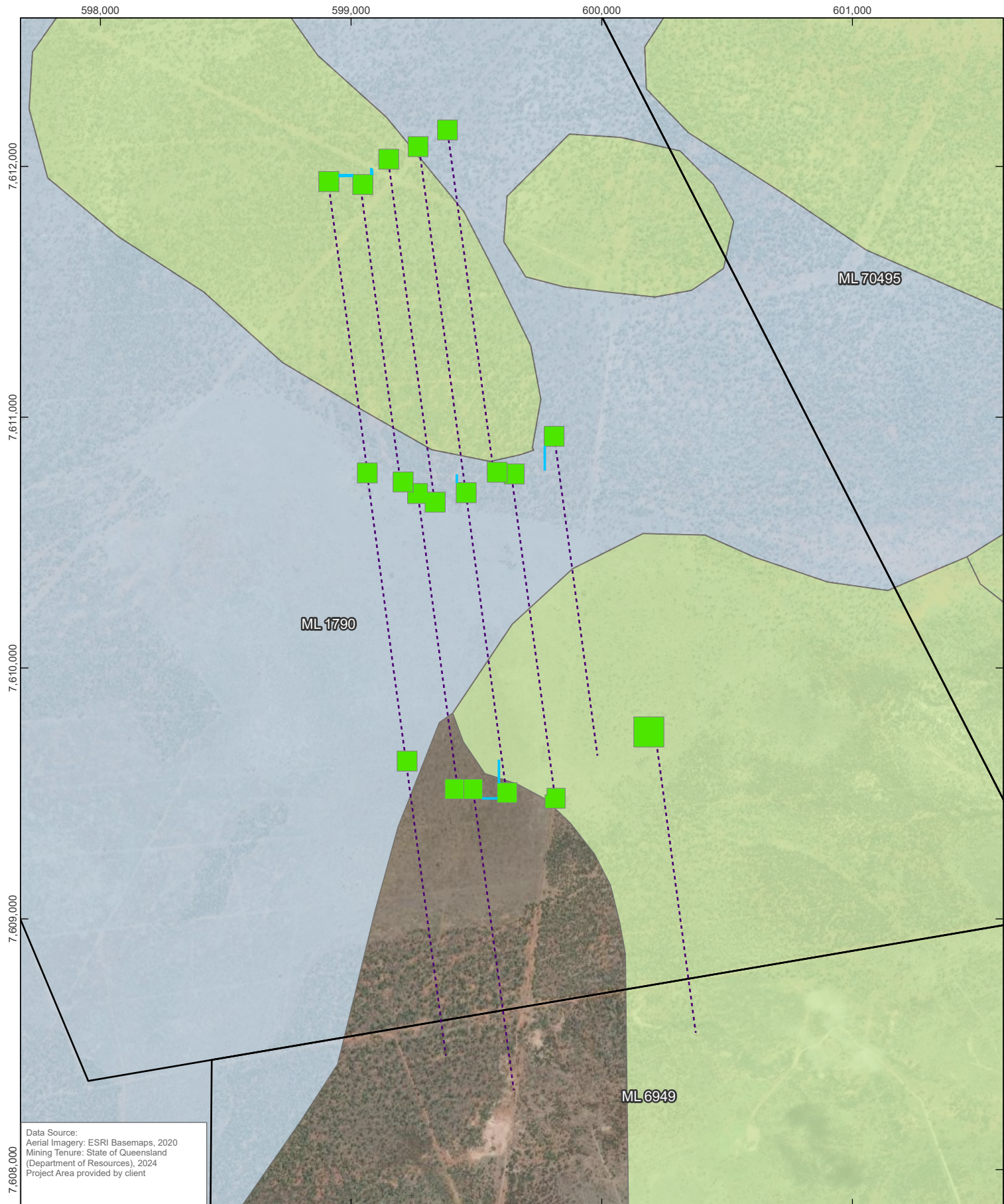
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**GRAZING LAND CLASS
SUITABILITY**



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FIGURE 6.8



Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:20,000 at A4
Project Number: 620.040594.00001
Date Drawn: 10-Sep-2024
Drawn by: RB

LEGEND

- Lateral Well Length
- Drill Pad
- Access Track
- Mining Lease

Land Suitable for Cropping

- 3 - Cropping land with moderate limitations (Kandasols)
- 4 - Marginal cropping land (Dermosols, Sodosols, Vertosols)

EA AMENDMENT P-EA-100658735

**CROPPING LAND CLASS
SUITABILITY**



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FIGURE 6.9

6.4.1.6 Regional Interest Areas

This desktop strategic cropping land (SCL) assessment has been prepared generally in accordance with the requirements of the following relevant strategic land use planning documents:

- Regional Planning Interests Act 2014 (Act) (DSDMIP 2014).
- Regional Planning Interests Regulation 2014 (Regulation) (DSDMIP 2014).
- Act Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land (State of Queensland, 2014) (Guideline) (State of Queensland 2014).

The Act commenced in 2014 and replaced the repealed Act. The Act is designed to manage the impact of resource activities and other regulated activities on areas of the State that contribute, or are likely to contribute, to Queensland's economic, social and environmental prosperity. The relevant aspects of the Act, as with regard to this report, are as follows:

- The Act incorporates the current zonal criteria and on-ground guideline for assessing whether a property (or part of a property) is SCL.
- The Act does not allow the mapping of an Area of Regional Interest (ARI) to be challenged by proponents or third parties. However, through the process of a Regional Impact Development Approval (RIDA) application this will in essence determine if land is or not according to the Assessment Criteria contained in the Guideline. These criteria detailed are generally equivalent to those in the repealed Act.

The Project is located within the Western Cropping Zone. Four of the proposed drill pads and wells are located on trigger mapped SCL.

Resource activities that were the subject of a Protection Decision or Compliance Certificate do not need to obtain another approval in relation to for the approved activities.

The Strategic Cropping Land Standard conditions code for resource activities contains the standard conditions that were applied to certain resource activities that were triggered for assessment under the *Strategic Cropping Land Act 2011*. A compliance certificate was issued in November 2013 for ML1790 (Application Reference SCLRD2013/000151).

6.4.2 Potential Impacts

The following subsections detail the potential land and soil impacts as a result of the Project activities described in **Section 3.0**.

A risk-based assessment of these potential impacts are detailed in **Table 6.21** and determined that land resource and soil impacts are low due to the scale and location of the Project activities.

The Project consists of activities relevant to Condition 15 Schedule A, Condition 7 Schedule F, and Condition 22 Schedule F in P-EA-100658735. Key activities which may have an impact on the land resource and soil include:

- New access tracks (5 metres wide) totalling 0.31 km in length will be slashed to allow vehicle access. This will result in approximately 0.20 ha of ground disturbance.
- Construction of 19 drill pads, each 80 x 80 metres in size, will disturb a total of 12.65 ha. This includes 11.8 ha of new disturbance and 0.82 ha of previously approved disturbance.



- Construction of water management features such as holding ponds and bunds on the drill pads.
- The development of 13 vertical wells and 10 lateral wells requires clearing and preparing the drill pad areas.
- Placement of mobile offices, workshops, and other temporary facilities at the drill pad sites will involve localised ground preparation and disturbance.

These areas will involve vegetation removal, topsoil stockpiling and surface preparation for construction and operation activities.

6.4.2.1 Construction

The construction phase involves land disturbance, including site preparation, access track and drill pad clearance and the installation of infrastructure such as vertical and lateral wells. During this phase, soil compaction, erosion and loss of topsoil are primary concerns.

Impacts associated with the construction phase include:

- Increased erosion resulting from ground disturbance, vegetation clearance, alteration of natural drainage and flow concentration due to construction activities that disturbs the ground.
- Exposure of sodic and saline subsoils from soil profile inversion during ground disturbance.
- Deposition of eroded material downslope or downstream.
- Soil compaction from spoil placement or access tracks and laydown areas, potentially affecting long term cropping and grazing productivity.

6.4.2.2 Operation

During the operational phase, the risk to land resource and soil includes:

- Soil contamination from chemical spills, leaks from gas wells and improper management of wastewater.
- Increased erosion and deposition of eroded material downslope/downstream resulting from alteration of natural runoff regimes.
- Presence of heavy machinery can also result in soil compaction, reducing soil porosity and water infiltration, which may affect both the soil's biological activity and agricultural potential.

6.4.2.3 Closure and Rehabilitation

The closure and rehabilitation phase are focused on restoring the soil and ecosystem after Project activities cease. During this phase, the main goal is to address any damage caused by de-compacting soils, re-establishing vegetation and ensuring proper drainage systems are in place to prevent erosion. Risks associated with this phase include:

- Increased erosion resulting from ground disturbance and vegetation clearance.
- Soil not meeting requirements for post development land use.
- Insufficient topsoil to reinstate vegetation.



6.4.3 Management Practices

The potential impacts will be managed through current practices. The following general mitigation measures are to be implemented by the Project to minimise the extent and severity of land disturbance and constraints on rehabilitation, thus minimising risks that could result in environmental impacts:

- Clearing will occur within the area approved via the Permit to Disturb process.
- Minimise land disturbance with the smallest practical area of land being disturbed in the shortest practicable time.
- Erosion and sediment control measures will be implemented prior to any clearing activities where required.
- Establish clear delineation of disturbance boundary limits of works prior to commencement of clearing and soil stripping.
- Disturbance to be undertaken in consideration of water flows that could affect land resources during early construction activities.
- Topsoil will be stripped prior to construction and direct re-spread is the preferred method to minimise topsoil handling and reduce damage to soil structure and propagules.
- Strip soil according to designated profile depths, subject to further field investigations during stripping.
- Stripped and salvaged soil will be re-used within a short period of time in areas where rehabilitation immediately follows installation of infrastructure.
- Topsoil that is not directly re-spread will be stockpiled for re-use in rehabilitation.
- Surface of soil stockpiles to be left in as coarsely structured condition as possible to promote infiltration and minimise erosion until vegetation is established or suitable erosion controls have been applied.
- Appropriate surface water management measures will be implemented.
- Monitoring and maintenance of rehabilitation until post-mining land use criteria and relinquishment have been achieved.
- Appropriate storage and management of hydrocarbons and hazardous materials to prevent contamination of land e.g. bunding.

6.4.4 Risk Assessment

The potential land and soil impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.21**

The risk of land resource impacts is low. Any realised impacts will be low in comparison to the existing operations undertaken on ML1790.



Table 6.21 Land resources risk assessment

Stage	Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Construction	Increased erosion resulting from ground disturbance, vegetation clearance, alteration of natural drainage and flow concentration	Unlikely	Minor	Low	Erosion control measures such as drainage and sediment control will be implemented where required. Minimizing land disturbance and controlling water flow will reduce the risk of erosion.
Construction	Exposure of sodic and saline subsoils from soil profile inversion	Unlikely	Minor	Low	Topsoil stripping and controlled soil stockpiling will reduce the likelihood of exposure to sodic and saline subsoils.
Construction	Deposition of eroded material downslope or downstream	Unlikely	Minor	Low	Erosion control measures will be implemented where required to mitigate the deposition of eroded materials downslope.
Construction	Soil compaction from spoil placement or access tracks and laydown areas, potentially affecting long-term cropping and grazing productivity	Possible	Minor	Low	Limiting vehicle access and using designated tracks will reduce soil compaction. Compacted areas will be rehabilitated post-construction to restore productivity.
Operation	Soil contamination from chemical spills, leaks from gas wells, and improper management of wastewater	Unlikely	Minor	Low	Proper storage, bunding, and management of hydrocarbons and chemicals will minimize the risk of contamination.
Operation	Increased erosion and deposition of eroded material downslope/downstream resulting from alteration of natural runoff regime	Unlikely	Minor	Low	During operations, water from wells will be collected in water tanks located on drill pads to prevent erosion during operations.
Operation	Presence of heavy machinery can result in soil compaction, reducing soil porosity and water infiltration, affecting biological activity and agricultural potential	Possible	Minor	Low	Regular visual monitoring of compacted areas and decompaction during rehabilitation will help mitigate the impacts of machinery.



Stage	Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Closure and Rehabilitation	Increased erosion resulting from ground disturbance and vegetation clearance	Unlikely	Minor	Low	The re-establishment of vegetation and implementation of erosion control measures during closure will reduce erosion risks.
Closure and Rehabilitation	Soil not meeting requirements for post-development land use	Unlikely	Minor	Low	Rehabilitation will focus on restoring soil structure and quality to meet post-development land use requirements.
Closure and Rehabilitation	Insufficient topsoil to reinstate vegetation	Unlikely	Medium	Medium	Topsoil will be carefully stockpiled and re-used in rehabilitation, ensuring adequate supply for vegetation regrowth.



6.5 Terrestrial Ecology

This section presents the assessment of Project related terrestrial ecology impacts to environmental values.

6.5.1 Existing Environmental Values

The following subsections detail the existing EVs within the Project Area (see **Figure 3.2**) based on terrestrial ecological surveys undertaken to date. It also details the MSES impacted by the Project based on these findings.

6.5.1.1 Regional Ecosystems

A total of approximately 7.74 ha of remnant vegetation and 0.23 ha of mature regrowth were ground-truthed within the Project Area. A summary of REs and their associated vegetation condition and area is provided in Table 6.22 and depicted in **Figure 6.10**.

REs recorded within the Project Area comprised:

- 7.74 ha of remnant vegetation.
- 0.23 ha of mature regrowth vegetation.
- 4.89 ha of non-remnant vegetation comprising non-remnant young woody regrowth vegetation.

Table 6.22 Ground-truthed REs within the Project Area

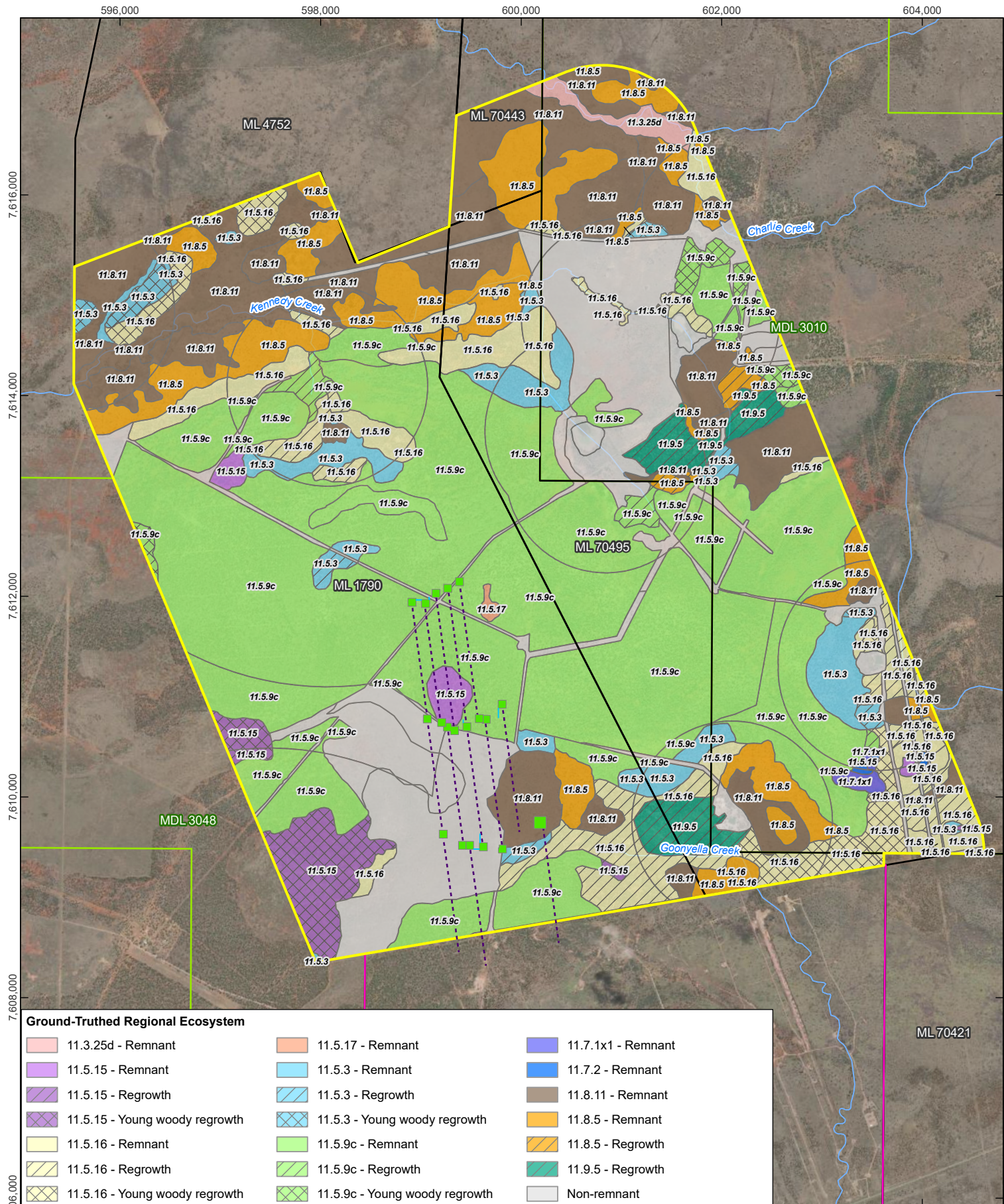
RE	RE description	RE type	Biodiversity status	VM Act class	Broad Vegetation Group	Area within Project Area (ha)
11.5.3	<i>Eucalyptus brownii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Mature regrowth	No concern at present	Least concern	17a	0.23
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland. Occurs on Cainozoic sandplains formed on plateaus and broad crests of hills and ranges. Soils are generally deep red earths.	Remnant	No concern at present	Least concern	18b	5.75
		Non-remnant: young woody regrowth	NA	NA	NA	4.89
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces	Remnant	Endangered	Least concern	7a	0.46
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks.	Remnant	Of concern	Of concern	30b	1.53

6.5.1.2 Threatened Ecological Communities

The Project Area intersects with 0.46 ha of the SEVT TEC. This TEC is mapped in association with a patch of remnant RE 11.5.15 which showed characteristic floristic and minimum structure requirements to be considered as the RE (**Figure 6.10**).

The Brigalow TEC and Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin TEC were identified as present within the Study Area, however neither are located within the Project Area.





Ground-Truthed Regional Ecosystem

11.3.25d - Remnant	11.5.17 - Remnant	11.7.1x1 - Remnant
11.5.15 - Remnant	11.5.3 - Remnant	11.7.2 - Remnant
11.5.15 - Regrowth	11.5.3 - Regrowth	11.8.11 - Remnant
11.5.15 - Young woody regrowth	11.5.3 - Young woody regrowth	11.8.5 - Remnant
11.5.16 - Remnant	11.5.9c - Remnant	11.8.5 - Regrowth
11.5.16 - Regrowth	11.5.9c - Regrowth	11.9.5 - Regrowth
11.5.16 - Young woody regrowth	11.5.9c - Young woody regrowth	Non-remnant

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

Study Area
 Mining Lease
 Centurion Coal Mine
 Mineral Development Licence

Lateral Well Length
 Drill Pad
 Access Track

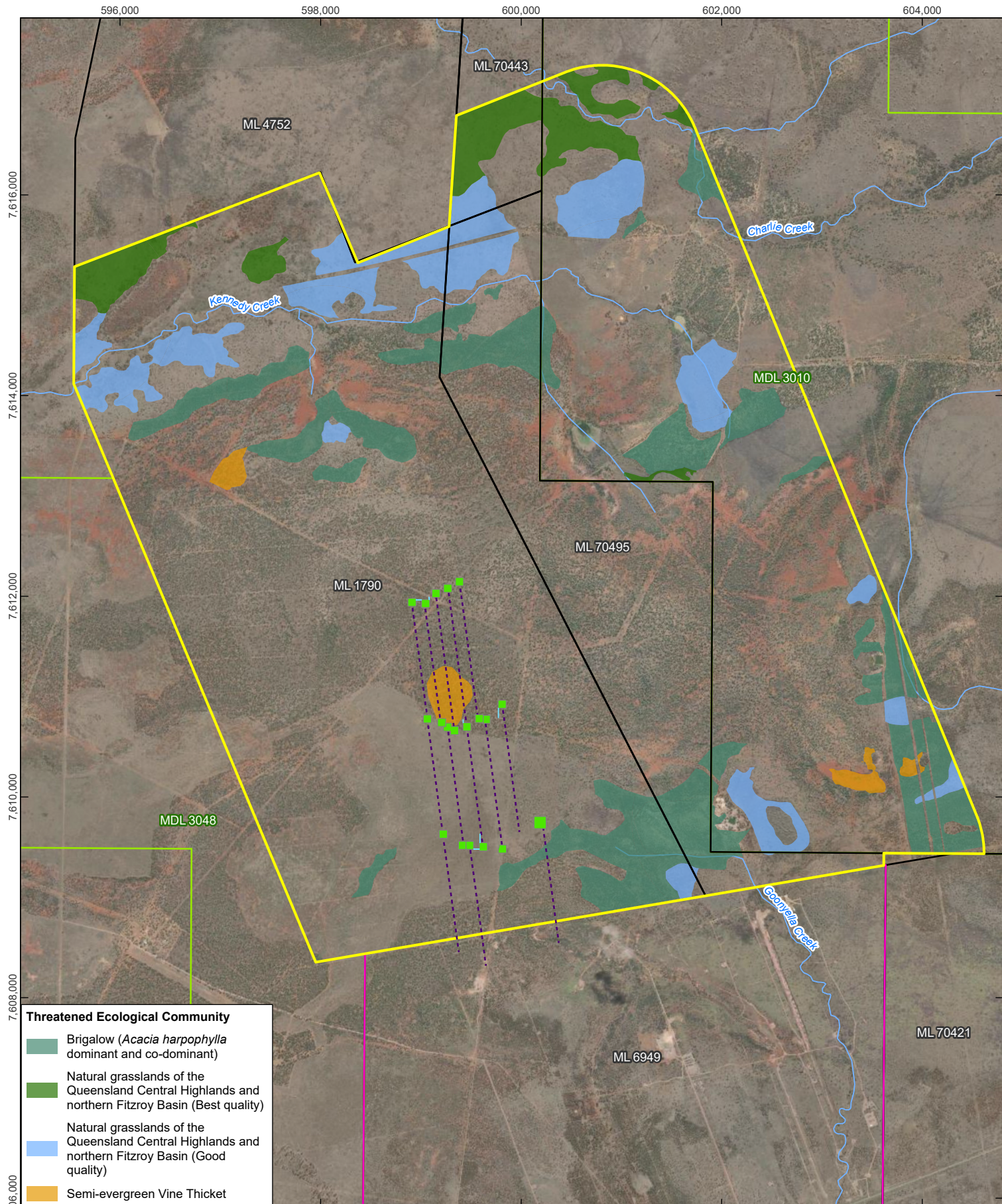
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**GROUND-TRUTHED
REGIONAL ECOSYSTEMS**



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FIGURE 6.10



Threatened Ecological Community

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Best quality)
- Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Good quality)
- Semi-evergreen Vine Thicket

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
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- Study Area
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THREATENED ECOLOGICAL COMMUNITIES



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FIGURE 6.11

6.5.1.3 Threatened Flora

The likelihood of occurrence assessment identified two threatened flora species that are known to occur within the Study Area. Given the presence of mapped habitat within the Project Area, these species are also considered known to occur within the Project Area. The species include:

- *Dichanthium queenslandicum* – Endangered under the EPBC Act and Nature Conservation Act 1992 (NC Act).
- *Digitaria porrecta* – Near Threatened under the NC Act.

Dichanthium Queenslandicum

There are no records for *D. queenslandicum* within the Project Area, however, 1,800 tussocks of this species were identified within the northern part of the Study Area in association with areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance.

Preferred habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance (RE 11.8.11 and 11.8.5) where records of *D. queenslandicum* were present within the Study Area.

The Project Area intercepts with 1.53 ha of preferred habitat for the species in RE 11.8.11 as shown in **Figure 6.12**.

Digitaria Porrecta

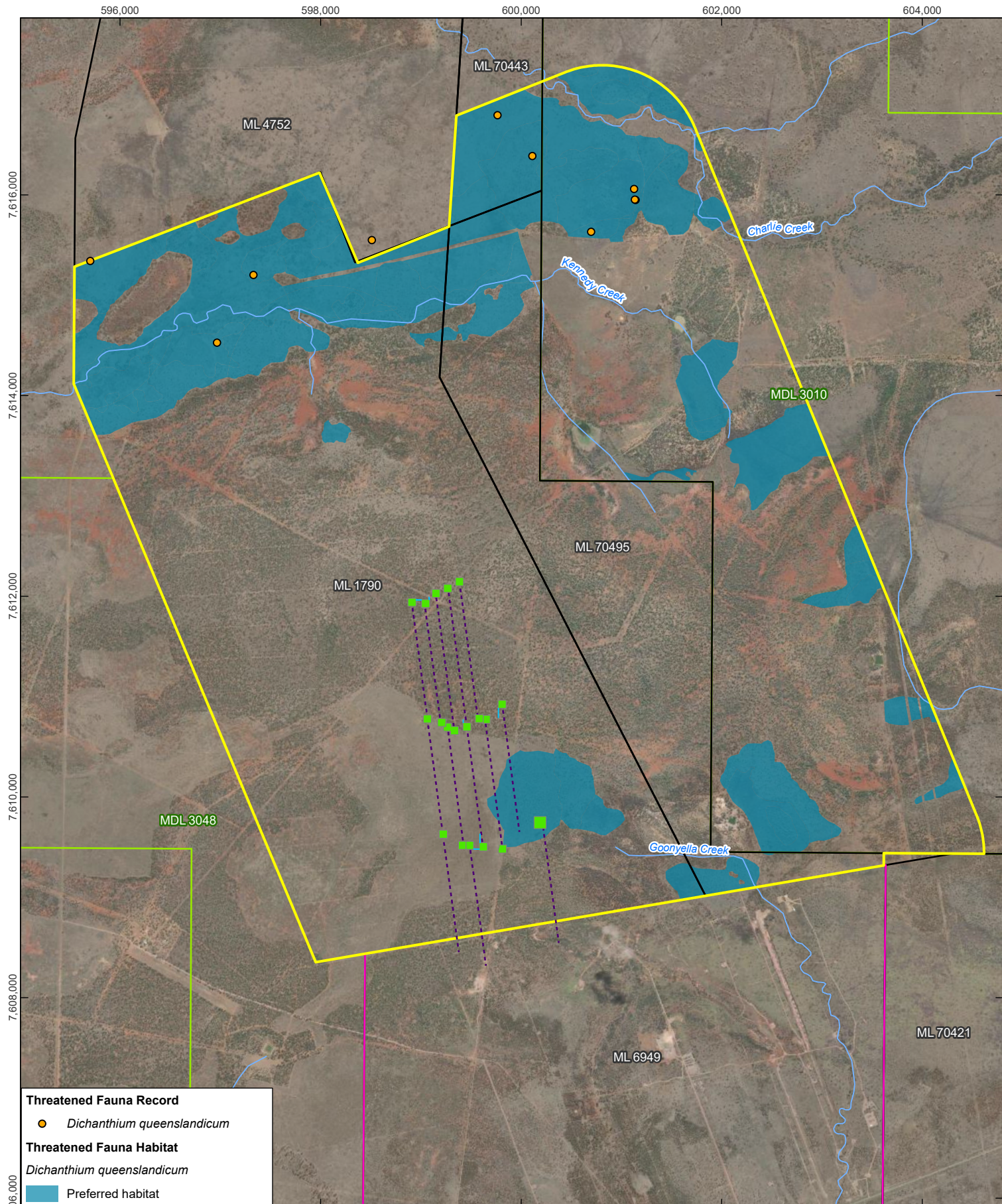
There are no records for *D. porrecta* within the Project Area, however, 71 tussocks were identified within the northern and central eastern part of the Study Area in associations with areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance.

Preferred habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant bluegrass grasslands and open woodlands on basalt plains with low weed abundance (RE 11.8.11 and 11.8.5) where records of *D. porrecta* were present within the Study Area.

The Project Area intercepts with 1.53 ha of preferred habitat for the species in RE 11.8.11 as shown in **Figure 6.13**.





Threatened Fauna Record

● *Dichanthium queenslandicum*

Threatened Fauna Habitat

Dichanthium queenslandicum

■ Preferred habitat

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

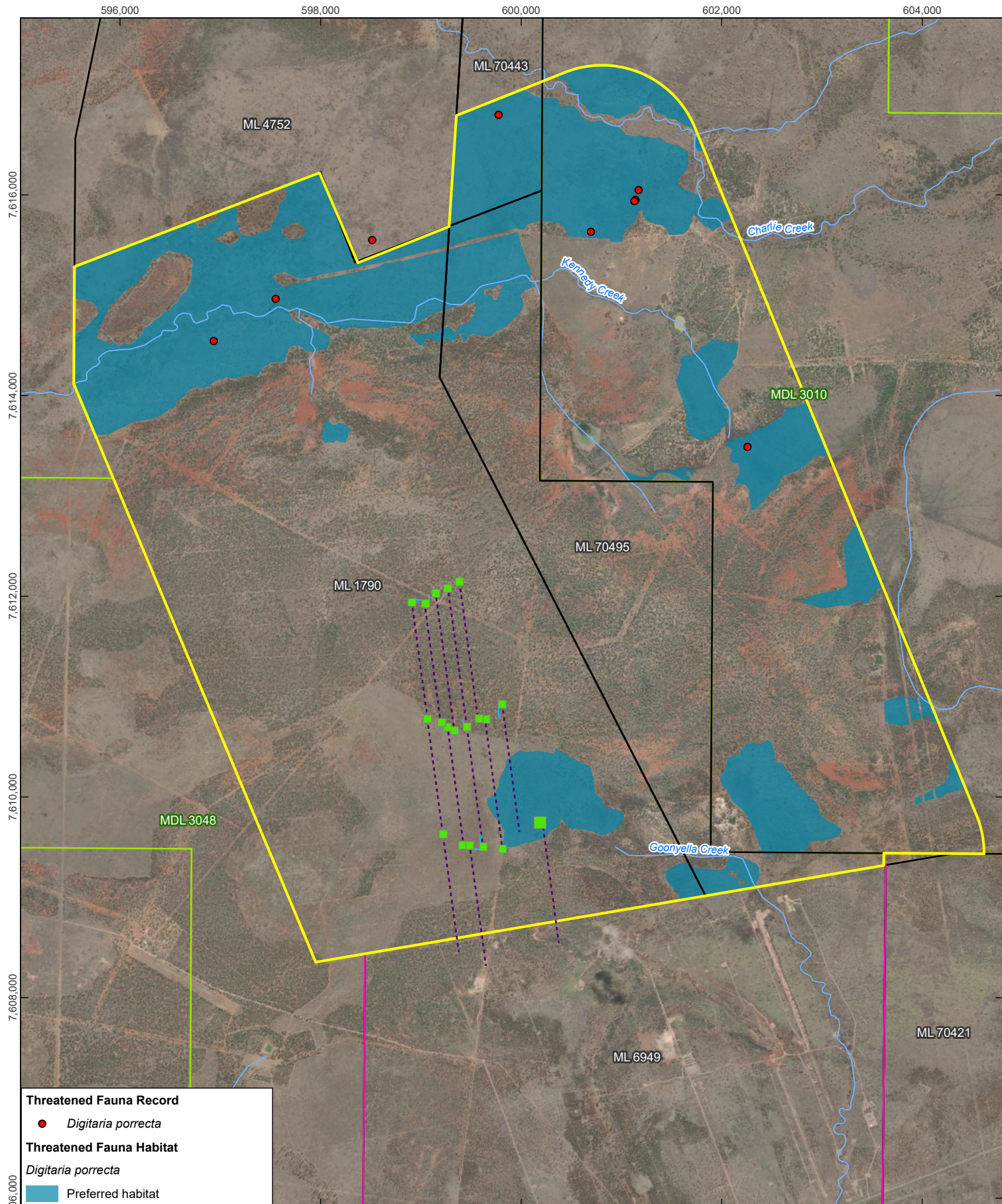
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**DICHANTHIUM
QUEENSLANDICUM
RECORDS AND HABITAT**



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FIGURE 6.12



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DIGITARIA PORRECTA
RECORDS AND HABITAT



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FIGURE 6.13

6.5.1.4 Pest Flora

Three weed species listed as Weeds of National Environmental Significance (WoNS) or restricted matters under the Queensland *Biosecurity Act 2014* (Biosecurity Act) were recorded within the Study Area and are therefore considered likely to also be present within the Project Area. These weed species include:

- *Harrisia martinii* (harrisia cactus) – Category 3 under the Biosecurity Act and WoNS.
- *Opuntia tomentosa* (velvet tree pear) – Category 3 under the Biosecurity Act and WoNS.
- *Parthenium hysterophorus* (parthenium) – Category 3 under the Biosecurity Act and WoNS.

The cactus-like species (*Harrisia martinii* and *Opuntia tomentosa*) were scattered across remnant and regrowth woodland vegetation types. Parthenium was in high abundance in wet areas.

6.5.1.5 Threatened Fauna

The likelihood of occurrence assessment identified two threatened fauna species and one conservation significant species that are known to occur within the Study Area. Given the presence of mapped habitat within the Project Area, these species are also considered known to occur within the Project Area. The species include:

- Koala (*Phascolarctos cinereus*) – Endangered under the EPBC Act and NC Act.
- Short-beaked echidna (*Tachyglossus aculeatus*) – Special least concern under the NC Act.
- Squatter pigeon (southern) (*Geophaps scripta scripta*) – Vulnerable under the EPBC Act and the NC Act.

An additional threatened fauna species was assessed as likely to occur within the Study Area and Project Area, including:

- White-throated needletail (*Hirundapus caudacutus*) – Vulnerable under the EPBC Act and the NC Act.

The Australian painted snipe (*Rostratula australis*) (Endangered under the EPBC Act and NC Act) was assessed as likely to occur within the Study Area, however, given that the Project Area does not contain mapped habitat for the species it is considered unlikely to occur within the Project Area and is not detailed further here.

Koala

There are no records for koala within the Project Area, however, individuals were identified from two BAR locations within the central western and central parts of the Study Area. The closest of these records is within 330 m of the Project Area. All records were in areas of *Eucalyptus crebra* woodland and *Eucalyptus brownii* woodland (RE 11.5.9c).

Koala habitat within the Study Area has been mapped as either preferred, suitable or marginal habitat, with guidance from *A review of koala habitat assessment criteria and methods* (Youngentob et al., 2021).

- Preferred habitat mapped for the species within the Study Area includes:



- Areas of remnant riparian eucalypt woodland RE 11.3.25d with locally important koala trees (LIKTs) present with high moisture content (*E. tereticornis* and *E. camaldulensis*) and connectivity to other areas of preferred habitat.

Suitable habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant and mature regrowth eucalypt woodland REs 11.5.3, 11.5.9c, 11.8.5 and 11.5.17 providing abundant LIKTs (*E. brownii*, *E. crebra* and *E. tereticornis*) where koalas were recorded within the Study Area.
- Marginal habitat mapped for the species within the Study Area includes:
- Areas of remnant and regrowth brigalow dominated communities RE 11.5.16 and 11.9.5 providing few LIKTs (*E. cambageana*) and ancillary habitat trees (*A. harpophylla*) that provide limited feeding resources but may facilitate dispersal to other areas of suitable and preferred habitat.

The Project Area intercepts with 5.98 ha of suitable habitat for the species in remnant RE 11.5.9c and mature regrowth RE 11.5.3 as shown in **Figure 6.10**.

Short-beaked Echidna

There are no records for short-beaked echidna within the Project Area, however, one individual was identified with the central part of the Study Area. This record is within 490 m of the Project Area. This record was recorded in remnant *Eucalyptus crebra* woodland (RE 11.5.9c). Scats attributable to the species were also recorded in multiple locations in remnant vegetation within the Study Area.

Short-beaked echidna habitat within the Study Area has been mapped as either suitable or marginal habitat.

Suitable habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of remnant and mature regrowth woodland REs providing habitat features such as large woody debris, shrubby areas and logs suitable for short-beaked echidna.

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas of grasslands and young woody regrowth vegetation providing limited habitat features such as large woody debris, shrubby areas and logs suitable for short-beaked echidna and provides dispersal habitat between areas of preferred habitat.

The Project Area intercepts with:

- 6.45 ha of suitable habitat for the species in remnant REs 11.5.9c and 11.5.15 and mature regrowth RE 11.5.3.
- 1.53 ha of marginal habitat for the species in remnant RE 11.8.11 as shown in **Figure 6.15**.

There are no records of the squatter pigeon (southern) within the Project Area, however, a total of 65 squatter pigeon (southern) individuals were recorded across the Study Area. The closest of these records (comprising 2 individuals) is within 170 m of the Project Area. Records were in proximity to dams where there were trees nearby to disperse into when startled. Wooded areas with tree cover had lower levels of grass productivity with mid-dense



to sparse ground cover. These areas are likely to be more suitable for squatter pigeon (southern) foraging habitat.

Squatter pigeon (southern) habitat within the Study Area has been mapped as either preferred, suitable or marginal habitat with guidance from the DCCEEW species profile (DotE, 2022).

Preferred habitat mapped for the species within the Study Area includes:

- Areas within 1 km of permanent water source suitable for breeding, that are areas of remnant and mature regrowth eucalypt woodland REs suitable for foraging.

Suitable habitat mapped for the species within the Project Area and greater Study Area includes:

- Areas within 3 km of permanent water source that are areas of remnant and mature regrowth eucalypt woodland REs suitable for foraging.

Marginal habitat mapped for the species within the Study Area includes:

- Dispersal habitat which includes non-remnant areas within 3km of a permanent water source.
- The Project Area intercepts with 5.98 ha of suitable habitat for the species in remnant RE 11.5.9c and mature regrowth RE 11.5.3 as shown in Figure 6.16.

White-throated Needletail

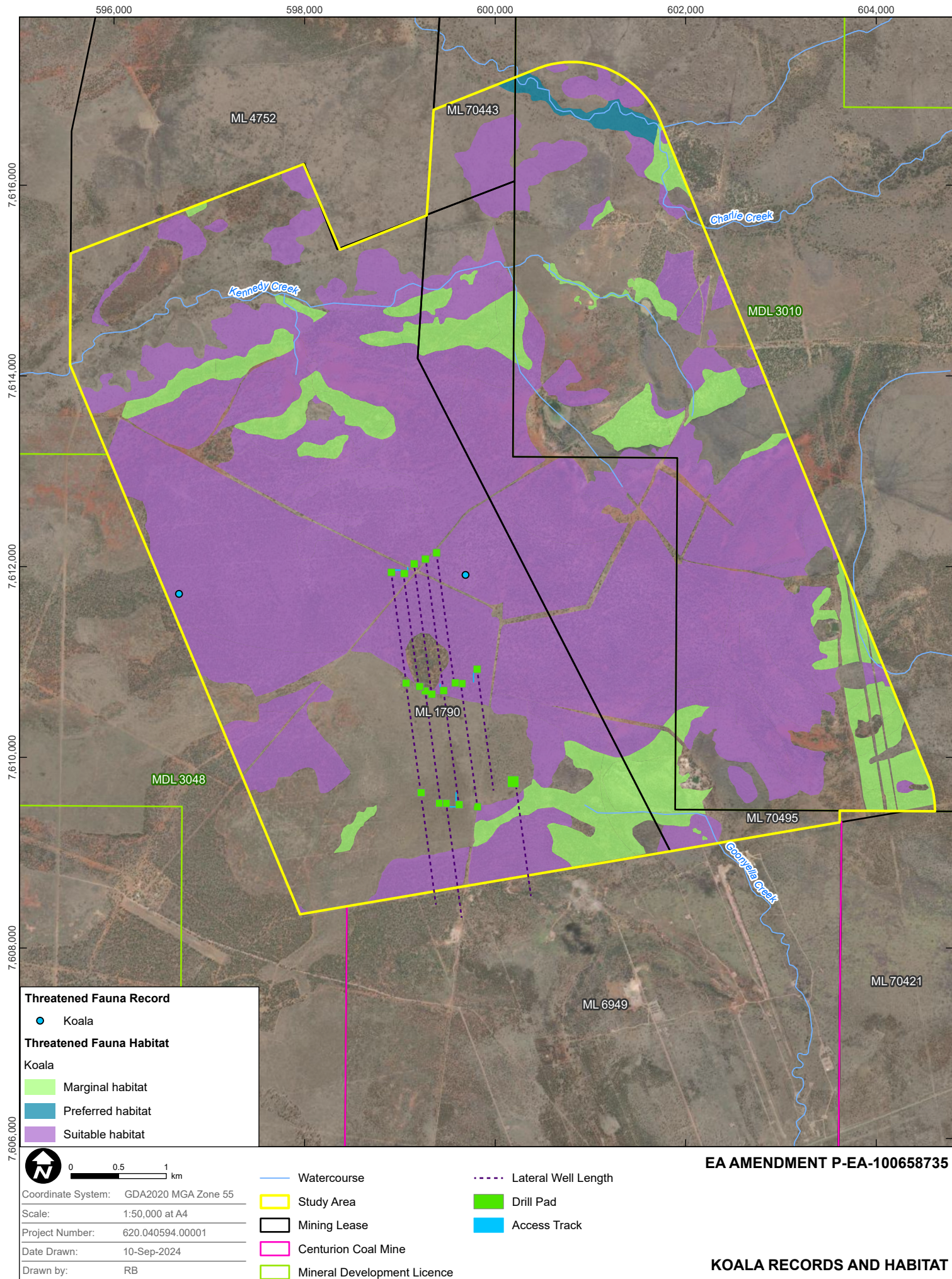
White-throated needletail was not detected during the field surveys, however, has been previously recorded nearby (approximately 20 km) the Study Area (ALA, 2024) and is considered likely to occur. Suitable habitat for the species includes a broad range of vegetation communities that support feeding resources in which they fly in the airspace above. No areas of emergent trees with hollows in woodlands or tall trees at the edges of clearing were observed within the Study Area.

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- All areas that provide aerial space above suitable for foraging.

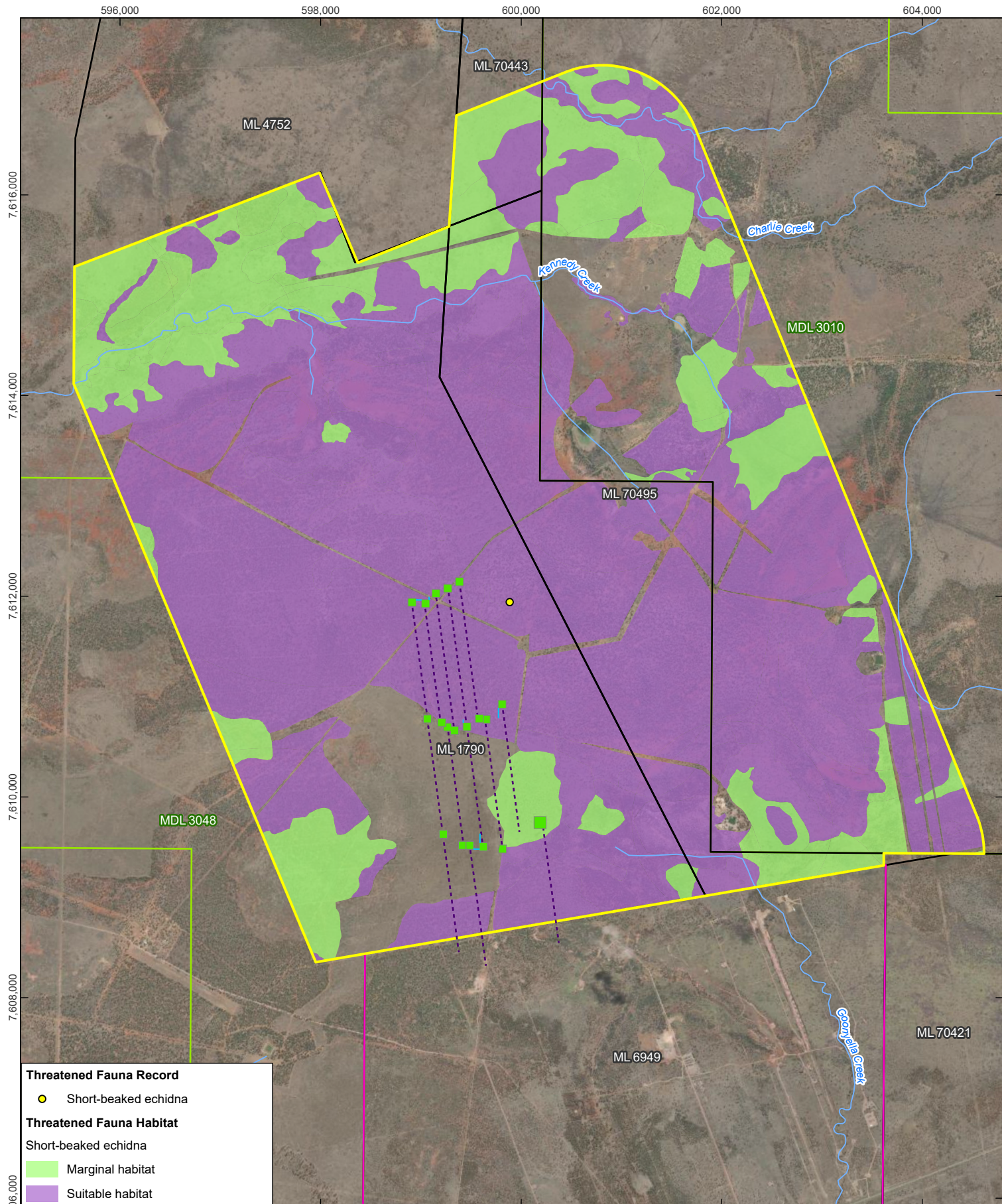
The Project Area intercepts with 12.86 ha of marginal habitat for the species comprising all aerial space above the Project Area as shown in Figure 6.17.





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FIGURE 6.14



Threatened Fauna Record

- Short-beaked echidna

Threatened Fauna Habitat

Short-beaked echidna

- Marginal habitat
- Suitable habitat

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

- Watercourse
- Study Area
- Mining Lease
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SHORT-BEAKED ECHIDNA
RECORDS AND HABITAT



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FIGURE 6.15

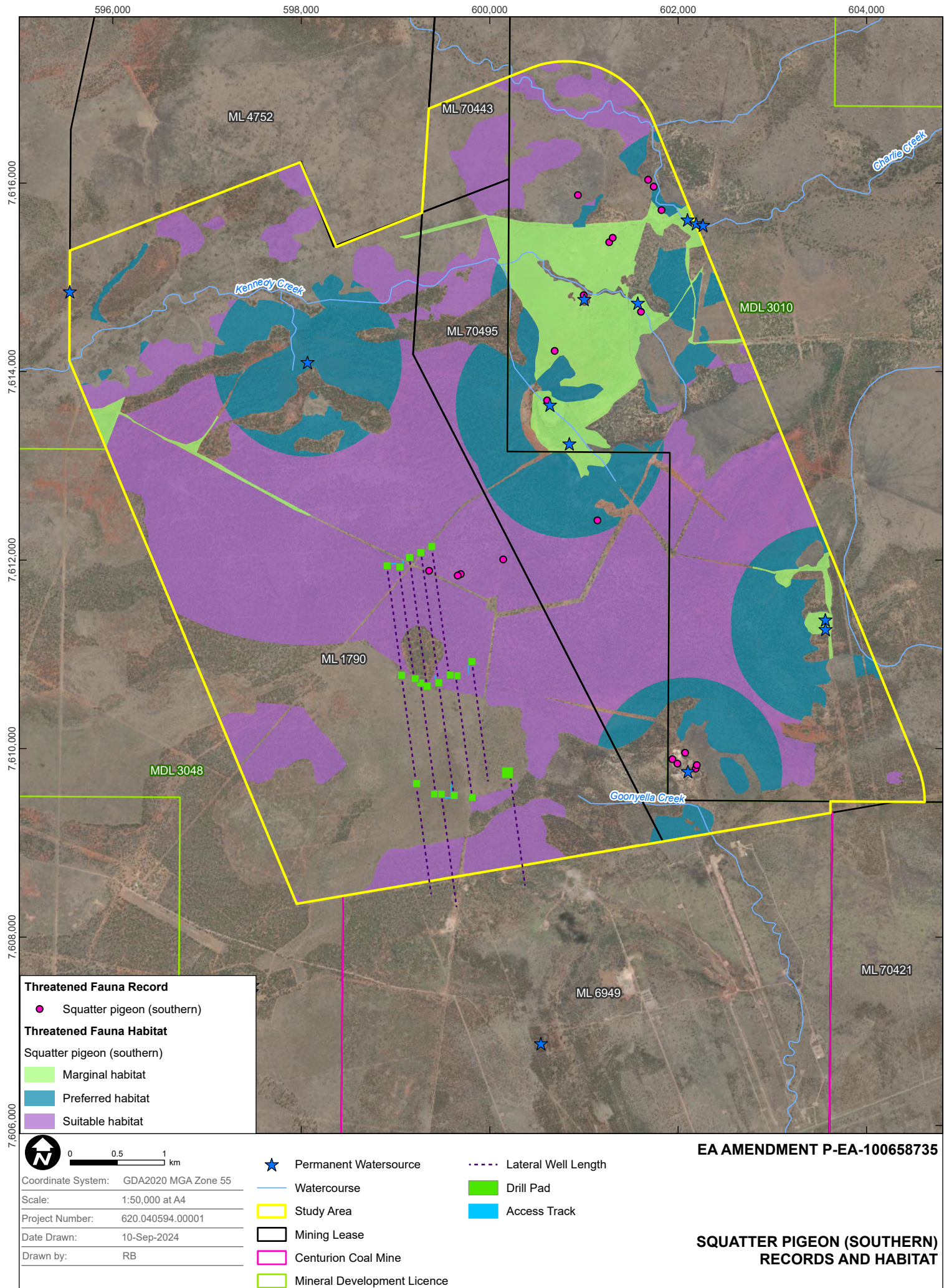
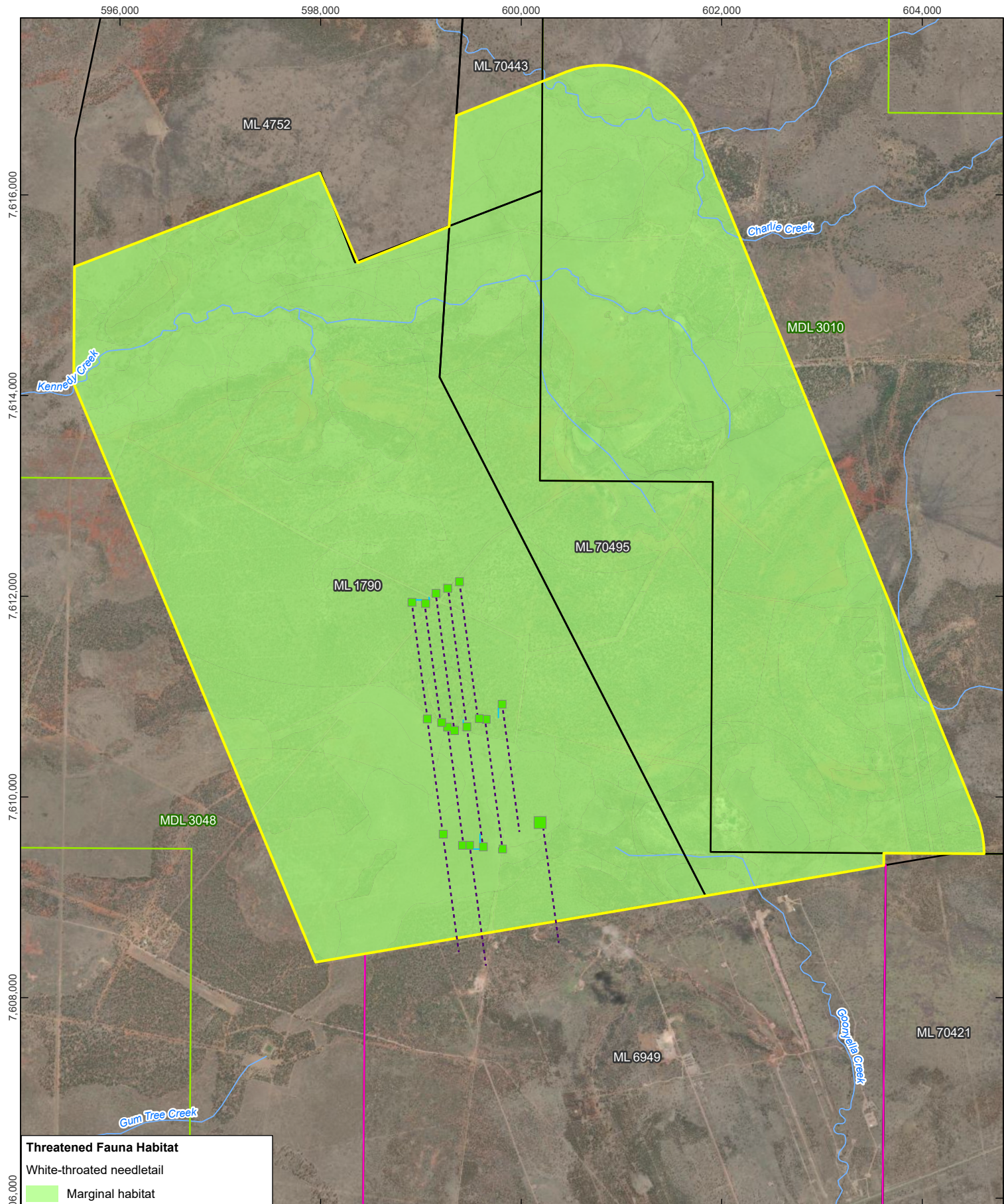


FIGURE 6.16



Threatened Fauna Habitat
 White-throated needletail
 Marginal habitat

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

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**WHITE-THROATED NEEDLETAIL
 HABITAT**



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FIGURE 6.17

6.5.1.6 Migratory Fauna

The likelihood of occurrence assessment identified two migratory fauna species that are likely to occur within the Study Area and Project Area, including:

- Fork-tailed swift (*Apus pacificus*) – Migratory under the EPBC Act and Special least concern under the NC Act.
- Oriental cuckoo (*Cuculus optatus*) - Migratory under the EPBC Act and Special least concern under the NC Act.

An additional two migratory fauna species were assessed as likely to occur within the Study Area, however, given that the Project Area does not contain mapped habitat for these species they are considered unlikely to occur within the Project Area and are not detailed further here. These species include glossy ibis (*Plegadis falcinellus*) and Latham's snipe (*Gallinago hardwickii*) (Migratory under the EPBC Act and Special least concern under the NC Act).

Fork-tailed Swift

Fork-tailed swift was not detected during the field surveys, however, has been previously recorded nearby (approximately 20 km) the Study Area (ALA, 2024) and is considered likely to occur. Suitable habitat for the species include a broad range of vegetation communities that support feeding resources in which they fly in the airspace above.

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- All areas that provide aerial space above suitable for foraging.

The Project Area intercepts with 12.86 ha of marginal habitat for the species comprising all aerial space above the Project Area as shown in **Figure 6.18**.

Oriental Cuckoo

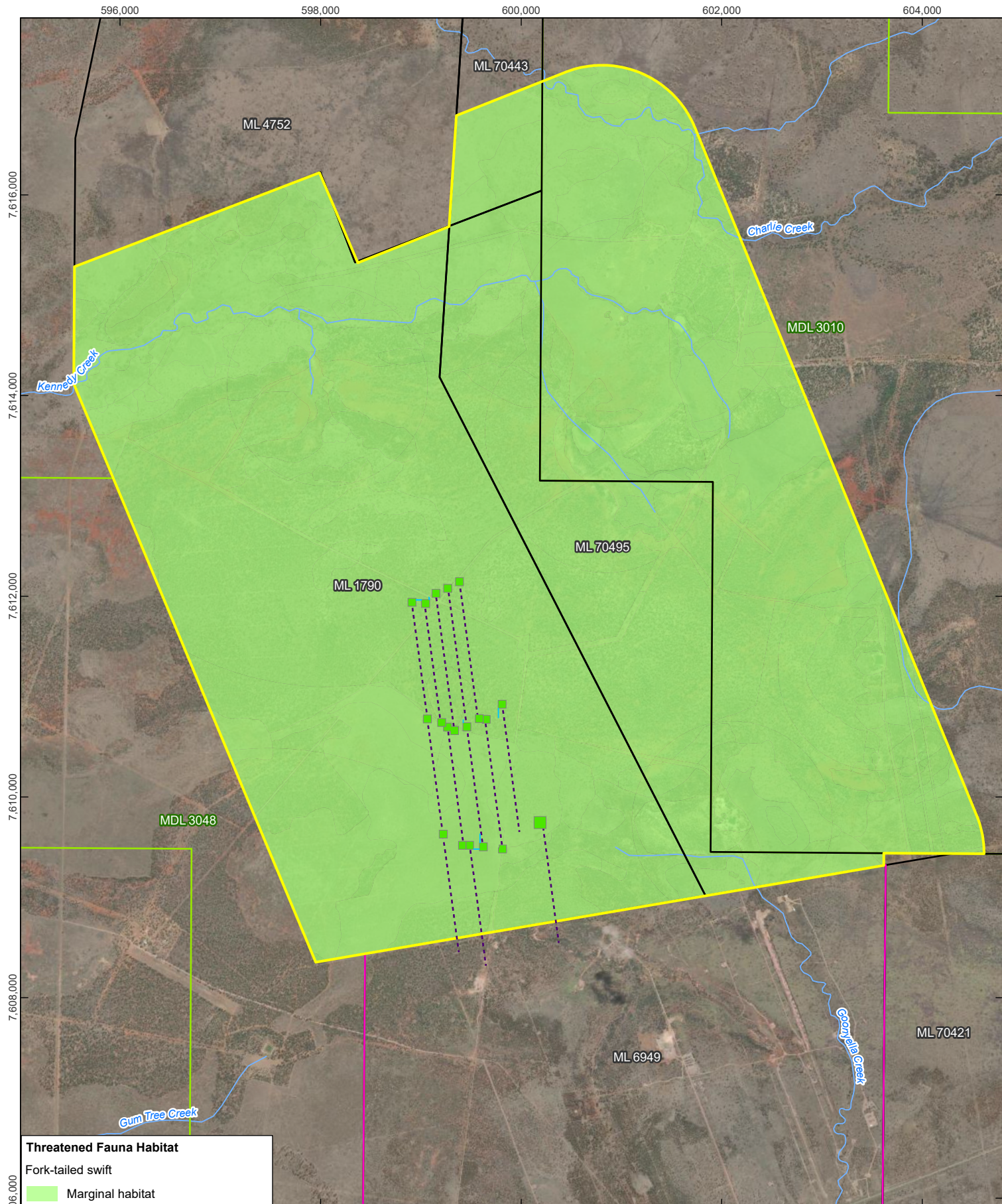
Oriental cuckoo was not detected during the field surveys, however, has been previously recorded approximately 17 to 25 km from the Study Area (BMA, 2014; ALA, 2024) and is considered likely to occur. The species does not breed in Australia. Suitable habitat for the species' only includes intermittent roosting and foraging habitat (DotE, 2015). Suitable habitat for the species includes a broad range of vegetation communities that support feeding and dispersal of the species. Therefore, oriental cuckoo habitat within the Study Area has been mapped as marginal habitat with guidance from the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DotE, 2015).

Marginal habitat mapped for the species within the Project Area and greater Study Area includes:

- All areas of remnant and regrowth woodland communities that intermittently provide roosting, feeding and dispersal opportunities.

The Project Area intercepts with 6.45 ha of marginal habitat for the species in remnant RE 11.5.9c and 11.5.15 and mature regrowth RE 11.5.3 as shown in Figure 6.18.





Threatened Fauna Habitat
 Fork-tailed swift
 Marginal habitat

	0 0.5 1 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.040594.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

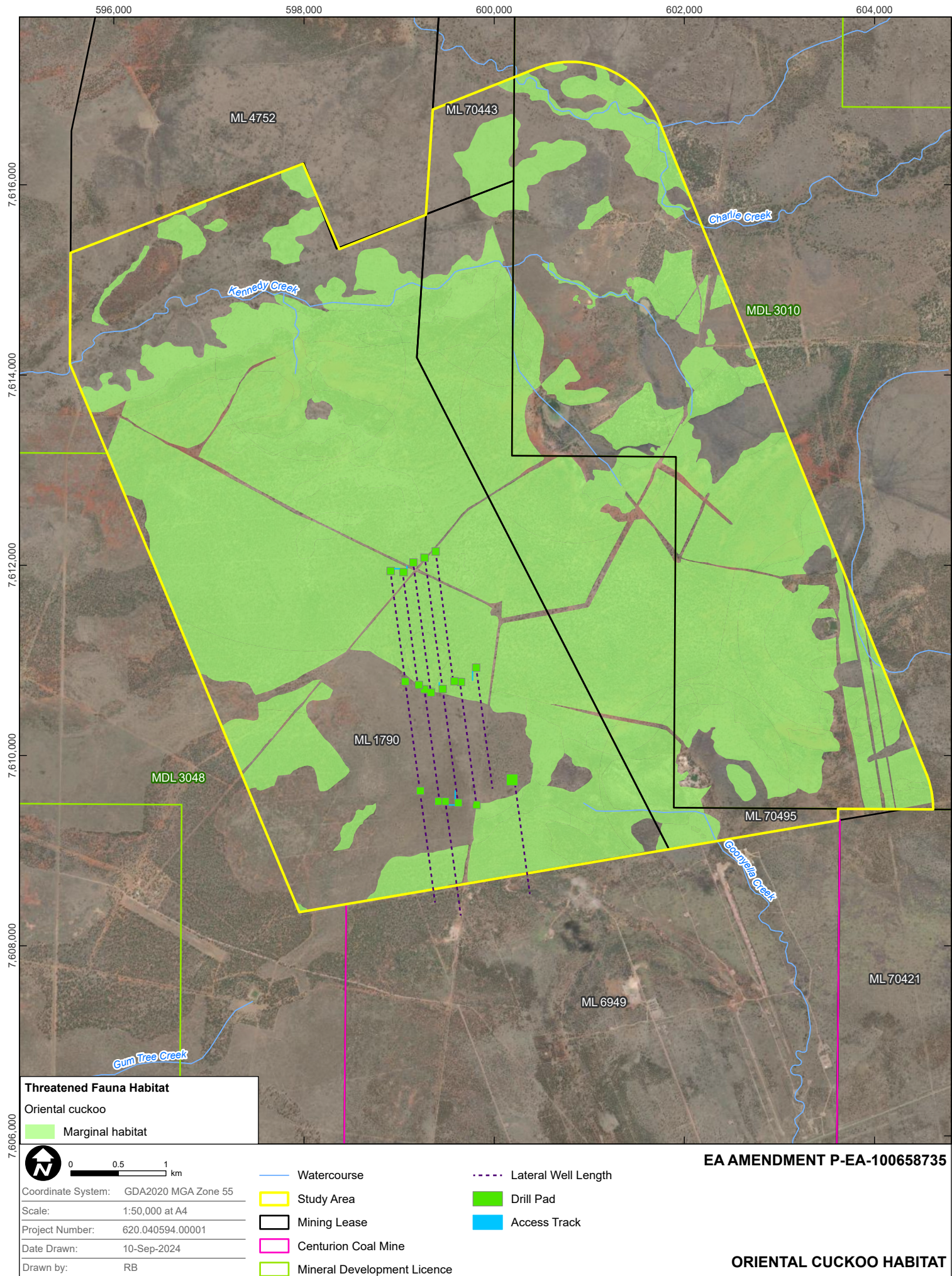
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FORK-TAILED SWIFT HABITAT



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FIGURE 6.18



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FIGURE 6.19

6.5.1.7 Pest Fauna

Five pest fauna species were recorded within the Study Area. Four of these species were listed as restricted matters under the Biosecurity Act, including:

- Cane toad (*Rhinella marina*).
- Cat (*Felis catus*) – Category 3, 4 and 6 restricted matter.
- Wild dogs (*Canis lupus*) – Category 3, 4 and 6 restricted matter.
- European rabbit (*Oryctolagus cuniculus*) – Category 3, 4, 5, and 6 restricted matter.
- Feral pig (*Sus scrofa*) – Category 3, 4, and 6 restricted matter.

Pest fauna species have varying adverse impacts on the environment. Pigs are known to contribute to habitat degradation by damaging the banks of wetlands, creek lines and gilgai, uprooting vegetation, causing soil erosion, spreading weeds and browsing/grazing native flora. Evidence of habitat degradation caused by pig rooting was observed within the Study Area including damage around gilgai as well as within SEVT vegetation.

Carnivorous pest fauna such as feral cats and dingos and opportunistic carnivores such as feral pigs, are known to directly predate native fauna. In addition, cane toads outcompete native amphibians and are toxic to animals such as ornamental snake that predate upon them.

6.5.1.8 Ecological Function

Watercourses and Wetlands

The Project Area does not intercept with any watercourses or wetland values.

Corridors and Connectivity

The Project Area does not intercept with any mapped terrestrial corridors.

Groundwater Dependent Ecosystems

The Project Area does not intercept with any ground-truthed potential terrestrial GDEs (refined during field surveys from BoM supplied mapping).

Environmentally Sensitive Areas

The Project Area does not intercept with any Category A or Category B ESAs as described in the Queensland *Environmental Protection Regulation 2019*.

Note: This was assessed utilising an RE amendment that has been submitted and approved by the Queensland Herbarium (MAR 3577) to refine vegetation mapping within the Study Area.

6.5.2 Summary of MSES

Three MSES as defined in the *Queensland Environmental Offset Regulation 2014* (EO Regulation) were identified within the Project Area, including:

- Regulated vegetation.
- Protected wildlife habitat.
- Connectivity areas.

No protected areas or legally secured offset areas are located within the Project Area.



6.5.2.1 Regulated Vegetation

MSES regulated vegetation includes *prescribed regional ecosystems* (remnant), as defined under the EO Regulation. In accordance with the EO Regulation, a prescribed regional ecosystem does not include:

- Regional Ecosystem comprising vegetation defined under Section 8 of the VM Act (i.e. grass or non-woody herbage, a grassland RE with a grassland structure, a mangrove).
- Regrowth or non-remnant vegetation.

MSES regulated vegetation includes prescribed REs that:

- Are 'endangered' (VM Act class) Res.
- Are 'of concern' (VM Act class) Res.
- Intersect with an area shown as a wetland on the vegetation management wetlands map (Wetland REs).
- Are an area of essential habitat on the essential habitat map for an animal that is critically endangered wildlife, endangered wildlife or vulnerable wildlife or a plant that is critically endangered wildlife, endangered wildlife or vulnerable wildlife.
- For a prescribed activity mentioned in Schedule 1, Item 7(e), if the ecosystem is an area of essential habitat on the essential habitat map for an animal that is near threatened wildlife or a plant that is near threatened wildlife.
- The extent the ecosystem is located within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature. In accordance with the Queensland Environmental Offset Policy (DES, 2021b), distances from the defining bank of the watercourse stream order (SO) (non-coastal Bioregion) comprised:
 - 25 m for SO 1 and 2
 - 50 m for SO 3 and 4; and
 - 100 m for SO 5 or greater.

Within the Project Area, MSES regulated vegetation was assessed utilising data from an RE amendment that has been submitted and approved by the Queensland Herbarium (MAR 3577) to refine vegetation mapping within the Study Area. A summary of MSES regulated vegetation within the Project Area is provided in **Table 6.23**.

REs located within the defined distance from the defining banks of a Vegetation Management watercourse were mapped by buffering all DoR mapped VM Act watercourses and drainage features (DoR, 2024) by a 2 m buffer to estimate the defining banks of the watercourse. The banks were then buffered by the defined distance⁴ and any E2M ground-truthed remnant REs within these defined distances were included as MSES regulated vegetation. The Project Area does not intercept regulated vegetation within the defined distance of a VM Act watercourse.

The Project Area also does not intercept with regulated vegetation that is an Endangered or Of concern RE. While the Project Area does intercept with remnant, Of concern RE 11.8.11

⁴ *defined distance*, for a RE, means a distance identified in the *Queensland Environmental Offsets Policy* as the relevant distance from the defining banks of a relevant watercourse or relevant drainage feature.



(see **Section 6.5.1.1**) this RE has a structure category / structure code of woody grassland / tussock grassland respectively and so is not classified as MSES regulated vegetation.

In accordance with the *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline* (DEHP 2014) (SRI Guideline), essential habitat included in **Table 6.23** will be assessed as part of MSES protected wildlife habitat.

Table 6.23 MSES regulated vegetation within the Project Area

MSES	Area within Project Area (ha)
Essential habitat	
Ornamental snake (<i>Denisonia maculata</i>)	6.45

6.5.2.2 Protected Wildlife Habitat

Protected wildlife habitat is defined in the EO Regulation as:

- A high-risk area on the flora survey trigger map that contains plants that are Critically endangered wildlife, Endangered wildlife or Vulnerable wildlife.
- An area that contains plants that are Critically endangered wildlife, Endangered wildlife or Vulnerable wildlife.
- A mapped koala habitat area.
- Habitat for an animal that is Critically endangered wildlife, Endangered wildlife or Vulnerable wildlife or a Special least concern animal (non-migratory).

The SRI Guideline defines habitat as ‘*the area occupied, or periodically or occasionally occupied, by any species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles*’.

The MSES protected wildlife habitat summarised in **Table 6.24** comprises those species that were identified as known or likely to occur within the Project Area. In addition, essential habitat for ornamental snake has been mapped as present by the DoR (see **Section 6.5.2.1** and **Table 6.23**) and will therefore be assessed further even though it was identified as unlikely to occur based on ecological field surveys. The following three threatened species identified as known and likely to occur within the Project Area are not considered as MSES protected wildlife habitat, for the following reasons:

- *Digitaria porrecta* – habitat mapped within the Project Area (see **Section 6.5.1.3**) but the species is listed as Near threatened under the NC Act.
- Fork-tailed swift (*Apus pacificus*) – habitat mapped within the Project Area (see **Section 6.5.1.6**) but the species is listed as Special least concern under the NC Act due to migratory status.
- Oriental cuckoo (*Cuculus optatus*) – habitat mapped within the Project Area (see **Section 6.5.1.6**) but the species is listed as Special least concern under the NC Act due to migratory status.



Table 6.24 MSES protected wildlife habitat within the Project Area

Species	NC Act status	Area within Project Area (ha)
<i>Dichanthium queenslandicum</i>	Endangered	1.53
Koala	Endangered	5.98
Short-beaked echidna	Special least concern (non-migratory)	6.45*
Squatter pigeon (southern)	Vulnerable	5.98
White-throated needletail	Vulnerable	12.86

* Dispersal habitat mapped as marginal habitat has been removed from this table due to this habitat type not being regarded as offsettable.

6.5.2.3 Connectivity Areas

Connectivity areas are defined under the EO Regulation as prescribed REs that contain remnant vegetation and an area of land that is required for ecosystem functioning.

Prescribed regional ecosystems (remnant) as defined under the EO Regulation does not include:

- RE comprising vegetation defined under Section 8 of the VM Act (i.e. grass or non-woody herbage, a grassland RE with a grassland structure, a mangrove), or
- Regrowth or non-remnant vegetation.

MSES connectivity areas was assessed utilising an RE amendment that has been submitted and approved by the Queensland Herbarium (MAR 3577) to refine vegetation mapping within the Study Area. Within the Project Area, all ground-truthed remnant vegetation containing a prescribed RE is considered to comprise connectivity values. The Project Area contains approximately 6.51 ha of connectivity areas.

6.5.3 Potential Impacts

The following subsections detail the potential terrestrial ecology impacts as a result of the activities described in **Section 3.0**. Where multiple activities contribute to a potential impact, all relevant activities have been listed in the subsection heading.

6.5.3.1 Access Tracks and Coal Seam Gas Exploration

Native Vegetation Clearing

The Project activities will result in native vegetation clearing of approximately 12.00 ha comprising non-remnant, remnant and mature regrowth vegetation. Table 6.25 details the remnant and mature regrowth vegetation that will be cleared and shows that this is a small portion of what will be retained in surrounding areas within the Study Area. In addition, the majority of this vegetation is listed as Least concern under the VM Act with only one small area (1.53 ha) listed as Of concern. The Project Area intersects with 0.46 ha of the SEVT TEC with other areas of TEC avoided where feasible and possible.



Table 6.25 Direct impacts to remnant and mature regrowth REs within the Project Area

RE	VM Act class	Area within Study Area (ha)	Area within Project Area (ha)	Percentage impacted (%)
Remnant				
11.5.9c	Least concern	2,119.64	5.75	0.27
11.5.15	Least concern	32.02	0.46	1.44
11.8.11	Of concern	741.57	1.53	0.21
Mature regrowth				
11.5.3	Least concern	29.64	0.23	0.78

Fauna and Flora Habitat Removal

The Project activities will also result in loss of habitat for MSES threatened flora and fauna species. The extent of habitat removal is detailed in **Table 6.26**. As shown, this is a small portion of what will be retained in surrounding areas within the Study Area.

Table 6.26 Direct impacts to threatened flora and fauna habitat within the Project Area

Species	NC Act status	Area within Study Area (ha)	Area within Project Area (ha)	Percentage impacted (%)
<i>Dichanthium queenslandicum</i>	Endangered	1,163.36	1.53	0.13
Koala	Endangered	2,831.40*	5.98	0.21
Short-beaked echidna	Special least concern (non-migratory)	3,398.89*	6.45*	0.19
Squatter pigeon (southern)	Vulnerable	2,759.26*	5.98	0.22
White-throated needletail	Vulnerable	5,191.48	12.00	0.25

* Dispersal habitat mapped as marginal habitat has been removed from this table due to this habitat type not being regarded as offsetable.

Habitat Degradation and Edge Effects

Project activities and native vegetation clearing have the potential to result in indirect degradation of adjacent (edge effects) and downstream habitats. Edge effects occur where vegetation communities are subject to distinct ecotones, as may occur due to vegetation clearing, resulting in changes in vegetation/habitat composition, and quality (Laurance & Yensen, 1991). Indirect influences associated with edge effects can include exposure to weeds, noise, light, dust, reduced foraging resources and species assemblages (Laurance & Yensen, 1991). Prolonged exposure to edge effects can degrade or reduce the quality of habitat.

While the Project activities are likely to result in edge effects to some degree, it is unlikely to contribute significantly at a landscape scale given the surrounding land use of the area being largely fragmented with agricultural and mining activities.



Fauna Injury and/or Mortality

Project activities, during construction and operation, have the potential to lead to fauna injury or mortality. Vehicles and machinery can cause injury or mortality to fauna if individuals are struck. Similarly, fauna that are unable to disperse away from areas under active clearing are also particularly susceptible to injury or mortality. Other causes of injury or mortality include animals becoming trapped in excavations/trenches.

6.5.3.2 Access Tracks, Coal Seam Gas Exploration, Amenities and Hours of Operation

Noise, Light and Dust

Project activities, during construction and operation, can disrupt local fauna roosting, breeding and foraging activities as a result of increased exposure to artificial lighting, noise and vibration. Artificial lighting poses risks to fauna, as increased light allows predators to locate prey more easily. Additionally, noise and vibration can also lead to increased predation of some species, as it makes it harder for prey to detect approaching predators.

Excessive dust deposition on foliage can cause impacts to vegetation, including reducing photosynthetic processes, respiration, transpiration, health and growth rates. Potential dust impacts on vegetation are concentrated near dust sources such as access tracks, drilling locations and stockpiles as a result of construction/operation activities.

Areas of remnant vegetation adjacent to the Project may be subject to degradation from dust deposition on foliage.

6.5.3.3 Amenities

Introduction and Spread of Pests

The Project may result in an increase in the presence and abundance of feral animals through improper waste disposal and increased permanency of water sources associated with the amenities located on drill pads. These pests can result in adverse impacts to native fauna through increased habitat degradation, predation pressure and competition for resources. They can also be identified as a particular risk to the recovery of threatened fauna species. Five pest fauna species were recorded within the Study Area, including:

- Cane toad (*Rhinella marina*).
- Cat (*Felis catus*).
- Wild dogs (*Canis lupus*).
- European rabbit (*Oryctolagus cuniculus*).
- Feral pig (*Sus scrofa*).

6.5.3.4 Equipment

Introduction and Spread of Weeds

Introduced flora species disrupt ecosystems by outcompeting and replacing native species, resulting in altered ecosystem diversity and function. They can also be identified as a particular risk to the recovery of threatened fauna and flora species. Proliferation and spread of environmental weeds and pests may occur as a result of the increased movement and use of heavy machinery and vehicles as required for vegetation clearing and soil



disturbance/movement. Three weed species listed as WoNS and/or restricted matters under the Biosecurity Act were recorded within the Study Area, including:

- *Harrisia martini*.
- *Opuntia tomentosa*.
- *Parthenium hysterophorus*.

Weed seeds can be transported in contaminated landfill, and as seed and material on machinery, vehicles or personnel. Construction activities have the potential to spread or introduce weeds throughout adjacent areas, resulting in a degradation of vegetation/habitat quality and native species assemblages.

6.5.4 Management Practices

The potential impacts will be managed through current practices. The methods used to mitigate impacts to terrestrial ecology are detailed in the following subsections.

6.5.4.1 Avoidance

During the design stages of the Project, terrestrial ecological values were considered and avoided where feasible and practical. These included the following.

- The total number of drill pads and wells has been optimised to align with Project objectives while also reducing the extent of disturbance to ecological values.
- Previously disturbed access tracks and areas used in exploration have been utilised where possible. Drill pads have been positioned closer to previously disturbed areas so that limited new access tracks would need to be cleared.
- Non-remnant areas of vegetation that provide limited habitat value in the south-western areas of the Study Area were prioritised over areas of mature regrowth and remnant vegetation. Nine of the proposed wells are situated in pastureland that has previously been cleared for agricultural purposes.
- Where remnant vegetation was required to be cleared, vegetation classified as No concern at present under the VM Act was utilised in preference of Of concern and Endangered REs.
- Areas of TEC were avoided where possible.

6.5.4.2 Mitigation

Native Vegetation Clearing and Habitat Removal

To mitigate and minimise the potential impacts from native vegetation clearing and fauna habitat removal (including habitat for MNES and MSES fauna) during the construction and operational stage of the Project, the following measures should be implemented.

- Vegetation clearing extents will be kept to the minimum area necessary for access road and drill pad construction.
- Boundaries of areas to be cleared, and those not to be cleared, are to be clearly defined during clearing activities and clearly communicated to all necessary construction personnel. Where necessary, signage, flagging and/or barricade fencing may be used to demarcate areas not to be cleared.



- Pre-clearance fauna surveys are to be undertaken by a suitably experienced and qualified person to identify fauna and habitat features at direct risk from clearing activities.
- Habitat features such as large logs will be moved out of disturbance areas into adjacent areas as habitat.
- A suitably experienced and qualified person will be present during the clearing of any structures that may serve as habitat or refugia for animals.
- Directional clearing towards retained vegetation would be undertaken where practical to enable the movement of fauna into retained vegetation.
- Hollow-bearing trees providing shelter for native fauna should be felled slowly (in sections), so as to minimise the risk of injury to fauna.
- In the event a MSES fauna (such as koala) is identified within areas to be cleared, the individual is to be left to vacate the area in accordance with the legislation.
- During construction works, work areas and excavations (trenches) are to be checked regularly for fauna that may have become trapped.
- Fauna exclusion fencing will be erected around open trenches and pits >1 m depth to minimise the risk of injury to fauna.
- If trenches remain open after daily site works have been completed, fauna ramps would be put in place.

Fauna Injury and/or Mortality

To mitigate and minimise the potential for fauna injury and/or mortality during Project activities, the following measures should be implemented.

- Vehicles are to remain on designated access tracks and adhere to site rules relating to speed limits.
- Speed limits are to be clearly signposted to minimise potential fauna strike.
- Removal of roadkill should be undertaken to minimise the risk of attracting other fauna to the road corridor.
- Contingencies and procedures for the treatment of injured fauna will be implemented.
- Where installation of wire fencing is required to exclude personnel or vehicular traffic, consideration should be given to movement of fauna around and/or through such fencing. Barbed wire should not be used on the top strand of wire fences unless necessary for security.

Noise, Light and Dust

To mitigate and minimise the potential impacts from noise, light and dust during the construction and operational stage of the Project, the following measures will be implemented:

- Where artificial lighting is required, directional lighting and glare guards should be implemented to focus on work areas and minimise lighting of adjacent remnant vegetation.
- Active roads are to be regularly watered (or applied with dust suppressants) to minimise dust generation potential.



- Regular maintenance of machinery and mobile plants should be undertaken to minimise unnecessary noise.

Introduction and Spread of Pests and Weeds

To mitigate and minimise the potential for the introduction and spread of pests and weeds during Project activities, the following measures should be implemented:

- Weeds or soil removed as a result of construction activities are to be appropriately disposed of or stored separately to minimise potential spread and proliferation of weed species.
- Prior to vegetation clearing activities, a pre-clearance survey should be undertaken to identify and map infestations of WoNs and restricted matters under the Biosecurity Act to minimise spread during clearing works and the operational phase.
- Waste management measures should be identified and enacted to minimise occurrences of pest fauna.
- All vehicles, equipment and materials (e.g. landfill, soil etc.) brought to site are to be certified free of biosecurity matter and carry weed hygiene certification.
- Biosecurity monitoring will be undertaken during construction, operational and rehabilitation phases to identify and assess the risk of weed and pest occurrences within the Project.
- Pest fauna will be monitored and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land.
- Biosecurity measures will be undertaken to ensure no diseases will be spread during construction and operational phases of the Project.

Rehabilitation and Closure

Rehabilitation will be undertaken to ensure land be progressively rehabilitated to achieve completion criteria for a safe, stable and non-polluting landform able to sustain an agreed post-mining land use. This will include:

- Top-soil to be stockpiled to be utilised during rehabilitation.
- Rehabilitated areas will be of similar floristic diversity and structure to pre-disturbance.
- Any habitat features in adjacent habitat that are unoccupied may be returned to pre-disturbance locations.

6.5.5 Risk Assessment

The field surveys identified that the Project Area contains three MSES identified under the EO Act (see **Section 6.5.2**). The Queensland Government has produced the *Queensland Environmental Offsets Policy – Significant Residual Impact Guideline* (DEHP 2014) (SRI Guideline) to assist in determining if significant residual impacts associated with a Project will require offsetting. Self-assessments against the SRI Guideline are provided in Appendix A.

An assessment against the SRI Guideline determined the Project is unlikely to result in a significant residual impact on any of the three MSES. This is summarised below for each MSES.



Regulated Vegetation

In accordance with the SRI Guideline, essential habitat has been assessed as part of MSES protected wildlife habitat.

Protected Wildlife Habitat

Protected wildlife habitat was assessed in accordance with the SRI Guideline for the following five threatened species and essential habitat for one species:

- ***Dichanthium queenslandicum*** – The Project will result in the direct clearing of 1.53 ha of preferred habitat for *D. queenslandicum*. This amount comprises less than 1% of preferred habitat for the species mapped within the broader Study Area. Any individuals removed will be a small portion of the population within the habitat patch that is being disturbed and therefore, it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **Koala** – The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The Project is located outside of areas of preferred habitat for the species and given survey effort across the Study Area it is considered that koala is present at low densities in this area. Therefore, it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **Ornamental snake (comprising Essential Habitat)** – The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake. Seasonal targeted surveys for the species (comprising pitfall trapping and spotlighting) within the Study Area failed to detect the species, and no suitable habitat was identified. Therefore, the species is assessed as unlikely to occur within the Study Area and Project Area and it is considered unlikely that the Project will have a significant residual impact on the species.
- **Short-beaked echidna** – The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The species has a relatively widespread distribution across its range (Van Dyck & Strahan, 2008) and given the small portion of habitat being cleared and retained connectivity of avoided habitat within the Study Area, it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **Squatter pigeon (southern)** – The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern). This comprises less than 1% of suitable habitat for the species within the broader Study Area. The species is locally abundant within its range (DCCEE, 2024) and given the small portion of habitat being cleared and retained presence of important habitat features (i.e. permanent and seasonal waterbodies) (Squatter Pigeon Workshop, 2011), it is considered unlikely that the Project will have a significant residual impact on the species. The implementation of mitigation measures will further minimise potential impacts to the species.
- **White-throated needletail** – The species is a wide-ranging nomadic species that is almost exclusively aerial in Australia (DCCEE, 2024). As such, the clearing of vegetation is considered largely inconsequential to the species. Therefore, it is



considered unlikely that the Project will lead to a long-term decrease in the species population, extent of occurrence, quality of habitat or result in an invasive species or disease that may cause the species to decline. Furthermore, the Project is unlikely to interfere substantially with the recovery of the species.

Connectivity Areas

In accordance with the SRI Guideline, the Landscape Fragmentation and Connectivity Tool was used to assess the associated impacts to connectivity areas resulting from the Project. Based on the Landscape Fragmentation and Connectivity Tool, the Project will not result in a significant residual impact on MSES connectivity areas. The two tests identified:

- **Test 1:** The regional extent of core remnant areas is approximately 41.61%, resulting in a local impact threshold of 10.00%. The core remnant extent at the local scale pre-impact was calculated as 5,700.58 ha with a 0.36% change post impact. As such, Test 1 did not exceed the 10.00% threshold for change in core remnant ecosystem extent at the local scale.
- **Test 2:** One core remnant area was identified within the site pre-impact and this was retained post impact. As such the loss or fragmentation of core remnant ecosystem at the site does not result.

6.6 Aquatic Ecology

This section presents the assessment of Project related aquatic ecology impacts to environmental values.

6.6.1 Existing Environmental Values

The following subsections detail the existing EVs within the Project Area (see **Figure 3.2**) based on aquatic ecological surveys undertaken to date. It also details the MSES impacted by the Project based on these findings.

6.6.1.1 Subterranean GDEs and Stygofauna

According to state mapping, high potential GDEs are present along two of the creeks that are located within the Study Area; Kennedy Creek and Goonyella Creek. However, field surveys of these creeks identified that they were dry and did not exhibit characteristics of an ecosystem likely to be dependent on the surface expression of groundwater. Additionally, neither of these creeks intersect with the Project Area.

There are no mapped subterranean GDEs within or near (within 100 km) the Study Area. Additionally, no stygofauna were collected from bores within or immediately surrounding the Study Area, suggesting the absence of subterranean GDEs within these aquifers.

6.6.1.2 Habitat

The creeks of the Study Area are ephemeral in nature, where flow and pool habitat only occur following sufficient rainfall. Habitat condition of the creeks within the Study Area ranged from poor to fair, given that they were impacted by grazing, heavily eroded, dominated by fine sediment and affected by scouring and channelisation. The Project Area does not intercept with these creeks.

Two constructed dams in the Study Area were surveyed and likely provide a perennial source of water, though do not appear to supply water or be directly connected to surrounding creeks. The Project Area does not intercept with constructed dams.



6.6.1.3 Water Quality

Water quality was only measured in the two dams present in the Study Area and one creek when it held water in the early-wet survey. Water quality was typical for constructed dams, though some extremes were noted in pH and dissolved oxygen, owing to the high macrophyte density. High turbidity was noted in the only creek to hold water, though this is typical for an ephemeral creek. The Project Area does not intercept creeks or constructed dams.

6.6.1.4 Macroinvertebrates

Macroinvertebrate diversity indices (taxonomic richness, PET richness and SIGNAL score) were generally low, largely due to the lack of macro and microhabitat diversity within the creeks or constructed dams. The Project Area does not intercept creeks or constructed dams.

6.6.1.5 Fish and Macrocrustaceans

Fish were only caught in one dam and were typical species for the area, potentially being stocked in the past. Red claw crayfish (*Cherax quadricarinatus*) was also caught in the same dam and though native to northern Queensland, are considered non-native in the area. Freshwater inland crabs were also caught in the only creek site to hold water and provide an indication of ephemerality. The Project Area does not intercept with creeks or constructed dams.

6.6.1.6 Threatened Species

No threatened flora or fauna species were identified during the field survey. The critically endangered white-throated snapping turtle (Critically endangered under the EPBC Act and NC Act) and Fitzroy River turtle (Vulnerable under the EPBC Act and NC Act) have not been recorded in or near (within 100 km) the Study Area and suitable habitat was not identified mostly due to the lack of perennial, flowing water. The platypus (Special least concern under the Nc Act) was also not caught and suitable habitat was not identified, again largely due to the lack of suitable habitat in the Study Area.

6.6.2 Summary of MSES

No MSES as defined in the EO Regulation were identified within the Project Area. More specifically, the Project Area does not intercept with the following MSES:

- Wetlands and watercourses (including High Ecological Significance wetlands and wetlands or waterways in High Ecological Value waters).
- Protected wildlife habitat (for aquatic species).
- Declared fish habitat areas under the Fisheries Act 1994.
- Protected areas.
- Legally secured offset areas.
- Watercourses as defined in the *Water Act 2000*:
 - Waterways providing for fish passage.
 - Threatened aquatic species.



6.6.3 Potential Impacts

There are no direct Project impacts to aquatic ecology considered likely to occur. As such, the following subsections detail the potential indirect aquatic ecology impacts as a result of the activities described in **Section 3.0**. Where multiple activities contribute to a potential impact, all relevant activities have been listed in the subsection heading.

6.6.3.1 Access Tracks, Coal Seam Gas Exploration and Water

Surface Water Quality

Changes in the surface water quality and quantity may impact terrestrial ecosystems downstream of the Project Area. Sedimentation and chemicals can enter downstream environments resulting from overland flow patterns (Evans, 2000). While no uncontrolled spills of water will be impacted by Project activities, some overflow may occur when rainfall exceeds the design standard (e.g. flood events).

Groundwater Drawdown

Changes to groundwater quality and quantity can have an indirect impact on ecosystems surrounding the Project Area, including ecosystems that are dependant or partially dependant on groundwater (terrestrial GDEs). The process of CSG drainage may reduce water levels in the surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown.

6.6.4 Management Practices

6.6.4.1 Avoidance

During the design stages of the Project, aquatic ecological values were considered and avoided where feasible and practical. This included the complete avoidance of MSES associated with aquatic ecology (see **Section 6.6.2**).

6.6.4.2 Mitigation

To mitigate and minimise the potential indirect impacts to surface water and groundwater during the Project activities, the following measures should be implemented.

- Erosion and sediment control monitoring should be implemented to reduce the amount of sediment laden run-off entering downstream waterways. The following general principles should apply to the erosion and sediment controls:
 - Minimise the surface disturbance areas
 - Where possible, apply local temporary erosion control measures, and
 - Intercept run-off from undisturbed areas and divert around surface disturbance areas, where required.
- Active access tracks are to be regularly watered (or applied with dust suppressants) to minimise dust generation potential.
- Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with AS1940:2004, and where practical, will be located away from any waterbodies.



- Oil spill recovery equipment will be available and located with construction crews conducting activities with the potential for significant spills.
- As soon as practical, disturbed areas will be rehabilitated to reduce the extent of exposed soils.

6.6.5 Risk Assessment

As detailed in **Section 6.6.2**, no MSES are located within the Project Area. As such, no SRIs in accordance with the SRI Guideline are considered likely to result from the Project.

6.7 Groundwater

The following section describes the hydrogeological environment, and analytical modelling undertaken to assess potential impacts on groundwater receptors resulting from the Project. The proposed location of vertical and lateral wells is presented in **Figure 6.20**.

Table 6.27 sets out where in this groundwater assessment the exercise of underground water rights for site-specific application as per Section 126A of the EP Act are considered.

Table 6.27 Groundwater Section 126A

Section 126A of the EP Act	Reference
2 (a) any proposed exercise of underground water rights during the period in which resource activities will be carried out under the relevant tenure	Refer to Section 6.7.2 for a description of the proposed activities.
(b) the areas in which underground water rights are proposed to be exercised	Refer to Section 6.7.2 for the underground water rights area.
(c) for each aquifer affected, or likely to be affected, by the exercise of underground water rights — I. a description of the aquifer; and II. an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers and surface water; and III. a description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights; and IV. the predicted quantities of water to be taken or interfered with because of the exercise of underground water rights during the period in which resource activities are carried out;	I. Refer to Section 6.7.1.1 for a description of the aquifers. II. Refer to Section 6.7.1.1 and Section 6.7.1.2 for a description of the movement and interactions of groundwater. III. Refer to Section 6.7.3 for a description of predicted water level decline. IV. Refer to Section 6.7.2 for anticipated water take.
(d) the environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values;	Refer to Section 6.7.1 and Section 6.7.4 for a description of EV impacts.
(e) any impacts on the quality of groundwater that will, or may, happen because of the exercise of underground water rights during or after the	Refer to Section 6.7.1 and Section 6.7.4 for a description of EV impacts.



Section 126A of the EP Act	Reference
period in which resource activities are carried out;	
(f) strategies for avoiding, mitigating or managing the predicted impacts on the environmental values stated for paragraph (d) or the impacts on the quality of groundwater mentioned in paragraph (e).	Refer to Section 6.7.4 for a risk assessment of predicted impacts.

6.7.1 Existing Environmental Values

6.7.1.1 Aquifers

Hydrostratigraphy

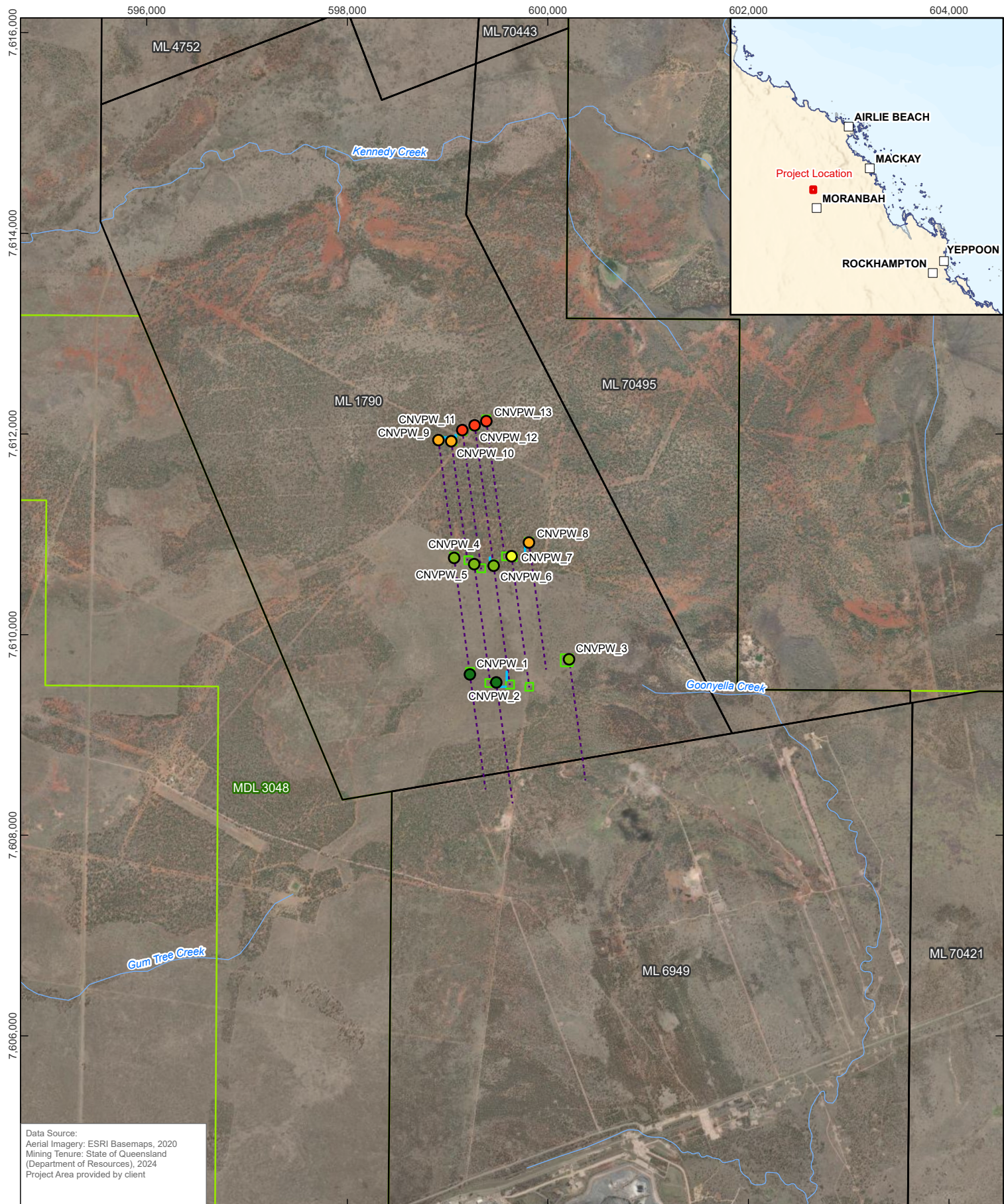
The hydrostratigraphy relevant to the Project comprises the Quaternary alluvium, Tertiary strata (basalt and sediments) and Permian strata. A conceptual cross section of the hydrogeological setting is provided in **Image 6.4** and the surface geology of the Project Area is shown in **Figure 6.21**. Solid geology (excluding Tertiary and Quaternary cover sequences) used for the representation of dip angles and formation contacts is per geology model provided by Peabody.

Quaternary Alluvium

The Quaternary alluvium forms an unconfined aquifer and includes alluvial deposits associated with local creeks. Where present, the thickness of the alluvium is likely to be highly irregular, with estimates of maximum thicknesses in the range of 15 to 25m (Golder, 2020). Groundwater flow within the alluvium (if/where saturated) will follow topographic gradients but it is considered unlikely that, where present, the alluvium forms a continuous saturated aquifer. Relative to the vertical and lateral wells, the Quaternary Alluvium is located along Kennedy Creek, approximately 7.5 kilometres (km) northwest of the Project Area.

Recharge to the Quaternary alluvium will occur via direct infiltration of rainfall and occasional creek flow/flooding during the wet season (Golder, 2020, BMC, 2021). Discharge mechanisms from the alluvium include evapotranspiration, leakage to underlying/adjacent aquifers and groundwater extraction (BMC, 2021). Previous conceptualisations have noted all creeks in the area are ephemeral. No water level data for this unit is available in the monitoring network.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:50,000 at A4
Project Number: 620.041540.00001
Date Drawn: 10-Sep-2024
Drawn by: RB



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LEGEND

- Watercourse
- Lateral Well Length
- Mining Lease
- Mineral Development Licence
- Drill Pad
- Access Track

Planned Vertical Well

Approximate Depth

- 290 - 305
- 306 - 425
- 426 - 460
- 461 - 505
- 506 - 565

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VERTICAL WELL DEPTH

FIGURE 6.20

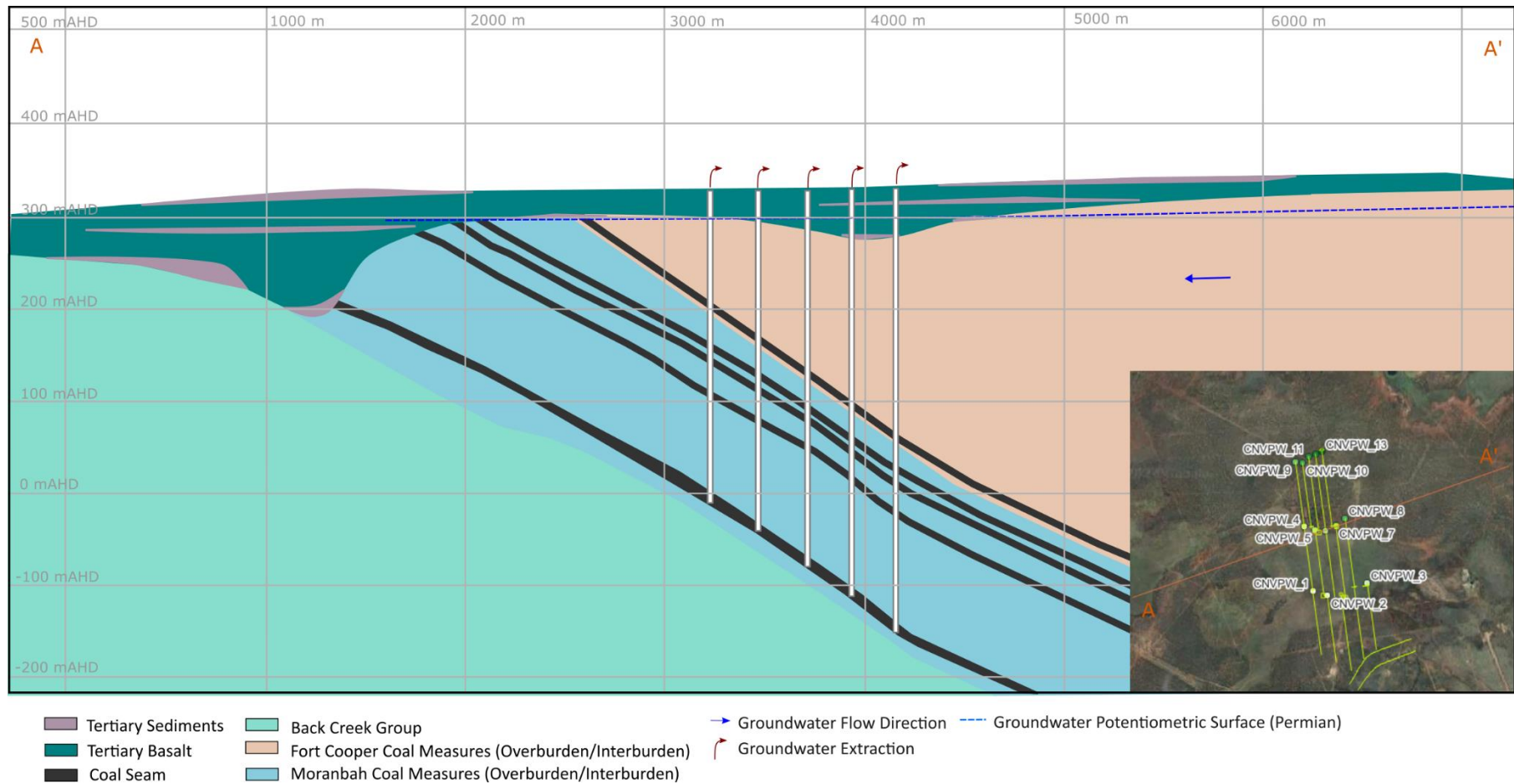


Image 6.4 Conceptual hydrogeological cross section



Tertiary

The Tertiary Strata includes thick basalt flows interbedded with sediments. The flows and sediments occupy Tertiary paleochannels in the Permian coal measures basement. These strata represent the most significant groundwater resource in the region.

Groundwater within the basalt is stored and transmitted through fractures, joints, and discontinuities within the rock mass. The aquifer is layered due to the presence of sediments and weathering horizons which develop between individual flows. Additionally, low permeability associated with massive basalt in the centre of the flows typically separate the higher permeability vesicular basalts, which develop at the top and bottom individual flows (Golder, 2017). In most areas the basalt is underlain by sediments of variable thickness, however, in some areas the basalt is directly in contact with the underlying Permian strata. These underlying sediments occasionally express as lenses of sand that may be hydrogeologically significant due to high primary porosity and hydraulic conductivity.

Golder, 2017 presents geological model data including mapping for the base of the Tertiary, basalt thickness, and the inferred thickness of Tertiary sediments underlying the basalt across ML1790 and the immediate surroundings. The basalts are thickest along the western, north-western and northern edge of ML1790 reaching thicknesses of up to 150m, including one data point at the south-western corner of ML 1790, proximal to the proposed well field.

Permian

The Permian strata comprise siltstone, sandstone, calcareous and carbonaceous shale and coal seams. The coal seams and jointed sandstone units are generally the most transmissive units within in the coal measures with water moving through the coal seams via joints and fractures. The lower permeability interburden/overburden units (siltstones and mudstones / shales) may have some fracture permeability but typically confine groundwater within the coal seams.

Recharge to the Permian will occur via downwards seepage from overlying aquifers, though faults or discontinuities and where the unit outcrops through direct rainfall infiltration or overland flow (Golder, 2020, BMC, 2021). Discharge from the Permian is expected to occur through downgradient flow, downwards seepage through structural discontinuities and groundwater extraction (including dewatering) (Golder, 2020, BMC, 2021)

Hydraulic Properties

Site specific hydraulic conductivity estimates from field testing are presented in **Table 6.28**.

Hydraulic conductivity estimates for the Quaternary alluvium indicate a range from 2 to 20 metres per day (m/day). However, this is based on testing of the Suttor Creek alluvium and regional studies and no site-specific testing has been conducted.

Hydraulic conductivity estimates from one bore in the Tertiary sediments (sandy sediments of the Suttor Formation), shows a range from 0.3 to 0.8 m/day. The silt and clay layers of this formation would be expected to have permeabilities several orders of magnitude lower. The Tertiary sediments distribution model (Silwa, 2011) indicates a varied composition and distribution of sand, clay and mixed material for these sediments.

Two long term pumping tests in the basalt (Streamline Hydro, 2012) were conducted at the northern end of ML 1790 some 8-10 km north of the proposed production well area. The hydraulic conductivity, transmissivity and storage of the Tertiary basalt is likely to vary significantly across the area.



Hydraulic conductivity estimates for the Permian interburden/overburden range from 2×10^{-6} to 0.33 m/day. Hydraulic conductivity estimates for the Permian coal seams ranged from 2×10^{-6} to 0.47 m/day, with estimates for the Goonyella seams in the range 0.003 to 0.47 m/day.

Table 6.28 Hydraulic conductivity estimates from field testing

Aquifer	K (m/day)	Test bore/area	Type	Source ¹
Alluvium	2 to 20	Regional study		Arrow (2012)
	3	Suttor Creek	-	Golder, 2005
Tertiary sediments	0.3 to 0.8	PB03	CRT	Streamline Hydro (2012)
Tertiary Basalt	0.5 to 2.4	PB01	CRT	Streamline Hydro (2012)
	0.01 to 0.4	PB02	CRT	Streamline Hydro (2012)
Permian GM Seam	0.003 to 0.034	GBMC	-	URS, 2013
	0.01	GBMC	-	Golder, 2016
Permian GL Seam	0.06 to 0.47	GBMC	-	URS, 2013
	0.01 to 0.1	GBMC	-	URS, 2013
	0.01	GBMC	-	Golder, 2016
Permian GU Seam	0.01	GBMC	-	Golder, 2016
Permian coal seams (undifferentiated)	1×10^{-6} to 0.001	Wards Well ML	packer	AGE, 2012
Permian Interburden	2×10^{-5} to 0.33	GBMC	-	URS, 2013
	2×10^{-6} to 3×10^{-5}	Red Hill	-	URS, 2013
Permian Overburden/Interburden	8×10^{-4}	GBMC	-	Golder, 2016

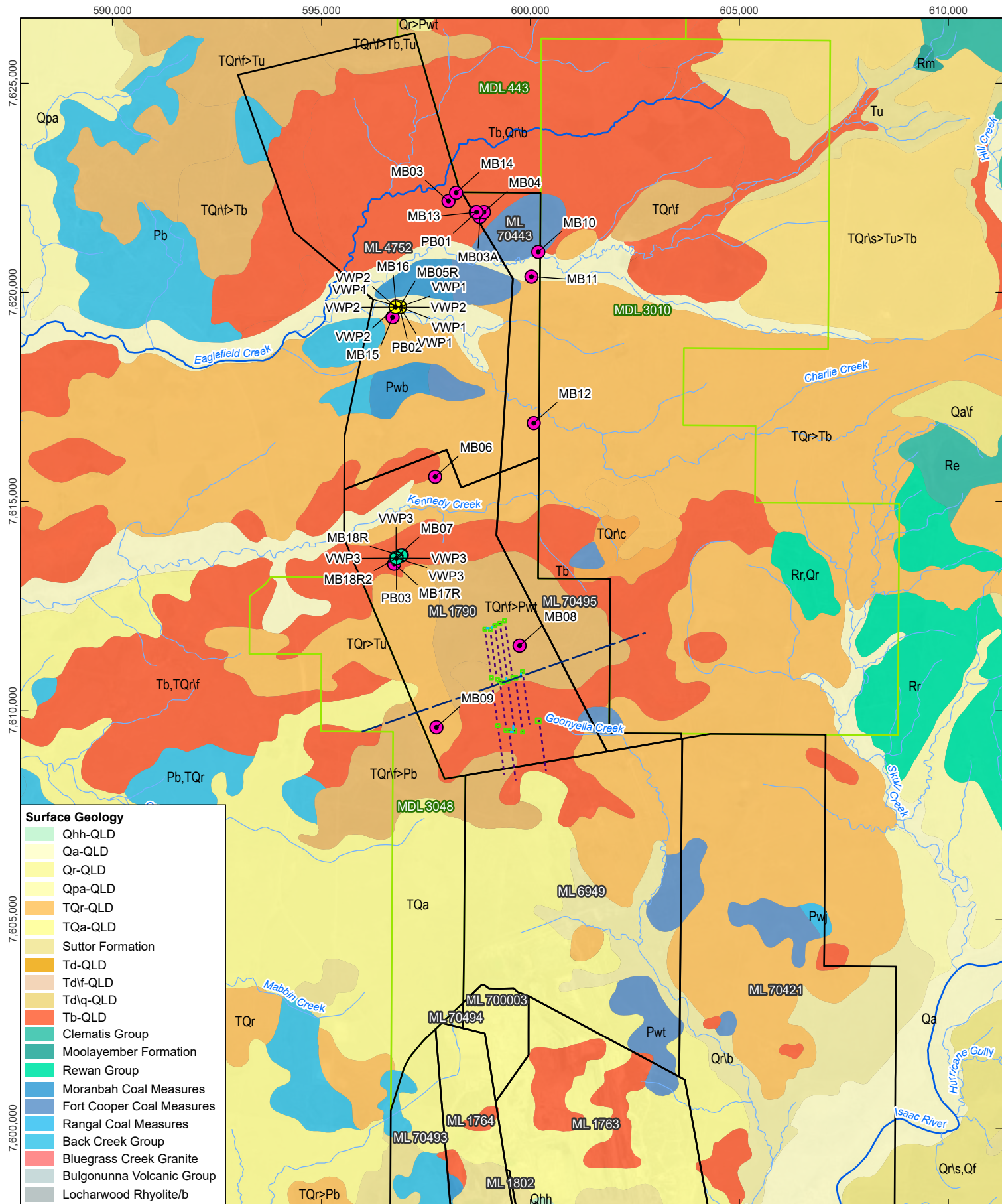
¹ as reported by Golder (2020)

- test type not reported

CRT = Constant Rate Test

GBMC = Goonyella Broad Meadow Complex





Surface Geology	
	Qhh-QLD
	Qa-QLD
	Qr-QLD
	Qpa-QLD
	TQr-QLD
	TQa-QLD
	Sutor Formation
	Td-QLD
	Td/f-QLD
	Td/q-QLD
	Tb-QLD
	Clematis Group
	Moolayember Formation
	Rewan Group
	Moranbah Coal Measures
	Fort Cooper Coal Measures
	Rangal Coal Measures
	Back Creek Group
	Bluegrass Creek Granite
	Bulgonunna Volcanic Group
	Locharwood Rhyolite/b

	0 1 2 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:120,000 at A4
Project Number:	620.041540.00001
Date Drawn:	10-Sep-2024
Drawn by:	RB

LEGEND

Monitoring Bore

- Basalt
- Permian (Coal)
- Permian (Interburden/Overburden)
- Tertiary Sediments
- Hydrogeological Cross Section
- Lateral Well Length

- Major Watercourse
- Minor Watercourse
- Mining Lease
- Mineral Development Licence
- Drill Pad
- Access Track

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**SURFACE GEOLOGY AND
MONITORING NETWORK**



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FIGURE 6.21

6.7.1.2 Groundwater Conditions

This section outlines the baseline understanding of hydrogeological conditions that informs the analytical model design and impact assessment.

Water Level

Located in between CNVPW_13 and CNVPW_8, MB08 is screened in the basalt aquifer and gives the best indication of groundwater conditions in this aquifer at the production well field. **Image 6.5** shows a hydrograph MB08 with Cumulative Rainfall Departure included to assess the impact of monthly rainfall variations in the groundwater hydrographs.

Groundwater levels at MB08 very broadly reflect the long-term rainfall trend with a clear recession from the significant recharge associated with very high rainfall during the 2010-11 wet season. Based on groundwater levels at MB08, Tertiary basalt groundwater levels in the immediate footprint of the Project Area are considered likely to range between approximately ~296 and 297m AHD.

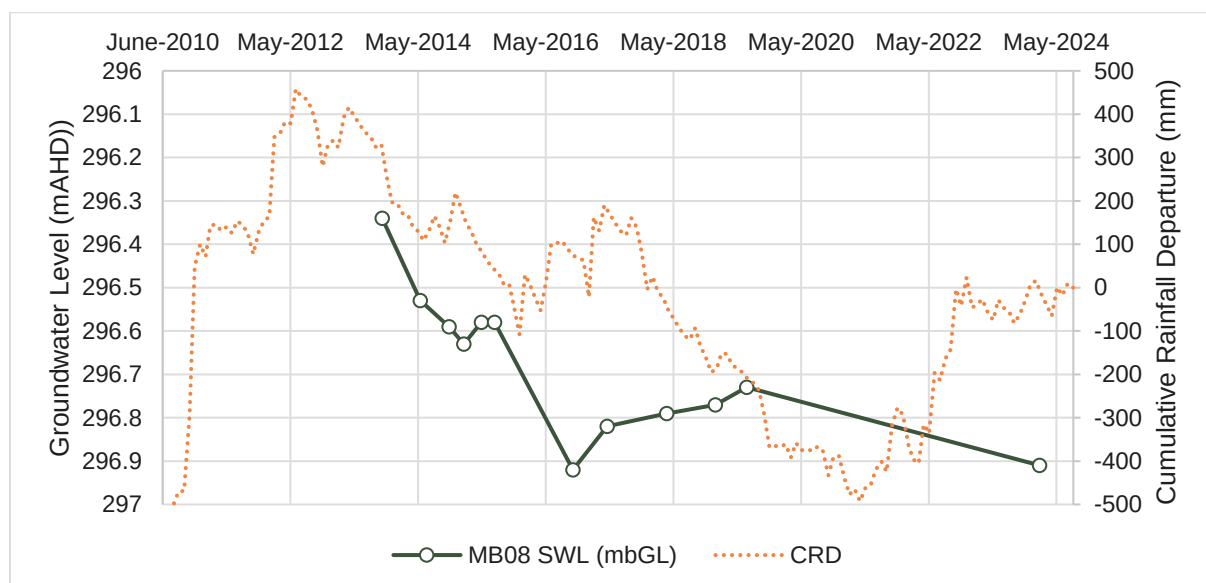


Image 6.5 Groundwater level monitoring bore MB08 hydrograph

The nearest groundwater level monitoring in the Permian coal seams is VWP03, approximately 2.7 km northwest of the proposed Project Area. Hydrograph of this data is provided in **Image 6.6**. Sensor lithology corresponds to:

- Sensor 4: Interburden
- Sensor 3: Goonyella Middle 0
- Sensor 2: Goonyella Lower 3, and
- Sensor 1: Goonyella Lower 8.

Groundwater level and flow direction in the Permian was additionally investigated by developing groundwater level contours from exploration drilling bores that were cased to below 150 metres below ground level (mbGL) i.e. reflecting groundwater conditions in the Permian (**Image 6.6**). These are considered to be low reliability water level estimates as they are likely to present as averaged piezometric level Permian strata that are exposed in the borehole (including coal and overburden). Based on these localised contours for data collected in 2011, the interpreted groundwater flow direction is to the south and west.



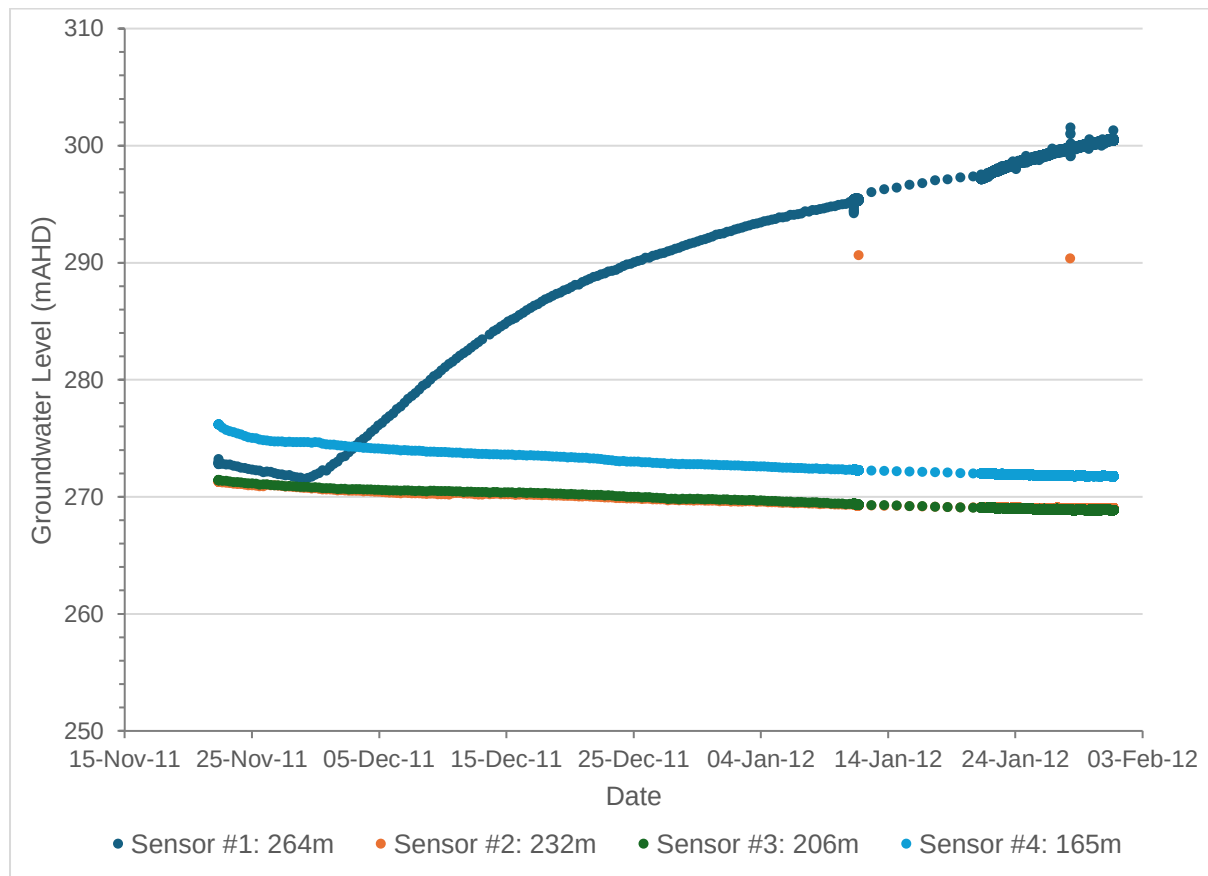


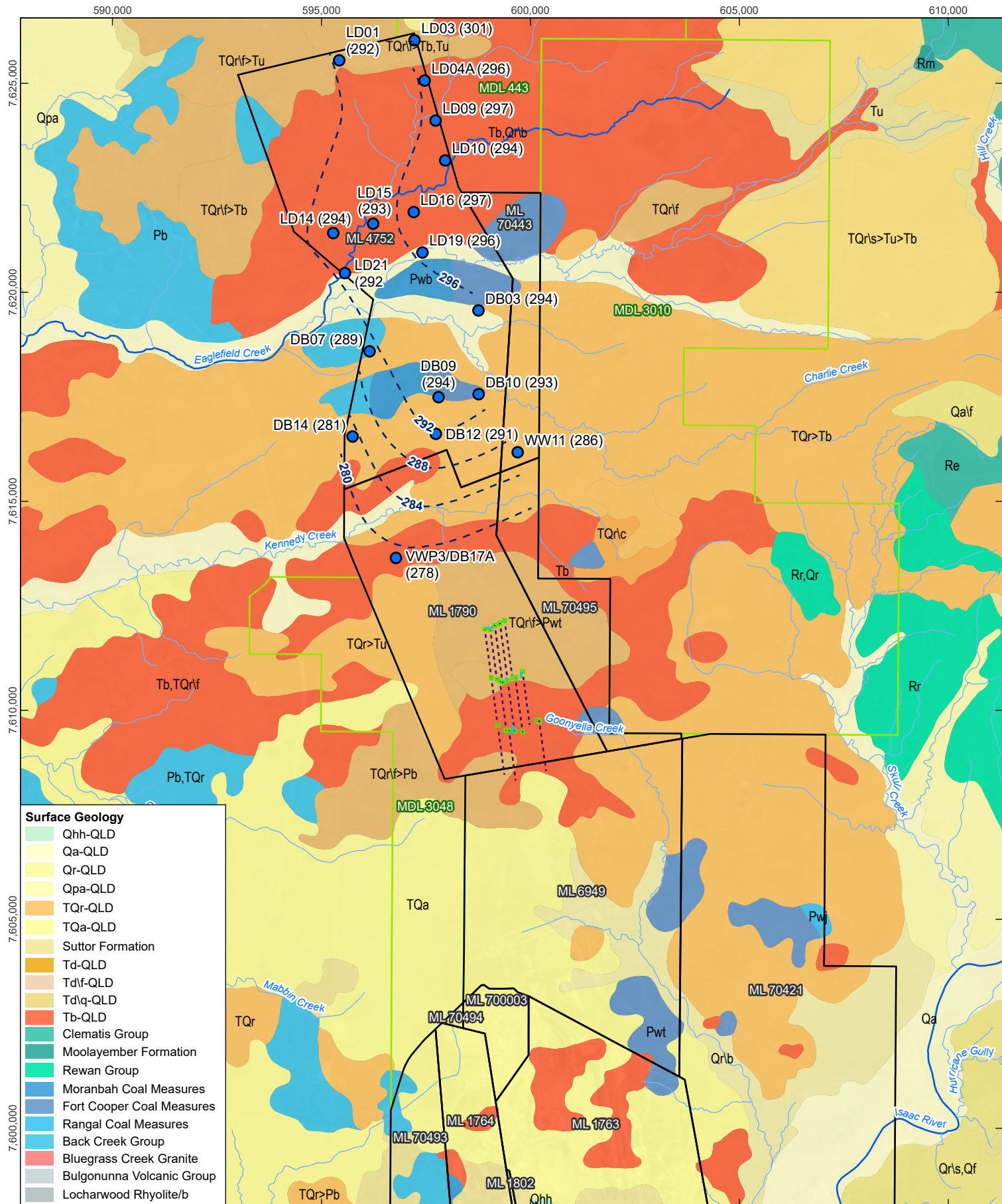
Image 6.6 VWP03 hydrograph

Water Chemistry

Groundwater quality data collected for the Project Area indicates the following:

- **Alluvium:** Variable salinity, but generally brackish to saline (up to 6,600 $\mu\text{S}/\text{cm}$, with an average of $\sim 3,700$ $\mu\text{S}/\text{cm}$), slightly alkaline pH (7.32 to 7.61) and sodium chloride dominated.
- **Basalt:** Moderate salinity, ranging from slightly brackish to saline (893 $\mu\text{S}/\text{cm}$ to 4,670 $\mu\text{S}/\text{cm}$), very slightly alkaline to moderately alkaline pH (7.16 to 8.97), and sodium chloride dominated.
- **Permian Coal Measures:** Limited data exists for monitoring bores screened within the coal measures outside of two rounds of grab samples in late 2011. Chemistry results from these sampling rounds indicated that groundwater in the coal measures is of significantly higher in salinity, and more alkaline compared to samples from the basalt and alluvium.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:120,000 at A4

Project Number: 620.041540.00001

Date Drawn: 10-Sep-2024

Drawn by: RB



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FIGURE 6.22

6.7.1.3 Environmental Values

Groundwater Management Areas

The south-eastern corner of ML 1790 and the southern half of the adjoining ML 70495 lie within the Isaac-Connors Rivers catchment of the Fitzroy Basin and the Isaac Connors GMA. The rest of ML 1790 to the north-west lies within the Suttor River catchment of the Burdekin Basin. The south-western area of ML 1790 which lies within the Suttor River catchment also lies within the Highlands Underground Water Area.

Groundwaters in the portion of the Project intersecting the Isaac Connors GMA are scheduled under the Queensland Environmental Protection Policy (Water and Wetland Biodiversity) 2019 (under the Environmental Protection Act 1994) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated Environmental Values (EVs) for these groundwaters are:

- Biological integrity of aquatic ecosystems – these occur where groundwater baseflow supports streams and water holes to some extent (e.g. seasonally or permanently).
- Human use EVs:
 - Suitability of water supply for irrigation – where groundwater is used to grow crops and pastures for commercial purposes.
 - Farm water supply/use – where groundwater is used to provide domestic supply and support growing domestic produce.
 - Stock watering – where groundwater is used to provide stock water.
 - Drinking water supply – where groundwater is used for potable water supply.
 - Primary recreation – where groundwater supports recreational use that involves direct contact and a high probability of being swallowed, e.g. diving, swimming, water skiing.
 - Cultural and spiritual values – where groundwater supports both indigenous and non-indigenous values, e.g. recreational fishing, heritage, ecology.

The majority of ML1790 is located within the Suttor River Catchment which is not a defined water management zone within the Burdekin Basin and no legislated EVs for groundwaters are currently defined. However, within this catchment the southwestern portion of ML 1790 lies within the Highlands Underground Water Area. The Water Act states that declared underground water areas may be subject to the following regulations:

- The taking of, or interfering with, underground water.
- The types of works for taking or interfering with underground water that are assessable development or accepted development of the Planning Act.

The Water Regulation 2016, which describes the relevant legislation surrounding declared underground water areas, states that the Highlands Underground Water Area does not require water entitlement, water permit or seasonal water assignment notice for stock or domestic purposes or a prescribed activity. Prescribed activities in the context of mining operations include:

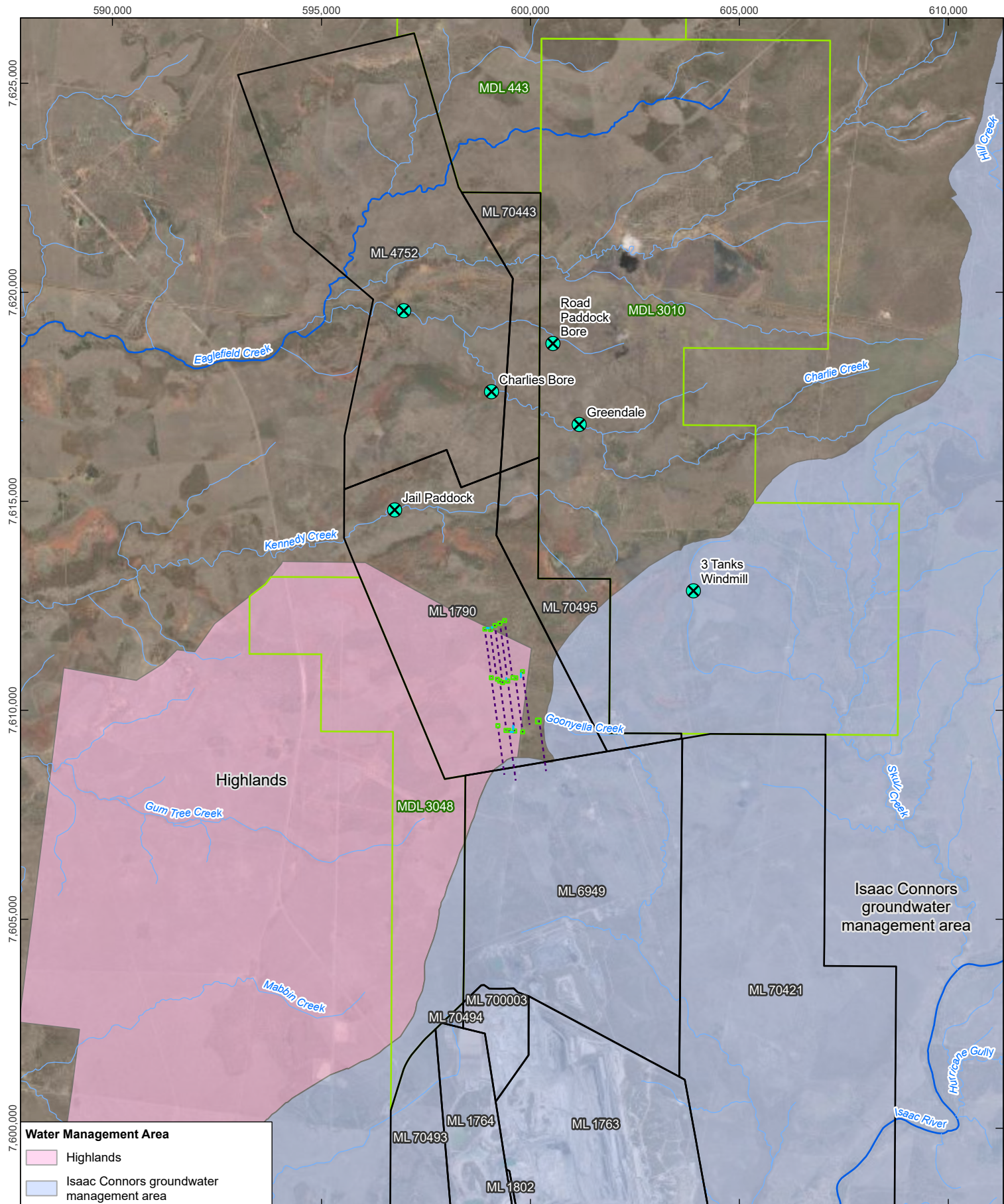
- Washing down equipment plant or vehicles.
- Supplying water for temporary camps or living quarters for staff, for example, for operating toilets, showers, kitchens, or laundries.



- Construction works, infrastructure or plant that are temporary and reasonably necessary for, or incidental to, carrying on mining under a mining lease granted under the Mineral Resources Act.
- Constructing, but not maintaining, roads with the area of a mineral development licence, or mining lease, granted under the Mineral Resources Act.
- Rehabilitation of riparian land.
- The following activities in relation to pumps, wells, or bores:
 - Constructing or drilling.
 - Proving supply.
 - Testing water quality.
 - Flushing out.

Any dewatering requirements occurring within the bounds of the Highlands Underground Water Area will be subject to obtainment of a water entitlement, water permit or seasonal water assignment notice.





Water Management Area

- Highlands
- Isaac Connors groundwater management area

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:120,000 at A4
 Project Number: 620.041540.00001
 Date Drawn: 11-Sep-2024
 Drawn by: RB

LEGEND

- Bore Census Water Supply Bore (AGE 2012)
- Major Watercourse
- Minor Watercourse
- Mining Lease
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

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WATER MANAGEMENT AREAS AND PRIVATE BORES



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FIGURE 6.23

Water Supply Bores

A search of the Queensland Government's Registered Groundwater Bore Database (GWDB) (DRDMW, 2024) was undertaken to identify registered bores within the 10 km of the Project Area. The search returned 45 bores with the following uses:

- Mine monitoring (28 bores).
- Petroleum exploration (1 bore).
- Water supply (7 bores).
- Sub-artesian monitoring (5 bores).
- Unknown use (10 bores).
- Decommissioned (1 bore).

Monitoring bores, exploration, and decommissioned or abandoned bores were excluded, which left no existing registered water supply bores within the search area. A landholder bore census was conducted for the Wards Well EIS by AGE (2012). The census included a total of 21 bores and identified six unregistered bores. The results of the survey indicated that these bores are used for stock watering. The locations of the six unregistered bores identified are included on Figure 6.23.

Groundwater Dependent Ecosystems

A groundwater dependant ecosystem (GDE) is a natural ecosystem that requires "access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services" (Richardson, S., et al., 2011).

The BoM's National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (BoM, 2017) classifies ecosystems based on the potential for dependence on groundwater through multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater dependence (indicating a strong possibility the ecosystem is interacting with groundwater).
- Moderate potential for groundwater dependence.
- Low potential for groundwater dependence (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

BoM GDE Atlas regional study mapping indicates that areas with possible high, moderate, and low potential for groundwater interaction occur in the vicinity of the Project Area (Figure 6.23). This includes "high potential" terrestrial GDEs associated with regional ecosystems on basalt within the immediate mining footprint and the riparian corridor of Kennedy Creek across the northern end of ML 1790.

Ecological field surveys (refer to Section 6.6) have identified that there are no aquatic or terrestrial GDEs present within the Study Area. There are no mapped subterranean GDEs within or near (within 100 km) the Study Area. Additionally, no stygofauna were collected from bores within or immediately surrounding the Study Area, suggesting the absence of subterranean GDEs within these aquifers.



6.7.2 Proposed Activities

Groundwater extraction will occur at the vertical and lateral wells that may have impact on groundwater levels in the area. The extraction of groundwater from the wells, located on ML 1790, is the primary activity to be assessed for potential hydrogeological impacts.

Proposed activities will include drilling of vertical and lateral wells to target the GM seam between 290 - 570 mbGL. These activities are detailed in Section 3. The summary presented below focuses on the relevant information for prediction of potential groundwater impacts.

Groundwater in the coal seam will be pumped from the wells, reducing the hydrostatic pressure in the production seam by a planned 40 kilopascals (kPa) per day, or 4 metres water head (mH₂O). Based on information provided by Peabody, it is anticipated that depressurisation of the coal seam will take up to 90 days. From the well head, the water will pass through the well head to storage tanks and ultimately be added to the CCM mine water management system.

- The reduction in hydrostatic pressure within the coal seam allows CSG to desorb from the coal matrix. The CSG will migrate through the coal's natural fractures (cleats) through the perforations made in the casing and into the well.
- The desorbed CSG will flow up the well to the surface, where it will be separated from any co-produced water. The CSG will pass through a steel pipe before being flared. Data logging will take place to record the amount of CSG produced from the wells. It is anticipated that CSG will be produced at 500 l/sec rate.
- Currently, Peabody estimates water production rates of 20 kilolitres (kL) per day over the operational life of the well.
- Report on Surface to Inseam (SIS) well performance at North Goonyella (Weisstech, 2023) demonstrates that production effectively ceased at four production locations before the 800th day online, indicating that CSG production per bore will likely be less than 800 days. As a conservative assumption, the following prediction of impact is based on well life of 800 days. Analytical model runs extended to t = 1200 days.

6.7.3 Prediction of Impacts

The following subsections detail the potential groundwater impacts as a result of the activities described in **Section 3.0**. Impacts may result from the propagation of drawdown that results from the depressurisation of the target coal seam to groundwater receptors (**Section 6.7.1.3**). The prediction of drawdown impacts has been investigated through analytical modelling of the hydrogeological environment outlined above, with conservative estimates of input parameters selected to inform the assessment of risk.

The analytical assessment of the Project activities has aimed to adopt an overly conservative approach to offset some of the limitations of the simple representation of the hydrogeological setting.

A risk-based assessment of these potential impacts is detailed in **Section 6.7.4**.

6.7.3.1 Analytical Modelling

The proposed well field was represented using MLU (Multi Layer Unsteady) (Hemker and Post, 2012), an aquifer testing software that computes drawdown within layered aquifer systems. Analytical model represented the proposed activities discussed above as:



- 13 vertical wells, and 10 lateral wells, distributed across the Project Area targeting the GM seam near the base of the Moranbah Coal Measures.
- Initial pumping period involving depressurising the coal seam by approximately 4 mH₂O per day for 90 days, followed by CSG extraction. Model results are presented below for up to 1200 days to include some recovery period representation. A conservative assumption is included that all production bores are operating simultaneously, which will increase the predicted drawdown.
- Estimated water production rate of 20 kilolitres per day (kL/day) for the life of the bores.

The detail of these inputs is discussed in subsequent sections.

Model Inputs

Model Layers

Model aquifer/aquitard layers were based on geological logs of monitoring in the Project Area (MB08 and MB09 bore logs) as well as the geological model and a conceptual understanding of the surrounding area. A thin unit representing surficial Tertiary/weathered basalt regolith was represented at the surface, comprising tertiary sediments although not a regionally significant aquifer. Below this is a basalt layer which is between 30 and 150 metres thick near the production well field. This unit is underlain by Permian overburden between 300 and 150 m thick in this area, comprising interbedded siltstone, claystone and coal seams.

The model development process included evaluating different scenarios where the thicknesses of Basalt Aquifer and Overburden Aquitard was varied between 50 and 200 metres to gauge the sensitivity of predicted impacts in the basalt to the thickness of intervening overburden. The results of this basic sensitivity analysis are outlined below. A consolidated thickness of 7 metres was used for the target coal seam.

The basal unit of the model is taken to be the Back Creek Group contact underneath target coal seams. For the purposes of simplifying the model, and as a conservative assumption, there is no vertical flow component upwards from the basal unit to the target coal seam. This is considered appropriate as the back Creek Group at this depth is not likely to be a significant groundwater contributor, and this has the effect of focusing groundwater flow within the target aquifer (and the overlying aquifer/aquitards).

Hydraulic Parameters

Hydraulic conductivities were based on test data summarised in **Section 6.7.1.1**. Permeability values provided by the client in millidarcies for nearby CSG projects were not used as this is a pressure dependant quantification of material flow capacity that is incompatible with this analytical modelling method. As displayed in **Table 6.30**, a range of vertical hydraulic conductivities between 0.001 and 0.00001 were tested, with variable aquifer thickness to assess the sensitivity interaction between the basalt aquifer and target coal seam. Horizontal conductivity for the Basalt was taken to be 2 m/day as a conservatively high point within the range of site-specific hydraulic testing for this unit. Coal seam horizontal conductivity and storativity was refined to produce the anticipated production well drawdown curve, under the pumping regime that is outlined above. This is considered an appropriately conservative value in the higher range of hydraulic testing data for this unit.

Storage values for the shallow basalt and Tertiary layers were selected based on mid-point values from pumping tests carried out at PB01, PB02 and PB03, as presented in Golder (2021). No storage values were available in the previous studies for the Permian overburden



or coal seams. Coal seam storage was selected based on re-producing planned drawdown rate with anticipated pumping volumes discussed below. Overburden storage values were aligned with the coal seam estimate as a conservative assumption, with values in the mid-point of typical range (Fitts, 2012).

Pumping Stress Periods

The pumping arrangement was modified from the design locations due to the need to represent groundwater extraction along the length of the horizontal coal seam wells. Hence, the collar positions of some vertical production wells were moved to a mid-point along the trace of the lateral well connecting to them. These new locations, (termed image bores) were used along the path of lateral wells to simulate the distributed extraction and avoid over-localisation of drawdown at the clustered vertical production well points. Note that two locations (indicated as Approved VPB in **Image 6.5**) are vertical production wells that will be drilled within existing approved disturbance area. These are included in modelling due to likely interaction between the drawdown induced at these locations and the proposed disturbance for approval.



Image 6.7 Bore locations with designed vertical production well collar locations



Pumping stress periods were defined based on:

- Communication from Peabody is that hydrostatic pressure within the bores will be reduced at 40 kilopascals per day (kPa/day), approximately 4 mH₂O (metres of water head), for 90 days.
- Estimated water make for the production well field, provided by Peabody is approximately 20 kilolitres per day (kL/day), averaged over the production life of the wells.

Observation bores positioned within 10 metres of the active vertical production wells were used to approximate an initial high water production period, as groundwater levels are lowered to the CSG production pressure. Extraction rates between 20 L/sec (1753 kL/day) and 0.2 L/sec (20 kL/day) were tested for this period, with the best re-production of planned drawdown occurring at approximately 0.58 L/sec (50 kL/day). In practice, the well then transitions to CSG production, with lower water production as piezometric pressure is maintained constant and gas flow is primary discharge from the wells. This was represented conservatively by using the average water production estimate of 20 kL per day.

Table 6.29 Pumping stress periods used in model

Stress Period	Starting Time (days)	Pumping Rate (kL/day)
1	0	50
2	90	20
3	800	0

Base Case

For the base case scenario, model layers were aligned with general geological information as described above. Hydraulic conductivity data selected, aquifer model layout and parameterisation are shown in **Table 6.30** and **Image 6.6**.



Table 6.30 Model aquifer layering and hydraulic parameters

Layer	Thickness (m)	Vertical Conductivity (m/day)	Horizontal Conductivity (m/day)	Storativity (-)	Justification Assumptions
Regolith	5	0.01	-	0.001	- Little to no regolith influence on pumping arrangement or groundwater utilisation - Hydraulic parameters per Golder (2021)
Basalt Aquifer	Range: 50 to 200 Base Case: 50	-	2.0	0.0001	- Thickness varied to test sensitivity. Thick and thin areas present on site. - Relatively high hydraulic conductivity used as conservative assumption (Golder 2021) - Middle order-of-magnitude storage value used from pumping test data (Golder 2021)
Claystone/Siltstone/Sandstone Overburden	Range: 50 to 275 Base Case: 250	Range: 1×10^{-4} to 1×10^{-6} Base Case: 1×10^{-4}	-	0.0001	- Thickness varied to test sensitivity. Thick and thin areas present on site. - Hydraulic conductivity range from Golder (2021). Sensitivity analysis applied to K_v. Base case uses upper range as conservative assumption - No storativity data from previous studies, estimate derived from literature values (Fitts, 2002)
Permian Coal Measures	7	-	Range: 3×10^{-1} to 1×10^{-6} Base Case: 1×10^{-2}	0.0005	- Hydraulic conductivity data presented per Golder (2021) - Hydraulic conductivity and storativity values refined to produce anticipated drawdown response in production wells. Correspond to upper range of reported conductivity in this unit, therefore appropriately conservative - No storativity data from previous studies
Siltstone Underburden	30	0.0		0.0	Basal unit, assumed impermeable



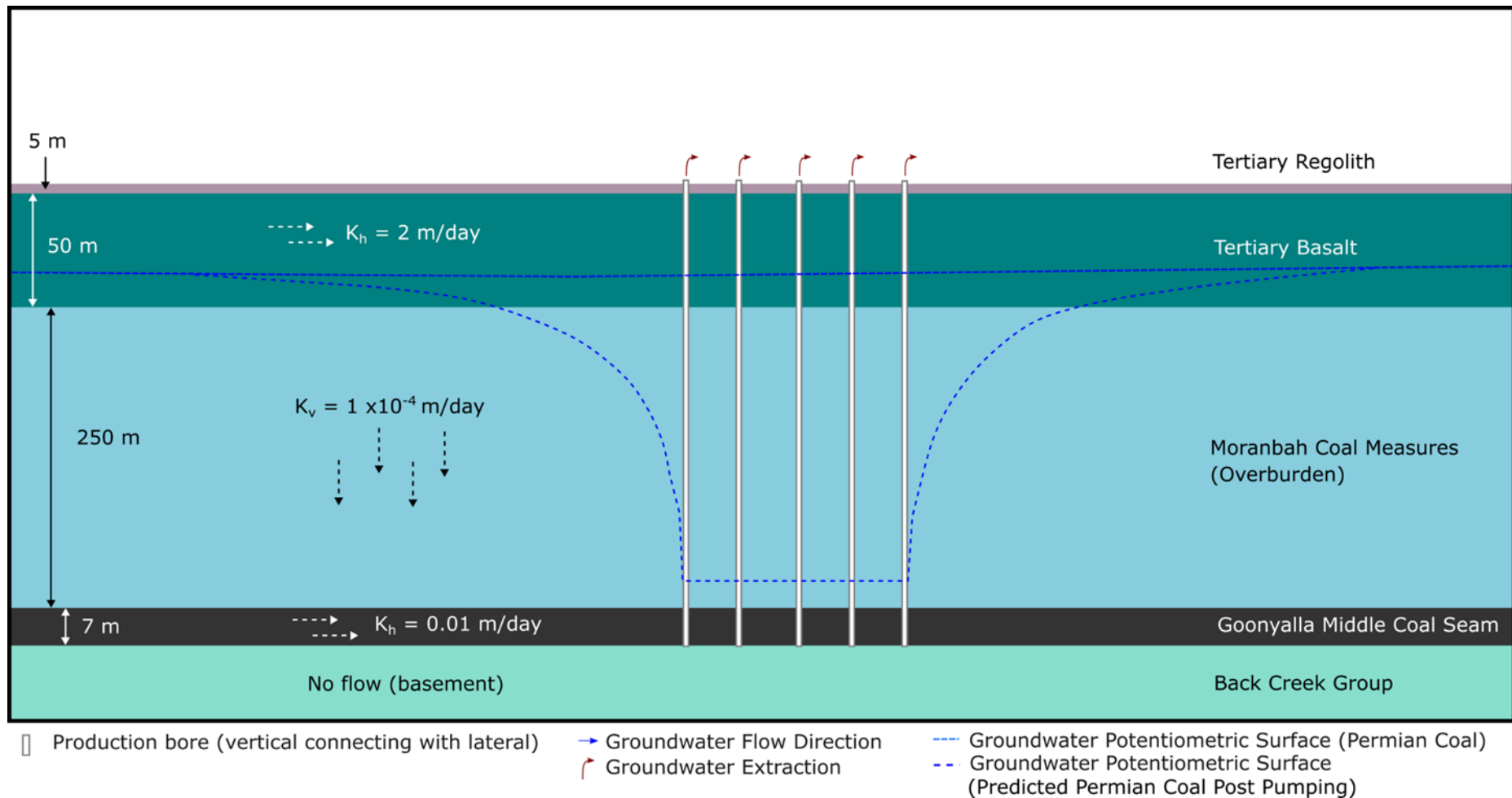


Image 6.8 Analytical model layout and base case diagram



6.7.3.2 Results

Drawdown predictions from the analytical model are presented as hydrographs in **Image 6.7** and **Image 6.8**. **Image 6.7** shows drawdown observations at CNVPW6, a centrally located vertical production well. High drawdown in initial pumping period stabilises once target drawdown has been attained. **Image 6.8** depicts water level response in the basalt adjacent to CNVPW_6, together with predicted impacts at the location of landholder bores in the overlying basalt aquifer. Predicted coal seam drawdown contours for $t = 800$ days are presented in **Figure 6.24**.

Observed drawdown in the shallow aquifer, is negligible i.e. <0.02 m. No drawdown is observed in the basalt aquifer at three of the closest potential water supply receptors. Coal seam drawdown is pronounced in the immediate area of the production bores, however horizontal drawdown propagation (**Figure 6.24**), is relatively limited, within 1 kilometre of the production well field.

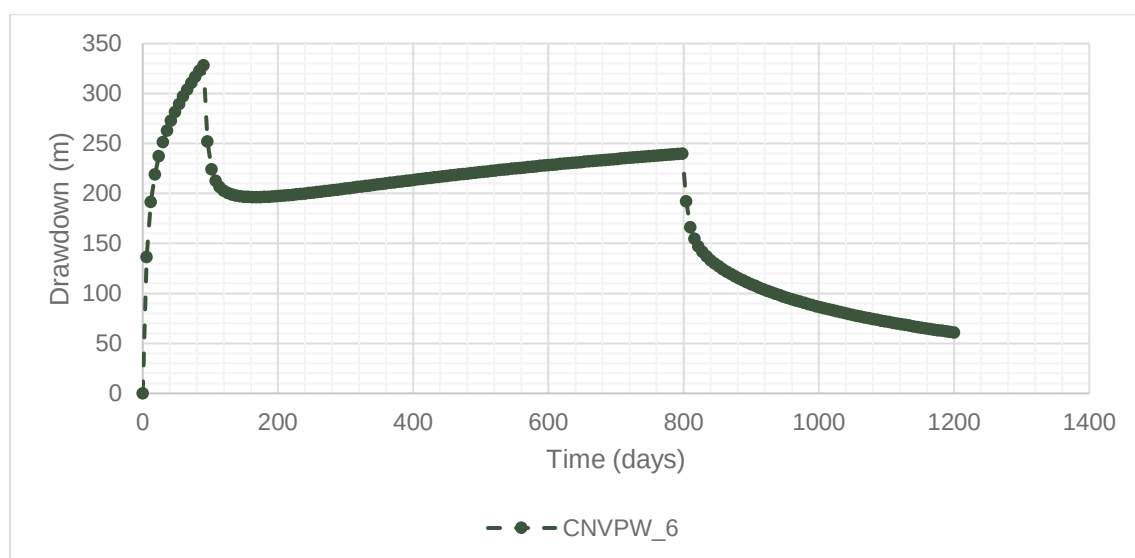


Image 6.9 Predicted drawdown in the target coal seam at the production well field

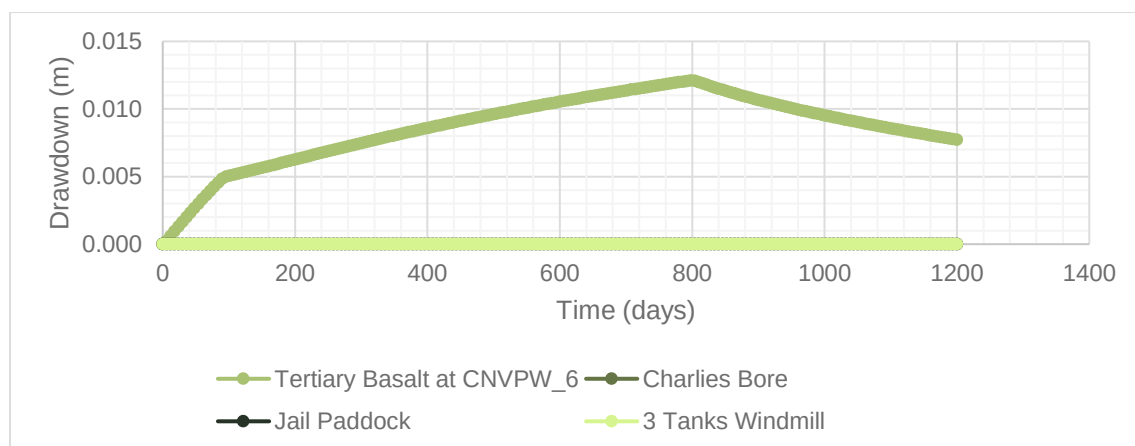
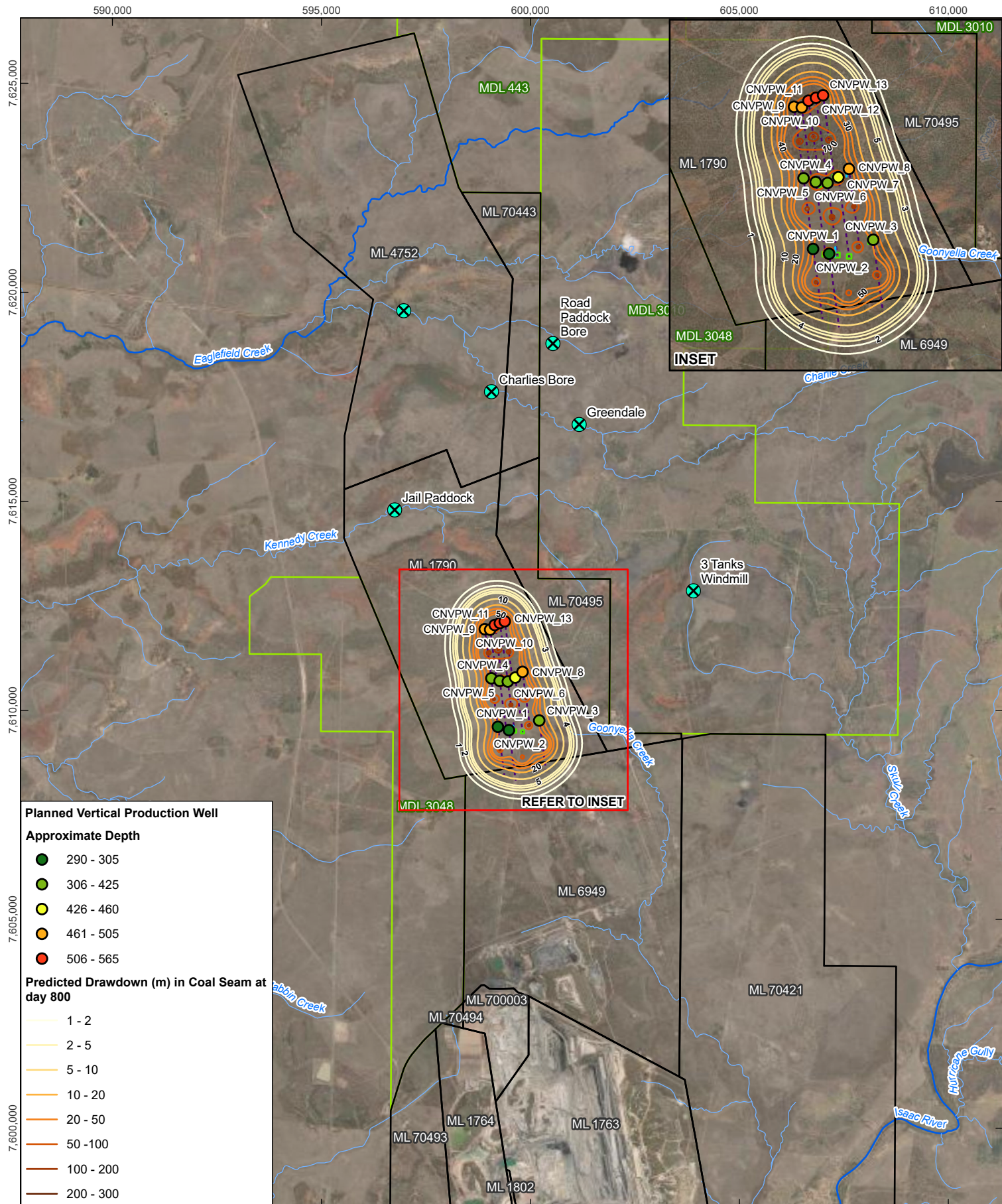


Image 6.10 Predicted drawdown in the shallow aquifer observation bores, basalt aquifer at the production well field, and nearby landholder bores





Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:120,000 at A4
 Project Number: 620.041540.00001
 Date Drawn: 10-Sep-2024
 Drawn by: RB

LEGEND

- Bore Census Water Supply Bore (AGE 2012)
- Major Watercourse
- Minor Watercourse
- Mining Lease
- Mineral Development Licence
- Lateral Production Well Trace
- Drill Pad
- Access Track

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PREDICTED DRAWDOWN IN COAL SEAM



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FIGURE 6.24

Sensitivity Analysis

The key impact of groundwater extraction for the purposes of this assessment is the propagation of depressurisation in the target coal seam propagating into the overlying strata, specifically the basalt aquifer. Therefore, the sensitivity analysis focuses on interaction / connection between the basalt aquifer and the target coal seam. A range model inputs for the thickness and vertical hydraulic conductivity of the Permian overburden between the target coal seam and the basalt aquifer, and the thickness of the basalt aquifer, were tested. Parameter combinations and predicted drawdowns in the basalt aquifer are presented in Table 6.31. An observation point located at CNVPW_6, which is positioned at a central point in the Project Area, and observing the basalt aquifer was used to measure the predicted maximum drawdown after 1200 days of pumping. This location was selected as this is expected to be the point of maximum potential interaction, with the lowest coal seam pressures inducing leakage from the overlying layers.

Table 6.31 Sensitivity analysis of interburden vertical conductivity

	Vertical Hydraulic Conductivity of Overburden (m/day)	Basalt & Overburden Thickness (m)		
		200 / 50	150 / 100	50 / 250
Predicted Drawdown In Basalt at Production Bore Field (m)	Minimum: 1×10^{-6}	0.0009	0.0005	0.0003
	Median: 1×10^{-5}	0.008	0.004	0.002
	Maximum: 1×10^{-4}	0.026	0.023	0.017

Predicted drawdown in the overlying basalt aquifer is negligible for all scenarios. A high overburden vertical hydraulic conductivity (1×10^{-4} m/day) was selected to bring forward in the modelling process, reflecting a conservatively high value, on the upper estimates of potential vertical conductivity for the region. Basalt thickness of 50 m and overburden thickness of 250 m was selected as these represent values more in line with the geological information for the production well field, and these combine for a reasonably conservative representation of the aquifer layout based on sensitivity analysis.

6.7.4 Risk Assessment

A risk assessment has been used to summarise the potential impacts on groundwater receptors arising from the Project activities based on a consideration of likelihood and consequence of potential risks being realised. The following were considered as part of the risk assessment:

- Brief description of the potential issue in terms of source > pathway > receptor.
- Description of the potential impact.
- Potential likelihood of the risk being realised.
- Potential consequence of the impact.
- Risk rating derived from likelihood vs consequence.

Descriptions of the categories that were used to rank the likelihood and consequence of potential risks being realised are provided in **Table 6.32** and **Table 6.33** respectively.



Table 6.32 Likelihood Categories

Likelihood	Basis of Rating
Highly Likely	Expected to occur
Likely	More likely to occur than not to occur
Possible	As likely to occur as not to occur
Unlikely	More likely to not occur than to occur
Highly Unlikely	Very unlikely to occur even in the long term

Table 6.33 Consequence Categories

Rating	Environmental	Reputational / Legal & Compliance
5 Severe	Widespread environmental damage or effect (permanent; >10 years)	Formal expression of significant dissatisfaction by government Sustained campaign by one or more international NGOs resulting in physical impact on the assets or loss of ability to operate Major litigation / prosecution at Glencore corporate level
4 High	Long term impact (2 to 10 years)	Broad societal concern and criticism Negative media coverage at international level resulting in a Corporate statement within 24 hours Investigation from government and/ or international (or high-profile) NGOs Negative impact on share price Major litigation / prosecution at Department level
3 Moderate	Medium term impact (<2 years impact)	Negative media coverage at national level over more than one day Local Stakeholder action resulting in national societal scrutiny Major litigation / prosecution at Operation level
2 Low	Short term impact (<1 year)	Negative local/ regional media coverage Complaint received from an internal or external stakeholder Regulation breaches resulting in fine or litigation
1 Negligible	No lasting environmental damage or effect	Negligible media interest Regulation breaches without fine or litigation

The risk rating for each potential impact was determined by combining the likelihood and consequence of a risk being realised. The modelling predictions allow quantification of the likelihood of drawdown impacts occurring. The likelihood vs consequence risk assessment matrix is presented in **Table 6.34**.



Table 6.34 Risk Ranking Matrix

		Likelihood				
		Highly Unlikely	Unlikely	Possible	Likely	Highly Likely
Consequence	5	Moderate	Moderate	High	High	High
	4	Low	Moderate	Moderate	High	High
	3	Low	Low	Moderate	Moderate	High
	2	Insignificant	Low	Low	Moderate	Moderate
	1	Insignificant	Insignificant	Low	Low	Low

The risk assessment summary is presented in Table 6.35.

The risk of significant impacts to groundwater receptors from the proposed limited CSG development are considered to be low to negligible. Note that the conclusions discussed here are subject to the assumptions and exclusions outlined in **Section 6.7.5**.



Table 6.35 Risk assessment summary

Source	Pathway	Receptor	Potential Impact	Consequence	Likelihood	Risk
Depressurisation of the target coal seam at depth below the basalt aquifer for the purpose of CSG production	Upward propagation of drawdown from the depressurised coal seam through the overburden into the basalt aquifer	Landholder bores	Drawdown impacts at landholder bores – loss of yield	Moderate: loss of water source for landholder, reputational risk for operator.	Highly unlikely: modelling predicts no significant drawdown in the basalt at landholder bore locations.	Low
		Aquatic and terrestrial GDEs	Drawdown reaches potential terrestrial GDEs which are dependent on the saturated water table rather than shallow perched water tables. Decline in health or loss GDE	Ecological field surveys (Section 6.6) identified that terrestrial GDE are not present within the Study Area. Therefore, assessment of risk is not required.		N/A
		Watercourses	Drawdown impacts reach creek locations and reduce baseflow.	Negligible: The creeks are ephemeral and not supported by baseflow and so a reduction in basalt groundwater levels could not affect creek flows.	Highly unlikely: The local watercourses are ephemeral, flowing only in response to heavy rainfall and runoff events. There is no baseflow to the creeks and so a reduction in groundwater levels beneath isolated creek reaches can have no effect on creek flow. In addition, drawdown impacts in the basalt are considered negligible.	Negligible
Contaminant release through drilling or water storage activities	Hydraulic gradient away from disturbance activities, either in deep aquifer through	Landholder bores	Unable to use water for domestic or stock purposes	Moderate: loss of water source for landholder, reputational risk for operator.	Highly unlikely: No fracking to be conducted, therefore hydraulic gradient will be towards production well. Appropriate post-production rehabilitation and decommissioning to be taken to	Low



Source	Pathway	Receptor	Potential Impact	Consequence	Likelihood	Risk
	production bores, or shallow aquifers through surficial infiltration				mitigate long-term risk. Additionally, surface water controls are to mitigate contaminant release potential at surface.	
		Aquatic and terrestrial GDEs	Harm to water reliant ecosystems	Ecological field surveys (Section 6.6) identified that terrestrial GDE are not present within the Study Area. Therefore, assessment of risk is not required.		N/A
		Watercourses	Harm to water reliant ecosystems	Negligible: The creeks are ephemeral and not supported by baseflow and so a reduction in basalt groundwater levels could not affect creek flows	Highly unlikely: The local watercourses are ephemeral, flowing only in response to heavy rainfall and runoff events. There is no baseflow to the creeks and so a reduction in groundwater levels beneath isolated creek reaches can have no effect on creek flow. In addition, surface water controls are to mitigate contaminant release potential	Negligible



6.7.5 Limitations

The analytical modelling has adopted a conservative approach and included a sensitivity analysis to assess the outcome of high vertical conductivity in the overburden and reduced thickness of overburden in order to compensate for potential limitations.

As with an analytical model, this method is subject to simplifying assumptions (outlined in Carlson and Randall, 2012) including:

- All layers are of infinite horizontal extent.
- All aquifer layers are homogeneous and isotropic with respect to transmissivity and storativity.
- All aquitard layers are homogeneous with respect to vertical resistance and storativity.
- Darcy's law is valid, except for turbulent flow near well screen.



6.8 Surface Water

This section presents the assessment of Project related surface water impacts to environmental values.

6.8.1 Existing Environmental Values

The environmental values associated with surface water for this Project are downstream aquatic ecosystems, farm water supply, stock watering, drinking water supply, industrial use and cultural values.

Aquatic environmental values are not present in the Study Area or immediate surrounds and accordingly, there are unlikely to be any aquatic ecosystem environmental values associated the Study Area. Refer to Section 6.5 for further details on aquatic ecology.

6.8.1.1 Land Use

The predominant land use in the Study Area comprises relatively natural environments, including grazing, native vegetation (99%) and localised areas of residential homesteads and farm infrastructure.

6.8.1.2 Protected Areas

The nearest protected area is Homevale National Park which is located approximately 60 km to the east of the Project Area. This Park is not hydrologically connected to the Project Area.

6.8.1.3 Regional Drainage

The Project Area is located within the Burdekin Basin water management area with the Fitzroy Basin immediately adjacent to the southeast.

There are no mapped creek systems within the Project Area. The mapped head of Goonyella Creek, a stream order 1 watercourse, is approximately 1 km to the east of the Project Area and runs east before heading south before joining into Isaac River in the Fitzroy Basin water management area. Kennedy Creek, a stream order 2 watercourse, is approximately 2.3 km to the north of the Project Area and runs east and discharges towards the Suttor River, which is situated to the west of the Project Area in the Burdekin Basin water management area. The mapped head of Gum Tree Creek is approximately 2 km southwest of the Project Area and drains westward, again discharging towards the Suttor River, shown in **Figure 6.25**. The mapped head of Goonyella Creek, a stream order 1 watercourse, is approximately 1 km to the east of the Project Area and runs east before heading south before joining into Isaac River in the Fitzroy Basin water management area. Kennedy Creek, a stream order 2 watercourse, is approximately 2.3 km to the north of the Project Area and runs east and discharges towards the Suttor River, which is situated to the west of the Project Area in the Burdekin Basin water management area. The mapped head of Gum Tree Creek is approximately 2 km southwest of the Project Area and drains westward, again discharging towards the Suttor River, shown in **Figure 6.25**.

These creeks are ephemeral waterways, meaning that there is extreme variability in both water quality and volume as a natural part of the water system. A 'typical' year could see local waterways dry from March through to November, intermittently flowing or flooding following high intensity rainfall events between November - March, with this flow slowing and developing into pools of stagnant water that slowly dry out until the more typical dry conditions return.



Streamflow gauging stations are sparsely distributed in the region, and none are located near the Project Area. The nearest gauging station is on the Suttor River at Eaglefield (# 120304A) approximately 30 km to the northwest. Details of flow volumes at this gauging station are provided in **Table 6.36**. This data demonstrates the ephemeral nature of this river and by proxy, the nearby creek systems. The catchment area for this gauging station is approximately 1,915 km². In comparison the total drill pad area is approximately 0.12 km².

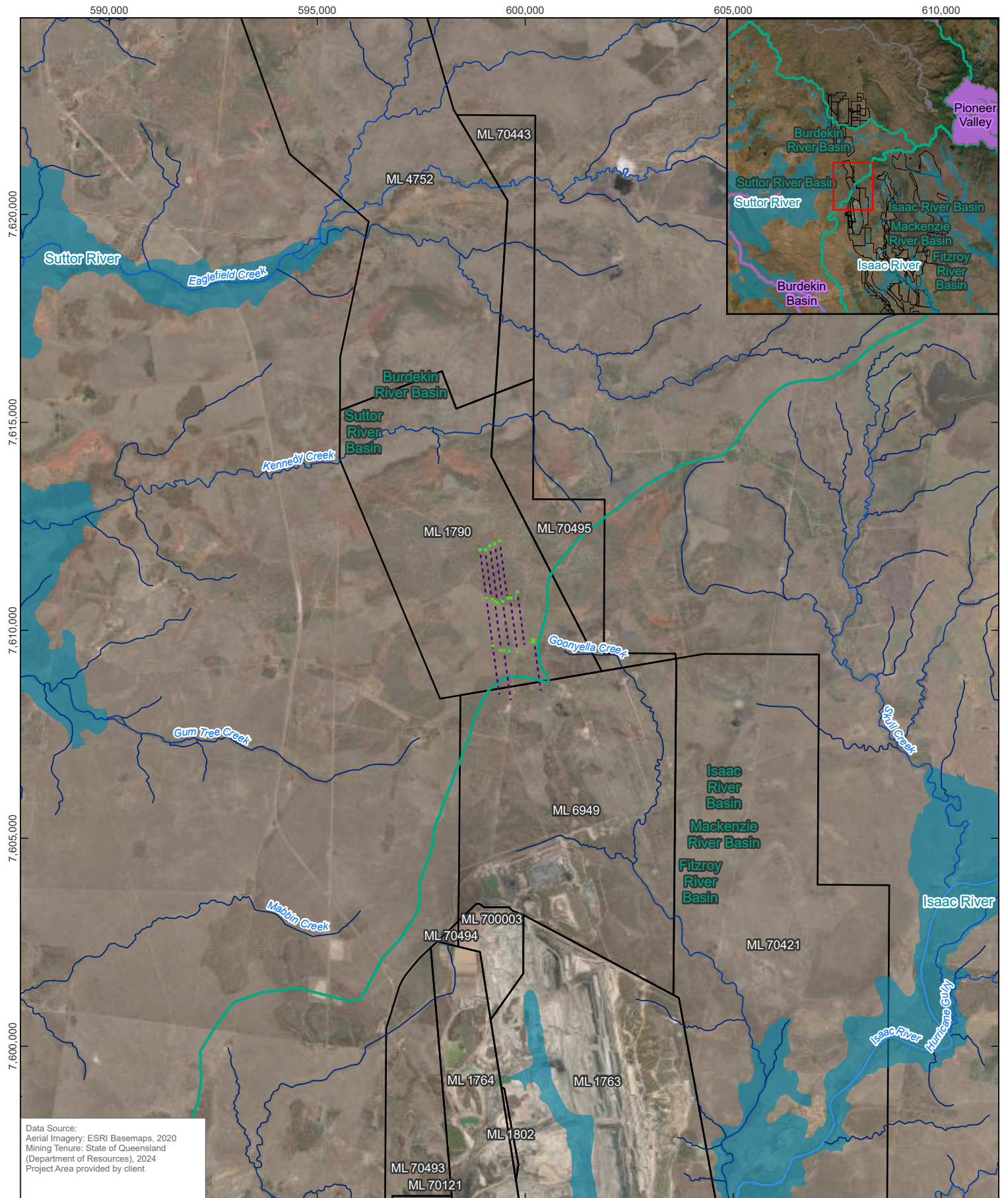
For ungauged catchments in the region, peak streamflow discharges can be estimated using empirical techniques, as recommended in Australian Rainfall and Runoff 2019.

Table 6.36 Suttor River at Eaglefield: flow volume summary (ML)

	Daily				Monthly
	Max	Min	Mean	Median	Mean
Jan	70,286	0	669	4	20,748
Feb	110,991	0	1,054	13	29,802
Mar	110,328	0	554	5	17,178
Apr	34,107	0	116	0	3,423
May	59,461	0	110	0	3,412
Jun	6,600	0	20	0	614
Jul	5,978	0	17	0	519
Aug	13,300	0	9	0	276
Sep	2,085	0	3	0	85
Oct	5,314	0	11	0	336
Nov	22,768	0	114	0	3,413
Dec	48,444	0	502	0	15,547
All months	110,991	0	263	0	7,974

<https://water-monitoring.information.qld.gov.au/>





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client



Coordinate System: GDA2020 MGA Zone 55
Scale: 1:120,000 at A4
Project Number: 620.040594.00001
Date Drawn: 10-Sep-2024
Drawn by: RB

LEGEND

Stream Order

- 1
- 2
- 3
- 4
- 6

- Lateral Well Length
- Drill Pad
- Access Track
- Potential Flood Hazard Area
- River Basin
- Surface Water Management Area

EA AMENDMENT P-EA-100658735

REGIONAL DRAINAGE



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6.25

6.8.2 Potential Impacts

Potential surface water impacts as a result of the activities described in Section 3 include:

- Clearing for access track and drill pads will affect runoff regimes locally.
- Surface water contamination from chemical spills, leaks from gas wells and improper management of wastewater.

A risk-based assessment of these potential impacts is detailed in Table 6.37 and determined that surface water impacts are low due to the scale and location of the proposed activities described in **Section 3.0**.

6.8.3 Management Practices

The potential impacts to the surface water resulting from Project activities outlined in **Section 3.0** will be managed through practices currently employed at CCM. The following management and mitigation measures will be implemented to minimise and/or prevent unauthorised harm to environmental values from the Project:

- Operation water management and control measures associated with potential pollutant and contaminant sources will be maintained to prevent uncontrolled discharge to surface waters. This includes:
 - Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with AS1940:2004, and where practical, will be located away from any waterbodies.
 - Provision of spill recovery equipment will be available and located with construction crews conducting activities with the potential for significant spills.
- Water extracted during operations will be contained in water tanks located on drill pads and will be trucked to CCM for treatment and integration into the mine water system.
- Erosion and sediment control monitoring should be implemented to reduce the amount of sediment laden run-off entering downstream waterways. The following general principles apply:
 - Minimise the surface disturbance areas.
 - Where possible, apply local temporary erosion control measures.
 - As soon as practical, disturbed areas will be rehabilitated to reduce the extent of exposed soils.

6.8.4 Risk Assessment

The potential surface water impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.37**.

The risk of surface water impacts is low. Any realised impacts will be low in comparison to the existing operations undertaken on ML1790.



Table 6.37 Surface water risk assessment

Potential Impact	Likelihood	Consequence	Risk Rating	Justification
Sedimentation of surface waters result from erosion and surface water runoff from Project area	Possible	Minor	Low	Due to the minor scale and size of the Project activities, and the distance to the nearest creeks, this impact poses a low risk of environmental harm
Water and drilling muds contaminate surface waters	Unlikely	Low	Low	Due to the minor scale and size of the Project activities, and the distance to the nearest creeks this impact poses a low risk of environmental harm
Impact to EVs caused by contaminates	Unlikely	Low	Low	Due to the minor scale and size of the proposed activities, and the distance to the nearest creeks this impact poses a low risk of environmental harm



6.9 Waste

This section presents the assessment of Project related waste management impacts to environmental values.

6.9.1 Existing Environmental Values

EVs relevant to waste management refer to the qualities or physical characteristics of the environment that support ecological health, public amenity, safety, or are otherwise defined under a declared environmental protection policy or regulation. The identified waste management EVs for the Project include:

- Air (refer to **Section 1.1**)
- Land resources (refer to **Section 6.4**)
- Terrestrial and aquatic ecological values (refer to **Section 6.5** and **Section 6.6** respectively)
- Groundwater (refer to **Section 6.7**)
- Surface water (refer to **Section 1.1**).

6.9.2 Potential Impacts

The following subsections detail the potential waste impacts resulting from Project activities as described in **Section 3.0**. The sections below outline the Project activities that are relevant to waste generation management. **Table 6.38** outlines the waste types which are likely to be generated by Project activities.



Table 6.38 Waste types anticipated from Project activities

Type of waste	Type	Nature
General: Waste that is <u>not</u> classified as regulated waste, as set out in schedule 9 of the <i>Environmental Protection Regulation 2019</i> and must be managed according to local council regulations and can be disposed of in designated landfills or through other authorized waste management services.	Putrescible – administrative and maintenance buildings	Solid
	General waste (non-regulated) generated from Project-related activities	Solid
	Green waste (vegetation)	Solid
	Soil (uncontaminated from topsoil removal)	Solid
Recyclable: Waste that can demonstrate a higher level of use in the waste management hierarchy such as reuse, reprocessing or recycling	Paper and cardboard – administrative and maintenance buildings	Solid
	Drink containers (such as aluminium cans and plastic bottles)	Solid
	Scrap steel	Solid
Regulated: Waste listed in schedule 9 of the <i>Environmental Protection Regulation 2019</i> , requiring specific handling and disposal control defined by legislation to manage associated risks to the environment (may also be recyclable)	Hydrocarbon waste – waste oils, solvents and greases, water emulsions, oil filters, oily rags, oil interceptor sludges, and oil and grease drums	Liquid/ Solid
	Light and heavy vehicle tyres	Solid
	Batteries	Solid
	Other regulated waste (such as paint tins and aerosol cans)	Solid
	Sewage and sewage sludge	Liquid/solid
	Water from dewatering activities (produced/ formation water)	Liquid with fine particulates



Type of waste	Type	Nature
	Drill cuttings and drill fluid additives	Solid



6.9.2.1 Access Tracks

Site clearance activities for the establishment of new access tracks will comprise the removal of existing minor surface structures or material (such as boulders or fencing if present). Following removal, there will be vegetation clearing (tress, bushes, and grasses) and stripping and removal of topsoil.

Potential waste impacts associated with site clearance in the construction and rehabilitation and closure phase will include:

- Generation of organic waste which if not properly managed, may decompose on-site attracting pests or impact local ecology.
- Improper waste disposal of organic material, example by burning, can result in air pollution and increase in particulate matter emissions (refer to **Section 1.1**).
- Removal of vegetation will result in increased erosion and dust (refer to **Section 1.1** and **Section 6.4**).
- During the operation phase, minimal impacts are anticipated because clearance will occur for maintenance purposes. Potential generation of organic waste which is not properly managed may decompose on-site attracting pests or impacts local ecology.

6.9.2.2 Vertical and Lateral Well Operation

The construction and operation of the vertical and lateral wells comprise vegetation clearance, stripping and removal of topsoil (for the drill pads and wells), installation of casing, pipelines, and wellheads, which can generate waste. In addition to this, the drilling activities involve creating both vertical and lateral wells, which generate various forms of waste which may impact soil and water quality.

Potential waste impacts associated with Project activities in the **construction phase** includes:

- Generation of organic waste, if not properly managed, may decompose on-site, attracting pests and negatively impacting local ecology. Additionally, improper disposal methods, such as burning, can contribute to air pollution through the release of particulate matter and other harmful emissions (refer to Section 1.1 and Section 6.4).
- Potential for contamination of identified EVs due to improper disposal or management of generated waste, such as:
 - Sedimentation in surface waters from improper handling and management of topsoil.
 - Overflow or improper disposal of sewage from portable toilets.
 - Contamination from improper disposal drilling mud and rock cuttings or spills from cement, lubricants, and other chemicals used during well construction.
- Potential for contamination of identified EVs due to accidental spillages or improper management of equipment, such as:
 - Accidental spillages or leakages due to improper storage of chemicals or transfer of waste products.
 - Hydrocarbon leakages from unmaintained equipment.



- Increased generation of gaseous waste from vehicular movement and operation (refer to **Section 1.1**).

Potential waste impacts associated with CSG extraction activities in the **operation phase** includes:

- Potential for contamination of identified EVs due to improper disposal or management of generated waste, such as:
 - Putrescible & organic (food waste) leading to the introduction of nuisance pests and vermin.
 - Accidental overflow of sewage from administration buildings.
 - Accidental spillages or leakages due to improper storage of chemicals used for maintenance of equipment.
 - Hydrocarbon spillages or accidental leaks from equipment.

Potential contamination of water resources due to improper management of wastewater, including the risk of overflow of produced water from dewatering activities and spillage during the transfer of produced water by truck to CCM facilities.

Potential contamination of identified EVs due to improper disposal of produced water, such as uncontrolled releases.

Potential waste impacts associated with CSG extraction activities in the rehabilitation and closure phase includes:

- Dismantling of infrastructure (where required) will generate large amounts of solid wastes.
- Potential contamination of soil and water resources due to improper disposal or handling of materials, including:
 - Improper sealing of wells.
 - Residual contamination from inadequate cleaning of wells or pipelines.
 - Improper disposal of wastewater from dewatering activities.
 - Improper disposal of hazardous materials, such as fuel, oil, and cleaning chemicals used in equipment maintenance.

6.9.2.3 Power and Water

On-site diesel generators will be used for power generation. Water will be supplied via truck to drill pad locations, and water collection from the dewatering activities (from the wells) will be contained in holding tanks. Impacts related to produced water storage is provided as part of the Project activities (**Section 3.0**), other impacts are outlined below.

- The use of the diesel generator during the Project will result in waste in the form of particulate emissions affecting air quality (see **Section 1.1**).
- Operation of the generators may increase the risk of accidental spillages, or leaks of hydrocarbons (diesel), potentially contaminating identified EVs.
- There is a risk of contamination to land or surface water resources due to accidental spillages of hydrocarbon (fuels and oils) from water transportation by trucks.



6.9.2.4 Amenities

On-site amenities for workers will be located on the drill pads and will include a mobile office and workshop. Waste generation from the mobile office will include domestic solid waste, and sewage and greywater. The workshop is likely to generate hazardous waste (such as hydrocarbon materials from fuel, oils). Potential impacts associated with amenities include the following:

- Potential contamination of land and water due and increased risk of occurrence of pests and diseases due to improper handling, treatment or disposal of sewage and greywater.
- Potential contamination of identified EVs because of improper management of litter, causing windblown litter which may affect surface water quality or cause an increase pests which affect the local ecology.
- Potential contamination of surface water and land resources, and increased risk of pests due to improper storage and disposal of organic waste.
- Potential contamination due to accidental spillages, leakage of hazardous materials such as hydrocarbons fuels, oils, chemicals, detergents from the workshop operation.

A risk-based assessment of these potential impacts is detailed in **Table 6.39** and determined that waste impacts are low due to the scale and location of the Project activities.

6.9.3 Management Practices

The following principles, in preferential order, may be applied to management of waste for the Project:

- *Waste avoidance and minimisation* – includes practices that prevent or reduce the generation of waste. This can be achieved either by using products/processes that do not generate waste or products/processes, thus reducing the total volume of waste generated.
- *Waste reuse* – includes practices to re-use wastes without first substantially changing its form. Examples include recovering solvents, metals, oil and re-using them for a secondary purpose or substituting a waste for a virgin material in a production process.
- *Waste recycling* – includes treatment practices for waste that is no longer useable in its present form and using it to produce new products. This can be achieved by using products that can be recycled and then collected for storage and removal by a recycling company.
- *Waste disposal* – all waste generated as part of the Project activities must be disposed of ensuring compliance with Queensland's environmental legislation, particularly the *Environmental Protection Act 1994* and *Environmental Protection Regulation 2019* and should employ best practice approaches.

The potential impacts will be managed through current practices. These methods are used to mitigate impacts to waste, and include:

- Ensure personnel are trained and competent in waste identification, segregation, storage, and disposal activities.
- Segregate and classify all construction and operational waste for appropriate disposal according to Queensland's regulated waste guidelines.



- Implement containment measures and rapid response protocols to manage spills, preventing soil and water contamination.
- Use low-emission diesel generators and manage fuel waste, such as spent oils and filters, to minimize air and soil contamination.
- Minimize vegetation clearing to reduce green waste, overburden, and emissions from equipment use and decomposition.
- Maintain a procurement policy which encourages goods and services that reduce waste generation, substituting for more sustainable alternatives where feasible.
- Conduct routine preventative maintenance and inspections of plant equipment, wastewater containment structures, waste disposal locations, and workplaces.
- Store liquid waste (excluding CSG water and sewage) and periodically remove for disposal or recycling.
- Contained waste drilling fluids from drilling activities in properly lined storage tanks before re-use, recycling, treatment, or disposal.
- Store putrescible solid waste in covered containers to prevent odours, public health hazards, and access by fauna.

6.9.4 Risk Assessment

The potential waste impacts were assessed to provide an overall risk rating, of which details are provided in **Table 6.39**.

The risk of waste impacts is low. Any realised impacts will be low in comparison to the existing operations undertaken at CCM.

Table 6.39 Waste risk assessment

Impact	Likelihood	Consequence	Risk Rating	Justification
Contamination of surface water or land resources	Unlikely	Low	Low	Due to the small scale of the project activities and the distance away for surface water resources, this impact poses a low risk of environmental harm. Proper storage and management of regulated wastes such as hydrocarbons and chemicals will minimise the risk of contamination and result in a low risk of environmental harm.
Generation of wastes from infrastructure and maintenance	Unlikely	Low	Low	Due to the small scale and size of Project activities, in the context of proper waste management and disposal, this impact poses a low risk of environmental harm.
Generation of litter and windblown waste	Unlikely	Low	Low	Given the small scale of the Project activities and the fact that there will be a minimal staff complement the generation of litter and windblown



Impact	Likelihood	Consequence	Risk Rating	Justification
				waste poses a low risk of environmental harm.
Increased prevalence of pests and vermin due to improper management of organic waste	Rare	Low	Low	Proper handling and disposal of waste material, and routine removal of organic waste will mitigate against the occurrence of pests and vermin. Additionally, waste generated by the small staff complement will be on a smaller scale, posing low environmental risk.



7.0 Conclusion

To obtain authorisation for the proposed Project activities, an amendment to:

- EA P-EA-100658735:
 - Condition 15 Schedule A
 - Condition 7 Schedule F
 - Condition 9 Schedule F
 - Condition 22 Schedule F
- PRCP P-PRCP-100669070_V1:
 - Section B - Figure 1, and
 - Section C – (RA1) Rehabilitation area 1

Assessment of air quality, GHG, noise and vibration, terrestrial ecology, aquatic ecology, groundwater, surface water, and waste management impacts resulting from Project activities are presented in the supporting report.

Risk assessments have determined that the changes proposed pose a low risk of causing environmental harm/ nuisance beyond that authorised by the EA. This is attributed to the scale and location of the Project activities, and that these activities can be managed under the monitoring and compliance requirements of the existing EA and CCM management practices that will be applied to Project to minimise and/or prevent unauthorised harm to EVs from the Project.

Based on the outcomes of the assessments undertaken, Centurion Coal Mine Pty Ltd consider that the approvals pathway is commensurate to a minor EA Amendment process.



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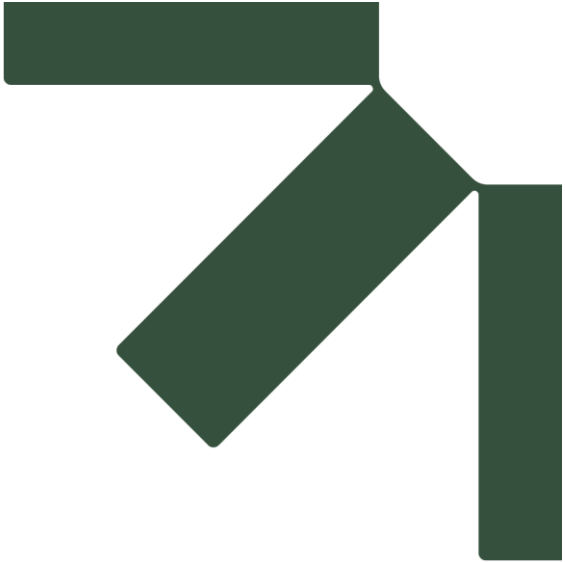
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Appendix A Terrestrial Ecology and Aquatic Ecology Methodology to Identify Environmental Impacts

**Environmental Authority Amendment Application
Supporting Report**

P-EA-100658735 and P-PRCP-100669070_V1

SLR Project No.: 620.040594

13 September 2024

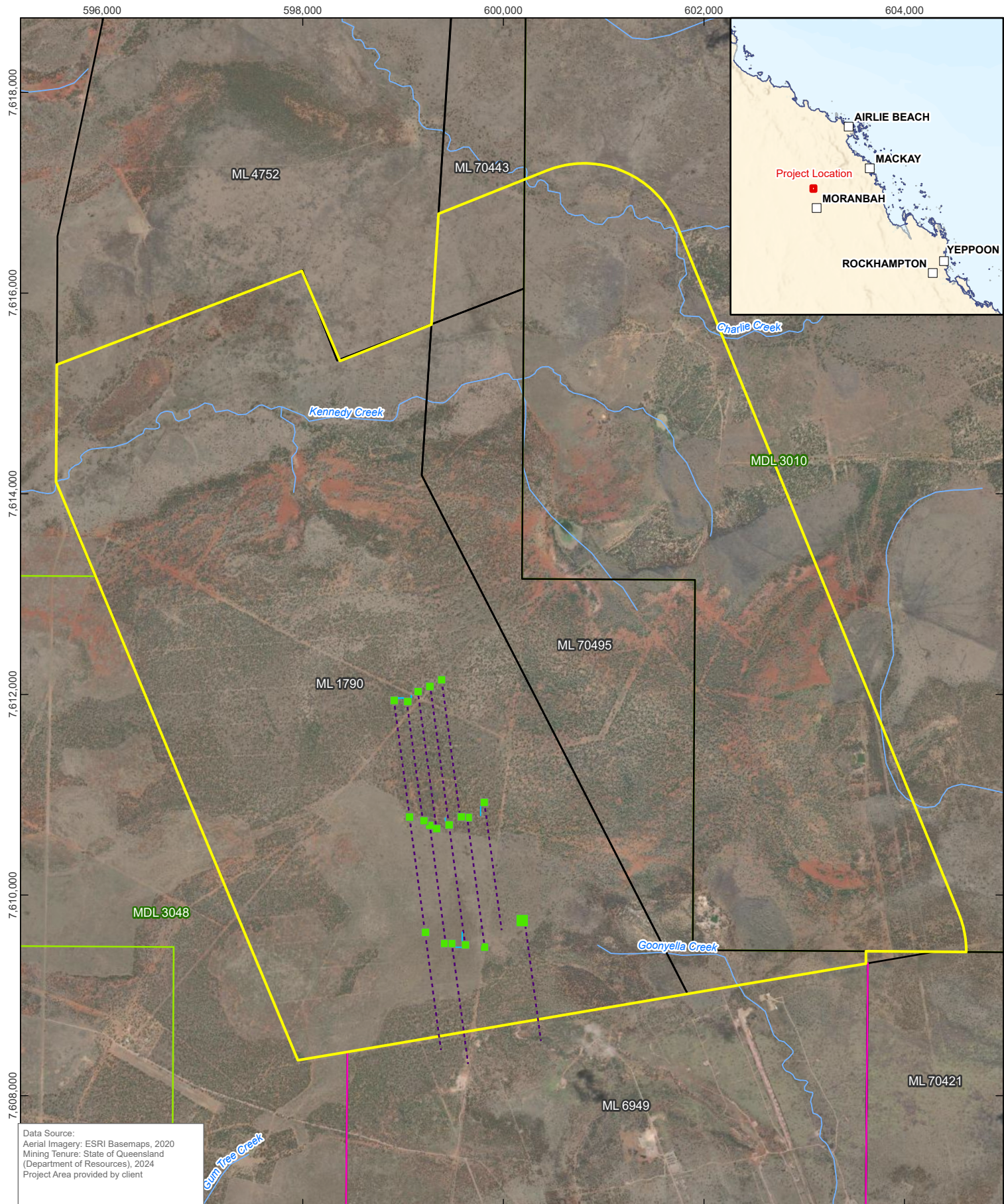
Terrestrial Ecology Methodology to Identify Environmental Impacts

Terrestrial ecological assessments were undertaken by E2M Consulting Pty Ltd (E2M) within a broader Study Area encompassing the Project Area and surrounds located within MLs 1790, 70495 and 70443 and MDL 3010 (**Table A.1**). Within the Study Area, E2M have undertaken two field surveys; comprising a:

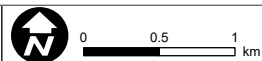
- 'Wet season' survey undertaken in mid-February 2024, and
- 'Dry season' survey undertaken in July 2024.

These surveys aligned with the optimal timing and were undertaken during suitable survey conditions for the identification of target Matters of National Environmental Significance (MNES) and Matters of State Environmental Significance (MSES) within the Study Area.





Data Source:
Aerial Imagery: ESRI Basemaps, 2020
Mining Tenure: State of Queensland
(Department of Resources), 2024
Project Area provided by client



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:50,000 at A4

Project Number: 620.040594.00001

Date Drawn: 09-Sep-2024

Drawn by: RB

LEGEND

— Watercourse

— Study Area

— Mining Lease

— Centurion Coal Mine

— Mineral Development Licence

--- Lateral Well Length

■ Drill Pad

— Access Track

EA AMENDMENT P-EA-100658735

ECOLOGY STUDY AREA



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APPENDIX A.1

Flora Survey

Vegetation and flora surveys were undertaken to categorise vegetation groups and understand floristic diversity within the Study Area. Threatened ecological community (TEC) and threatened flora surveys were also undertaken to determine the presence of any Commonwealth and/or State listed entities within the Study Area.

Regional Ecosystems

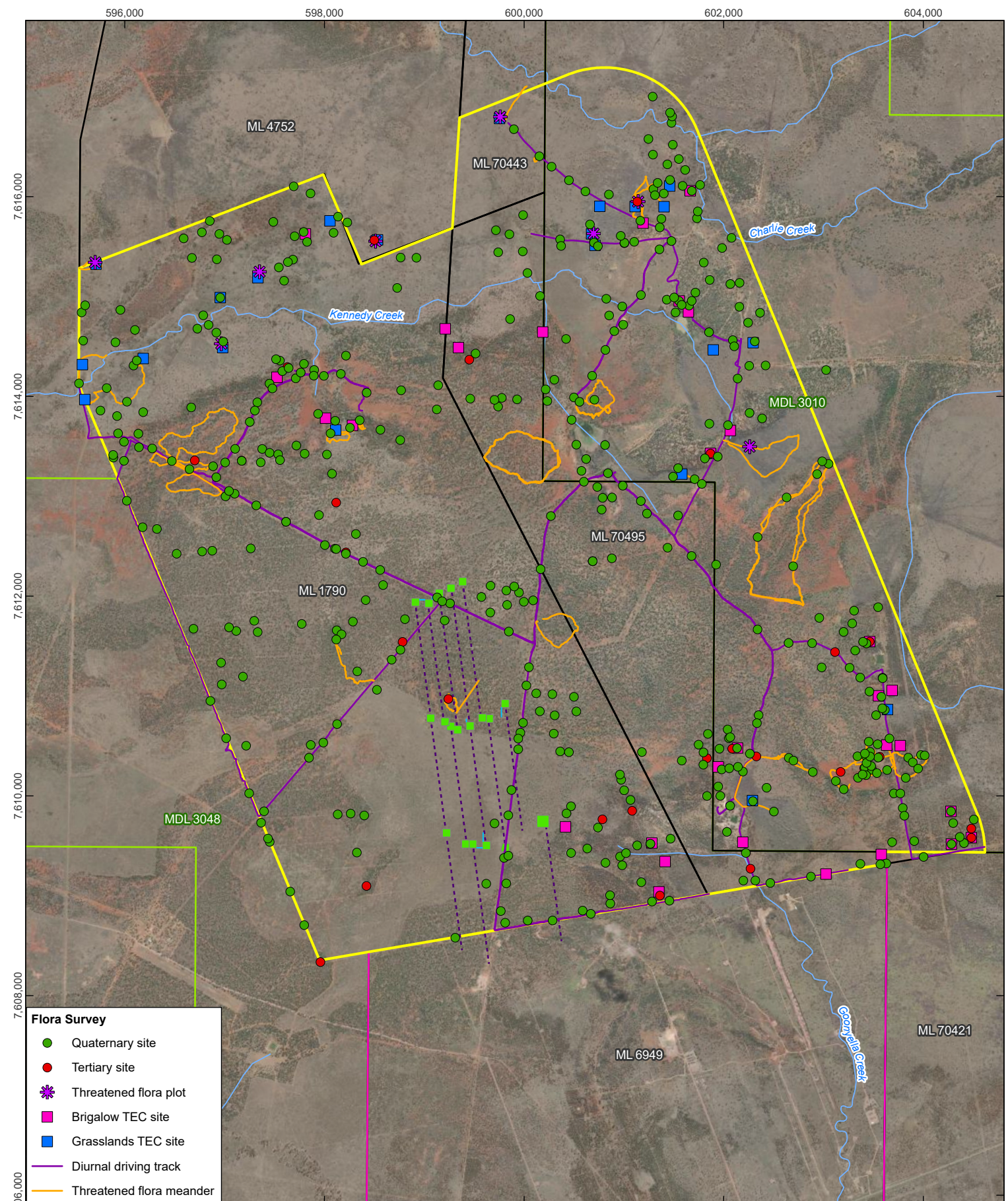
Ground-truthing and verification of vegetation community mapping within the Study Area was conducted in accordance with the methodology for surveying and mapping of regional ecosystems and vegetation communities in Queensland (Neldner et al., 2022). Tertiary and quaternary vegetation assessments were undertaken across the Study Area over the wet and dry season surveys as depicted in **Figure A.2** Tertiary assessments comprise comprehensive survey of flora species (by strata), relative abundance and overall vegetation structure, such as height and cover. Tertiary assessments are typically undertaken during wet season conditions with the emergence of annual herbs and grasses, which more accurately reflects species richness and composition. Quaternary surveys are a rapid assessment used to verify regional ecosystem (RE) based on the structure, composition and condition of the ecologically dominant layer.

Vegetation was categorised into three classes based on RE description, vegetation structure and condition. These categories comprised:

- Remnant vegetation - communities that conform with the definition under the Queensland Vegetation Management Act 1999 (VM Act) and referenced by Neldner et al. (2022). Specifically, this comprises 'vegetation, part of which forms the predominant canopy of the vegetation:
 - Covering more than 50% of the undisturbed predominant canopy
 - Averaging more than 70% of the vegetation's undisturbed height, and
 - Composed of species characteristic of the vegetation's undisturbed predominant canopy.'
- Mature regrowth – vegetation communities that have previously been cleared but meet the broad floristics and structural characteristics consistent with a particular RE. Specifically, this comprises native vegetation regrowth that is greater than 15 years old and meets either the minimum cover or the minimum height requirements to be considered remnant vegetation.
- Non-remnant vegetation – all vegetation that is not mapped as remnant vegetation. This included:
 - Young woody regrowth: vegetation that contained species composition consistent with a particular RE, but failed to meet the undisturbed height and canopy cover consistent with that of remnant vegetation, and
 - Other vegetation: communities that have been historically cleared/disturbed or heavily modified (i.e. improved pastures, weed encroachment etc).

Where benchmark strata height and cover data was unavailable for a particular RE, information provided in the Regional Ecosystem Technical Descriptions for the Brigalow Belt (DES, 2018b) and vegetation formations defined by (Specht, 1970) were used to determine remnant height thresholds.





Flora Survey

- Quaternary site
- Tertiary site
- ✱ Threatened flora plot
- Brigalow TEC site
- Grasslands TEC site
- Diurnal driving track
- Threatened flora meander

 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:50,000 at A4
 Project Number: 620.040594.00001
 Date Drawn: 09-Sep-2024
 Drawn by: RB

LEGEND

- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

EA AMENDMENT P-EA-100658735

FLORA SURVEY SITES



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APPENDIX A.2

Threatened Ecological Communities

In conjunction with tertiary and quaternary assessments, TEC assessments were undertaken to verify the presence and condition of EPBC Act listed TECs. The locations of TEC survey sites are depicted in **Table A.2**.

Specific condition criteria and characteristics used for the assessment are based on respective information provided within the listing advice published for each TEC. The following sections provide further details on the key diagnostic characteristics and condition thresholds assessed for each TEC assessed.

Brigalow (*Acacia harpophylla* dominant and co-dominant)

To determine whether a community meets the condition requirements of the Brigalow TEC (DotE, 2013), brigalow communities were assessed on whether they met the minimum thresholds pertaining to patch size and weed encroachment. Each community was also assessed on whether brigalow (*Acacia harpophylla*) was the dominant or co-dominant species within the tree layer. Using the recommendations of Butler (2007), vegetation communities of poor condition were excluded from the Brigalow TEC if they included any of the following characteristics:

- Where regrowth was less than 15 years old
- Had a patch size smaller than 0.5 ha, or
- The cover of exotic perennial plants was greater than 50%, assessed in a minimum area of 0.5 ha (100 m by 50 m).

E2M calculated the cover of exotic perennial plants for each structural layer. Exotic covers were then weighted by the percentage cover contribution of each structural layer to the RE, in accordance with published benchmarks (Queensland Herbarium, 2023), and summed.

Within Queensland, 16 REs are associated with the Brigalow TEC (DotE, 2013). Relevant Brigalow REs within the Study Area were assessed against the threshold criteria outlined in the approved conservation advice (DotE, 2013) to determine their status as the Brigalow TEC (see **Figure A.2**).

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions

The semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions TEC (SEVT TEC) is an extreme form of dry seasonal subtropical rainforest occurring on soils of high to medium fertility that is characterised by the presence of trees with microphyll size leaves, *Brachychiton* spp. in the emergent layer and thickets (TSSC, 2001).

Within the Brigalow Belt bioregion, this TEC comprises the following REs: 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8 and 11.11.18 (TSSC, 2001).

An additional RE relevant to this assessment, RE 11.7.1x1 is also considered analogous to the SEVT TEC after its addition into the Regional Ecosystem Description Database in 2002, following the listing of this TEC (DCCEEW, 2024).

Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin

The Commonwealth listing advice for the natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin (TSSC, 2009) characterises the community as containing a:

- Usually sparse or absent tree canopy (less than 10% projective crown cover)



- Shrub layer of less than 50% projected crown cover, and
- Dominance of perennial native grasses and the presence of at least three indicator native grass species outlined by the TSSC (2009b).

Within the Brigalow Belt bioregion, the Queensland Herbarium (2019) has defined the following REs as being associated with this TEC: 11.3.21, 11.4.4, 11.4.11, 11.8.11, 11.9.3, 11.9.12 and 11.11.17. Each community was assessed for whether they belong to at least one of these REs to determine whether it fits the classification of the TEC (TSSC, 2009).

Relevant REs must be a patch that is considered 'good quality' or 'best quality' to be classified as this TEC. The thresholds for defining these conditions are outlined in **Table A.1**.

Table A.1 Condition classes for the natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin TEC

Criteria	Best quality	Good quality
Patch size	At least 1 ha	At least 5 ha
Grasses	At least 4 native perennial grass species from the list of perennial native grass indicator species	At least 3 native perennial grass species from the list of perennial native grass indicator species
Tussock cover	At least 200 native grass tussocks	At least 200 native grass tussocks;
Woody shrub ¹ cover	Total projected canopy cover of shrubs is less than 30%	Total projected canopy cover of shrubs is less than 50%
Introduced species	Perennial non-woody introduced species are less than 5% of the total projected perennial plant cover	Perennial non-woody introduced species are less than 30% of the total projected perennial plant cover
¹ The shrub layer is typically absent. However, where shrubs are present, they are defined as woody plants, more than 0.5 m tall that occupy the mid vegetation layer. The upper, or tree canopy layer, also is typically absent but may comprise scattered trees to less than 10% projective crown cover.		
Sampling would be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, sites must be assessed during a good season, two months after cessation of disturbance (fire/grazing/mowing/slashing) and within two months of effective rain.		

Threatened Flora Meanders

The random meander technique (Cropper, 1993) was undertaken to survey for potential threatened flora throughout the Study Area. The technique involves traversing each habitat type that is suitable for the target species within the Study Area in a manner that maximises the coverage of habitat and potential to encounter threatened flora species. This method also allows for exploration of microhabitat features and the discovery of clumps of individuals encountered during survey. The tracks from these meander sites are depicted in **Figure A.2**.

A variation of this method has been adopted as the preferred method under the Queensland Nature Conservation Act 1992 Flora Survey Guidelines -Protected Plants (DES 2020) and Draft Survey Guidelines for Australia's Threatened Orchids (DoTE 2013). No specific Commonwealth survey guideline is currently available for other threatened flora species.

Threatened Flora Plot Surveys

Plot surveys were undertaken in accordance with the Queensland Government Flora Survey Guidelines (DES, 2020) to estimate population sizes of threatened or near threatened flora



species known to occur in the Study Area. The locations of these plots are depicted in **Figure A.2**.

Plot survey sites comprised a 50 m x 4 m plot and were undertaken when target species were first recorded in a patch. A patch being a contiguous area of habitat and homogenous vegetation. Within each plot, the number of target threatened flora species were recorded. This method was undertaken in the late wet season survey to identify population estimates across the Study Area. In the case of one of the target species, *Digitaria porrecta*, as the grass tussock ages the central portion dies and the resultant ring of plantlets eventually separate and become independent tussocks (TSSC, 2013). Since target species that were detected were not rhizomatous, separate grass tussocks were counted as individuals within the plot.

Population size (tussocks per ha) was estimated by finding the average count per plot within the habitat area and then multiplying to convert to a density per hectare. This density is based on areas of suitable habitat where the species is present.

Opportunistic Observations

Flora species, including threatened species, observed that were not recorded via other survey methods, were also collected as opportunistic observations. This included those species observed while driving or walking between survey sites.

Fauna Survey

A suite of fauna survey methods were undertaken to detect the presence of target MNES and MSES species within the Study Area, in accordance with relevant Commonwealth and State Government survey guidelines.

Habitat Assessment

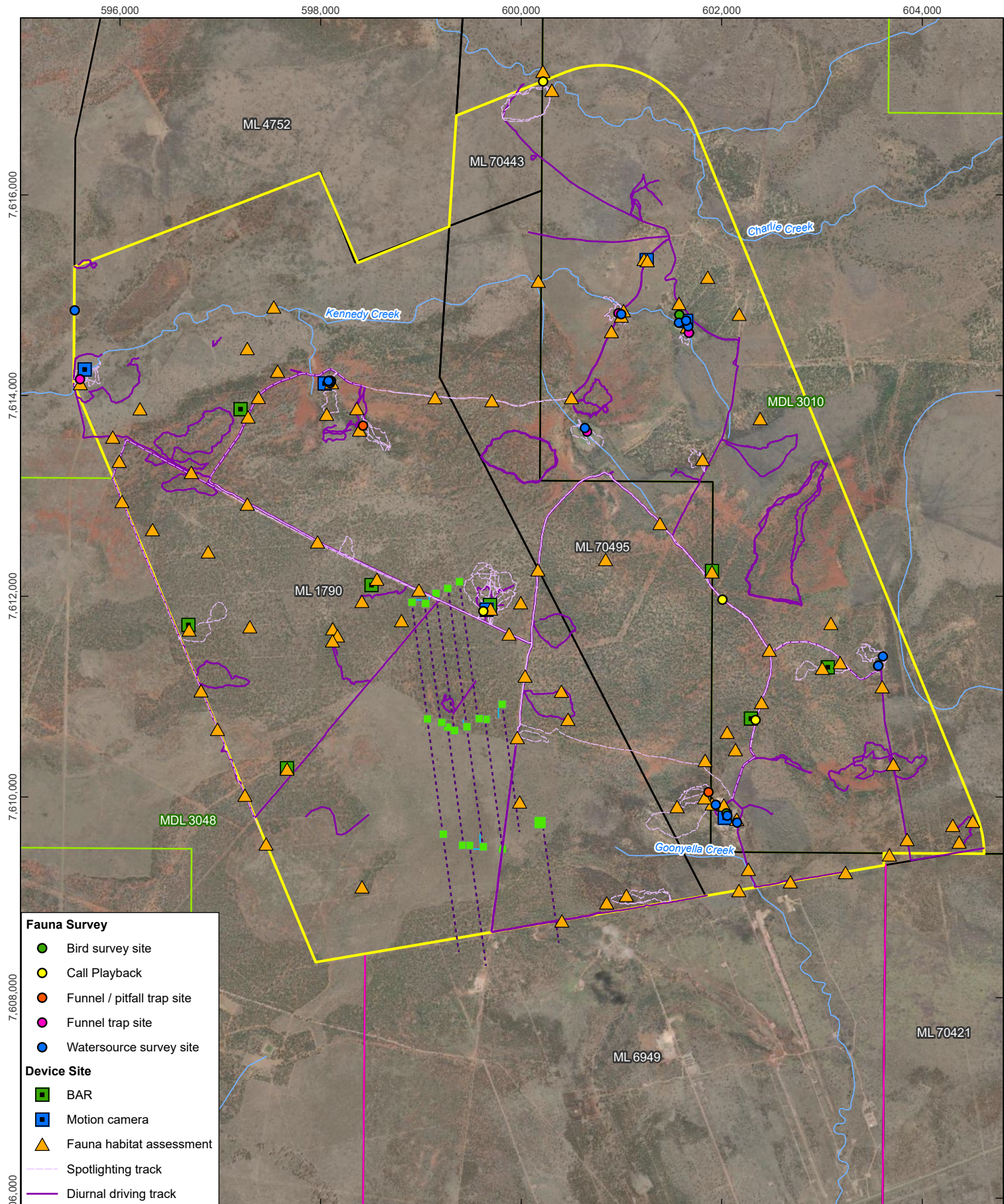
Habitat assessments were undertaken throughout the Study Area to identify the presence of habitat features that may support fauna. Assessments were completed at 90 sites during the wet season and focused on the identification of key microhabitat features for general fauna as well as threatened species (refer to **Figure A.3**). Fauna habitat assessments were conducted within representative habitat throughout the Study Area to document:

- The presence and condition of watercourses, wetlands, or artificial waterbodies (e.g., dams), including relative permanency of water
- Abundance of feed trees and Locally Important Koala Tree species (LIKTs) and ancillary shelter species as identified by (Youngentob et al., 2021)
- Presence and abundance of native grasses and forbs
- Abundance of hollow bearing trees and logs
- Abundance of coarse, woody debris and leaf litter
- Soil crack abundance and depth, and
- Evidence of existing threats, including:
 - Presence and abundance of feral species (i.e. wild dogs, feral cats, European foxes etc.)
 - Woody weed encroachment, and
 - Presence and abundance of barbed wire fencing, etc.



The outcomes of these habitat assessments were used to direct additional fauna survey effort in the dry season.





Fauna Survey

- Bird survey site
- Call Playback
- Funnel / pitfall trap site
- Funnel trap site
- Wtersource survey site

Device Site

- BAR
- Motion camera
- ▲ Fauna habitat assessment
- Spotlighting track
- Diurnal driving track



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:50,000 at A4

Project Number: 620.040594.00001

Date Drawn: 09-Sep-2024

Drawn by: RB

LEGEND

- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
- Mineral Development Licence
- Lateral Well Length
- Drill Pad
- Access Track

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FAUNA SURVEY SITES



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APPENDIX A.3

Pitfall and funnel trapping

Pitfall and funnel trapping was undertaken during the wet season to target threatened reptile species, particularly ornamental snake (*Denisonia maculata*), in accordance with the Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles (DSEWPC, 2011a). Each trap site utilised the 'T configuration', comprising a 30 m and 15 m drift fence with pitfall buckets and funnel traps arranged at set distance along the drift fences, as described by (Eyre et al., 2022). Two sites contained both funnel and pitfall traps, while four sites only contained funnel traps. A total of six trap sites were installed within suitable habitat each deployed over a four-night period at the locations depicted in **Figure A.3**.

Nocturnal Spotlighting

Nocturnal spotlighting surveys were undertaken to target fauna that are most active and detectable at night and are a prescribed survey method for applicable species under the following guidelines:

- Survey guidelines for Australia's threatened reptiles (DSEWPC, 2011b)
- Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022)
- Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles (DSEWPC, 2011a), and
- Species specific guidelines published by the Commonwealth DCCEEW (2024).

A team of two ecologists walked parallel, meandering transects using a handheld torch and/or a head torch to detect eye shine and investigate microhabitats (e.g. peeling bark or lifting coarse woody debris). Nocturnal spotlighting commenced approximately 30 minutes after sunset for a duration of approximately four to five hours per night for a combined nine nights over the wet and dry season surveys. This method was used to target greater glider (*Petauroides volans*), koala (*Phascolarctos cinereus*) and ornamental snake (*Denisonia maculata*). Spotlighting tracks are depicted in **Figure A.3**.

During the dry season, slow drive vehicle transects were the primary survey technique employed, allowing for more extensive areas to be surveyed efficiently. The slow-drive transects involved scanning suitable vegetation with handheld spotlights (50-100W). This method was used to target greater glider (*Petauroides volans*) and koala (*Phascolarctos cinereus*) in areas of eucalypt woodlands.

Call Playback

Call playback was undertaken at four locations within the Study Area in association with spotlighting surveys, as shown in **Figure A.3**. Calls of koala were broadcast on a loudspeaker for a period of two minutes, followed by 15 minutes of silence, during which observers listened for call backs. Calls of koala were then broadcast a second time (for a period of two minutes) followed by another 15-minute listening period.

Diurnal Bird Surveys

Standardised bird surveys were undertaken in the early morning and late afternoon across multiple sites within the Study Area (**Figure A.3**). Bird surveys occurred in accordance with the area search method prescribed in the Survey guidelines for Australia's threatened birds (DEWHA, 2010). Surveys were completed within 100 x 200 m survey sites (2 ha) located in suitable habitat and any threatened bird species observed and/or heard during the survey period were recorded.



Bird surveys were undertaken at eight water sources targeting threatened and migratory species, such as Latham's snipe (*Gallinago hardwickii*), Australian painted snipe (*Rostratula australis*), glossy ibis (*Plegadis falcinellus*) and squatter pigeon (southern) (*Geophaps scripta scripta*). These visual and flushing surveys were undertaken at dawn, dusk and other times of day, as depicted in **Figure A.3**.

Diurnal Searches

Diurnal active searches were undertaken concurrently with diurnal bird surveys and opportunistically with other fauna habitat assessments, following methods prescribed in the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022). Active searches involved searching suitable microhabitat (e.g. fallen woody debris, leaf litter, decorticated bark) for the species or evidence of the species presence (e.g. scats, scratches, burrows). These surveys were targeted to ornamental snake, koala and squatter pigeon (southern).

Diurnal slow-drive vehicle transects were also undertaken when moving between survey sites targeting squatter pigeon (southern).

Motion Cameras

Baited camera traps were deployed at six locations within the Study Area (**Figure A.3**) over seven consecutive nights during the dry season survey. This assisted in the detection of targeted threatened fauna and pest fauna species that may pose a threat to native species (i.e. wild dogs, feral cats and feral pigs).

Bioacoustic Recorders

Four bioacoustics records (BARs) were deployed (and moved) over seven consecutive nights during the wet season survey. BARs were installed at eight locations of suitable habitat within the Study Area (**Figure A.3**) to record calls projected by koalas.

Opportunistic Surveys

Fauna species for which evidence of presence was not detected via other survey methods, were recorded as opportunistic observations. Non-target fauna observed during fauna surveys and driving between survey sites were also recorded.

Species Habitat Mapping

The results of desktop and field surveys were used to generate habitat mapping for threatened flora and fauna species assessed as known or likely within the Study Area. Specifically, species habitat was mapped using the following categories:

- Preferred habitat: is most important to the species and provides breeding, roosting and/or foraging habitat that is required for the species to persist in the area.
- Suitable habitat: is habitat that provides breeding, roosting and/or reliable foraging habitat but is not essential for the species to persist in the area. It may occasionally provide resources or be in low density of resources and only be used intermittently.
- Marginal habitat: is habitat that provides limited resources for the species and may only be occupied infrequently, during transit between suitable habitat, or when desired habitat is scarce. The species is unlikely to be undertaking key activities such as breeding, roosting or extensive foraging.



Not all categories are relevant for each species due to their ecological role and regional context. What constitutes these categories for each species is discussed in **Sections 6.5.1.3, 6.5.1.5 and 6.5.1.6**.

Likelihood of Occurrence Assessment

A likelihood of occurrence assessment evaluates the qualitative probability that a flora or fauna species, can physically occupy the Study Area during all or part (e.g. breeding season, migration) of its life cycle. The assessment evaluates:

- Species-specific ecological and physiological requirements.
- Recorded species observations including during field surveys and existing records.
- The resources and constraints present in the Study Area informed by the desktop assessment.
- The resources and constraints present in the Study Area informed by the field surveys.

Following the field surveys, the likelihood of occurrence assessment was evaluated for the Study Area using the field data to modulate the target species list prior to further assessment. It has now been re-evaluated for the Project Area to direct the assessment of Project impacts.

The likelihood of occurrence assessment criteria is detailed in **Table A.2**.

Table A.2 Likelihood of threatened and migratory species to occur in the Project Area

Assessment Outcome	Criteria
Known to occur	The species or community has been observed within the Study Area or Project Area
Likely to occur	Suitable habitat to support the species/community is present; and the species/community has been previously recorded within the desktop search extent based on field observations and/or contemporary records.
Possible to occur	The Project Area is located within the species/community's known distribution and suitable habitat to support the species/community is present, however: • The species/community has not previously been recorded within the desktop search extent; and/or • Suitable habitat is degraded, limited in extent, and/or isolated from areas of known occupied habitat, thereby reducing the likelihood of occurrence.
Unlikely to occur	The Project Area does not comprise suitable habitat for the species/community and/or is outside of the species known distribution; or failure to detect the species during targeted surveys suggests the species is likely absent from the Project Area.



Aquatic Ecology Assessment

Aquatic ecological assessments were undertaken by Hydrobiology Pty Ltd (Hydrobiology) within a broader Study Area encompassing the Project Area and surrounds located within MLs 1790, 70495, and MDL 3010 (**Figure A.4**) and some areas just outside of this.

Hydrobiology have undertaken two field surveys, comprising:

- An 'early-wet season' survey undertaken in mid February 2024, and
- A 'late-wet season' survey undertaken in late April 2024.

These surveys were timed to adequately capture the nature and spatial extent of seasonal ecological / hydrological changes. More specifically, they were conducted at times where the aquatic habitat(s) and/or wetland(s) were assessed at their full range of productivity and inherent seasonal variation, while also capturing the dynamics of fish and other aquatic biota migratory responses to seasonal variability.

Aquatic Values

During the fieldwork planning phase, potential sites within representative habitats and relevant localities were identified that appeared to be accessible. Specifically, the site locations were selected on the basis that:

- They encompass all four creeks relevant to the Project, these being Kennedy Creek, Charlie Creek, Goonyella Creek and Skull Creek. They also include the ultimate receiving environment, the Isaac River
- They best represent identified habitat variation within the Study Area (determined from aerial imagery and review of historical reports and State and Federal databases)
- They encompassed the range of potential Groundwater Dependent Ecosystem (GDE) types present in the Study Area (BoM 2019)
- They could be readily accessed through existing infrastructure, and
- The selected survey techniques could be safely carried out.

Survey Sites

Sites surveyed for aquatic values are listed in **Table A.3** and shown in **Figure A.4**. All sites were within the Study Area except for site four, located approximately 350 m northwest from the Study Area boundary. Sites one and three were dams and Sites one, four, five and six were identified aurally as containing potential creek habitat.

Table A.3 Aquatic values and survey sites

Site	Latitude	Longitude	Lot and Plan	Survey Techniques*
1	-21.6181	147.989	2 SP214117	H, G, L
2	-21.5978	148.0005	2 SP214117	H, G, M, IW, E, F, B, C, L
3	-21.5677	147.9812	2 SP214117	H, G, M, IW, E, F, B, C, L
4	-21.5598	147.9907	8 GV807254	H, G, L
5	-21.5489	147.9772	2 SP214117	H, G, L
6	-21.5715	147.9253	2 SP214117	H, G, M, IW, E, F, L



* H: Habitat, G: Groundwater Dependant ecosystems, M: Macroinvertebrate, IW: In situ water, E: electrofishing, F: fyke netting, B: Box traps, C: Cathedral traps and L: Likelihood of occurrences

Methods

An overview of implemented methods is displayed in **Table A.4**. The implemented survey methods for the identified threatened and special least concern species included both passive (habitat assessments and visual assessment) and active (cathedral trapping and fyke netting) survey techniques. Identified active survey methods for the survey of *Elseya albagula* (white throated snapping turtle), (*Rheodytes leukops*) Fitzroy River turtle; and (*Ornithorhynchus anatinus*) platypus followed current defined guidelines as detailed in **Table A.4**.

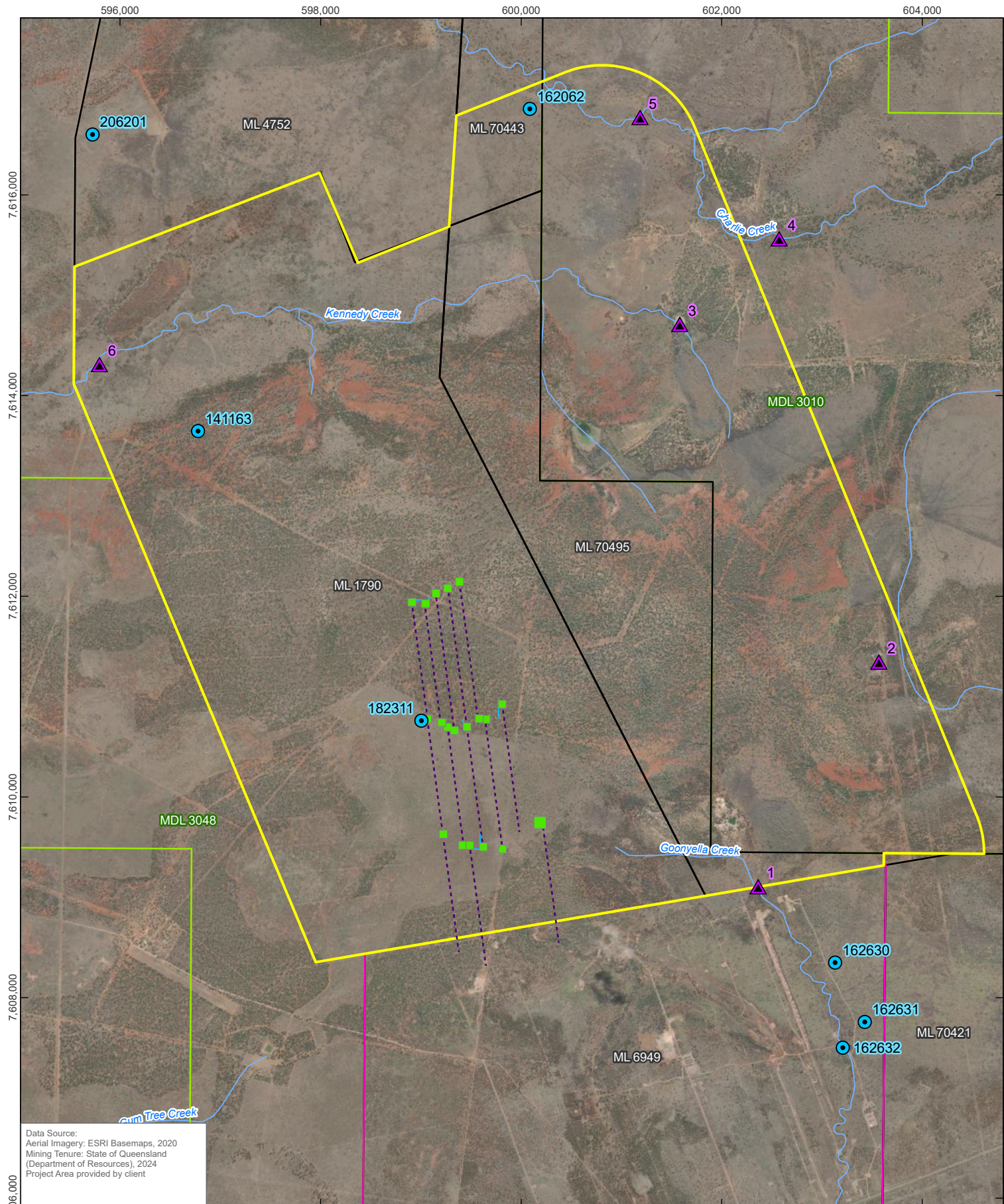
Table A.4 Sampling methods for the Study Area and associated guidelines

Species	Method	Guideline and Standards
Aquatic Fauna		
Fish	Overnight fyke netting Overnight box trapping Visual observations; and Likelihood of occurrence assessments based off areas occurrence and presence of preferred habitat features.	DES (2018a) Monitoring and sampling manual DSEWPaC (2011) Guidelines for Threatened Fish
Turtles	Overnight cathedral trapping Visual observations; and Likelihood of occurrence assessments based off areas occurrence and presence of preferred habitat features.	DSEWPaC (2011b) Guidelines for threatened reptiles DES (2018a) Monitoring and sampling manual
Platypus	Overnight fyke netting Burrow searches and visual observations; and Likelihood of occurrence assessments based off areas occurrence and presence of preferred habitat features.	DES (2018a) Monitoring and sampling manual Lugg et al. (2017) Optimal survey designs for eDNA sampling
Habitat and Water Quality		
Aquatic habitat (including macrophytes) and stream condition	Habitat and condition assessments in accordance with AUSRIVAS and State of the Rivers protocols. Macro (riffles, pools, runs, dry, etc.) and micro habitat (large woody debris, leaf litter, etc.) presence/cover. Macrophyte identification and density River bioassessment condition assessment Bank and stream morphology Identification of local land use and pressures Documentation of erosion and sedimentation Substrate analysis	Parsons et al. (2002) Australian River Assessment System: AusRivAS Physical Assessment Protocol DNRM (2001) AusRivAS for Queensland streams Cover estimate methods as per DNRM (2001)



Species	Method	Guideline and Standards
Aquatic GDEs	Analysis of aerial imagery to identify water permanence. Ground-truthing of surface GDE presence based on the series of questions described in Eamus et al. (2006) and Doody et al. (2019) in IESC (2018) GDE value characterisation as per the criteria identified in IESC (2018) To characterise groundwater connectivity, both surface and groundwater quality results regarding major ion composition will be relied upon to determine chemical signature matches.	Eamus et al. (2006) Doody et al. (2019) IESC (2018)
In-situ water quality	In-situ physiochemical analysis including temperature, pH, turbidity, dissolved oxygen, electrical conductivity	DES (2018a) Monitoring and sampling manual





Coordinate System: GDA2020 MGA Zone 55
Scale: 1:50,000 at A4
Project Number: 620.040594.00001
Date Drawn: 09-Sep-2024
Drawn by: RB

- Aquatic Values Survey Site
- Stygofauna Survey Site
- Watercourse
- Study Area
- Mining Lease
- Centurion Coal Mine
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- Access Track

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AQUATIC ECOLOGY
SURVEY SITES



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APPENDIX A.4

Stygofauna

The stygofauna pilot survey was conducted in accordance with the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (DSITI 2015) using the methods described in DES (2018a). A single sampling event was undertaken during the early-wet season survey between the 12th and 17th of February 2024.

Survey Sites

A total of 19 bores were visited, however only nine groundwater bores could be sampled for stygofauna with sampling sites located both on-lease and off-lease (**Table A.5** and **Figure A.4**). The remaining 10 bores were either too narrow for sampling or not present at the registered coordinates.

Table A.5 Stygofauna bore sampling sites

Bore ID	Latitude	Longitude	Lot and Plan	Standing Water Level (SWL) (m)	Type
141163	-21.5775	147.934809	2SP214117	-26.02	Deep
162053	-21.525	147.934208	2SP214117	-11.07	Shallow
162062	-21.5482	147.96652	2SP214117	-13.53	Shallow
162065	-21.5233	147.93544	411SP285383	-11.54	Shallow
162630	-21.625	147.996484	411SP285383	-20.33	Shallow
162631	-21.6303	147.99938	411SP285383	-18.32	Shallow
162632	-21.6327	147.99728	411SP285383	-15.76	Shallow
182311	-21.6035	147.956487	11SP235906	-25	Deep
206201	-21.5508	147.924516	2SP214117	-25.93	Deep





Appendix B MSES significant residual impact assessments

Environmental Authority Amendment Application Supporting Report

P-EA-100658735 and P-PRCP-100669070_V1

SLR Project No.: 620.040594

13 September 2024

B.1 MSES protected wildlife habitat

Definitions and terminology

Term	Definition under the EO Act
Habitat	An area occupied, or periodically or occasionally occupied, by any species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles.
Essential Habitat	A Category B area shown on the regulated vegetation management map under the <i>Vegetation Management Act 1999</i>: i. that has at least three essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; OR ii. in which the protected wildlife, at any stage of its life cycle, is located. Please Note: Under the SRI Guidelines, Essential Habitat is assessed in accordance with the MSES Protected Wildlife assessment criteria.
Long-term decrease	Any decline in a local population that is greater than which would be apparent without the action being present
Population	An occurrence of the species in a particular area. In relation to Endangered, Vulnerable and Special Least Concern species, occurrences include but are not limited to: • a geographically distinct regional population, or collection of local populations; or • a population, or collection of local populations, that occurs within a particular bioregion.

B.1.1 *Dichanthium queenslandicum* (king blue-grass)

MSES protected wildlife habitat for *Dichanthium queenslandicum* identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i>. This amount comprises less than 1% of preferred habitat for the species mapped within the broader Study Area. Any individuals to be removed would be a small portion of the population within the habitat patch that is being disturbed. Any indirect activities from the project are unlikely to reduce the quality of surrounding habitat to the point where populations will decline. Therefore, while some habitat for the species will be cleared, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely <i>D. queenslandicum</i> is found across three population areas, including the area between Nebo and Monto and west to Clermont and Rolleston (SEWPaC 2013). The extent of occurrence of the species is estimated at around 245 km² (SEWPaC 2013). Given that the Project Area is central to this range and that the extent of clearing equates to less than 0.01% of the extent of occurrence of the species, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i> across two gas extraction wells. Small portions of the habitat patch will be removed however the patch will not be split into two or more patches. The species is wind dispersed and is therefore not limited by small scale linear network infrastructure. Therefore, it is considered unlikely that the Project will fragment an existing population of the species.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i> across two gas extraction wells. Small portions of the habitat patch will be removed however the patch will not be split into two or more patches. The species is wind dispersed and is therefore not limited by small scale linear network infrastructure. Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely One of the known threats to <i>D. queenslandicum</i> is invasion from weeds such as <i>Parthenium hysterophorus</i> (parthenium) and <i>Parkinsonia aculeata</i> (SEWPaC 2013). Parthenium has been recorded within the broader Study Area in high densities in wet areas. The implementation of weed control and monitoring to reduce and prevent the incursion and spread of weeds and pests (refer to Section 6.5.4.2) will minimise the potential for parthenium and other invasive species to become established in <i>D.</i>

MSES Significant Residual Impact Guideline criteria	Response
	<i>queenslandicum</i> habitat. As such, the Project is considered unlikely to result in invasive species harmful to <i>D. queenslandicum</i> spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely There are no known diseases that impact <i>D. queenslandicum</i> and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for <i>D. queenslandicum</i> . The Project will result in the direct clearing of 1.53 ha of preferred habitat for the species, which equates to less than 0.01% of the extent of occurrence of the species (SEWPaC 2013). Therefore, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 1.53 ha of preferred habitat for <i>D. queenslandicum</i> , however, this comprises less than 1% of preferred habitat for the species mapped within the broader Study Area. Retained habitat in the Study Area will continue to support individuals of the species and provide habitat, and therefore it is considered unlikely that the Project will disrupt ecologically significant locations for the species.
Conclusion	The Project is unlikely to result in a significant residual impact on <i>D. queenslandicum</i> .

B.1.2 Koala (*Phascolarctos cinereus*)

MSES protected wildlife habitat for koala identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The species was recorded on bioacoustic devices and was not identified during extensive spotlighting surveys nor were scat frequently observed within the Study Area. The Project Area does not contain any preferred habitat for the species such as riparian areas with large eucalypts that contain high-moisture content. Areas of preferred habitat are limited to Charlie creek in the north of the Study Area. Therefore, the species is considered to be at low densities within the Study Area. Due to the small proportion of habitat being cleared for the Project and low density of individuals, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The listed population of the koala has a wide but patchy distribution that spans the coastal and inland areas of Queensland north to the Herberton area, extending westwards into hotter and dryer semi-arid climates of central Queensland, New South Wales and the Australian Capital Territory (DAWE 2022). In Queensland, the species are widespread and patchy across their range, often occurring in low density populations (DAWE 2022). The extent of occurrence of the species is estimated at around 1,665,850 km² (DAWE 2022). The Project is not located near the edge of this known distribution and the extent of clearing equates to less than 0.01% of the extent of occurrence of the species. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Koala has a wide but patchy distribution within Queensland in which it is generally present in low density populations (DAWE 2022) and it has been recorded once within 25 km of the Project Area (BMA 2014). Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species as mapped within the Study Area. The 19 well gas

MSES Significant Residual Impact Guideline criteria	Response
	network will not prevent dispersal for the species within the Study Area. Koala has a wide but patchy distribution within Queensland in which it is generally present in low density populations (DAWE 2022) and it has been recorded once within about 25 km of the Project Area (BMA 2014). Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely Known threats to koala relevant to the Project Area include: - direct predation from dogs leading to mortality of individuals; and - invasion of weeds leading to habitat degradation (DAWE 2022). Wild dogs (<i>Canis lupus</i>) have been recorded multiple times within the broader Study Area. Pest fauna will be monitored, and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land (refer to Section 6.5.4.2). Invasive flora within the Study Area is not considered to pose a threat to the point where Koala dispersal is hindered. The implementation of mitigation measures to reduce and prevent the incursion and spread of invasive species (refer to Section 6.5.4.2) will minimise the potential for invasive species to become established in retained habitat. Therefore, it is considered unlikely that the Project will result in invasive species harmful to koala spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely One of the known threats to koala is infection from diseases and viruses in the population, including <i>Chlamydia pecorum</i>, koala retrovirus and koala herpesvirus (DAWE 2022). The implementation of mitigation measures to reduce and prevent the incursion and spread of these diseases (refer to Section 6.5.4.2) will minimise the potential for diseases to become established in retained habitat. Therefore, it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely The national recovery plan for the koala includes the follow strategies: - build and share knowledge - engage and partner with the community in listed koala conservation - increase the area of protected habitat for the listed koala - integrate koala conservation into policy, statutory and land use plans - strategically restore listed koala habitat; and - actively management koala metapopulations (DAWE 2022). The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. Due to the small proportion of habitat being cleared for the project and low density of individuals, the clearing of koala habitat within the Project

MSES Significant Residual Impact Guideline criteria	Response
	Area is considered unlikely to interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for koala across multiple gas extraction wells. The species was identified through bioacoustic recorders and was not identified during spotlighting surveys nor were scat frequently observed within the Study Area. The Project Area does not contain any preferred habitat for the species such as riparian areas with large eucalypts that contain high-moisture content. Areas of preferred habitat are limited to Charlie creek in the north of the Study Area. This area would be considered an ecologically significant location. Due to the small proportion of habitat being cleared for the project and low density of individuals, it is considered unlikely that the Project will disrupt ecologically significant locations for the species.
Conclusion	The Project is unlikely to result in a significant residual impact on koala.

B.1.3 Ornamental snake (*Denisonia maculata*)

MSES protected wildlife habitat comprising Essential Habitat for ornamental snake mapped within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake. Seasonal targeted surveys for the species (comprising pitfall trapping and spotlighting) within the Study Area failed to detect the species, and suitable habitat was not identified. Therefore, ornamental snake is assessed as unlikely to occur within the Study Area and Project Area and it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The distribution of ornamental snake includes the Brigalow Belt North and South Bioregions, with the stronghold of the species being within the Fitzroy and Dawson River catchments, particularly in the area surrounding Moranbah (DCCEW 2024). The extent of occurrence for the species has not been estimated. The Project is not located near the edge of this known distribution and the species is identified as unlikely to occur within the Study Area and Project Area. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake across multiple gas extraction wells. These wells are located within an area of relatively contiguous DoR mapped Essential Habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. In addition, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake across multiple gas extraction wells. These wells are located within an area of relatively contiguous DoR mapped Essential Habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. In addition, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.

MSES Significant Residual Impact Guideline criteria	Response
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely Known threats to ornamental snake relevant to the Project Area include: destruction of wetland habitat by feral pigs (<i>Sus scrofa</i>) poisoning from the ingestion of cane toads (<i>Rhinella marina</i>); and invasive weeds (DCCEEW 2024; DotE, 2014). Both feral pigs and cane toads have been recorded multiple times within the broader Study Area. Pest fauna will be monitored, and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land (refer to Section 6.5.4.2). Three weed species have been recorded within the broader Study Area. The implementation of mitigation measures to reduce and prevent the incursion and spread of invasive species (refer to Section 6.5.4.2) will minimise the potential for invasive species to become established. In addition, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will result in invasive species harmful to the species spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely There are no known diseases that impact ornamental snake and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for ornamental snake, however conservation actions in the conservation advice for the species include: reducing habitat loss and disturbance controlling fauna pests (particularly cane toads); and raising awareness with the community (DotE, 2014). The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake across multiple gas extraction wells. However, the ornamental snake is identified as unlikely to occur within the Study Area and Project Area after the completion of seasonal targeted surveys failed to detect the species, and suitable habitat was not identified. Therefore, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of DoR mapped Essential Habitat for ornamental snake. Seasonal targeted surveys for the species (comprising pitfall trapping and spotlighting) within the Study Area failed to detect the species, and suitable habitat was not identified. Therefore, ornamental snake is assessed as unlikely to occur within the Study Area and Project Area.

MSES Significant Residual Impact Guideline criteria	Response
	As such, the Study Area and Project Area is not considered to be an ecologically significant location and it is considered unlikely that the Project will disrupt ecologically significant locations for the species.
Conclusion	The Project is unlikely to result in a significant residual impact on ornamental snake.

B.1.4 Short-beaked echidna (*Tachyglossus aculeatus*)

MSES protected wildlife habitat for short-beaked echidna identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna. This comprises less than 1% of suitable habitat for the species mapped within the broader Study Area. The species was recorded once during field surveys within the Study Area and additional evidence of presence was not observed. Short-beaked echidna has a relatively widespread distribution and occurs where ant and termite species are available, including across a range of modified habitats (Van Dyck & Strahan, 2008). Due to the small portion of habitat being cleared for the Project and widespread distribution of the species across the landscape, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The short-beaked echidna is relatively widespread and occurs throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008). The extent of occurrence for the species has not been estimated. The Project is not located near the edge of the known distribution of the species. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Short-beaked echidna has a widespread distribution, occurring throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008) and it has been recorded multiple times within about 25 km of the Project Area (AECOM 2015; DESI 2024). Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Short-beaked echidna has a widespread distribution, occurring throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008) and it has been recorded multiple times within about 25 km of the Project Area (AECOM 2015; DESI 2024). Therefore, it is

MSES Significant Residual Impact Guideline criteria	Response
	considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 6.45 ha of suitable habitat for short-beaked echidna across multiple gas extraction wells. The species was recorded once during field surveys within the Study Area and additional evidence of presence was not observed. Short-beaked echidna has a widespread distribution, occurring throughout Australia in a broad variety of habitats (Van Dyck & Strahan, 2008) and it has been recorded multiple times within about 25 km of the Project Area (AECOM 2015; DESI 2024). Ecologically significant locations for the species have not been identified and so the precautionary approach can be taken to classify all habitat areas as ecologically significant. Retained habitat in the broader landscape within the Study Area and surrounds will continue to support individuals of the species and provide suitable habitat that individuals will be able to move into and use for breeding, feeding and as a refuge area. Due to the small portion of habitat being cleared for the Project and widespread distribution of the species across the landscape, it is considered unlikely that the Project will disrupt ecologically significant locations of the species.
Conclusion	The Project is unlikely to result in a significant residual impact on the short-beaked echidna.

B.1.5 Squatter pigeon (southern) (*Geophaps scripta scripta*)

MSES protected wildlife habitat for squatter pigeon (southern) identified within the Project Area has been assessed against the SRI Guideline below.

MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern). This comprises less than 1% of suitable habitat for the species within the broader Study Area. A total of 65 squatter pigeon (southern) individuals were recorded across the Study Area, all of which were nearby dams. Such permanent and seasonal waterbodies are known to be important habitat features for the species (Squatter Pigeon Workshop, 2011). Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). Due to the small proportion of habitat being cleared and fact that the Project Area does not intercept with permanent or seasonal waterbodies, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). The extent of occurrence of the species is estimated at around 440,000km² (DCCEEW 2024). The Project is not located near the edge of this known distribution and the extent of clearing equates to less than 0.01% of the extent of occurrence of the species. Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). In addition to records during E2M's field surveys, the species has been recorded a total of 13 times within the Study Area and twice within 25 km of the Project Area (AECOM 2015; BMA 2014). Therefore, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction

MSES Significant Residual Impact Guideline criteria	Response
	wells. These wells are located within an area of relatively contiguous suitable habitat for the species within the Study Area. The 19 well gas network will not prevent dispersal for the species within the Study Area. Squatter pigeon (southern) is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) where it is considered to be common in grazing country north of the Tropic of Capricorn (DCCEEW 2024). In addition to records during E2M's field surveys, the species has been recorded a total of 13 times within the Study Area and twice within 25 km of the Project Area (AECOM 2015; BMA 2014). Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely Known threats to squatter pigeon (southern) include: - direct predation from feral cats (<i>Felis catus</i>) and foxes (<i>Vulpes vulpes</i>) - trampling of nests by livestock - habitat degradation by invasive weeds; and - overgrazing of habitat by livestock and feral herbivores such as rabbits (<i>Oryctolagus cuniculus</i>) (DCCEEW 2024; TSSC 2015). Feral cats and rabbits have been recorded within the broader Study Area. Pest fauna will be monitored, and control actions will be undertaken to limit the abundance and spread of pest fauna in the Project Area and adjacent land (refer to Section 6.5.4.2). Three weed species have been recorded within the broader Study Area. The implementation of mitigation measures to reduce and prevent the incursion and spread of invasive species (refer to Section 6.5.4.2) will minimise the potential for invasive species to become established in retained habitat. Therefore, it is considered unlikely that the Project will result in invasive species harmful to squatter pigeon (southern) spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely There are no known diseases that impact squatter pigeon (southern) and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for squatter pigeon (southern), however conservation actions in the conservation advice for the species include: - identify sub-populations of high conservation priority - protect and rehabilitate areas of vegetation that support important sub-populations - protect sub-populations through the development of covenants, conservation agreements or inclusion in reserve tenure - develop and implement a stock management plan for key sites - develop and implement a management plan, or nominate an existing plan to be implemented, for the control and

MSES Significant Residual Impact Guideline criteria	Response
	eradication of feral herbivores in areas inhabited by the squatter pigeon (southern) raise awareness of the squatter pigeon (southern) within the local community monitor selected sub-populations; and undertake a range of activities for information and research priorities (TSSC 2015). The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction wells. Due to the small proportion of habitat being cleared and the Project Area's location within the broader distribution of the species, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The Project will result in the direct clearing of 5.98 ha of suitable habitat for squatter pigeon (southern) across multiple gas extraction wells. A total of 65 squatter pigeon (southern) individuals were recorded across the Study Area, all of which were nearby dams. Such permanent and seasonal waterbodies are known to be important habitat features for the species (Squatter Pigeon Workshop, 2011). Such features could be considered ecologically significant locations. Retained habitat in the broader landscape within the Study Area and surrounds will continue to support individuals of the species and provide suitable habitat that individuals will be able to move into and use for breeding, feeding and as a refuge area. Due to the small proportion of habitat being cleared and fact that the Project Area does not intercept with permanent or seasonal waterbodies, it is considered unlikely that the Project will disrupt ecologically significant locations of the species.
Conclusion	The Project is unlikely to result in a significant residual impact on squatter pigeon (southern).

B.1.6 White-throated needletail (*Hirundapus caudacutus*)

MSES protected wildlife habitat for white-throated needletail identified within the Project Area has been assessed against the SRI Guideline below.

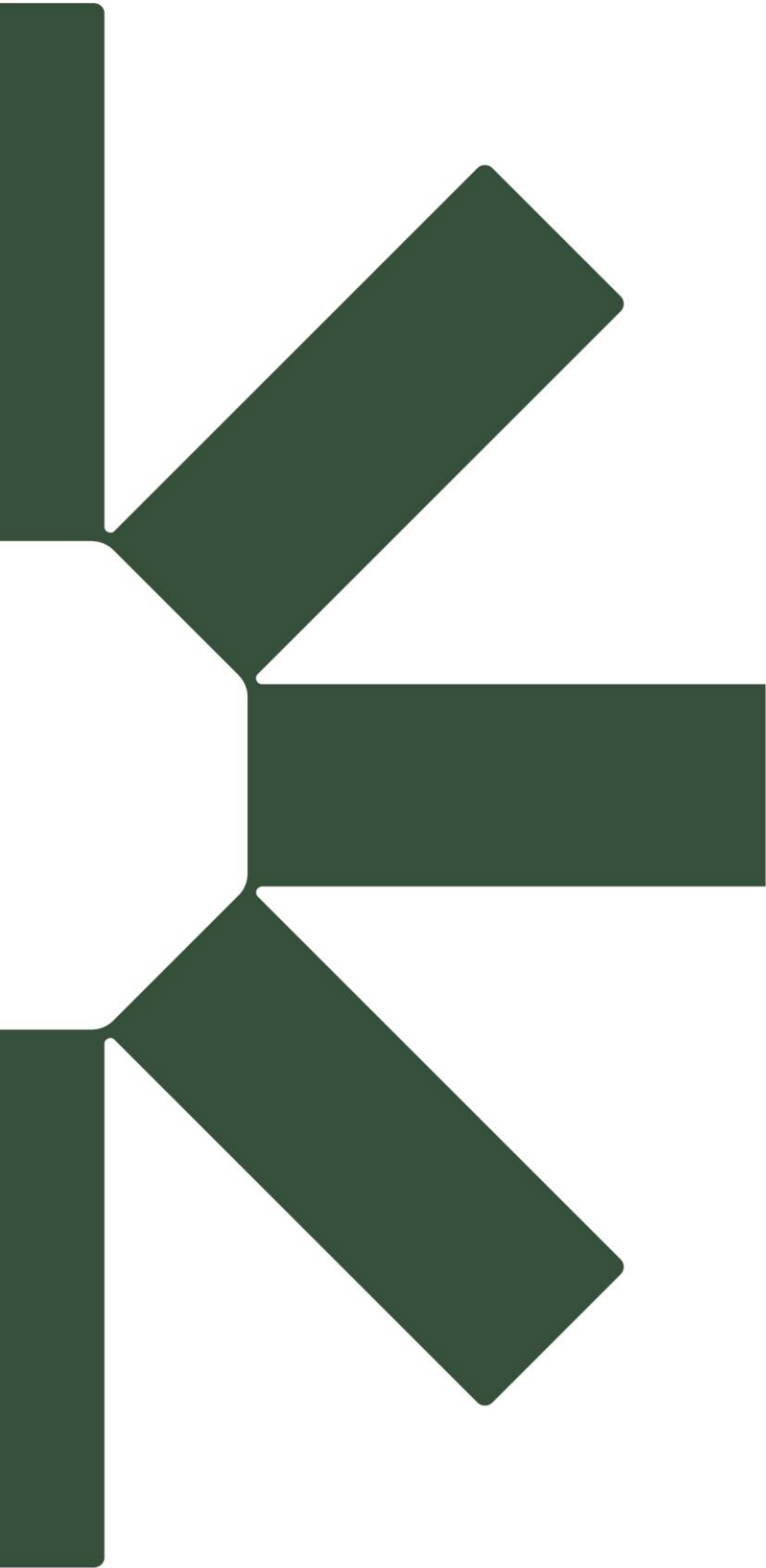
MSES Significant Residual Impact Guideline criteria	Response
Lead to a long-term decrease in the size of a local population	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia (DCCEEW 2024). The species can occur over most habitat types, however, because the species is aerial, it has been suggested that conventional habitat descriptions are inapplicable (DCCEEW 2024). As such, the clearing of vegetation is considered largely inconsequential to the species. Aerial space above the Project Area is considered to comprise marginal habitat for white-throated needletail. Due to the species use of a broad range of habitats and its wide-ranging distribution, it is considered unlikely that the Project will lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Therefore, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Due to the mobile nature of the species (i.e. movement by flight), it is considered unlikely that the Project will fragment a population of the species.
Result in genetically distinct populations forming as a result of habitat isolation	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Furthermore, the species is a non-breeding visitor to Australia that migrates to the northern hemisphere during the breeding season (DCCEEW 2024). Therefore, it is considered unlikely that the Project will result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat	Significant residual impact unlikely There are no known invasive species that are harmful to the white-throated needletail and therefore it is considered unlikely that the Project will result in invasive species harmful to the species spreading or becoming established in retained habitat.
Introduce disease that may cause the population to decline	Significant residual impact unlikely

MSES Significant Residual Impact Guideline criteria	Response
	There are no known diseases that impact white-throated needletail and therefore it is considered unlikely that the Project will introduce disease that may cause the population to decline.
Interfere with the recovery of the species	Significant residual impact unlikely There is no current State or Commonwealth recovery plan for white-throated needletail. Due to the species use of a broad range of habitats and its wide-ranging distribution, it is considered unlikely that the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.	Significant residual impact unlikely The white-throated needletail is a wide-ranging nomadic species that is almost exclusively aerial in Australia, and as such the clearing of vegetation is considered largely inconsequential to the species (DCCEEW 2024). Furthermore, the species is a non-breeding visitor to Australia that migrates to the northern hemisphere during the breeding season (DCCEEW 2024). It is therefore considered that Australia is not part of an ecologically significant location. Due to the species use of a broad range of habitats and its wide-ranging distribution, it is considered unlikely that the Project will disrupt ecologically significant locations of the species.
Conclusion	The Project is unlikely to result in a significant residual impact on white-throated needletail.

B.2 Connectivity areas

MSES connectivity areas identified within the Project Area have been assessed against the SRI Guideline below. The Landscape Fragmentation and Connectivity Tool was used to assess the significance of impact on connectivity areas.

Output	Value
Significance test one	
Regional total area	139,258.37 ha
Regional extent of core remnant	57,952.33 ha (41.61%)
Area of core at the local scale (pre impact)	5,700.58 ha
Area of core at the local scale (post impact)	5,679.82 ha
Percent change of core at the local scale (post impact)	0.36%
Significance test two	
The number of core remnant areas occurring on the site	1
The number of core remnant areas occurring on the site post impact	1
Result	
This analysis has determined no significant impact on connectivity areas.	



Making Sustainability Happen

Spatial information

GIS data associated with this application is available upon request to the Department of Environment and Science.

Information on how to make a request is available at:

<https://www.qld.gov.au/environment/pollution/licences-permits/public-register>