Jacinth-Ambrosia

Program for Environment Protection and Rehabilitation

Iluka Resources (Eucla Basin) Pty Ltd

2021

Name of mining operation	Jacinth-Ambrosia
Mine owner	Iluka (Eucla Basin) Pty Ltd
Mine operator	Iluka (Eucla Basin) Pty Ltd
Tenement details	Mining Lease ML 6315 Miscellaneous Purposes Licences MPL 110, MPL 111, MPL 161 Extractive Mineral Lease EML 6316
Commodity to be mined	Heavy Mineral Sands; Calcrete
Date	28 May 2021

Document Control

Version	Description	Prepared By	Date Created
1.0	Draft for DSD review (April 2015). Update from MARP to PEPR format.	JW, NT, JL, TL (Iluka)	April 2015
1.1	Final for submission to DSD	JW, NT, JL, TL (Iluka)	October 2015
2.0	Updated draft PEPR (not submitted to DEM)	EMM Consulting (EMM), JL, JZ (Iluka)	April 2019
2.1	Updated draft PEPR for DEM review	Eco Logical Australia (ELA), JL, JZ, BR (Iluka)	24 February 2020
2.2	Updated to incorporate draft feedback received from DEM, DEW and EPA	ELA, JL, JZ, BR (Iluka)	21 October 2020
2.3	Updated to incorporate draft feedback received from DEM, DEW and EPA	BR, JL, JZ (Iluka)	04 March 2021
2.4	Updated to incorporate draft feedback received from DEM, DEW and EPA	BR, JL, JZ (Iluka)	28 May 2021

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DECLARATION OF ACCURACY

The following declaration of accuracy is made in accordance with Regulation 65(8) under the *Mining Act 1971*. I, Shane Tilka, holding the position of General Manager – Australian Operations for the tenement holder Iluka (Eucla Basin) Pty Ltd, have taken the following steps to review the information in this PEPR amendment application to ensure its accuracy: • Implemented an audit process against the ministerial determination MD006 to ensure the minimum requirements have been addressed; • Undertaken an internal process for review, endorsement or sign off by senior management of Iluka (Eucla Basin) Pty Ltd; and • Internal peer review by a suitably qualified and experienced company employee.

Name	Position	Signature	Date
Shane Tilka	General Manager – Australian Operations	Shane Tilk	9/06/21

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EXECUTIVE SUMMARY

Iluka Resources Limited (Iluka) commenced mining at Jacinth-Ambrosia (J-A) in 2009: an open pit mineral sands mining operation located approximately 800 km north west of Adelaide, South Australia. The J-A Project was developed within the Yellabinna and Nullarbor Regional Reserves; these reserves are identified as mixed use which permits exploration and mining to occur under a multiple-use framework. Mining has been scheduled to occur sequentially until 2029, with operations first occurring at the Jacinth South deposit, then transitioning to the Ambrosia deposit.

This document presents the Program for Environment Protection and Rehabilitation (PEPR) for the J-A Project to provide an integrated approach to managing all stages of the life cycle of the mine, including its closure and completion. It seeks to update the previous PEPR for the operations, approved in October 2015.

This version of the PEPR has been updated to:

- apply learnings gained since the October 2015 version of the PEPR;
- incorporate updates to the description of the environment (i.e. new information) where applicable;
- update key J-A Project infrastructure elements and mine plan data to reflect current and expected future operations;
- incorporate approved regulatory notifications (i.e. Minor Change Notifications and the Canberra Road Miscellaneous Purposes Licence (MPL 161) application);
- incorporate details of the revised Significant Environmental Benefit (SEB) and rehabilitation bond, inclusive of the Ambrosia pit voids, MPL161 for-Canberra Road and the access track between the J-A Project and nearby mineral sands satellite deposit, Atacama for exploration;
- incorporate findings of scientific studies undertaken since the October 2015 PEPR (i.e. groundwater, geochemistry and landform erosion modelling);
- provide updated stakeholder engagement records; and
- provide a review and update of the environment impacts and outcomes.

New potential environmental impacts which have been identified as part of the update of the PEPR are presented in Table ES1. These impacts represent the key variations proposed for the closure phase of the J-A Project.

Table ES1: Proposed variations from the 2015 PEPR

Proposed Variation	Aspect/s which could be Impacted	Phase	Change in Residual Risk Level	New Environmental Outcome Required?
Revised rehabilitation soil profile for all landscape vegetation units with or without the use of red loam	Soil Vegetation	Closure	No	No
Hardstand material from Whyalla Port (if used for shipping J-A product) to be returned to the J-A site and disposed of in-pit at the completion of mining	Waste management	Closure	No	No
On-site bioremediation of hydrocarbon impacted soils for reuse during rehabilitation works	Soil Waste management	Closure	No	No
Construction and widening of road as part of MPL 161.	Cultural heritage Pest species Soils Dust and air quality Native vegetation Native fauna Surface water	Operation and closure	No	Yes – Surface water
Power generation efficiency improvements including installation of solar power generation facility	Dust and air quality	Operations	No	No

Recent studies reviewing potential groundwater quantity and quality impacts informed the decision to amend four outcome measurement criteria and/or associated leading indicators (impact events C41, C43, C44 and C45) relating to groundwater. The amendments are discussed further in Section 5.15.6 and are outlined in Table ES2 below. These studies and subsequent updates provided an opportunity to reassess and update GW3 wording to better suit operational and closure phases of mine.

Outcome measurement criteria was also amended in relation to soil profile and radiation (C22) and visual amenity (C49 and C50), as well as a new criteria developed for surface water (C36) relating to MPL 161. Information on these changes has been included in Table ES2 below.

Table ES2: Summary of environmental outcome changes as part of this PEPR

Outcome	Criteria ID	Phase	2015 PEPR Leading Indicator	2020 PEPR Leading Indicator	2015 PEPR Outcome Achievement	2020 PEPR Outcome Achievement
The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and groundwater quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities. **This outcome relates only to Domain 4 (ML6315)**	C41	Operations	Periodic review and update (recalibration) of the J-A regional groundwater model. Model used to predict mine area groundwater behaviour over time through life-of-mine and post-closure (levels, flows and extent); and review and refinement of groundwater management trigger levels.	NA	NA	The site groundwater model (JACMIN2.0) is updated and validated.
	C42	Operations	Groundwater standing water levels (SWLs) in the mine workings zone and outside this zone (background zone) do not exceed the maximum ('impact') site-specific risk trigger levels (SSTLs) for those zones (see Figure 56, Table 71).	Groundwater standing water levels (SWLs) in the mine workings zone and outside this zone (background zone) do not exceed the maximum ('impact') site-specific risk trigger levels (SSTLs) for those zones (see Figure 56, Table 71). Note: trigger levels will be revised following development of the J-A regional model.	Groundwater chemistry target parameters do not exceed maximum threshold site-specific trigger levels (SSTLs) as defined in Table 71.	Groundwater SWL are not greater than IGS (2020) modelled predictions
	C43	Operations	NA	Water quality analysis (as per the measurement criteria) shows that there is no statistically significant* increasing trend for specified Leading Indicator (LI) wells sampled **inside** the Mine Workings Zone. Specified LI wells include: Canberra, MBN07, MB08D, MBN11, IH06, MBN01D, MBN02, MBN03, MBN04, MB10D, MBN06, MBN09, MBN10, MB05D, MB06D, MB07, MBN08D, MB16S, MB16D, MB17D, MB18S, MB18D, AMB01S, AMB01D, ABMB01D-old, AMB02, AMB03, AMB05 and AMB06.	Groundwater chemistry target parameters do not exceed maximum threshold site-specific trigger levels (SSTLs) as defined in Table 71.	A verification report of water quality data by a suitably qualified and experienced person demonstrates either: • statistically significant evidence of a decreasing* trend; or • insufficient statistical evidence of a significant trend over time (assessed using a robust statistical assessment method) Non-compliance with this outcome occurs when: • the assessment finds statistically significant evidence of an increasing* trend at wells outside the Mine Workings Zone *Note: This is the opposite case for pH and alkalinity (i.e. decreasing trend would result in a non-compliance) Where a statistically significant trend is observed (in accordance with US EPA 2009 Guidance) investigation of the source of change, assessment of potential impacts and recommendations to address are to be provided to Iluka by a suitably qualified person.
The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and groundwater quality within aquifers outside of the defined mine working zone as a result of mining	C44	Closure	NA	Annual review of observed SWLs against the predicted quarterly modelled SWL trends for closure (JACMIN2.0)	NA	Groundwater levels are recovering towards pre-mining levels in line with most recent modelled predictions post closure.
	C45	Closure	NA		Desktop closure model validation and closure model update (recalibration) undertaken at required intervals.	Groundwater levels are recovering towards pre-mining levels in line with most recent modelled predictions post closure.

operations or mining-related activities. **This outcome relates only to Domain 4 (ML6315)**						
Soil profile and function is restored and capable of supporting agreed land use	C22	Closure	NA	NA	Surface radiation on the rehabilitated area is consistent with pre-mining levels.	The average gamma dose rate over the rehabilitated areas does not exceed 90 nSv/h (i.e. twice the maximum dose rate measured by an RS-125 or equivalent over the pre-mining area) and dose rates for U, Th and K40 do not exceed the following limits: U (4.4 ppm), Th (16.2 ppm) and K40 (1.8%).
The Tenement Holder must ensure mining related activities related to Canberra Road do not decrease the quantity of surface water available to water dependent ecosystems on or off the Land **This outcome relates only to MPL161**	C36	Operations	NA	NA	NA	Comparison on annual water course monitoring demonstrates installation of the road has not significantly reduced water quality downstream of the road.
The reconstructed landform is consistent with surrounding topography	C49	Closure	NA	NA	No point in the rehabilitated landscape greater than 177 mAHD (+1 m of the highest designed mAHD) for Domain 4A. No point in the rehabilitated landscape less than 124 mAHD (the lowest designed mAHD) for Domain 4A.	No point in the rehabilitated landscape greater than 178 mAHD (+1 m of the highest designed mAHD) for Domain 4A. No point in the rehabilitated landscape less than 124 mAHD (the lowest designed mAHD) for Domain 4A.
	C50	Closure	NA	NA	No point in the rehabilitated landscape greater than 181 mAHD (+1 m of the highest designed mAHD) for Domain 4C.	No point in the rehabilitated landscape greater than 178 mAHD (+1 m of the highest designed mAHD) for Domain 4C.

This PEPR has been prepared to satisfy the requirements of the Department for Energy and Mining (DEM) and to comply with Regulation 42 (b) (1) under the *Mining Act 1971* (SA) (Mining Act).

This document has been prepared in accordance with advice provided by DEM, Department of Environment and Water (DEW) and Environment Protection Authority (EPA) representatives during ongoing consultation. It has been written in general accordance with DEM's *MG2b Preparation of a program for environment protection and rehabilitation (PEPR) for metallic and industrial minerals (excluding coal and uranium) in South Australia,* updated May 2020 and *Ministerial Determination: Minimum information required to be provided in a program for environment protection and rehabilitation (PEPR) for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) for metallic and industrial minerals (excluding coal and uranium)*, MD005, amended 12 December 2019.

The PEPR addresses the following topics:

- the receiving environment;
- description of mining operations;
- environmental outcomes, assessment criteria and monitoring program;
- stakeholder consultation;
- operator capability; and
- reference to lease and licence conditions.

A summary of the key aspects presented in this PEPR, inclusive of where an updated risk assessment has been applied, is summarised in Table ES3.

Table ES3: Summary of aspects which may be impacted by J-A mining operations

Aspect	Updated risk assessment from 2015 PEPR	Updated OMC from 2015 PEPR
Public safety and traffic	No	No
Heritage	No	No
Pest species (weeds and pests)	No	No
Soil	No	Updated outcome measurement criteria
Waste management	No	No
Dust and air quality	No	No
Native vegetation	No	No
Native fauna	No	No
Surface water	No	New operational outcome measurement criteria

Aspect	Updated risk assessment from 2015 PEPR	Updated OMC from 2015 PEPR
Groundwater	No	Updated outcome measurement criteria and leading indicator criteria/ Updated wording to outcome.
Hazardous materials	No	No
Visual amenity	No	No
Radiation	No	Updated closure outcome measurement criteria
Rehabilitation and closure	Yes New impacts assessed: • revised rehabilitation soil profile for chenopod vegetation unit to 1.3 m thickness of brown loam (due to availability, red loam may or may not be used); • revised rehabilitation profile for myall/mallee vegetation units (with or without the use of red loam in rehabilitation); • hardstand material from Whyalla Port (if used for shipping J-A product) to be returned to the J-A site and disposed of in-pit at the completion of mining; and • on-site bioremediation of hydrocarbon impacted soils for reuse during rehabilitation works.	No

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1 Introduction

1.1 Overview of operations

Iluka Resources Limited (Iluka) operates the Jacinth-Ambrosia (J-A) Mineral Sands Project (the 'J-A Project'), located in the Eucla Basin, 800 kilometres (km) from Adelaide, South Australia. The closest township is Ceduna, approximately 290 km south east of the J-A Project area. The J-A Project area consists of two contiguous deposits, Jacinth and Ambrosia. The J-A Project was developed within the Yellabinna and Nullarbor Regional Reserves; these reserves are identified as mixed use, which permits exploration and mining to occur under a multiple-use framework.

Mining has been planned to occur sequentially, with operations first commencing in 2009 at Jacinth. At current rates of production and ore reserves, the estimated approximate remaining mine life for J-A is 10 years (i.e. life of mine (LOM) in 2029). Dry mining techniques are used to produce heavy mineral concentrate (HMC).

All phases of the ongoing mine development are subject to approval under the PEPR (this document).

1.2 Objective

The objective of this PEPR for J-A is to provide an integrated approach to managing all stages of the life cycle of the J-A Project, including its closure and completion. It seeks to update the previous PEPR (Version 1.1) for the operations, approved in October 2015.

This version of the PEPR has been updated to:

- apply learnings gained since the October 2015 version of the PEPR;
- incorporate updates to the description of the environment (i.e. new information) where applicable;
- update key Project infrastructure elements and mine plan data to reflect current and expected future operations;
- incorporate approved regulatory notifications (i.e. Minor Change Notifications and MPL161);
- incorporate details of the revised Significant Environmental Benefit (SEB) and rehabilitation bond, inclusive of the Ambrosia pit voids, MPL161 and the access track between J-A and nearby mineral sands satellite deposit Atacama for exploration related activities;
- incorporate findings of scientific studies undertaken since the October 2015 PEPR (i.e. groundwater, geochemistry and landform erosion modelling);
- provide updated stakeholder engagement records; and
- provide a review and update of the environment impacts and outcomes.

1.3 History of approvals

An overview of the approvals history for the J-A Project is provided in Figure 1. The Jacinth and Ambrosia mineral sands deposits were first discovered in 2004, with feasibility studies commencing from 2005.

In November 2007 Iluka (Eucla Basin) Pty Ltd submitted applications for a Mining Lease (ML), Extractive Mineral Lease (EML) and various MPLs to the then Department of Primary Industries and Regions South Australia (PIRSA[1]) (now Department for Energy and Mining (DEM)) to gain approval for the J-A Project.

The ML (ML6315), EML (EML6316) and associated MPLs for the borefield, pipeline and access road (MPL110), and airstrip and village accommodation (MPL111) were granted by the Minister for Resources Development on 2 July 2008. Copies of lease and licence conditions are contained in Appendix A.

Construction activities at J-A commenced in August 2008 and were completed in September 2009. Mining activities commenced in September 2009 with the pre-stripping of vegetation, topsoil and overburden and the commissioning of the Wet Concentrator Plant (WCP), off-path Tailings Storage Facility (TSF), HMC storage area and Mining Unit Plant (MUP). Processing of ore commenced in November 2009.

In 2008 a construction or early works Mining and Rehabilitation Program (MARP) was approved, followed by an operational MARP in 2009. The PEPR for the J-A Project was first approved under the *Mining Act 1971* (Mining Act) and *Mining Regulations 2011* in October 2015; this superseded the previously approved 2009 MARP.

In December 2019, an MPL application was submitted for the widening and extension of Canberra Road - an existing exploration track running north east of the airfield - to the west of the Jacinth deposit. This road will be expanded into a haul road which is required for the transportation of treated waste water (B class water) for dust suppression purposes and the transportation of equipment to the Ambrosia deposit, reducing the overall haul distance from 10.2 km to 6.2 km. The upgrade of the road will also reduce interactions between the water cart, road trains, and light vehicles. An MPL was granted for the Canberra Road on 11 August 2020 (MPL 161). Further details regarding MPL161 is included in Section 3.11.8.

This document represents an update to the 2015 PEPR, and once approved by DEM will supersede all previous PEPRs and MARPs.

[1] Now Department for Energy and Mining (DEM)

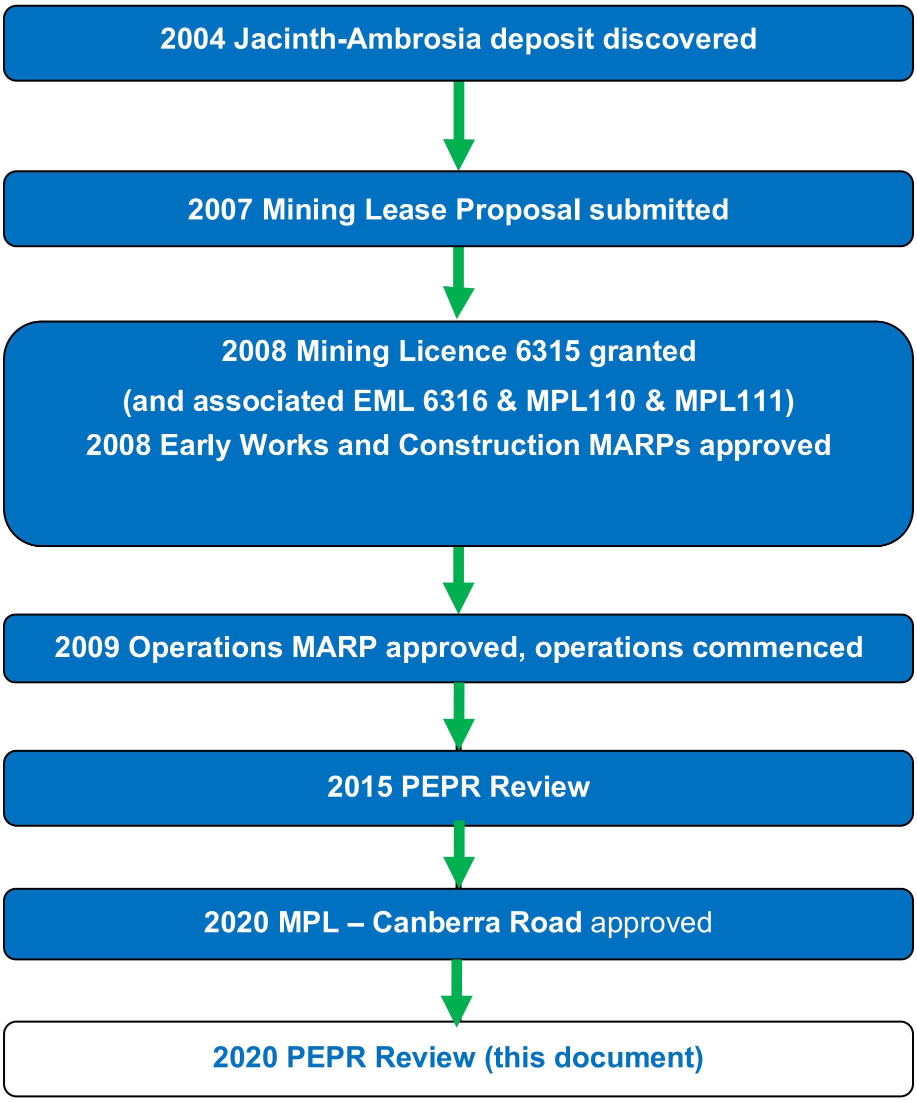


Figure 1: History of licencing and approvals for the J-A Project

1.4 Project location

The location of the J-A Project area in a regional context is shown in Figure 2. Infrastructure and operations within the ML and EML include mining facilities, TSFs, WCP, process water dam, power station, workshops, warehouse, administration building and water treatment facility.

The groundwater borefield, access road, airfield, and worker accommodation village have been developed on the MPL110 and MPL111. MPL161 has been established to develop a new haulage road to the north east of the existing road and airfield.

Collectively, activities occurring on the ML, EML and MPLs are referred to as the J-A Project.

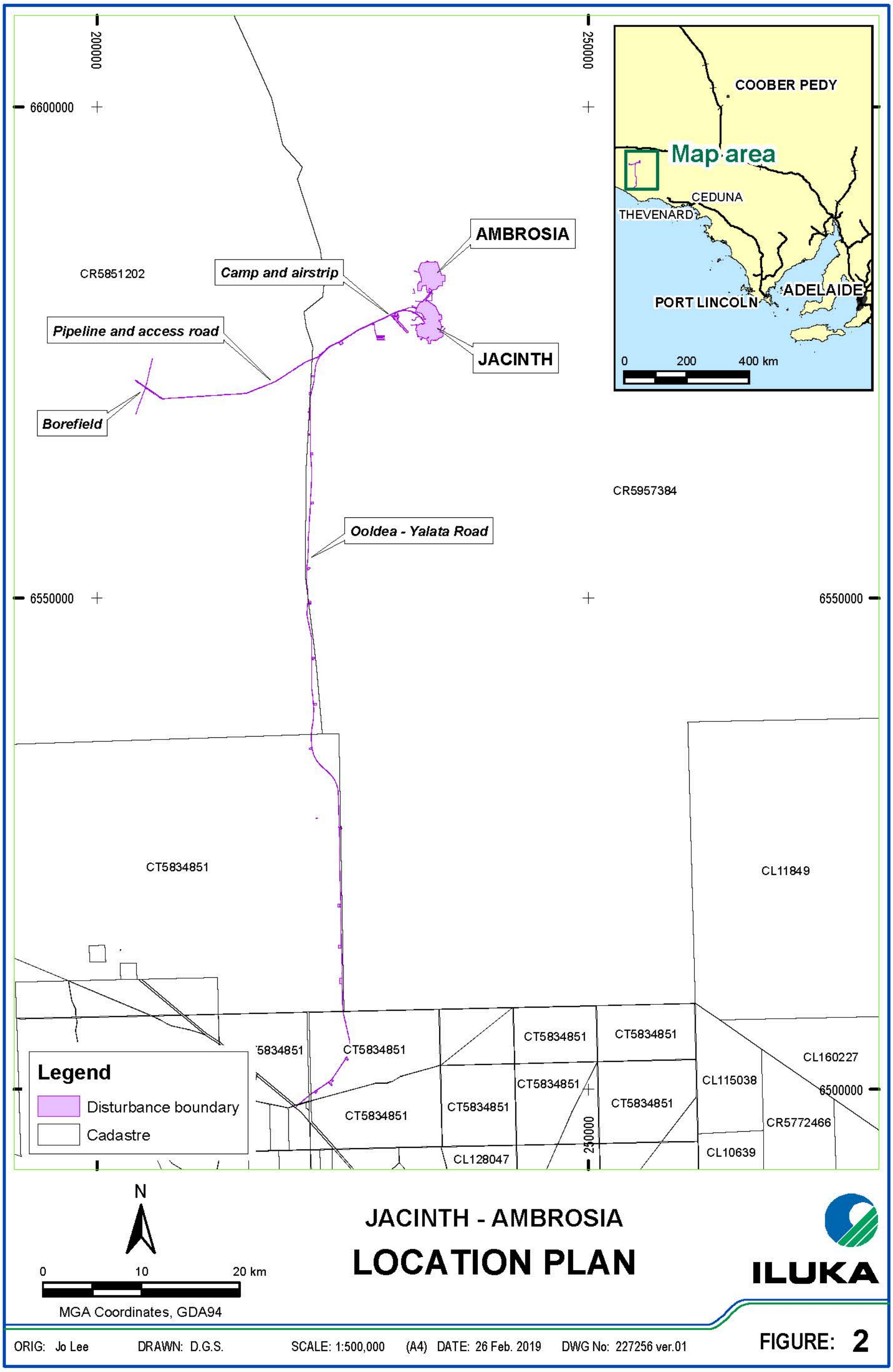


Figure 2: Location plan J-A Project

1.5 Mining tenements

A summary of the mining tenements associated with the J-A Project is provided in Table 1. The location of mining tenements associated with the J-A Project are detailed in Figure 3.

Table 1: Mining tenements associated with the J-A Project

Mining Lease			
Number	6315		
Term	21 years		
Expiry	2 July 2029		
Tenure	Crown Land		
Certificate of Title	Crown Record 5957/384		
Name of Lessee/Owner	Minister for Environment and Water, the State of South Australia		
Registered Native Title Traditional Owners	The Far West Aboriginal Corporation (SAD6008/98)		
Current land use	Yellabinna Regional Reserve.		
Extractive Minerals Lease (same boundary as Mining Lease 6315)			
Number	6316		
Term	21 years		
Expiry	2 July 2029		
Tenure	Crown Land		
Certificate of Title	Crown Record 5957/384		
Name of Lessee/Owner	Minister for Environment and Water, the State of South Australia		
Registered Native Title Traditional Owners	The Far West Aboriginal Corporation (SAD6008/98)		
Current land use	Yellabinna Regional Reserve.		
Miscellaneous Purposes Licences			
Number	110	111	161
Purpose	Borefield, pipeline and access road	Air strip and accommodation village	Canberra Road widening for access
Term	21 years		21 years
Expiry	2 July 2029		3 July 2029
Tenure	Crown Land		Crown Land
Certificate of Title	Crown Record 5851/202	Crown Record 5957/384	Crown Record 5957/384

Miscellaneous Purposes Licences		
Name of Lessee/Owner	Minister for Environment and Water, the State of South Australia	
Current land use	Nullarbor Regional Reserve	Yellabinna Regional Reserve

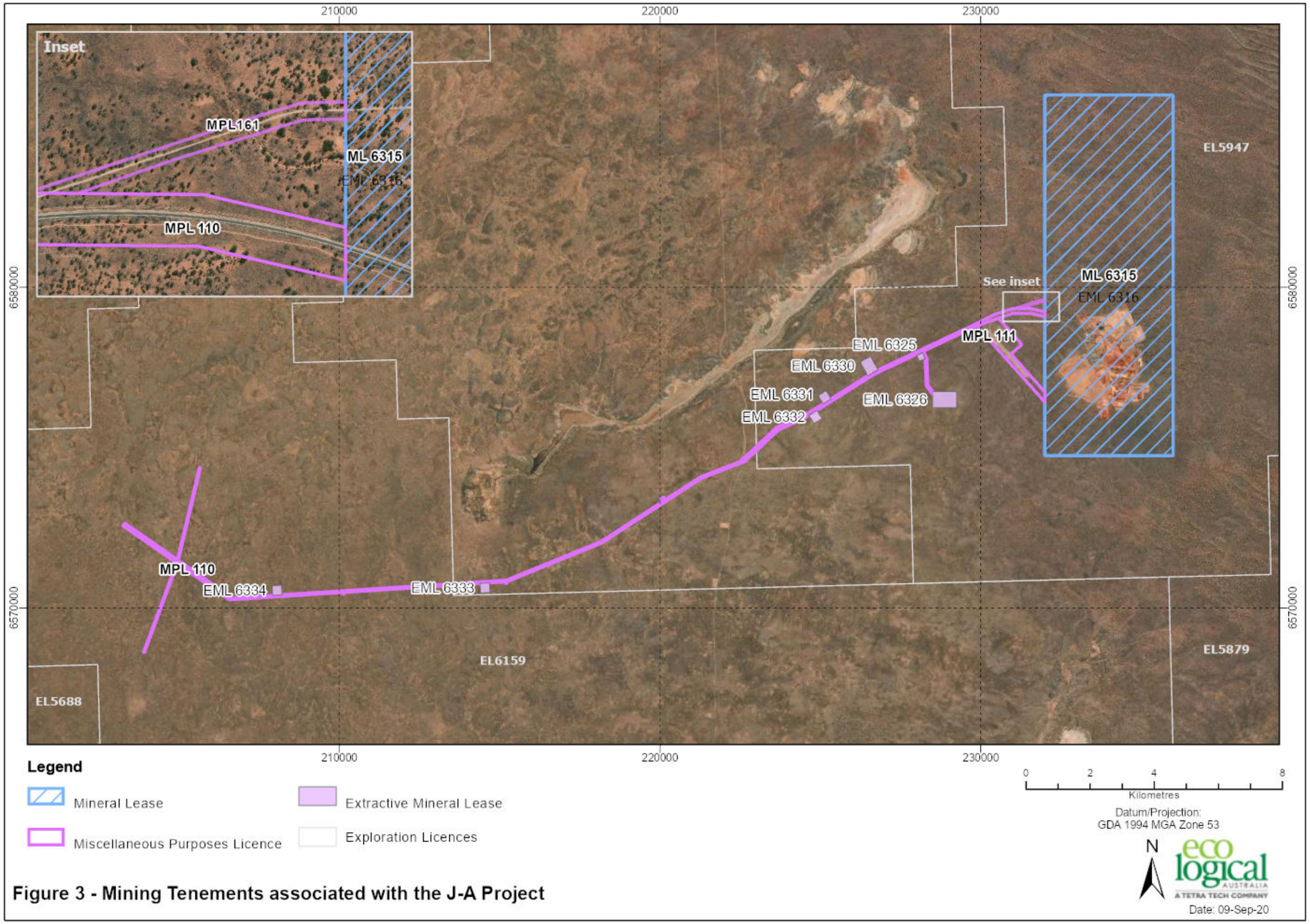


Figure 3: Mining tenements associated with the J-A Project.

1.6 Structure of the PEPR

This document has been prepared in accordance with advice provided by DEM, Department for Environment and Water (DEW) and the South Australian Environment Protection Authority (EPA) representatives during ongoing consultation. It has been written in general accordance with DEM's *MG2b Preparation of a program for environment protection and rehabilitation (PEPR) for metallic and industrial minerals (excluding coal and uranium) in South Australia,* updated May 2020 and *Ministerial Determination: Minimum information required to be provided in a program for environment protection and rehabilitation (PEPR) for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) for metallic and industrial minerals (excluding coal and uranium)*, Ministerial Determination 005 (MD005), amended 12 December 2019.

This PEPR builds on the J-A Project information provided to DEM during the Mining Lease Application, and in the original MARP and PEPR. Once approved, this PEPR supersedes all previous versions of the PEPR for the J-A Project.

Key content in each section of the PEPR is outlined in Table 2.

Table 2: Structure of the PEPR

MD005 Reference	PEPR Section Reference
1. Requirement for declaration of accuracy	Page iii
2. Description of the environment	Section 2
3. Description of mining operations	Section 3
4. Consultation	Section 4
5. Environmental outcomes, strategies, criteria, and monitoring	Section 5
6. Operator capability	Section 6
7. Lease and licence conditions	Section 7

2 Description of the Environment

The existing environment is described in this section; and has also been previously reported in the preceding approved MARP and PEPR for the J-A Project. It provides context for interpretation of potential environmental impacts described in later sections. Where additional knowledge or information about the environment has been obtained since the previous description presented in the PEPR (Version 1.1), updates have been made under the relevant sub-section.

2.1 Local community

Ceduna is the closest population centre to the J-A Project area, located approximately 290 km south east. The region has also been determined native lands of the FWC Aboriginal Traditional Owners.

The J-A Project area is remote, located within two of South Australia's Regional Reserves. The Jacinth and Ambrosia deposits are situated within Yellabinna Regional Reserve, with the associated borefield being located within the Nullarbor Regional Reserve (refer to Figure 4 and Section 2.16).

2.1.1 Ceduna local government area

The proximity of local council and nearby communities to the J-A Project area is shown in Figure 5. In 2016 the Ceduna Local Government Area (LGA) recorded a population of 3,408 persons (ABS 2016). Aboriginal and Torres Strait Islander people made up 21.7% of the population. Ceduna is a major service town providing essential amenities and social infrastructure to the West and FWC Region including businesses, medical and health services centres, education facilities, and the Ceduna Airport.

2.1.2 Aboriginal communities

A number of Aboriginal communities and homelands exist on the outskirts of Ceduna and to the west. The larger populated communities are Yalata (197 people, ABS 2016) located approximately 200 km to the west of Ceduna and the Koonibba community (127 people, ABS 2016). Oak Valley community approximately 516 km north west of Ceduna is a community of the Maralinga Tjarutja Aboriginal Council Government Area. In 2016 no population statistics were recorded for Oak Valley, however based on information provided by the Maralinga Tjarutja Council, the local population ranges from 80–100 people, and peaks up to 1,500 people during cultural activities. The remote community is self-sufficient and has project managed the development of essential services such as housing, roads, water and power.

The Scotdesco Aboriginal community (estimated population of 55) along with several other homelands are smaller communities also located in the region FWC Region.

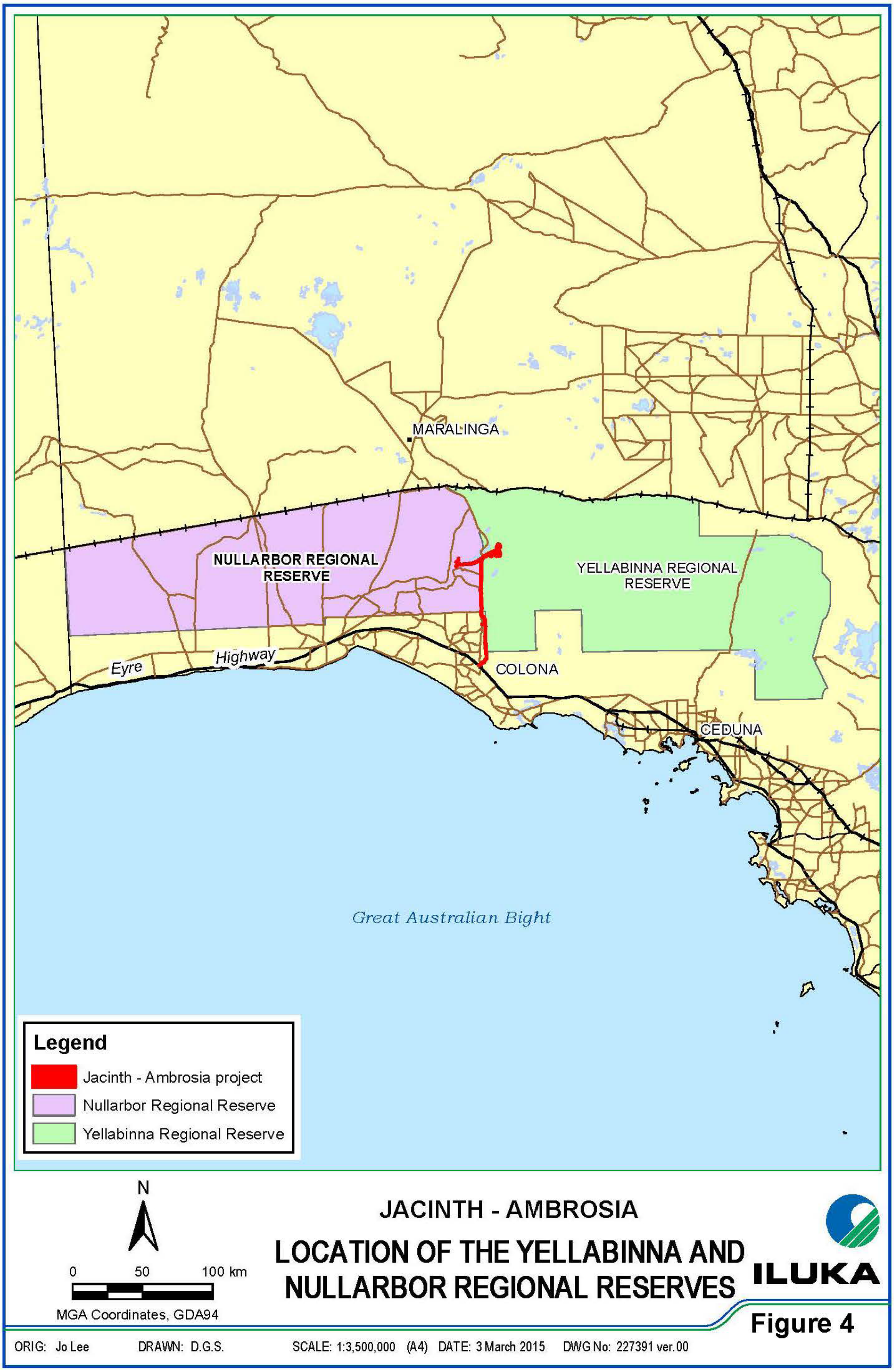


Figure 4: Location of the Yellabinna and Nullarbor Regional Reserves

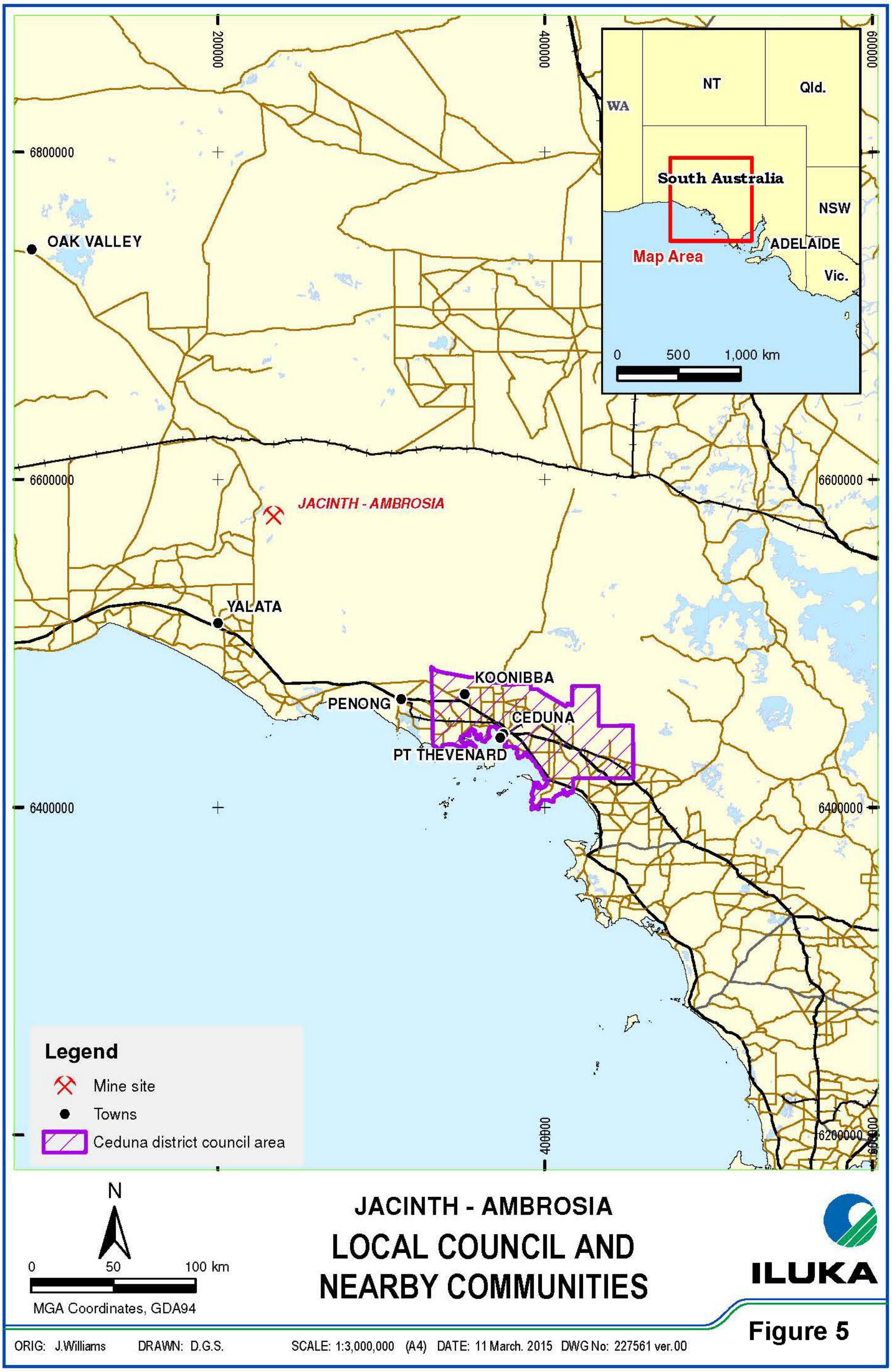


Figure 5: Local council and nearby communities

2.1.3 Population demographic

A summary of the population statistics for the Ceduna District Council Area, provided by the most recent Australian Bureau of Statistics (ABS) census data is shown in Table 3.

Table 3: Regional population statistics

Characteristic	Ceduna (District Council Area) 2016
Male	1,697
Female	1,716
Total no. of people	3,413
Median age (years)	39

Source: ABS 2016

2.1.4 Employment

The community labour force participation rate of 96.5% (for people aged 15 years and over) is above the State average of 92.4%, accounting for the full time, part time and other employment work force (ABS 2016). Currently 46% of the J-A workforce is made up of people from the region, with Aboriginal and Torres Strait Islander employment averaging approximately 23% of the total workforce.

The main employing industry in the district is Combined Primary and Secondary Education (6.1% of the workforce) followed by Grain-Sheep or Grain-Beef Cattle Farming (4.9% of the workforce). The industry profile within the towns of the Ceduna LGA area is shown in Table 4.

Table 4: Primary Community – Top 5 Industries profile

Ceduna	No	%	Thevenard	No	%	Penong	No	%
Total persons	**1,850**	**-**	**Total persons**	**559**	**-**	**Total persons**	**289**	**-**
Combined Primary and Secondary Education	58	7.8	Supermarket and Grocery Stores	18	8.1	Other Non-Metallic Mineral Mining and Quarrying	16	14.8
Hospitals (except Psychiatric Hospitals)	38	5.1	Combined Primary and Secondary Education	15	6.7	Grain-Sheep or Grain-Beef Cattle Farming	15	13.9
Accommodation	31	4.1	Other Social Assistance Services	11	4.9	Other Grain Growing	12	11.1
Road Freight Transport	28	3.7	Road Freight Transport	8	3.6	Primary Education	7	6.5
Local Government Administration	28	3.7	Port and Water Transport Terminal Operations	8	3.6	Fuel Retailing	5	4.6

Source: ABS Census Data 2016

2.1.5 Economy

The economy statistics provided by the Australian Bureau of Statistics (ABS) are shown in Table 5 below.

Table 5: Economy statistics

Ceduna Economy Statistics	Period	Ceduna (DC)	Australia
Total number of businesses (no.)	2015	371	2,121,235
Number of employing businesses: 5 or more employees (no.)	2015	54	*
Building Approvals – Private sector houses (no.)	2016	8	*
Building Approvals – Value of private sector houses ($m)	2016	2	*

Source: ABS Census Data 2016
** Statistic not available from ABS Census Data 2015 or 2016*

2.1.6 Iluka employment and economic contribution

A study of the employment and economic contribution of Iluka's activities in Australia, the United States and China was conducted by Ernst and Young in 2014. Analysis included employment, contractor and procurement data pertaining to the previous calendar year (2013) and direct and indirect contributions were assessed.

Findings indicated that in Australia, Iluka contributed 1,082 direct jobs, 3,264 indirect positions and $994 million in economic value add to the regions where it operated, including the Eucla Basin.

2.1.7 Services and infrastructure

There are a range of services and infrastructure established in the region (Table 6). The Ceduna Health Services (SA Health, Government of South Australia) is the key medical and health service provider in the FWC Region.

Table 6: Ceduna District Health Service

Amenity items	Service description
General hospital amenities	15 overnight beds and 4 day beds, 2 dialysis chairs and 38 beds for people requiring high and low level aged care; on-site parking; disabled access; General Practitioners
Emergency care	24-hour ambulance and emergency
Specialist services	Physiotherapy, podiatry, diabetes education
Dialysis services	Renal haemo-dialysis (specialised equipment to cleanse the kidneys)
Dental	Public and private health care
Maternity and obstetrics	Shared care arrangement with General Practitioners, community midwives to provide and care and services to women before, during and childbirth
Residential aged care	10 beds for people who require high level care at the hospital, and 29 beds for people with low level needs for care at the Far West Senior Citizens Lodge

Amenity items	Service description
Community Health Services – Aged care	Home based aged care services
Adult activity centre	Aged and adult therapy services
Ceduna Kooniba Aboriginal Health Service	Specialised health services for Aboriginal communities within the district

Source: SA Health 2014

Other key emergency and social services identified in the region are recorded in Table 7.

Table 7: Key emergency and social services

Regional emergency and social services	
Other emergency and medical services	SA Police Ceduna SES unit SA Ambulance Service Ceduna & Districts CFS Group Country Health SA
General health and social service providers in Aboriginal communities	Tullawon Health Service Inc available to the Yalata community Yalata-Maralinga Health Services in the Oak Valley community Ceduna Aboriginal Family Violence Program Prevention Services Aboriginal Legal Rights Movement Inc (not-for-profit organisation) The Aboriginal Family Support Services, including a Foster Care Program, Child and Welfare Association SA
Wangka Wilurrara Accommodation Centre	Short-term accommodation for transient communities who visit Ceduna. The facility is supervised 24 hours, 7 days a week
Sobering Up Centre	Located in Ceduna and provides short term accommodation, and drugs and alcohol management programs
Child and Welfare Association SA	Implement the Aboriginal Family Support Services, including a Foster Care Program. Key role in providing training, education and support to members of the Aboriginal community to ensure culturally appropriate foster care for young people
Seaview Village- Aged Care	Provides services to people aged 45 years and overs, and those with a disability who require full time care

Details of infrastructure and associated service providers in the region are detailed in Table 8.

Table 8: Regional infrastructure and service providers

Summary of regional infrastructure and service providers	
Electricity	ETSA Utilities provide off-grid electricity to the Aboriginal lands including the Yalata community, 70 km south of the J-A Project The nearest connection to the South Australian electricity grid is located at Ceduna

Summary of regional infrastructure and service providers	
Water Supply	SA Water provides water, wastewater and related services as far west as Ceduna, 290 km south east of the J-A Project There is no recorded use of groundwater other than for road construction and maintenance within many kilometres of the borefield, due to the high salinity, deep water table and generally low yields
Communications	A Code Division Multiple Access (CDMA) phone tower is located at the Yalata community some 70 km south of the J-A Project; however this is too far from site for reception There are fibre optic cables running along the Eyre Highway and the transcontinental railway line that runs through Ooldea siding some 70 km north of the J-A Project
Other	A dog fence constructed to protect the pastoral areas in the south from the wild dogs in the north, stretches 5,300 km and is located 40 km to the south of the J-A Project
Road	The Eyre Highway, connecting the eastern States to WA, is the major interstate road closest to the J-A Project. Current access to the site is along a minor road north from the Eyre Highway Traffic data is available for the Eyre highway as far west as Ceduna. The data is based on Annual Average Daily Traffic (AADT), which is the total volume of traffic travelling in both directions during one 24 hour period. At Ceduna, the AADT is 1,000, with 30% of these being commercial vehicles. Between Ceduna and the West Australian border, the AADT reduces to 380 vehicles, with 37% commercial vehicles (DTEI August 2007) The Ooldea to Yalata Road is a public road approximately 130 km long between Eyre Highway and Ooldea. The road is an unsealed and maintained by the Department of Planning, Transport and Infrastructure (DPTI). As outlined in Table 3.2, a Development Application for the upgrade of this road was lodged by Iluka as part of the J-A Project. Approval for the upgrade of Ooldea Road was granted in May 2008 No traffic estimates are publicly available for the Ooldea to Yalata Road.
Rail	The Trans-Australian railway between Adelaide and Perth passes through the region. Ooldea siding is approximately 70 km from the J-A Project.
Air	There is an airport at Ceduna serviced by Regional Express, which provides a daily passenger service to and from Adelaide. There are also airstrips at Ooldea siding and the Yalata community, the latter of which is to Royal Flying Doctor Service standard.
Port	Port Thevenard is located 3 km south east from the centre of Ceduna. The major export cargoes handled through the port include gypsum, grains, seeds, salt, and heavy mineral.

2.2 Land use

The mine and associated infrastructure is located within Yellabinna and Nullarbor Regional Reserves (Figure 4). The dominant land uses of the reserves are described as conservation of the wildlife, conservation of the landscape and historic features, Aboriginal land use, mineral exploration, and tourism. The J-A Project does not fall within any local council boundaries and as such is described as located in an ‘out of council’ area.

Post-mining land use will revert to that use prescribed for Yellabinna and Nullarbor Regional Reserves.

Further information on the Yellabinna and Nullarbor Regional Reserves is provided in Section 2.16.

2.3 Proximity to infrastructure and housing

Information on proximity to public infrastructure and housing is provided in Section 2.1.7.

2.4 Amenity

Amenity values are as described within the Yellabinna Regional Reserve's Management Plan (DEWNR 2013) including variable habitat and vegetation associations, geological and cultural features (e.g. rock holes), and high quality endemic ecosystems minimally affected by anthropogenic disturbance and incursion of exotic species.

2.5 Noise, dust, air quality

2.5.1 Dust and air quality

The background dust levels in the reserve are expected to be high on intermittent occasions due to the dry arid conditions of the surrounding area. At the Ceduna and Eucla weather stations, dust storms are observed on average once a year. Ceduna has an average of 110 days a year of haze while the average haze at Eucla is 57 days a year (BOM n.d.).

Background levels of air pollutants are considered to be negligible, with no major industries within 290 km of the J-A Project area (Ceduna). There are no known measurements of air pollutants in the remote area.

2.5.2 Noise

No specific environmental noise monitoring data has been collected for the J-A Project as there are no sensitive land uses within the vicinity of the operation. The closest residential buildings are at Yalata, approximately 60 km away (Figure 5).

2.6 Topography and landscape

The area consists of landscape features, such as dune fields and karst areas, which influence vegetation assemblages (and consequently faunal communities) present within the area (see Section 2.13). The pre-mining surface contours are shown in Figure 6.

2.7 Geology and soils

2.7.1 Geology

The regional geology of the Eucla Basin includes Tertiary sediments deposited in marine and terrestrial settings in the south west part of South Australia (Benbow et al. 1995) and extends into adjacent parts of Western Australia.

The J-A Project area occurs in Tertiary age sediments of the Eucla Basin. North of the J-A Project area, the Eucla Basin is underlain by the older Palaeozoic Officer Basin, which subcrops and outcrops north of the railway. South east of the J-A Project area, Eucla Basin sediments overlie the Precambrian Gawler Craton, which subcrop and outcrop to the east (Iluka 2007b).

The Jacinth deposit is a north-south oriented palaeo-sedimentary sand deposit approximately 5 km long by 900 m wide and up to 42 m deep. The average thickness of overburden is approximately 8 m. Ore thickness ranges from approximately 20 - 45 m.

The Ambrosia deposit consists of a larger central zone up to 700 m wide, approximately 2.2 km long and up to 30 m deep as well as three smaller satellite pits to the east and north. The average ore thickness is 12 m; overburden thickness varies, averaging 8 m.

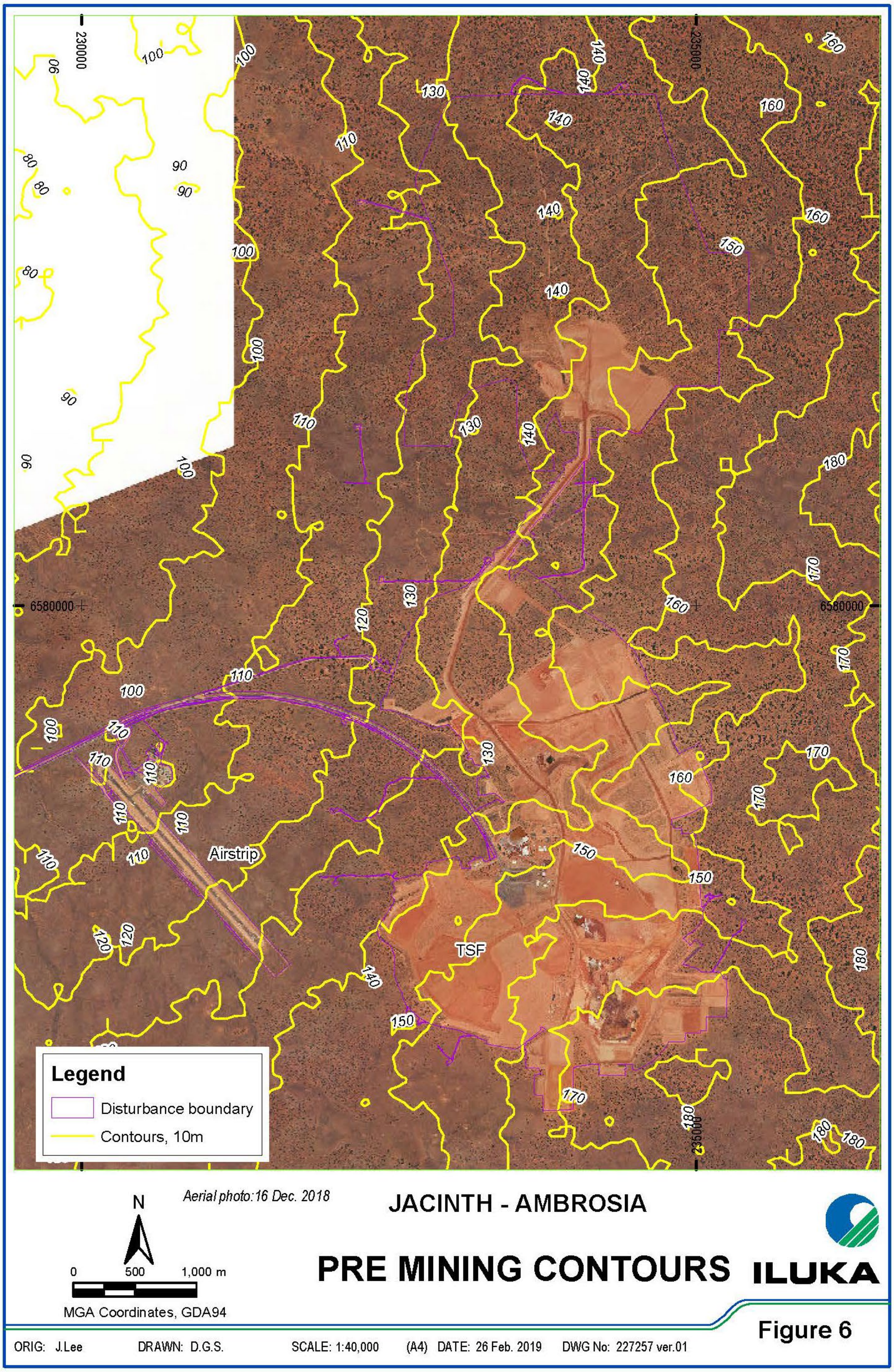


Figure 6: Pre-mining contours

The regional surface geology of the area is shown in Figure 7. The aerial distribution of the Eucla Basin, Officer Basin and Gawler Craton (including overlaps) is detailed in Figure 8.

2.7.2 Soils

The soil distribution across the J-A Project area reflects the geological history of the area. At least five marine transgression and regression events have occurred in the Eucla Basin (depositing 40–50 m of sediments), the most recent event forming the Nullarbor Limestone found in the borefield and pipeline areas. The sedimentary sequence overlies partially weathered granitic and gneissic rocks of the Gawler Craton. The characteristics of the sediments from the various marine regression and transgression events vary sufficiently to form distinct stratigraphic units. The stratigraphic units observed at the Eucla Basin deposits are conceptualised in Figure 9.

The thickness of these stratigraphic units varies across the J-A Project area and individual units may be absent at some locations. West of the airstrip and village, the stratigraphic units are not present and the soils are dominated by the Nullarbor Limestone, with occasional Aeolian dunal sand ridges.

A number of soil sampling and characterisation studies have been completed over the J-A Project area and adjacent areas, including:

- Soil characteristics and management at the Eucla Basin – Jacinth and Ambrosia deposits (Outback Ecology 2006);
- Soil distribution in the Eucla Basin deposits – Jacinth and Ambrosia. Desktop study (Soil Water Consultants 2007);
- Pre-mine soil survey for the proposed Jacinth mine site, Eucla Basin (Soil Water Consultants 2008);
- Rehabilitation of Jacinth-Ambrosia Mine, Ceduna, South Australia (SRK Consulting 2011); and
- Sonoran Development Project: Baseline Soil Survey (Sinclair Knight Merz 2014) (NB: Soil survey of an adjacent project on the same landscape).

The regolith in the J-A Project area and adjacent areas is highly heterogeneous, with thickness and physio-chemical characteristics varying significantly spatially, with depth, and between soils. The soil surface is fragile, with the high percentage of fine sand particles in the surface (and some regolith) samples being particularly susceptible to wind erosion. Soil strength measurements indicate that weak soil crusts develop within the topsoil material which offers some protection from wind erosion.

The soil profile above the orebody and barren Ooldea Sands can be broadly subdivided into soil materials that have been termed Brown Loam and Red Loam, occurring beneath topsoil and, in places, dunal sand, termed Yellow Sand (Soil Water Consultants 2008). A conceptual model of the soil profile, which re-interprets the geological stratigraphy through additional survey and data from a soil science perspective, is shown in Figure 9. The physio-chemical characteristics of the soil materials can vary significantly (Table 9), especially Red Loam which represents an amalgam of clayey- and sandy-members of the Quaternary Sand Unit. Red Loam generally has higher clay content than Brown Loam and can be dispersive as a result of a higher exchangeable sodium percentage (ESP). Areas of higher pH are generally associated with the presence of calcium carbonate ($CaCO_3$) that can manifest as calcrete in the profile, although this is not a continuous layer. Beneath the topsoil, which is non- to slightly saline, the soils are classed as slightly to extremely saline. Plant available water capacity (PAWC) is low in topsoil and Yellow Sand, increasing in the Brown Loam and Red Loam layers due to their higher clay content, but PAWC is moderated by these materials' higher salinity.

Non-wetting and acid sulphate soils are absent from the J-A Project area.

Table 9: Physio-chemical characteristics of the soil materials identified in the J-A Project area

Characteristic	Topsoil	Yellow Sand	Brown Loam	Red Loam
Location in profile	Surface 0.1 m	In dunes and creek-lines with variable depth	Generally underlies topsoil of variable depth	Generally underlies the Brown Loam
Texture	Sand to loamy sand	Sand	Loamy sand to silty loam, clay content increasing with depth	Sandy loam to clay loam, sandy, variable with breadth and depth
Salinity (EC1:5 dS/m)	Non to slightly saline 0.01–0.17	Non to slightly saline 0.03–0.06	Slightly to extremely saline 0.2–2.8	Moderately to highly saline 0.7–1.6
PAWC (unit-less)	0.05–0.17	0.06–0.08	0.18–0.28	0.05–0.20
Stability (Emerson Class and ESP)	Not dispersive Class 4/6 ESP 1–5%	Not dispersive ESP 10–20%	Generally, not dispersive Class 4/6 ESP 29–30%	Some highly dispersive Class 1 & 2 to 4/6 ESP 36–41%
pH (1:5 in water)	8.5–9.2	9.2–9.8	7.8–9.3	4.8–8.4

Data collated from Outback Ecology (2006), SWC (2007), SWC (2008) and SRK Consulting (2011)

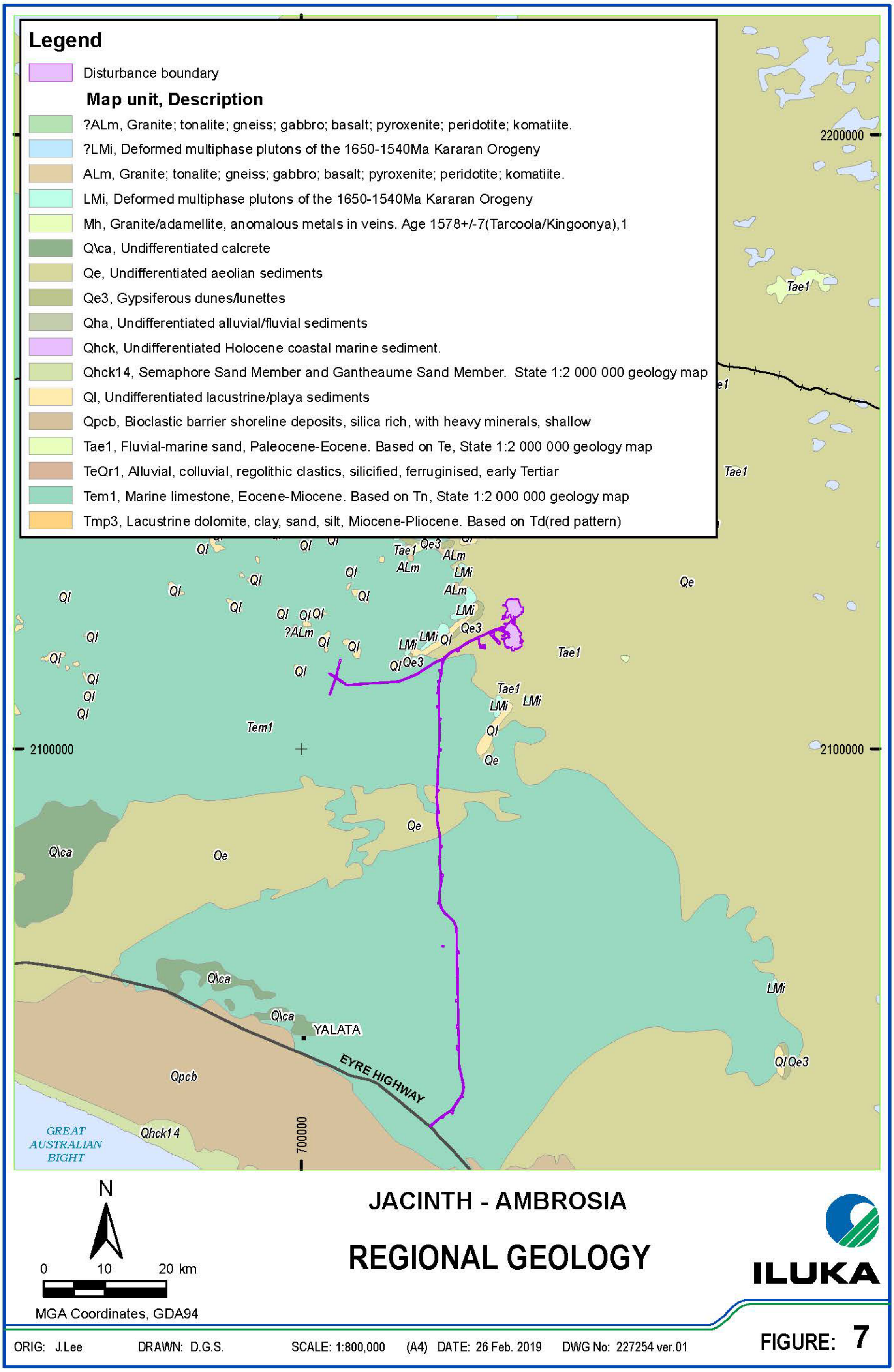


Figure 7: Regional geology

Figure 8: Groundwater provinces and basins

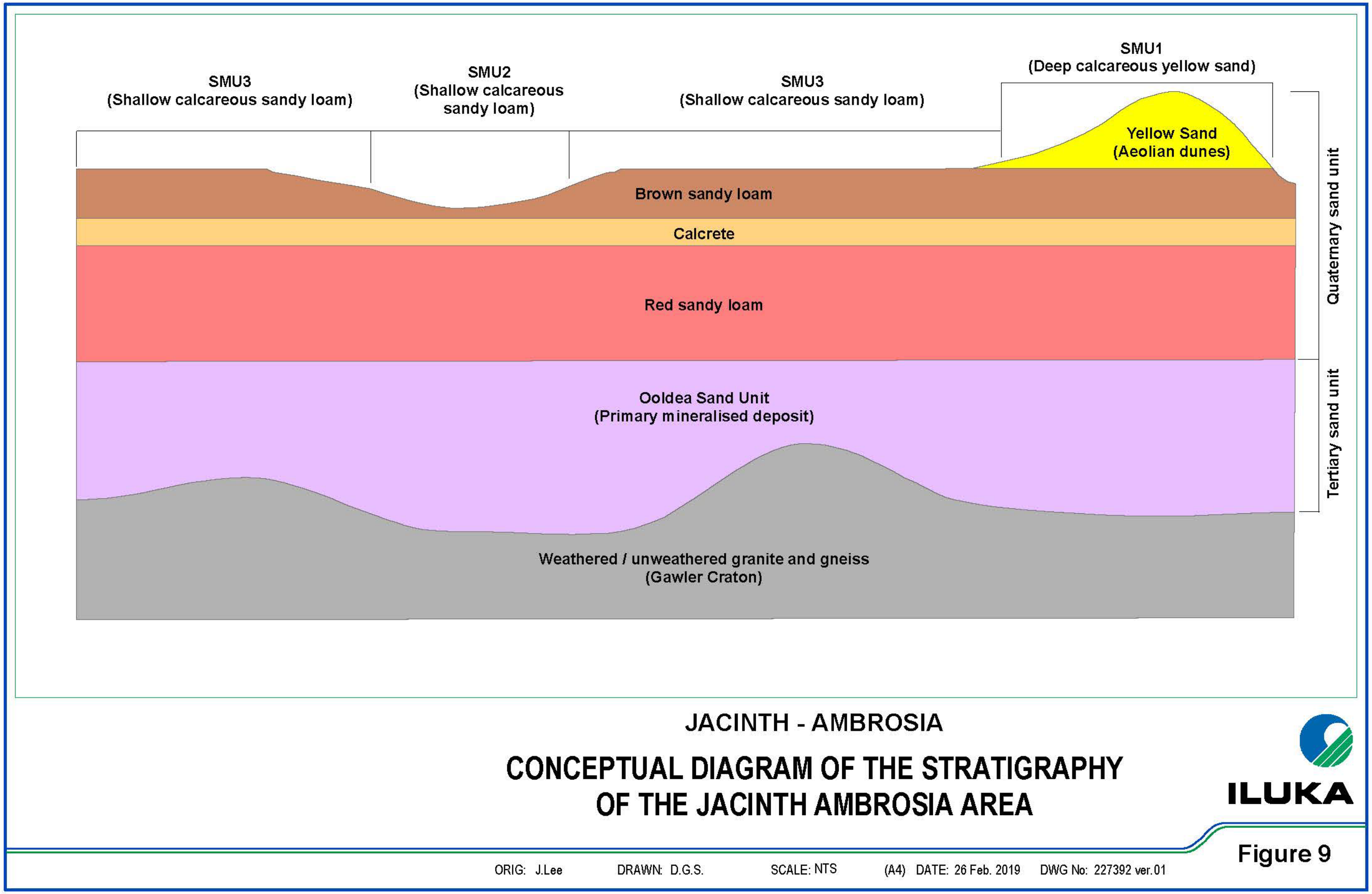


Figure 9: Conceptual cross-section of the stratigraphy of the Jacinth-Ambrosia Area

2.8 Climate

2.8.1 Temperature and rainfall

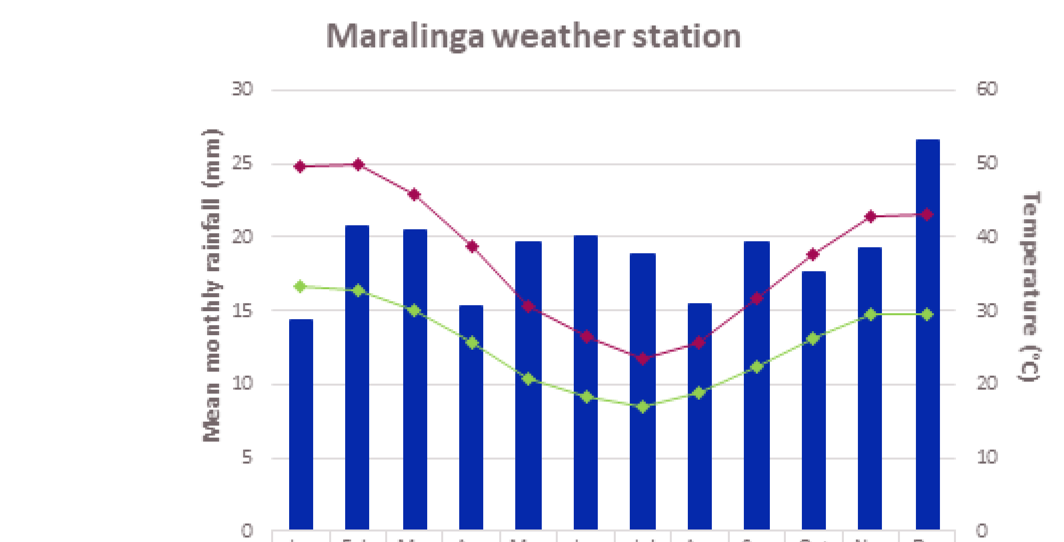
The J-A Project area is located in the Eucla Basin: part of the arid region that is classified as hot and persistently dry under the Köppen Classification Scheme (BOM 1990). The terms ‘semi-arid and ‘arid’ refer to areas with a mean annual precipitation (MAP) of between 250 - 350 mm, and less than 250 millimetres (mm) respectively (Godske et al. 1957). A weather station operates at the J-A Project area, however, given the short-term nature of the current J-A Project area climate data, the data presented below is from the Bureau of Meteorology (BOM).

The two BOM weather stations nearest the J-A Project area are located at Maralinga and Tarcoola (Table 10; Figure 10 and Figure 11).

Table 10: BOM climate data for the region surrounding the J-A Project area

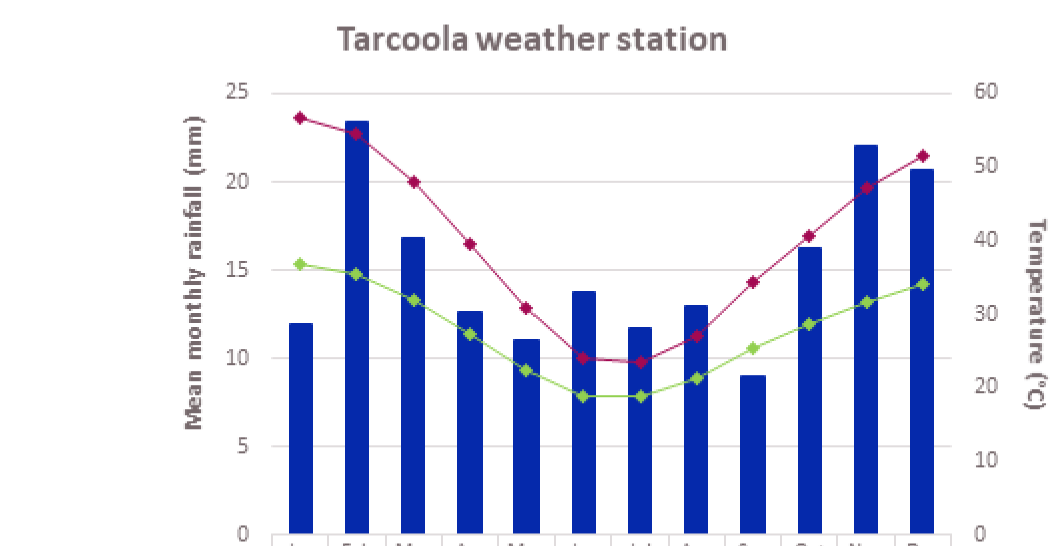
Station (number)	Zone	Easting	Northing	Approximate location relative to mine	Length of rainfall record	Measured parameters
Maralinga (018114)	52	785811	6646603	70 km north west	1955 to current	Rainfall, temperature, relative humidity and wind speed
Tarcoola (pre 1997:16044) (post 1997:16098)	53	458822	6602630	240 km east	1904 to current	Rainfall, temperature, relative humidity and wind speed

Evaporation data is not available at either of the sites detailed thus an analysis on the rainfall deficit/surplus rates cannot be reported on.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	14.4	20.7	20.5	15.3	19.6	20	18.8	15.5	19.7	17.6	19.3	26.6
Temp (Mean Min)	16.5	17	15.7	13.2	9.8	8.1	6.5	7	9.2	11.3	13.4	13.6
Temp (Mean Max)	33.2	32.8	30.1	25.6	20.9	18.4	16.9	18.8	22.4	26.3	29.5	29.5

Figure 10: Average climatic conditions, Maralinga



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	11.9	23.4	16.8	12.6	11	13.7	11.7	12.9	9	16.2	22	20.7
Temp (Mean Min)	19.9	19.1	16.1	12.3	8.3	5.3	4.6	5.7	8.9	12.1	15.6	17.5
Temp (Mean Max)	36.9	35.4	31.8	27.2	22.5	18.8	18.9	21.2	25.4	28.6	31.7	34

Figure 11: Average climatic conditions, Tarcoola

Similar rainfall occurs at Maralinga and Tarcoola in all months, with Tarcoola typically displaying a slightly higher MAP in the cooler months (Figure 10 and Figure 11).

Mean temperatures are similar at both Maralinga and Tarcoola, ranging from approximately 4 °C to 35 °C; Tarcoola however, displays greater variability with significantly more days per annum above 30 °C (Table 11).

Due to the large distances between these two weather stations, there is potential for some uncertainty in the application of the data to the J-A Project area. Climate conditions (rainfall and temperature) for Tarcoola are considered more reflective of conditions at the J-A Project area based on operational experience.

Table 11: Annual temperature data, Maralinga and Tarcoola

Temperature	Maralinga	Tarcoola
Mean Maximum Temp (°C)	25.4°C	27.7°C
Mean Minimum Temp (°C)	11.8°C	10.7°C
Mean no. of Days ≥ 40°C	8.5	25.2
Mean no. of Days ≥ 35°C	38.6	71.9
Mean no. of Days ≥ 30°C	91.5	134.4
Mean no. of Days ≤ 2°C	2.6	2.6
Mean no. of Days ≤ 0°C	0.4	0.4

2.8.2 Humidity

Humidity is very low, which is representative of the aridity of the area. Annual average humidity ranges at Maralinga and Tarcoola are similar, highest in morning and declining in the afternoon in line with increasing diurnal temperature (Table 12).

Table 12: Mean humidity values (%), Maralinga and Tarcoola

Time	Maralinga		Tarcoola	
	Min	Max	Min	Max
9am	45%	74%	42%	75%
3pm	23%	45%	23%	46%

Evaporation data has not been provided as it is not collected at the BOM sites.

2.8.3 Wind

Wind data available for Maralinga and Tarcoola is presented in Figure 12 and Figure 13, respectively. Both sites show a similar pattern of dominant north-easterly winds in the morning, tending to dominant southerly and south-westerly winds in the afternoon and evening. This pattern has been consistently observed at the J-A Project area since commencement of operations in 2009.

At Maralinga, approximately 30 – 35% of winds exceed 20 km/h (both morning and afternoon). Wind intensity is generally lower at Tarcoola, with approximately 14% of morning and 10% of afternoon winds exceeding 20 km/h, respectively.

Wind erosion potential is variable according to soil type (particle size and weight), cover and moisture content with significant wind erosion generally occurring at the J-A Project area at speeds in excess of 20 km/h (DERM 2011).

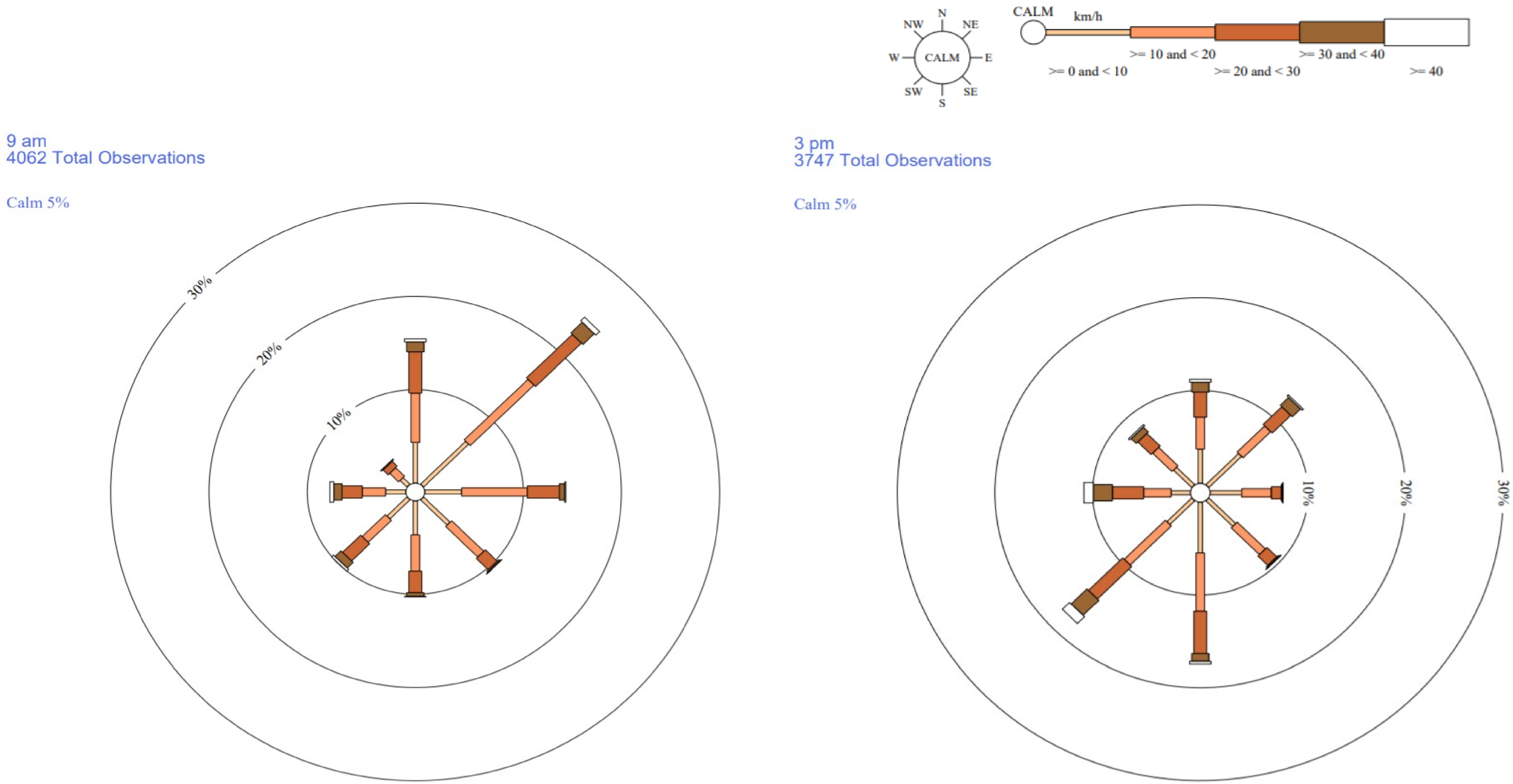


Figure 12: Maralinga, 9am and 3pm average wind directions and intensity (BOM 2019)

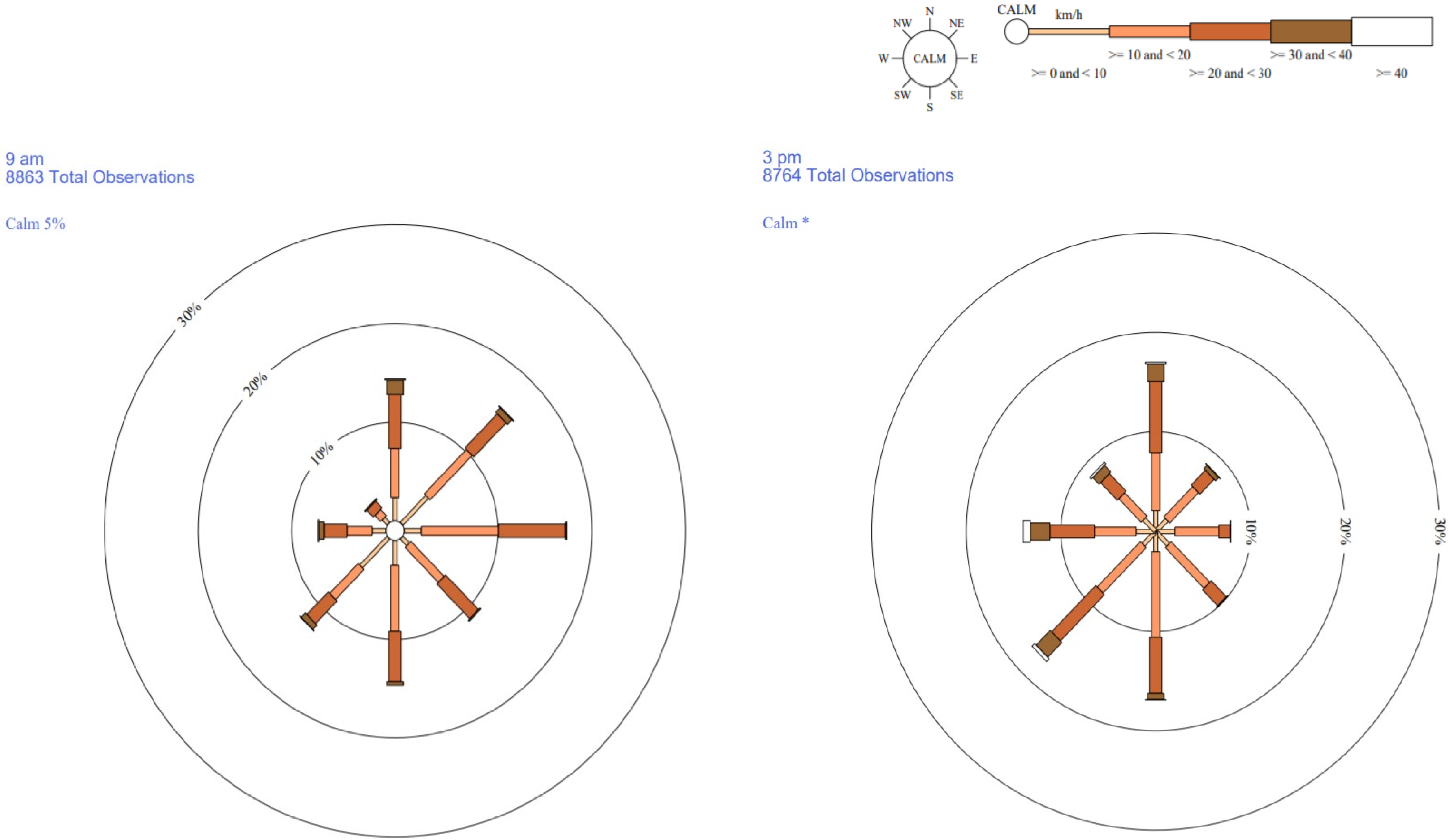


Figure 13: Tarcoola weather station, 9am and 3pm wind directions and intensity (BOM 2019)

2.9 Geohazards

2.9.1 Asbestiform minerals

To date, no asbestiform minerals have been observed during the drilling at the J-A project area and are not expected to be encountered due to the sedimentary nature of the Jacinth and Ambrosia deposits.

2.9.2 Radioactivity

J-A heavy mineral is a naturally occurring radioactive material (NORM). The ore has low levels of Uranium (U) and Thorium (Th) with a combined concentration of approximately 38 ppm. U and Th concentrations are increased by the mineral concentration process and average 170 ppm and 509 ppm in the final HMC, respectively.

The U and Th concentrations within the final HMC product brings the material under the provisions of the South Australian *Radiation Protection and Control Act 1982*, with the facility licensed to carry out mining or mineral processing (Certificate No. LM10). Pursuant to this Licence the operation must comply with *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Processing*, and an EPA-approved *Radiation and Radioactive Waste Management Plan.*

A baseline radiation survey was conducted by SA Radiation Pty Ltd in 2018 to quantify radionuclide concentrations and dose rates in the area surrounding and directly above the Ambrosia deposit (see Appendix O). The parameters measured were terrestrial gamma dose rate, radionuclide concentration in soil and derived U, Th and Potassium-40 (K-40) concentrations.

The baseline radiation survey for the Ambrosia deposit found that the U and Th concentrations within the Ambrosia study area are lower than the typical background concentrations in Australia. No clear trend could be established from the K-40 contribution. As a result, background terrestrial dose rates are low compared to typical dose rates within Australia.

2.9.3 Earthquakes

The J-A Project area is remote from areas of historical earthquake activity, such as the Flinders Ranges or Tennant Creek area of the Northern Territory. There has been no known occurrence of an earthquake in the vicinity of the J-A Project area.

2.10 Flooding

The J-A Project area is situated in an elevated area with ephemeral creek lines. During significant rainfall events, surface water runoff from the J-A Project area currently flows in a westerly direction toward the eastern side of Lake Ifould through existing creek lines or as sheet flow across the surface. There is no known record of flooding in the J-A Project area.

2.11 Surface water

The J-A Project area is partially located within the Lake Ifould catchment, with the Jacinth and Ambrosia deposits located 6 km to the east of the lake (Figure 14). The catchment is approximately 77,000 hectares (ha) with Lake Ifould situated in the south western portion. The catchment is generally steep along the eastern boundary and has well-defined tributaries mainly located to the north and east of the lake. These flow paths have been formed from smaller subcatchment flows. The eastern tributaries run through both the Jacinth and Ambrosia deposits.

The watercourses located around the J-A Project area are ephemeral and are shaped by rainfall and flow events that are highly variable both spatially and temporally. When the watercourses do flow, they experience significant transmission losses for smaller and medium-sized flows. These significant transmission losses can result in ongoing cycles of incision and deposition along the watercourse. Vegetation and biological soil crust (BSC) play a crucial role in slope and watercourse bed and bank stability in the catchment.

The J-A watercourse system is complex and vulnerable to accelerated erosion, as is typical of an arid zone environment. The fluvial processes and physical form can vary substantially along the length of a watercourse. Using the River Styles® framework, a geomorphic classification, six River Styles® have been identified within the J-A catchment (Alluvium 2013). The framework categorises watercourses based on common geomorphic forms and processes to identify common parameters that can be used to inform rehabilitation design.

The flow directions and surface drainage patterns are outlined in Figure 14 and Figure 15. Further details of J-A Project area surface water drainage are provided in the appended report, '*Jacinth-Ambrosia Watercourse Rehabilitation'* (Alluvium, 2013) provided in Appendix B.

No surface water quality data is currently available due to insufficient flows.

The catchment associated with the J-A Project is not within a water protection area or surface water prescribed area as defined under the *River Murray Act (2003)* or the *Landscapes South Australia Act (2019)* (Landscapes Act) respectively.

2.12 Hydrogeology

Three major geological domains identified within the region are (see Figure 7):

- Eucla Basin;
- Gawler Craton; and
- Officer Basin.

J-A is situated within the Gawler Craton, while the borefield is located in the Eucla Basin. Results of the hydrogeological assessments undertaken for the J-A Project are summarised below.

2.12.1 Eucla Basin

The Jacinth and Ambrosia deposits are found within the unsaturated Eocene-aged sediments of the Eucla Basin, which is underlain by the Gawler Craton formation.

The South Australian portion of the Eucla Basin covers an area of 41,000 km^2. This area has Eocene-age sediments that range from 20 m to over 400 m thick, thickening towards the centre of the basin. The significant groundwater resources of the Eucla Basin occur to the west of J-A. Martin *et al*. (1988) considered that there may be up to 14,000 million litres per year (L/yr) of groundwater sustainably available from the Eucla Basin in South Australia. This was based on an assumed recharge rate of 1 millimetre per year (mm/yr), of which 70% would be recoverable.

There are no significant natural surface water resources in the region. In the south, there is virtually no surface drainage due to the high permeability of the outcropping Nullarbor Limestone. Elsewhere, ephemeral creeks occasionally develop in response to intense periods of rainfall; these generally flow toward terminal drainages such as Lake Ifould and Lake Tallacootra.

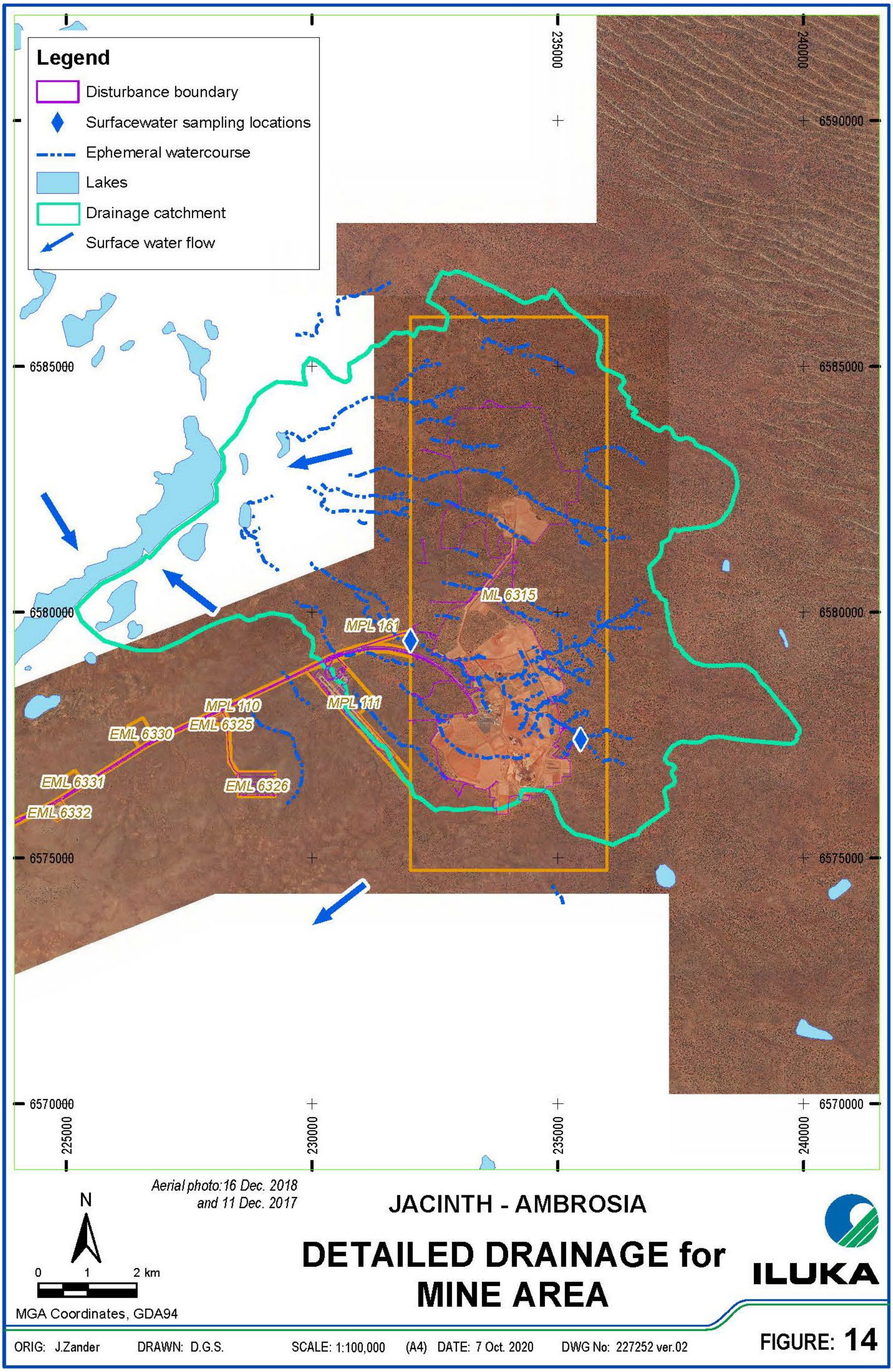


Figure 14: Detailed drainage for the Mine area

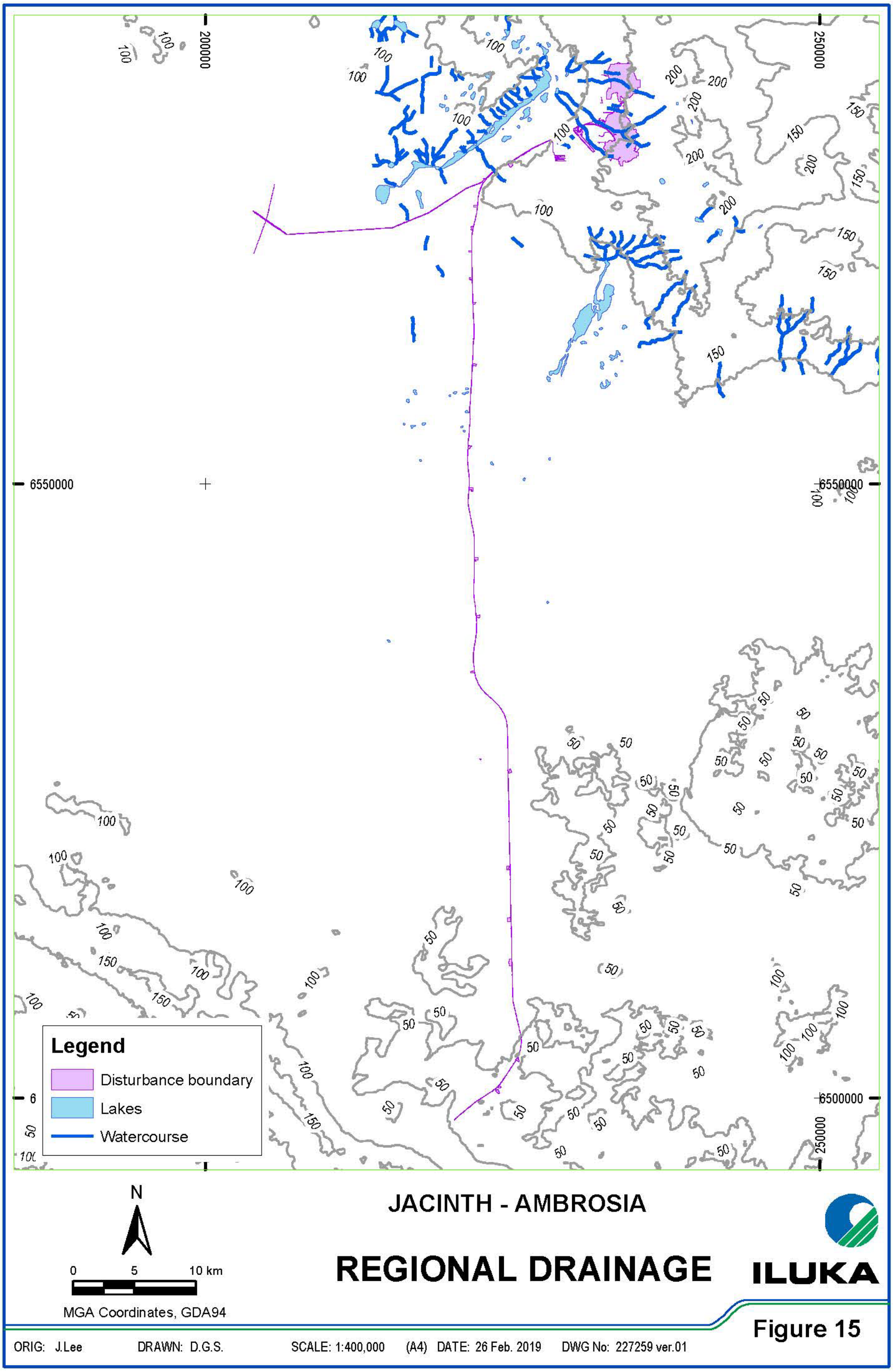


Figure 15: Regional drainage

Regionally, two different aquifer types are represented including:

- **Primary porosity aquifers:** These aquifers are generally heterogeneous to homogeneous and anisotropic. Groundwater is stored within pores that were present at the time of rock formation. These aquifers develop upon saturation of unconsolidated and consolidated sediments. The palaeochannel aquifer that supplies the mine with water is an example of a primary porosity aquifer. This aquifer, which is hosted in sediments of the Pidinga Formation (SKM 2011), appears to represent the most significant pre-mining groundwater resource in the J-A Project area. A geological cross section of the palaeochannel, including construction details of the production wells, is shown in Figure 16.
- **Fractured rock aquifers:** These aquifers, which are heterogeneous and anisotropic, are represented in basement and more competent Cainozoic lithologies. Groundwater at the mine is restricted to aquifers of this type. Usable supplies are generally sourced from preferential pathways for groundwater flow that occur within the rock mass. Such pathways including faults, joints or bedding partings; post-date the formation of the rock and thus represent secondary porosity. Fractured rock aquifers may also have dual-porosity characteristics where groundwater is stored in preferential pathways (secondary porosity) and/or the rock matrix (primary or secondary porosity). In dual porosity aquifers, the hydraulic conductivity of preferential pathways is often significantly greater than the matrix.

Groundwater represents the main water resource regionally, although its beneficial use is constrained by its salinity and the low transmissivity or storativity of some host lithologies. Groundwater quality in the Eucla Basin is generally unsuitable for drinking or stock use, with total dissolved solids (TDS) typically greater than 10,000 milligrams per litre (mg/L). Groundwater of lower salinity does occur in higher rainfall areas nearer the coastline, which is associated with perched aquifers of limited extent. No specific environmental guideline values were identified from the Australian and New Zealand Environment Conservation Council Guidelines (ANZECC) guideline (2000) Fresh and Marine Water Quality guidelines based on the potential beneficial use of groundwater or the EPA Environment Protection (Water Quality) Policy (2015). Therefore, site-specific guideline values based on baseline monitoring data were developed for the operation with selected guideline values adopted from the ANZECC (2000) guideline when no baseline data was available (i.e. marine or recreational use guidelines).

Indicative pre-mining groundwater depths in the palaeochannel and at the mine were approximately 40 and 50 m below ground level (mBGL) respectively. This equates to potentiometric surface elevations of about 23 metres with respect to Australian Height Datum (mAHD) at the palaeochannel and 100 mAHD at J-A, with the groundwater gradient orientated from east to west. Large discharge features including Lake Ifould may intercept groundwater along this flow path.

Recharge to both the J-A Project area aquifers and fractured rock aquifers is likely to be very low given the low rainfall regionally, the high rainfall deficit observed in most months (using temperature as a crude surrogate for evapotranspiration), the significant depth to the water table, and the highly efficient interception of infiltrating water by J-A Project area vegetation. Martin *et al*. (1988) estimated an average recharge of approximately 1 mm/yr for J-A.

2.12.2 Local setting

Palaeochannel aquifer

The palaeochannel aquifer containing Iluka's water supply for the J-A Project is located on the eastern margin of the Eucla Basin in Cainozoic sediments. This palaeochannel is located approximately 41 km from the nearest karst areas and approximately 100 km north of the coast (sea).

The palaeochannel aquifer is located approximately 30 km west of J-A. Data from resource investigation drilling, followed by airborne electromagnetic (AEM) and hydrogeological investigations (SKM 2006b), identified poorly sorted, fluvial sands and gravels containing highly saline and moderately acidic groundwater in an unconfined aquifer that has a known thickness between 40 m and 50 m. The palaeochannel aquifer was found to be between 1.5 km and 2.5 km wide and at least 15 km in length. Further detailed AEM was completed for the Paleochannel in 2019 and interpretation of results extended the spatial extent in addition to the aquifer thickness (Jacobs 2020), above the initial interpretation.

The water bearing unit within the palaeochannel aquifer comprises sand units of the Lower Pidinga Formation. Recharge is thought to be very limited both through the weathered basement, the upper strata or the valley sides. This is supported by the relatively low hydraulic gradient that is observed within the palaeochannel aquifer system. A conceptual model of the palaeochannel is described below in Table 13 and the cross section in Figure 16.

Abstraction from the palaeochannel-hosted aquifer will create drawdown in this groundwater system. The drawdown extent and associated impacts have been previously detailed by SKM (SKM 2006b) and Iluka (Iluka 2013) in a series of numerical modelling and validation exercises respectively. In 2020 Jacobs updated and validated this model. Further detail and assessment of risks associated with aquifer drawdown are provided in Section 5.15.

Table 13: Conceptual palaeochannel stratigraphy

Geological unit	Age	Description	Typical top elevation	Typical thickness
Nullarbor Limestone	Miocene	Competent white to brown limestone with occasional cavities	~ 70 mAHD	Up to 25 m
Upper Pidinga Formation	Mid to late Eocene	Fine to very fine grained, more uniform sands overlain by silts and clays. Estuarine/marginal marine deposits	~ 40 mAHD	10 to 20 m
Lower Pidinga Formation (Maralinga)	Early to mid Eocene	Medium to coarse, poorly sorted quartz sand unit. Likely to be fluvial origins due to: rounded to sub-angular grains; presence of grit; and occasional carbonaceous clay layering/lignite lenses	15 to 30 mAHD	Up to 50 m at centre of the valley. Predominance of quartz gravel (with pebble size grains). At base, up to 4 m thick

Geological unit	Age	Description	Typical top elevation	Typical thickness
Granite/Gniess Basement	Precambrian	Saprolite/weathered granite or gneiss. Blue-green clay overlaying very compact bedrock	~ -30 mAHD	Weathered unit (which refers to the saprolite horizon only) ranges from < 1 m to several metres thick. The actual thickness of the basement could be kilometresthick

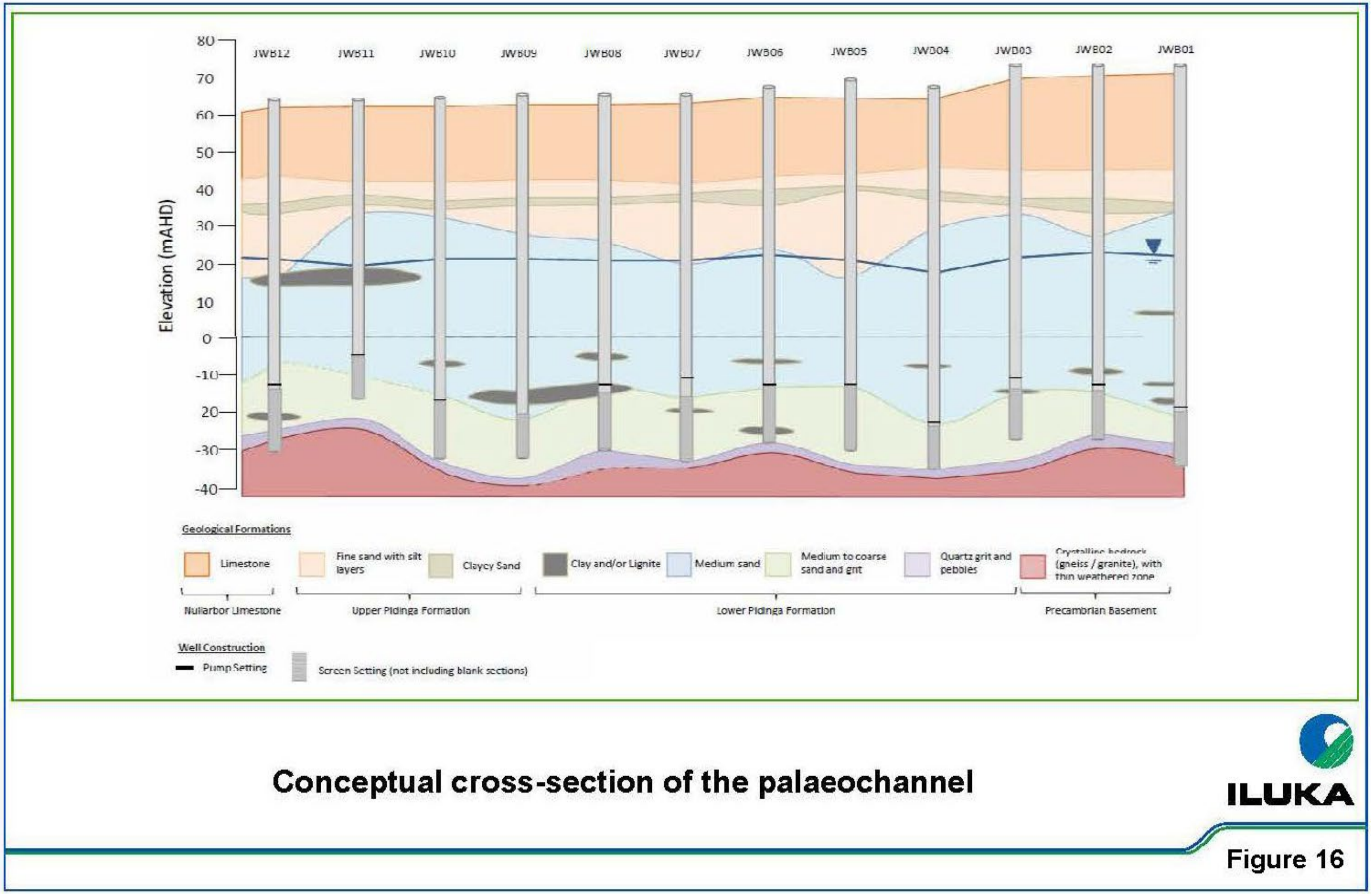


Figure 16: Conceptual cross-section of the palaeochannel

Groundwater-dependent ecosystems

Groundwater dependent ecosystems (GDEs) are generally of subterranean or aquatic type.

Aquatic GDEs

A search of the BOM GDE Atlas indicated the presence of 194 potential GDEs within the Gairdner River Region, in which the J-A Project is located. Potential for these ecosystems to be GDE's range from low to high and are primarily Lacustrine and Palustrine, with rare seasonal/intermittent saline lakes. Groundwater fed surface water bodies, including Lake Ifould and Lake Talacootra are located within the project area as a source of groundwater discharge (EMM 2020). Notable GDEs in the area on the BOM GDE Atlas are listed in Table 14 and displayed on Figure 17

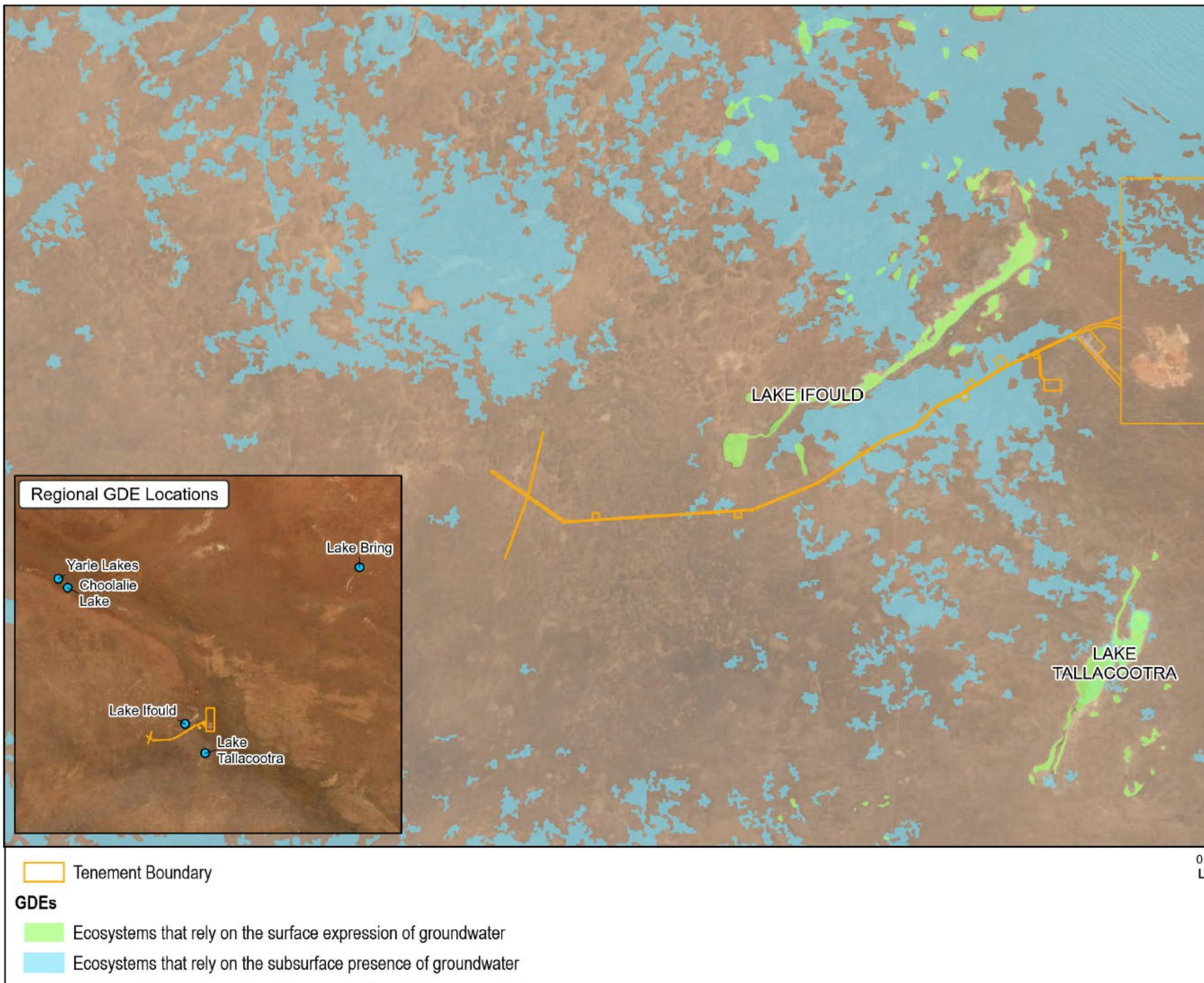


Figure 17: Groundwater Dependant Ecosystems

Figure 17.

Table 14: GDEs in the Gairdner River Region

Name	Ecosystem	Ecosystem type	GDE potential	River Region

Lake Ifould	Wetland	Lacustrine	High	Gairdner
Yarle Lakes	Wetland	Lacustrine	High	Gairdner
Lake Talacootra	Wetland	Lacustrine	Moderate	Gairdner
Choolalie Lake	Wetland	Lacustrine		Gairdner
Lake Bring	Wetland	Lacustrine	Moderate	Gairdner

Subterranean GDEs

Subterranean GDEs are generally species-rich, comprising aquatic groundwater-inhabiting organisms called stygofauna.

Previous studies indicate that the potential for subterranean GDEs such as stygofauna is very low in J-A, based on the following:

- The relatively high depth to groundwater. The Tertiary limestone deposits in the vicinity of the Jacinth and Ambrosia deposits are typically unsaturated and not known to be karstic. It is considered unlikely that either the granite basement or any saturated silt and sand immediately overlying the basement host significant stygofauna populations (PB 2008).
- Poor groundwater quality, represented by high salinity and low nutrient concentrations.
- Low recharge rates and high residence times. The pre-mining groundwater environment is relatively static, a consequence of low recharge and groundwater flow rates. The observed high groundwater salinities are one consequence of these low rates.

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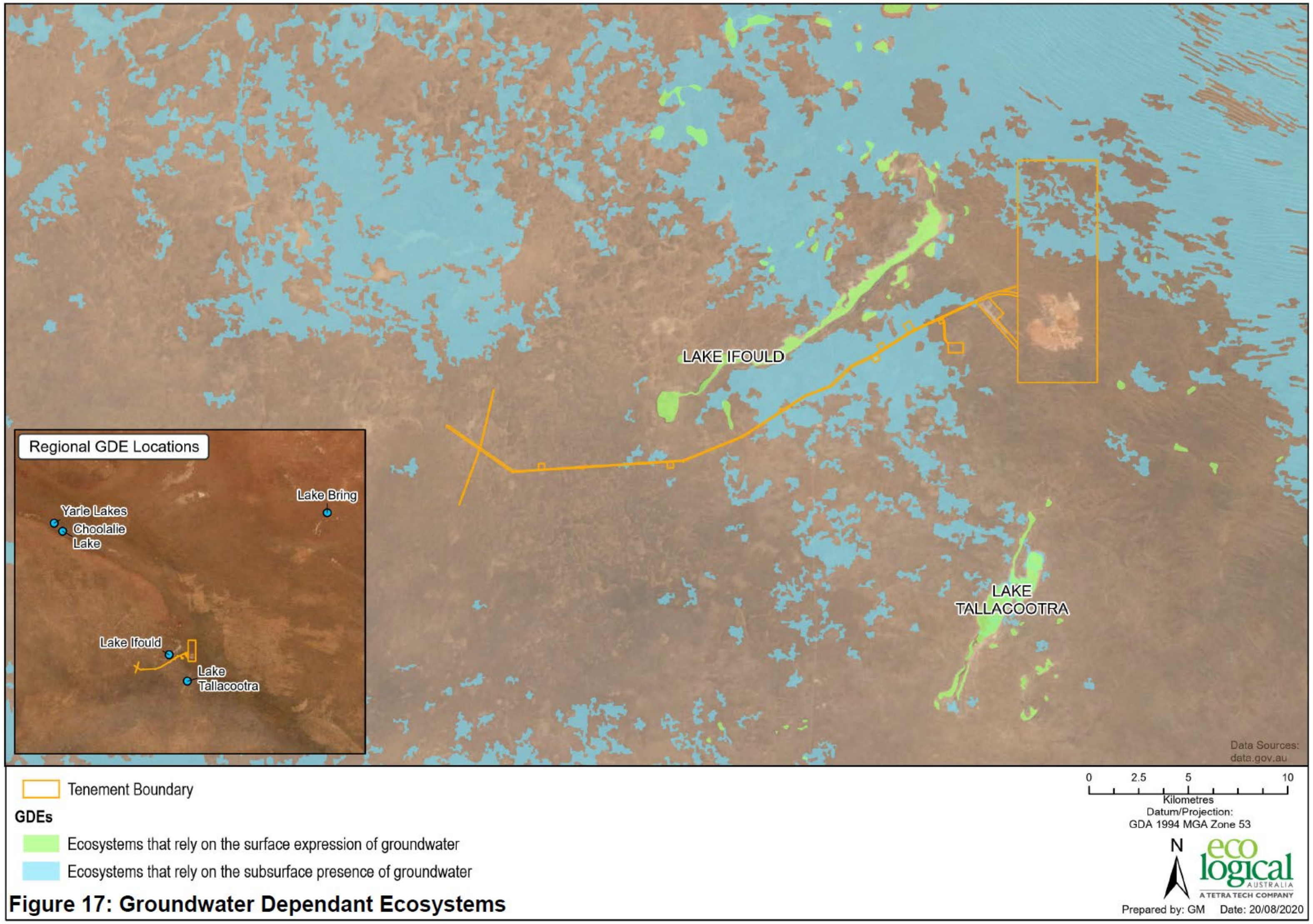

Figure 17 Groundwater dependent ecosystems

The closest known occurrence of stygofauna to J-A is the Nurina Cave in WA, located approximately 500 km west of the J-A Project area. The closest caves to J-A are two Nullarbor Caves (part of the Diprose Cave group) which are located approximately 41 km to the south west of the western edge of the borefield. These caves are not water containing and are located in a separate hydrogeological domain to the J-A Project water supply (palaeochannel).

Groundwater levels

Indicative pre-mining depths to groundwater in the palaeochannel aquifer were approximately 40 and 50 mBGL respectively, which equates to potentiometric surface elevations of about 23 mAHD at the palaeochannel. In 2019 the depth to groundwater in the palaeochannel aquifer was measured to be between 46 - 52 mBGL, indicating little change since mining commenced (Figure 18).

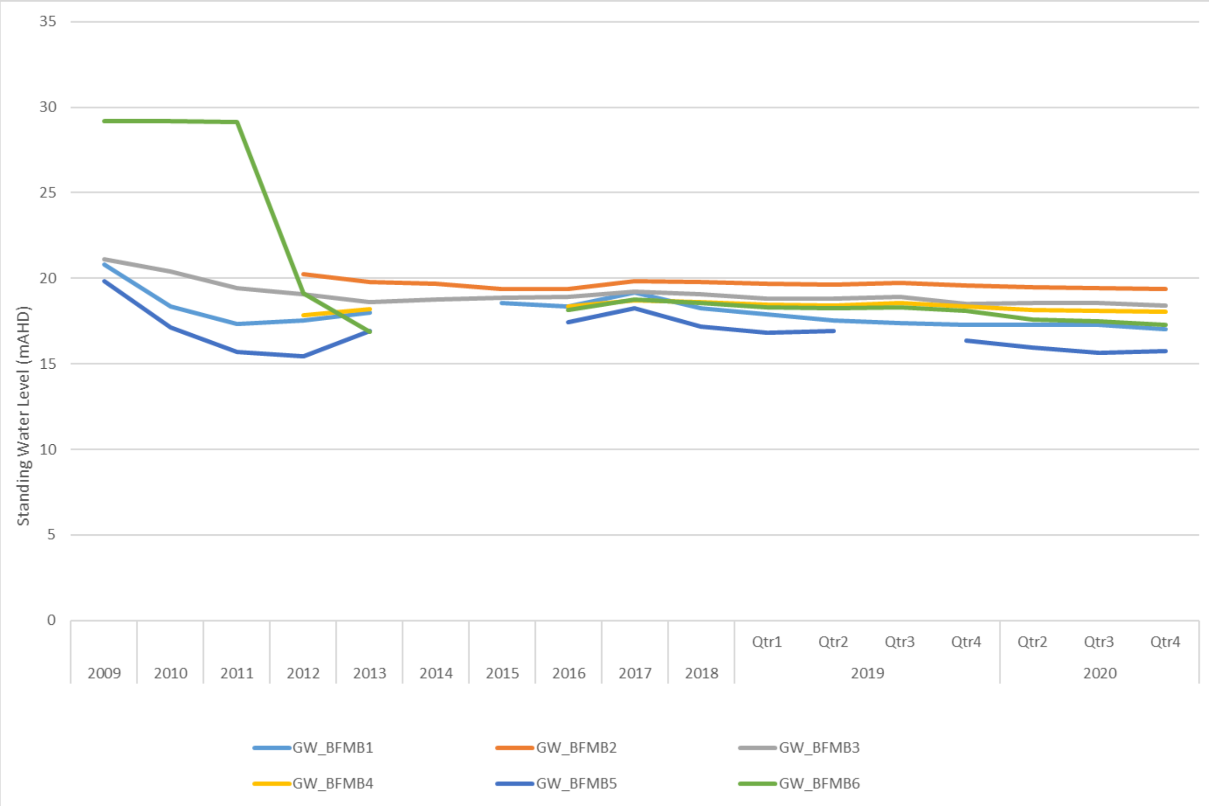

Figure 18: Observed groundwater levels (mAHD) at the monitoring wells in the palaeochannel aquifer

Palaeochannel groundwater chemistry

Groundwater chemistry data from the palaeochannel aquifer was collected during feasibility studies (PB 2007) and as part of routine monitoring. Data collected during feasibility study suggested groundwater salinity increased with depth in palaeochannel sediments. This indicates:

- density-driven stratification occurs at the J-A Project area; and
- groundwater quality of extracted groundwater may decrease over time.

The groundwater of the palaeochannel is characterised as sodium chloride (Na-Cl) type and is hypersaline (Electrical Conductivity [EC] = 5,400–8,600 Millisiemens per metre (mS/m) or TDS = 35,000–52,200 mg/L). Measured pH is generally circum-neutral to acidic (pH = 4.3–7.4).

Concentrations of total iron (Fe) and manganese (Mn) maximum concentrations reach 53 mg/L and 6.5 mg/L, respectively. Much of the total Fe is in Fe^{2+} form. The oxidative state of groundwater has not been routinely monitored. However, based on the groundwater depth, low recharge potential, and presence of Fe^{2+}, groundwater in the palaeochannel is assumed to be in a reducing condition. Concentrations of dissolved nutrient species (nitrate [NO_3], ammonia [NH_3], Total nitrogen [TN]), and organic and hydrocarbon concentrations, are low. Those hydrocarbon species that are present are attributed to the presence of organic-rich lithologies and methanogenic microbes.

Groundwater and surface water interaction

The land surface is relatively flat and with the depth to groundwater being between 40 - 50 mBGL (approximate elevation of 23 mAHD) there is no opportunity for the groundwater in the palaeochannel aquifer to be expressed at the surface. In particular, the elevation of Lake Ifould is approximately 70 mAHD. Thus, after any heavy rainfall event the normally dry Lake Ifould would lose its water to the deeper aquifer (through infiltration) and to evaporation.

Registered wells

Because of the high salinity, deep water table and generally low yields there is no recorded use of groundwater other than for road construction and maintenance within the search area of 50 km radius from the borefield and mine operations, and 10 km radius from the access road. Additionally, the palaeochannel aquifer is not in a prescribed well area.

2.12.3 J-A Project hydrogeology

Mineral exploration drilling undertaken by Iluka indicated that the pre-mining water table was below the base of the orebody, and thus dewatering to allow dry-mining of the Jacinth and Ambrosia deposits was not required (PB 2005). Subsequent hydrogeological studies by PB (2008) correlated particle size distribution (PSD) with hydraulic conductivity. These correlations suggested:

- the Quaternary sands and clays above the Ooldea Sands are spatially and hydraulically variable, and up to 25 m thick;
- the thickness of the Ooldea Sands, which are more permeable and less variable than younger lithologies, ranges between 10 - 20 m;
- a weathered clay unit (referred to as “saprolite”), which is of variable thickness (locally absent) and of very low hydraulic conductivity, overlies the granite basement; and
- the basement surface is undulating, which given its lower hydraulic conductivity, may have a groundwater damming effect.

Hydrogeological studies suggested that the unsaturated and saturated horizons are likely to be highly heterogeneous, and display anisotropic flow characteristics. The porosity type is likely to vary between lithological units, ranging from primary- (sediments) and secondary-

(basement) types. Furthermore, there is significant potential for perched aquifers to develop; potentially containing groundwater of different quality to deeper, regional aquifers.

Groundwater levels

Indicative pre-mining depths to groundwater beneath the J-A Project area were approximately 40 and 50 mBGL respectively, which equates to potentiometric surface elevations of about 100 mAHD. The pre-mining groundwater levels were hosted within the fractured rock basement aquifer.

Figure 19 and Figure 20 show the simulated pre-mining (2009) groundwater levels and depth to water for reference.

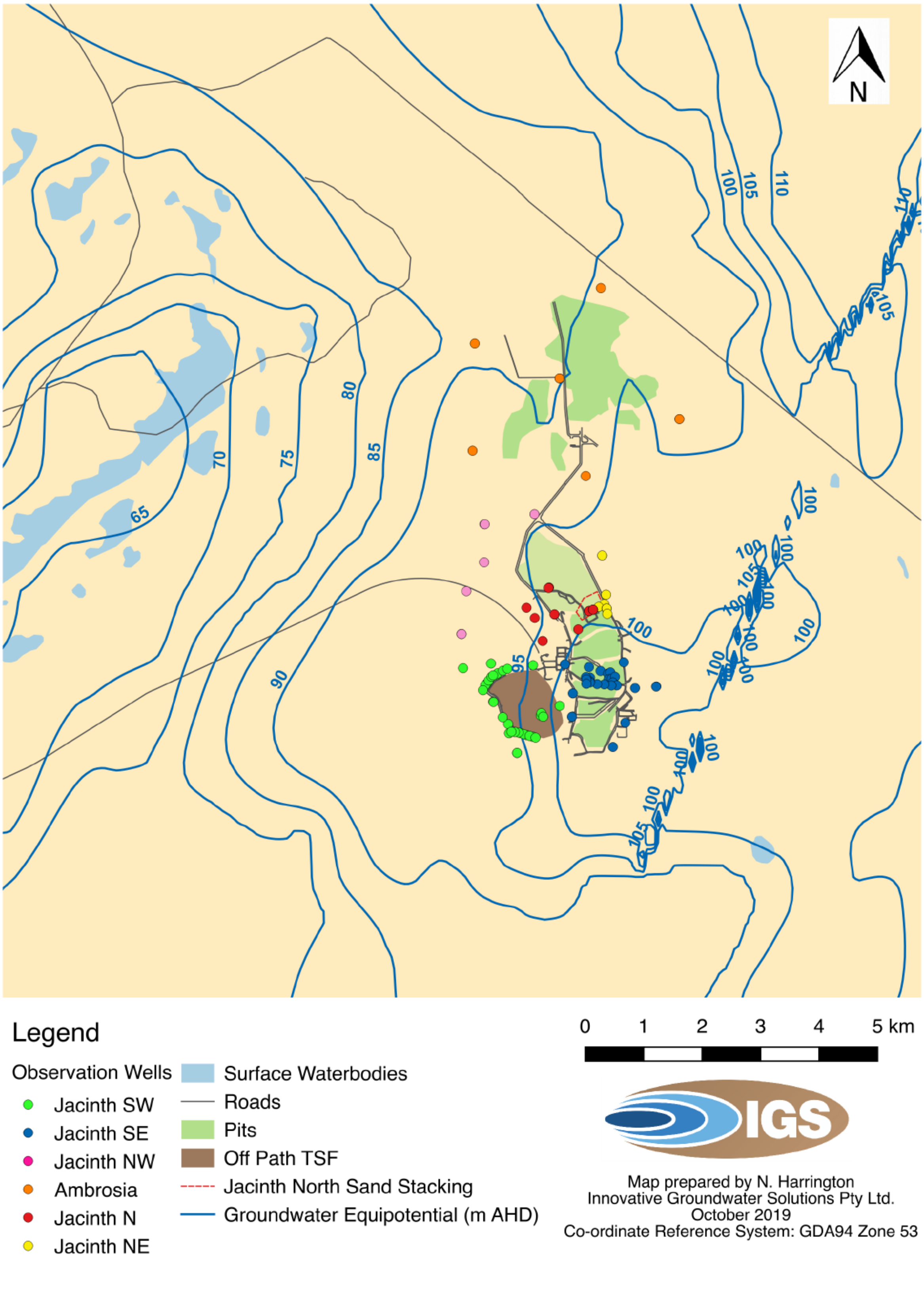

Figure 19 - Pre-mining equipotentials

Figure 19: Pre-mining equipotential (sourced from IGS (2020)

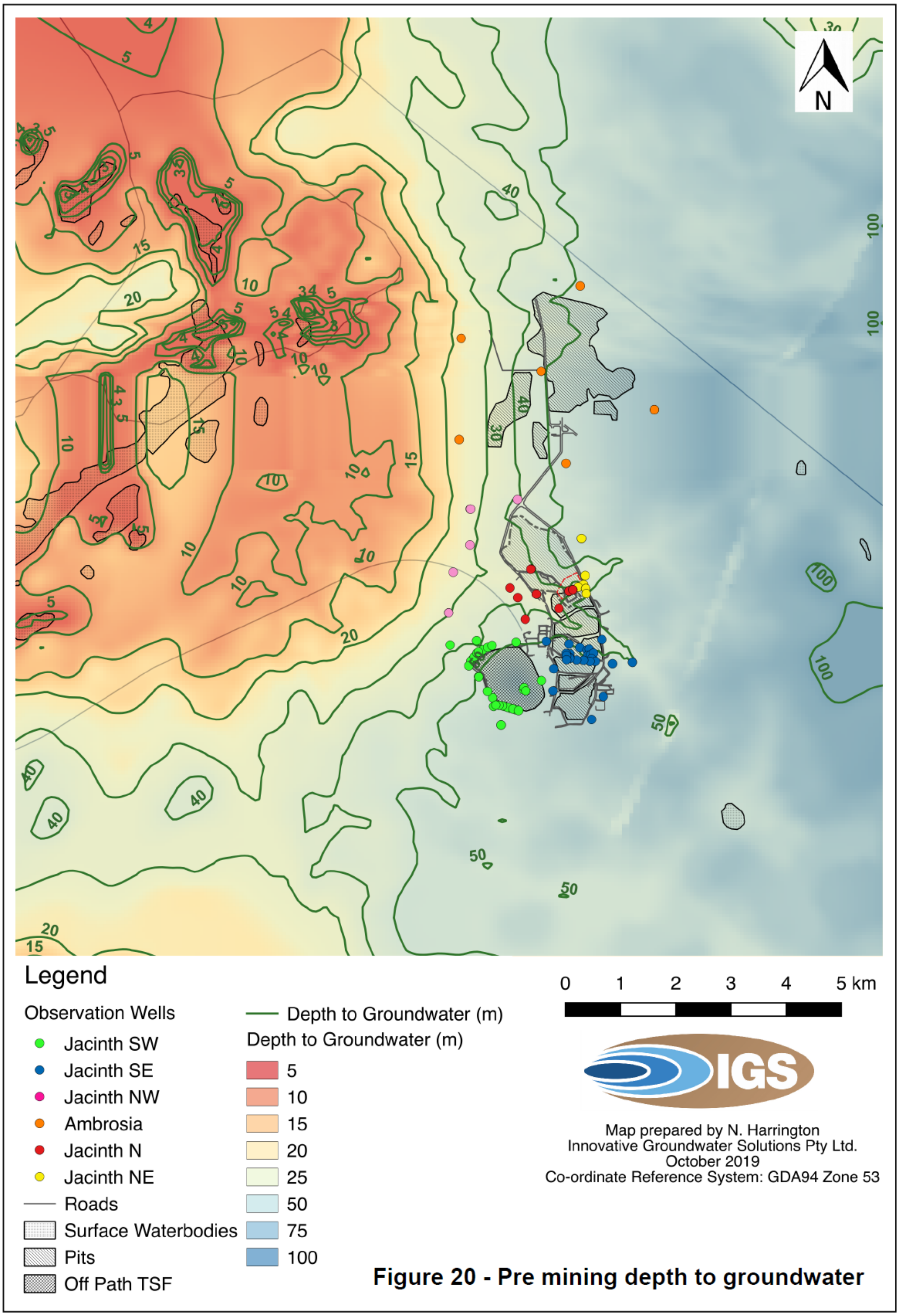

Figure 20: Pre-mining depth to groundwater (sourced from IGS (2020))

Groundwater chemistry

Groundwater chemistry data from the aquifer underlying the J-A Project Area was collected during feasibility studies (PB 2007) and as part of routine monitoring. Groundwater is of a Na-Cl type and hypersaline (Electrical conductivity (EC) = 5,100 – 7,100 mS/m). Observed pH is near-neutral, with a pH range between 6.1 and 7.9. However, acidic conditions have on a single occasion been observed in monitoring wells MBN01S (pH = 3.29) and CANBERRA (pH = 3.8). These conditions are attributed to the oxidation of relatively high concentrations of dissolved Fe and low buffering capacity; this ferrolysis effect is described in more detail by Bean and Hattingh (2011).

Similar to the chemistry observed at the palaeochannel production wells, dissolved Fe and aluminium (Al) concentrations are high. All instances of elevated Fe and Al are associated with mildly acidic pH. Organics including total recoverable hydrocarbons and benzene, toluene, ethylbenzene and xylene remain low (generally less than 0.3 mg/L). The sporadic spatial distribution (observed in near-mining wells, and regional/background monitoring wells in generally undisturbed areas) – and the confirmation in duplicate/triplicate/split samples obtained to-date – suggests that the source is not a result of contamination but likely 'false-positives' potentially due to organic-rich lithologies and methanogenic-microbes. Similar to hydrocarbon observations at J-A, benzene is reported to have been detected in some monitoring wells in methanogenic, high salinity, playa, or coastal wetland environments in which mobilization of some hydrocarbons from organic matter in the subsurface has occurred (Landon and Belitz 2012; Devai and Delaune 1996).

Groundwater and surface water interaction

The land surface is relatively flat, depth to groundwater being between 40 - 50 mBGL (approximate elevation of 100 mAHD), low hydraulic conductivity and the distance from the nearest surface water body, there is no opportunity for the groundwater in the J-A Project area aquifer to be expressed at the surface (i.e. Lake Ifould).

Groundwater wells

Iluka has developed numerous monitoring and production wells in the project area intended to monitor water levels, sample groundwater chemistry, provide water for operations and to recover water from tailings. These wells are described briefly in the context of monitoring in Section 5.15, with further details provided in Appendix U.

2.13 Vegetation, weeds and pathogens

Prior to the commencement of mining a number of baseline vegetation surveys were completed within J-A. These included:

- Eucla Basin Vegetation Survey: Jacinth and Ambrosia Deposits (Badman 2006a);
- Eucla Basin, Baseline Vegetation Survey: Jacinth & Ambrosia Deposits, Infrastructure Corridor, Fowlers Bay (Badman 2006b);
- A Vegetation survey of the Jacinth-Ambrosia Wellfield and Pipeline Corridor (Badman 2007);
- Seed ecology research project (Pound *et al.* 2007);
- Survey of weeds along current and proposed roads (haul road) for the Jacinth-Ambrosia mine on the Far West Coast of South Australia (EBS 2008); and

- Ecological assessments relating to MPL161 (BlackOak Environmental 2019).

Following the commencement of mining, annual impact assessment surveys were conducted by Ecological Biodiversity Services Ecology (EBS Ecology) (EBS 2009–2015). From 2016 onwards, annual landscape function analysis monitoring was conducted in rehabilitated areas by EBS Ecology and from 2018 by BlackOak Environmental. The results of these surveys have been presented annually to the DEM in the Annual Compliance Reports (ACR).

2.13.1 Regional vegetation

J-A consists of several major landforms that influence vegetation assemblages present within the region. To the north and east of the J-A Project area, the dominant landform feature is the dune fields of the Yellabinna Regional Reserve consisting of dunes and inter-dune swales, which represent a south east extension of the Great Victoria Desert dune fields.

The landscape of the Nullarbor Plain to the west of the J-A Project area represents a second major landform and it is generally a much less variable environment than the dune fields to the north east. Overlying rocks of the Eucla Basin, the Nullarbor limestone creates an almost featureless calcrete surface punctuated by small-scale variations in relief.

South of the J-A Project area, the limestone of the Nullarbor Plain ends and soils comprising red brown sandy and clayey-sand Callabonna clays are apparent. Further south towards Colona (within the Yalata Aboriginal Reserve), silts and fine-grained sandy wind-blown (Aeolian) deposits, often rich in quartz and calcareous in nature, dominate. This broadly undulating landscape is characterised by open mallee woodland generally atop low dunal rises and myall woodland within the shallow troughs, interspersed with open low shrublands.

The Nullarbor Plain is a generally treeless karst plain with chenopod low shrubland vegetation. Occasional depressions on the plain have deeper soils and support taller vegetation. The low shrubland vegetation is dominated by bluebush species, particularly *Maireana sedifolia*. Low open woodland dominated by *Acacia papyrocarpa* occurs towards the eastern edge of the J-A Project area, with an understorey similar to the vegetation of the Nullarbor Plain. This woodland grades into the mallee woodlands of the Yellabinna dune field, with the *A. papyrocarpa* woodlands replaced by mallee in the eastern part of the J-A Project area. The *A. papyrocarpa* woodlands are the least common of these communities in this area and represent a transition between the low shrublands of the Nullarbor Plain and the mallee woodlands of the Yellabinna dune field. This type of vegetation is more common on the eastern side of the Yellabinna dune field. The low shrubland vegetation is common across the Nullarbor Plain to the west of the survey area and the mallee woodlands are common, and cover several thousand square kilometres, to the east and north in the Great Victoria Desert.

2.13.2 J-A Project area vegetation associations

Four vegetation groups were identified in the original vegetation surveys (Badman 2006; EBS 2008) (see Table 15 and Figure 21). Vegetation in the J-A Project area transitions between:

- the chenopod low shrubland (Plate 1) of the Nullarbor Plain, on the lower and southern fringes of the catchment;

- through low open woodland dominated by *Acacia papyrocarpa* (Plate 2) across the lower and middle catchments; and
- the myall/mallee woodlands (Plate 3) of the Yellabinna dune field in the upper catchment and along the creeks.

An additional vegetation group can be found at the margins of Lake Ifould and at several large salt pans (Plate 4). However, this vegetation group is not found within the J-A Project area. Vegetation in and along watercourses was found to be comparable to the dominant species in each of the vegetation groups.

Table 15: Vegetation groups in the J-A Project area

Group Name	Description	Dominant Species	Average Tree Canopy (%)	Mean Species Richness (# species per site)
Acacia papyrocarpa low open woodland (Plate 1)	Emergent or very open *Acacia papyrocarpa* (western myall) and a chenopod low shrubland understorey	*Maireana sedifolia* (pearl bluebush) *Atriplex vesicaria* (bladder saltbush) *Rhagodia spinescens* (spiny saltbush) *Acacia papyrocarpa* (western myall) *Austrostipa nitida* (balcarra spear-grass) *Eriochiton sclerolaenoides* (woolly-fruit bluebush)	5	19
Nullarbor low shrubland (Plate 2)	Chenopod low shrubland	*Maireana sedifolia* (pearl bluebush) *Atriplex vesicaria* (bladder saltbush) *Austrostipa nitida* (balcarra spear-grass) *Eriochiton sclerolaenoides* (woolly-fruit bluebush) *Sclerolaena obliquicuspis* (oblique-spined bindyi)	0	12
Mallee woodlands of Yellabinna dune field (Plate 3)	Open mallee or *Acacia papyrocarpa* (western myall) low woodland	*Acacia papyrocarpa* (western myall) *Eucalyptus oleosa* ssp. *ampliata* (red mallee) *Atriplex vesicaria* (bladder saltbush) *Maireana sedifolia* (pearl bluebush) *Maireana trichoptera* (hairy-fruit bluebush) *Rhagodia spinescens* (spiny saltbush) *Zygophyllum aurantiacum* (shrubby twinleaf) *Triodia scariosa* (spinifex) *Eremophila scoparia* (broom emubush) *Santalum acuminatum* (quandong) *Alectryon oleifolius* (bullock bush)	16	28
Salt lake margin (Plate 4)	Salt lake margins and drainage areas	*Tecticornia halocnemoides* ssp. *halocnemoides* (brown-head samphire) *Atriplex vesicaria* (bladder saltbush) *Eragrostis setifolia* (bristly lovegrass)	NA	NA

A full list of species identified during the J-A Project baseline vegetation surveys are detailed in Appendix C.

BSC are present across the vegetation groups and are estimated to cover approximately 45% of the ground in the J-A mine area (Doudle and Eckert 2011). BSC consists of lichens, cyanobacteria, algae, mosses, liverworts, fungi and bacteria and exists within the top few millimetres of the soil surface in the soil interspaces between the sparse trees, shrubs and grasses of the semi-arid landscape. BSC performs nitrogen fixation and carbon sequestration, which can be used by higher forms of vegetation.

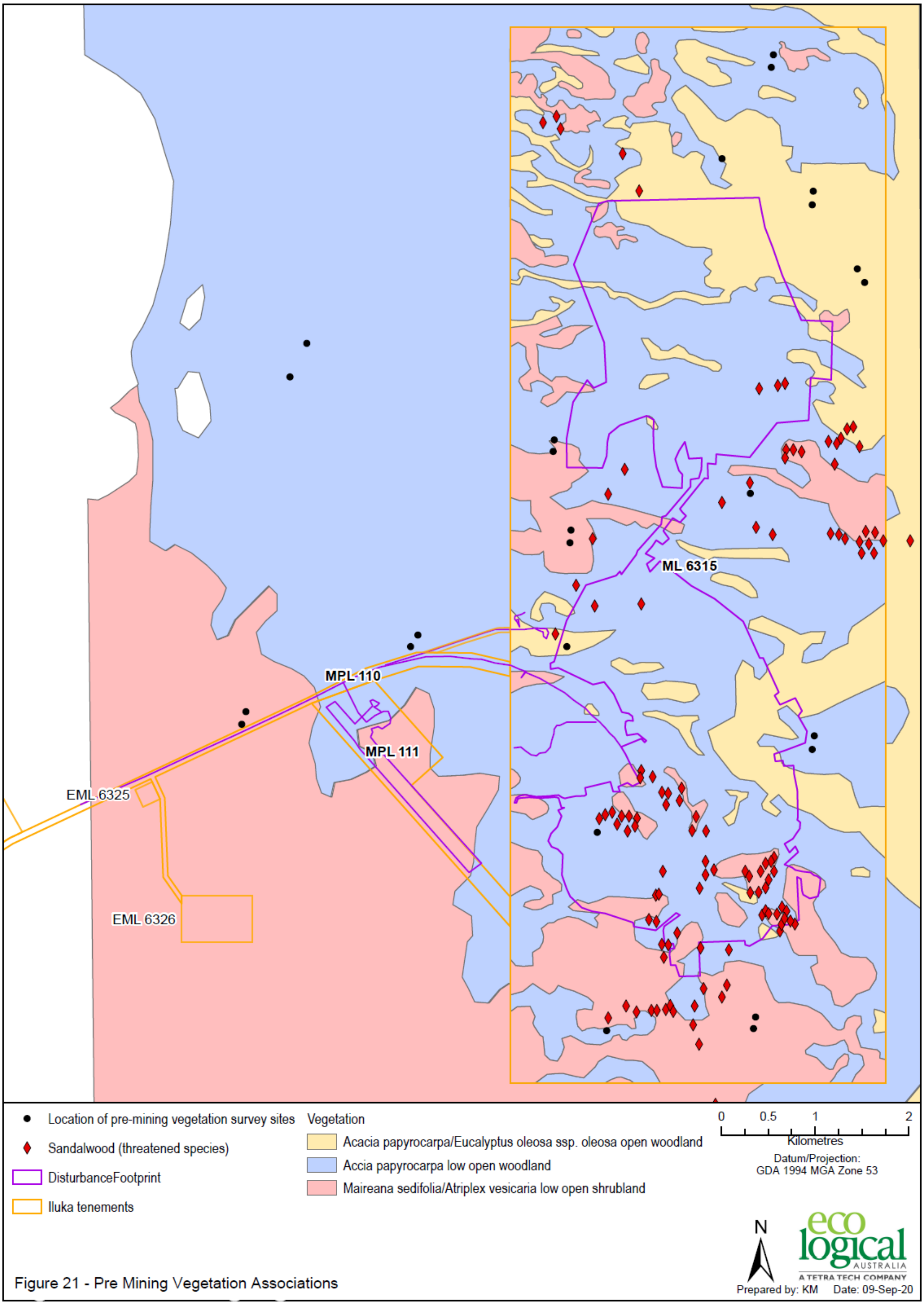

Figure 21: Pre-mining vegetation

Plate 1: Open myall woodland

Plate 2: Chenopod shrubland

Plate 3: Open mallee and myall woodland

Plate 4: Sites associated with salt lakes and drainage areas

2.13.3 Vegetation of conservation significance

Badman (2006a, 2006b, 2007) recorded five plant species of conservation significance during the pre-mining vegetation surveys (Table 16). All are listed under the South Australian *National Parks and Wildlife Act 1972* (NPW Act), with *Austrostipa nullanulla* being listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

It should be noted that of the five species observed during the surveys, only *Santalum spicatum* is known to occur within the J-A Project footprint. No additional species of conservation significance have been detected in the annual vegetation surveys that have been conducted since the commencement of mining.

Table 16: Plant species of conservation significance recorded in pre-mining vegetation surveys

Common Name	Scientific Name	EPBC Act	NPW Act	Vegetation Association Where Observed
club spear-grass	*Austrostipa nullanulla*	Vulnerable	Vulnerable	Sites associated with salt lakes and drainage areas
ridged noon-flower	*Sarcozona bicarinata*	Not listed	Vulnerable	Sites associated with salt lakes and drainage areas
sandalwood	*Santalum spicatum*	Not listed	Vulnerable	All vegetation associations
-	*Gratwickia monochaeta*	Not listed	Rare	Sites associated with salt lakes and drainage areas
-	*Frankenia cinerea*	Not listed	Rare	Sites associated with salt lakes and drainage areas

Three other plant species of conservation significance may occur in the vicinity of the J-A Project area, based on their known ranges. These are *Austrostipa plumigera* (spear-grass), *Maireana rohrlachii* (Rohrlach's bluebush) and *Maireana suaedifolia* (lax bluebush). None of these species were recorded during the vegetation surveys.

BlackOak Environmental undertook a vegetation survey of the MPL161 area in August 2019. The survey identified three vegetation associations within the original low open woodland group:

- *Acacia papyrocarpa, Eucalyptus oleosa* ssp. *oleosa* Open Woodland
- *Acacia ligulata, Senna* sp. Shrubland
- *Acacia papyrocarpa*, Open Woodland.

A number of other species with State conservation ratings are known to occur in the general vicinity but have not been recorded at the J-A Project area and are not believed to occur there due to habitat requirements and current geographical distributions (Badman 2006a, 2006b) (for a full list refer to Appendix C).

A referral under the EPBC Act was submitted to the Commonwealth Department of the Environment for the J-A Project and Iluka was subsequently advised that the J-A Project was "not a controlled action". As part of this submission, a report was generated using the Protected Matters Search Tool. The results of this search outlined a number of species that could potentially occur within the vicinity of the J-A Project area. Habitat and geographical assessments for each of these species (and the review of records of nationally threatened species in the region) identified only *Hibbertia crispula* (Ooldea guinea-flower) as potentially occurring in the area.

Hibbertia crispula is listed as Vulnerable under the EPBC Act. It is a perennial shrub to 0.5 m high that is near-endemic to Yellabinna Regional Reserve (Copley and Kemper 1992). *Hibbertia crispula* is known from herbarium collections from the Ooldea and Immarna areas and also from Kondoolka and Lake Everard to the east, on the opposite side of the Yellabinna dune fields. It was not recorded during the vegetation surveys and is a fairly conspicuous plant when in flower, which is August-September, the time of the 2006 vegetation survey. Notes on herbarium collections give insufficient detail to accurately locate the previous collection localities. It could occur near Ooldea and in the dune field to the east, but the likelihood of finding it within the J-A Project area is low.

There are no threatened ecological communities as listed under the EPBC Act within the J-A Project area.

2.13.4 Weeds and plant pathogens

During the baseline surveys of the J-A Project area conducted by Badman (2006a, 2006b, 2007) seven weed species were recorded. Subsequent to this, an additional 14 weed species have been detected in the J-A Project area. Table 17 provides a summary of weeds recorded within the Yellabinna Regional Reserve (Copley and Kemper 1992, DEHAA 1999a) and within the J-A Project area.

Table 17: Weed species recorded in Yellabinna Regional Reserve and the J-A Project area

Scientific Name	Common Name	Yellabinna Regional Reserve	Baseline Surveys	Subsequent to Baseline
Acetosa vesicaria	ruby dock			✓
Arcotheca calendula	cape weed			✓
Avena barbata	wild oats	✓		✓
Brassica tournefortii	wild turnip	✓	✓	✓
Bromus rubens	red brome	✓		✓
Buglossoides arvensis	sheep weed	✓		
Bupleurum semicompositum	hare's ear	✓		
Cardaria draba	hoary cress	✓		
Carrichtera annua	ward's weed	✓	✓	✓
Carthamus lanatus	woolly star thistle	✓		
Centaurea melitensis	Maltese cockspur	✓		
Chenopodium sp.	fat hen			✓
Citrullus colocynthis	colocynth	✓		✓
Cucumis myriocarpus	paddy melon	✓		
Cynodon dactylon	couch grass	✓		✓
Diplotaxis muralis var. *muralis*	-	✓		
Dittrichia graveolens	stinkwort	✓		

Scientific Name	Common Name	Yellabinna Regional Reserve	Baseline Surveys	Subsequent to Baseline
Echium plantagineum	salvation jane	✓		
Erodium aureum	stork's bill	✓	✓	
Erodium botrys	long stork's bill	✓		
Erodium cicutarium	cut leaf stork's bill	✓	✓	✓
Erodium moschatum	musky stork's bill	✓		
Gypsophila tubulosa	chalkwort	✓		
Heliotropium europaeum	potato weed	✓		
Hordeum sp.	barley grass	✓		✓
Hypochaeris glabra	smooth cat's ear	✓		
Lactuca serriola	wild lettuce			✓
Lolium sp.	rye grass			
Lycium ferocissimum	African boxthorn	✓		
Malva parviflora	small flower marshmallow	✓		
Marrubium vulgare	horehound			✓
Medicago sp.	medic	✓		✓
Mesembryanthemum aitonis	angled iceplant	✓		✓
Mesembryanthemum crystallinum	iceplant	✓		✓
Neatostema apulum	hairy sheep weed		✓	
Nicotiana glauca	tree tobacco	✓		
Onopordum acaulon	stemless thistle	✓		
Parapholis incurve	curly ryegrass	✓		
Plantago bellardii	hairy plantain	✓		
Polycarpon tetraphyllum	allseed	✓		
Prunus dulcis	almond	✓		
Raphanus raphanistrum	wild radish			✓
Reichardia tingitana	false sow thistle		✓	✓
Rostraria cristata	annual cats tail	✓		
Rostraria pumila	tiny bristle grass	✓	✓	
Schinus areira	pepper tree	✓		
Schismus arabicus	-	✓		
Schismus barbatus	mulga grass	✓		
Sisymbrium erysimoides	smooth mustard	✓		
Sisymbrium irio	London rocket	✓		
Sisymbrium orientale	wild mustard	✓		✓
Solanum nigrum	blackberry nightshade	✓		✓
Sonchus oleraceus	sow thistle	✓		✓
Sonchus tenerrimus	clammy sow thistle	✓		

Scientific Name	Common Name	Yellabinna Regional Reserve	Baseline Surveys	Subsequent to Baseline
Spergularia diandra	lesser sand-spurrey	✓		
Tribulus terrestris	yellow vine	✓		
Urtica urens	stinging nettle	✓		
Vulpia muralis	-	✓		
Vulpia myuros	rat's tail fescue	✓		

No evidence of plant pathogens have been identified during field investigations to date and the J-A Project area is not located in a high risk *Phytophthora cinnamomi* (root-rot fungus), or Mundulla Yellows area.

2.14 Fauna

Background research into the potential existence of fauna species within the J-A Project area was undertaken through literature review and database searches. Database searches of fauna previously recorded in and around the Project area were conducted using the DEW and SA Museum database records. The outcomes of previous surveys in the region were also reviewed (including biological surveys undertaken by SA National Parks and Wildlife, SA Museum and WA Department of Conservation and Land Management of the Yellabinna dune fields and the Nullarbor Region). Additionally, a 'protected matters' search was performed under the EPBC Act to determine if any species of national significance possibly occur within the J-A Project area.

Prior to the commencement of mining a baseline field fauna survey was completed by Sinclair Knight Merz (SKM) Ltd (SKM 2006a). Annual fauna surveys were carried out from the commencement of mining activity until 2015. Following on from the 2015 PEPR revision, fauna monitoring has been carried out on a biennial basis by EBS Ecology. The results of these surveys (EBS 2008-2017) have been presented to DEM in the ACRs.

The aim of the fauna impact monitoring program during operations is to establish an accurate understanding of the impacts of the mine operation on fauna communities. Data from control sites (>5 km from the impact zone) is used to determine trends in species richness and abundance of species present. In addition to this data collected from the fauna monitoring program will be used to determine local fauna communities and their habitat requirements to assist rehabilitation works.

The techniques used for the fauna surveys are based on the standard biological survey methodology developed by the Department for Environment and Heritage (DEH) (Owens 2000). Pitfall traps, Elliott traps, cage traps, spotlighting, active searching and the use of an Anabat detector were employed at selected sites within the J-A Project area to determine fauna species presence. Opportunistic sightings of fauna not detected or captured by the above methods were also recorded if animals were seen while travelling between trapping sites.

A desktop fauna assessment of the borefield was completed by EBS (EBS 2007).

An ecological assessment relating to MPL161 was undertaken by BlackOak Environmental (2019).

A summary of the fauna monitoring survey results, completed by EBS (2008-2017), is contained within Appendix D.

2.14.1 Habitat

Fauna assemblages in the region generally reflect the confluence of three major habitat blocks: the Nullarbor Plain, the Great Victoria Desert and the southern Myall-Mallee belt. They also reflect the presence in the J-A Project Area of three general habitat types: chenopod shrubland, open myall woodland and mallee woodland.

Pre-mine vegetation surveys identified three vegetation associations (see Section 2.13.2) that support distinct faunal assemblages, it should be noted that the three vegetation groups at J-A are not discrete but merge into one another. For example, the myall woodland forms an interface between the chenopod shrubland and the extensive mallee dune system to the east. It is therefore feasible that some species, such as bats and birds that can fly extensive distances from their roost sites to foraging grounds, may not be restricted to single vegetation associations.

Of the three major habitat types, the Nullarbor Plain has less than half the diversity of the other two habitat types, due to the lack of complexity in both the physical environment and the vegetation.

2.14.2 Native fauna

A total of 22 mammal, 98 bird and 44 reptile species have been recorded in the J-A Project area since the first baseline fauna survey in 2005. A full list of species recorded during the fauna impact monitoring surveys is provided in Appendix D. It should be noted that bats were not surveyed in the 2015 and 2017 monitoring periods.

2.14.3 Fauna species of conservation significance

Seven threatened fauna species and one migratory fauna species listed under the EPBC Act and/or NPW Act have been recorded at J-A during impact fauna surveys conducted between 2008-2017. The Nationally Endangered *Sminthopsis psammophila* (sandhill dunnart) has only been detected through one capture in April 2009. The State Rare *Cacatua leadbeateri* (Major Michell's cockatoo) was observed in 2008 and 2015 during surveys and observed and photographed at J-A mine by mine personnel throughout 2017 (EBS 2017) and on occasion since 2018. The State Rare *Acanthiza iredalei* (slender-billed thornbill) (previously listed as Vulnerable under the EPBC Act) has been recorded in all surveys from 2009 – 2017 apart from the 2015 survey. The State Vulnerable *Aredeotis australis* (Australian bustard) has been observed in all survey periods, apart from the 2012 survey, and by mine personnel in all years since mining commenced. Finally, the State Rare *Neopherna splendida* (scarlet-chested parrot) was observed for the first time in the December 2017 survey period.

Table 18 summarises the fauna species of conservation significance that have been recorded in the J-A Project area based on current knowledge of fauna activities gained from annual fauna surveys conducted by EBS (2008-2017), opportunistic sightings, and baseline fauna survey data. A *Fauna Management Plan* is in place for the management of these species.

Table 18: Fauna species of conservation significance recorded in the J-A Project area

Scientific Name	Common Name	Conservation significance		Baseline	Subsequent to Baseline
		NPW Act	EPBC Act		
Birds					
Acanthiza iredalei	slender-billed thornbill	R			✓
Ardea ibis	cattle egret	R	M		✓
Aredeotis australis	Australian bustard	V			✓
Biziura lobata	musk duck	R			✓
Cacatua leadbeateri	Major Mitchell's cockatoo	R			✓
Cladorhynchus leucocephalus	banded stilt	V			✓
Falco peregrinus	peregrine falcon	R			✓
Merops ornatus	rainbow bee-eater		M	✓	
Myiagra inquieta	restless flycatcher	R		✓	
Neophema splendida	scarlet-chested parrot	R			✓
Pachycephala inornata	Gilbert's whistler	R			✓
Tringa glareola	wood sandpiper	R	M		✓
Mammals					
Sminthopsis psammophila	sandhill dunnart	V	E		✓
Reptiles					
Neelaps bimaculatus	western black-naped snake	R		✓	

E = Endangered R = Rare V = Vulnerable M = Migratory

During the Project approval phase of the J-A mine, a referral under the EPBC Act was submitted to the Commonwealth Department of the Environment and Energy. Iluka was subsequently advised that the Project was "not a controlled action" under the EPBC Act.

2.14.4 Feral species

The following feral animal species have been observed or tracks and warrens recorded within the J-A Project area:

- *Camelus dromedaries* (one-humped camel);
- *Felis catus* (cat);
- *Mus musculus* (house mouse);
- *Oryctolagus cuniculus* (European rabbit); and
- *Vulpes* (European red fox).

The feral species that have been recorded during the monitoring program are known to be established across the broader landscape. Importantly, no new introduced fauna species have been detected since the inception of the mine's fauna monitoring program.

Two occurrences of *Columba livia domestica* (domestic pigeon) have been recorded within the mine lease since the mine's inception. Both birds were captured and were found to be racing pigeons and the birds were returned to their owners in Adelaide.

2.15 Heritage

2.15.1 Cultural heritage surveys

Australian Cultural Heritage Management Pty Ltd (ACHM) and Culture and Heritage (Scott and Annie Cane) were engaged as the anthropological and archaeological specialists by the then Far West Coast Traditional Lands Association, through the Aboriginal Legal Rights Movement Native Title Unit (ALRM NTU).

Cultural heritage surveys were undertaken for the entire J-A Project area (including the ML and associated MPL areas) prior to commencement of operations. The reports associated with these investigations (and maps of identified sites) have not been reproduced in this PEPR, or prior MARP's, for confidentiality and cultural sensitivity reasons.

All cultural heritage surveys undertaken as part of the Project have involved representatives from Far West Coast Aboriginal Corporation (FWCAC), Iluka and ACHM or Culture and Heritage.

Summary findings from these pre-mine surveys (as originally presented the MARP(Ops)) are provided below and in Figure 22.

Ooldea Road[2]

The ethnographic component of the pre-mine Aboriginal cultural heritage surveys did not reveal any locations of Aboriginal cultural heritage significance within the haul road survey area (Ooldea Road). However, the FWC representatives raised a number of cultural heritage issues relating to the construction of the haul road, associated borrow pits and water drilling targets.

The archaeological survey identified 12 Aboriginal cultural heritage sites. Stone chips, wooden ladders, culturally modified trees, charcoal heath, cut wood and shelters were found during the survey. In addition, the dune systems are of interest to local Aboriginal people due to their potential for yielding Aboriginal sites and objects.

As a result of the findings of the cultural heritage survey, the alignment of Ooldea Road was revised to ensure no impact to the identified areas.

Mining Lease and Miscellaneous Purposes Licence Areas

The surveys associated with the ML6315, EML6316, MPL110 and MPL111 revealed a number of cultural heritage sites in which small items (e.g. stone chips) were identified. No areas of cultural significance were identified.

[2] Ooldea Road is not part of the Mining Lease area and is not covered by the PEPR. Approvals for works to Ooldea Road were facilitated under the requirements of the *Development Act 1993*.

Canberra Road

Independent Heritage Consultants (IHC) carried out a cultural heritage survey of ML 161 on 4 November 2020. One artefact was recorded inside the project area. The presence of the artefact will be managed in accordance the J-A Cultural Heritage Management Plan if it falls withing the disturbance envelope.

2.15.2 Non-Indigenous heritage

No non-Indigenous heritage sites were located within the vicinity of the J-A Project area during the original pre-mine searches of the Australian Heritage Places Inventory of the Commonwealth Heritage List, Register of the National Estate, SA Heritage Register and the World Heritage List.

2.15.3 Natural heritage

Original pre-mine searches were undertaken on the Australian Heritage Places Inventory for natural heritage sites in the region. Results included:

- Yellabinna Region (i.e. Yellabinna Regional Reserve) (ID: 19424) Listed on the Register of the National Estate.
- Yellabinna Area (i.e. Yellabinna Regional Reserve) (ID: 6049) Listed on the Register of the National Estate.

Mineral exploration and the use of natural resources are outlined in the framework of Yellabinna Regional Reserve Management Plan (DEWNR 2013) as existing and future land uses.

2.16 Proximity to conservation areas

The J-A Project area is located within two of South Australia’s Regional Reserves. The Jacinth and Ambrosia deposit are situated within Yellabinna Regional Reserve, with the associated borefield being located within Nullarbor Regional Reserve. Both Regional Reserves are managed by the DEW.

Regional Reserves were created through a 1987 amendment to the NPW Act to enable the areas to be managed under a conservation framework while also allowing for multiple-use. The over-arching objective of the reserves is to conserve any wildlife and the natural or historic features of the land whilst permitting the utilisation of the natural resources of the land.

2.16.1 Yellabinna Regional Reserve

Information on the Yellabinna Regional Reserve has been extracted from two ten-year governmental reviews (Department for Environment, Heritage and Aboriginal Affairs (DEHAA) 1999a; DEH 2009a), and the now established Yellabinna Reserve Management Plan 2013 (DEWNR 2013a; DEWNR 2013b).

The J-A Project area is located in the north west corner of Yellabinna Regional Reserve. The reserve was proclaimed in 1990 to protect a significant area of natural habitat, whilst also allowing the use of natural resources (particularly with regard to mineral exploration). The reserve is dominated by the south east extension of the parallel dune fields of the Great

Victoria Desert and represents the largest, least modified, tract of mallee vegetation in South Australia. The reserve comprises 2,000,896 ha and lies to the north/north west of Ceduna. The reserve is important to a number of Aboriginal groups, reflecting the cultural value of the area (DEHAA 1999a).

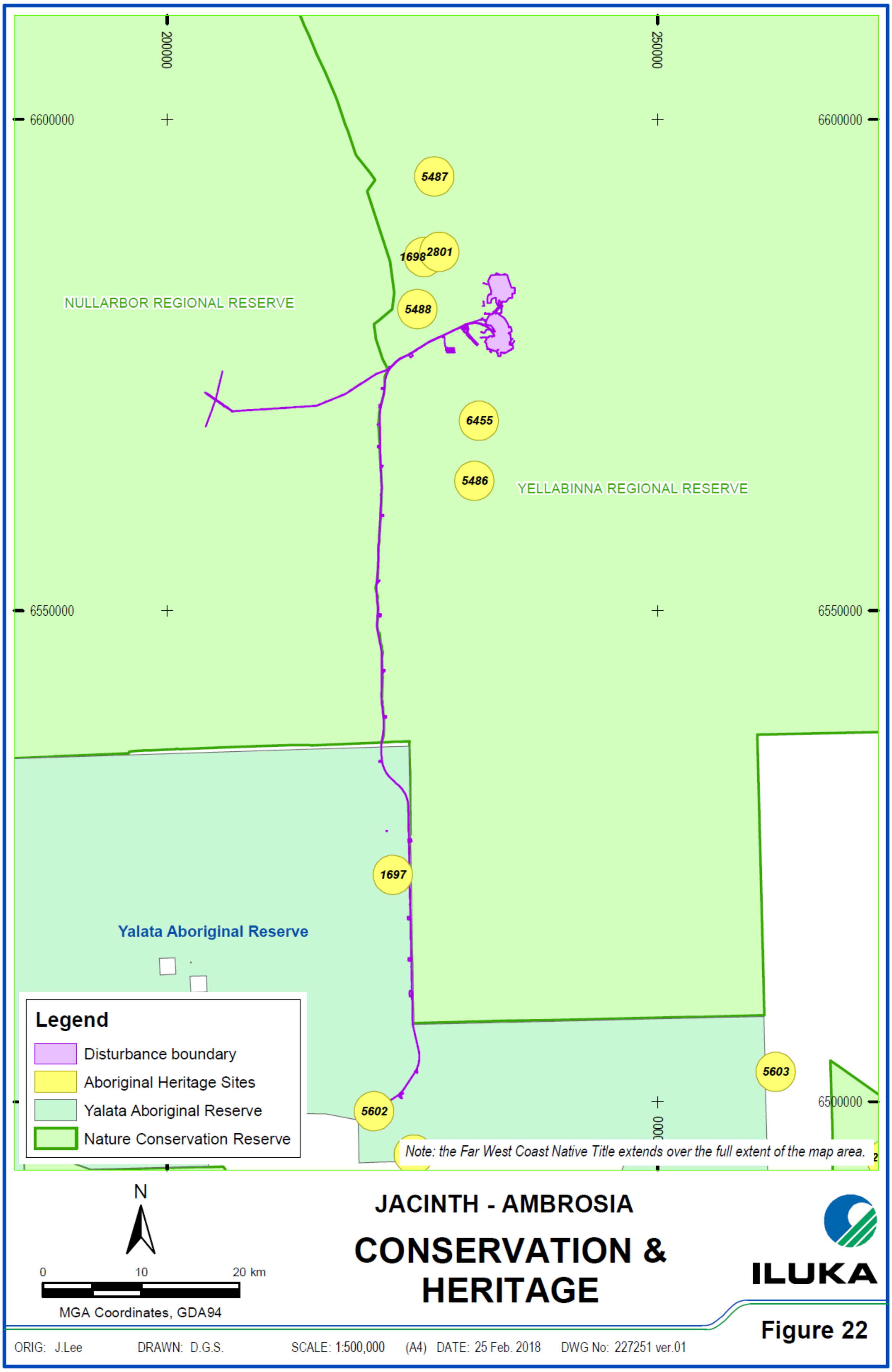

Figure 22: Conservation and heritage

Lying within Yellabinna Regional Reserve is Yellabinna Wilderness Protection Area, a 500,704 ha area 100 kms to the east of the J-A Project area. The 2005 proclamation of Yellabinna Wilderness Protection Area, in which exploration and mining activities are not permitted, recognises the ecological and biological significance, remoteness and pristine quality of the natural environment in this region.

Conservation Values

Yellabinna Regional Reserve is the largest contiguous area of mallee vegetation conserved within South Australia's reserve system (DEH 2004). The Yellabinna region, comprised of Yellabinna Regional Reserve, Yellabinna Wilderness Protection Area and other neighbouring blocks of native vegetation, is a key component of the biodiversity corridor connecting mallee and mulga woodlands in eastern and Western Australia (DEH 2004). Within the Yellabinna region, many plant and animal species occur at the eastern or western-most limit of their distribution. As such, the region's mallee associations are more diverse than, and floristically distinct from, corresponding associations in the east of South Australia (DEH 2004). The transition that occurs in the Yellabinna region between the mallee ecosystems in the southern portion and mulga ecosystems in the more arid, northern portion is such that many species are also at the northern- or southern-most limit of their distribution (DEH 2004).

Yellabinna Regional Reserve conserves the Yellabinna region mallee, which is dominated by *Eucalyptus oleosa* and *E. gracilis*. This type of mallee has been most cleared for agriculture elsewhere in the State (DEH 2004), further contributing to its conservation value in this region.

Yellabinna Regional Reserve contains a large number of plant and animal species that are endemic, near endemic or of conservation significance. The Yellabinna region is a refuge for many native birds and has one of the most diverse reptile faunas for an arid or semi-desert region in the world (DEH 2004).

The reserve also contains a number of Aboriginal heritage sites, mythological stories and associations that are important to Aboriginal people (DEHAA 1999a; DEWNR 2013a).

The proclamation is a reflection of the reserve's significant wilderness values. The majority of Yellabinna Regional Reserve was assessed as having high wilderness quality, with areas with lower wilderness quality corresponding to access tracks and railways (DEH 2004).

2.16.2 Nullarbor Regional Reserve

Information on the Nullarbor Regional Reserve has been extracted from two ten-year governmental reviews (DEHAA 1999b; DEH 2009b).

The borefield associated with the project is situated in the north east corner of the Nullarbor Regional Reserve, which was proclaimed in 1989 to protect natural habitat, whilst also permitting the use of available natural resources. The landscape consists primarily of a slightly undulating limestone plain covered in a low shrubland of saltbush (*Atriplex* spp.) and bluebush (*Maireana* spp.) (DEHAA 1999b).

The reserve is bordered to the west by the Western Australian/South Australian border, to the south by Nullarbor National Park and the Yalata Aboriginal Lands, and to the east by Yellabinna Regional Reserve.

In 2013 a 900,000 ha portion of the Nullarbor Plan within South Australia was proclaimed a Wilderness Protection Area under the *Wilderness Protection Act 1992*. This Nullarbor Plain Wilderness Protection Area comprises land formerly part of the Nullarbor National Park with the remainder part of the Nullarbor Regional Reserve. As per the Yellabinna Wilderness Protection Area, no exploration or mining activities are permitted in the Nullarbor Wilderness Protection Area.

Conservation Values

The Nullarbor Regional Reserve contains a range of semi-arid and subterranean ecosystems and is regarded as an outstanding natural area (DEH 2009b). A remarkable feature of the area is the uniformity of its vast, flat landscape. Limited post-settlement land use has resulted in the uniformly high wilderness quality of the area (DEH 2009b).

The Nullarbor Plain is home to over 390 species of plants and 160 species of animals of which nine species recorded in the reserve are recognised as species of conservation significance at national and state levels (DEH 2009b). This includes the State listed *Acanthiza iredalei* (slender-billed thornbill) and State Vulnerable *Sarcozona bicarinata* (ridged noon-flower) and *Santalum spicatum* (sandalwood) DEH 2009b). Refer to Sections 2.13 and 2.14 for more detail on these species.

The reserve also contains a number of Aboriginal heritage sites of cultural heritage significance associated with the semi-arid karstic landscape (DEH 2009b).

The proclamation in 2013 of the Nullarbor Wilderness Protection Area reflects the unique ecological and conservation values of this environment.

2.17 Pre-existing J-A Project area contamination and disturbance

Original pre-mine investigations found no evidence of J-A Project area contamination or previous disturbance in the Mining Lease boundary or near vicinity. As described above, the Lease area is situated within the high quality environments of the Yellabinna and Nullarbor Regional Reserves.

3 Mining Operations

3.1 General description

There are two separate, discrete ore bodies that make up the operations, Jacinth and Ambrosia. In order to access the target ore, topsoil, subsoil and overburden are removed. These are typically removed using a combination of excavators, haul trucks and tractor scoops and are either stockpiled or direct-returned to the mine void pending final surface rehabilitation.

Dry mining techniques are used for recovery of the ore. The sand, containing heavy minerals, is fed into the MUP to remove oversized material, including rock and other debris, before being slurry pumped to the WCP. The WCP separates the clay and quartz from higher specific gravity (SG) minerals in the ore to produce a HMC. The HMC produced is temporarily stockpiled on-site at the HMC Stockpile Area and then transported via road to the Port of Thevenard. The Port of Whyalla, operated by GFG Alliance, has also been identified as a suitable alternative for the storage and shipping of HMC, should the Port of Thevenard ever be unavailable during periods of planned upgrade or unplanned maintenance.

Tailings are also generated from the WCP, comprising of quartz sand and a mixture of quartz sands and clay fines (modified co-disposal (ModCoD) material), both discharged to the mine void. In-pit tailings are re-contoured prior to overburden and topsoil replacement and final surface rehabilitation.

A mining and mineral processing flow chart is shown in Figure 23. Further detail on the process, supporting infrastructure, waste management and water balance is contained in subsequent sections.

A summary of the key attributes of the pits for the current mining plan is shown in Table 19.

Table 19: Jacinth and Ambrosia key attributes

Pit	Pit floor (mRL)	Maximum pit depth (m)	Ore volume (MBCM)	Ore Volume (Mt)	HM grade (%)	Overburden (MBCM)	Strip Ratio waste:ore
Jacinth	110	42	20.0	35.8	3.5	5.6	0.3
Ambrosia	103	35	30.1	56.5	3.4	20.8	0.7

The disturbance footprints (proposed and actual) are shown in Figure 24. This includes disturbance boundaries for stockpiles (refer Section 3.9 for further information).

3.1.1 Modes and hours of operation

Mining of the Jacinth and Ambrosia deposits is undertaken as a continuous operation with mining and processing operations (including mineral haulage) occurring 24 hours, 7 days a week.

3.1.2 Workforce

The workforce is expected to comprise up to 200 persons, averaging 120 persons. Personnel are rostered on a fly-in/fly-out (FIFO) basis ex-Adelaide and Ceduna.

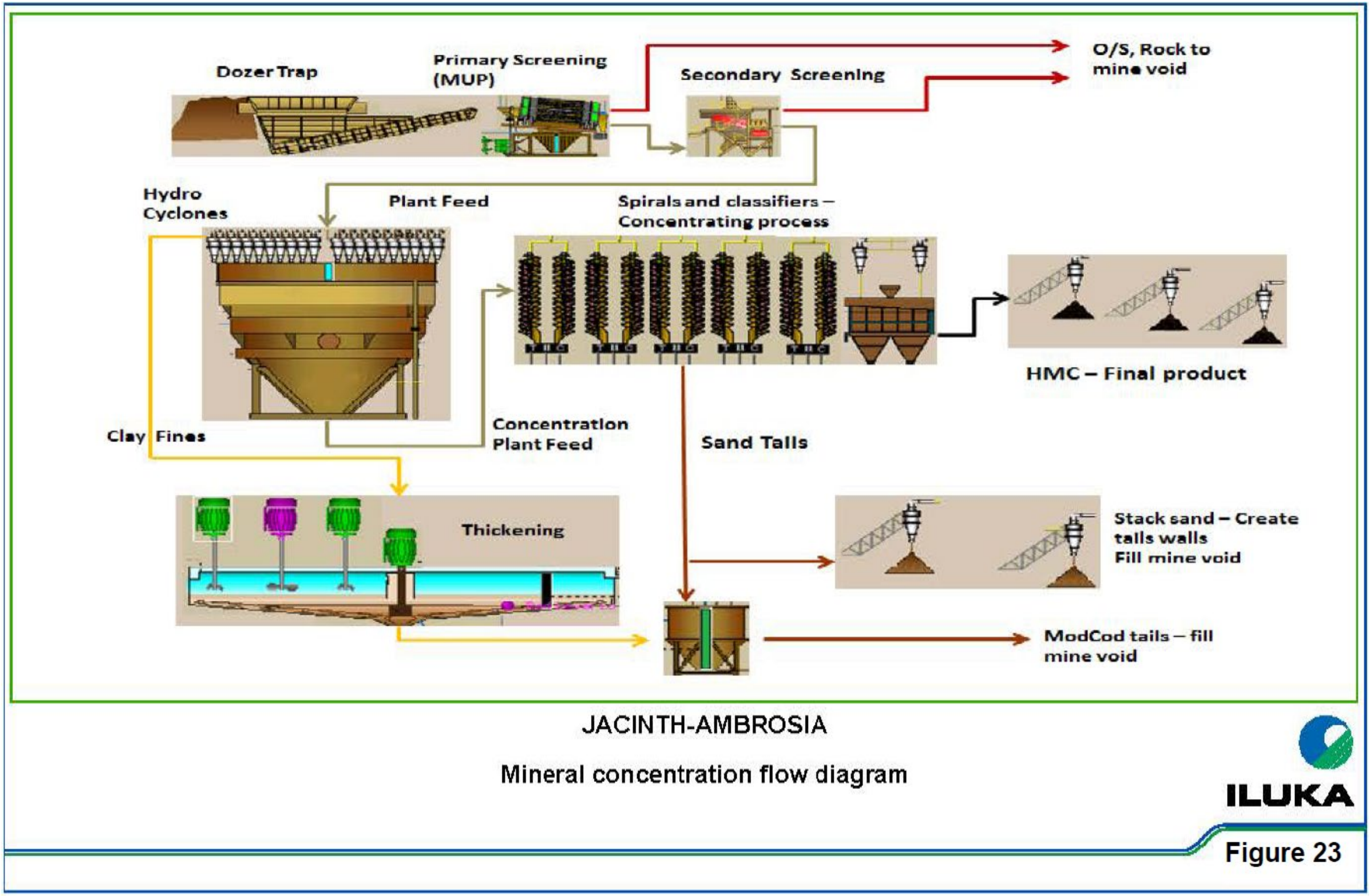

Figure 23: Mineral concentration flow diagram

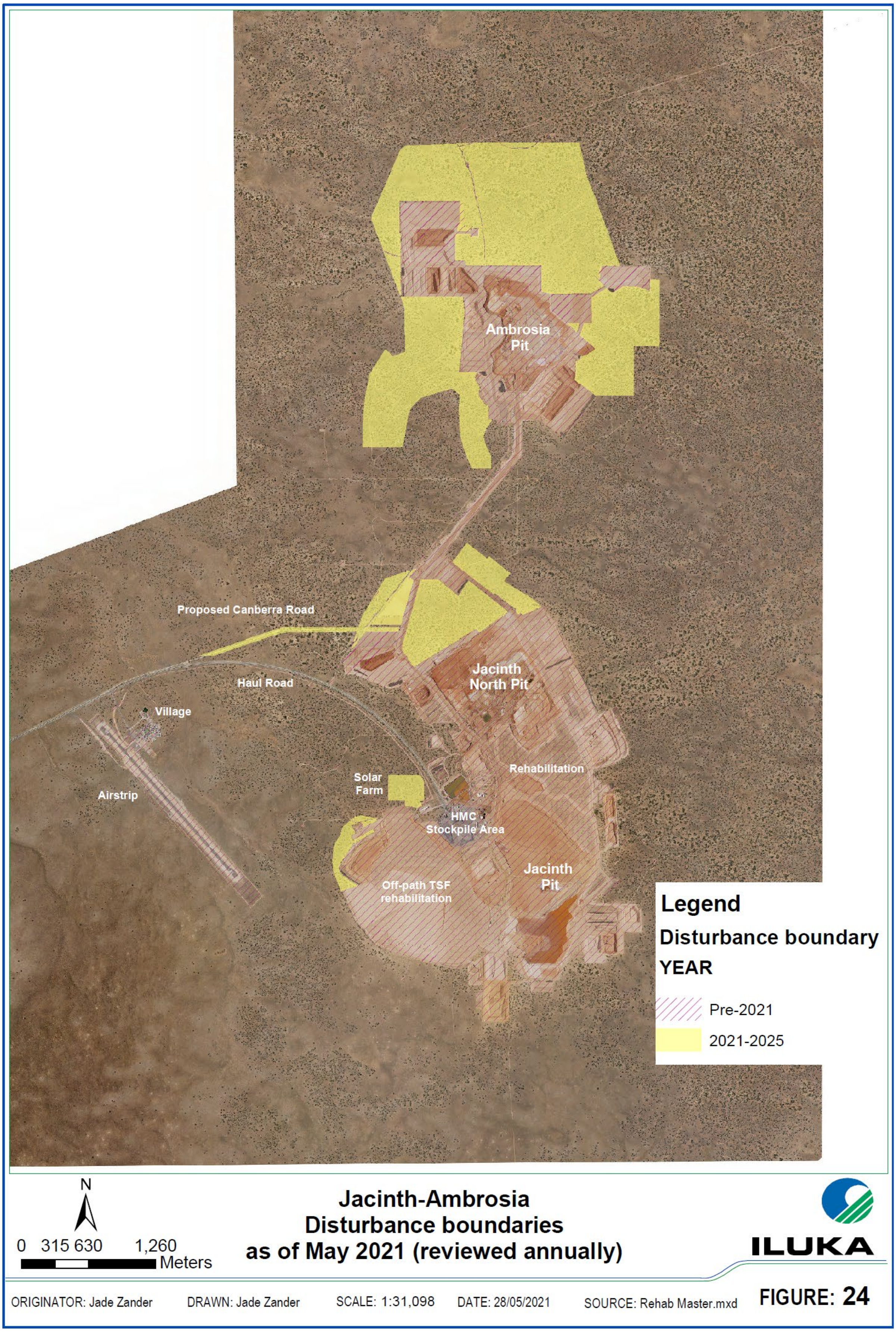

Figure 24: Disturbance boundaries

3.2 Reserves, products and markets

3.2.1 Ore reserves

The Jacinth deposit is a north-south oriented paleo-sedimentary sand deposit approximately 5 km long by 900 m wide and up to 42 m deep. The Ambrosia deposit consists of a larger central zone up to 700 m wide, approximately 2.2 km long and up to 30 m deep as well as three smaller satellite pits to the south of the main Ambrosia pit.

The combined Jacintha and Ambrosia deposits contain an estimated 4.6 million in situ tonnes of heavy mineral (HM) with an average grade of 4%, and a valuable heavy mineral assemblage of 50% zircon, 27% ilmenite and 4% rutile. Current ore reserves for J-A are provided in Table 20.

Ore reserves and mineral resources are estimated using all available geological and relevant drill hole and assay data, including mineralogical sampling and test work on mineral recoveries and final product qualities. Ore reserve estimates are determined by the consideration of all of the 'modifying factors' in accordance with the Joint Ore Reserves Committee (JORC) Code 2012, and for example, may include but are not limited to, product prices, mining costs, metallurgical recoveries, environmental consideration, access and approvals.

Table 20: Current J-A ore reserves (as of 31 December 2018)*

JORC Status (as at 31 Dec 2017)	Ore Reserve (Mt)	HM In-Situ (Mt)	HM Grade (%)	Zircon (%)	Ilmenite (%)	Rutile (%)
Reserve - proved	88	3.1	3.5	48	29	5
Reserve - probable	4	0.1	2.2	52	20	4
Total	**92**	**3.2**	**3.5**	**48**	**29**	**5**

* Adapted from Iluka Resources Ltd 2018 Annual Report

3.2.2 Production rate and product

An estimated 93 Mt of ore will be mined over the remaining LOM at a rate of approximately 10 Mt per annum, yielding between 0.2 and 0.4 Mt per annum of HMC.

At current rates of production and ore reserves, the estimated remaining LOM is 10 years (i.e. ending in 2029).

Separation of HMC into component product streams (zircon, Ilmenite and rutile) is undertaken at downstream Iluka Mineral Separation Plants (MSP) in Narngulu and Capel.

Downstream mineral separation and export to market are outside the scope of the J-A operation and this PEPR, and as such are not discussed further within this document.

3.2.3 Commodities list

The commodity mined at the J-A operation is Heavy Mineral (HM). HM assemblage information is provided in Table 20 above.

3.3 Exploration activities

3.3.1 Mineral resource and geotechnical drilling

During operations, drilling will be carried out within the ML to further define the characteristics of both ore bodies (Jacinth and Ambrosia). Drilling will be conducted for purposes such as grade control, resource definition, sterilisation and pit delineation.

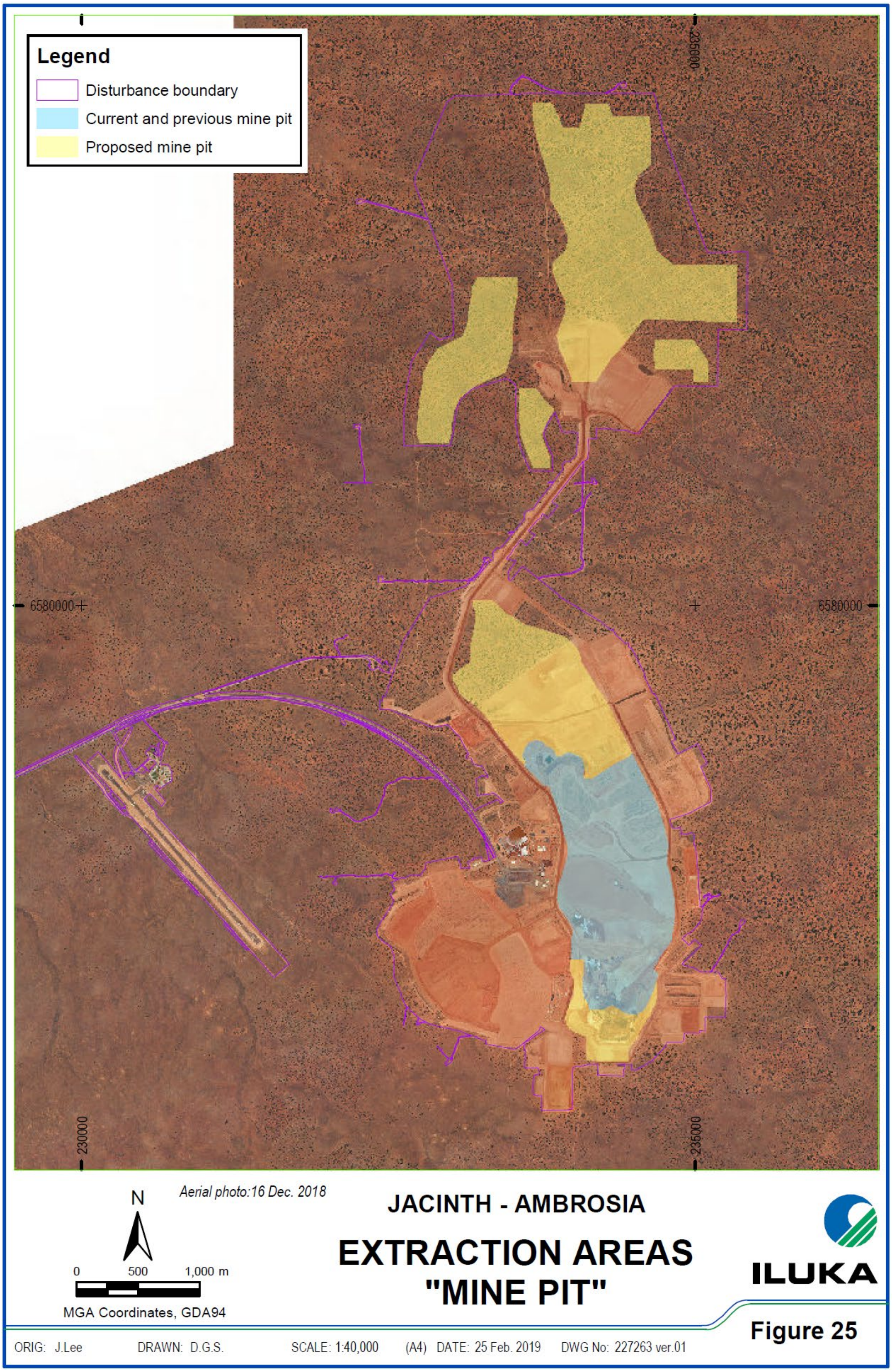

Figure 25 shows the identified extraction areas. Drilling methodology will vary according to requirements and will be undertaken by qualified and licensed drillers.

The drilling team will typically comprise three vehicles, being:

- drill rig – track, truck or 4-6 wheel drive mounted air-core (or alternative) rigs drilling usually 60 – 75 mm hole diameter drill holes;
- rod truck – supports the drill rig rod and also carries approximately 1,200 litres of water and a fire fighting pump; and
- light vehicle.

In areas to be mined, drill cuttings will be put back down the hole on a last out first in basis. In the case where all sample cannot be put back in the hole, excess material will be buried in a small pit greater than 0.3 m in depth. Holes will be cased with PVC to prevent cave-in from unconsolidated sediments, the casing will be removed at the end of the hole and if not completely removed will be cut off and capped below surface.

All drilling activities will be undertaken in accordance with DEM *Information Sheet M21 – Mineral Exploration Drillholes* and all drill holes will be rehabilitated in accordance with *Information Sheet M33 – Statement of environmental objectives and environmental guidelines for mineral exploration activities in South Australia*, unless otherwise agreed to with DEM and DEW.

All disturbances are to be pre-approved through an operation Vegetation Clearance Permit and limited to the hole, the sample pit, access track (where applicable) and a vehicle turnaround point.

3.3.2 Water well drilling

Drilling for the installation of monitoring wells, interception wells and/or vibrating wire piezometers (VWPs) will also be conducted during operations. Such drilling may occur within any of the J-A associated tenements. Groundwater drilling will be undertaken by licensed drillers using mud-rotary, down-hole hammer, auger or other appropriate method. Drilling, well construction and decommissioning will adhere to the requirements of the *Minimum Construction Requirements for Water Bores in Australia* (National Uniform Drillers Licensing Committee 2012).

Well Construction Permits will be obtained for all wells, prior to any drilling occurring, in accordance with section 112 of the Landscapes Act. Drill logs are maintained for each well for permitting and interpretation purposes.

Existing groundwater monitoring and interception well locations are presented in Section 5.15. with further details provided in Appendix U.

3.4 Mining method and infrastructure

3.4.1 Mining operations

All mining is open-cut and utilises dry-mining techniques.

A summary of the infrastructure at J-A is detailed in Table 21 with the locations detailed in Figure 32 to Figure 34[3].

Table 21: Operational mining infrastructure

Mining Infrastructure and areas
• Jacinth mine pit • Ambrosia mine pit • TSF • MUP • Topsoil and overburden stockpile areas

3.4.2 Open pit

Pit design

The final planned mining area will be approximately 3.6 km long, 800 m wide and an average of 25 m deep at Jacinth, and 2.5 km long, 800 m wide and average 25 m deep at Ambrosia.

Geotechnical investigations determined that pit slope design was for the two pits were 40 degrees for the red and browns loams and 30 degrees for the Ooldea sand. The overall slope angle averages ~35 degrees.

[3] Figures and tables of equipment and infrastructure included in Section 3 of the PEPR should be considered as indicative. It is possible that during operations infrastructure location and/or details may be modified to improve operational efficiency. The installation of new and/or amendment of existing facilities will be discussed with relevant authorities (where relevant) and information provided in ACRs in accordance with Lease and Licence conditions

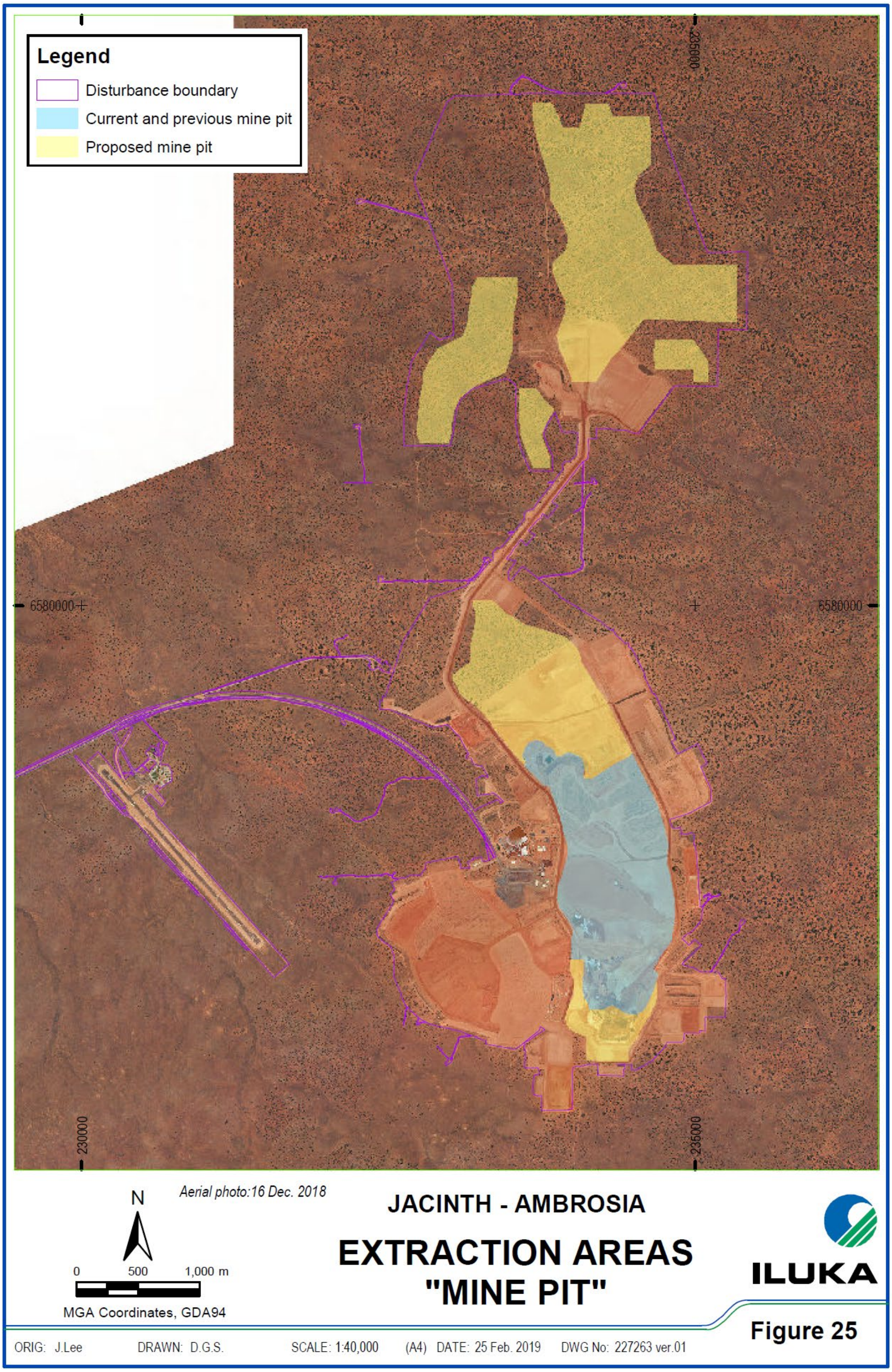
Legend
Disturbance boundary
Current and previous mine pit
Proposed mine pit
235000
6580000
6580000
230000
235000
N
Aerial photo:16 Dec. 2018
0
500
1,000 m
MGA Coordinates, GDA94
JACINTH - AMBROSIA
EXTRACTION AREAS
"MINE PIT"
ILUKA
ORIG: J.Lee
DRAWN: D.G.S.
SCALE: 1:40,000
(A4) DATE: 25 Feb. 2019
DWG No: 227263 ver.01

Figure 25

Figure 25 provides an indication of the pit areas associated with the Jacinth and Ambrosia pits. Figure 26 to Figure 31 provide indicative cross sections of both the Jacinth and Ambrosia pits.

Pit operations

Located within the open pit is the MUP. The MUP receives ore from the surface mobile equipment and feeds it to a wet screen which removed any rocks and particles larger than 10 mm. Water is added to the screened ore and the resulting ore and water slurry is pumped to the WCP via pipelines that move with the MUP.

The MUP moves as the mine face advances and typically moved every 3-4 weeks via hydraulically driven dozer tracks. The plant feed rate varies depending on grade and ore characteristics between 800 and 1,500 t/h. Plate 5 shows the MUP operating within the Jacinth open pit.

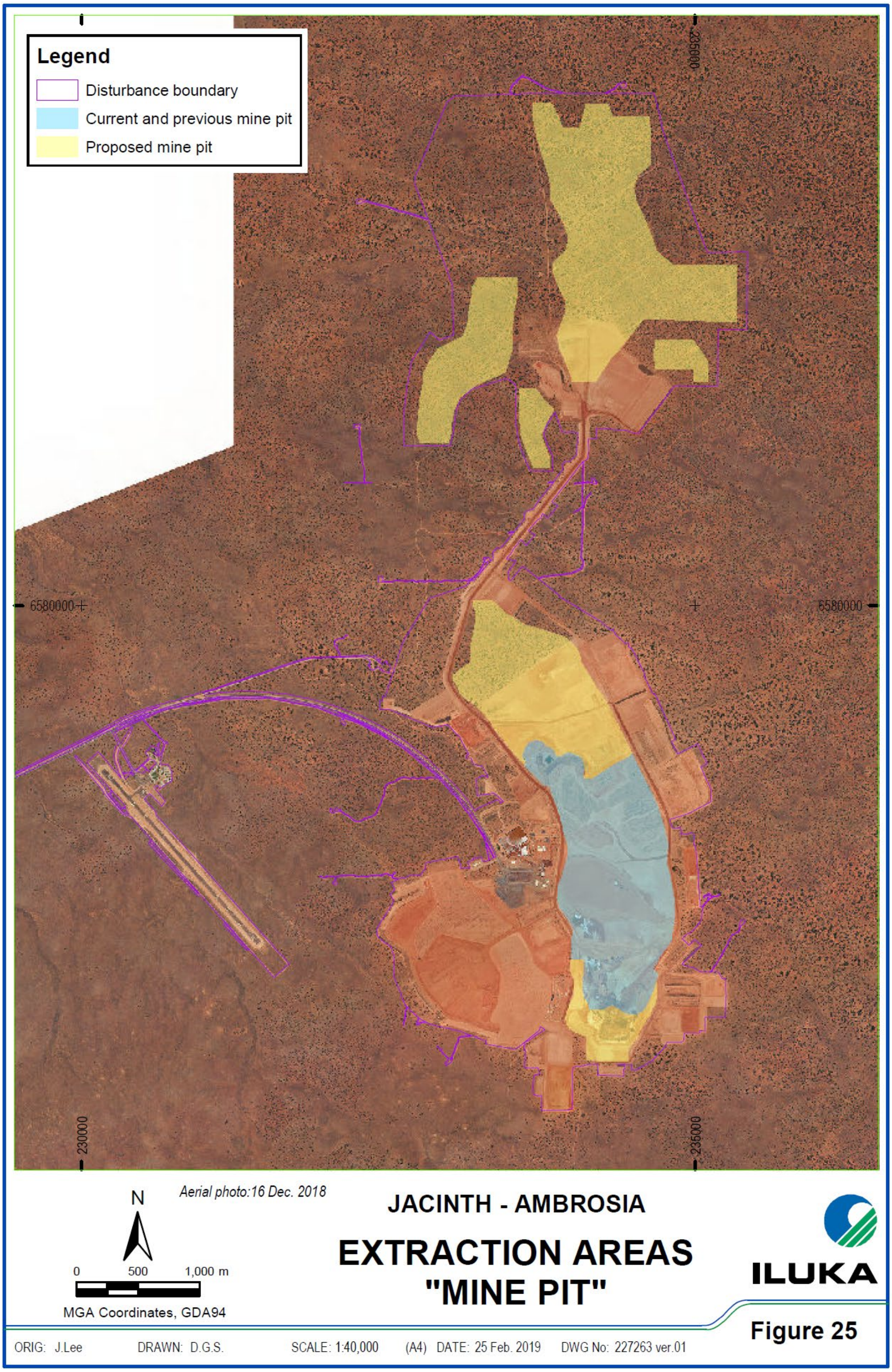

Figure 25: Extraction areas

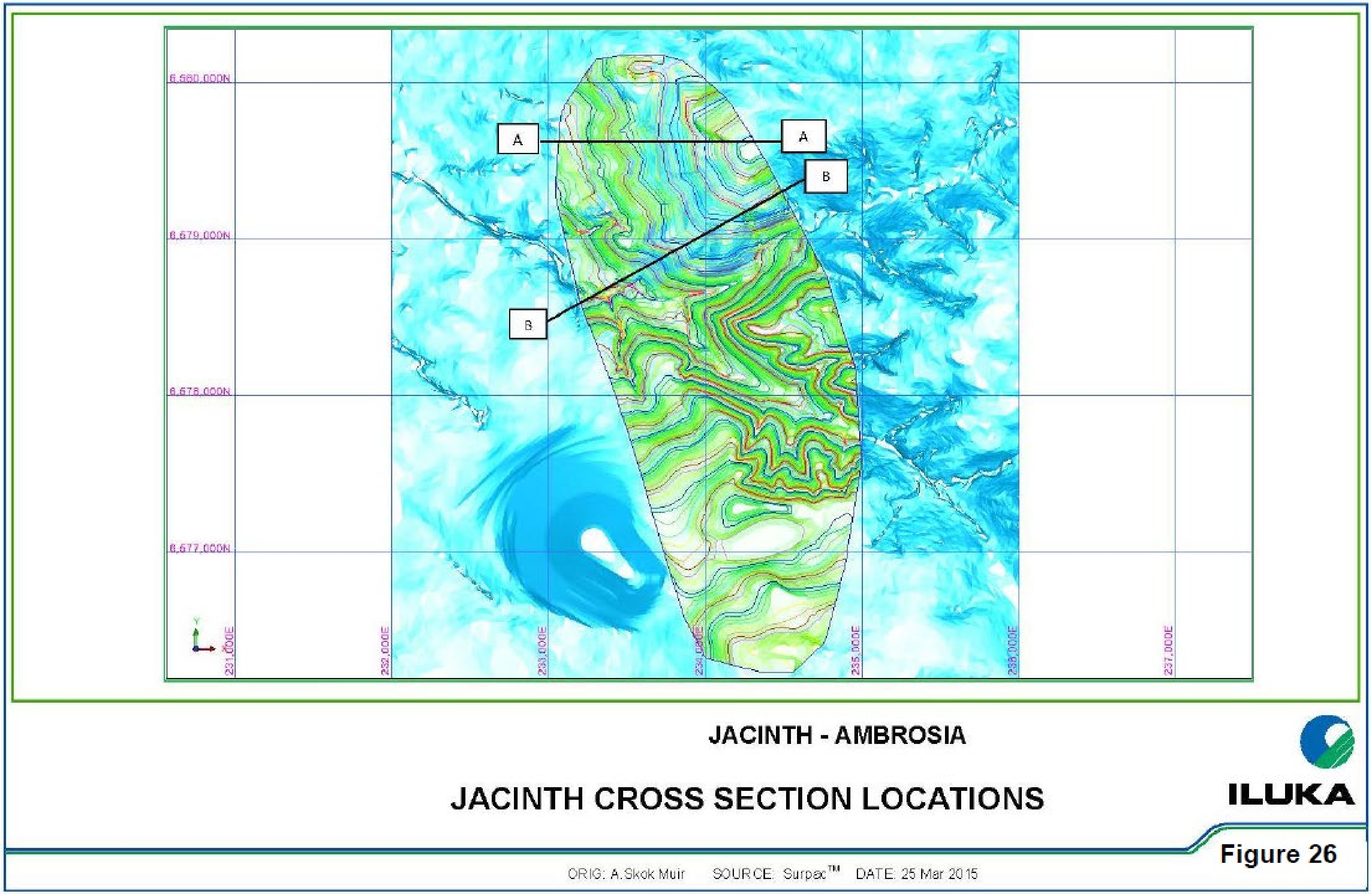

Figure 26: Jacinth cross-section locations

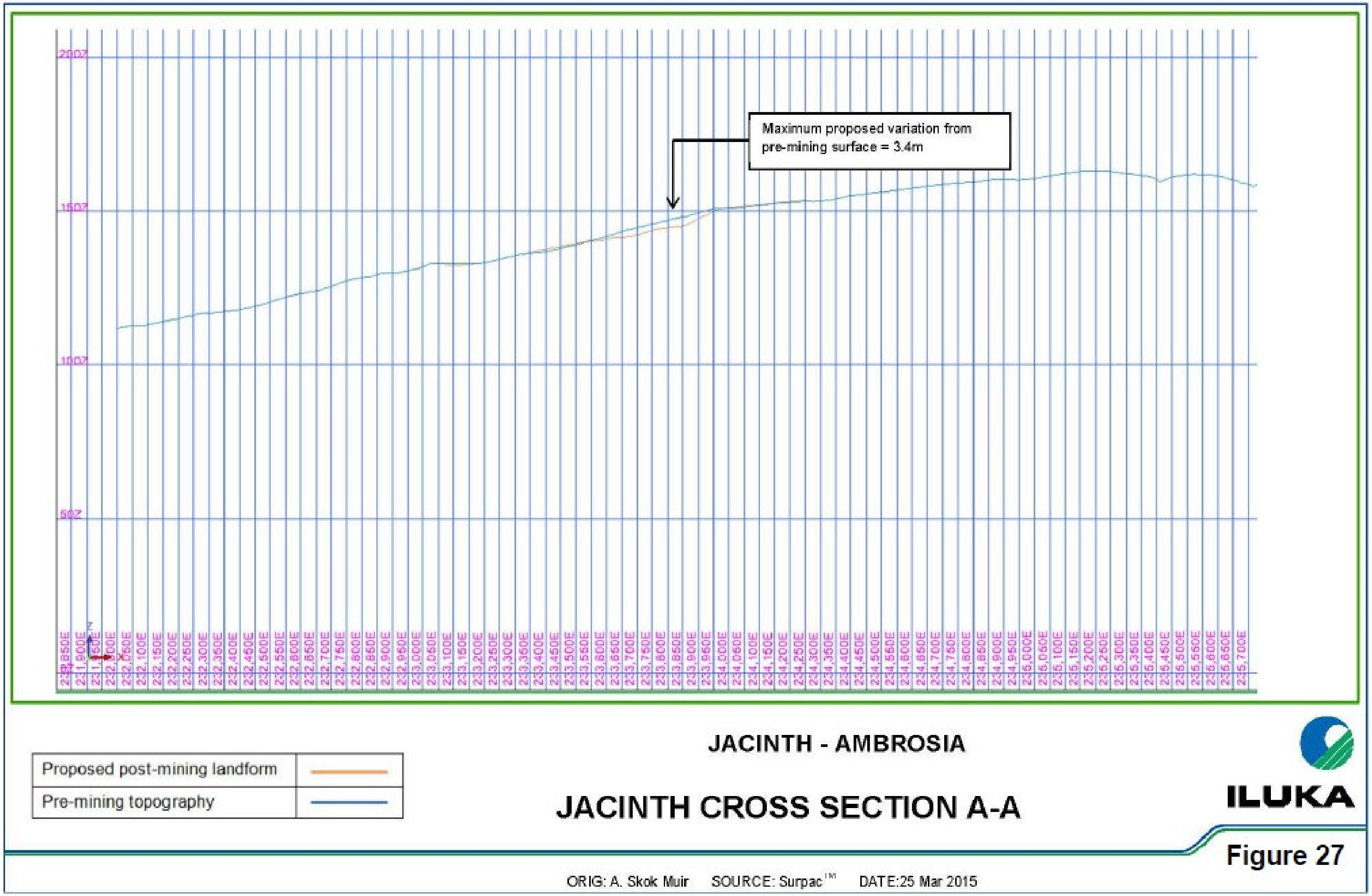

Figure 27: Jacinth cross-section A-A

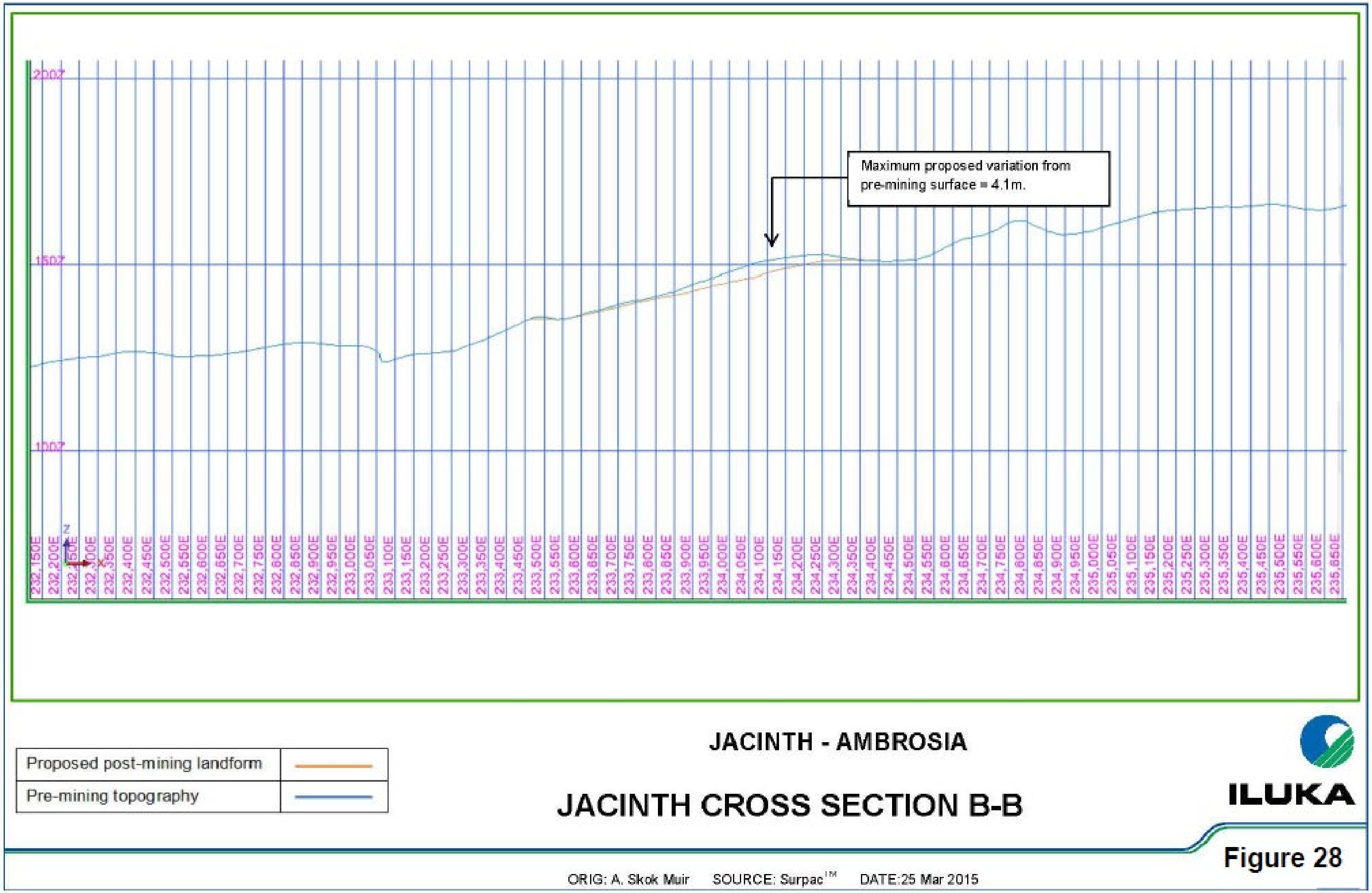

Figure 28: Jacinth cross-section B-B

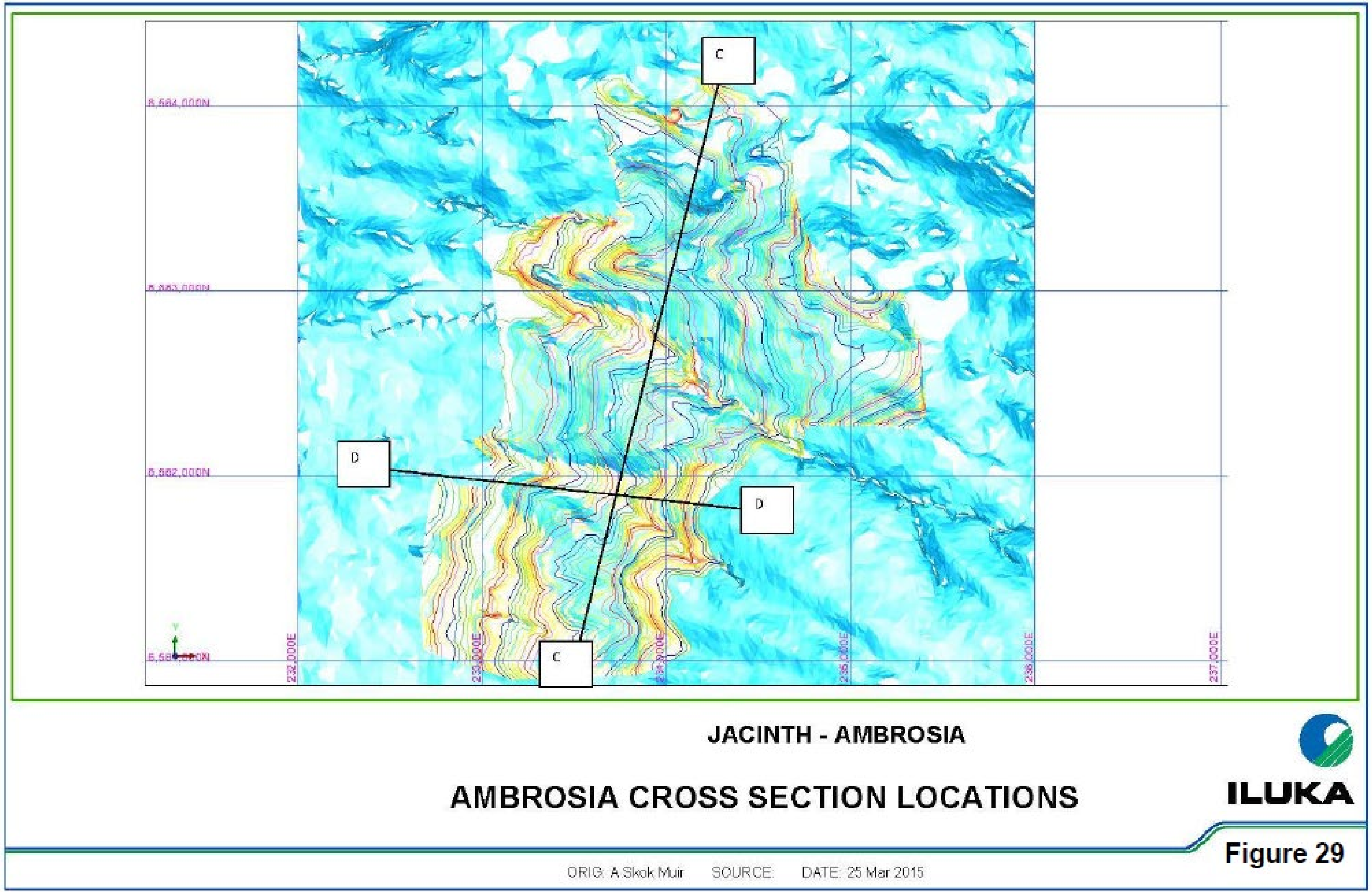

Figure 29: Ambrosia cross-section locations

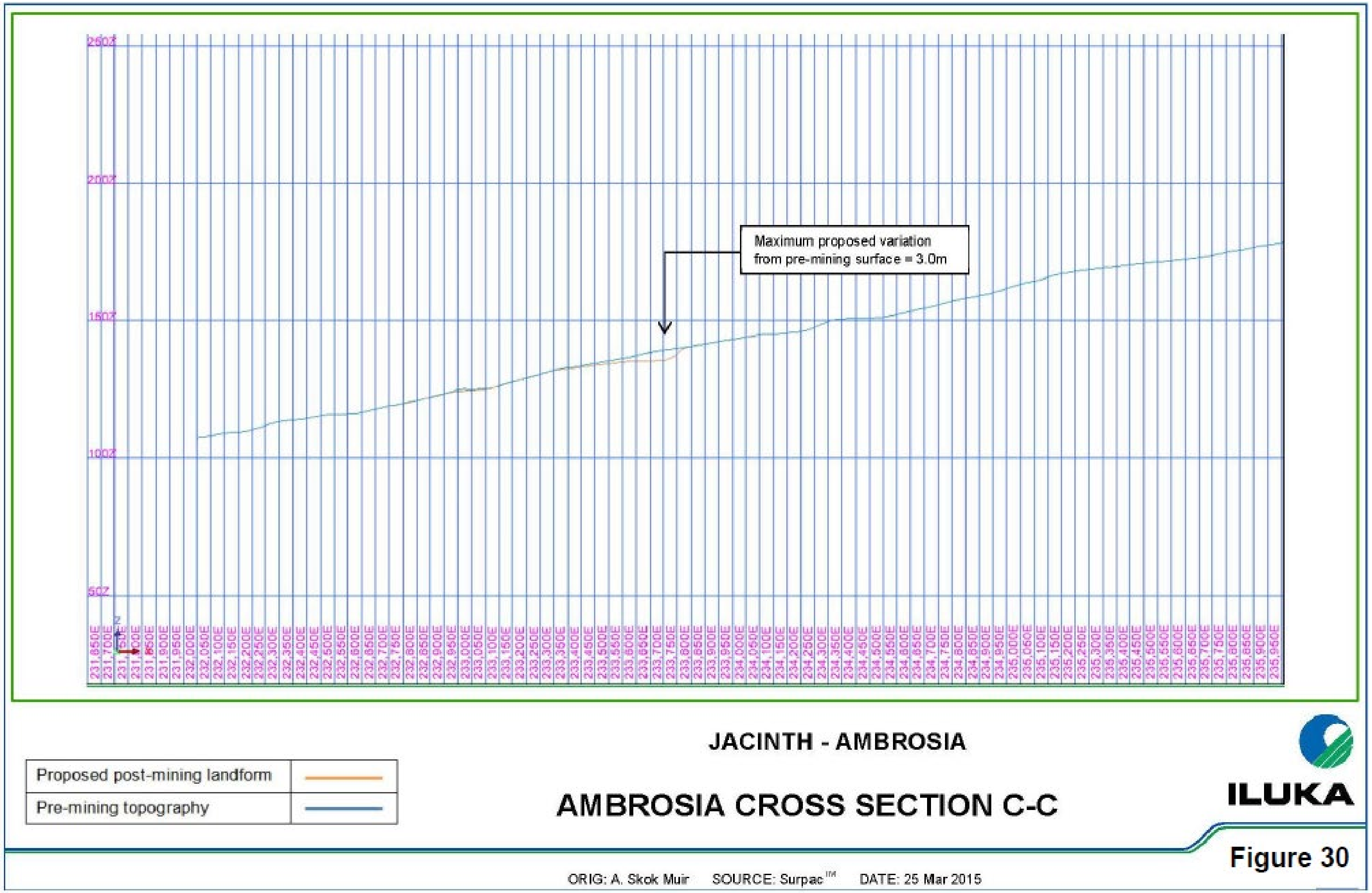

Figure 30: Ambrosia cross-section C-C

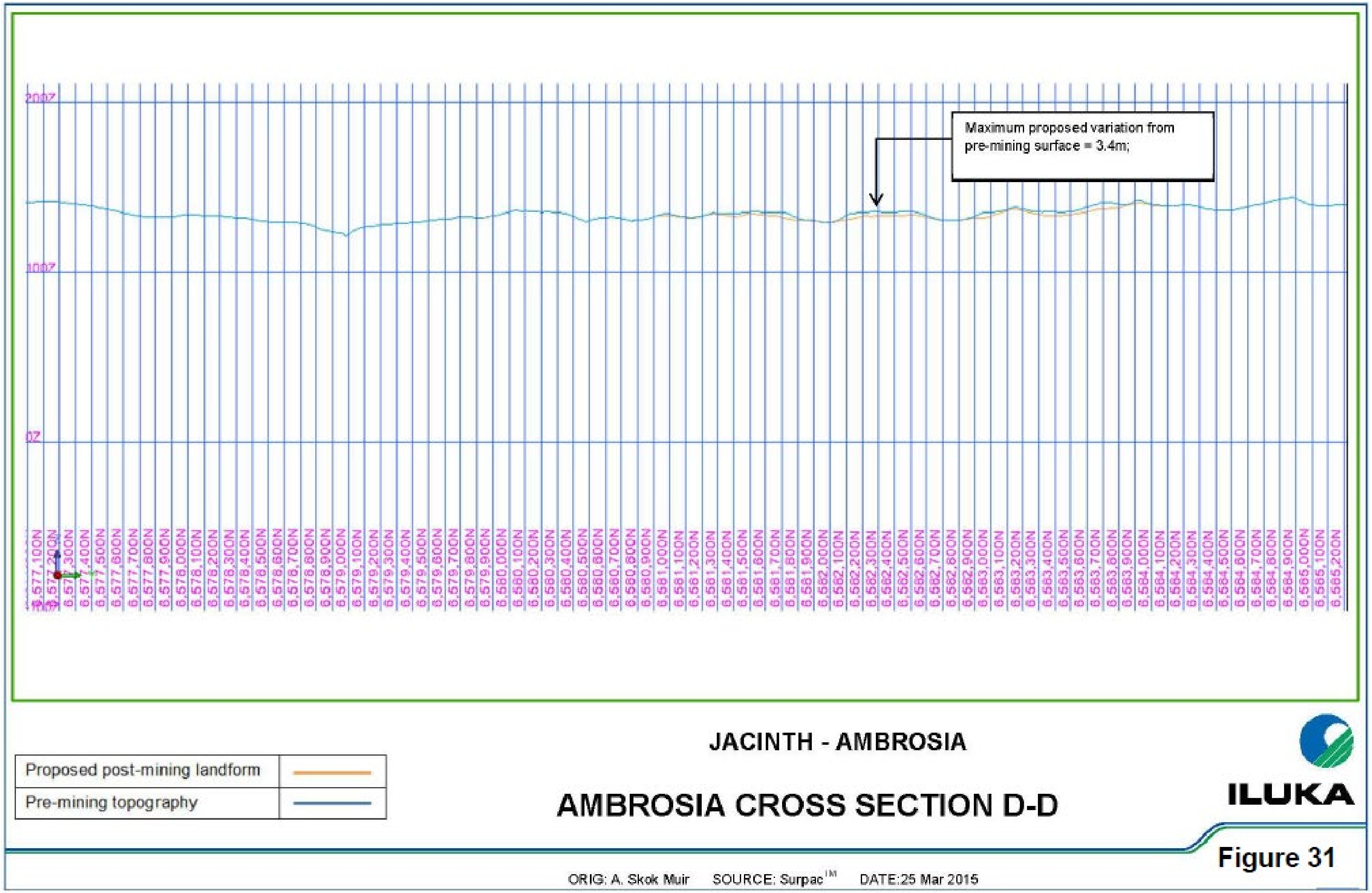

Figure 31: Ambrosia cross-section D-D

Plate 5: Typical operating Mining Unit Plant

3.4.3 Underground

Not applicable as no underground mining operations are undertaken at J-A.

3.4.4 Material movements

The LOM material movement (extraction schedule) is routinely reviewed. The schedule is used as a planning tool to determine the availability of overburden, subsoil and topsoil for rehabilitation areas over the LOM. An example of the 2018 schedule for Jacinth and Ambrosia is shown in Table 22. This schedule is updated annually.

Table 22: Material movement summary (extraction, subject to variation)

Year	Overburden (m^3)	Subsoil (m^3)	Topsoil (m^3)	Strip ratio
Jacinth				
2023	1.3 M	0.05 M	0.05 M	0.3
2029	2.3 M	0.05 M	0.05 M	0.3
2030	4.6 M	0.05 M	0.05 M	0.5
Life of Mine	**10.0 M**	**0.3 M**	**0.15 M**	**0.3**
Ambrosia				
2027	1.2 M	0 M	0 M	0.8
2028	2.6 M	0.2 M	0.1 M	0.8
2029	2.0 M	0.1 M	0.05 M	0.8
Life of Mine	**21 M**	**1.1 M**	**0.6 M**	**0.8**

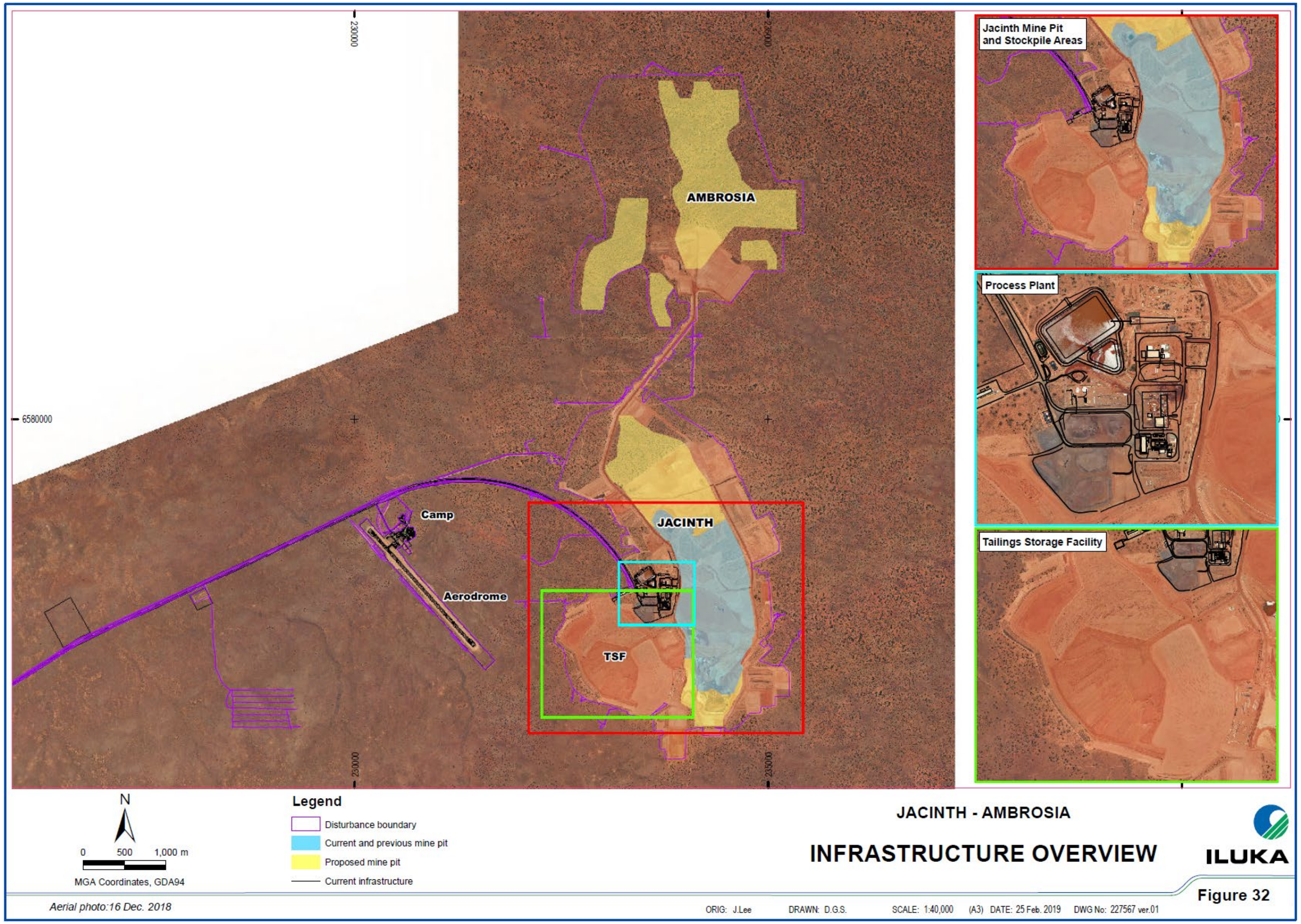

Figure 32: Infrastructure overview

Figure 33: Mine complex layout

3.4.5 Blasting

Based on the nature of the operations (mineral sand mining) it is not anticipated that blasting activities will be undertaken during operations. In the event that blasting is required (i.e. to remove calcrete from within the Jacinth or Ambrosia deposits); blasting activities will be undertaken in accordance with relevant standards and statutory requirements (including gaining necessary approvals).

3.4.6 Type of equipment

Indicative mining and mobile equipment associated with the operation is listed in Table 23. For economic reasons, Iluka seek to minimise the surface mobile equipment as far as practicable.

Table 23: Indicative mining and mobile equipment

Equipment Type	Number	Emissions *
Mining and Handling		
Hydraulic excavator – face/shovel, 190–300 tonne	0-2	E, N, V
Hydraulic excavator, 30–150 tonne	1-5	E, N, V
Haul Trucks		
Off-highway rear dump haul truck, 77 tonne	4-6	E, N
Ancillary		
Dozer – track, 40–110 tonne	5-8	E, N, V
Haul trucks, 100 tonne	2-10	E, N
Haul trucks, 40 tonne	2 – 6	E, N
Grader – motor, 20 tonne	2	E, N
Loader – wheel, 50 – 100 tonne	2	E, N
Loader – wheel (IT), 14–18 tonne	2	E, N
Loader – wheel, 30 tonne	1	E, N
Tractor, 20 tonne	4	E, N
Truck – water, 10–45 KL	3	E, N
Miscellaneous		
Miscellaneous plant and equipment will also be utilised during operations, including but not limited to light vehicles, cranes, forklifts, emergency service vehicles and mobile work platforms as required.		

* Key: V (Vibration), E (Exhaust) or N (Noise)

Based on pre-mining air quality modelling and lack of nearby sensitive land uses (refer Section 2.5) no data has been provided on emissions and air quality impacts for equipment listed in Table 23. On the same basis no risk assessment and controls are nominated for noise and vibration within this PEPR.

3.5 Processing and product transport

A summary of the infrastructure at J-A is detailed in Table 24.

Table 24: Operational mining infrastructure

Processing Area
• WCP – including thickener and flocculant plant • Process water storage dams • Process plant buildings • HMC stockpile area • Ore and tailings pumping units and pipelines

3.5.1 Wet concentrator plant

The WCP separates heavy minerals (SG > 2.96) of a size less than approximately 0.5 mm in diameter and greater than 0.05 mm from grit, clays and quartz using physical separation systems (e.g. vibrating screens). These by-products are pumped back to the mine void. Further detail on tailings management is in Section 3.10.1.

As a wet plant, no dust emissions or odours arise from operation of the WCP. The primary emissions are noise and vibration associated with the vibrating screens. The principle discharges from the WCP are process water (returned to process water circuit for reuse), tailings (discharged to mine void) and oversize material (returned to mine void). No ignition sources exist within the WCP.

3.5.2 Heavy mineral stackers and HMC stockpiles

Mineral concentrate from the WCP is dewatered through stackers and drainage bays. The drainage bay is 200 m long and 55 m wide providing a stacked HMC draining capacity of approximately 90 kt. The stacker pad comprises a base geo-fabric membrane, coarse free-draining top-course and network of spoon drains and silt traps for screening and recovery of this drained water. Water is returned to the process water dam for reuse. A trap captures and recycles solids from surface runoff for re-processing back to the WCP.

Stacked HMC reaches 2–5% moisture content prior to loading and haulage off-site.

The stacker pad is encircled with an access road and apron for the loading the road trucks.

Areas to the south and west of the HMC stacker pad are given to the storage of drained mineral, subject to operational requirements.

Figure 34 shows the general layout of the HMC stacker pad, road train circuit and storage stockpiles.

Figure 34: HMC stacker and stockpile area

3.6 Mining and rehabilitation sequence

3.6.1 Planned disturbance sequence

Mining operations commenced from 2009 in the central section of the Jacinth pit moved in a southerly direction toward the far southern wall of the Jacinth pit, which was completed in December 2018. The MUP was then relocated to northern end of the Jacinth Pit.

It was previously scheduled to complete the mining of the northern Jacinth pit before moving to Ambrosia in 2019. Mining commenced in the south of Ambrosia deposit progressing north until the MUP was returned to Jacinth North in August 2020 in response to production setting changes.

The current mine plan proses to continue progressing the Jacinth North pit from south to north with the pit planned for completion in 2022 after which the MUP will return to Ambrosia.

The current mine plan proposes ceasing mining in around 2029 depending on mining rates.

The mining and rehabilitation sequence is reviewed and updated periodically. It is subject to change in response to changing market conditions. The planned mining disturbance schedule is shown in Figure 35.

The processing of samples taken from the 2018 Ambrosia drilling campaign is still ongoing and will be followed by a re-optimisation of the resource and reserve. This may lead to changes in the mine design and plan, which would alter both the disturbance schedule and total disturbance footprint.

3.6.2 Proposed rehabilitation sequence

Rehabilitation activities are a major focus of the mine planning phase; and are progressively implemented in conjunction with mining operations. Before mining commences, vegetation, topsoil and overburden is removed from the disturbance area. As the active mine area moves forward, the mine pit is backfilled with tails.

Wall divisions are constructed between the cells using sand tails. The cell is then filled with remaining slurried tailings to a level that ensures the final tailings design surface can be achieved. After the tails have drained sufficiently, it is shaped into the final profile. After reshaping the overburden is replaced to provide a soil profile for regeneration of vegetation.

Red loam (where available) followed by brown loam are hauled to the rehabilitation area and then dumped to construct a profile layer. Loam is sourced from stockpiles or is direct returned from the mining areas. As each soil horizon is completed the layer is ripped to prevent compaction of the soils. The depth of profile varies with the vegetation association to be reinstated. Subsoil and topsoil, sourced from stockpiles or the mining face, is then reinstated to an approximate profile thickness of 0.15 m and 0.05 m respectively. The final topsoil layer is ripped on the contour to assist in erosion control.

The planned rehabilitation sequence for J-A is presented in Figure 36. Further detail on rehabilitation methods is provided in the *Rehabilitation Management Plan*.

Off-path Tailings Storage Facility (TSF) Rehabilitation

Rehabilitation of the off-path TSF commenced in 2017 (see Figure 36) via a staged approach. Rehabilitation of a large section of the off-path TSF commenced in 2020 with planned completion in 2021.

Figure 35: Indicative proposed mining disturbance schedule

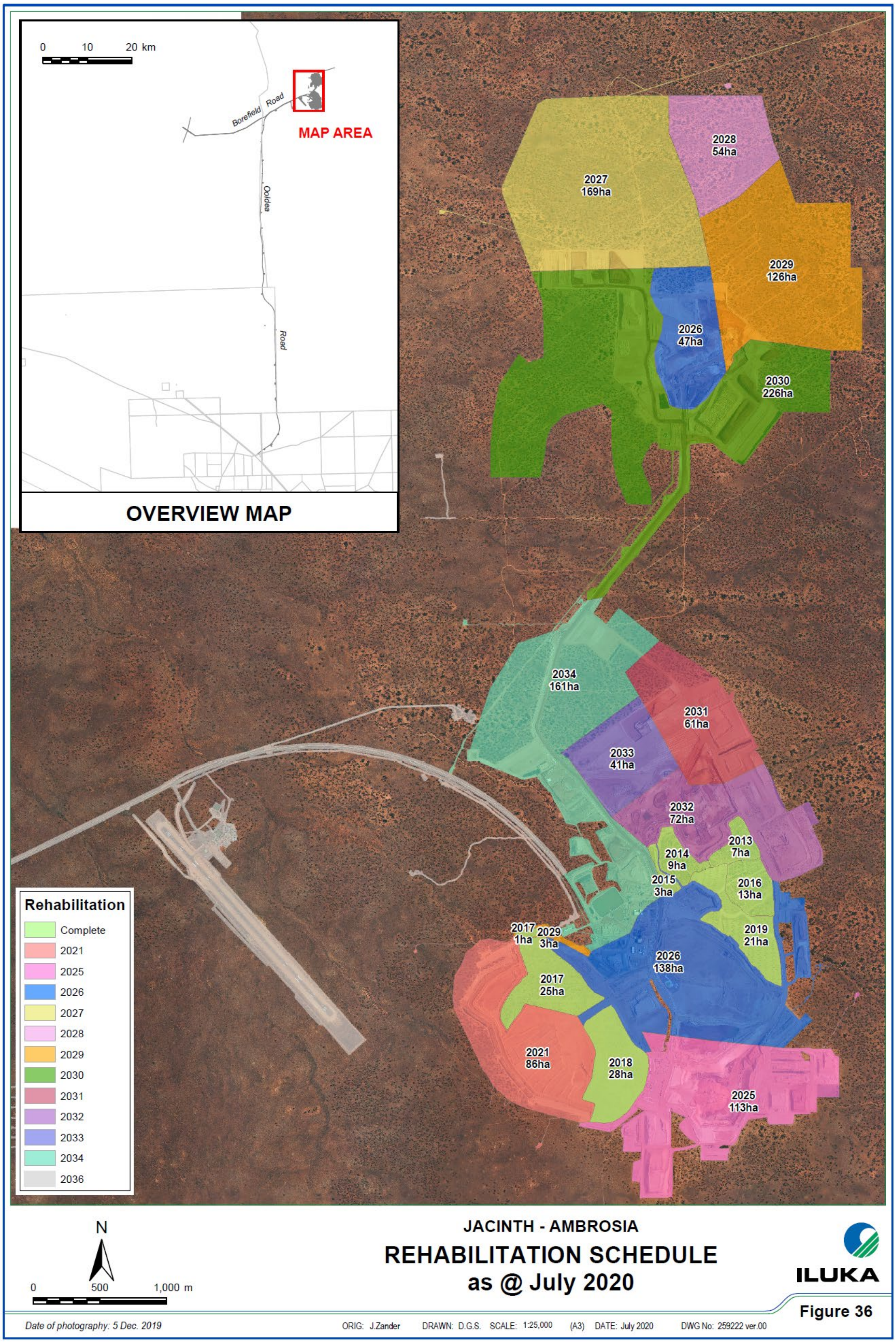

Figure 36: Indicative proposed rehabilitation schedule

3.7 Supporting J-A Project area infrastructure

Supporting J-A Project area infrastructure includes the accommodation village, aerodrome and water supply borefield, as shown in Figure 37 and Figure 38.

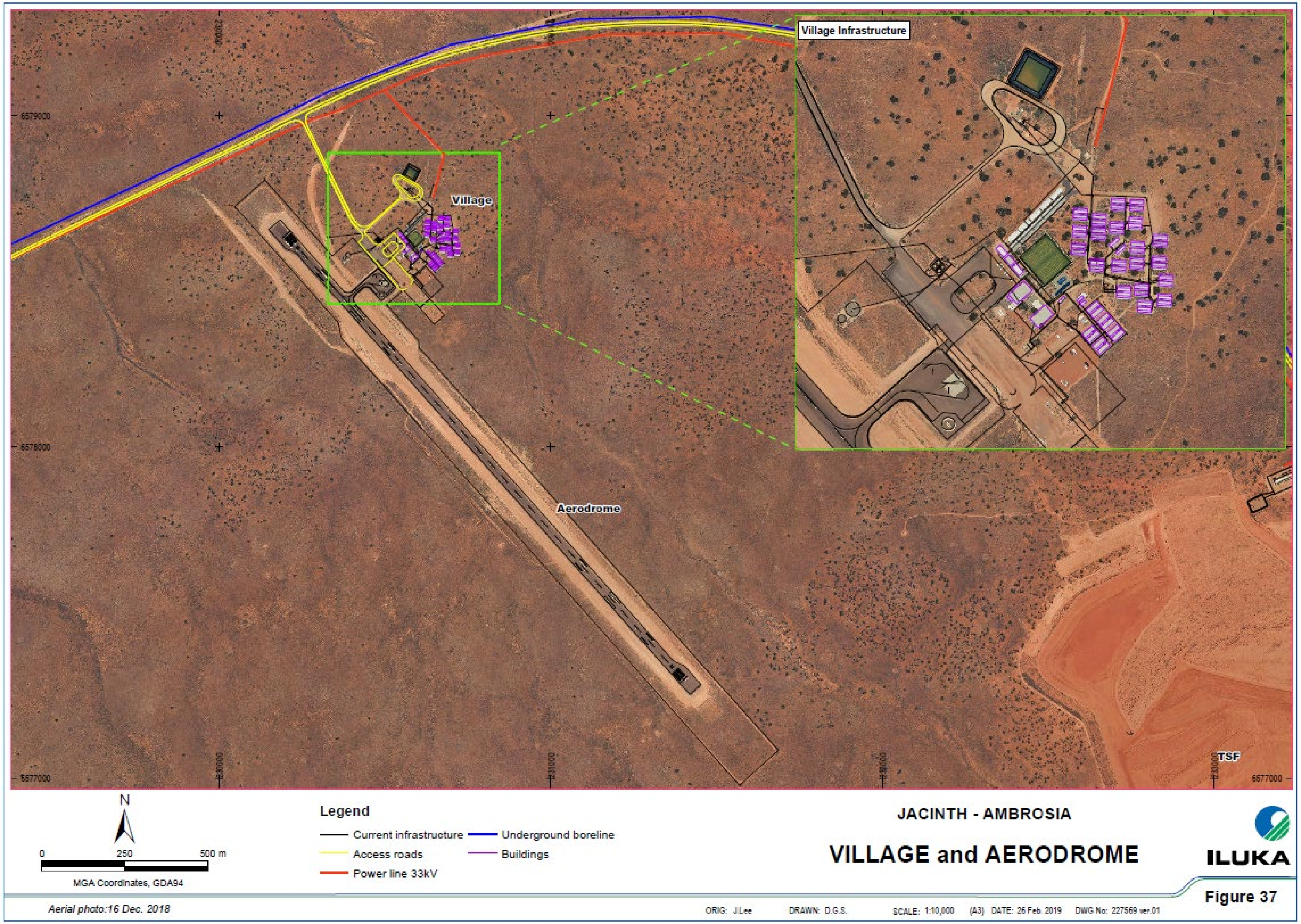

Figure 37: Village and aerodrome layout

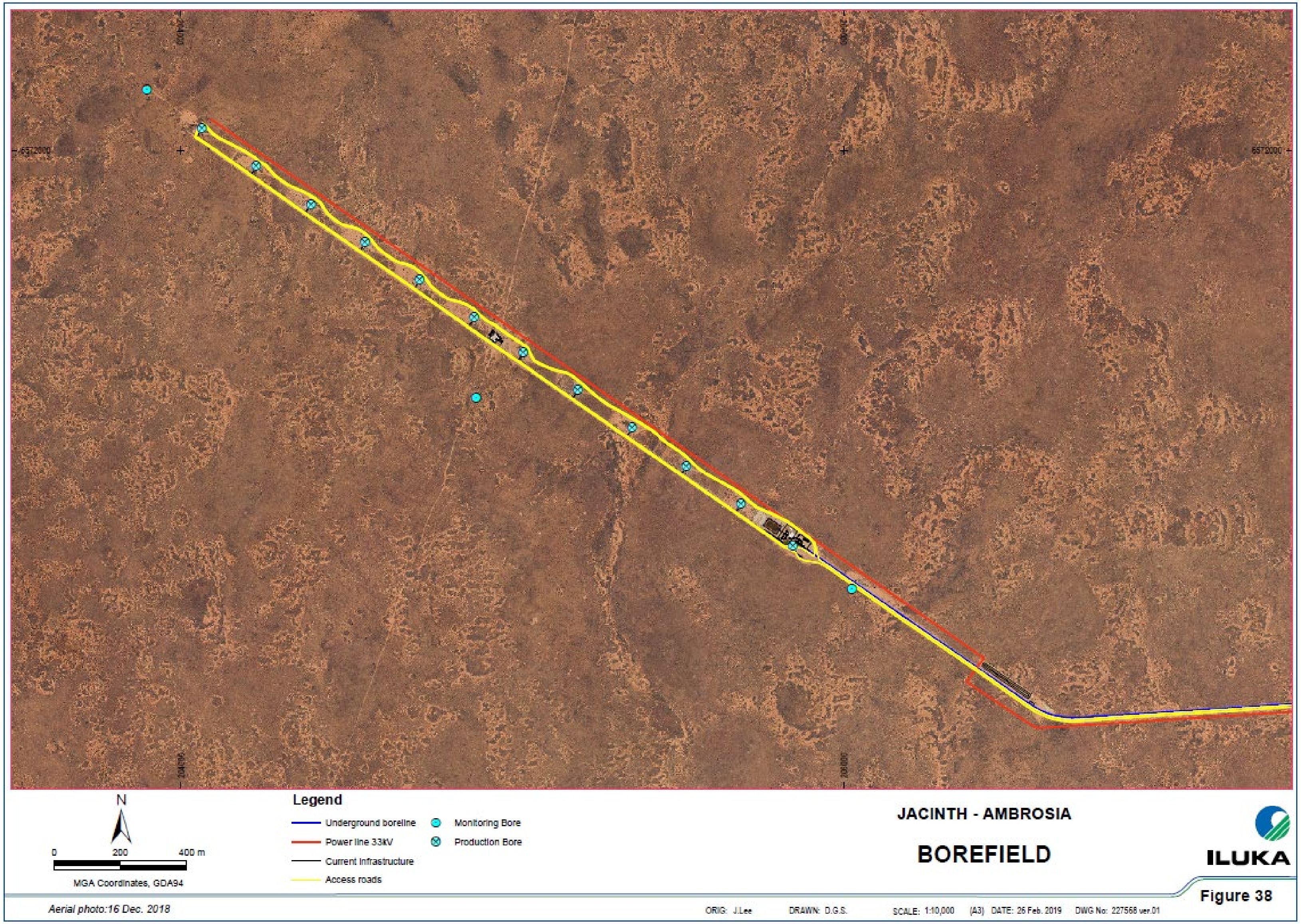

Figure 38: Borefield layout

3.8 Process water

3.8.1 Water supply system

Water supply is from the palaeochannel aquifer borefield located on MPL110, approximately 32 km from the J-A Project area (refer Figure 2). Based on a maximum extraction rate of 300 L/s, the annual extraction volume is estimated at 7 GL/yr. The average daily and yearly abstraction volumes vary over time in line with operational requirements.

The borefield system comprises twelve production wells (depths from 100–120 mBGL), a pumping station and below-ground pipeline for water transfer to the J-A Project area.

The transfer pipeline is Glass Reinforced Pipe (GPR) with a design delivery rate of approximately 360 L/s at 2100 kPa. The transfer pipeline includes pigging capability to remove scale.

3.8.2 Process water storage

Inflow hypersaline raw water (pH 4–6) from the borefield supply system enters a geo-fabric and high density polyethylene (HDPE)-lined process water dam (PWD). An off-take line separately supplies raw water to a pre-treatment pond (PTP) for desalination.

The PWD has a 97 ML capacity and is constructed from locally sourced soils. A minimum freeboard of 500 mm from the bottom of the overflow weir is maintained at all times during operations. The PWD receives water from the following sources:

- borefield supply system;
- return water sources:
    - WCP (recycled);
    - tailings, decant pond return water (recycled);
    - tailings, cell sub-floor drainage systems (recovered water); and
    - tailings, sand stacker return water (recycled).
- return water sources (direct return to PWD):
    - reverse osmosis plant (brine);
    - heavy mineral stacker pad return water (recycled);
    - groundwater interception wells; and
    - washbay water following oil water separation.

As noted above, WCP and tailings return water is first discharged into the Drop-Out Dam (DOD) for primary settling of sediments, with cleaner water overflow via a weir into the PWD.

Summary water quality chemistry for raw and process water is provided in Appendix E.

3.8.3 Process water balance

Water is continuously recycled through the process water circuit to offset borefield palaeochannel aquifer demand (make up water). System inflows, outflows and recycling are shown in Figure 39. The variance in the inflow and outflow balance depicts the continuous water recycling. Any water losses from the process water circuit (e.g. evaporation or tailings seepage) can be regained through make-up demand on the palaeochannel aquifer to a maximum flow up to approximately 360 L/s.

3.8.4 Mine dewatering

The ore at the J-A mine is located above the water-table, and thus precludes any requirement for groundwater dewatering.

As a dry ore body comprised of free draining tailings and underlying geology, all operational strategies and mitigation measures are focussed on minimising process water losses to groundwater and optimisation of process water recovery.

3.8.5 Water volume required

The volume of water required to operate the WCP and MUP during normal operations is as follows:

- WCP – 800 to 1,900 m^3/hr; and
- MUP – 800 to 1,500 m^3/hr.

3.8.6 Surplus/Deficit

On-path tailings water recovery is variable, with an average water recovery efficiency of approximately 60% (see Table 25). The remainder represents system losses, primarily infiltration to groundwater, with some losses via evaporation and entrainment within tailings.

Recovery is affected by geology of the basement, clay in ore and the mining sequence.

Table 25: Tailings water recovery, running average from September 2014 to September 2018

Location	Total In (L/s)	Total Loss (L/s)	Total Seepage (L/s)	Loss to Seepage
On-path	274	122	116	42%

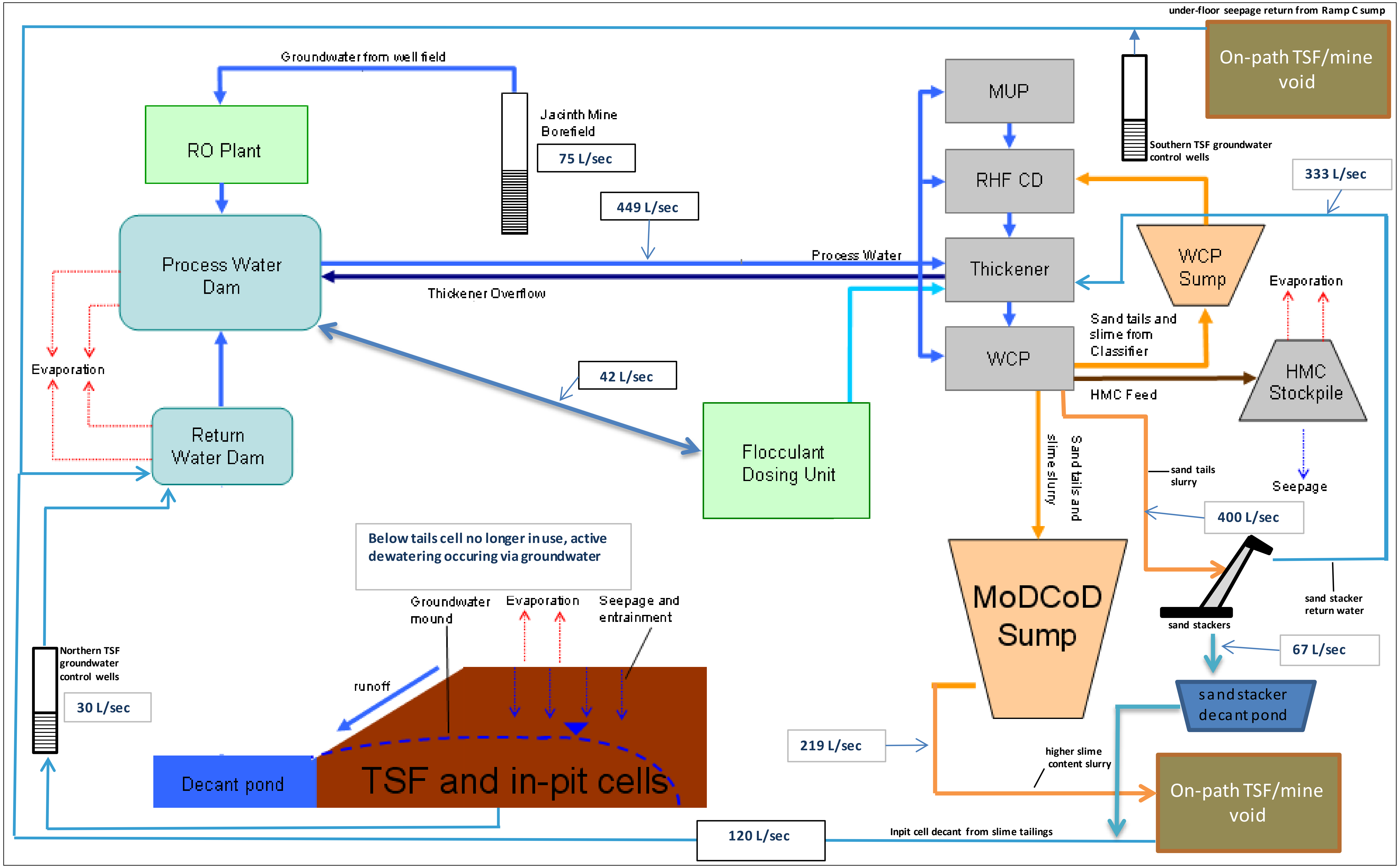

Figure 39: Process Water Balance

3.9 Stockpiles

Mining and processing materials are stockpiled during operations. The section below provides a summary of each type of stockpile at J-A. All stockpiles are built in accordance with the EPA *Guideline for stockpile management: Waste and waste derived products for recycling and reuse* (EPA 2010).

3.9.1 Overburden stockpiles

Removal of topsoil, subsoil and overburden is required to access the ore. Vegetation (timber) and overburden are typically removed using conventional earthmoving equipment such as excavators, dump trucks and tractor scoops. The overburden is categorised as brown loam, red loam, calcrete, creek sand and yellow sand, and is either stockpiled for later use in rehabilitation or direct returned as part of surface rehabilitation activities.

The overburden stockpiles are built by paddock dumping and end tipping of the overburden material. Stockpile design and construction (including tip head safety) will be in accordance with Iluka's geotechnical design criteria. Generally angles of repose will range from 29–34^0 depending on material type; a factor of safety of 1.3 will apply to stockpiles above 20 m in height in conjunction with a risk-based approach.

No overburden will remain in stockpiles at the completion of mining as it will be utilised during the rehabilitation process.

Interburden that is encountered between target ore layers is removed from the mining process, stockpiled and typically returned to the pit. Low-grade ore is also stockpiled for future processing or returning to the pit if considered cost prohibitive to process.

Figure 40 shows the location of existing overburden stockpiles in the J-A Project area.

Figure 41 shows the location of potential future stockpiles and projected additional disturbance footprint. Any change to the current disturbance boundary will be reported in the ACRs provided to DEM.

Table 26 provides further explanation on each overburden category.

Table 26: Overburden stockpile characteristics at J-A

Overburden Category	Characteristics
Vegetation (timber)	Felled trees and tall shrubs are stockpiled separately to overburden stockpiles. The timber is used in the final stages of rehabilitation process to reduce wind erosion of the final rehabilitation surface, provide micro-habitats for invertebrates and fauna and act as a nursery for native vegetation.
Brown/Red Loam Stockpiles	Brown loam and red loam is stockpiled separately and are constructed as flat-topped landforms. Bunding is added to the final lift as a safety measure to control vehicle movements
Yellow Sand Stockpiles	Yellow sands encountered during the removal of dunal features are stockpiled as a separate substrate to be reinstated as part of the rehabilitation of dunal features post mining.

Overburden Category	Characteristics
Creek Sand Stockpiles	Sands encountered during the removal of watercourse features are stockpiled as a separate substrate to be reinstated as part of the rehabilitaiton of watercourse features post mining.
Calcrete Stockpile	Where a discrete layer of calcrete is encountered during the overburden removal process it is stockpiled for later use in rehabilitation activities e.g. soil profile in creek construction.

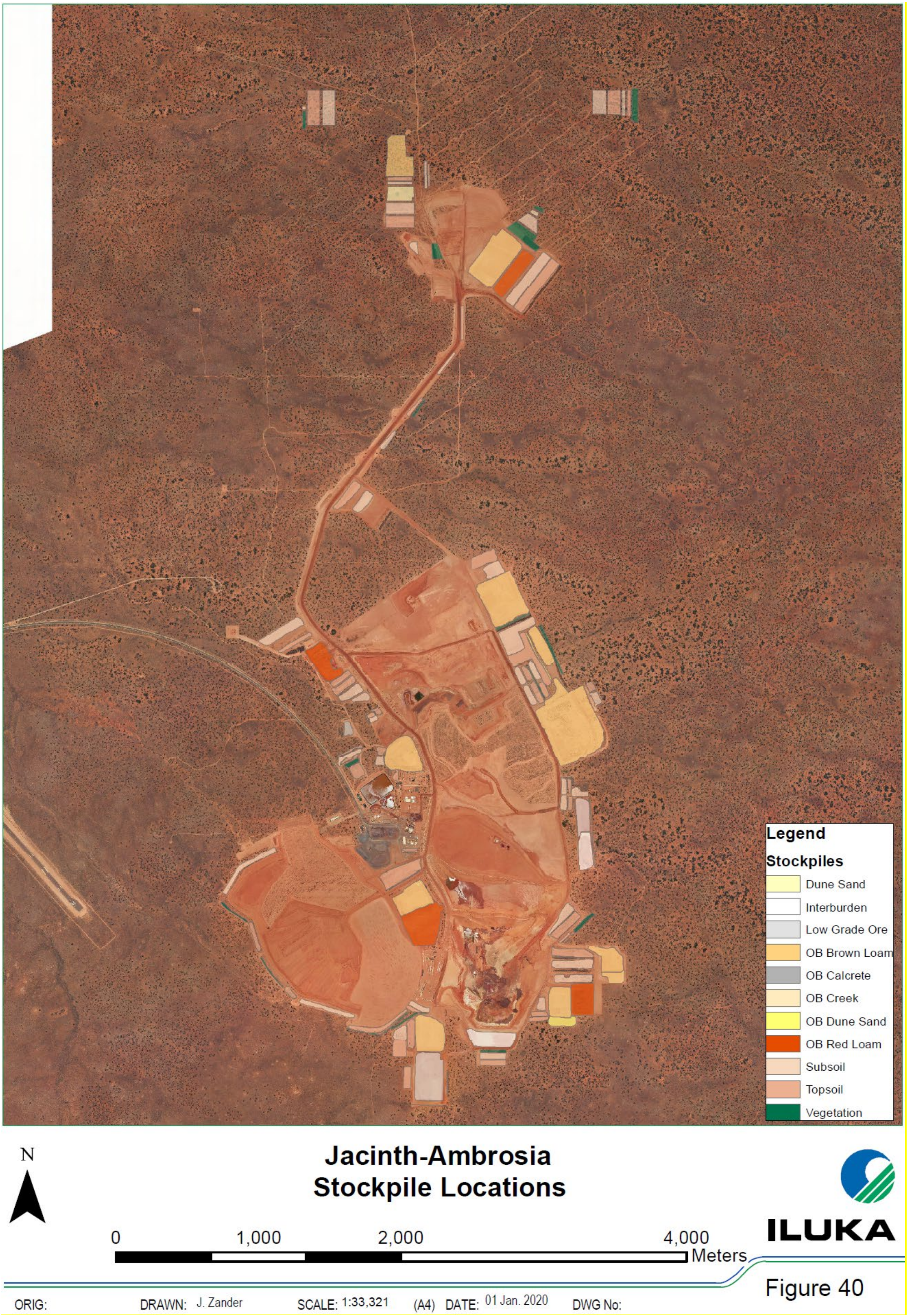

Figure 40: Stockpile locations

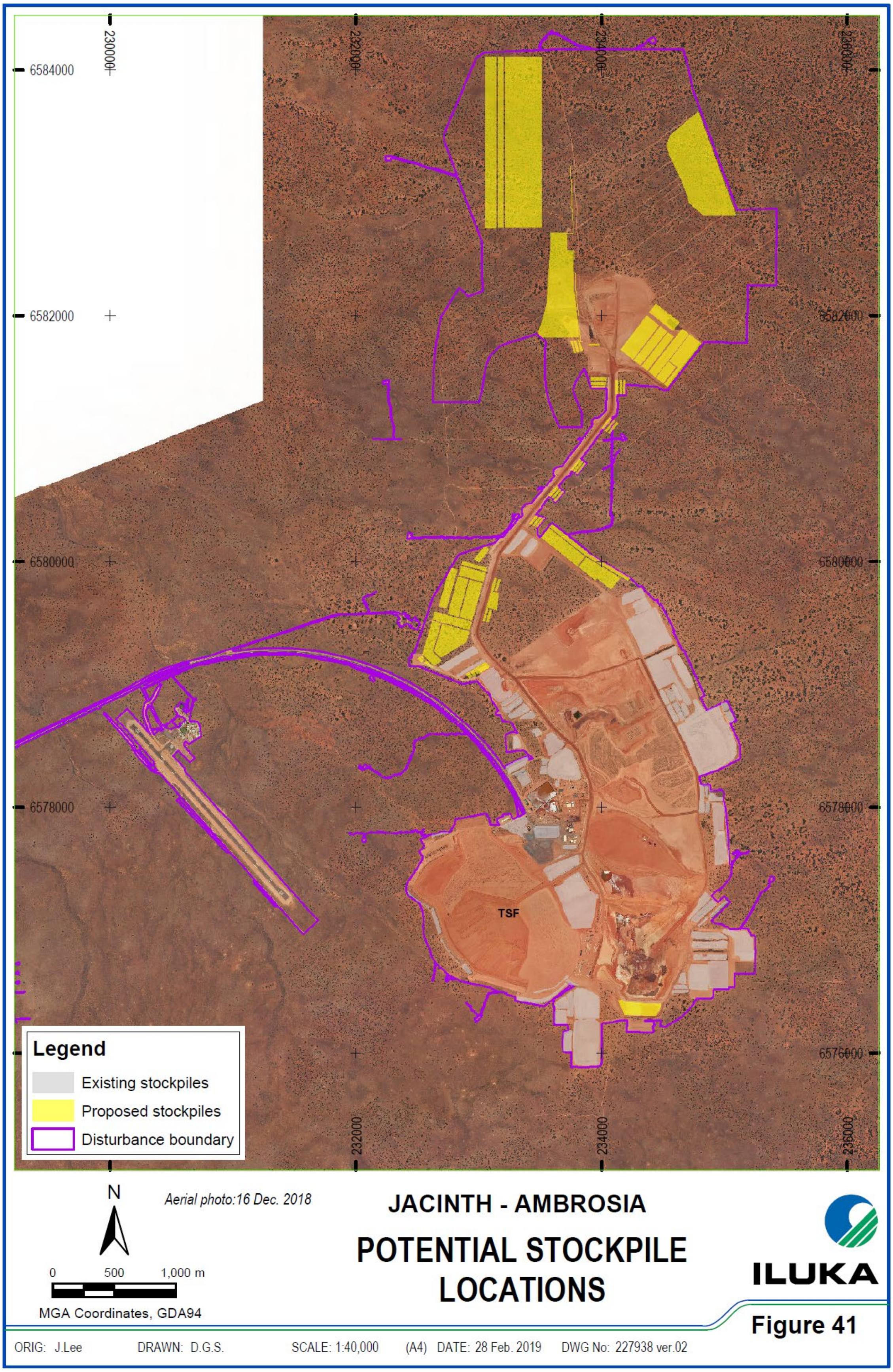

Figure 41: Potential future stockpiles and associated impact

3.9.2 Vegetation stockpiles

Where clearance of vegetation is required, the overstorey timber is retained and stockpiled for later replacement as part of rehabilitation. The vegetation stockpiles are located adjacent to topsoil stockpiles to assist in protecting from wind erosion.

3.9.3 Topsoil/subsoil stockpiles

Topsoil and subsoil profiles that are stripped during the clearance process, and not direct returned as part of rehabilitation activities, are stockpiled separately. These profiles are stockpiled in areas adjacent to the pit. Stockpiles are separated according to the vegetation association they were sourced from.

The topsoil/subsoil stockpiles are located away from natural drainage lines and are constructed to a maximum height of 2 m (topsoil) and 4 m (subsoil). The stockpiles are monitored for evidence of erosion and soil stabilisation methods implemented if required.

3.9.4 WCP oversize

WCP oversize material is discharged via a stacking conveyor at the WCP. This material is either disposed back to the mine void or stockpiled for general use within the mine area (e.g. road sheeting, bund construction, other) as required.

3.9.5 HMC stockpiles

Refer to Section 3.5.2.

3.10 Wastes

3.10.1 Tailings and storage facilities

At the commencement of mining, a off-path TSF was required for the initial void development. Once an appropriate void was created, the tails were able to be returned in-pit. The tails are generated from the WCP and comprise quartz sands (sand tails) and a ModCoD (a mixture of quartz sands and clay fines).

The sand tails are pumped and dewatered into the pit void (Plate 6). A proportion of the residual water deposited with the sand is recovered either via decant ponds or sub-surface drainage systems. The sand stackers are mobile and provide flexible tailings operation for the direct back-fill of completed mining cells and/or the construction of cell walls within the mine void. The latter allows the separation of completed and active mining cells necessary for concurrent tailing and mining operations.

The ModCoD tails are pumped to the mine pit and used for the backfill of completed tailings cells. The tailings stream is dosed with flocculant immediately prior to deposition. Flocculant dosing accelerates dewatering.

Plate 6: Deposition of sand tailings through sand stacker

Design of the Tailings Storage Facility

The TSF was established to the south west of Jacinth (Figure 32). It was constructed using compacted soil and overburden. The design of the TSF meets the requirements of DEM's Guidelines for miners: tailings and tailings storage facilities in South Australia, MG5, Version 1.4, dated September 2009.

Rehabilitation of the off path TSF is discussed further Section 3.12. The post-disturbance contours are shown in Figure 49 and the erosion assessments in Appendix F.

3.10.2 Processing Wastes

Processing wastes are limited to tailings and reverse osmosis reject water (brine). Detail on these waste streams, including their composition and fate, is provided in Sections 3.10.1 and 3.11.4, respectively.

3.10.3 Industrial and commercial wastes

The industrial and commercial waste streams generated by the operation and their management are summarised in Table 27. Wastes include general, hazardous and listed wastes managed in accordance with relevant legislation via the operational *Waste Management Plan*. Priority will be given to reuse and recycling pathways in preference to disposal, where applicable.

Other wastes that are generated during operations, and not already listed in Table 27, will be managed in accordance with relevant legislation.

Radioactive wastes are defined and managed in accordance with the operational *Radiation Management Plan*, approved and regulated by the South Australia EPA Radiation Protection Branch. This plan is compliant with relevant Commonwealth and State radiation legislation, codes of practice and EPA radiation protection licences for the operation. Detail on radioactive waste management is outside the scope of this PEPR.

The majority of wastes are aggregated at the J-A Project area waste transfer station pending regular collection by a licensed waste contractor. EPA bunding guidelines apply to the storage of liquid wastes and wastes with residues (e.g. waste drums/containers, oil filters). The J-A Project area waste transfer station is a fully-enclosed compound for exclusion of fauna and containment of litter.

The location of the key waste infrastructure at J-A is shown in Figure 42.

3.10.4 Sewage treatment

All sewage and greywater generated in the J-A Project area (village accommodation precinct and Jacinth mine site amenities) is treated through SA Health approved wastewater treatment plants (WWTP).

WWTPs comprise a series of anaerobic, aerobic and primary chlorine disinfection units before final discharge of treated water. Biosolids are retained with the primary settling tanks with periodic removal and disposal (refer Section 3.10.5).

The village WWTP (SA Health Approval Reference WCS-2664) is fed from accommodation huts, amenities, laundries and kitchen. Treated effluent is discharged to a lined and fenced collection pond pending secondary chlorine disinfection and dust suppression reuse as post-treated (Class B) reclaimed water, managed in accordance with the SA Health *Recycled Water Guidelines 2012*.

The Jacinth mine site WWTP (SA Health Approval Reference 2009-6164) is fed from J-A Project area ablutions and crib facilities, with treated effluent approved for discharge to soakage.

An additional WWTP, with discharge to a designated soakage area has been installed at the Ambrosia mine site to service offices and crib rooms (SA Health Approval Reference WWI-10503).

3.10.5 Biosolids management

Treated biosolids are either removed for off-site disposal by an EPA-licensed waste contractor, or disposed in the J-A Project area per SA EPA Guidelines (*Liquid Biosolids from Domestic Septic Tanks – Disposal onto Agricultural Land, 2003*). On-site disposal of biosolids is undertaken in accordance with a *Biosolids Management Procedure* which outlines requirements for disposal location, size, application method/rate and monitoring in line with these EPA guidelines.

The on-site disposal of biosolids does not trigger EPA licensing per Schedule 1(2) of the *Environment Protection Act 1993* (EP Act) (plant capacities < 1000 persons per day, not in water protection area and no disposal to marine waters).

3.10.6 Hydrocarbon contaminated soils

Iluka seeks to minimise hydrocarbon contamination of soils. Small volumes (approximately 240 tonnes per annum) of hydrocarbon-contaminated soils will be generated during the life of operations. Sources include leaks and spills (e.g. plant and equipment hydraulic failures) and soils/residues removed from facilities such as vehicle wash-down pads, refuelling areas, bunds and interceptor pits.

Soil contamination is assessed in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM)* to determine how to manage any hydrocarbon impacts identified in the soil. Where the soils are to be excavated and disposed off-site, the soil is assessed and classified in accordance with SA EPA Information Sheet (March 2010): Current criteria for the classification of waste—including Industrial and Commercial Waste (Listed) and Waste Soil.

Validation sampling (in accordance with the NEPM is also undertaken in the area where contaminated soils have been excavated to ensure that there are no further impacts to the soil or a potential threat to groundwater.

Miscellaneous quantities of soils impacted by minor leaks and spills during normal operations (e.g. mobile plant hydraulic leaks and spills), recovered during spill response and clean-up activities, are not likely to exceed defined ASC NEPM Ecological Investigation Level (EIL) or Health Investigation Level (HIL) thresholds and will be treated as trivial contamination events per *s5B Environment Protection Act (1993)* (EP Act) and *SA EPA Information Sheet 830/09 (January 2009: Site contamination—what is site contamination?).* A NEPM-based validation will not be undertaken for these events, unless concerns exist that non-trivial soil and/or water impacts have or may occur. The recovery, classification and off-site disposal of these soils will be managed strictly per *SA EPA Information Sheet (March 2010): Current criteria for the classification of waste—including Industrial and Commercial Waste (Listed) and Waste Soil.*

Hydrocarbon-contaminated soils will be managed via an on-site bioremediation program in accordance with the *Bioremediation Management Plan* (BMP) provided in Appendix P. The principal objective of the bioremediation program is to treat the hydrocarbon impacted soil materials to an acceptable level such that they may be utilised in the J-A Project area for use during mine rehabilitation works whilst providing adequate protection to identified receptors.

Contaminated material is to be sourced regularly from the wash-down bay and, less frequently, from accidental spills in the J-A Project area. The material will be transported to the bioremediation treatment pad where a bioremediation agent will be added, and the material covered and regularly aerated/watered by mixing to promote bioremediation. Once the soil reaches an acceptable level, as confirmed by analytical testing, the material will be utilised in the J-A Project area as backfill during rehabilitation works.

All work will be carried out in accordance with the BMP to mitigate potential risk to the current and future users of the J-A Project area, J-A Project area workers and the surrounding environment.

The location of the new bioremediation treatment pad was yet to be determined (at time of writing), but will be selected based on the following criteria:

- proximity to the wash down facility, to enable easy transfer of biosolids to the pad;
- proximity to water supply (potable water supply connection or stand pipe), to enable irrigation of the bioremediation pad; and
- proximity to the existing process water dams, to facilitate drainage of leachate, preferably by gravity.

The bioremediation pad includes the following design elements, as summarised in the BMP (see Appendix P):

- the pad will be subdivided into cells to allow for separate treatment cycles;
- to ensure adequate aeration of the soil during bioremediation the stockpile height has been capped at a maximum of 1 meter to enable personnel access;
- the bioremediation pad and each cell must also accommodate suitable earthmoving equipment from at least one side to irrigate and aerate the soils;
- each lot will be divided using competent barriers to divide and demarcate the cells;
- the pad will be bunded using a rollover (trafficable) concrete kerb above the finished surface level to contain surface water. The outcropping kerb will also prevent surface runoff outside the pad draining into the pad;
- water supply for irrigation of the treated soil is assumed to be provided from a nearby connection at the adjacent RO plant, with a running hose to the pad;
- no allowance for additional water storage has been provided within the design; and
- the bioremediation pad has been designed with a trafficable containment layer to prevent migration of contaminants to the soils and groundwater below.

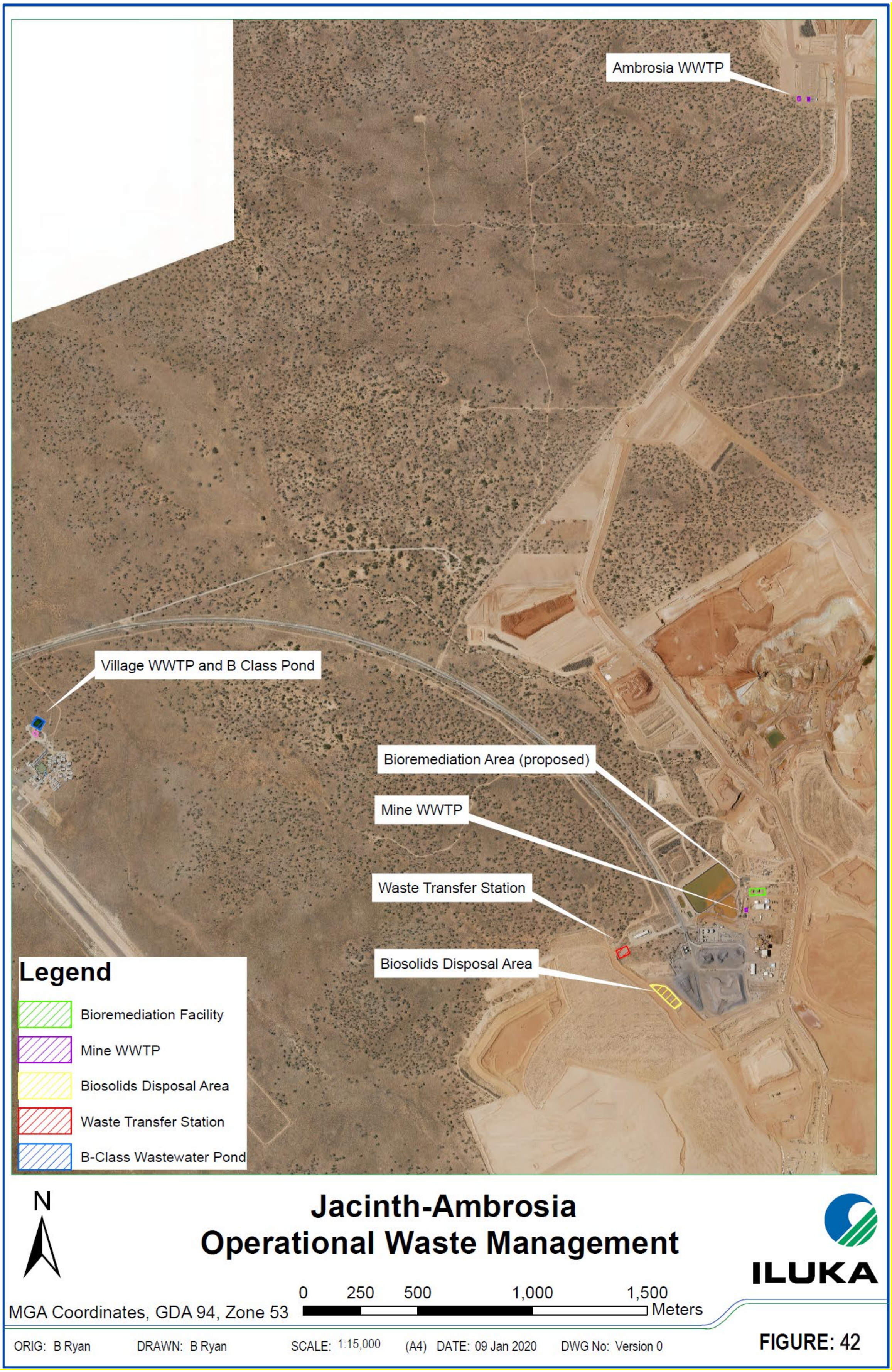

Figure 42: Operational waste management

Table 27: Commercial and industrial wastes

Commercial and Industrial Waste (General)			
Waste Type	**Fate**		**Method**
Aluminium cans	Recycled	Off-site	Shipped to third-party for processing
Cleaning rinsate and emulsions	Treatment	On-site	Only septic-safe cleaning agents approved for use on-site; treatment through SA Health approved on-site wastewater treatment systems
Commingled recycling	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
E-waste	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
General and putrescible waste	Disposal	Off-site	Collected by EPA-licensed waste contractor and disposed to approved landfill facility
Pipes (polypropylene and polyethylene)	Reuse or Recycled	Off-site	Subject to pipe condition, either shipped to other operations or to third-party for re-use or recycling
Paper and cardboard	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
Plastics (packaging and misc.)	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
Printer/toner cartridges	Recycled	Off-site	Shipped to third-party for processing
Scrap steel/metals	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
Waste cooking oil	Reuse or Recycled	Off-site	Collected by external contractor for processing, or collected and processed by EPA-licensed waste contractor
Waste timber	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
Commercial and Industrial Waste (Hazardous and Listed Waste)			
Waste Type	**Fate**		**Method**
Batteries	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
Containers and drums containing chemical residues	Recycled	Off-site	Triple-rinsed; collected and managed by EPA-licensed waste contractor
Containers and drums containing hydrocarbon residues	Recycled	Off-site	Collected and managed by EPA-licensed waste contractor
Effluent (treated)	Reuse	On-site	Treated effluent discharged from on-site wastewater treatment system per SA Health approvals (dust suppression or soakage). Post-treated (Class B) reclaimed water reused for on-site dust suppression per approvals and SA Health *Recycled Water Guidelines 2012*
Grease trap solids	Disposal	Off-site	Removed by EPA-licensed waste contractor and disposed to approved facility

Commercial and Industrial Waste (Hazardous and Listed Waste)			
Waste Type	**Fate**		**Method**
Hydrocarbon-contaminated soil and sludge	Treatment & Reuse Disposal	On-site Off-site	On-site bioremediation program in accordance with the BMP Off-site disposal required by EPA-licensed waste contractor if soils cannot be remediated to acceptable levels
Hydrocarbon-contaminated spill-response materials	Disposal	Off-site	Managed per SA EPA Guidelines (*Disposal of used hydrocarbon absorbent materials*). Collected and managed by EPA-licensed waste contractor
Medical waste	Disposal	Off-site	Collected by EPA-licensed waste contractor. Treatment via incineration at EPA-approved facility
Mercury containing lights	Recycled	Off-site	Shipped to third-party for processing
Oil Filters	Recycled	Off-site	Filters drained; collected and managed by EPA-licensed waste contractor. Drained oil managed as per '*Waste oil and grease*'
Oily water/oil-water emulsions	Treatment & Reuse	On-site	Disposed to oil/water separation system. Water return to process water circuit for reuse. Hydrocarbons recovered and managed as per '*Waste oil and grease*'
Sewage and greywater (raw, untreated)	Treatment	On-site	Treatment through SA Health approved on-site wastewater treatment plants. Post-treated (Class B) reclaimed water reused for on-site dust suppression per approvals and SA Health *Recycled Water Guidelines 2012*
Sewage sludge (biosolids) (treated)	Disposal	On-site Off-site	Treated septic biosolids removed by EPA-licensed contractor with on-site reuse per SA EPA Guidelines *(Liquid Biosolids from Domestic Septic Tanks – Disposal onto Agricultural Land, 2003*), or disposed to off-site approved community wastewater treatment system
Waste oil and grease	Recycling	Off-site	Collected and managed by EPA-licensed waste contractor
Waste pharmaceuticals, drugs and medicines	Disposal	Off-site	Collected and managed by EPA-licensed waste contractor. Treatment via incineration at EPA approved facility
Tyres	Recycling	Off-site	Shipped to third-party for processing

3.11 Supporting surface infrastructure

3.11.1 J-A Project area access

J-A Project area access is via air and the Ooldea Road.

Pursuant to the *Development Act 1993* (now the *Planning, Development and Infrastructure Act 2016*), Iluka sought and was granted approval by Planning SA[4] in 2008 to construct the Ooldea access road between the Eyre Highway and the mine. This included an upgrade of the intersection with the Eyre Highway, upgrade of existing sections of road to Yalata, and construction of new road bypassing Yalata and north to the J-A Project area.

[4] Now part of the Department for Infrastructure and Transport (DIT)

A section of the upgraded Ooldea road passes through the Yalata lands (Crown Land, governed by the Aboriginal Lands Trust; ALT) the access road was approved as and is deemed a public road. The access road is subject to a *Deed for Construction and Licence of Haul Road (Ooldea Bypass and Ooldea Road North)* between Iluka and the ALT.

Borrow pits were established to facilitate construction with all works undertaken in accordance with a DEH-approved *Construction Environmental Management Plan* (CEMP). Pre-mine cultural heritage surveys were undertaken for the proposed access road resulting in realignment of the proposed route to avoid identified features (refer Section 2.15). Borrow pits have been subject to progressive rehabilitation post commencement of operations.

The access road and intersection with the Eyre Highway were constructed in accordance with Australian Standards. Road construction (initially unsealed) was completed in 2009 and sealed in 2012. The Ooldea access road is approximately 100 km long between the Eyre Highway and the J-A Project area.

An overview of the Ooldea access road, Eyre Highway intersection is provided in Figure 2.

3.11.2 Ore and tailings pumping units and pipelines

Pumping Units

Field pumping units are mounted on skids to facilitate relocation (as may be required) during operations. The pumping units consist of:

- ore slurry pumps;
- tailings pumps; and
- water pumps.

All skid mounted pit infrastructure is supplied power via high voltage electrical cable or locally installed diesel generation.

Pipelines

Water, tailings and drainage pipelines are HDPE. Mining hose is used to provide flexible connection to infrastructure.

Pipelines in the J-A Project area consist of:

- ore pipeline(s);
- tailings pipeline(s) – one pipe for the slurry mix of barren sand tails and thickened clay fines, one that will contain flocculant dilution water and one that will contain flocculant solution that is used to stabilise the tails mix within the mine void; and
- recovery pipeline(s).

Booster pumps are used along the pipelines.

3.11.3 Fuel and chemical storage

Operational fuel storage is provided within a 480,000 L bunded storage facility (comprising two 240,000 L tanks) adjacent to the J-A Project area power station. This facility is the primary diesel supply to the power station.

Diesel supply for J-A Project area mobile plant and equipment is provided via two 68,000 L self-bunded tanks (Figure 33). The transtanks adjoin a concrete hardstand refuelling bay which is connected to the downstream washbay oil/water separation system for containment and treatment of hydrocarbon residues.

Unleaded fuel (< 200 L) is securely stored in accordance with Australian Standard and EPA guidelines (refer to Section 5.16.2) including:

- *AS1940-2004 Storage and Handling of flammable and combustible liquids;*
- *AS 1692-2006: Steel tanks for flammable and combustible liquids;* and
- *SA EPA Guideline EPA 080/12 Liquid storage: bunding and spill management.*

Storage systems include Dangerous Goods (DG) cabinets, self-bunded shipping containers, spill pallets and within designated bunded hardstand areas.

Bulk chemicals used in the J-A Project area include:

- sodium hypochlorite (water treatment);
- sodium hydroxide (water treatment); and
- flocculant.

As per the storage bulk diesel, bulk chemicals are stored in bunded facilities of design and capacity compliant to SA EPA Guideline *EPA 080/12 (Liquid storage: bunding and spill management)*. Chemical storage is per the applicable Australian/New Zealand Standard relevant to product kept, with observation of DG protocols for the segregation of incompatible goods.

3.11.4 Water treatment

Water treatment infrastructure includes a pre-treatment plant and reverse osmosis (RO) plant.

Pre-Treatment Plant

The pre-treatment facility is located at the entrance to the J-A mine operations and is fed via an off-take line from the borefield transfer pipeline.

The pre-treatment facility comprises two HDPE-lined open pre-treatment ponds. The first pre-treatment ponds are used for alkali dosing and aeration to adjust (increase) the raw water pH and precipitation of key dissolved heavy metals (principally iron and manganese) which settle as treatment pond sludge.

Summary water quality chemistry for pre-treated water is provided in Appendix E.

Reverse Osmosis Plant

Production of potable water is undertaken via a RO Plant, with a plated output of up to 210 KL of potable water per day, approved as a prescribed activity under Iluka EPA Licence 22442 (*Desalination plant that discharges wastewater to a wastewater lagoon*). The RO plant receives water from the process water pre-treatment plant.

The RO Plant facilities include tanks (for raw water storage, and potable water) and a series of pumps and pipes. Tank configuration and storage capacity provides for approximately five days raw water storage.

The treated and disinfected water is pumped to the potable water storage tanks for use in J-A Project area crib/ablutions, village and accommodation use and on-site dust suppression.

The plant production capacity of permeate is approximately 2 L/s with approximately 8 L/s wastewater (brine) discharge. Brine water is discharged to the Process Water Dam for process re-use (refer Section 3.6.2.).

Refer Figure 33 for the RO Plant location and configuration.

The RO Plant produces potable water to a quality that is compliant with the Australian Drinking Water Guidelines (ADWG), and is subject to a *Potable Water Risk Management Plan* pursuant to SA Health requirements.

3.11.5 Supporting infrastructure in J-A Project area

Supporting infrastructure in the J-A Project area includes the following:

- first aid facility;
- ablutions, linked to downstream WWTP (see Section 3.11.4);
- metallurgical laboratory;
- office buildings (central building and separate units);
- crib room;
- native seed stores (airconditioned)
- telecommunications tower/IT data centre;
- warehouse and vehicle workshop; and
- contractor heavy vehicle workshop (including vehicle wash-down facility).

The majority of office and ancillary structures are portable and demountable. Warehouse and workshop facilities are industrial sheds comprised of steel frame and steel cladding with concrete slab flooring.

3.11.6 Accommodation village

The mine worker accommodation village (Figure 37) is located on MPL111.

The accommodation village includes the following facilities:

- ensuite accommodation for up to 200 people.
- ancillary buildings (all pre-fabricated) that include:

- administration building;
- training and conference facility;
- recreation room and air-conditioned gymnasiums;
- wet and dry mess;
- kitchen (including refrigerated containers);
- ablution and laundry blocks;
- car parks; and
- swimming pools.

3.11.7 Airfield

The airfield (Figure 37) is located on MPL111, adjacent to the accommodation village.

The sealed airstrip is 1.4 km in length with a 30 m wide runway and 30 m verges either side (90 m total width). The airstrip has been designed and constructed in accordance with South Australian Country Fire Service (CFS) Civil Aviation Safety Authority requirements.

The airfield includes a sealed terminal hardstand area, security fencing, navigational aids and drainage channel network for stormwater management.

3.11.8 Public roads, services and utilities

No public services or utilities are utilised by the operation. Road access to the J-A Project area is via the shared Ooldea Haul Road (between the Eyre Highway and the J-A Project area), which was upgraded and is maintained by Iluka for the purpose of mine operations. This road is utilised by the operation and local communities at Yalata, Maralinga and Oak Valley.

A dedicated fibre-optic service was installed from the Eyre Highway to the J-A Project area during the construction of the Ooldea Haul Road in 2008/2009 (see Section 3.11.1).

3.11.9 Vehicle movements

Vehicle movements between the mine and Ceduna (Port Thevenard) are variable in accordance with mine operations and market conditions but will average 10–20 road trains per day. Haulage of heavy mineral is conducted 24/7 in line with J-A Project area hours and mode of operation (refer Section 3.4.1).

3.11.10 Other infrastructure

In late 2019, an MPL application to extend and widen an existing exploration track (MPL161) was submitted to DEM. This MPL was approved on 11 August 2020. The development of Canberra Road is necessary for the transportation of treated waste water (class B water) for dust suppression use, as well as to allow the transportation of equipment to the Ambrosia deposit. The use of Canberra Road will also assist to reduce haul distances (from 10.2 km to 6.2 km).

3.11.11 Power generation and reticulation

Operational power requirements for Jacinth mining are between 5 to 7 MW while power demand during Ambrosia mining is higher at approximately 6 to 8 MW.

Power is generated on site by an on site diesel power station consisting of ten generators.

The site power station is approved as a prescribed activity under EPA Licence 22442 (*fuel burning: rate of heat release exceeding 5 megawatts*).

Details of the diesel generators are summarised in Table 28. The location of the power station within the plant processing area is shown in Figure 33.

Table 28: Summary of diesel generator specifications

Parameter	Details
Capacity per generator	950 KW
Number of stacks per generator	2
Stack height	9–10 m
Stack diameter	0.42 m
Exit velocity	55.7 m/s
Temperature	420°C

The site power station provides power at 11 kV with overhead reticulation to the mine and underground reticulation to the processing plant. Power is stepped up to 33 kV for overhead reticulation to the remote borefield and village.

Power reticulation infrastructure on-site includes the following:

- underground connection between Generator Power Station and 11 kV Main Switch room;
- 11 kV Main Switch room at Jacinth
- Underground connection between 11kV Switch room and Jacinth Processing Plant Infrastructure (PC12, R/O, Admin, Pia's etc)
- 11kV transformers at Jacinth Processing Plant LV Switch rooms and Ambrosia Booster Stations LV Switch rooms
- 11/33kV transformer and 33 kV Overhead Powerline to Borefield and Village;
- 11 kV Overhead Powerline to Mining Plant (Jacinth South, Jacinth North, Jacinth Far North, Ambrosia);
- site HV Earthing System

In 2021, the site power generation will be improved with the addition of a 3.0 MVA solar photovoltaic power grid and replacement of existing generators to more efficient units. This upgrade will reduce diesel usage and combustion, causing a reduction in emissions of carbon dioxide and other combustion gases and particles.

3.11.12 Site security

Due to the remoteness of the mine operation and limited public traffic no fixed security infrastructure (e.g. boom gates, security stations) are installed. Information and mine access prohibition signage is installed at key points on the inbound Ooldea Haul Road to deter undesired vehicle traffic, and/or direct traffic to the mine village office.

Where members of the public do present themselves at the mine village a dedicated Travellers Drop-In Procedure is in place to direct what assistance and support is provided by Iluka.

3.11.13 Silt control and drainage

The J-A Project area is located within an arid climate with an average annual rainfall of 200 mm to 300 mm per year (BOM 2011). While a number of small watercourses dissect the J-A Project area (refer section 2.11), the watercourses are ephemeral and only flow after significant rain events.

The site surface water drainage system has been designed to minimise the potential for soil erosion and discharge of sediment-laden water to the downstream environment. It should be noted that in arid zone environments, the stream flow from storm events is naturally sediment laden. A number of surface water management features have been incorporated in the design and operation of the J-A Project and include:

- using site topography to divert surface water from the site admin, carpark and process plant areas towards a drainage channel that captures silt and water at the process water dam;
- construction of a drainage channel at the HMC pad to divert process water (and surface water) to the process water dam;
- process water dam with capacity to withstand a 100 yr average recurrence interval (ARI), with a spill way incorporated to manage flows in the event of a 1,000 yr ARI.
- regular dredging of the process water dam to remove captured silt, which is then fed back through the process plant;
- camber of haul road angled towards the pit to direct surface water flows away from surrounding vegetation;
- construction of bunds, drainage channels and collection ponds at overburden stockpiles; and
- drainage from the wash bay is directed to an oil/water separator with treated water recycled back to the process water dam.

Figure 43 (with insets 39a to 39d) shows the location of drainage features and surface water movement within the J-A Project area.

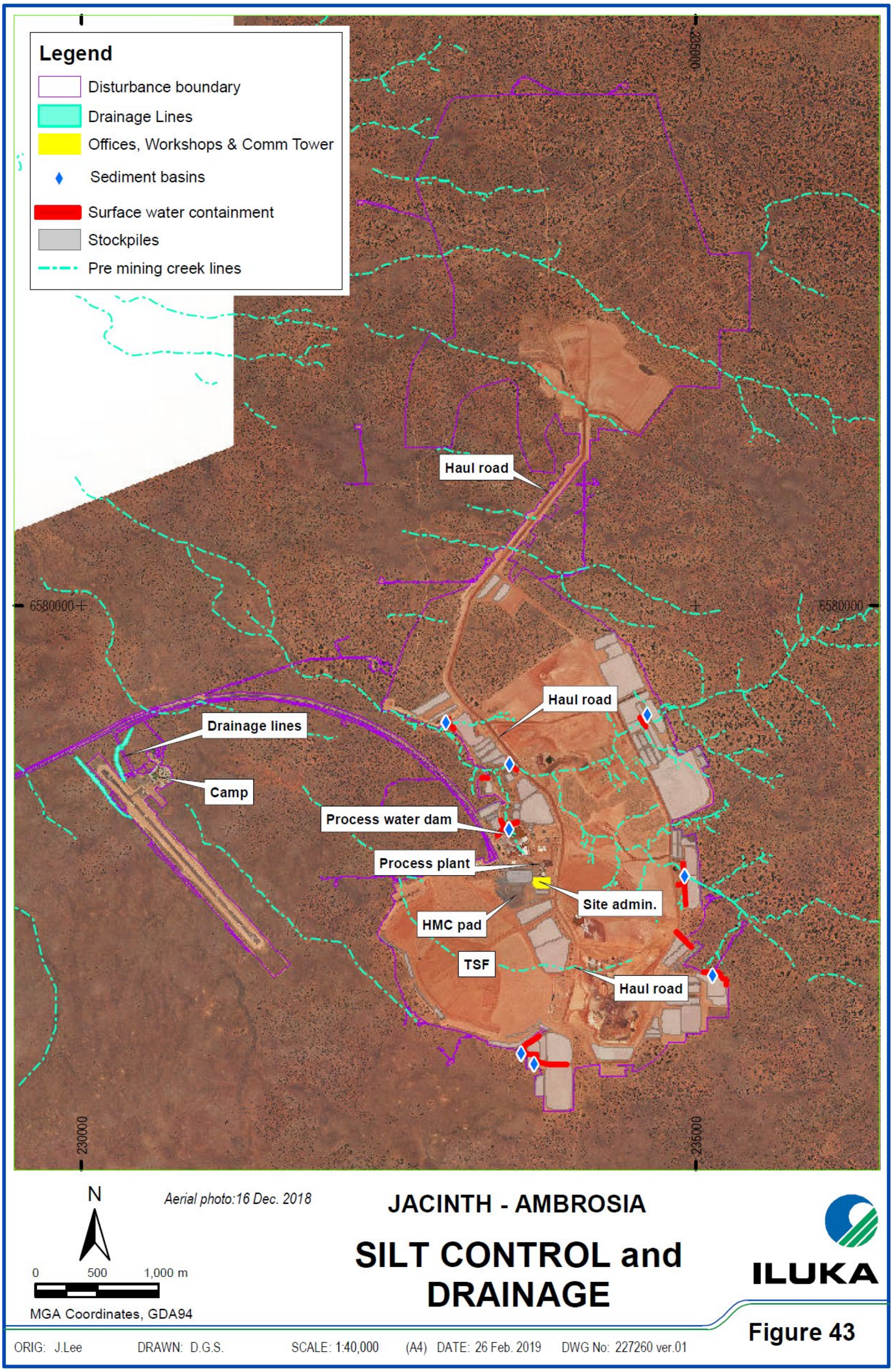

Figure 43: Silt control and drainage overview

3.12 Mine completion

All mine closure activities are described in the *Mine Closure Plan* (Appendix G). The closure plan is periodically reviewed and updated.

3.12.1 Care and maintenance

A sudden J-A Mine closure may occur due to unforeseen or unplanned events and in this event Iluka would transition from mining to care and maintenance or closure activities.

The objectives of a sudden unplanned mine closure would be to ensure the:

- long-term protection of human health and safety;
- long-term protection of ecological systems and receptors;
- closure of the mine is undertaken in a cost-effective and efficient manner;
- cost of decommissioning and rehabilitation is understood and that a mechanism for funding exists through the life of the mine; and
- closure of the mine considers stakeholder issues and concerns.

With regards to unplanned mine closure, the closure may be temporary in nature or permanent. A mine may be temporarily shut and placed into care and maintenance if there is potential for mining to recommence in the near future.

In the event of a temporary mine closure, the J-A mining areas will be maintained in a safe and stable state until operations can recommence. Drainage will be maintained and erosion monitored to ensure stability of landforms. Existing security measures for site access will be reviewed and modified as required to control access to the site and secure remaining infrastructure. All non-essential services and mining equipment will be removed. Any hazardous materials, such as explosives and hydrocarbons, will be reduced to minimum levels or moved to an alternative site or company for storage and/or use. Any monitoring required as per the PEPR or ML conditions will continue. Iluka will undertake a series of stakeholder consultation sessions to outline the care and maintenance phase of the Project and inform stakeholders if and when the care and maintenance phase is anticipated to end.

In the event of permanent unplanned mine closure, the strategies outlined in the *Mine Closure Plan* (Appendix G) would be implemented and, depending on timing, some modifications to this plan would be required.

Proposed mine completion activities for all Domains are detailed further in the *Mine Closure Plan* (Appendix G)

3.12.2 . Description of J-A project area at completion

Disturbance areas have been divided into a number of closure domains (Figure 44, Table 29) from which an assessment of land capability following mining has been carried out. The domains are defined as:

- Domain 1 – Ooldea Road;
- Domain 2 – Airfield and Village;
- Domain 3 – Borefield and access road; and

- Domain 4 – Mine site.

The closure domains will be rehabilitated to re-create a safe, stable, vegetated landform that is consistent with surrounding conditions and suitable for biodiversity conservation, passive tourism and traditional Aboriginal land uses. Some domains may remain in their upgraded form, subject to consultation with the final landowner (for example Ooldea Road).

The buried water supply line from the borefield to J-A Project area, and mine void subsurface drainage systems, will remain in-situ on closure. With the exception of crushed concrete reused as road base, hardstand material from the Whyalla Port (if used for shipping J-A product) and borrow pit backfill, no demolition, industrial or solid waste will be disposed of on-site as part of decommissioning, rehabilitation or closure activities.

A more detailed description of the final closure land uses for each domain is provided and in the *Mine Closure Plan* (Appendix G) and an overview below.

Domain 1 Ooldea Road

The domain contains:

- borrow pits;
- water points; and
- Ooldea Road.

Ooldea Road is intended to remain a public road post-mining. The borrow pits and water points will be rehabilitated to recreate a safe, stable, vegetated landform that is consistent with surrounding conditions.

Domain 2 Airfield and Village

The domain contains:

- airstrip;
- village; and
- drainage lines.

Domain 2 will be rehabilitated to a recreate a safe, stable, vegetated landform that is consistent with surrounding conditions and suitable for biodiversity conservation, passive tourism and traditional Aboriginal land uses. However, the final land use of the airstrip will be negotiated with the FWCAC and DEW and may remain if requested.

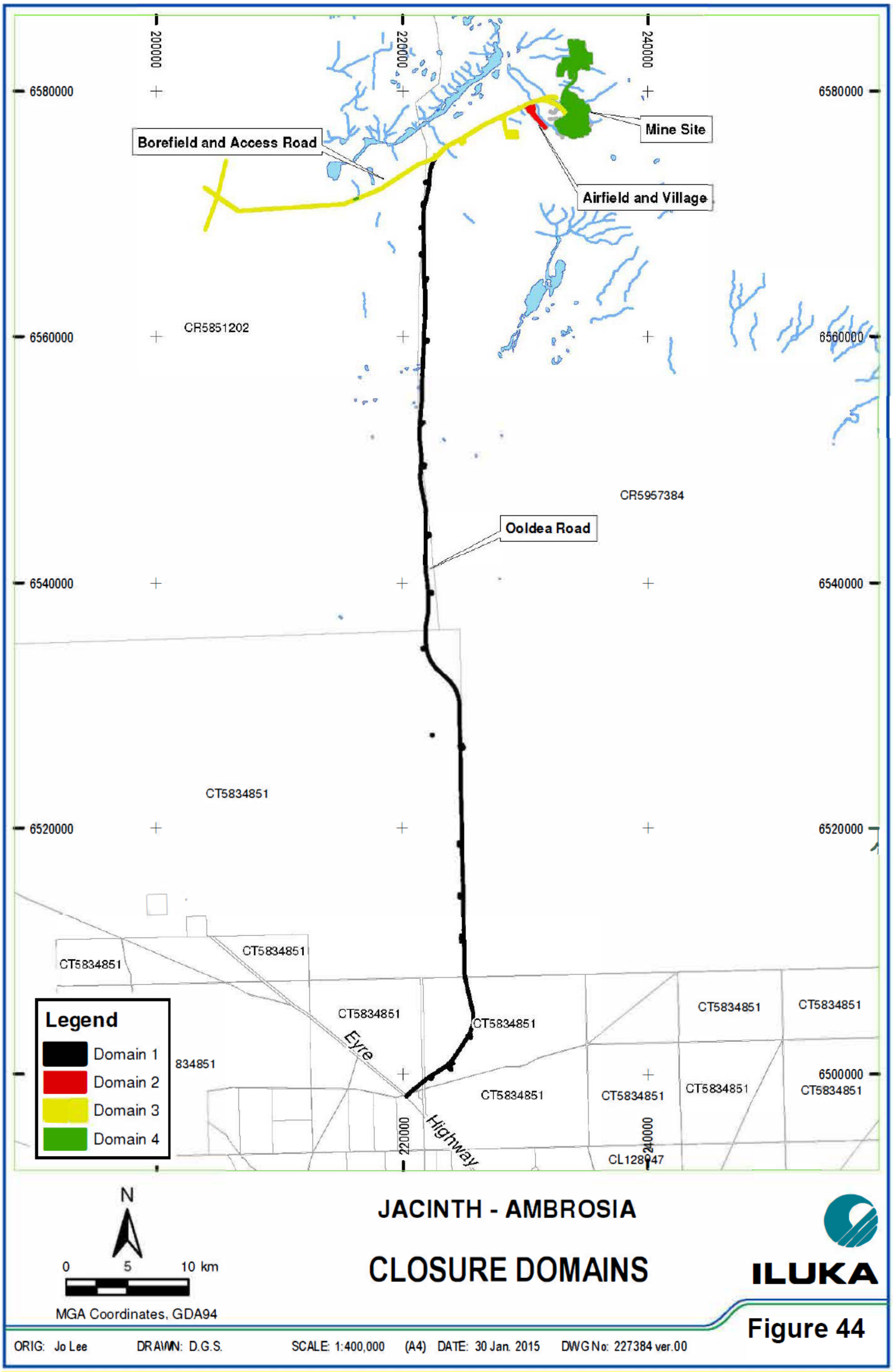

Figure 44: Closure domains

Closure domains, including their subdomains are further defined in Table 29.

Table 29: Closure domains

Parcel	Domain	Subdomain	Description
CR 5763/215 (Crown Reserve)	1	C	Ooldea Road
CR 5763/217 (Crown Reserve)	1	C	Ooldea Road
CR 5851/202 Nullarbor Regional Reserve (including borefield, pipeline, Ooldea Road and borrow pits)	-	-	Cultural track
	1	A	Borrow Pits
		B	Water points
		C	Ooldea Road
	3	A	Borefield Road
		B	Power lines and infrastructure
		C	Water points
		D	Tank farm 1
		F	EMLs, borrow pits
CR 5957/384 Yellabinna Regional Reserve (including mine, camp, Ooldea Road and borrow pits)	1	A	Borrow pits
		B	Water points
		C	Ooldea Road
	2	A	Airfield
		B	Village
		C	Drains
	3	A	Borefield Road
		B	Power lines and infrastructure
		C	Water points
		D	Tank farm 1
		E	Tank farm 1
		F	EMLs, borrow pits
	4	A	Jacinth Pit
		B	Ambrosia Pit
		C	off-path TSF
		D	Stockpiles

Parcel	Domain	Subdomain	Description
		E	Roads
		F	Process plant
		G	Offices
		H	Exploration-sites, water points
CT 5834/851 Yalata Aboriginal Reserve (including Ooldea Road and borrow pits)	1	A	Borrow pits
		B	Water Points
		C	Ooldea Road

Domain 3 Borefield and access road

The domain contains:

- access roads (including Canberra Road);
- Power Transmission Line;
- borefield infrastructure;
- water supply pipeline;
- Tank Farm 1; and
- borrow pits (located on adjacent EMLs).

Domain 3 will be rehabilitated to a recreate a safe, stable, vegetated landform that is consistent with surrounding conditions and suitable for biodiversity conservation, passive tourism and traditional Aboriginal land uses. Iluka will apply for permits to decommission the borefield wells and decommissioning will be completed in accordance with the *Minimum Constriction Requirements* for a single unconfined aquifer. The subterranean component of the water supply pipeline will remain in-situ. The depth of the water supply pipeline is 0.6 m deep to top of pipeline from surface and is not expected to impact on the closure outcomes.

Domain 4 Mine Site

The domain contains:

- Jacinth Mine area;
- Ambrosia Mine area;
- TSF;
- overburden storage areas;
- Process Plant site (including HMC stockpile areas);
- offices, workshops and communications tower; and
- exploration drill sites and access tracks.

Domain 4 will be rehabilitated to a recreate a safe, stable, vegetated landform that is consistent with surrounding conditions and suitable for biodiversity conservation, passive tourism and traditional Aboriginal land uses.

3.12.3 Landform

The final landform has been designed to ensure that it integrates with the surrounding undisturbed topography (Figure 46 to Figure 49). The design considered the availability of overburden materials, the location of surface water systems and erosion potential of the final surface. The design also utilised direct return materials where possible.

The topography has been lowered by an average of 2 m across Ambrosia and Jacinth North (Figure 46), which enables the volume of the off-path TSF to remain in situ and the opportunity for early rehabilitation. The pre-mining and proposed post disturbance surface contours are shown in Figure 47 to Figure 49.

Surface water modelling (including 2D hydraulic modelling) and erosion modelling (SIBERIA and WEPP simulations) were completed on the proposed post-disturbance landform design with the objective of achieving a sustainable landform (refer to Landform Erosion reports at Appendix F and Surface water catchment assessment at Appendix H).

Updated erosion modelling has occurred in 2019 by Landloch (Appendix F). This modelling was undertaken to account for the increased final landform height at Jacinth South (also known as Cell 6) and the modifications to the off-path TSF.

The assessments (including the updated modelling in 2019) for both surface water and erosion have verified that the post-disturbance landform provides a low risk of erosion or surface water impacts.

The design principles employed for the post-disturbance landform included:

- avoiding removal of ridgelines. Ridgelines play an important role in containing the surface-flow distribution to a specific catchment or area and maintaining the general alignment of watercourses. The removal of ridgelines may lead to channel abandonment if flood flows are able to link two watercourses which previously were separated by the ridgeline. Ridgelines may be lowered, but should not be lowered below the height of the design storm e.g. the water level of the 0.01 AEP flood (Alluvium 2015).
- avoiding lowering of watercourse bed levels, particularly in the vicinity of significant tributaries. Bed level lowering is highly likely to initiate incision which will have both local and catchment scale impacts. Where lowering is required, the majority of the watercourse needs to lowered and the bed gradient is to remain similar to the existing gradient (Alluvium 2015).
- modified slopes should be less than 15%.

Batter gradient of off-path TSF less than 10%.

Indicative elevation variation between proposed post-disturbance and pre-mining topography is shown in Figure 46.

3.12.4 Vegetation

Final rehabilitation vegetation will comprise the three vegetation types identified in the J-A Project area, chenopod shrubland, myall woodland and myall mallee woodland (Figure 50). The location and layout of the vegetation types within the rehabilitated matrix considers:

- preference for direct return of soils in keeping with best practice rehabilitation principles;
- location of surface water systems to minimise erosion potential;
- location of threatened vegetation;
- location of cultural heritage sites;
- alignment with Yellabinna Regional Reserve Management Plan objectives; and
- minimisation of habitat fragmentation.

3.12.5 Soil

The soil profile that is reinstated will vary dependent on the vegetation association that is being rehabilitated. Table 30 defines indicative profile thickness according to vegetation association.

For myall and myall/mallee woodland area, the total thickness of brown and red loam (if available) combined will be a minimum of 5.5 m, plus subsoil (0.15 m) and topsoil (0.05 m). For chenopod shrubland the total thickness of brown and red loam (if available) combined or only brown loam will be a minimum of 1.3 m, plus subsoil (0.15 m) and topsoil (0.05 m).

Table 30: Indicative soil profile

Soil materials	Landscape Vegetation Unit		
	myall/mallee Woodland	myall woodland	chenopod shrubland
	Thickness of layer (m)	Thickness of layer (m)	Thickness of layer (m)
Topsoil	0.05	0.05	0.05
Subsoil	0.15	0.15	0.15
Sand[a]	various	various	n/a
Calcrete layer[b]	various	various	n/a
Brown loam	2.30-5.50[c]	2.30–5.50[c]	0.30 - 1.30
Red loam	0.00 – 3.20[c]	0.00–3.20[c]	0.00 - 1.00[d]
Tailings	variable	variable	variable

[a] Yellow sand associated with dune and creek features.

[b] Calcrete layer associate with creek features only.

[c] Brown and red loam layers together to sum to 5.5 m thickness.

[d] In October 2017, Iluka received approval from DEM to modify the rehabilitation soil profile for the off-path TSF to 1.3 m thickness of brown loam.

Previous concerns regarding upward movement of salts from saline tailings material into overlying soils resulted in the requirement for a capillary break to be placed between the tailing and soil profiles within the original operations MARP (2009). However, further work completed by SRK (2011) and Iluka (2014) has determined that the tails are free draining and would reach a state of residual moisture content within two years. In the absence of a saline groundwater surface near the soil surface and within the critical depth, no upward movement of liquid water, and therefore entrained salts, could occur. This negates the need for a capillary break (Appendix I and Section 5.9). However, capillary break is to be installed should the tailings surface not reach a state of residual moisture content.

The proposed thickness of the red and brown loam was reviewed in 2014 in response to a brown loam excess and red loam deficit being experienced in comparison to the early pre-mine drilling surveys. This likely occurred due to the inexact boundaries between the brown loam/red loam layers. It is proposed to increase the brown loam thickness and reduce red loam thickness; whilst maintaining overall soil cover depth (Figure 45) from that prescribed in the MARP (Ops). This variation is expected to result in negligible change in storage, flux or plant available water of the soil profile, enabling the function of the soil profile being maintained (Appendix J).

Due to a re-optimisation of the ore reserve in late 2017, a surplus of approximately 300,000 bcm of brown loam material was identified at J-A. To minimise the rehandling, possible dust emissions and vegetation clearance that would be associated with stockpiling of this material, Iluka sought and received approval from DEM to return the entire volume of soil directly to the 2018 rehabilitation area on the off-path TSF. The rehabilitation area is approximately 28 ha in size and has been allocated as chenopod shrubland vegetation association. This means that the rehabilitated soil profile for the off-path TSF will consist of brown and red loam combined or only brown loam of minimum thickness 1.3 m, plus subsoil (0.15 m) and topsoil (0.05 m). Please note that whilst a surplus of brown loam has been identified, there is a limited volume of red loam. As such it will be used during rehabilitation sparingly.

The chenopod shrubland vegetation association comprises shallow rooted vegetation species. The species with the deepest recorded root structure in this vegetation association is *Maireana sedifolia* (up to 0.5 m). In undisturbed soils the roots of species in the chenopod vegetation association would generally sit within the brown loam profile, with a silcrete layer present at 1 m. Therefore, any natural interaction with the red loam soils is unlikely. Further, given that the rainfall infiltration depth is generally considered to be 0.3 m from surface, the exclusion of red loam from the profile is not likely to impact on the water availability in the rehabilitated soil profile. Therefore, it is unlikely that the proposed soil profile will be inadequate for the successful reestablishment of the chenopod shrubland in the off-path TSF area.

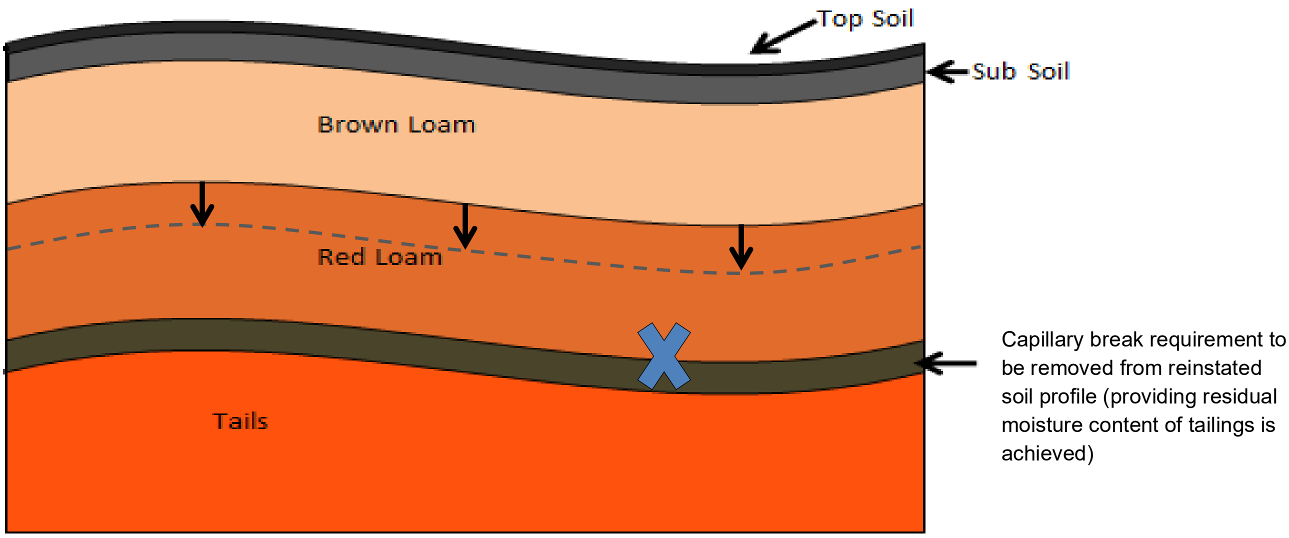

Figure 45: Proposed variation to brown and red loam layer when compared to the MARP. Red loam layer detailed above depicts its maximum extent in the soil profile, actual volume of red loam used may differ.

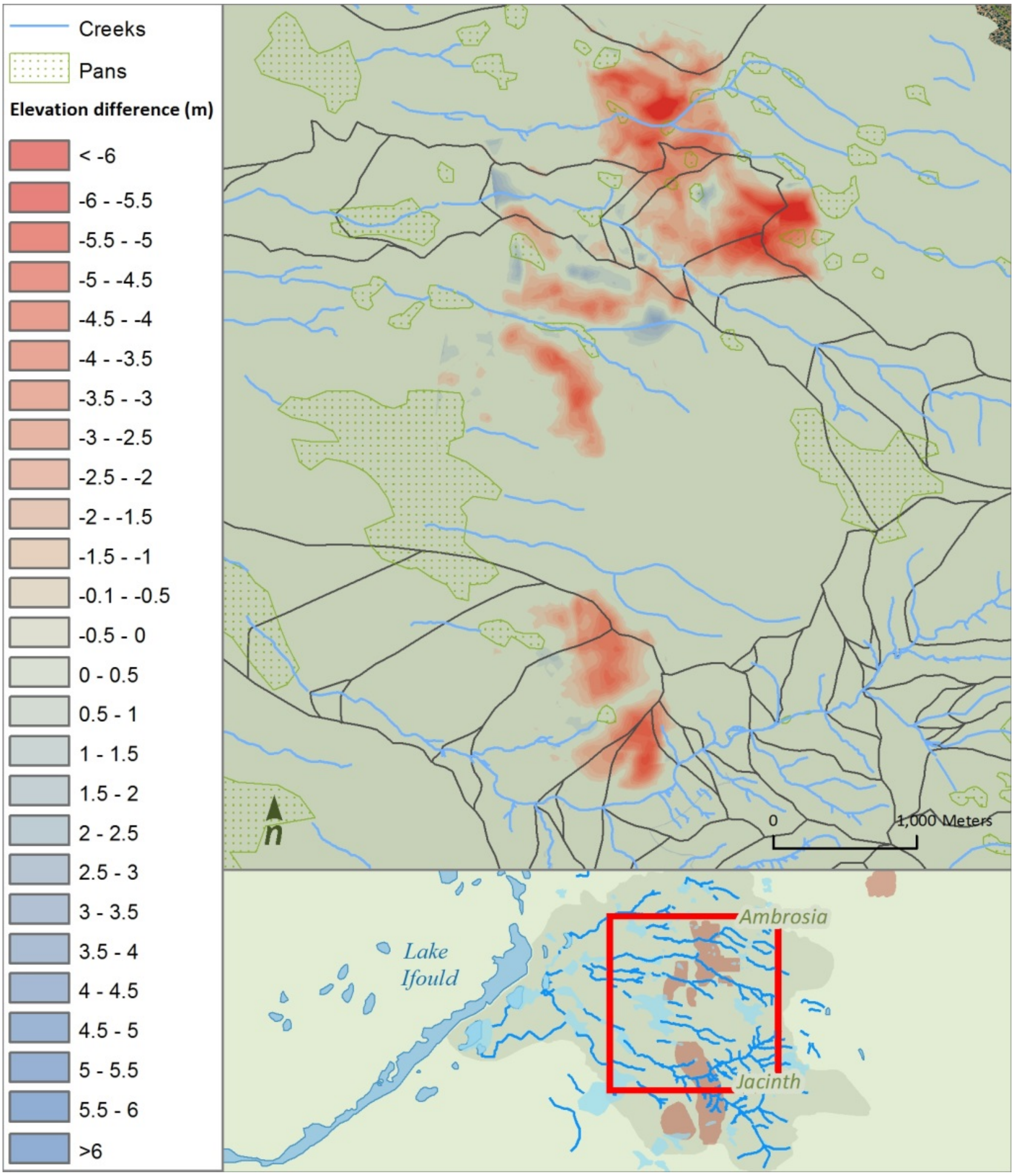

Figure 46: Indicative elevation variation between proposed post-disturbance and pre-mining topography *(Source: Alluvium 2015)*

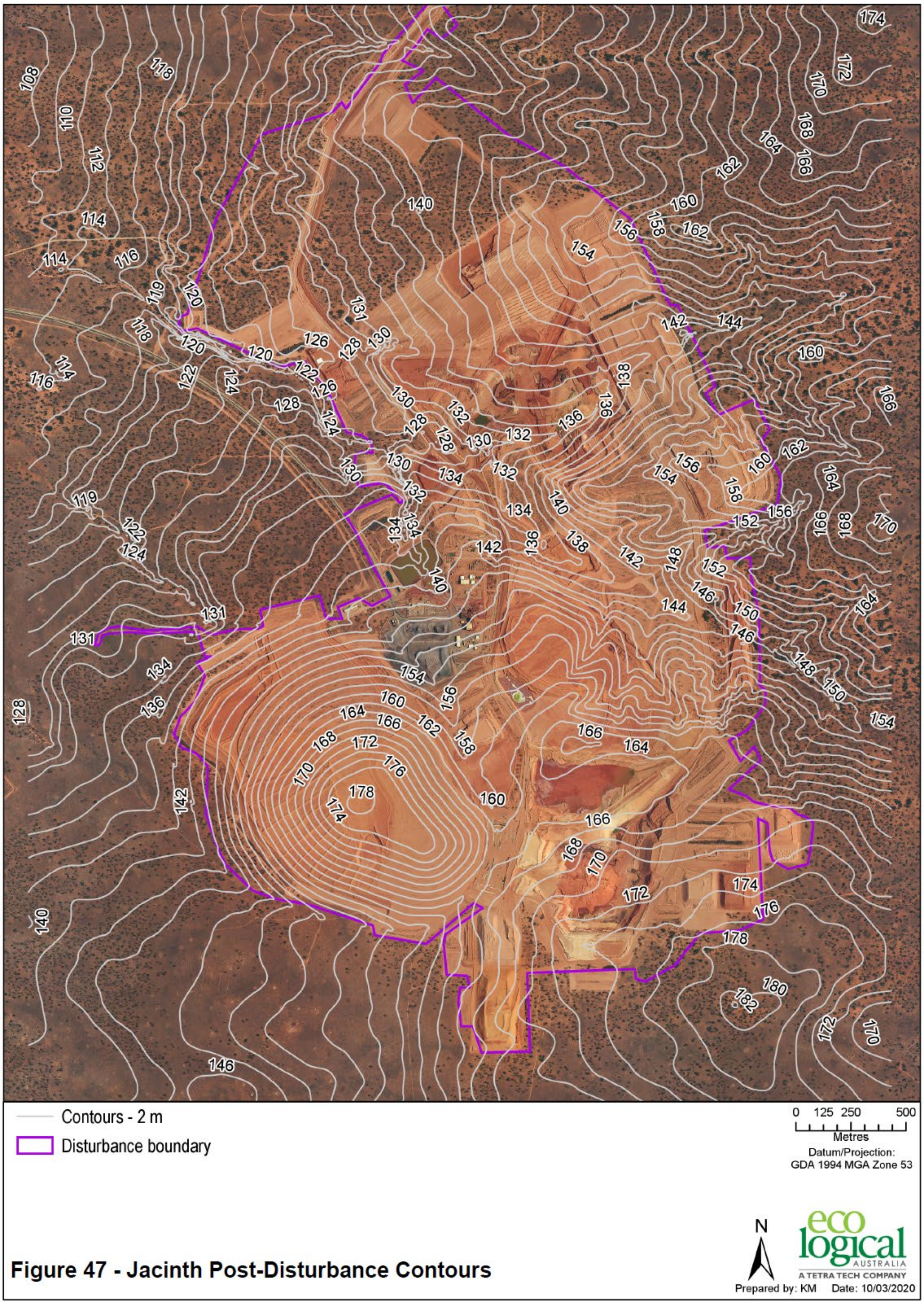

Figure 47: Jacinth post-disturbance contours

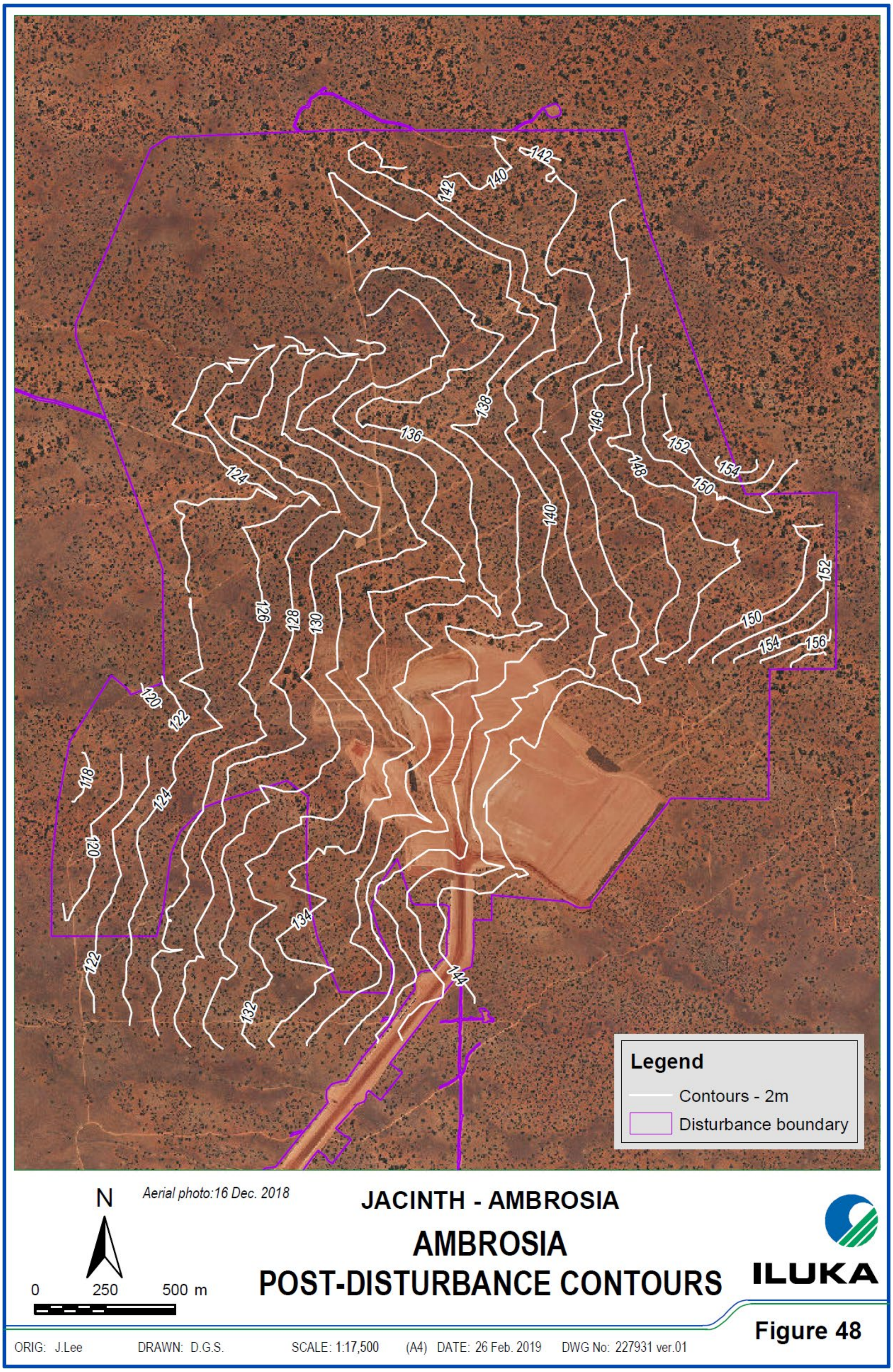

Figure 48: Ambrosia post-disturbance contours

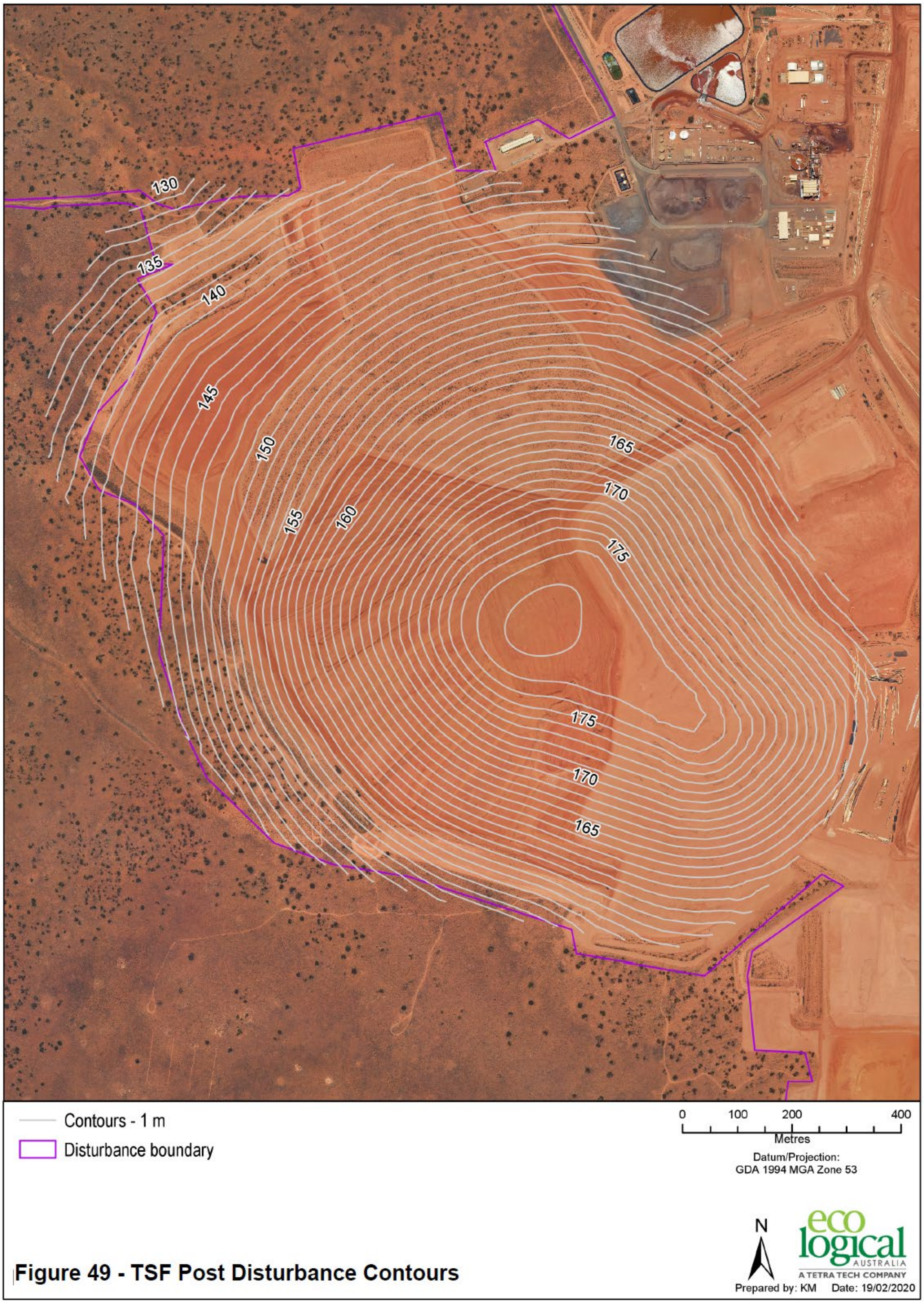

Figure 49: TSF post-disturbance contours

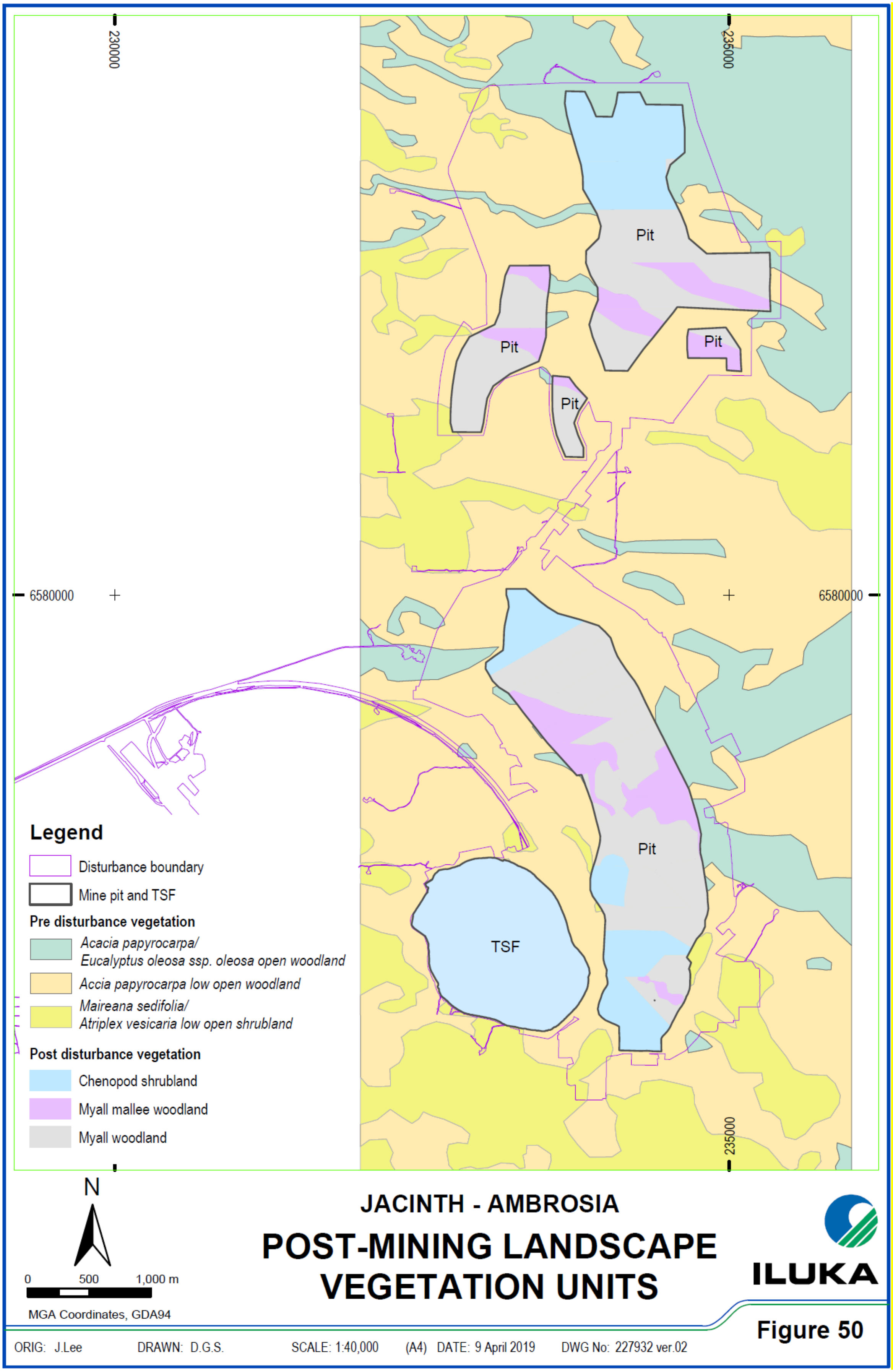

Figure 50: Proposed post-disturbance landscape vegetation units

3.12.6 Rehabilitation liability estimate

The rehabilitation liability estimate for J-A has been prepared using the South Australian Mine Rehabilitation Liability Calculator Tool (Rev. 5.21), per recommendation from DEM. The cost estimate is based on the assumption that a third party undertakes the rehabilitation and decommissioning works at the end of mine life. The liability estimate takes into consideration progressive rehabilitation and is based on the maximum area that will be open at one time (i.e. not rehabilitated) during the life-of-mine. The maximum area open, will be provided annually in the ACR provided to DEM.

The rehabilitation liability has been estimated at $56,967,840 (Table 31).

Table 31: Summary of estimated rehabilitation liability

Aspect	Cost
Exploration	**$0**
Underground workings	**$0**
In Pit TSF (Jacinth and Ambrosia) and Off Path TSF	$28,206,854
Waste rock dumps (low grade ore and interburden)	$4,757,534
Processing facilities	$2,403,866
Haul roads and access roads	$556,402
Administration and accommodation	$778,540
Services infrastructure (water sewage, power, water borefields)	$636,485
Water management (e.g. dams, watercourses, diversions)	$342,654
Subtotal	**$37,682,35**
Third party project management and contingency	$19,285,506
Total estimated rehabilitation liability	**$56,967,840**

4 Stakeholder Engagement

Iluka recognises that open and meaningful engagement with stakeholders is integral to the establishment, operation, rehabilitation and relinquishment of its mining and processing facilities. The company works in partnership with its stakeholders, including landholders, communities, Indigenous groups and government representatives for mutually beneficial outcomes.

All stakeholder engagement activities are conducted in accordance with the Iluka Health, Safety, Environment and Community (HSEC) Policy and the associated Health, Safety, Environment and Community Management System (HSECMS) group standard for stakeholder relations. The HSEC Policy outlines the company's principles for engagement and ensures that its business activities are conducted in consideration of all internal and external stakeholders.

A specific regional stakeholder engagement plan exists to include the Mine and adjacent locations, implemented through the appointment of dedicated internal resources.

The quality and transparency of Iluka's consultation with key stakeholders has been a key underpinning for the continuation of Iluka's mining and processing operations throughout Australia and in establishing its credentials in new areas of operation.

Iluka was the recipient of the South Australian Premier's Award for Excellence in Social Inclusion in 2018 for its enduring commitment to social inclusion and for delivering and developing programs in conjunction with the FWC Native Title Group. Iluka is a past recipient of this Award in 2017 as well as receiving commendations in a number of other years.

4.1 Results of consultation

Consultation that has occurred specifically for preparation of this revised PEPR and the previous PEPR version (version 1.1) application is provided in Table 32 below. This was undertaken following development of a Project specific (PEPR review) stakeholder engagement plan. The plan set out the processes for engaging with and receiving feedback from stakeholders, as well as for considering community issues and concerns relating to updating the PEPR.

The objectives of the plan were to:

- identify and prioritise stakeholders;
- identify appropriate engagement methods and frequencies;
- complement the existing *Eucla Basin Stakeholder Engagement Plan*; and
- minimise potential risks and/or impacts to operations through stakeholder feedback.

The engagement approach underpinning the Plan has been developed in accordance with:

- Project Management Institute – A Guide to the Project Management Body of Knowledge (PMBOK Guide);
- International Association for Public Participation;
- International Council on Mining and Metals – Community Development Toolkit;

- Iluka’s HSEC Standard – Social Performance; and
- Iluka’s HSEC Policy.

Table 32: Summary of consultation activities for previous and revised PEPR

Stakeholder	Date	Forum	Discussions/Issues	Outcomes/Responses
DSD	18 February 2014	Site visit	Site tour with focus on closure and rehabilitation activities	Improved understanding on rehabilitation and closure information required for PEPR. In-field acquaintance established for DSD officer of J-A site and Iluka rehabilitation standards
DSD	29 April 2014	Meeting	General discussion on intention to review and update the 2009 MARP (Ops)	Clarification of approval process to update from MARP to PEPR format. Letter submitted to DSD on 11 May 2014 to formally notify Iluka's intention to revise MARP (Ops) Subsequent workshops scheduled to provide notification of proposed MARP variations prior to PEPR application submission
DSD	21 October 2014	Workshop	Discussion on risk assessment process and information requirements for PEPR application	Improved understanding of information requirements required for PEPR application Review and update of MARP environmental risk register
DSD	27 November 2014	Meeting	Presentation of the key proposed variations to be submitted in the PEPR application	Acceptance of strategy for seeking approval of proposed amendments. No concerns raised over key proposed variations including: • Final landform variation • Removal of Capillary break requirement • Revision of soil profile prescription
DEWNR	27 November 2014	Meeting	Presentation of the key proposed variations to be submitted in the PEPR application	Verbal feedback that the proposed variations were of acceptable risk level to be recommended for approval, pending review of formal PEPR application
Far West Coast Native Title Claimant Group	10 December 2014	Meeting (Quarterly)	Presentation of the key proposed variations to be submitted in the PEPR application	Acceptance that the proposed variations would not impact on conservation and cultural heritage values
SA EPA	15 December 2014	Meeting	Presentation of the key proposed variations to be submitted in the PEPR application	Acceptance that the proposed variations would not impact existing activities under the EP Act (prescribed activities and radiation) or represent new prescribed activities
District Council of Ceduna	Periodically	Site Tour (Proposed Q2 2015)	General notification of intention to review and update MARP (Ops) to PEPR	N/A
Local Community	1 January 2015	Newsletter (Biannual)	General notification of intention to review and update MARP (Ops) to PEPR	No feedback received
DPC	5 September 2017	Meeting	J-A site update pre-J-A start up. Discussion of operations/rehab and future projects	Information only

Stakeholder	Date	Forum	Discussions/Issues	Outcomes/Responses
DEM	26 September 2017	Meeting	Presentation of the status of the current groundwater chemistry investigations at Jacinth-Ambrosia and discussion of non-compliance	Iluka to provide final report and commence discussion of suitable criteria
DEM	25 January 2018	Meeting	Presentation of groundwater geochemistry study results and initial discussion of suitability current SSTLs	Iluka to develop new criteria based on impact and study outcomes
DEM	2 February 2018	Meeting	J-A site update post J-A start up. Discussion of operations/rehab and future projects	Information only
Far West Coast Native Title Claimant Group	9 February 2018	Meeting	Far West Coast Native Title Liaison Committee Meeting. Update and presentation of the recommencement of mining at J-A	Information only
DEM/DEW	21 February 2018	Meeting	Presentation of proposed leading indicator and measurement criteria	Criteria agreed in principal, final wording to be determined at a later date
DEM/SA EPA/DEW	1 May 2018	Meeting	Presentation of PEPR update 2018 (including mine upgrade)	Information only
Far West Coast Native Title Claimant Group	15 June 2018	Meeting	Far West Coast Native Title Liaison Committee Meeting Update and presentation of the recommencement of mining at J-A	Information only
Far West Coast Native Title Claimant Group	15 June 2018	Meeting	Far West Coast Traditional Lands Aboriginal Corporation Meeting: Update presentation – re proposed upgrades at J-A	Information only
District Council of Ceduna	16 August 2018	Meeting	District Council of Ceduna; recommencement of the operations at J-A, making the DCC aware of increased traffic flow from the mine site through the town	Was made aware of potential increase on the local roads as a result of recommencement activity at J-A
DEM	21 August 2018	Site Visit	Site visit to J-A, discussion of operations/rehab and future projects	Information only
DEM	3 September 2018	Meeting	Presentation of the proposed scope and timing of PEPR updates	Information only

Stakeholder	Date	Forum	Discussions/Issues	Outcomes/Responses
SA EPA	20 September 2018	Meeting	Land & Water Consultants; Bioremediation management. LWC sought confirmation that the bioremediation of hydrocarbon contaminated material generated from J-A operations would be supported in principle by the EPA	Support of bioremediation as a sustainable treatment/management option indicated; identified further consultation with DEM and DEW
SA EPA	20 November 2018	Email correspondence	SA Radiation Pty Ltd; Ambrosia Baseline Radiation Survey SA Radiation sought early engagement with EPA regarding the closure criteria for radiation levels	EPA indicated that the proposed closure criteria align with similar rehabilitated sites in SA. EPA provided guidance on expectations of management if levels are higher than the set closure criteria, and on how to conduct ERICA assessments in this context
DEM/DEW	10 December 2018	Meeting	Update on the progress and timing of PEPR updates including specialist consultant studies undertaken to date for radiation, bioremediation management and groundwater. Presentation of the updated groundwater modelling and aquifer review results and discussion of groundwater measurement criteria updates	Follow up meeting to be organised with DEM and DEW once groundwater reporting is nearing completion
DEM/SA EPA/DEW	8 February 2019	Meeting	Further detailed presentation of the updated groundwater modelling and aquifer review results including more detailed discussions around the proposed updated groundwater measurement criteria and leading indicator criteria updates	Updated groundwater modelling and aquifer review report to be provided to DEM, SA EPA and DEW for review ahead of the updated PEPR submission. Follow-up meeting to be organised once report has been received and reviewed.
DEM	22 March 2019	Meeting	Preliminary discussion with DEM on the proposed new MPL for Canberra Road.	Discussed that an MPL submission would be issued for the proposed Canberra Road.
DEM	28 May 2019	Phone	Discussion on the MPL application, particularly the application format and native vegetation clearance requirements.	Discussed that a native vegetation clearance for the MPL and offsets will be required to align with the *Native Vegetation Regulations 2017*. DEM to review a proposed table of contents for the application.

Stakeholder	Date	Forum	Discussions/Issues	Outcomes/Responses
DEM	31 May 2019	Email	Email sent to DEM with proposed table of contents sent for MPL application.	None
DEM	3 June 2019	Email	Email received from DEM with commentary on the proposed table of contents for the MPL application.	None
DEM, DEW	15 July 2019	Meeting	Monthly Iluka/DEM meeting	None
DEM	19 July 2019	Email	Information provided by DEM Tenements Team on the application process for an MPL within a regional reserve.	None
DEM, DEW	20 August 2019	Meeting	Monthly Iluka/DEM meeting	Discussed the proposed timeframes for submission of MPL.
Yumbarra Co Management Board	3 September 2019	Meeting	Information provided by Iluka to the board on the proposed MPL and application to J-A mine. Visuals of the new design for the off-path TSF were also presented.	None
DEM	23 September 2019	Meeting	Discussion on updated timing for submission of PEPR inclusive of new MPL application.	Agreed best approach would be to submit a draft PEPR this year, which will be reviewed by all agencies. The PEPR will then be formally submitted once the Canberra Road MPL has been approved.
FWC	27 September 2019	Meeting	Update on J-A rehabilitation, changes to final landform design visuals presented, location of MPL-Canberra and explanation as to why required.	None

Stakeholder	Date	Forum	Discussions/Issues	Outcomes/Responses
DEM	17 October 2019	Draft	Draft review of MPL application prior to submission	Comments
DEM/SA EPA/DEW	12 November 2019	Meeting	Presented results from updated numerical groundwater modelling study. Draft changes to groundwater outcome measurement criteria and leading indicators were discussed	Agreed to submit draft PEPR before the end of 2019 inclusive of changes to outcome measurement criteria and leading indicators as presented in this meeting. All agencies will provide feedback along with the review of the draft PEPR.
DEM	24 December 2019	Email	Submission of MPL tenement application for Canberra Road.	None.
DEM/SA EPA/DEW	8 May 2020	Meeting (MS Teams)	Preliminary feedback on the proposed changes (with a particular focus on groundwater and radiation) to the PEPR was received prior to the meeting. Aspects of feedback from DEM, DEW and EPA were discussed.	Agreed that some feedback will be discussed further with the relevant regulator.
EPA	21 May 2020	Meeting (MS Teams)	Further discussion with EPA on how to respond to feedback received on items relating to radiation.	All parties agreed on how to incorporate feedback within PEPR.
DEM	21 July 2020	Phone	Update from DEM on when to expect remaining feedback on draft PEPR submission. Update provided on status of the MPL application for Canberra Road.	Confirmed feedback would be received within two weeks.
DEM	28 July 2020	Email	Provided clarification to DEM regarding response commentary on PEPR draft regarding density correction for modelling. Agreed with DEM and IGS to apply density corrections to all calibration data in the groundwater model and	Update PEPR and appendices.

Stakeholder	Date	Forum	Discussions/Issues	Outcomes/Responses
			update figures and relevant report sections.	
DEM	31 July 2020	Email	Final feedback on draft PEPR received from DEM.	None.
FWC	4 September 2020	Meeting	Presentation to new FWC Liaison Committee members on current PEPR update, including: New MPL tenement application; and Proposed changes to landform.	None
DEM	6 September 2020	Email	Update to DEM on PEPR submission date and details.	None.
DEM/EPA-DEW	4 March 2021	Meeting	Clarification and discussion of the departmental PEPR comments	Changes to PEPR as discussed.
DEM	18 March 2021	Meeting	Clarification and discussion of the DEM groundwater PEPR comments	Changes to PEPR as discussed.

4.2 History of consultation

A summary of consultation undertaken prior to approval of the mining proposal and associated MARP and subsequent PEPR, can be reviewed in the MARP (Ops), PEPR (Version 1.1), as well as earlier versions for construction and early works.

During the operations phase, the consultation program detailed in the *Eucla Basin Stakeholder Engagement Plan* has involved:

- ongoing liaison with government and non-government organisations, and community representative groups;
- meetings with councillors and staff of local authorities;
- providing information on the project to the Iluka workforce;
- dissemination of information through community newspapers in the region; and
- publication of a regular community newsletter, distributed to local landholders and the regional community.

Other considerations recorded in the stakeholder engagement plan are detailed below.

4.2.1 Land manager requirements

Iluka routinely engages and liaises with the land manager to ensure they are aware of the operational status and associated activities.

In accordance with Lease conditions within the Second Schedules of ML6315 (Condition 15), EML6316 (Condition 14), MPL110 (Condition 15) and MPL111 (Condition 14) Iluka is to have developed an operating protocol with the Director of National Parks and Wildlife which articulates operating procedures between mining operations and park management. This is contained in Appendix K.

4.2.2 Indigenous group communications

A Native Title Claim was lodged for the subject area by the then FWC Native Title Claimant Group (FWNTCG) (Federal Court Number SAD6008/98 and National Native Title Tribunal Number SC06/01) on 4 January 2006. A Part 9B Native Title Agreement (NTA; pursuant to the requirements of the *Native Title Act 1994*) was signed between Iluka Resources and the FWCNTG on the 13 December 2007. This agreement formalises protocols and systems for the parties to work together to achieve mutual benefits.

The FWCNTG were formally recognised as the Traditional Owners by the Australian Federal Court on 5 December 2013 (Lake Pidinga Consent Determination Ceremony). All matters pertaining to the NTA are now managed through the FWCAC, (Indigenous Corporation Number 7985, registered under the *Corporation (Aboriginal and Torres Strait Islander) Act 2006*).

The FWC traditional owners and communities are represented by the FWCAC. All Native Title Mining Agreement (NTMA) related engagement or J-A operational updates are required to go through the FWC Liaison Committee (FWCLC) and any community visits and/or activities must be reported to the Liaison Committee through the quarterly meetings.

Consultation with the FWC group has continued during operations.

4.3 Complaints management

All complaints are managed in accordance with the Iluka stakeholder complaint reporting and resolution procedure. The objectives of the procedure are to set out the minimum requirement for the resolution of grievances and complaints by external stakeholders across the business, specifically by:

- providing a channel for stakeholders to raise concerns either anonymously or directly;
- establishing a transparent and mutually respectful relationship with stakeholders;
- creating a culturally acceptable and accessible process to allow stakeholders to raise their issues, concerns, problems, and claims;
- implementing a process through which grievances can be resolved in a constructive, timely and respectful manner;
- recording complaints and the lessons learnt from incident investigations; and
- following the appropriate procedure in escalating comments and grievances.

All complaints shall be logged through the Consultation Management System or in the Iluka Loss Control Reporting System and entered into an internal database. Depending on the threshold of the complaint and ensuing response, entry into Iluka's Emergency and Crisis Management System may also be required.

4.4 Recording and reporting

All consultation activities are recorded in Iluka's consultation database Isometrix. Records of regulator consultation are also stored in Iluka's document management system.

4.5 Ongoing stakeholder engagement

Ongoing community consultation is undertaken in accordance with Iluka's *Eucla Basin Stakeholder Engagement Plan*. The plan is reviewed annually at a minimum and contains the process for:

- identification, classification and prioritisation of stakeholders;
- setting engagement objectives, identifying issues/concerns, selection of communication tools and an implementing an indicative schedule;
- grievance mechanism for managing stakeholder complaints or feedback;
- stakeholder data management; and
- roles and responsibilities for implementation of the plan.

5 Environmental Impacts and Outcomes

5.1 Overview

This section provides an assessment of the environmental impacts for J-A, for the life of the Project. It is presented as an update to the 2015 PEPR (Version 1.1) impact assessment, and it incorporates learnings obtained since mining commenced. Consideration of new environmental impacts is addressed in Section 5.3.

For each aspect assessed, the following information is provided:

- description of the potential environmental impacts that may be associated with the Project. Identification of the impacts is based on knowledge of the existing environment, operational experience in the J-A Project area and consideration of stakeholder views.
- an assessment of the primary risk level, without consideration of control and management strategies.
- identification of control and management strategies to achieve desired environmental outcomes.
- a residual risk assessment associated with each impact event. This is based on successful implementation of the nominated control and management strategies.
- identification of environmental outcomes for impact events that have an inherent risk level or moderate or above, or those that are prescribed within the Lease conditions.
- measurable outcome criteria and leading indicators to provide early warning if the management and control measures are ineffective.

All measurement criteria and outcomes for new environmental risks have been integrated into Sections 5.6 to 5.17.

5.2 Process

5.2.1 Risk assessment

Risks associated with Iluka activities are systematically identified, analysed, evaluated and treated. The J-A environmental impact assessment was completed in accordance with Iluka's risk assessment framework (see Section 6).

Identified risks are first assessed for an inherent risk level. This is a measure of the likelihood and consequences of environmental harm occurring from an activity if it was to be undertaken without any regard to environmental management and mitigation measures.

Consideration is then given to avoidance, mitigation and/or management measures for identified risk events. Risk treatment may be through design control measures (i.e. those measures that can be incorporated into the design of the operations) or operational management measures (e.g. management approaches and plans to be implemented during operations). The control and management measures are considered technically and economically feasible and reflect Iluka's commitment to minimising environmental impacts.

The identified risks are then assessed for a residual risk level, which takes into account the effective implementation of the control and management measures.

The risk assessment matrix and criteria used to determine both inherent and residual risk level is provided in Table 33 to Table 36.

Table 33: Iluka risk matrix (Part A)

Risk Matrix						
LIKELIHOOD RATING	5 Almost Certain	5	10	15	20	25
	4 Likely	4	8	12	16	20
	3 Possible	3	6	9	12	15
	2 Unlikely	2	4	6	8	10
	1 Rare	1	2	3	4	5
		1 Negligible	2 Minor	3 Moderate	4 Significant	5 Major
CONSEQUENCES RATING						

Table 34: Iluka risk matrix (Part B)

Risk Level	Descriptor
17 - 25	Extreme
13 - 16	Very High
7 - 12	High
4 - 6	Moderate
1 - 3	Low

Indicators which are considered to determine consequence and likelihood ratings are provided in Table 35 and Table 36.

Table 35: Consequence indicators for risk assessment

Consequence		Indicators					
Descriptor	Rating	Financial (AUD)	Company Objective	Injury/Illness	Environment	Stakeholder	Compliance
Negligible	1	< 100K	The impact can be dealt with by routine operations	No medical treatment required	Limited damage to minimal area of low significance	Low-level repairable damage to commonplace structures	Technical breach of legal obligations without penalties or damages claims
Minor	2	100K – 1M	The impact would threaten the ability to achieve current year objectives	First aid with no permanent disability	Minor effects on biological or physical environment	Minor medium-term social impacts on local population. Mostly repairable	Breach of legal obligations resulting in minor penalties or damages claims
Moderate	3	1M – 10M	The impact would threaten the ability to meet strategic objectives in short term	Medically treated injury with no permanent disability	Moderate, short-term effects but not affecting ecosystem function	Ongoing social issues. Permanent damage to items of cultural significance	Breach of legal obligations resulting in moderate penalties, or damages claims
Significant	4	10M - 100M	The impact would threaten the ability to meet strategic objectives in medium term	Permanent disabling injury or Lost Time Injury	Serious medium term environmental effects	Ongoing serious social issues. Permanent damage to items of cultural significance	Breach of legal obligations resulting in significant penalties or damages claims
Major	5	>100M	The impact is beyond ability to manage or resource and threatens the survival of the company	Fatality or serious permanent disabling injury	Very serious, long-term environmental impairment of ecosystem function	Very serious widespread social impacts. Irreparable damage to highly valued items	Breach of legal obligations resulting in major penalties or damages claims, or prosecution of the Company

* Note Indicators are not intended to correlate, an indicator is selected which best suits the event

Table 36: Likelihood indicators for risk assessment

Likelihood		Indicators		
Descriptor	Rating	Description	Probability*	Frequency*
Rare	1	The event may occur only in exceptional circumstances	< 10%	Less than once in 25 years
Unlikely	2	The event could occur at some time	11 - 25%	At least once in 25 years
Possible	3	The event should occur at some time	26 - 75%	At least once in 5 years
Likely	4	The event will probably occur in most circumstances	76 – 90%	At least once a year
Almost certain	5	The event is expected to occur in most circumstances	>90%	At least once per month

* Note Probability and Frequency are not intended to correlate, an indicator is selected which best suits the event

5.2.2 Control and management measures

For each impact event with an inherent risk level of moderate or above, control and management strategies are described. These risk treatment strategies are considered using a hierarchy of controls approach provided in Iluka's *Group Risk Assessment Criteria Procedure*. The hierarchy ranges from elimination through to administration (management system) controls. Generally, design engineering control measures (primary control) and management system measures (secondary controls) are selected as suitable controls for risk treatment and are described in this PEPR.

Implementation of both design control and management measures are aimed to facilitate the achievement of the identified environmental outcomes.

5.2.3 Environmental outcomes and measurement criteria

Environmental outcomes are derived from both Lease conditions and impact events which have an inherent risk level of moderate or higher. Environmental risks ranked lower than moderate are not discussed in detail within the PEPR, but are captured and managed separately through the J-A environmental risk register.

The outcomes reflect the anticipated level of environmental impact associated with the Project. A summary table of all outcomes, measurement and leading indicator criteria is provided in Section 5.18. Further discussion on closure impacts is discussed in Section 5.19 and Appendix G.

Environmental outcomes which have been derived from Lease conditions are summarised in Table 37 below.

Table 37: Outcomes derived from Schedule 2 or 6 Lease conditions

Lease Reference	Schedule 2 Lease Conditions	Environmental Outcome	PEPR Section
ML6315	**Groundwater** The Lessee must ensure that groundwater systems outside of the extent of mine workings are not altered by the disposal of process water in the pit.	The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity (compared to the groundwater model) and quality (compared to quality changes in the preliminary geochemical model) within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities.	5.15
MPL110	**Groundwater** The Licensee must ensure that the extraction and use of groundwater does not adversely affect any environmental processes which are reliant on that groundwater system.	The extraction and use of groundwater does not adversely affect environmental processes that are reliant on that groundwater system.	5.15
ML6315, EML6316 MPL111, MPL110, MPL161	**Native Vegetation and Fauna** The Lessee must ensure that the post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	The post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	5.12, 5.14
ML6315, EML6316 MPL111, MPL110, MPL 161	**Native Vegetation** The Lessee must, in constructing and operating the lease, ensure that all clearance of native vegetation is authorised under appropriate legislation.	All clearance of native vegetation is authorised under appropriate legislation.	5.12
ML6315, EML6316, MPL111, MPL110, MPL161	**Native Fauna** The Lessee must in constructing and operating the lease ensure that there are no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	There are no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	5.13
ML6315, EML6316, MPL111, MPL110	**Native Fauna** All sick and injured fauna must be managed as per the requirements of the *Animal Welfare Act 1985.*	All sick and injured fauna must be managed as per the requirements of the *Animal Welfare Act 1985.*	5.13
ML6315, EML6316, MPL111, MPL110	**Public Safety** The Lessee must in constructing and operating the lease ensure that there are no public injuries and or deaths resulting from unauthorised entry to the site that could have been reasonably prevented.	There are no public injuries and or deaths resulting from mine operations traffic, or unauthorised entry to mine site that could have been reasonably prevented	5.6
ML6315, EML6316, MPL111, MPL110	**Public Safety** The Lessee must in constructing and operating the lease ensure that there are no uncontrolled fires caused by mining operations.	No uncontrolled fires caused by mining operations.	5.6

Lease Reference	Schedule 2 Lease Conditions	Environmental Outcome	PEPR Section
ML6315, EML6316, MPL111, MPL110	**Consultation and Engagement** The Lessee must take responsibility for developing and operating a stakeholder engagement plan, as a part of the PEPR, which ensures effective communication and exchange of information between the operator and stakeholders including but not restricted to the landowner, Ceduna community and Aboriginal groups or individuals.	Maintain a Stakeholder Engagement Plan throughout the life of project, including closure.	4
ML6315, EML6316, MPL111, MPL110	**Hazardous Materials** The Lessee must ensure that fuel and liquid chemical storage is adequately bunded to capture spillage and to prevent the migration or infiltration of any spillage or leakage to the surrounding environment in conformance with relevant Environment and Protection Authority guidelines.	Fuel and liquid chemical (hazardous materials) storage are adequately bunded to capture and prevent the migration and infiltration of any spillage or leakage to the surrounding environment in conformance with relevant EPA guidelines.	5.16
ML6315, EML6316, MPL111, MPL110, MPL161	**Pest Species** The Lessee must in constructing and operating the lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the lease area and adjacent areas caused by mining operations	No introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the lease area and adjacent areas caused by mining operations.	5.8
ML6315, EML6316, MPL111, MPL110, MPL161	**Heritage** The Lessee must in constructing and operating the lease, ensure that there is no disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.	No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.	5.7
ML6315, EML6316, MPL111, MPL110, MPL161	**Soil** The Lessee must ensure that the pre-existing soil profile and function are reinstated.	The pre-existing soil profile and function are reinstated.	5.9
ML6315, EML6316, MPL111, MPL110	**Waste Management** The lessee must ensure that no demolition, industrial or solid domestic (other than treated sewage) wastes are to be disposed of within the lease.	No demolition, industrial or solid domestic (other than treated sewage) wastes are to be disposed on-site.	5.10
ML6315, EML6316, MPL111, MPL110	**Consultation and Engagement** The Lessee must take responsibility for developing an operating protocol with the Director of National Parks and Wildlife to articulate operating procedures between mining operations and park management.	That an operating protocol between Iluka and DEW is implemented and maintained.	4
MPL161	**Surface Water**	Mining related activities do not adversely affect surface water	5.14

Lease Reference	Schedule 2 Lease Conditions	Environmental Outcome	PEPR Section
	The tenement holder must ensure mining related activities related to Canberra Road do not decrease the quantity of surface water available to water dependant ecosystems on or off the Land.	available to water dependant ecosystems.	

Outcomes which have been developed for impact events which have an inherent risk level of moderate or higher; or that are derived to ensure compliance with relevant legislation are provided in Table 38.

Table 38: Summary of outcomes derived from risk assessment and legislative review

Impact ID	Impact Description	Outcome	PEPR Section
SW1	**Surface Water** Adverse impacts to local drainage patterns due to modification of flow regimes (from clearing and earthworks activities).	The post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	5.14
SW2	**Surface Water** Impact on general surface water quality due to release of sediment laden water/contaminated water (hydrocarbons/salt) from operational activities.	Ecosystems are not damaged by release of contaminated water off lease.	5.14
DA2	**Dust and Air Quality** Impact on local/regional air quality due to the emission of fuel combustion products (associated with vehicles and diesel power generation).	All fuel burning equipment is operated in accordance with the requirements of the EPA.	5.11
VA2	**Visual Amenity** The post mining topography does not adequately integrate with the surrounding 'natural' topography (visual amenity).	The reconstructed landform is consistent with surrounding topography.	5.17

Each environmental outcome is accompanied by measurable criteria (outcome measurement criteria) for both the operational and closure phases of the Project. The outcome measurement criteria will be used to demonstrate the achievement of the environmental outcome and are used by DEM to assess compliance.

Leading indicator criteria have been developed for impact events, where relevant. Lead indicators are proactive and aim to provide an early indication about whether the control and management strategies are effective.

A summary of all measurement and leading indicator criteria is provided in Section 5.18.

5.2.4 Monitoring

Monitoring of environmental aspects to demonstrate achievement of the outcomes is described in Sections 5.6 to 5.17. All monitoring programs are incorporated in existing management plans maintained in the J-A Project area. These are reviewed and continuously improved in accordance with Iluka's HSEC Management System standards.

External reporting of compliance against environmental outcomes is provided to DEM via an ACR, which provides discussion on the monitoring results.

5.3 New environmental impacts

A key objective of the PEPR is to identify opportunities at J-A which will provide improved economic outcomes while maintaining or surpassing environmental commitments. For each proposed variation, potential environmental impacts were identified and assessed to determine if the existing outcomes were adequate or if new or modified outcomes were required.

Assessment of the residual risk to the receptor (resulting from the 'potential change', see Table 40) was considered when determining if the existing outcome was adequate. The risk assessment criteria described in Section 5.2.1 was applied for this assessment. The residual risk took into account application of the control and management strategies detailed in Table 40.

Proposed variations from the 2015 PEPR are described in Table 39.

Table 39: Proposed variations from the 2015 PEPR

Proposed Variation	Aspect/s which could be Impacted	Phase	Change in Residual Risk Level	New Environmental Outcome Required?
Revised rehabilitation soil profile for all landscape vegetation units with or without the use of red loam	Soil Vegetation	Closure	No	No
Hardstand material from Whyalla Port (if used for shipping J-A product) to be returned to the J-A site and disposed of in-pit at the completion of mining	Waste management	Closure	No	No
On-site bioremediation of hydrocarbon impacted soils for reuse during rehabilitation works	Soil Waste management	Closure	No	No
Construction and widening of road as part of MPL 161.	Cultural heritage Pest species Soils Dust and air quality Native vegetation Native fauna	Operation and closure	No	Yes – Surface water

Proposed Variation	Aspect/s which could be Impacted	Phase	Change in Residual Risk Level	New Environmental Outcome Required?
	Surface water			
Power generation efficiency improvements including installation of solar power generation facility	Dust and air quality	Operations	No	No

The assessment of new potential impacts which may arise from these variations, as well as a determination of whether current outcomes are sufficient, is provided in Table 40 below.

Management and control strategies for these new impacts have been integrated into the individual aspect Sections 5.6 to 5.17 and referenced in Table 40.

Recent studies reviewing potential groundwater quantity and quality impacts informed the decision to amend five outcome measurement criteria and/associated leading indicators (impact events C40, C41, C42, C43 and C44) relating to groundwater. The amendments are discussed further in Section 5.15.6 and are outlined in Table ES2 below.

Outcome measurement criteria was also amended in relation to soil profile and radiation (C22). Due to a lack of baseline radiation data, it was determined that a criteria based on impact would prove a more effective measurement.

The visual amenity outcome measurement criteria (C48 and C49) was amended to reflect newly proposed rehabilitation landform design.

Table 40: Assessment of potential new environmental risks

Environmental Outcome	Currently achieving outcome?	Impact Event Analysis			Additional management and control strategies (if applicable)	Change in residual risk level to receptor?	Outcome still appropriate?	Applicable measurement criteria reference
		Potential changes to/new impact event (source)	Pathway	Receptor				
Proposed variation: Revised rehabilitation soil profile for all landscape vegetation units with or without the use of red loam								
Soil profile and function is restored and capable of supporting agreed land use	Yes	Revised rehabilitation soil profile for all landscape vegetation units to maintain current total loam thickness, with or without the use of red loam	Pre-existing soil profile	Soil	• No additional strategies proposed	No	Yes **New Outcome Required?** No	C15
Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	Yes	Revised rehabilitation soil profile for chenopod vegetation community to 1.3 m thickness of brown loam, due to the lack of availability red loam may or may not be used Revised rehabilitation soil profile for mallee woodland vegetation communities to 5.5 m thickness of brown loam, due to the lack of availability of red loam may or may not be used	Growth of chenopod vegetation	Native Vegetation	• The majority of flora species are shallow-rooted. The species with the deepest recorded root structure in the chenopod vegetation association is *Maireana sedifolia* (up to 0.5 m). The deepest-rooted species in the mallee and myall woodland vegetation associations are *Eucalyptus spp*. and *Acacia papyrocarpa* (western myall). • In undisturbed soils the roots of species in the chenopod vegetation association would generally sit within the brown loam profile, with a silcrete layer present at 1 m. • Therefore, any natural interaction with the red loam soils is unlikely. • Further, given that the rainfall infiltration depth is generally considered to be 0.3 m from surface, the exclusion of red loam from the profile (if required) is not likely to impact on the water availability in the rehabilitated soil profile.	No	Yes **New Outcome Required?** No	C29
Proposed variation: Hardstand material from Whyalla Port (if used for shipping J-A product) to be returned to the J-A site and disposed of in-pit at the completion of mining								

Environmental Outcome	Currently achieving outcome?	Impact Event Analysis			Additional management and control strategies (if applicable)	Change in residual risk level to receptor?	Outcome still appropriate?	Applicable measurement criteria reference
		Potential changes to/new impact event (source)	Pathway	Receptor				
No demolition, industrial or solid domestic wastes (other than treated sewage) are to be disposed on-site	Yes	Hardstand material from Whyalla Port to be returned to the J-A site and disposed of in-pit at the completion of mining	Contamination via leaching or infiltration	Soil and groundwater	• Hardstand material analytical testing for contamination, with results compared to remediation criteria in the *Bioremediation Management Plan* (BMP), prior to transport to J-A site. • Hardstand material to be disposed of at an appropriately EPA-licensed facility if contamination levels do not meet remediation criteria in the BMP at closure.	No	Yes **New Outcome Required?** No	C25 and C26
Proposed variation: On-site bioremediation of hydrocarbon impacted soils for reuse during rehabilitation works								
Soil profile and function is restored and capable of supporting agreed land use	Yes	On-site bio-remediation of hydrocarbon impacted soils and reuse during rehabilitation works	Contamination via leaching or infiltration	Soil	• Bioremediation program conducted in accordance with BMP • Bioremediation works undertaken in accordance with SA EPA (2018) Guidelines for the Assessment and Remediation of Site Contamination and the SA EPA (2005) Guidelines for soil bioremediation • Bioremediation pad design in accordance with the SA EPA (November 2005) Guidelines for soil bioremediation • Bioremediation pad construction in accordance with principle outlined in Section 3.10.6.	No	Yes **New Outcome Required?** No	C15
No demolition, industrial or solid domestic wastes (other than treated sewage) are to be disposed on-site	Yes	On-site bio-remediation of hydrocarbon impacted soils and reuse during rehabilitation works	Contamination via leaching or infiltration	Soil and groundwater	• Bioremediation program conducted in accordance with BMP • Bioremediation works undertaken in accordance with SA EPA (2018) Guidelines for the Assessment and Remediation of Site Contamination and the SA EPA (2005) Guidelines for soil bioremediation • Hydrocarbon impacted soils to be disposed of at an appropriately EPA-licensed facility if contamination levels do not meet remediation criteria in the BMP at closure	No	Yes **New Outcome Required?** No	C25 and C26
Proposed variation: Expansion and widening of new haul road (Canberra Road)								

Environmental Outcome	Currently achieving outcome?	Impact Event Analysis			Additional management and control strategies (if applicable)	Change in residual risk level to receptor?	Outcome still appropriate?	Applicable measurement criteria reference
		Potential changes to/new impact event (source)	Pathway	Receptor				
Various outcomes that relate to the following impacts: • Cultural heritage • Pest Species • Soils • Native Vegetation • Native Fauna; and • Surface Water.	Yes	Ground disturbance during road development and widening	Construction and operation, land clearing	• Cultural heritage • Pest Species • Soils • Native Vegetation • Native Fauna; and • Surface Water.	Maintain the existing control and management strategies for all.	No for all, except for NV2 which was assessed for the MPL161 to be Moderate from Low	Yes **New Outcome Required?** No	Cultural Heritage: C7, C8 an C9 Pest Species: C10, C11, C12, C13 Soils: C14, C15, C16, C17, C18, C19, C20, C21, C22 C23 Native Vegetation; C27, C28, C29, Native Fauna: C30, C31, C32 Surface Water; C33, C34, C35, C36

5.4 Existing environmental impacts

Environmental impacts which have been previously assessed for the Project within the original Mining Proposal application and subsequent MARPs are provided in this section. These impacts have been provided to consolidate all impacts, outcomes and measurement criteria into the one document, this PEPR. While they have been provided in an updated format to meet requirements of MD005 when compared to the MARP, they do not contain new impacts or outcomes for assessment.

New information which has been provided in this PEPR, as a result of the structure change when compared to PEPR (version 1.1) and the MARP, includes:

- leading indicator criteria;
- identification of uncertainties; and
- inclusion of any further management and control strategies which have been identified since operations have commenced.

5.5 Views of affected parties

The key stakeholders identified which may be impacted by the Project are:

- DEW (land manger);
- DEM;
- EPA; and
- FWCAC.

These stakeholders are applicable for all aspects covered in sections 5.6 to 5.16.

Through ACR and consultation in accordance with the *Stakeholder Engagement Plan* and NTMA, these stakeholders are all kept informed of the operational impacts and performance against assessment criteria.

There are no surrounding landholders or residents in close proximity to the J-A Project area.

5.6 Public safety and traffic

5.6.1 Context

The mining operations are remote from populated centres. In rare instances there may be visitors to the area given the regional reserve status. Local indigenous communities of Yalata, Maralinga and Oak Valley may also access the public road infrastructure which provides access to the J-A Project area.

Access to the J-A Project area is via Ooldea Road from the Eyre highway (see Figure 2). The Eyre Highway connects the eastern states to Western Australia. Ooldea Road was upgraded in 2008 via a Development Application (reference 2005/04273/01). The road, which is maintained by Iluka, is external to the Lease/Licence areas covered by this PEPR.

Due to the remoteness of the J-A Project area with very limited pubic traffic, no fixed infrastructure (e.g. boom gates, security stations) is installed. Information and mine access warning signage is installed at key points on the inbound Ooldea Haul Road to deter unintended vehicle traffic or direct it to the mine village office.

In cases where members of the public do present to the mine village, a Travellers Drop-in Procedure is in place to direct what assistance and support is provided by Iluka.

In addition to unauthorised/uncontrolled third-party access to the J-A Project area, risks to public safety includes operational traffic between the J-A Project area and Thevenard Port (mineral haulage and general transport) and fires caused by mine operations.

5.6.2 Applicable legislation and standards

The following legislation is applicable for public safety and traffic management:

- Mining Act;
- *Work Health and Safety Act 2012 (SA)*;
- *Crown Land Management Act 2009 (SA)*; and
- EP Act.

5.6.3 Potential impacts

Potential impacts related to public safety and traffic, are summarised in Table 41 and described below.

Table 41: Potential impacts associated with public safety and traffic

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
PST1	Unauthorised access to the project area	Site security failures, unintentional site access through bushland tracks	Member of the public	Injury or death caused by mine operations	Yes – Due to the remote location of the site it is unlikely that the public will gain access to the site, however it remains possible.
PST2	Increased traffic from mine operations, including light vehicles and road trains.	Traffic accident /collision with person, vehicle or property	Member of the public	Injury or death caused by collision with mine operations traffic	Yes – Traffic will increase on public roads during operations due to material movements of HMC to the Port of Thevenard or to the Port of Whyalla (if utilised). It remains possible that an accident or collision with the public could occur.

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
PST3	Bushfire (where caused by mine operations)	Hot works/ignition sources, use/storage of flammable materials Accident/rollover of mobile plant	Member of the public	Injury or death caused by uncontrolled fire caused by mine operations.	Yes – Due to the remote location of the site it is unlikely that the public will gain access to the site, however it remains possible. Furthermore an uncontrolled fire is unlikely but could potentially occur from lightning strikes, arson, hot works/on-site ignition sources or storage of flammable materials.

Injury or death caused by operations from unauthorised access

Injury or death could result to members of the public through a range of means if unauthorised or uncontrolled access to the J-A Project area occurs, especially the mine pit and stockpile areas. The J-A Project area has been designed so that the village is the first point of contact along the access road to the mine. Due to its remote location, it is unlikely the public would gain unauthorised access to the J-A Project area. The J-A Project area is occupied and operated continuously, 24 hours a day, 7 days a week. The inherent risk level is considered **high**.

Injury or death caused by collision with mine operations traffic

Potential injury or death could result to members of the public through traffic accident/collision of mine traffic (e.g. road trains) with persons, vehicles or property. These events could be external to the Lease area. Traffic would increase during the mining operations phase due to material movements of HMC to the Port of Thevenard or to the Port of Whyalla (if utilised). The haul road, external to the Lease area, is maintained by Iluka. The inherent risk level is considered **high**.

Injury or death due to uncontrolled fire caused by mine operations

There is a very low (unlikely) likelihood that potential injury or death could result to members of the public through uncontrolled fire as a result of operations. Ignition of fires could potentially occur from lightning strikes, arson, hot works/on-site ignition sources or storage of flammable materials. The inherent risk level is considered **high**.

5.6.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to public safety, including traffic, are outlined below:

Construction and operation:

- pre-mobilisation-site Access Request (SAR) process.
- Implementation of traffic management procedure that includes:
    - design considerations for roads, intersections and drainage;
    - journey management;
    - traffic plan and rules, including off-site haul roads; and
    - training.
- Signage erected and maintained to deter unauthorised access; and identify mine operations.
- Personnel educated to direct any unauthorised visitors to the village office.
- Induction training to inform of traffic and incident management.
- Implementation of a Travellers Drop-In Procedure.
- All company roads are speed limited, with appropriate signage.
- Maintain site-based Emergency Response Team and Ambulance Officers including assets and equipment.
- Incident reports concerning unauthorised site access, operational fires and traffic/haulage events recorded in Iluka's Incident Management System.
- Vehicle movements confined to identified access routes and work areas.
- Road maintenance activities undertaken as required.
- Mine plan designed to ensure the village is the first point of contact on the access road.
- Authorised public visits are managed through SAR process.
- Implementation of Emergency Crisis System and Iluka Group Standard.
- Maintenance of firebreaks.
- Implementation of *Fire Risk Management Plan*.
- Observation of fire ban rules.
- Maintenance of hot work permit system.
- Annual vegetation fire load and bushfire risk assessment – reporting to CFS and DEW.
- Annual field-based site fire risk audit.
- All vehicles and equipment carry fire suppression equipment.

These management and control strategies will also be maintained during the closure phase.

5.6.5 Residual risk

Injury or death caused by operations from unauthorised access

Unauthorised access is deterred by signage and the design of the J-A Project area with the village as the first point of contact from the access road. The J-A Project area, which is clearly signed, is operated continuously which enables early identification of any unauthorised visitors. The J-A Project area maintains a procedure to manage the occurrence of unauthorised access and unexpected presentation to the village by members of the public. All incidents are recorded in the Iluka incident management system. Reconsideration of the risks associated with public safety from unauthorised access to mining operations and taking into account the design and operational management measures has resulted in the residual risk ranking of **moderate**.

Injury or death caused by collision with mine operations traffic

A *Traffic Management Procedure* has been implemented, which prescribes road and intersection design, drainage and maintenance. It also covers journey management and traffic plans to control vehicle movements. Road maintenance activities are routinely undertaken and all company roads are speed limited with appropriate signage. An emergency response plan has been developed to prepare and respond to traffic accidents. The residual risk associated with public safety from a collision with mine operations traffic, taking into account the implemented control and management strategies, has been ranked as **moderate**.

Injury or death due to uncontrolled fire caused by mine operations

A *Fire Risk Management Plan* and *Emergency Response Plan* have been implemented and are routinely reviewed. A fire truck, trained CFS authorised fire officers and suppression equipment is maintained on-site. Training is provided on fire preparedness and response. Fire ban rules are observed. Annual vegetation fuel load and bushfire risk assessment is undertaken. Reconsideration of the risks to public safety from uncontrolled fire, taking into account control and management strategies has resulted in a residual risk ranking of **moderate**.

The residual risks (**moderate** for all) are considered to be as low as reasonably practicable and therefore considered by Iluka as acceptable for the Project. Outcomes, measurement criteria and monitoring requirements have been developed based on results of the residual risk assessment and outlined in Section 5.6.6. The residual risk assessment is provided in Table 42.

Table 42: Risk assessment on public safety and traffic potential impacts

Impact ID	Potential Impact	Inherent risk level			Controls and management Strategies	Residual risk level			Uncertainties	Commitments to address uncertainties	Outcome
		L	C	R		L	C	R			
PST1	Unauthorised/uncontrolled access to the project area during operations by members of the public causing injury or death	Unlikely	Significant	High	• SAR process. • Signage to deter unauthorised access. • Traveller drop-in procedure. • Cintellate incident management system. • *Emergency Response Plan* and training. • Maintain on-site emergency response team, including assets and equipment.	Unlikely	Minor	Moderate	N/A	N/A	No public injuries or deaths resulting from mine operations traffic or unauthorised access that could have been reasonably prevented
PST2	Injury or death caused by collision with mine operations traffic.	Unlikely	Significant	High	• Implementation of an *Emergency Response Plan* and training. • Road maintenance. • Speed limit restrictions. • Traffic management procedure. • Designated pedestrian walkways on-site. • Designated access roads for vehicles. • Training on traffic and incident management. • Maintain on-site emergency response team, including assets and equipment.	Unlikely	Minor	Moderate	N/A	N/A	No public injuries or deaths resulting from mine operations traffic or unauthorised access that could have been reasonably prevented
PST3	Injury or death due to uncontrolled fire caused by mine operations.	Unlikely	Significant	High	• Implementation of *Fire Risk Management Plan*, and *Emergency Response Plan*. • Observation of fire ban rules. • Maintenance of fire breaks. • Fire truck, suppression equipment and with trained emergency response team on call 24/7. • Vehicles and equipment carry fire suppressant equipment. • Consultation with CFS, DEW, Ceduna Council and emergency service providers prior and during fire danger periods. • Emergency evacuation procedures established and communicated.	Unlikely	Minor	Moderate	N/A	N/A	No public injuries or deaths resulting from uncontrolled fire that could have been reasonably prevented

5.6.6 Measurement criteria and monitoring requirements

Table 43 outlines the outcome measurement criteria and monitoring requirements for each outcome in relation to public safety.

Table 43: Measurement criteria and monitoring requirements for outcomes in relation to public safety and traffic

Outcome	Criteria ID	Leading indicator criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
No public injuries or deaths resulting from mine operations traffic or unauthorised access that could have been reasonably prevented	C1		Operations	Unauthorised access or traffic incidents recorded (incident type, description, classification and action taken) in Iluka Incident Management System (Cintellate)	All operational Project areas and haul road as defined in Figure 3.	No unauthorised access or traffic incidents resulting in public injury or death, caused by the mine operations, or that could have reasonably been prevented by the Mine Operator	Incident trends reviewed annually	NA	Site Manager Safety Specialist
	C2	NA	Operations	Incident investigation (report stored in Iluka Incident Management System, Cintellate)	All operational Project areas and haul road as defined in in Figure 3.	No unauthorised access or traffic incidents resulting in public injury or death, caused by the mine operations, or that could have reasonably been prevented by the Mine Operator	As required – incident investigation completed within 14 days or other time period as agreed with the Director of Mines	NA	
	C3[5]	NA	Closure	Site audit of infrastructure type, disposal location, and record of removal off-site	All domains per Figure 44.	All plant, equipment and mine related infrastructure has been removed from site	At closure, and/or prior to lease relinquishment	NA	Site Manager Rehabilitation Specialist
	C4	NA	Closure	Site audit of safety and compliance certificates (or similar records) for any retained infrastructure Negotiation and sign-off from landowners (DEW and Far West Coast Aboriginal Corporation (FWCAC)) on relinquishment/handover of retained infrastructure	All domains per Figure 44	All retained infrastructure is safe and stable	At closure, and/or prior to lease relinquishment	NA	Site Manager HSEC Manager Rehabilitation Specialist

[5] Note the C3 measurement criteria excludes/does not apply to:

- The subterranean portion of the J-A water supply pipeline - refer Section 8.14 - J-A Mine Closure Plan;
- Buried mine-site tailings drainage infrastructure - refer Section 8.15 - J-A Mine Closure Plan; and
- Infrastructure that may be relinquished to third-parties for post-mining use (e.g. Ooldea road) - refer Sections 8.12 and 8.13, J-A Mine Closure Plan.

Outcome	Criteria ID	Leading indicator criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
No uncontrolled fires caused by mining operations. *Note: This outcome does not apply to natural or third-party fires.*	C5	Quarterly review of incidents, audits and hazards related to fire.	Operations	Fire incidents caused by mine operations recorded (incident type, description, classification and action taken) in Iluka incident management system (Cintellate) (*Does not apply to natural bushfires recorded in Cintellate for purposes of internal hazard reporting*)	All operational tenements (Figure 3)	No fire incidents, caused by the mine operations, or that could have reasonably been prevented by the Mine Operator	Incident trends reviewed annually	NA	All personnel
	C6	NA					As required – incident investigation completed within 14 days or other time period as agreed with the Director of Mines		

5.7 Heritage

5.7.1 Context

Indigenous Heritage

Indigenous people in the FWC region maintain a strong connection to the natural environment and associated features of this region. The dune systems present in the wider area are generally of interest to local Aboriginal people due to their potential for yielding Aboriginal sites and relics. Sites and relics may include fossils, remains, treasure troves, and articles of antiquity; structures and other remains; any valuable things of a scientific, geological, historical, anthropological or archaeological interest.

Aboriginal cultural heritage in South Australia is governed by the *Aboriginal Heritage Act 1988* (AH Act) and the *Aboriginal and Torres Strait Islander Heritage Protection Act 2005*. It is an offence under the AH Act to damage or disturb any Aboriginal cultural heritage unless the appropriate approvals are in place and the relevant procedures have been followed. Significant penalties apply for breaches of these provisions.

As outlined in Section 2.15, cultural heritage clearances were obtained by Iluka to facilitate establishment and operation of the J-A mine. In addition, Iluka developed and implemented a specific internal *Cultural Heritage Management Plan* and *Heritage Discovery/Clearance Procedure*. These documents outline key processes including:

- consultation with Native Title Traditional Owners to discuss cultural surveys over defined areas (e.g. access inspection surveys with Traditional Owner representatives and qualified heritage archaeologists and/or anthropologists);
- minimising adverse impacts to Aboriginal cultural heritage (both known and newly discovered) during construction and operations;
- the protection, reporting and salvage (clearance) of cultural heritage relics/artefacts discovered during construction and operations; and
- ensuring that Aboriginal cultural heritage is managed in accordance with statutory requirements.

Non-Indigenous Heritage

No non-Indigenous heritage sites exist within the vicinity of the operation as determined through pre-mine desktop investigation and subsequent early works, construction and operations activities.

5.7.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- AH Act*;*
- *Native Title Act 1994 (SA);*
- *Development Act 1993* (now *Planning, Development and Infrastructure Act 2016*)*;* and
- *Heritage Places Act 1993.*

5.7.3 Potential impacts

Potential Project-related heritage impacts are summarised in Table 44 and described below.

Table 44: Potential impacts associated with heritage

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
HE1	Ground disturbance	The following are all potential mechanisms for disturbance: • Exploration activities (drilling, track installation) • Construction (land clearing) • Operations (land clearing, pit development)	Indigenous sites/relics	Disturbance or destruction of indigenous sites/relics of scientific, mythological and cultural significance (without prior approval)	Yes – indigenous sites/relics of cultural significance are present in the Project area and could be disturbed or destructed without controls.

Disturbance or destruction of indigenous sites and/or relics of scientific, mythological and cultural significance (without prior approval)

If no planning or mitigation measures were in place, there would be potential for disturbance or destruction of indigenous sites/relics to occur as a result of exploration, construction and mining activities. The consequence of disturbance (without prior approval) is considered significant with an overall risk ranking of **high**.

5.7.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts to indigenous heritage are outlined below.

Construction and operations

- Implementation of a *Cultural Heritage Management Plan* that includes:
    - Legislative framework for indigenous cultural heritage protection;
    - Subsidiary Indigenous Site/Relic Discovery Procedure to be enacted on discovery of an indigenous site/relic (protection and notification to relevant authorities); and
    - PEPR outcomes and measurement criteria.
- Minimisation of disturbance areas;
- Assessment of proposed vegetation clearance with reference to known heritage sites;
- Workforce cultural awareness training; and
- Site induction to include details of indigenous heritage, native title commitments and the site/relic discovery procedure.

Closure

- Closure planning and post-mining landform design includes:
    - Reinstatement of pre-mine landscape features for areas recorded as being of cultural heritage significance or containing cultural objects/artefacts; and

- Reinstatement of cultural heritage artefacts (salvaged prior to and during mine operations) at mine closure.
- Domain audit/inspection by cultural heritage custodians to ensure requirements have been met.

5.7.5 Residual risk

Disturbance or destruction of indigenous sites and/or relics of scientific, mythological and cultural significance (without prior approval)

The cultural heritage surveys and clearances undertaken prior to commencement of mining operations have significantly reduced the likelihood of disturbance to indigenous sites/relics within approved lease boundaries. Designs for mine infrastructure were also adjusted pre-construction where potential issues with indigenous sites were identified.

The implementation of both pre-mine and operational/closure controls yields a **low** residual risk.

This residual risk is considered to be as low as reasonably practicable (low) and for this reason is considered by Iluka to be acceptable for the operation. Whilst the results of the residual risk assessment was low there is a requirement to have outcomes, measurement criteria and monitoring requirements as per the Second Schedule Lease Conditions (Table 37) as such these have been developed and are outlined in Section 5.7.6. The residual risk assessment is provided in Table 45.

Table 45: Risk assessment on heritage potential impacts

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
HE1	Disturbance or destruction of indigenous sites/relics of scientific, mythological and cultural significance (without prior approval)	Possible	Significant	High	• Pre-mine cultural heritage surveys and approved clearances • Indigenous Site/Relic Discovery Procedure • Minimisation of disturbance areas • Assessment of proposed vegetation clearance with reference to known heritage sites • Workforce cultural awareness training • Site induction to include details of indigenous heritage, native title commitments and the site/relic discovery procedure • Implementation of *Cultural Heritage Management Plan*	Rare	Moderate	Low	Potential presence of unknown, lost or hidden sites/relics within approved tenement boundaries	Existing control – Iluka J-A Indigenous Site/Relic Discovery Procedure	No disturbance to aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained

5.7.6 Measurement criteria and monitoring requirements

Table 46 outlines the measurement criteria and monitoring requirements for each outcome in relation to heritage.

Table 46: Measurement criteria and monitoring requirements for outcomes in relation to heritage

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
No disturbance to aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained	C7	NA *NOTE: Land access and/or clearance authorisation may include the requirement for cultural heritage surveys and clearance activities, as directed by or negotiated with the FWCAC and Iluka*	Operations	Desktop assessment (GIS) of proposed disturbance (potential impact to known sites/relics) compared to actual disturbance	All domains (Figure 44)	No unapproved disturbance to aboriginal artefacts or sites of significance	On event (on generation of internal vegetation clearance permits)	NA	Rehabilitation Specialist Environmental Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
				Visual identification – suspected site/relic	As identified	Mine records demonstrate that if an aboriginal site, object or remain was discovered/disturbed during operations, works ceased and the native title claimants and the Aboriginal Affairs and Reconciliation Division were notified Works re-commenced only after notification and consultation over the appropriate actions	On event	NA	All personnel Community Relations Advisor HSEC Manager
				Site audit/inspection by heritage custodians *(Note: site audit/inspection may include cultural surveys and artefact collection and relocation as agreed with FWCAC).*	As identified	Compliance with agreed disturbance and heritage protection requirements, as defined in the SA *AH Act 1988*, and as agreed with the FWCAC	On event	NA	Community Relations Advisor HSEC Manager
	C8	NA	Operations	Desktop assessment (GIS) of proposed disturbance (potential impact to known sites/relics) compared to actual disturbance	All domains (Figure 44)	No unapproved disturbance to aboriginal artefacts or sites of significance	On event (on generation of internal vegetation clearance permits)	NA	Rehabilitation Specialist Environmental Specialist
	C9	NA	Closure	Desktop audit to compare pre-mining cultural heritage site reinstatement	All domains (Figure 44)	All heritage sites restored to pre-mining vegetation associations, and all artifacts restored to original position (or as agreed with FWCAC)	At closure and/or prior to lease relinquishment	NA	Rehabilitation Specialist HSEC Manager
				Domain audit/inspection by heritage custodians	Disturbance areas within tenement boundaries				Community Relations Advisor HSEC Manager

5.8 Pest species

5.8.1 Context

Disturbance within the Yellabinna and Nullarbor Regional Reserves has been limited to introduced fauna, Aboriginal use, passive tourism and mineral exploration and as such, the region has retained much of its biological integrity. The area has a low incidence of weed infestation, with twenty four species currently identified within the J-A Project area (see Section 2.13).

No evidence of plant pathogens has been identified during field investigations to date and the J-A Project area is not located in a high risk *Phytophthora cinnamomi* (root-rot fungus), or Mundulla Yellows area.

A number of introduced fauna species are present in the area, including rabbit, camel, house mouse, feral cat and the European red fox.

5.8.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- EPBC Act;
- Mining Act;
- NPW Act;
- *Native Vegetation Act 1991 (SA)* (NV Act);
- Landscapes Act; and
- *Yellabinna and Warna Manda Parks Management Plan 2019 (DEW 2019)*

5.8.3 Potential impacts

Potential pest species impacts are summarised in Table 47 and described below.

Table 47: Potential impacts associated with pest species

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
PS1	Weed species	The following are all potential vectors for weed seeds: • wind • vehicles & earthmoving equipment • animals (pest species and native) • surface water flows	Native vegetation Native fauna	Increased diversity and/or abundance of weed species in project area Decrease in habitat quality of project area	Yes – A number of weed species are already known to be present in the area. Due to Project related clearance and vehicle movement it is likely that if not controlled there may be an increase in the abundance and/or diversity of weeds within the Project area.

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
PS2	Pest animals	Migration onto site from surrounding land	Native fauna Native vegetation	Increased diversity and/or abundance of pest animal species. Resulting in: Predation on native fauna resulting in decreased diversity and/or abundance of native fauna Decreased diversity and/or abundance of native vegetation	Yes – A number of pest species are already known to be present in the area. It is possible that pest species will increase near the Project if not controlled.

Increased diversity and/or abundance of weed species in the Project area

A number of weed species are already present in the J-A Project area and within the reserve. Due to Project related clearance and vehicle movement it is likely that if not controlled there may be an increase in the abundance and/or diversity of weeds within the J-A Project area. This may result in a decrease in habitat quality of the J-A Project area. The inherent risk level is considered to be **high**.

Increased diversity and/or abundance of pest animal species in the Project area

A number of pest animal species are known to occur in the J-A Project area and within the reserve. It is unlikely that the diversity and/or abundance of pest animal species will increase if unmanaged, as a result of Project related activities. An increase in pest animal species may impact on native fauna species by means of increased predation and decrease in resources through grazing impacts. The inherent risk level is considered to be **moderate**.

5.8.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to pest species are outlined below.

Construction and operations

- Implementation of a *Pest Species Management Plan* that includes:
  - pest species monitoring and management program (e.g. rabbit baiting, cat trapping and weed spraying/removal);
  - notification requirements for sightings within J-A Project area;
  - vehicle and machinery inspection and wash down procedure; and
  - PEPR outcomes and measurement criteria.
- Inspection for pest plants ahead of vegetation clearance to prevent transfer of pest species to stockpiles.
- Minimisation of disturbance areas.
- Progressive rehabilitation of disturbed areas.

- Ensure road building material is not brought in from an area where pest species may be present.
- Prevent vehicle access to undisturbed areas.
- Liaison with government agencies such as DEW, on appropriate measure to eradicate or control weed outbreaks, should they occur.
- Ensure all waste and food storage containers are adequately sealed.
- Site waste transfer station to be enclosed with fauna proof fencing.
- Site induction to include details of pest species and reporting requirements.

Closure

- Maintain *Vehicle and Machinery Inspection and Wash Down Procedure*.
- Progressive rehabilitation of disturbed areas.
- Monitoring program as outlined in the *Pest Species Management Plan.*
- Implement targeted pest species control measures for any observed significant increase in the distribution or abundance of existing pest species, or introduction of new populations of pest species, as outlined in the *Pest Species Management Plan.*

5.8.5 Residual risk

Increased diversity and/or abundance of weed species in the Project area

Reinstatement of native vegetation by means of progressive rehabilitation will decrease the amount of open area susceptible to weed infestation. This action, as well as the implementation of the other control and management strategies outlined in Section 5.8.4, will assist in controlling weed invasion. Given the uncontrolled movements of weed seeds through animals, surface water and public vehicles, and the lack of control of weed management in the greater Yellabinna Reserve area, the risk of weed introduction into the J-A Project area is possible.

Vegetation monitoring carried out between 2009 to2015 did not show an increase in weed species or abundance in impact sites over the controlled monitoring sites (EBS 2015). However any increases in abundance or diversity of weed species will be identified with ongoing monitoring, and therefore of minor consequence. The residual risk has been assessed as **moderate**.

Increased diversity and/or abundance of pest animal species in the Project area

Management of pest species within the J-A Project area is generally conducted on a more frequent basis than activities conducted in the reserve area as a whole. Taking into consideration the prevalence of pest species prior to the commencement of Project activities it is unlikely that Project related activities will result in an increase in diversity or abundance of pest animal species in the J-A Project area. Changes to pest animal populations would be identified with ongoing monitoring and therefore would be of minor consequence. The residual risk is considered to be **low**.

The residual risks are considered to be as low as reasonably practicable (between moderate and low) and for this reason are considered by Iluka to be acceptable for the project. Based on the results of the residual risk assessment only one of these impact events (Increased diversity and/or abundance of weed species in the J-A Project area) requires an outcome. However outcomes, measurement criteria and monitoring requirements have been developed for both as per the requirements of the Second Schedule Lease Conditions (Table 37); these are outlined in Section 5.8.6. The residual risk assessment is provided in Table 48.

Table 48: Risk assessment on pest species potential impacts

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
PS1	Increased diversity and/or abundance of weed species in project area Decrease in habitat quality of project area	Likely	Moderate	High	• Inspect for pest plants ahead of vegetation clearance to prevent transfer of pest plants to stockpiles • Minimisation of disturbance areas • Ensure road building material is not brought in from an area where pest plants may be present • Implementation of vehicle and equipment hygiene/wash down procedure • Regularly monitor disturbance areas for presence of pest plants • Reporting of pest plant sightings via internal reporting system and reporting requirements highlighted in site induction program • Implement targeted pest species management for observed significant increases in distribution or abundance or presence of new pest species • Implementation of Pest Species Management Plan	Possible	Minor	Moderate	Weed introduction via uncontrolled public vehicles using haul road (public access area) Intensity of weed management by DEW in the greater Yellabinna Reserve area (outside of the tenement boundaries)	Regular monitoring of haul road for weed outbreaks. See *Pest Species Management Plan* for further details. Liaison with DEW	No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations
PS2	Increase diversity and/or abundance of pest animal species. Resulting in: Predation on native fauna resulting in decreased diversity and/or abundance of native fauna Decreased diversity and/or abundance of native vegetation	Unlikely	Minor	Moderate	• Waste storage infrastructure is designed and maintained to prevent access by pest animal species • Ensure all waste and food storage containers are adequately sealed • Domestic animals prohibited on-site • Prohibit feeding of wildlife • Reporting of pest plant sightings via internal reporting system and reporting requirements highlighted in site induction program • Implement targeted pest species management for observed significant increases in distribution or abundance or presence of new pest species • Implementation of *Pest Species Management Plan*	Rare	Minor	Low	Intensity of pest animal management by DEW in the greater Yellabinna Reserve area (outside of the tenement boundaries)	Liaison with DEW	No increase in abundance of pest animal species in the lease area and adjacent areas caused by mining operations

5.8.6 Measurement criteria and monitoring requirements

Table 49 outlines the measurement criteria and monitoring requirements for each outcome in relation to pest species.

Table 49: Measurement criteria and monitoring requirements for outcomes in relation to pest species

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations	C10	Annual review of the pest flora survey and weed management register (comprising results of field monitoring and visual observations) considering trends that could indicate population increase or introduction of new weed species	Operations	Weed survey to measure the diversity and abundance of weed species	Watercourse monitoring sites (upstream and downstream), per Figure 53	No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species in watercourse monitoring sites (upstream and downstream) caused by mining operations	Annually (after winter rainfall)	Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17	Environmental Specialist Rehabilitation Specialist
				Field monitoring for the presence of weed species in disturbance areas	Soil stockpiles (see Figure 40), creeks, borefield, road edges, camp, rehabilitation areas	No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species in disturbed areas caused by mining operations	Monthly	Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17	Environmental Specialist Rehabilitation Specialist
				Visual observations of the presence of weed species	All domains (Figure 44)	No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species caused by mining operations	Opportunistic	Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17.	All personnel
	C11	NA	Closure	Weed survey to measure the diversity and abundance of weed species	Watercourse monitoring sites (upstream and downstream), per Figure 53	Weed species diversity and abundance at closure to be consistent with control sites	Following completion of active rehabilitation. Annually, for a minimum of 5 years	Baseline LFA surveys undertaken following rehabilitation Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17	Rehabilitation Specialist
No increase in abundance of pest animal species in the lease area and adjacent areas caused by mining operations.	C12	Annual review of register of pest animal sightings considering trends that could indicate population increase	Operations	Fauna survey of the abundance of pest animal species	Fauna monitoring sites (see Figure 52)	No increase in abundance of pest animal species at fauna monitoring sites caused by mining operations	Biennial	Baseline fauna surveys of the Project areas conducted by SKM (2006a)	Environmental Specialist Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
				Field monitoring of the presence of pest animal species, including warrens and tracks	Soil stockpiles (see Figure 40), creeks, borefield, road edges, camp, rehabilitation areas	No increase in abundance of pest animal species in disturbed areas caused by mining operations	Monthly	Baseline fauna surveys of the Project areas conducted by SKM (2006a)	Environmental Specialist/Technician Rehabilitation Specialist
				Visual observations of the presence of pest animal species	All domains (Figure 44)	No increase in abundance of pest animal species caused by mining operations	Opportunistic	Baseline fauna surveys of the Project areas conducted by SKM (2006a)	All personnel
	C13	NA	Closure	Fauna survey of the abundance of pest animal species	Fauna monitoring sites (see Figure 52)	Pest animal abundance at closure to be consistent with control sites	Following completion of active rehabilitation Annually, for a minimum of 5 years	Baseline fauna surveys of the Project areas conducted by SKM (2006a)	Rehabilitation Specialist

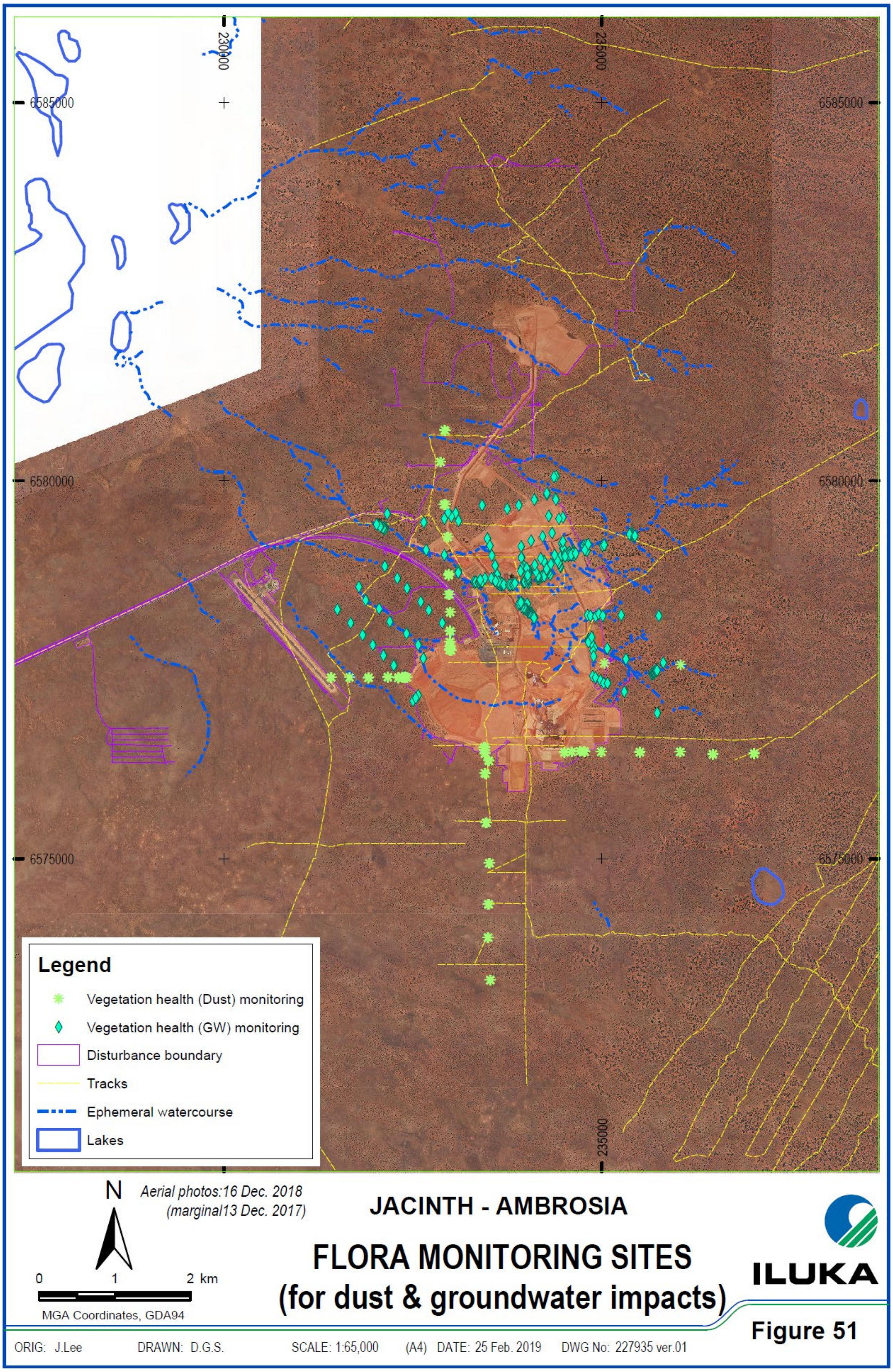

Figure 51: Flora monitoring sites (for dust and groundwater impacts)

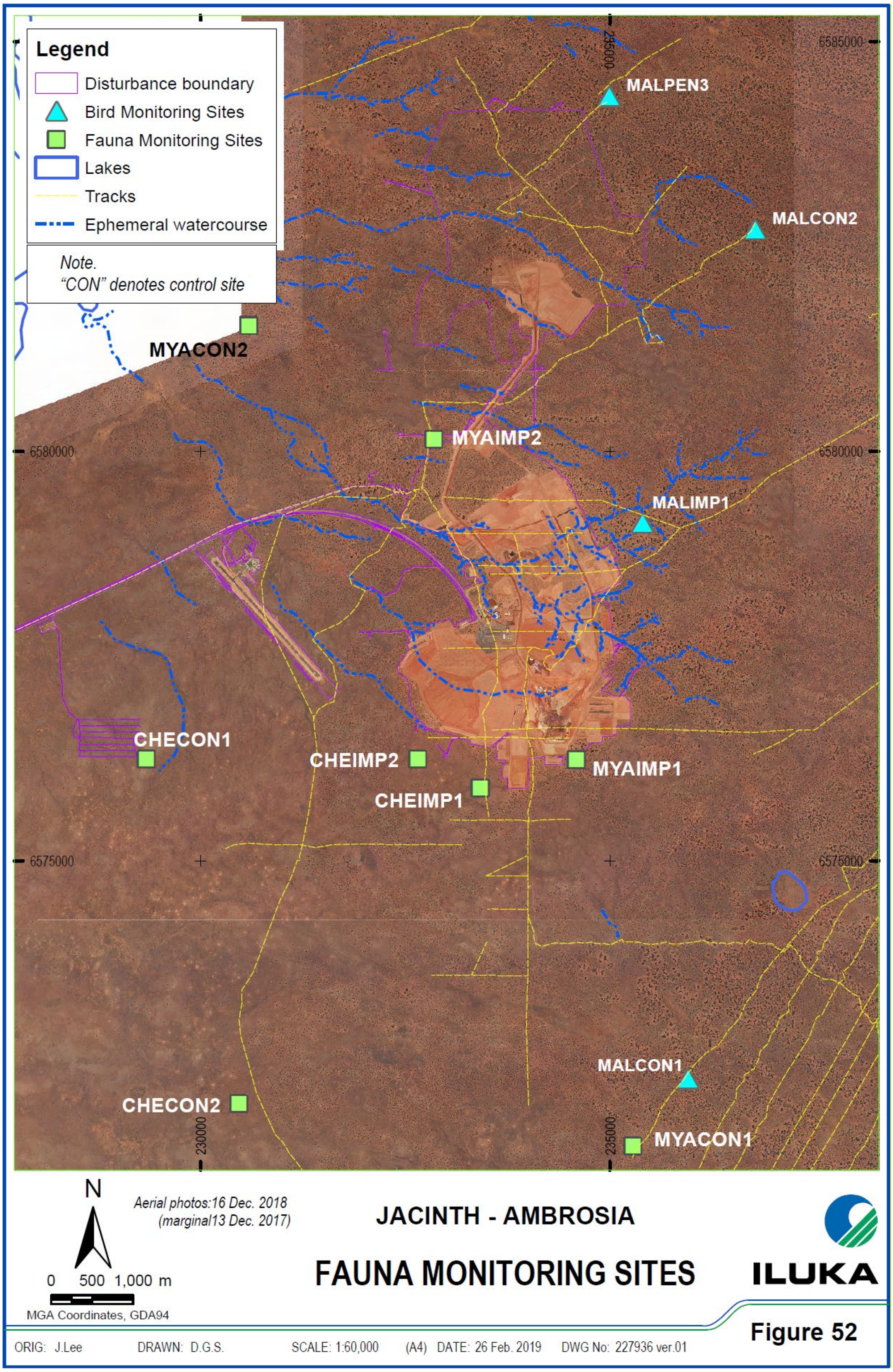

Figure 52: Fauna monitoring sites

5.9 Soils

5.9.1 Context

The soils in the J-A area are highly heterogeneous, with thickness and physio-chemical characteristics varying significantly spatially, with depth, and between soils. The soil surface is fragile, with the high percentage of fine sand particles in the surface (and some regolith) samples being particularly susceptible to wind erosion. Soil strength measurements indicate that weak soil crusts develop within the topsoil material which offers some protection from wind erosion. Refer to Section 2.7 for further information on soils in the J-A Project area.

Clearance and excavation conducted as part of operational activities will result in considerable disturbance to the soil profile. Salt contamination of undisturbed and reinstated soil profiles due to uncontrolled mine-derived hyper saline groundwater rise and/or migration also presents a risk to soil function.

5.9.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- Mining Act;
- NPW Act;
- NV Act;
- Landscapes Act; and
- *Yellabinna and Warna Manda Parks Management Plan 2019* (DEW 2019)

5.9.3 Potential impacts

Soil in the J-A Project area may be affected by mining activities. Potential Project related soil impacts are summarised in Table 50 and described below.

Table 50: Potential impacts associated with soil

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
S1	Vegetation clearance	Planned clearance for operational activities	Native vegetation	Significant loss of topsoil/subsoil resources due to erosion	Yes – clearance and subsequent erosion of topsoil/subsoil might occur if not managed appropriately.
S2	Stockpiling of soils	Vegetation clearance	Native vegetation Native fauna	Decrease in ecological viability of stockpiled topsoil and subsoils	Yes – ecological viability of seed and microorganisms present within the topsoil and subsoil profiles might diminish by the stockpiling process.
S3	Dust suppression; Processing activities	Hyper saline process water	Soil Native vegetation	Saline contamination of soils from surface water contamination (Also refer to NV3)	Yes – saline process water is proposed to be used for dust suppression activities and could impact on soil and native vegetation if

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
					not appropriately managed.
S4	Excavation of soils and overburden	Soil profile reinstatement	Native vegetation Native fauna	Reinstated soil profile unsuitable for successful re-establishment of vegetation	Yes – without control and management strategies the excavation of soils and overburden may result in the reinstated soil profile being unsuitable for re-establishment of vegetation.
S5	Saline tailings disposal	Capillary rise into reinstated soil profile	Soil Native vegetation	Salt contamination of reinstated soil profile through capillary rise from tailings material	Yes – without management the saline tailings could contaminate the reinstate soil profile.
S6	Erosion of final landform	Bare soil as vegetation and BSC re-establish	Soil Native vegetation	Significant loss of topsoil/subsoil resources due to erosion	Yes – soil characteristics of area mean loss of topsoil/subsoil could occur post-disturbance if controls strategies are not implemented.
S7	Stockpiling of HMC (NORM material)	Wind dispersion of stockpiled material	Soil	NORM contamination of soils	Yes – low levels of uranium (U) and thorium (Th) could result in radioactive soils if not appropriately managed.
GW3 (See Section 5.15)	Saline tailings disposal	Tailings seepage to groundwater (groundwater rise)	Soil Native vegetation	Hyper saline groundwater rise (salinity) impacting soils and vegetation within the extent of mine workings. Unapproved clearance of vegetation	Yes – there is potential that hypersaline groundwater rise could impact on soils and vegetation.
GW4 (See Section 5.15)	Saline tailings disposal	Tailings seepage to groundwater (groundwater rise)	Soil Native vegetation Native fauna – refer to Section 5.13	Hyper saline groundwater rise (salinity) impacting soils and vegetation beyond the extent of mine workings due to groundwater mound migration Unapproved clearance of vegetation	Yes – there is potential that hypersaline groundwater rise could impact on soils and vegetation.
For Hydrocarbon contamination of soils, refer to Section 5.16, impact ID HZ1 and HZ2					

Significant loss of topsoil and subsoil resources due to erosion

Vegetation clearance is required as part of Project operations to facilitate Project infrastructure and mining activities. Approximately 1,665 ha of vegetation is proposed to be cleared over the LOM (inclusive of the MPL-Canberra).

The characteristics of the soil in the J-A Project area indicate that they are highly erosive when the surface crust is disturbed. Without the implementation of control and management strategies, it is likely that there would be a significant loss of soil resources which could result in a moderate impact on native vegetation and the success of rehabilitation in the J-A Project area. This provides a **high** level of inherent environmental risk associated with the Project.

Decrease in ecological viability of stockpiled topsoil and subsoils

When not directly returned, topsoil and subsoil that is stripped as part of mining activities will be stockpiled during operations for later use in rehabilitation activities. Currently the length of time between soil stockpiling and final reinstatement of the topsoil and subsoil profiles varies. For soils returning to the pit area it is dependent on the progress of the placement and adequate drainage of the tails, for soils returning to current infrastructure and off-path TSF areas, soils could potentially be stockpiled in excess of 10 years.

It is possible that the ecological viability of seed and microorganisms present within the topsoil and subsoil profiles may be diminished by the stockpiling process, or if stored for long periods of time, this could consequently impact on rehabilitation success (Golos and Dixon 2014).

Without the implementation of control and management strategies, it is possible there will be an impact on the ecological viability of soils that are stockpiled which could have a significant effect on ecosystem function of rehabilitated areas within the disturbance footprint. This provides a **high** level of inherent environmental risk associated with the Project.

Saline contamination of soils from surface water contamination

Saline water is stored and used for ore and mineral processing and dust suppression during operations. Without the implementation of management measures it is possible that soils within the J-A Project area could become salinised through uncontrolled release or inappropriate/excessive application, with a moderate consequence to the environment. This provides a **high** level of inherent risk.

Risk to soils associated with hazardous materials storage and handling are addressed in Section 5.16. Refer to 5.12.1, impact ID NV3 for impacts to native vegetation from saline water contamination.

Reinstated soil profile unsuitable for successful reestablishment of vegetation

Rehabilitation activities within the pit footprint will involve the reinstatement of a soil profile to support a resilient, self-sustaining ecosystem. As outlined in Table 30, the thickness of the soil profile to be reinstated will vary dependent on the landscape vegetation unit that is being rehabilitated in each area. Figure 51 shows the planned location of the landscape vegetation units within the J-A Project area.

The profile thicknesses to be used for each vegetation unit were initially determined from baseline soil studies completed for the Project (Outback Ecology 2006; Soil Water Consultants 2007; Soil Water Consultants 2008), assumptions about the biological requirements of vegetation in the J-A area and the soil balance calculated during the resource definition process prior to the commencement of mining.

Research projects implemented at J-A since the commencement of mining operations (JARMS 2011; JARMS 2013) have revealed new information associated with the modified soil profile. These include:

- a discrepancy between the pre-disturbance soil profile depth utilised by deeper rooted plant species, i.e. *Acacia papyrocarpa* and *Eucalyptus oleosa* and the profile that is reinstated during rehabilitation has been revealed by root mapping work at J-A.
- during periods of high rainfall, the deeper rooted plants species may hydraulically redistribute water via their root systems into deeper soil layers, allowing that water to be available in drier seasons. The modified soil profile may reduce plant rooting depths so that the hydraulic redistribution process is not reinstated, removing this deeper soil water source from the ecosystem.

It is therefore possible that the reinstated soil profile is not suitable for the re-establishment of some vegetation units within the disturbance footprint. Without the implementation of control and management strategies there could be a moderate consequence to the environment. This provides a **high** level of inherent risk.

Salt contamination of reinstated soil profile through capillary rise from tailings material

Previous concerns regarding upward movement of salts from saline tailings material into overlying soils resulted in the requirement for a capillary break to be placed between the tailing and soil profiles. Further work completed by SRK (2011) and Iluka (2014) has determined that the tails are free draining and would reach a state of residual moisture content within two years, and in the absence of a saline groundwater surface near the soil surface and within the critical depth, no upward movement of liquid water, and therefore entrained salts, could occur. This negates the need for a capillary break (Appendix I). However, a capillary break will be installed should the tailings not meet residual moisture content at the time of rehabilitation. This provides a **low** level of inherent risk.

Erosion of final landform

The characteristics of the soil in the J-A Project area indicate that they can be erosive when the surface crust is disturbed. As replaced soils will not initially have a strong surface crust bond, without the implementation of control and management strategies, it is possible there could be a significant loss of soil resources which could result in a moderate impact on native vegetation and the success of rehabilitation in the J-A Project area. This provides a **high** level of inherent environmental risk associated with the Project.

NORM contamination of soils

The J-A ore body has low levels of uranium (U) and thorium (Th). These concentrations are not high enough for the ore to be considered radioactive; however, the process concentrates the U and Th in the final product (HMC).

Where radiation levels are below 1 Bq/g, material is considered to be non-radioactive (e.g. overburden, ore, oversize and tailings). NORM material that has activity levels > 1 Bq/g but < 10 Bq/g material is considered to be radioactive, but is below the activity level at which the Australian Government transport regulations (ARPANSA - Safe Transport of Radioactive Material 2008) apply.

HMC at J-A typically averages between an activity level of 1.8 to 2 Bq/g. Overburden, ore and tailings all have specific activity levels measured < 0.2 Bq/g.

At closure all HMC would have been removed from the J-A Project area as product and any contaminated material (soils) collected and buried at depth in the pit (with tails). This provides a **high** level of inherent environmental risk associated with the Project.

Risk to soils associated with hazardous materials storage and handling are addressed in Section 5.16. Refer to 5.12.1, impact ID NV3 for impacts to native vegetation from saline water contamination.

5.9.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to soil are outlined below.

Construction and Operations

- Implementation of a *Dust & Air Quality Management Plan* that includes:
  - Details of dust management and monitoring program; and
  - Procedures for dust suppression including matrix of what suppressant is appropriate for each work area (e.g. potable water for the power station compound).
- Implementation of a *Native Vegetation Management Plan* (Appendix V) that includes:
  - Internal vegetation clearance procedure and vegetation clearance register; and
  - Details of the native vegetation management and annual monitoring program.
- Implementation of a *Rehabilitation Management Plan* (Appendix T) that includes:
  - Procedures for progressive rehabilitation of disturbed areas;
  - Procedures for vegetation clearance and removal of soil profiles for stockpiling or direct return;
  - Procedure for confirmation of adequate tails drainage prior to the reinstatement of the soil profile;
  - Procedures for stabilisation of rehabilitation areas and soil stockpiles;
  - Procedures for collection and storage of seed for rehabilitation purposes;
  - Research program to clarify unknown characteristics of soils and vegetation; and
  - Details of monitoring and management of rehabilitation activities.
- Implementation of a *Surface Water Management Plan* that includes:

- Requirements for drainage design to minimise vegetation contamination from saline water.
- Implementation of a *Groundwater Management Plan* that includes:
  - Monitoring of phreatic surface level below rehabilitated areas in the pit and off-path TSF.
- Implementation of *Minerals Stockpile Management Plan.*
- Implementation of a *Bioremediation Management Plan* (Appendix P) that includes:
  - Bioremediation works undertaken in accordance with SA EPA (2018) Guidelines for the Assessment and Remediation of Site Contamination and the SA EPA (2005) Guidelines for soil bioremediation;
  - Bioremediation pad design in accordance with the SA EPA (November 2005) Guidelines for soil bioremediation; and
  - Bioremediation pad construction in accordance with the Basis of Design detailed in Attachment B.
- Soil water and salt movement modelling in reconstructed soil profiles.
- Field trials.
- Texture analysis and soil water characteristic curves.
- Monitoring stockpiles to highlight potential erosion issues.
- Planning clearance to occur as required for mine operations to reduce large expanses of cleared land.
- Research program to determine the suitability of the soil profile prescription.
- Restricting access to stockpiles.
- Avoid topsoil and subsoil removal when winds exceed 20 km/h.
- Daily inspection of water supply infrastructure for leaks and splits.
- Flow sensors installed on water supply pipeline (from borefield).
- Site based Emergency Response Team and spill clean-up equipment.

Closure

- Monitoring program as outlined in the *Native Vegetation; Rehabilitation and Groundwater Management Plans* (based on PEPR outcomes and measurement criteria).
- Progressive rehabilitation of disturbed areas, commencing within first few years of operations.

5.9.5 Residual risk

Significant loss of topsoil and subsoil resources due to erosion

The importance of maintaining soil quantities for rehabilitation purposes has been acknowledged with the implementation of several management and control measures including: restricting vegetation clearance to that deemed essential to complete operational activities; completing planned clearance only as required; only performing clearance activities when weather conditions are appropriate; stabilising stockpiles and disturbed areas; limiting stockpile heights to 2 m (topsoil) and 4 m (subsoil); performing progressive rehabilitation to reduce the area of exposed soils; and ripping rehabilitated landforms on the contour to reduce erosion.

With the implementation of these and other management measures outlined in the J-A environmental management plans, the likelihood of a significant loss of soil due to erosion is reduced to unlikely with the consequence remaining at moderate. The residual risk is therefore considered to be **moderate**.

Decrease in ecological viability of stockpiled topsoil and subsoils

When topsoil and subsoil cannot be direct returned, it is currently stockpiled for later use in rehabilitation. Soils are stockpiled for the least amount of time practical, in line with the timing of rehabilitation activities; however, it is likely that some stockpiles will still be stored for extended periods.

Findings from research activities completed at J-A have found the longevity of seed buried for a 17-month period varies from minimal loss to a rapid decline of viability over time, with the majority of the short viability species being annuals (Pound et al. 2009). While the length of stockpiling is likely to be at least two years in most instances, the loss of seed viability can be managed by supplementing topsoil with seed that is actively collected and stored on-site for rehabilitation purposes. Direct seeding is conducted upon rehabilitation of areas and this negates the loss of some species' seed viability whilst in stockpiles. In keeping with current mining best practice, the height of the stockpiles is limited to 2 m (topsoil) and 4 m (subsoil). The height restriction assists in maintaining the viability of microorganisms within the stockpiles as it enables the roots of plants that regenerate on the surface to penetrate the majority of the stored profile and maintain microbial activity.

With the implementation of the current management measures the likelihood of a decrease in ecological viability of stockpiled soils is unlikely and the consequence would be moderate, reducing the residual risk to **moderate**.

Saline contamination of soils from surface water contamination

Control measures in place to minimise the risk of saline contamination of soils include; restricting the use of hyper-saline process water for dust suppression to haul roads outside of the pit boundary and the TSF; conducting daily inspections on infrastructure to ensure no leaks or spills; and management of surface water flows from process infrastructure to catchment ponds.

With the implementation of the current management measures it is unlikely that soil quality will decrease due to saline contamination. Given such an event would be localised; the consequence to the environment would be minor. The residual risk is **moderate**.

Reinstated soil profile unsuitable for successful re-establishment of vegetation

The current prescription for soil reinstatement requires a minimum profile thickness of 1.5 m, which includes topsoil, subsoil, and brown and red 'loam' layers. This soil profile has a calculated water storage capacity and nutrient provision that is likely to be adequate for the shallow rooted plant species at J-A. There is uncertainty, however, from where in the soil profile the vegetation, particularly the deep rooted myall and mallee trees, obtain water in this arid environment.

Roots have been observed penetrating deep into the red loam and trees are potentially using water at the capillary fringe of the regional groundwater. It is currently unknown if the vegetation can obtain water from these saline sources or if the vegetation will utilise water within tailings. These uncertainties have been addressed by the research aims of the University of Adelaide ARC Linkage Project that included research on: root architecture and soil characteristics; water sources for key plant species through examining hydraulic redistribution by tree roots and isotopic methods to trace plant water sources, and; species response to saline tailings incorporating the Blue Drum trial and the Cell 1 Trial (JARMS 2012, JARMS 2014, JARMS 2016). The residual risk is **moderate**.

Salt contamination of reinstated soils through capillary rise from tailings material

The inclusion of a capillary break layer between saline tailings and overlying soil layers was originally included in the prescription for soil profile reinstatement based on modelling of soil water movement that was done prior to mine operations commencing. Modelling and test work carried out subsequently on a larger sample of soil and tailings materials and their inclusion in a review of the physical basis of capillary rise of salts from saline tailings concluded a capillary break would be unnecessary in the reinstated soil profile, as no capillary rise would occur with prescribed tailings and groundwater management controls in place (Appendix I). The removal of a capillary break also reduces the potential adverse effects that this layer may have on plant rooting (i.e. restriction on rooting depths due to capillary break barrier) and the downward infiltration of water from the soil above (Section 3.4, Appendix I).

Prior to the reinstatement of clean overburden (e.g. red and brown loam) a series of strategically located test pits will be excavated and examined to validate that the phreatic surface within the tails profile is within acceptable limits, specifically:

- > 2.1 m below the tails surface in myall/mallee and myall woodland associations; and
- > 4.5 m below the tails surface in chenopod associations.

The surface soil water content of the tailings will also be measured to ensure it has reached residual water content, which is 3% gravimetric water content (expressed on a dry weight basis) as determined from soil water characteristic curves of tailings. Samples of surface tailings will be collected at the same locations as the test pits and their water content measured. If rainfall has been received within the previous two months, water content will not be measured and only the phreatic surface used as management control. This is because rainfall would increase the water content of the surface but flush salts thus lowering the risk of saline water rise even though the water content may not be within the target residual water content range. Should the tailings not meet residual water content at the time of rehabilitation, a capillary break will be installed.

Control measures, management trigger levels and monitoring programs for groundwater are detailed in Section 5.15 – Groundwater. This includes monitoring of phreatic groundwater levels within the extent of mine workings (inclusive reinstated soil profiles) to ensure levels remain > 6 m from surface.

With the implementation of the current management measures and ongoing research into how vegetation responds to a reconstructed soil profile (see Impact ID S4) at J-A the likelihood is unlikely. Given that any impacts would be localised and related to deep root species only the consequence is considered to be minor with an overall residual risk of **low**.

Erosion of final landform

The J-A *Rehabilitation Management Plan* (Appendix T) identifies management measures associated with control of erosion of the final landform. Control measures include ripping the final surface on the contour to increase surface roughness and slow wind speed at ground level, erosion modelling of the final landform design to ensure erosion is minimised, placement of vegetation debris to act as a wind break, stabilisation of the final surface as soon as practicable and monitoring of watercourses and rehabilitated areas.

With the implementation of the current management measures and monitoring of rehabilitated landforms it is possible that there will be significant erosion of the final landform. If erosion were to occur, it would be detected as part of the erosion monitoring program and remediated accordingly. The residual risk is **moderate**.

NORM contamination of soil

The J-A *Radiation Management Plan* identifies management measures associated with radioactive materials. At closure all HMC would have been removed from the J-A Project area as product and any contaminated material (soils) collected and buried at depth in the pit (with tails).

Given the ongoing radiation management and closure cleanup activities it would be considered possible that radiation levels would exceed the prescribed soil profile and radiation measurement criteria (C22).

Any residual contaminated material would require cleanup and considerable work will be undertaken by Iluka to ensure that the measurement criteria will be met. The residual risk is **high**.

The residual risks are considered to be as low as reasonably practicable (between **high** and **low**) and for this reason are considered by Iluka to be acceptable for the project. Based on the results of the residual risk assessment, one of these impact events (salt contamination of reinstated soils through capillary rise from tailings material), which was found to have a low residual risk, does not require an outcome. However, outcomes, measurement criteria and monitoring requirements have been developed for all impact events as per the requirements of the Second Schedule Lease Conditions (Table 37); these are outlined in Section 5.9.6. The residual risk assessment is provided in Table 51.

Table 51: Summary of residual risk assessment in relation to Project impacts on soils

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
S1	Significant loss of topsoil and subsoil resources due to erosion	Likely	Moderate	High	• Implementation of the *Native Vegetation Management Plan* • Implementation of the *Rehabilitation Management Plan* • Implementation of the *Dust and Air Quality Management Plan* • Implementation of the *Surface Water Management Plan* • Progressive rehabilitation of disturbed area, commencing within first few years of operations • Annual stockpile monitoring • Restricting access to stockpiles • Prohibiting topsoil and subsoil stripping when winds exceed 20 km/h	Possible	Moderate	Moderate	Stability of topsoil and subsoil stockpiles Stability of rehabilitated soil surface	Stockpile monitoring program Annual stockpile balance	Soil profile and function is restored and capable of supporting agreed land use
S2	Decrease in ecological viability of stockpiled soils	Possible	Significant	High	• Implementation of a *Rehabilitation Management Plan* • Procedures for stockpiling and stockpile maintenance • Direct return of topsoil and subsoil where possible • Restricting access to stockpiles • Direct seeding of rehabilitated areas	Unlikely	Moderate	Moderate	Seed longevity beyond previously examined 17 months Microorganism availability in long-term (> 5 years) stockpiles	Biological viability testing of topsoils and subsoil with stockpile age and height	Soil profile and function is restored and capable of supporting agreed land use
S3	Saline contamination of soils from surface water contamination	Possible	Moderate	High	• Implementation of the *Rehabilitation Management Plan* • Implementation of the *Dust and Air Quality Management Plan* which manages dust emissions and suppression. • Implementation of the Surface Water Management Plan which includes regular inspections of the surface water drainage systems	Unlikely	Minor	Moderate	Depth of salinity in soils where saline water used for dust suppression	Salinity monitoring at depth of haul roads	Soil profile and function is restored and capable of supporting agreed land use
S4	Soil profile unsuitable for successful reestablishment of vegetation	Possible	Moderate	High	• Implementation of a *Native Vegetation Management Plan* • Implementation of a *Rehabilitation Management Plan* • Implementation of a *Groundwater Management Plan* • Soil water and salt movement modelling in reconstructed soil profiles • Field trials • Texture analysis and soil water characteristic curves • Draining of tailings to residual water content (3% gravimetric water content expressed on a dry weight basis) • Confirm phreatic surface within tails profile is within acceptable limits i.e. > 2.1 m below tails surface in myall/mallee and myall woodland associations and > 4.5 m in chenopod associations, prior to reinstatement of clean overburden (i.e. red loam, brown loam). • Research program to clarify unknown characteristics of soils and vegetation	Unlikely	Minor	Moderate	Rooting depth requirements for deep rooted plant species	Adelaide University ARC Linkage Project (Cell 1 Trial). Refer to J-A research and monitoring summary (JARMS) 2016 for more information Rehabilitation trials. Refer to JARMS (2012, 2014, 2016)	Soil profile and function is restored and capable of supporting agreed land use

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
S5	Salt contamination of reinstated soils through capillary rise	Rare	Minor	Low[6]	• Implementation of a *Groundwater Management Plan* to monitor groundwater levels • Soil water and salt movement modelling in reconstructed soil profiles • Texture analysis and soil water characteristic curves • Draining of tailings to residual water content (3% gravimetric water content expressed as a dry weight basis) • Confirm phreatic surface within tails profile is within acceptable limits i.e. > 2.1 m below tails surface in myall/mallee and myall woodland associations and > 4.5 m in chenopod associations, prior to reinstatement of clean overburden (i.e. red loam, brown loam)	Rare	Minor	Low			Soil profile and function is restored and capable of supporting agreed land use
S6	Erosion of final landform	Likely	Minor	High	• Erosion modelling of final landform design • Rehabilitated areas ripped on the contour to increase surface roughness and slow wind speed at ground level • Replacement of vegetation debris to reduce wind and water erosion	Possible	Minor	Moderate	*Note: Erosion potential via materials characterisation is shown in Appendix F*		Soil profile and function is restored and capable of supporting agreed land use
S7	NORM contamination of soils	Possible	Moderate	High	• Implementation of the *Dust and Air Quality Management Plan* • Implementation of *Stockpile Management Plan* • Implementation of *Radiation Management Plan*	Possible	Moderate	High			Soil profile and function is restored and capable of supporting agreed land use

[6] See Section 5.9.3

5.9.6 Measurement Criteria and Monitoring Requirements

Table 52 outlines the measurement criteria and monitoring requirements for each outcome in relation to native vegetation.

Table 52: Measurement criteria and monitoring requirements for outcomes in relation to soils

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
Soil profile and function is restored and capable of supporting agreed land use	C14	NA	Operations	Survey of profile depth and thickness	All domains (as detailed in Section 0; Figure 44)	Soil profile is restored in accordance with Table 30 indicative soil profile (Section 3.12.5)	During in pit rehabilitation	Baseline soil investigations completed by Outback Ecology (2006) and Soil Water Consultants (2007 & 2008)	Surveyor Mine Engineer Rehabilitation Specialist
	C15	NA	Closure	Test drill holes (co-located with groundwater monitoring locations) *Note: Monitoring locations, when installed, will be provided in the ACR*	Domains 4A, 4B and 4C	Soil profile is restored in accordance with Table 30 indicative soil profile (Section 3.12.5)	Once, 3 years after tailings are complete for each pit	Baseline soil investigations completed by Outback Ecology (2006) and Soil Water Consultants (2007 & 2008)	Rehabilitation Specialist
	C16	NA	Operations	Landscape function analysis (LFA) monitoring BSC (minimum age class 2) as described in *Field guide for landscape function analysis for environmental monitoring and assessment, Minerals Regulatory Guidelines* (DMITRE 2013)	Rehabilitated areas Each rehabilitated area per year will contain a minimum of two LFA sites for the first 5 years of rehabilitation works. Final LFA regime to be determined based on results	BSC profile and function is restored	1, 2 and 5 years post-rehabilitation	Baseline soil investigations completed by Outback Ecology (2006) and Soil Water Consultants (2007 & 2008)	Rehabilitation Specialist
	C17	NA	Closure	Landscape function analysis (LFA) monitoring BSC (minimum age class 2) as described in *Field guide for landscape function analysis for environmental monitoring and assessment, Minerals Regulatory Guidelines* (DMITRE 2013)	Rehabilitated areas Each rehabilitated area per year will contain a minimum of two LFA site for the first 5 years of rehabilitation works Final LFA regime to be determined based on results	BSC profile and function is restored	1, 2 and 5 years post-rehabilitation	Baseline soil investigations completed by Outback Ecology (2006) and Soil Water Consultants (2007 & 2008)	Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
	C18	NA	Operations	Visual inspection of test pits	In-pit rehabilitation areas and off-path TSF (Domains 4A, 4B and 4C, as detailed in Section 3.12.10) Each TSF cell will contain a minimum of 1 test pit for every 2 Ha	Phreatic surface is > 2.1 m below top of tails final surface in myall/mallee and myall associations and > 4.5 m in chenopod associations	Once, prior to placement of soil profile	Baseline soil investigations completed by Outback Ecology (2006) and Soil Water Consultants (2007 & 2008)	Rehabilitation Specialist
	C19	Depth to groundwater measured between 6 to 10 mBGL	Operations	Groundwater levels measured with calibrated water level meter (dipper)	In-pit rehabilitation areas and off-path TSF (Domains 4A, 4B and 4C, as detailed in Section 3.12.1) *Note: Monitoring locations, when installed, will be provided in the ACR*	Groundwater levels > 6 m below the top of final landform surface	Monthly, after replacement of soil profile	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008)	Environmental Specialist
	C20	NA	Closure	Soil sampling during test hole drilling as described in Criteria C15 Analysis of soil salinity (electrical conductivity, EC) using 1:5 soil:water extract (per method 4A1, Rayment & Lyons 2011)	In-pit rehabilitation areas and off-path TSF (Domains 4A, 4B and 4C, as detailed in Section 3.12.1)	No salinisation of rehabilitated soil profile due to capillary rise	Once, 3 years after tailings are complete for each pit	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Pre-mining physio-chemical characteristics of the soil materials summarised in Table 9	Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
	C21	NA	Closure	Analysis of soil salinity (electrical conductivity, EC) using 1:5 soil:water extract (per method 4A1, Rayment & Lyons 2011)	Domains 3 and 4 (as detailed in Section 0)	Surface site contamination (salinity) does not exceed control site conditions	Once, prior to lease relinquishment	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Pre-mining physio-chemical characteristics of the soil materials summarised in Table 9	Rehabilitation Specialist
	C22	NA	Closure	A gamma surface radiation survey carried out using appropriate methods (consistent with ARPANSA guidelines)	All rehabilitated areas in Domains (as detailed in Section 0)	The average dose rate (RS-125 contact dose rate) over the rehabilitated areas does not exceed 90 nSv/h (i.e. twice the maximum dose rate measured over the pre-mining area) and dose rates for U, Th and K40 do not exceed the following limits: U (4.4 ppm), Th (16.2 ppm) and K40 (1.8%)	Once, prior to lease relinquishment	Baseline radiation survey for Ambrosia conducted by SA Radiation (2018) Background surface gamma radiation as per Section 4.2.1, Iluka Resources J-A *Radiation and Radioactive Waste Management Plan* (as lodged with the SA EPA Radiation Protection Branch)	Environmental Specialist
	C23	NA	Closure	Dust deposition monitoring	Domains 2, 3 and 4 (as detailed in Section 0) Prior to closure, dust gauge sites will be established at agreed locations with DEM. Location of control sites will be determined based on the results of operational dust deposition monitoring (i.e. beyond extent of known operation fugitive dust)	Fugitive dust emissions from the rehabilitated landscape are consistent with control sites	Monthly for 12 months following closure	NA	Rehabilitation Specialist

5.10 Waste management

5.10.1 Context

Various types of liquid and solid wastes will be generated as a result of mine operations. These include general wastes (e.g. putrescible waste, inert solid waste and recyclables) and hazardous and listed wastes (e.g. waste chemicals and hydrocarbons, contaminated soils, sewage and clinical waste).

Inappropriate storage, handling and disposal of waste can lead to public health issues, contamination of soils and groundwater, and problems with vermin and native fauna.

During operations all wastes will be managed in accordance with waste hierarchy objectives, where feasible. Waste disposal is described in Section 3.10.

The management of impacts associated with mine waste, such as tailings, are discussed in Sections 5.9 (Soils), 5.12 (Native Vegetation) and 5.15 (Groundwater).

5.10.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- *Dangerous Substances Act 1979 (Regulations 2002);*
- *Environment Protection (Used Packaging Materials) Policy 2012*;
- *Environment Protection (Waste to Resources) Policy 2010*;
- EP Act *(Regulations 2009);*
- *Environmental Protection (Water Quality Policy) 2015;*
- *National Environment Protection (Used Packaging Materials) Measure 2011;*
- *National Environment Protection (Assessment of Site Contamination) Measure (Amendment 2013)* (‘ASC NEPM’);
- *Natural Resources Management Act 2004;*
- *South Australian Public Health (Wastewater) Regulations 2013;*
- *South Australian Public Health Act 2011;*
- EPA Draft Guidelines for solid waste: criteria for assessment, classification and disposal of waste (2009) (and Solid Waste Disposal Information Sheet);
- EPA Draft Guidelines for the Safe Handling, Reuse or Disposal of Biosolids (2009);
- EPA Guidelines: Disposal of used hydrocarbon absorbent materials;
- EPA Guidelines: Liquid biosolids from domestic septic tanks – disposal onto agricultural land 2003;
- EPA Guidelines: Medical waste – storage, transport and disposal 2003;
- EPA Guidelines: Regulatory monitoring and testing – Waste and wastewater sampling;
- EPA Guidelines: Waste tracking form;
- EPA Guidelines: Waste transport certificate;
- EPA Guidelines: Waste tyres; and
- South Australian Reclaimed Water Guidelines – Treated Effluent (1999).

5.10.3 Potential impacts

Potential Project-related waste management impacts are summarised in Table 53 and described below.

Table 53: Potential impacts associated with waste management

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
WD1	Waste management	Inappropriate/uncontrolled storage or disposal	Amenity, pest species and native fauna	Loss of amenity (odour, litter), increased abundance of pest species and opportunistic access by native fauna	Yes - A number of pest species are already known to be present in the area With no mitigation measures in place its possible there would be an increased abundance of pests.
WD2	Waste management	Inappropriate/uncontrolled storage or disposal	Soils, surface water and groundwater	Contamination of soils, surface and groundwaters	Yes – With no mitigation measures in place its possible that there could be impact to soil, surface water and groundwater.

Loss of amenity (e.g. odour and litter), increased abundance of pest species and opportunistic access by native fauna

If no mitigation measures were in place it is possible that inappropriate waste storage and disposal could lead to an increased abundance of pest species (e.g. weeds, mice), opportunistic access by native fauna (e.g. dingos) and amenity issues with odour and litter. The consequence of these impacts is considered minor, with an overall inherent risk level of **moderate**.

Contamination of soil, surface water and groundwater due to inappropriate or uncontrolled storage or disposal of wastes

Multiple legislative instruments (acts, regulations, measures, policies, codes and guidelines) exist which govern the storage, handling, treatment and disposal of commercial and industrial wastes. These have relevance to wastes managed through the off-site disposal pathways as summarised in Section 3.10.

A lack of adherence to these instruments and proper waste management processes could result in possible contamination of surface waters, groundwater and/or soils. The consequence of these impacts is considered minor, with an overall inherent risk level of **moderate**.

5.10.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts of waste disposal are outlined below.

Construction and operations

- Implementation of a *Waste Management Plan* that includes:
  - Waste management matrix for all waste streams (classification, storage and fate) aligned with regulatory requirements and waste hierarchy.
  - Requirements for storage and handling of hazardous and listed wastes to mitigate impacts to soil, surface water and groundwater.
  - Relevant approvals (i.e. waste water treatment plants (WTTPs)).
  - Auditing requirements.
  - Monitoring and inspection requirements.
  - Record keeping – waste disposal, waste transport documentation.
- Implementation of a *Hazardous Materials Management Plan* that includes:
  - Requirements for the storage, handling, bunding/containment and transport of dangerous goods (DG) and hazardous substances (including hazardous commercial and industrial waste) per relevant legislation, guidelines and standards.
  - Hazardous Materials Approval procedure.
  - Inventory management, monitoring and inspection requirements.
- Implementation of a *Pest Species Management Plan* that includes:
  - Monitoring and treatment of weed infestations.
  - Baiting programs for pest species (e.g. rabbit, house mouse).
- Implementation of a BMP (Appendix P) that includes:
  - Bioremediation works undertaken in accordance with SA EPA (2018) Guidelines for the Assessment and Remediation of Site Contamination and the SA EPA (2005) Guidelines for soil bioremediation.
  - Bioremediation pad design in accordance with the SA EPA (November 2005) Guidelines for soil bioremediation.
  - Bioremediation pad construction in accordance with the Basis of Design detailed in Appendix P.
- Hardstand material from Whyalla Port (if used for shipping J-A product) to undergo analytical testing for contamination, with results compared to remediation criteria in the BMP, prior to transport to the J-A Project area. Hardstand materials to be disposed of at an appropriately EPA-licensed facility if contamination levels do not meet remediation criteria in the BMP at closure.
- Dedicated Waste Transfer Station that includes:
  - Barrier fence for exclusion of fauna and containment of litter;
  - Systems for waste segregation; and
  - Relevant signage.
- Closed bins for general wastes and recyclables installed throughout mine complex and village.
- Waste collection and management by EPA-licensed transporters and treatment/disposal to EPA-approved facilities (where applicable).

- Waste register for capturing all waste movement; waste volumes, fate of waste, licence numbers (transport and waste facility) and waste tracking records.
- Dedicated, SA Health-approved WWTPs for the treatment of sewage and greywater.
- Site induction content and awareness training on waste management.
- Site awareness training on hazardous materials management.
- Spill response/clean-up procedures.
- Loss Control reporting system.

Closure

- As per construction and operations controls.
- Domain audit – no demolition, industrial or solid domestic wastes left on-site.
- Assessment of areas used for the storage and handling of hazardous materials for potential legacy site contamination, 2013 amended NEPM (NEPC,1999).

5.10.5 Residual risk

Loss of amenity (e.g. odour and litter), increased abundance of pest species and opportunistic access by native fauna

The operational control measures outlined will significantly reduce the potential amenity, pest species and fauna impacts of inappropriate waste storage/disposal to a **low** residual risk.

Contamination of soil, surface water and groundwater due to inappropriate/uncontrolled storage or disposal of wastes

Potential adverse impacts to soil, surface water and groundwater are significantly reduced through adherence to legislation, guidelines, engineering controls and appropriate waste management practices. A residual risk of **low** is achieved with these measures in place.

Whilst the the results of the residual risk assessment was **low** there is a requirement to have outcomes, measurement criteria and monitoring requirements as per the Second Schedule Lease Conditions (Table 37) as such these have been developed and are outlined in Section 5.10.6. The residual risk assessment is provided in Table 54.

Table 54: Summary of residual risk assessment in relation to potential impacts from waste management

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
WD1	Loss of amenity (odour, litter), increased abundance of pest species and opportunistic access by native fauna	Possible	Minor	Moderate	• Waste Transfer Station for segregation of wastes • Waste facility fencing for exclusion of fauna/containment of litter • Receptacles for general wastes and recyclables installed throughout mine complex and village • Approved Wastewater Treatment Plants for treatment of greywater and sewage • Preventive baiting programs for vermin (house mouse) • Waste collection by EPA-licensed transporters and treatment/disposal to EPA-approved facilities (where applicable) • Monitoring and housekeeping inspections • Site induction inclusive details on-site waste management procedures • Waste management awareness training • Implementation of a *Waste Management Plan* (refer to Section 5.10.4) • Implementation of a *Pest Species Management Plan* (refer to Section 5.10.4)	Unlikely	Negligible	Low	Not Applicable	Not Applicable	No demolition, industrial or solid domestic wastes (other than treated sewage) are to be disposed on-site* Note: This excludes residual infrastructure designated in Section 8.0 of J-A *Mine Closure Plan* (Appendix G)
WD2	Contamination of soil, surface water and groundwater.	Possible	Minor	Moderate	• Waste Transfer Station for segregation of wastes • Storage of hazardous and listed wastes in accordance with dangerous goods and EPA bunding guidelines • Approved Wastewater Treatment Plants for treatment of greywater and sewage • Waste collection by EPA-licensed transporters and treatment/disposal to EPA-approved facilities (where applicable). • Monitoring and housekeeping inspections • Spill response/clean-up procedures • Site induction inclusive details on-site waste management procedures • Waste management awareness training • Implementation of a *Waste Management Plan* (refer to Section 5.10.4) • Implementation of a *Hazardous Materials Management Plan* (refer to Section 5.10.4) • Implementation of a *Bioremediation Management Plan* (refer to Section 5.10.4)	Unlikely	Negligible	Low	Potential legacy soil contamination in areas used for storage and handling of hazardous and listed substances	Closure soil assessments as per ASC NEPM	No demolition, industrial or solid domestic wastes (other than treated sewage) are to be disposed on-site Note: This excludes residual infrastructure designated in Section 8.0 of J-A *Mine Closure Plan* (Appendix G)

5.10.6 Measurement criteria and monitoring requirements

Table 55 outlines the measurement criteria and monitoring requirements for each outcome in relation to waste disposal.

Table 55: Measurement criteria and monitoring requirements for outcomes relating to waste management

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
No demolition, industrial or solid domestic wastes (other than treated sewage) are to be disposed on-site	C24	Quarterly review of site waste register containing records of all waste movements from site	Operations	Visual monitoring and recording in the site waste register of appropriate waste treatment, segregation and disposal	All waste collection, storage and handling areas (Figure 42)	Site waste register contains records of all waste movements from site and demonstrates appropriate waste treatment, segregation and disposal	Monthly	NA	Environment Specialist
	C25	NA	Operations	Audit of waste disposal records for all waste types (general waste, recyclables, hazardous and listed wastes)	Waste disposal records	Waste correctly stored and managed in accordance with *Waste Management Plan* (refer to Section 5.10.4) A bioremediation program will be conducted in accordance with the BMP (Appendix P).	Annually	NA	Environment Specialist
			Closure	Domain audit and reporting	All Domains (Figure 44)	No demolition, industrial or solid domestic wastes (except biosolids and residual infrastructure designated in Section 8.0 of J-A *Mine Closure Plan*, Appendix G) are to be disposed or left on-site A bioremediation program will be conducted in accordance with the BMP (Appendix P).	Once, at closure, and/or prior to lease relinquishment	NA	Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
	C26	NA	Operations	Audit of waste disposal records for industrial and demolition wastes	Waste disposal records	Waste correctly stored and managed in accordance with *Waste Management Plan* (refer to Section 5.10.4)	Annually	NA	Environment Specialist
			Closure	Domain audit and reporting	All Domains (Figure 44)	No demolition, industrial or solid domestic wastes (except biosolids and residual infrastructure designated in Section 8.0 of J-A *Mine Closure Plan*, Appendix G) are to be disposed or left on-site	Once, at closure, and/or prior to lease relinquishment	NA	Rehabilitation Specialist

5.11 Dust and air quality

5.11.1 Context

No specific pre-mine baseline monitoring of dust or other air quality parameters were undertaken for operation. Ambient air quality, inferred from existing land use and vegetation cover and air-dispersion modelling for the operation, is most significantly influenced by wind generated dust from exposed/cleared areas during moderate to strong winds (Katestone 2008).

Wind erosion potential is variable according to soil type (particle size and weight), vegetation cover and moisture content with significant wind erosion generally occurring at speeds in excess of 20 km/hr (DERM 2011). At Maralinga, approximately 30–35% of winds exceed 20 km/hr (both morning and afternoon). Wind intensity is generally lower at Tarcoola, with approximately 14% of morning and 10% of afternoon winds exceeding 20 km/hr, respectively.

For mine operations dust generation is primarily associated with:

- vegetation clearance;
- wind erosion of existing open areas (e.g. pit and tailings areas, haul roads);
- wind erosion of soil and product stockpiles; and
- mobile plant and excavation activities.

Dust emissions are exacerbated in high wind and low rainfall/drought conditions. Key risks include the loss of soil resources required for rehabilitation and adverse impacts to vegetation. The potential for NORM contamination of soils is addressed in Section 5.9 (Soils). Management controls, assessment criteria and outcomes associated with these risks are outlined in Sections 5.12 (Native Vegetation) and 5.9 (Soils).

With respect to contaminant emissions to air, the J-A Project area diesel power generation plant and mobile equipment (see Section 3.11) contribute extremely low levels of fugitive and point source fuel combustion emissions at J-A. Further, the distance to the nearest public community at Yalata (70 km from J-A Project area) is well beyond any zone of potential impact. The risk of adverse air quality impact from these sources is therefore considered to be extremely low.

5.11.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- *Mining Act 1971;*
- Landscapes Act;
- *Environment Protection (Air Quality) Policy 2015;*
- *Environment Protection (National Pollutant Inventory) Policy 2008;*
- EP Act *(Regulations 2009); and*
- National Environment Protection (Air Quality) Measure 2003.

5.11.3 Potential impacts

Potential operational dust and air quality impacts are summarised in Table 56 and described below.

Table 56: Potential impacts associated with dust and air quality

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
DA1	Particulate matter (dust)	Wind erosion from vegetation clearance, open areas, mobile plant operation and stockpiles	Air Public	Adverse effect on local/regional air quality	No – Due to the absence of sensitive land uses in proximity to the mine.
DA2	Fuel combustion contaminant emissions	Fuel combustion emissions from mobile equipment and diesel power generation	Public	Adverse effect on local/regional air quality	No – Due to the absence of sensitive land uses in proximity to the mine.
NV3 (Refer to Section 5.12.3)	Vegetation clearance	Vegetation stress/dieback from dust smothering	Native vegetation	Adverse effect on vegetation health due to "smothering" by dust from operational activities (vegetation on the fringe of cleared areas and regenerating vegetation)	Yes – Open areas and project activities have the potential to generate dust if appropriate dust control measures are not in place.

Dust generation from operational activities resulting in adverse effect on local/regional air quality.

Pre-mine air dispersion modelling (Katestone 2008) determined that PM10 dust emissions associated with operational activities would have negligible adverse impact on the environment beyond active mine areas, and nil adverse impact on sensitive receptors (public/community) beyond lease boundaries.

Based on this modelling, and the absence of any sensitive community/public receptors in proximity to the mine, adverse impacts to local and regional air quality from dust are considered unlikely and of negligible consequence, with **low** overall risk.

Emission of fuel combustion products from mobile equipment and power generation resulting in adverse effect on local/regional air quality.

Pre-mine air dispersion modelling (Katestone 2008; Katestone 2009) determined that fuel combustion contaminant emissions from mobile equipment and the J-A Project area power station would have negligible adverse impact on the environment beyond active mine areas, and nil adverse impact from nitrogen dioxide and carbon monoxide emissions on sensitive receptors (public/community) beyond lease boundaries. Further, since commencement of operations in 2009, no incidents have been recorded at J-A concerning dark smoke emissions from any mobile equipment or the diesel generation plant.

Based on this modelling, and the absence of any sensitive community/public receptors in proximity to the mine, adverse impacts to local and regional air quality from fuel combustion products are considered unlikely and of negligible consequence, with **low** overall risk.

The J-A Project area power station is approved as a prescribed activity under Iluka EPA Licence 22442 (fuel burning: rate of heat release exceeding 5 megawatts).

With respect to contaminant emissions, the *Environment Protection (Air Quality) Policy 2016* applies and is addressed through the operation's *Dust and Air Quality Management Plan*.

5.11.4 Control and management strategies

Control and management strategies that have been implemented to minimise potential dust and air quality impacts are outlined below.

Construction and operations

- Implementation of a *Dust and Air Quality Management Plan* that includes:
    - Dust management control strategies;
    - Monitoring programs – dust deposition, visual smoke; and
    - Procedures for dust suppression
- Implementation of a *Native Vegetation Management Plan* (Appendix V) that includes:
    - Internal vegetation clearance procedure and vegetation clearance register; and
    - Timing and management of clearance to minimise erosion.
- Implementation of a *Rehabilitation Management Plan* (Appendix T) that includes:
    - Procedures for progressive rehabilitation of disturbed areas;
    - Procedures for vegetation clearance and removal of soil profiles for stockpiling or direct return; and
    - Procedures for stabilisation of rehabilitation areas and soil stockpiles.
- Implementation of a *Mineral Stockpiles Management Plan* that includes:
    - Details on stockpile design, management and stabilisation.
- Suppression and stabilisation using potable water, reclaimed B-class wastewater, saline water, clay slimes and commercial sealants.
- Mobile equipment and power station maintenance programs.
- Site induction content and awareness training on dust and air quality.
- Loss Control reporting system.

Closure

These construction and operational management and control strategies will be maintained during the closure phase.

5.11.5 Residual risk

Dust generation from operational activities resulting in adverse effect on local/regional air quality.

Residual risk remains **low**; no commitments, outcomes or assessment criteria are assigned in this PEPR.

Emission of fuel combustion products from mobile equipment and power generation resulting in adverse effect on local/regional air quality.

Residual risk remains **low**; no commitments, outcomes or assessment criteria are assigned in this PEPR.

The residual risk of dust and fuel combustion emission impacts on local/regional air quality remains low (Table 57), with no credible receptors and there is no requirement to have outcomes, measurement criteria and monitoring requirements as per the Second Schedule Lease Conditions (Table 37). As a result, no commitments, outcomes or assessment criteria are assigned in this PEPR.

Table 57: Summary of residual risk assessment in relation to potential impacts on dust and air quality

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
DA1	Dust generation from operational activities resulting in adverse effect on local/regional air quality	Unlikely	Negligible	Low	• *Dust and Air Quality Management Plan* • *Native Vegetation Management Plan* • *Mineral Stockpiles Management Plan* • *Rehabilitation Management Plan* (Appendix T) • Weather forecast and field suppression plans • Traffic management restrictions • Suppression and stabilisation procedures • Suppression and stabilisation using potable water, reclaimed B-class wastewater, saline water, clay slimes and commercial sealants • Procedures for progressive rehabilitation of disturbed areas • Procedures for vegetation clearance and removal of soil profiles for stockpiling or direct return • Procedures for stabilisation of rehabilitation areas and soil stockpiles • Gravimetric dust deposition monitoring • Vegetation Clearance Procedure • Timing and management of clearance to minimise erosion • Minimisation of open areas through stage clearing • Site induction inclusive details on dust risks and management • Dust and air quality awareness training • Loss Control reporting system	Unlikely	Negligible	Low	Not Applicable	Not Applicable	Predicted outcomes and assessment criteria have only been developed for environmental aspects with an IRL of moderate or higher. As there is no SPR linkage for this potential impact event, an outcome is not deemed necessary.
DA2	Fuel combustion contaminant emissions resulting in adverse effect on local/regional air quality	Unlikely	Negligible	Low	• All controls as per risk DA1 • Mobile equipment and power station maintenance programs	Unlikely	Negligible	Low	Not Applicable	Not Applicable	All fuel burning equipment is operated in accordance with the requirements of the EPA

5.11.6 Measurement criteria and monitoring requirements

As the inherent risk level for identified risks is low no outcomes have been developed. Refer to Section 5.12 for dust monitoring in relation to monitoring vegetation impacts.

5.12 Native vegetation

5.12.1 Context

The J-A Project area is located within the Yellabinna and Nullarbor Regional Reserves, which provide for the conservation of over 4 million ha of essentially intact native vegetation from the WA border to the Eyre Peninsula. The vegetation in the Project footprint is generally dominated by three vegetation associations open myall woodland; myall/mallee woodland and chenopod shrubland. The disturbance footprint for each vegetation association that occurs in the J-A Project area is summarised in Table 58 and shown in Figure 21.

Refer to Section 2.13 for further information on native vegetation in the J-A Project area.

Table 58: Estimate disturbance footprint (Domain 2, Domain 3 and Domain 4)

Vegetation Association	Estimated disturbance footprint (ha) on ML6315, MPL110, MPL111 and MPL-Canberra
Chenopod	490
Myall woodland	925
Myall/mallee woodland	250

In accordance with the requirements of the '*Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the clearance of native vegetation associated with the minerals and petroleum industry*' (DWLBC 2005), Iluka will provide a SEB for native vegetation cleared for the Project. The SEB for the J-A operation is met through monetary payment into the Native Vegetation Fund (see Appendix L for details).

Reconciliation of annual vegetation clearance against the financial SEB offset is done on a calendar year basis, and details provided in the ACR submitted in March each year.

Any additional SEB payments required are to be paid at the time of SEB reconciliation the year prior to the anticipated clearance.

5.12.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- EPBC Act;
- Mining Act;
- NPW Act;
- NV Act;
- Yellabinna Reserves Management Plan 2013 (DEWNR 2013); and
- Nullarbor Parks Draft Management Plan 2017 (DEWNR 2017).

5.12.3 Potential impacts

Native vegetation including some species of conservation significance may be affected by project activities. Potential project related native vegetation impacts are summarised in Table 59 and described below.

Table 59: Potential impacts associated with native vegetation

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
NV1	Vegetation clearance	Planned clearance for project activities	Native vegetation Native fauna – refer to Section 5.13	Adverse effect on species abundance (including threatened species) both locally and regionally due to planned clearance activities	Yes – vegetation clearance is required for Project activities so might be species impacts without appropriate management.
NV2	Vegetation clearance	Vegetation stress/dieback from hypersaline process water	Native vegetation Native fauna – refer to Section 5.13	Adverse effect on vegetation health due to exposure to hyper-saline process water Unapproved clearance of vegetation	Yes – hyper saline water is used for dust suppression in and around the site and might impact on nearby vegetation if not managed.
NV3	Vegetation clearance	Vegetation stress/dieback from dust smothering	Native vegetation Native fauna – refer to Section 5.13	Adverse effect on vegetation health due to "smothering" by dust from operational activities (vegetation on the fringe of cleared areas and regenerating vegetation) Unapproved clearance of vegetation	Yes – Open areas and project activities have the potential to generate dust if appropriate dust control measures are not in place.
NV4	Vegetation clearance	Uncontrolled fire	Native vegetation Native fauna – refer to Section 5.13	Adverse effect on species abundance (including threatened species) both locally and regionally due to uncontrolled fire	Yes – if an uncontrolled fire occurs due to Project activities there is potential for impacts to native vegetation.
GW3 (Refer to Section 5.15)	Saline tailings disposal	Tailings seepage to groundwater (groundwater rise)	Soil Native vegetation	Hyper saline groundwater rise (salinity) impacting soils and vegetation within the extent of mine workings Unapproved clearance of vegetation	Yes – there is potential that hypersaline groundwater rise could impact on soils and vegetation.
GW4 (Refer to Section 5.15)	Saline tailings disposal	Tailings seepage to groundwater (groundwater rise)	Soil Native vegetation Native fauna – refer to Section 5.13	Hyper saline groundwater rise (salinity) impacting soils and vegetation beyond the extent of mine workings due to groundwater mound migration Unapproved clearance of vegetation	Yes – there is potential that hypersaline groundwater rise could impact on soils and vegetation.

Adverse effect on species abundance (including threatened species) both locally and regionally due to planned clearance activities

Vegetation clearance is required as part of operations to facilitate Project infrastructure and mining activities. A total of approximately 1,665 ha of vegetation will be cleared in Domains 2, 3 and 4 (refer to Figure 44). Vegetation removal will predominantly be undertaken within the myall woodland vegetation association, although clearance of chenopod shrubland and myall/mallee woodland will also occur. It is anticipated that planned clearance will also include the clearance of individuals of the threatened plant species *Santalum spicatum* (sandalwood).

Without the implementation of control and management strategies, it is possible that there will be reduced species abundance that will result in a **moderate** impact on native vegetation. This provides a high level of inherent environmental risk associated with the Project.

Adverse effect on vegetation health due to exposure to hyper-saline process water

Hyper-saline process water is transported through pipes as part of operations and is utilised for dust suppression. Exposure to hyper-saline process water from spills or spray drift could reduce plant regrowth or cause death to existing vegetation caused by salt impacts on foliage or increased soil salinity.

Without the implementation of control and management strategies, it is likely there will be an impact on vegetation from exposure to hyper-saline process water with a **moderate** consequence. This provides a high level of inherent environmental risk associated with the Project.

Adverse effect on vegetation health due to "smothering" by dust from operational activities (vegetation on the fringe of cleared areas and regenerating vegetation)

Open areas within the J-A Project area and Project activities will present an opportunity for dust generation. The smothering of vegetation with dust from operational activities has the potential to reduce plant regrowth or cause death to existing vegetation.

Without the implementation of control and management strategies, it is possible that vegetation impacts will occur. The consequence is considered to be minor, resulting in an inherent environmental risk level of **moderate.**

Adverse effect on species abundance (including threatened species) both locally and regionally due to uncontrolled fire

While natural fire regimes are important for ecosystem health uncontrolled fires as a result of Project activities could have an adverse effect on species abundance.

Without the implementation of control and management strategies, it considered possible that uncontrolled fire could have a significant consequence. This provides an inherent environmental risk of **high**.

5.12.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to native vegetation are outlined below.

Construction and Operations

- Implementation of a *Dust & Air Quality Management Plan* that includes:
    - Details of dust management and monitoring program; and
    - Procedures for dust suppression.

* Implementation of a *Fire Risk Management Plan* that includes:
    - Details of fire management, hot work permitting, training and fire suppression systems;
    - Details of the fire risk monitoring regime; and
    - Annual fire risk audit.
* Implementation of a *Native Vegetation Management Plan* (Appendix V) that includes:
    - Internal vegetation clearance procedure and vegetation clearance register; and
    - Details of the native vegetation management and annual monitoring program.
* Implementation of a *Rehabilitation Management Plan* (Appendix T) that includes:
    - Procedures for progressive rehabilitation of disturbed areas;
    - Procedures for vegetation clearance and removal of soil profiles for stockpiling or direct return;
    - Procedures for stabilisation of rehabilitation areas and soil stockpiles;
    - Procedures for collection and storage of seed for rehabilitation purposes;
    - Details of monitoring and management of rehabilitation activities; and
    - Provision of a SEB in accordance with the requirements of the NV Act and the *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the clearance of native vegetation associated with the minerals and petroleum industry* (2005) and *Guide for a Significant Environmental Benefit for the clearance of native vegetation associated with the Minerals and Petroleum Industry* (2017).
* Implementation of the *Tailings Management Plan:*
    - Requirements for under tails drainage system; and
    - Dewatering of tails prior to deposition in the TSF.
* Implementation of a *Surface Water Management Plan* that includes the requirements for drainage design to minimise vegetation contamination from saline water.
* Comparison of annual aerial photography to ensure vegetation clearance is within approved internal permit limits.
* Monitoring health of vegetation in dust and hyper-saline surface water and groundwater impact zones.
* Restricting access to undisturbed areas not required during operations.
* Daily inspection of water supply infrastructure (including borefield pipeline) for leaks.
* Burial of water supply pipeline (from borefield).
* Flow sensors installed on water supply pipeline (from borefield).
* Site based Emergency Response Team and firefighting equipment.

Closure

* Monitoring program as outlined in the *Native Vegetation and Rehabilitation Management Plans.*
* Progressive rehabilitation of disturbed areas, commencing within first few years of operations.

5.12.5 Residual Risk

Adverse effect on species abundance (including threatened species) both locally and regionally due to planned clearance activities

Approximately 1,665 ha total of vegetation will need to be cleared as part of Project activities. The vegetation associations that make up the clearance area i.e. myall open woodland, myall/mallee woodland and chenopod shrubland are common throughout the Yellabinna and Nullarbor Reserves and the clearance footprint comprises only 0.03% of the total reserve area.

However, to minimise any potential impact to species abundance a number of management measures have been implemented. The key measure in place is the progressive rehabilitation of disturbed areas. Rehabilitation within mined areas involves the reinstatement of the soil profile which includes replacing the seedbank located within the topsoil. Ongoing monitoring of rehabilitated areas throughout the life of the mine provides timely feedback on the success of rehabilitation techniques and will enable refinement of procedures in later stages of rehabilitation if required.

Staged landscape rehabilitation of the mine commenced in 2010 with Landscape Function Analysis (LFA) monitoring of analogue transects being carried out since 2010. LFA is a monitoring system that provides time series data from assessments of landscape functioning, vegetation growth and habitat development. LFA monitoring is used to assess the success and effectiveness of rehabilitation programs within the J-A Project area. The monitoring allows ecosystem development to be quantified and the information used to further improve rehabilitation strategies (EBS 2016).

Results of LFA monitoring at the J-A mine show a trend of continual improvement in landscape function, plant cover and diversity at rehabilitation-sites.

Rehabilitation of disturbed areas is also informed by the ongoing vegetation monitoring program (i.e. non-cleared vegetation), which documents an understanding of typical vegetation community and composition, including species richness, life form composition, and age-class compositions of the three main vegetation associations within the J-A Project area.

With the implementation of control and management measures it is unlikely that species abundance on a local or regional scale will be impacted by clearance activities. Early identification of impacts would ensure that they would be minimised and rectifiable, therefore of minor consequence. The residual risk is **low**.

Vegetation death due to exposure to hyper-saline process water

On-site trials conducted in 2010 (JARMS 2012) examined the impact on vegetation health associated with the application of a hyper-saline “slimes” (clay fines and water) which is used for dust suppression during operations. The findings of the trial, which involved the direct application of the sand/hyper-saline water mix onto 31 plants, demonstrated that the vegetation on-site is relatively salt tolerant, with no deaths recorded of the plants in the trial.

Despite these findings a cautionary approach is applied, and procedures are in place to prevent the use of hyper-saline water for dust suppression on vegetated areas, soil stockpiles and exposed overburden. This and the implementation of control and management strategies outlined in Section 5.12.4 mean that it is unlikely that vegetation will be exposed to hyper-saline water at levels that will be detrimental to vegetation health. If excessive exposure does occur the consequence would be negligible as it is likely to occur within only a limited area.

Vegetation surveys carried out since the commencement of mining show no adverse effects to the vegetation communities surrounding the mine and operational areas, with impact sites consistency displaying the same trends as control sites (located 5 km or more from impact zones). The residual risk for this impact is **low**.

Vegetation impact due to "smothering" by dust from operational activities (vegetation on the fringe of cleared areas and regenerating vegetation)

Although the generation of dust from mining activities will be minimised with the implementation of the control and management strategies outlined in Section 5.12.4, it is still possible that some plant species, such as *Maireana sedifolia* (which has fine hairs on its leaves) will be affected by dust smothering. The extent to which *M. sedifolia* responds to smothering is still unknown, and a monitoring program is currently in place to determine if plant health is impacted by excessive dust build up on foliage.

The extent of vegetation exposed to heavy dust cover tends to be limited to areas within close proximity to mining activities therefore the impact to vegetation on a regional scale would be minor. The residual risk is considered to be **moderate** until the uncertainties relating to this impact are excluded.

As outlined above, vegetation surveys carried out since the commencement of mining do not indicate any significant adverse impacts resulting directly from mining activities.

Adverse effect on species abundance (including threatened species) both locally and regionally due to uncontrolled fire

With the implementation of the control and management strategies outlined in Section 5.6.4 there a rare likelihood of an uncontrolled fire that would result in an adverse effect on species abundance. However, if a fire were to occur the consequence would be moderate, resulting in a residual risk of **low**.

The residual risks are considered to be as low as reasonably practicable (between **moderate** and **low**) and for this reason are considered by Iluka to be acceptable for the project. Based on the results of the residual risk assessment three of these impact events (adverse effect on species abundance (including threatened species) both locally and regionally due to planned clearance, vegetation death due to exposure to hypersaline process water and adverse effect on species abundance (including threatened species) both locally and regionally due to uncontrolled fire), which were found to have a low residual risk, do not require an outcome. However outcomes, measurement criteria and monitoring requirements have been developed for all impact events as per the requirements of the Second Schedule Lease Conditions (Table 37); these are outlined in Section 5.12.6. The residual risk assessment is provided in Table 60.

Table 60: Summary of residual risk assessment in relation to project impacts on native vegetation

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
NV1	Adverse effect on species abundance (including threatened species) both locally and regionally due to planned clearance activities	Possible	Moderate	High	• Implementation of a *Native Vegetation Management Plan* • Implementation of a *Rehabilitation Management Plan* (Appendix T) • Progressive rehabilitation of disturbed area, commencing within first few years of operations • Provision of a Significant Environmental Benefit (SEB) • Landscape Function Analysis • Comparison of annual aerial photography to ensure vegetation clearance is within approved internal permit limits • Restricting access to undisturbed areas not required during operations	Unlikely	Minor	Low	Plant growth response to reconstructed soil profiles Soil seed bank response to disturbance and stockpiling	Adelaide University and ARC linkage project (Cell 1 Trial). Refer to J-A research and monitoring summary (JARMS 2012, 2014 and 2016) for more information. Rehabilitation trials	All clearance of native vegetation Is authorised under appropriate legislation (see annual SEB reconciliation report) Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved
NV2	Vegetation impacts due to exposure to hyper saline process water	Likely	Moderate	High	• Implementation of a *Native Vegetation Management Plan* • Implementation of a *Rehabilitation Management Plan* • Implementation of a *Surface Water Management Plan* • Procedures for dust suppression • Daily inspection of water supply infrastructure for leaks and spills • Burial of water supply pipeline (from borefield) • Flow sensors installed on water supply pipeline (from borefield)	Unlikely	Negligible	Low	Not Applicable	Not Applicable	All clearance of native vegetation Is authorised under appropriate legislation
NV3	Vegetation impacts due to "smothering" by dust from operational activities (vegetation on the fringe of cleared areas and regenerating vegetation)	Possible	Minor	Moderate	• Implementation of a *Native Vegetation Management Plan* • Implementation of a *Rehabilitation Management Plan* • Implementation of a *Dust and Air Quality Management Plan* • Procedures for dust suppression • Comparison of annual aerial photography to ensure vegetation clearance is within approved internal permit limits • Monitoring health of vegetation in impact zones (Figure 51)	Unlikely	Minor	Moderate	Unknown how vegetation health, in particular *Maireana sedifolia*, is impacted by smothering of foliage with dust generated by project activities	Dust monitoring program in place, which incorporates a series of transects to examine health of vegetation within proximity of mining activities (see Figure 51)	All clearance of native vegetation Is authorised under appropriate legislation
NV4	Adverse effect on species abundance (including threatened species) both locally and regionally due to uncontrolled fire	Possible	Significant	High	• Implementation of a *Native Vegetation Management Plan* • Implementation of a *Fire Risk Management Plan* • Hot works permitting system • Fire suppression systems installed Site based emergency response team and firefighting equipment	Rare	Moderate	Low	Not Applicable	Not Applicable	No uncontrolled fires caused by mining activities

5.12.6 Measurement criteria and monitoring requirements

Table 61 outlines the measurement criteria and monitoring requirements for each outcome in relation to native vegetation.

Table 61: Measurement criteria and monitoring requirements for outcomes in relation to native vegetation

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
All clearance of native vegetation is authorised under appropriate legislation	C27	NA	Operations	Vegetation health survey measuring: • plant mortality; • new growth; • evidence of flowering and fruiting; • extent of dust smothering; and • evidence of saline stress	Transects for vegetation health (dust and groundwater impacts) established within close proximity to mining activities (see Figure 51)	All vegetation clearance is within authorised clearance boundaries (see annual SEB reconciliation report)	Annually	Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17	Rehabilitation Specialist
				Photo point monitoring	All Domains (as described in Section 0)	No loss of vegetative cover due to mining operations	Annually	Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17. JARMS reports: 2012, 2014, 2016, 2018	Environmental Advisor Rehabilitation Specialist
				Visual observations and recording of spills and leaks in incident register	Borefield and raw water pipeline (see Figure 38)	Minor spills and leaks are to be remedied within 7 days of occurrence. Major spills are to be reported to the Director of Mines.	Daily	NA	All personnel
	C28	NA	Operations	GIS comparison of approved clearance boundary and actual clearance boundary	All Domains (as described in Section 0; Figure 44)	All vegetation clearance is within authorised clearance boundaries see annual SEB reconciliation report)	Annually	Internal Map Reference = *ArcGIS MXD – J-A Veg Clearance Master*, which is updated per clearance event and provided in the ACR	Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	C29	NA	Operations/Closure	Landscape Function Analysis (LFA) monitoring of: • soil cover; • basal cover of vegetation; • litter cover; • BSC; • crust entirety; • erosion type and severity; • deposited materials; • surface roughness; • surface resistance to disturbance; • slake testing; • soil texture; and • vegetation diversity and abundance.	Rehabilitated areas (Domains 3 and 4 – areas within Domains 1 and 2 subject to agreement with final landholder) as detailed in Section 0) Each rehabilitated area per year will contain a minimum of two LFA site for the first 5 years of rehabilitation works Final LFA regime to be determined based on results	Rehabilitated systems are trending towards pre-disturbance landscape function based on comparison with control sites	1, 2, 5 and 10 years post-rehabilitation during operations 1,2 and 5 post-rehabilitation at closure	Baseline soil investigations completed by Outback Ecology (2006) and Soil Water Consultants (2007 & 2008) Baseline vegetation surveys of the Project area conducted by Badman (2006a, 2006b, 2007), see Table 17	Rehabilitation Specialist
No uncontrolled fires caused by mining activities	Apply C5 and C6	Apply C5 and C6 for assessment and recording of fire incidents.	Refer to Section 5.6.6, C5 to C6						

5.13 Native fauna

5.13.1 Context

Fauna assemblages in the region generally reflect the confluence of three major habitat blocks; the Nullarbor Plain, the Great Victoria Desert and the southern myall-mallee belt. They also reflect the presence on-site of three general habitat types; chenopod shrubland, open myall woodland and mallee woodland.

Refer to Section 2.14 for further information on native fauna in the J-A Project area.

5.13.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- EPBC Act;
- *Animal Welfare Act 1985;*
- Mining Act;
- NPW Act;
- NV Act; and
- Landscapes Act.

5.13.3 Potential impacts

Native fauna, including some species of conservation significance may be affected by project activities. Potential project related native fauna impacts are summarised in Table 62 and described below.

Table 62: Potential impacts associated with native fauna

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
NF1	Habitat loss	Vegetation clearance	Native fauna	Reduction in habitat and resources resulting in decreased diversity or abundance of native fauna	Yes – vegetation clearance due to Project activities could impact on native fauna.
NF2	Operational traffic	Interaction with vehicles on roads and tracks	Native fauna	Fauna fatalities due to traffic interactions resulting in decreased diversity or abundance of native fauna	Yes – operational traffic movements occur in and around the Project area and have potential to cause fauna fatalities.

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
NF3	Open water storage	Open water storage areas in the project area include: • process ponds • sewage treatment facility • swimming pool • tailing storage • turkey nests	Native fauna	Fauna fatalities due to drowning, resulting in decreased diversity or abundance of native fauna	Yes – open water storage infrastructure within the Project area has the potential to result in native fauna drowning.

Reduction in habitat and resources resulting in decreased diversity or abundance of native fauna

Vegetation clearance is required as part of Project operations to facilitate Project infrastructure and mining activities. A total of approximately 1,665 ha of vegetation will be cleared.

Vegetation removal will predominantly be undertaken within the myall woodland vegetation association, although clearance of chenopod shrubland and myall/mallee woodland will also occur (refer to Section 5.12). Section 2.14 and Appendix D provide a summary of the fauna present within the J-A mine area.

Without the implementation of control and management strategies, it is possible that mining operations will result in reduced species abundance and diversity, with a **high** impact on native fauna.

Fauna fatalities due to traffic interaction resulting in decreased diversity or abundance of native fauna

Without mitigation or management, it is likely that fauna fatalities will occur during operations. Although fatalities are typically related to common species; it is potential impacts to fauna abundance and or diversity in the region due to operational traffic is considered to be **high**.

Fauna fatalities due to drowning resulting in decreased diversity or abundance of native fauna

Without mitigation or management, it is possible that fauna entrapment within open water storage areas would occur but would have a minor consequence to the abundance and/or diversity of fauna in the region. This provides a **moderate** level of inherent environmental risk.

5.13.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to native fauna are outlined below.

Construction and operations

- Implementation of a *Fauna Management Plan* that includes:

  - Details of the native fauna species (including threatened species) management and monitoring program; and
  - Requirements for the maintenance of a fauna sightings and deaths register to indicate trends or if additional management is required.
- Fauna handling and euthanasia procedures.
- Implementation of a *Native Vegetation Management Plan* (Appendix V) that includes:
  - Internal vegetation clearance procedure and vegetation clearance register; and
  - Details of the native vegetation management and monitoring program.
- Provision of SEB offsets.
- Fauna caution traffic signage on haul road.
- Speed limits on roads used for project activities.
- Fauna proof fencing installed around long-term open water storage areas.
- Avian fauna proof screen installed on fresh water tanks at sewage treatment plant.
- Fauna escape matting or exit ramps installed in all open water storage areas.
- Daily inspection of potential fauna traps within project area e.g. ponds and trenches.
- Personnel forbidden from feeding or harassing wildlife.

Closure

- Monitoring program as outlined in the *Fauna Management Plan*; and
- Progressive rehabilitation of disturbed areas, commencing within first few years of operations.

5.13.5 Residual risk

Reduction in habitat and resources resulting in decreased diversity or abundance of native fauna

Approximately 1,665 ha total of vegetation will need to be cleared as part of Project activities. As a result of clearance, fauna may be forced out of the immediate J-A Project area. However, as the J-A Project area is surrounded by substantial areas of myall woodland; chenopod shrubland and myall/mallee woodland the fauna will have the opportunity to migrate into the neighbouring habitat. Also given the implementation of a progressive rehabilitation program within the first few years of operation, the reduction in habitat and resources will be short-term. This should reduce the likelihood of significant changes to diversity or abundance of native fauna in the J-A Project area.

Results from the monitoring program to date show no adverse effects to the faunal groups surrounding the mine and operational areas with no fauna assemblages having declined in abundance of species richness at impact sites. In general, impact sites are displaying trends similar to control sites.

Based on the results of the monitoring program and the continued implementation of the control and management strategies outlined in Section 5.13.4, the residual risk is considered **low**.

Fauna fatalities due to traffic interaction resulting in decreased diversity or abundance of native fauna

Given the traffic activity associated with the project and the lack of fencing along the haul road, there may still be fauna fatalities associated with traffic interactions. However, with the implementation of the control and mitigation measures outlined in Section 5.13.4 the consequence is likely to be minor on a regional scale. The residual risk is considered to be **low**.

Fauna fatalities due to drowning resulting in decreased diversity or abundance of native fauna

The installation of fauna proof fencing; exit matting and ramps will decrease the likelihood of fauna fatalities from drowning in open water storage areas. Fauna fatalities may still occur but would be of minor consequence on a regional scale. The residual risk is considered to be **low.**

The residual risks are considered to be as low as reasonably practicable (**low**) and for this reason are considered by Iluka to be acceptable for the project. Based on the results of the residual risk assessment all three of these impact events were found to have a low residual risk, do not require an outcome. However, outcomes, measurement criteria and monitoring requirements have been developed for all impact events as per the requirements of the Second Schedule Lease Conditions (Table 37); these are outlined in Section 5.13. The residual risk assessment is provided in Table 63.

Table 63 Summary of residual risk assessment in relation to Project impacts on native fauna

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
NF1	Reduction in habitat and resources resulting in decreased diversity and/or abundance of native fauna	Possible	Moderate	High	• Implementation of a *Fauna Management Plan* • Maintenance of a fauna sightings and deaths register • Implementation of a *Native Vegetation Management Plan* • Provision of SEB • Biennial fauna monitoring • Progressive rehabilitation of disturbed areas, commencing within first few years of operations	Unlikely	Minor	Low	Not Applicable	Not Applicable	No net adverse impacts from site operations on native fauna abundance or diversity within the lease area and adjacent areas
NF2	Fauna fatalities due to traffic interactions resulting in decreased diversity and/or abundance of native fauna	Likely	Minor	High	• Implementation of a *Fauna Management Plan* • Maintenance of a fauna sightings and deaths register • Fauna handling and euthanasia procedures • Fauna caution traffic signage on haul road • Speed limits on roads used for project activities • Personnel forbidden from feeding or harassing wildlife	Unlikely	Minor	Low	Not Applicable	Not Applicable	No net adverse impacts from site operations on native fauna abundance or diversity within the lease area and adjacent areas All sick and injured fauna are managed as per the requirements of the *Animal Welfare Act 1985*
NF3	Fauna fatalities due to drowning, resulting in decreased diversity and/or abundance of native fauna	Possible	Minor	Moderate	• Implementation of a *Fauna Management Plan* • Maintenance of a fauna sightings and deaths register • Fauna handling and euthanasia procedures • Fauna proof fencing installed around long-term open water storage areas • Avian fauna proof screen installed on fresh water tanks at sewage treatment plant • Fauna escape matting or exit ramps installed in all open water storage areas • Daily inspection of potential fauna traps within project area e.g. Ponds and trenches • All open water storage facilities infilled and closed at mine closure	Unlikely	Minor	Low	Not Applicable	Not Applicable	No net adverse impacts from site operations on native fauna abundance or diversity within the lease area and adjacent areas All sick and injured fauna are managed as per the requirements of the *Animal Welfare Act 1985*

5.13.6 Measurement criteria and monitoring requirements

Table 64 outlines the measurement criteria and monitoring requirements for each outcome in relation to native fauna.

Table 64: Measurement criteria and monitoring requirements for outcomes in relation to native fauna

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
No net adverse impacts from site operations on native fauna abundance or diversity within the lease area and adjacent areas	C30	Quarterly review of the incident register for the occurrence of injured or deceased fauna, including the identification of any procedural changes required	Operations	Fauna survey of the diversity and abundance of native fauna species in project (impact) areas and control sites	Monitoring sites (see Figure 52)	Fauna diversity and abundance in impact areas is comparable with control sites	Biennial	Baseline fauna surveys of the Project areas conducted by SKM (2006a)	Environmental Specialist Rehabilitation Specialist
				Visual observations and incident investigation (report stored in Iluka Incident Management System, Cintellate) of the occurrence of injured or deceased fauna	All Project areas	Mine records and investigations of fauna deaths recorded demonstrate that the Mine Operator did not cause or could not have reasonably prevented injuries or deaths from occurring	Opportunistic	NA	All personnel
				Visual observations	Open water storage areas		Daily		Environmental Specialist/Technician
	C31	NA	Closure	Site audit of rehabilitated water storage facilities	All domains (Figure 44)	Open water storage facilities backfilled and rehabilitated	Once, at mine closure, prior to relinquishment	NA	Rehabilitation Specialist
	Refer to C29	Apply C29 to measure that appropriate habitat is restored for faunal species.	Operations/Closure	Refer to Section 5.12.6, C29					
All sick and injured fauna are managed as per the requirements of the *Animal Welfare Act 1985*	C32	Quarterly review of the incident register for the management of sick or injured fauna, including the identification of any procedural changes required	Operations	Visual observations and incident investigation (report stored in Iluka Incident Management System, Cintellate) of the management of sick or injured fauna	All Project areas	Mine records indicate compliance with the requirements of the *Animal Welfare Act*, where an animal is sick or injured as a result of mining operations	Opportunistic	NA	Environmental Specialist/Technician

5.14 Surface water

5.14.1 Context

J-A is partially located within the Lake Ifould catchment, with the Jacinth and Ambrosia deposits located approximately 6 km east of the lake. The watercourses located within the J-A Project area are ephemeral and are shaped by rainfall and flow events that are highly variable both spatially and temporally. The J-A watercourse system is complex and vulnerable to accelerated erosion. This is typical of an arid zone system. Surface water flow direction and drainage patterns are shown in Figure 15.

Refer to Section 2.11 for further information on surface water in the J-A Project area.

5.14.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- EP Act;
- *Environment Protection (Water Quality) Policy 2015; and*
- Mining Act.
- Alinytjara Wilurara NRM Plan under the Landscapes Act

5.14.3 Potential impacts

Potential Project related surface water impacts are summarised in Table 65 and described below.

Table 65: Potential impacts associated with surface water

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
SW1	Vegetation clearance and earthworks activities	Mining activities	Ecosystem in disturbance area and downstream of mine	Altered surface water drainage patterns	Yes – vegetation clearance and mining earthworks have potential to impact on surface water drainage patterns.
SW2	Saline water use and residues	Accidental release of saline water from project area Stormwater runoff	Ecosystem downstream of mine	Saline contamination of surface water	Yes – saline process water is used for processing and dust suppression and has potential to enter ecosystems downstream of the mine.
SW3	Vegetation clearance and earthworks activities	Stormwater runoff	Ecosystem downstream of mine	Increased sediment load in surface water	Yes – during rainfall events there is potential for runoff sediment to impact downstream water courses.

Altered surface water drainage patterns

Vegetation clearance and mining earthworks are required as part of project operations. This activity will result in the temporary disturbance of surface water drainage patterns that occur within the J-A Project area. Without the implementation of control and management strategies it is possible that drainage patterns will be altered with a moderate effect on the environment. This provides a **high** level of inherent risk.

Contamination of surface water with saline water

Saline process water will be used for ore and mineral processing and dust suppression during operations. Without the implementation of management measures it is possible that saline contaminants could enter systems downstream of the mine, however any contaminants would be highly diluted with fresh surface water. The impact would likely be limited to creek beds where there is little vegetation therefore the consequence would be negligible. This provides a **low** level of inherent risk.

Increased sediment load in surface water

Mining and vegetation clearance activities may result in increased movement of sediment from cleared areas into downstream water courses during rainfall events. Without the implementation of management measures the likelihood of this occurring is possible (based on a 1:5 ARI). However the impact would be negligible, as impacts would be contained to clean overburden and limited to additional sedimentation of the active creek bed. The resulting inherent risk is **low**.

5.14.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to surface water are outlined below.

Construction and Operations

- Implementation of a *Surface Water Management Plan* that includes:
  - Requirements for drainage design to minimise storm water runoff to creeks; and
  - Details of monitoring program for surface water flows.
- Implementation of a *Hazardous Materials Management Plan* that includes:
  - Requirements for adequate storage of chemicals.
- Implementation of a *Rehabilitation Management Plan* (Appendix T) that includes:
  - Procedures for progressive rehabilitation of disturbed areas;
  - Procedures for vegetation clearance and removal of soil profiles for stockpiling or direct return;
  - Procedures for stabilisation of soil stockpiles;
  - Watercourse rehabilitation design parameters; and
  - Details of monitoring and management of rehabilitation activities.
- Flow sensors installed on water supply pipeline (from borefield).
- Burial of water supply pipeline (from borefield).
- Daily inspection of water supply infrastructure for leaks and splits.
- Site based Emergency Response Team and spill clean-up equipment.

- External peer review of rehabilitated landform design to ensure watercourse design is appropriate.

Closure

- Monitoring program as outlined in the *Rehabilitation Management Plan*.
- Progressive rehabilitation of disturbed areas, commencing within first few years of operations.

5.14.5 Residual risk

Altered surface water drainage patterns

Approximately 1,665 ha of vegetation will need to be cleared as part of Project activities this includes the disturbance of five ephemeral watercourses, two located within the boundary of the Jacinth pit; two within the boundary of the Ambrosia pit, and one within the TSF footprint (Figure 15).

The J-A watercourses are ephemeral and are shaped by rainfall and flow events that are highly variable both spatially and temporally. When the watercourses do flow, they experience significant transmission losses for smaller and medium-sized flows. These significant transmission losses can result in ongoing cycles of incision and deposition along the watercourse. Vegetation and BSC plays a crucial role in slope and watercourse bed and bank stability in the J-A catchment.

The J-A watercourse system is complex and vulnerable to accelerated erosion, as is typical of arid zone systems. The fluvial processes and physical form can vary substantially along the length of a watercourse. A geomorphic categorisation of the J-A watercourses was completed (Alluvium 2013) to develop an understanding of stream form and function and to identify key parameters that can be used as a basis for the rehabilitation design of the disturbed watercourses. These design parameters have been incorporated into the *Rehabilitation Management Plan* (Appendix T) and landform design processes on-site.

With the implementation of ongoing rehabilitation and the peer review of landform design it is unlikely that surface water drainage patterns will be altered, any alteration that could occur is considered to be of minor consequence to ecosystem and landscape function due to the localised nature of flows within the J-A catchment. The residual risk is therefore considered to be **moderate**.

Contamination of surface water with saline water

The *Surface Water Management Plan* includes requirements for drainage design and monitoring of surface water flows (including the minimization of storm water runoff to creeks) that will sufficiently mitigate potential impacts to surface water from saline water. Therefore, the residual risk is considered to be **low**.

Increased sediment load in surface water

Due to the limited occurrence of surface water flows and progressive rehabilitation, the water quality downstream is unlikely to be impacted. The watercourses are naturally eroded and are likely to receive high sediment loads during rainfall events. Any impacts (if any) will be limited to surface soils in exposed areas which will require some additional stabilisation. The residual risk is therefore considered to be **low**.

The residual risks are considered to be as low as reasonably practicable (**low** to **moderate**) and for this reason are considered by Iluka to be acceptable for the project. Based on the results of the residual risk assessment only one impact event (altered surface water drainage patterns) is required to have an outcome, measurement criteria and monitoring requirements. These are outlined in Section 5.14.6. The residual risk assessment is provided in Table 66.

There is no requirement under Second Schedule Lease Conditions (Table 37) for the other two impact events to have outcomes, measurement criteria and monitoring requirements, as such these have not been developed.

Table 66: Summary of residual risk assessment in relation to Project impacts on surface water

Impact ID	Potential Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
SW1	Altered surface water drainage patterns	Possible	Moderate	High	• Implementation of a *Surface Water Management Plan* • Requirements for drainage design to minimise storm water runoff to creeks • Operational monitoring program for surface water flows (water quantity monitoring) • Implementation of a *Rehabilitation Management Plan* • Progressive rehabilitation of disturbed area, commencing within first few years of operations • Watercourse rehabilitation design parameters • Peer review of rehabilitated landform design to ensure watercourse design is adequate	Unlikely	Minor	Moderate	Impacts to downstream waterways due to temporary interruption of upstream sediment sources	Monitoring of creeks for evidence of erosion, upstream and downstream (watercourse monitoring)	Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved. The Tenement Holder must ensure mining related activities related to Canberra Road do not decrease the quantity of surface water available to water dependent ecosystems on or off the Land
SW2	Saline contamination of surface water and downstream systems	Possible	Negligible	Low	Refer to Section 5.9 (Soils)	Unlikely	Negligible	Low	Not applicable	Not applicable	Predicted outcomes and measurement criteria have only been developed for environmental aspects with an IRL of moderate or higher
SW3	Increased sediment load in surface water	Possible	Negligible	Low	• Implementation of a *Surface Water Management Plan* • Requirements for drainage design to minimise storm water runoff to creeks • Operational monitoring program for surface water flows (water quality monitoring) • Implementation of a *Rehabilitation Management Plan* • Progressive rehabilitation of disturbed area, commencing within first few years of operations • Peer review of rehabilitated landform design to ensure watercourse design is adequate • Monitoring program for rehabilitated surface water flows (water course monitoring)	Unlikely	Negligible	Low	Not applicable	Not applicable	Predicted outcomes and measurement criteria have only been developed for environmental aspects with an IRL of moderate or higher

5.14.6 Measurement criteria and monitoring requirements

Table 67 outlines the measurement criteria and monitoring requirements for each outcome in relation to native vegetation.

Table 67: Measurement criteria and monitoring requirements for outcomes in relation to surface water

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	C33	NA	Operations	External peer desktop review of rehabilitated landform design to ensure watercourse design is adequate, including review of channel physical parameters (gradient, width, depth, sinuosity and stream power)	As required – prior to implementation of creek rehabilitation earthworks	External peer review of rehabilitated landform design confirms watercourse design is adequate	As required – prior to implementation of creek rehabilitation earthworks	NA	Mining Engineer Rehabilitation Specialist
	C34	NA	Closure	Water course monitoring – modified Before-After Control Impact (BACI) Methodology as per J-A watercourse rehabilitation report (Appendix B), including: • Comparison of imagery for changes in vegetation growth and evidence of erosion • Cross-section survey to capture measurement of creek bed dimensions • Longitudinal profile to capture topography of channel centre line • Record of flood debris line/high water mark • Erosion pins on creek bank • Measurement of BSC and vegetation growth on bank and creek bed	Upstream monitoring sites and rehabilitated watercourses (Figure 53)	Erosion rates of rehabilitated watercourses are comparable with upstream control sites	1,2 and 5 years and after stream flow events following upstream and downstream creek connection	Upstream control sites as per Figure 53	Rehabilitation Specialist
	C35	NA	Operations/Closure	Surface water quality monitoring – stage samplers, including measurement of EC, turbidity and pH[7]	Upstream and downstream monitoring sites (Figure 53)	Water quality in downstream creeks comparable with upstream control sites	Opportunistically, after significant flow events	Upstream control sites as per Figure 53	Environmental Specialist Rehabilitation Specialist
The Tenement Holder must ensure mining related activities related to Canberra Road do not decrease the quantity of surface water available to water dependent ecosystems on or off the Land **This outcome relates only to MPL161**	C36	NA	Operations	Water course monitoring – modified Before-After Control Impact (BACI) Methodology as per J-A *Surface Water Management Plan* (Appendix B), including: • Comparison of imagery for changes in vegetation growth and evidence of erosion • Cross-section survey to capture measurement of creek bed dimensions • Longitudinal profile to capture topography of channel centre line • Record of flood debris line/high water mark • Erosion pins on creek bank Measurement of BSC and vegetation growth on bank and creek bed	Downstream monitoring at creek crossing with Canberra Road	Comparison on annual water course monitoring demonstrates installation of the road has not significantly reduced water quality downstream of the road.	Annually	NA	Rehabilitation Specialist

[7] Concentration limits to be determined, and agreed upon with DEM prior to closure, once sufficient upstream data has been collected.

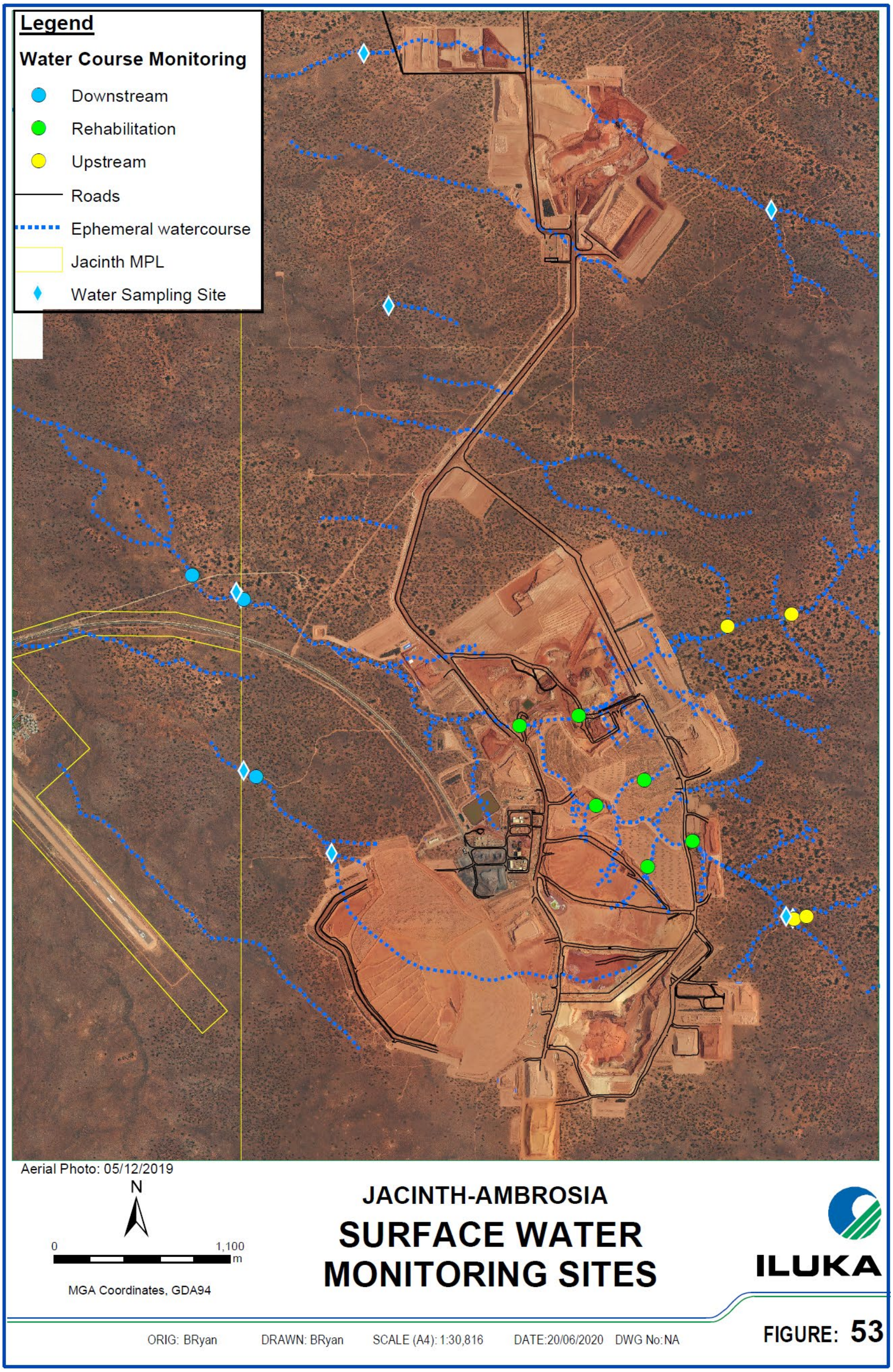

Figure 53: Surface water monitoring sites

5.15 Groundwater

5.15.1 Context

Target ore in both the Jacinth and Ambrosia deposits sit above the natural groundwater table which is located between 40 to 50 mBGL (an approximate elevation of 100 mAHD). This precludes the requirement to dewater the natural in-situ aquifer to facilitate mining; dewatering will only be required if/where tailings seepage losses to the underlying aquifer result in localised groundwater rise and a threat to the environment (as determined through application of the operation *Groundwater Management and* Monitoring *Plan*).

With respect to the palaeochannel aquifer, and as outlined in Section 2.12, the abstraction of groundwater creates localised drawdown that will be confined to this water supply palaeochannel and nearby basement rock aquifer. The quality of groundwater within the palaeochannel and the bedrock at the J-A Project area are generally similar.

High levels of salinity and poor transmissivity of the host lithologies represent a significant constraint to beneficial use of local groundwater systems (i.e. pastoral, irrigation or drinking water) other than industrial use (i.e. mining). The potential for mining operations to impact or prevent the beneficial use by other parties is therefore deemed to be extremely low. No risk assessment or controls are nominated in this PEPR.

The potential for impacts to GDEs (either terrestrial or subterranean) within the J-A project area and associated risks is considered moderate (as determined through application of the operation *Groundwater Management and Monitoring Plan*).

5.15.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- *Environmental Protection Act*;
- *Environment Protection Regulations 2009;*
- *Landscapes Act*;
- *Environment Protection (Water Quality) Policy 2015;*
- Mining Act; and
- *National Environment Protection (Assessment of Site Contamination) Measure (Amendment 2013)* ('ASC NEPM').

5.15.3 Potential impacts

Potential Project related groundwater impacts are summarised in Table 68 and described below.

Table 68: Potential impacts associated with groundwater

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
GW1	Groundwater abstraction	Mining operations	Palaeochannel aquifer	Long-term reduction in groundwater levels and associated aquifer impact(s) to the paleochannel aquifer due to groundwater abstraction	Yes – there is potential for mining operations to reduce the groundwater levels and impact on the aquifer if not appropriately managed

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
GW2	Process water seepage	Mining operations – tailings	Groundwater aquifer	Impacts to groundwater quality	Yes – it is possible that process water seepage could impact on groundwater quality if not appropriately managed.
GW3	Saline tailings disposal	Tailings seepage to groundwater (groundwater rise)	Soil Native vegetation	Hyper saline groundwater rise (salinity) impacting soils and vegetation within the extent of mine workings Unapproved clearance of vegetation	Yes – there is potential that hypersaline groundwater rise from tailings seepage could impact on soils and vegetation.
GW4	Saline tailings disposal	Tailings seepage to groundwater (groundwater rise)	Soil Native vegetation Native fauna – refer to Section 5.13	Hyper saline groundwater rise (salinity) impacting soils and vegetation beyond the extent of mine workings due to groundwater mound migration Unapproved clearance of vegetation	Yes – there is potential that hypersaline groundwater rise from tailings seepage could impact on soils and vegetation.
S5 (Refer to Section 5.9.3)	Saline tailings disposal	Capillary rise into reinstated soil profile	Soil Native vegetation	Salt contamination of reinstated soil profile through capillary rise from tailings material	Yes – there is potential for saline tailings disposal to impact soil and vegetation through capillary rise.

Long-term reduction in groundwater levels and associated impacts to the palaeochannel aquifer due to groundwater abstraction

Groundwater modelling has been used to estimate the extent of groundwater drawdown within and beyond the margins of the palaeochannel aquifer as a result of groundwater abstraction for the J-A Project. The groundwater model developed allows estimation of the drawdown within the palaeochannel aquifer, as well as drawdown from the underlying and surrounding basement rock aquifer. The following outlines a summary of the paleochannel model development over time:

- The paleochannel model was first developed in 2006 (SKM 2006);
- In 2007 (PB 2007) the model was refined to include assessment of the underlying and surrounding basement rock aquifer;
- In 2011 (SKM 2011) the model was updated and refined with operational abstraction rates and water level data monitored from the paleochannel aquifer;
- Ongoing model updates have occurred in 2013, and then annual between 2014 to 2018 confirming the reliability of the model.

In 2020 the model was updated and refined to include observed groundwater head data, groundwater abstraction rates and findings from airborne electromagnetic surveys that provided important insight into the size and thickness of the paleochannel aquifer (Jacobs 2020). This model update split records into two independent data sets to represent different time periods over the history of operations; the first to calibrate the model and the second to verify up until December 2019 (Jacobs 2020). Electromagnetic interpretations found that the aquifer is more extensive, both in thickness and in area, than the narrow aquifer previously modelled, and the model was updated in accordance with these parameters. Predictive modelling was completed for high, medium and low water demand options based on various tailings disposal options for the remaining life of mine (with a 5 year buffer in the instance that further resource if found, 5 years for rehabilitation), and 30 years of post-closure recovery. Water demand scenarios (high, medium and low) considered in the predictive modelling included three tailings alternatives, where:

- Scenario 1 assumes the current tailings disposal approach (within stacked sand TSF embankments and retained ModCoD) at Jacinth is ongoing for life of mine with a water demand of 300m³/h. Heads are predicted to remain above the shallowest pump section (~5mAHD) and the base of the aquifer (~26mAHD) at the end of 2029.
- Scenario 2 a mid point between Scenarios 1 and 2 with a water demand of 600 m³/h. Predicted heads for this Scenario have maximum drawdown between 19-12m at the end of 2029 and groundwater levels are set to recover as pumping reduces. Predicted heads stabilise at 2039.
- Scenario 3 where tailings is disposed by the ModCoD methods into facilities that had engineered embankments, a method previously used a Jacinth. This Scenario results in a higher water demand (900m³/h) in comparison to Scenario 1. The predicted groundwater drawdown ranges from 12-19m at the end of 2029.

The predictive scenarios demonstrated that the existing wellfield is likely able to meet all foreseeable water demand options without completely desaturating the aquifer, nor breaking existing well pump suctions.

An uncertainty analysis was undertaken to assess alternative aquifer parameters and to explore the sensitivity of model results to variation porosity and to the area of the aquifer, effectively assessing potential uncertainty in AEM results and interpretations. It was found that the modelled wellfield was able to meet the high water demand scenario in all uncertainty cases, thus providing further confidence in the ability of the wellfield to meet foreseeable future water demand for Iluka's mining operations.

The model was run for an additional 30 years post-mining to assess the rate and extent of water level recovery within the paleochannel aquifer. The following was found:

- Scenario 1: Groundwater levels are predicted to stabilise after about 25 years post-mining with the heads approximately 2.5 m lower than pre-mining levels. As negligible recharge to the groundwater system is assumed, groundwater extraction is not replenished, and groundwater levels are not expected to recover fully.
- Scenario 2: Groundwater levels are predicted to stabilise approximately 3.8 m lower than pre-mining levels.
- Scenario 3: Long term post-mining heads are predicted to remain about 5 m lower than the pre-mining levels suggesting a permanent decrease in groundwater head and unrecovered loss of storage.

It is acknowledged by Iluka that actual rate of recovery of the aquifer system will be dependent on rate of recharge experienced and this could be impacted by climatic conditions.

No localised springs have been identified within 50 km radius of the borefield location and the coast is approximately 100 km (at the closest point) from the J-A Project area.

The likelihood of groundwater abstraction activities resulting in a long-term adverse drawdown impact on the palaeochannel aquifer is considered unlikely. If an impact were to occur, the consequence is considered moderate. The inherent level of risk associated with the impact is consequently considered **moderate**.

Impacts to groundwater quality impacting beneficial use of the system

Detailed geochemical investigation into the groundwater environment at the J-A mine was first performed internally by Iluka in 2012 (Iluka 2012). As a result of this study, groundwater level and chemistry Site Specific Trigger Levels (SSTLs) were developed to determine potential impacts to the environment outside of the mine workings boundary. Areas surrounding the on-path TSF (Cell 1) and the off-path TSF were found to exceed water level SSTLs due to seepage from wet tailings. Iron and aluminium exceedances were noted around the off-path TSF due to the acidic groundwater conditions.

In 2018, Land & Water Consulting Pty Limited (LWC 2018) undertook further investigation into the hydrogeochemistry of the J-A mine with the aim of assessing the impact that tailings seepage was having on the groundwater environment and improving the impact assessment framework used for J-A. This study found that engineering improvements made between late 2012 and mid-2013 improved the efficiency of water usage in the J-A Project area, reducing makeup water requirements sourced from the palaeochannel and allowing the seepage induced mounding to recede. Acidity and concentrations of water quality leading indicators (TDS, pH, alkalinity, aluminium, cadmium, copper and nickel) were observed to frequently breach the SSTLs set in the previous Iluka investigation (Iluka 2012), and it was noted that this trend would continue while acidic groundwater conditions prevailed.

In early 2019, a review of the J-A mine hydro-geochemistry was undertaken by EMM Consulting Pty Ltd (EMM 2019), concentrating on groundwater level and quality trends. This review found that the location of maximum groundwater elevation occurs under the off-path TSF and Cells 2, 3A and 3B. Groundwater flows away from this area to the north west and south east. Some groundwater level trends had stabilised since the previous review undertaken by LWC across the wells assessed, but most continued to trend in a similar fashion identified in the previous aquifer reviews. An assessment of the groundwater quality was also undertaken by EMM (2019) with key conclusions being largely consistent with the previous LWC (2018) study. The EMM report is provided in Appendix Q.

In October 2019, RGS issued a report (the RGS report) that included a review of the existing project information to better understand the mechanisms for observed changes in groundwater chemistry and consider potential changes under the latest LOM tailings plan (refer to Appendix R). The RGS report found that the methods for reporting short term water quality trends were appropriate for the evaluation compliance, but the causes for potential changes occurring over time have not been appropriately addressed (i.e. there is a prevalence of mildly acid water and decreasing pH trends in some wells and increasing pH in others but the reasons are not clearly understood or explained).

Consequently, RGS concurred with previous studies that suggested geochemical analysis should occur to define potential contaminates. However, the recommendations by LWC (2018) and EMM (2019) to undertake XRF and XRD analysis for new wells that are installed in the J-A Project area are considered inadequate for this purpose.

RGS recommend using standard static and kinetic geochemical methods derived from the Australian Commonwealth and International Acid and Metalliferous Drainage Guidelines (AMD), which aim to identify sources and pathways by which acid salts and metal(loids) are mobilised through the environment surface water, vadose water moving through unsaturated regolith and groundwater systems.

The findings of the RGS report have informed an amendment to the groundwater quality environmental outcomes contained in this PEPR (C40-C49) to better reflect a fit-for-purpose approach to potential groundwater impacts at the J-A Project area (e.g. current SSTL values are fixed and applicable to all groundwater units when groundwater quality differs with depth and location). This also included the recommendation to cease the use of SSTLs and instead undertake statistical analysis of trends over time, using water quality leading indicators.

The chemistry of the in-situ groundwater present in the mine area is generally similar to that of the water supply palaeochannel aquifer at the borefield. Further, no beneficiation chemicals or reagents are used in the mining process with the exception of flocculants which enhance tailings consolidation and water recoveries.

Based on the studies undertaken to date and the beneficial use of the groundwater (i.e. industrial only), it is considered possible that process water seepage will adversely impact the groundwater quality of the local mine area aquifer. The consequence of this impact would be minor for an overall residual risk level of **moderate**.

Specific risks and controls associated with hazardous materials (e.g. chemical) spills or releases to groundwater are assessed in Section 5.16 – Hazardous Materials.

Hyper saline groundwater rise (salinity) impacting soils and vegetation within the extent of mine workings

Groundwater modelling has also been used to estimate the extent of groundwater rise within and beyond the margins of the mine workings zone as a result of seepage. Jacobs Group Pty Limited (Jacobs), in partnership with Iluka hydrogeologists, undertook a numerical groundwater modelling study of the J-A Project area, which used site-based groundwater levels, water balance estimates and mine schedules based on datasets developed in 2015 (Jacobs 2017). The numerical model was able to simulate the historical growth of seepage derived mounds with predictive modelling indicating that the mounds will attenuate over time. Ten years post mining (considering the Jacinth deposit only), depth to groundwater was predicted to be greater than 20 m at the mine. However, groundwater levels were predicted to remain above pre-mining levels for the duration of the simulated 100 year post mining recovery period.

An update to the J-A mine numerical groundwater flow model was undertaken by EMM in 2019 (see EMM 2019, Appendix Q) The existing groundwater flow model was updated to include additional groundwater level and seepage data obtained from 2015-2018. Following this update, the model calibration statistics were assessed and found to be consistent with the earlier model reported by Jacobs (2017) (scaled root-mean-square error of 11.6% compared to 11.1% previously). At the time, the model was deemed not to require recalibration; the previously calibrated hydraulic conductivity and storage parameters were retained for predictive scenario modelling.

Two scenarios were simulated by EMM (2019), including assessments of predictive uncertainty. Scenario 1 involved modelling of mining at the Jacinth mine, and groundwater recovery for 100 years post closure. Scenario 2 involved modelling of mining at both the Jacinth mine and proposed Ambrosia mine site, and groundwater recovery for 100 years post closure.

Key results from the updated EMM (2019) modelling were:

- groundwater levels beneath the Jacinth mine site are declining and will continue to decline;
- during mining at Ambrosia there will likely be groundwater mounding due to seepage from tailings;
- the groundwater mounds formed at Jacinth and Ambrosia will migrate west over time towards Lake Ifould; and
- groundwater levels at Lake Ifould are naturally close to the surface and are a location of groundwater discharge. As the groundwater mound approaches Lake Ifould, the spatial extent of land near the lake with shallow depth to groundwater will increase.

In late 2019 the JACMIN2.0 model was updated again to incorporate the revised mine plan, recent mine water balance (June 2018-2019) and observation well data. IGS (2020) was engaged to complete the assessment.

The extension of the calibration period and addition of new observation well data improved the calibration statistics with the scaled root-mean-square error reducing from 11.6% to 4.6%.

The revised mine plan included the following:

- minor differences in the timing and estimated volumes of recharge below Jacinth South Cells 5 and 6 and Ambrosia Cells 3 and 4;
- addition of sand stacking in the Jacinth North area;
- a longer period of tailings deposition to Ambrosia Pit 1; and
- a shorter period of deposition to Ambrosia Pit 2.

The changes resulted in a total estimated recharge to groundwater of 54.3 GL (between 1 July 2019 and 30 September 2029) compared with 35.0 GL simulated previously by EMM (2019). However, the return flows are considered to be conservative and therefore this prediction represents a conservative scenario.

Notwithstanding the above, the predicted mounding and depth to groundwater 100 years post-mining is similar to that predicted by EMM (2019). An additional area of 15 m depth to groundwater is simulated to the north west of Jacinth South, which was not predicted under the previous Mine Plan, as it would predominantly be caused by the inclusion of a new sand stacking area in Jacinth North.

Closure scenario (100 years) results were found to be similar to that predicted by EMM (2019).

Both the in-situ soil lithologies and tailings material (sand tailings and ModCod) at J-A are free draining (SRK 2011) and water readily infiltrates to the underlying fractured rock basement aquifer. As all in-situ groundwater (including abstracted process water) in the J-A Project area is hypersaline, any groundwater rise poses a threat to overlying soil lithologies and vegetation systems (including rehabilitated profiles) within the mine workings zone. There is potential for plant stress for those plants with roots reaching the elevated groundwater mound. Ongoing plant stress could result in plant death. The mine workings and background zones are as defined in Figure 56.

These impacts may occur in both the short term (e.g. vegetation stress) and longer term (e.g. rehabilitation viability). It is considered almost certain that seepage of process water into the groundwater will occur within the mine workings zone as a result of active tailings operations. The network of monitoring wells around the J-A Project area has identified the development of a groundwater mound beneath the mine site (Jacobs 2017).

The trigger levels for groundwater assessment are defined in Section 5.15.7 and the mine working and background zones are shown in Figure 56. If seepage leads to groundwater level rise (mounding) above the defined management trigger levels, the consequence to soils and vegetation (including rehabilitated profiles) is considered moderate resulting in an inherent risk level of **very high**.

Management of this risk is complimentary to outcomes relating to capillary salt rise (Impact ID S5, Table 51). The groundwater management trigger levels for these two impacts are the same (see Section 5.15.7).

Hyper saline groundwater rise (salinity) impacting soils and vegetation beyond the extent of mine workings due to groundwater mound migration

It is anticipated that elevated groundwater levels from within the mine workings zone may extend, or flow via hydraulic gradient into, adjacent background (undisturbed areas) areas on-site, although at a greater comparative depth from surface.

As all in-situ groundwater (including abstracted process water) in the J-A Project area is hypersaline, any elevated and migrating groundwater poses a threat to overlying soil lithologies and vegetation systems in areas beyond the extent of mine workings. As above, there is potential for plant stress for those plants with roots reaching the elevated groundwater mound. Ongoing plant stress could result in plant death. The mine workings and background zones are as defined in Section 5.15.7, Figure 56.

It is possible that elevated groundwater levels (caused by mining operations) will develop in this zone. The recent IGS (2020) report outlines that post-mining, the simulated groundwater mound migrates west, towards Lake Ifould. Therefore, a predicted expansion of the 5 m to 10 m depth to groundwater area could occur between the mine and Lake Ifould. It should be noted that there is uncertainty in model results for this part of the model domain, with only indicative groundwater levels predicted. The potential impact of migration of tailings seepage from both the off-path and in-pit tailings cells warrants investigation, particularly given the potential for water to migrate across the basement surface eventually reaching Lake Ifould.

Should these levels rise above the defined impact trigger levels for this zone, any subsequent salinity impacts to soils and vegetation will be of minor consequence, with a **moderate** level of inherent risk.

5.15.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts related to groundwater are outlined below.

Construction and Operations

- Implementation of a *Groundwater Management and Monitoring Plan* that includes:
  - Site-specific management trigger levels for groundwater elevation within the mine workings zone and background zone (see Figure 56);
  - Site-specific management trigger levels for groundwater quality;
  - Requirements for process water management focussed on minimising seepage losses to groundwater; and
  - Details of monitoring programs for groundwater level and quality.
- Implementation of a *Rehabilitation Management Plan* (Appendix T) that includes:
  - Monitoring of vegetation stress; and
  - Monitoring of groundwater levels in relation to final rehabilitation surfaces.
- Water efficient tailing disposal streams.
- Subsurface drainage systems in on-path tailings cells for interception and recovery of tailings water.
- Groundwater monitoring including:
  - Vibrating Wire Piezometer (VWP) networks in tailings cells;
  - Monitoring wells; and
  - Statistical software groundwater level contour mapping.
- Groundwater mound interception bores, where applicable.
- Water balance to monitor J-A Project area process water recoveries and losses.
- J-A mine groundwater model to:
  - Predict future groundwater levels over the life-of-mine and post-closure;
  - Predict future groundwater mound movement;
  - Assess seepage rates, in conjunction with the J-A Project area water balance;
  - Provide inputs to and validation of the J-A Project area water balance;
  - Refine current groundwater trigger levels (set-points and spatial extent);
  - Help identify potential locations for future interception/recovery wells, if necessary.
- Vegetation health (groundwater) monitoring program.

Closure

- Monitoring program as outlined in the *Rehabilitation Management Plan.*
- At-closure groundwater monitoring (levels and quality) based on Regional Groundwater Model predictions.

5.15.5 Residual risk

Long-term reduction in groundwater levels and associated impacts to the palaeochannel aquifer due to groundwater abstraction

Predictive groundwater modelling of drawdown, associated with abstraction of groundwater from the palaeochannel aquifer for mine operational demand, was undertaken. The model was developed in 2006, refined in 2007, 2011, 2013-2018 and most recently in 2020. The model was undertaken to determine the associated drawdown impacts associated with abstraction rates from the palaeochannel aquifer. Modelling determined that:

- maximum drawdown of 19 m will be observed;
- drawdown would be confined to palaeochannel and underlying basement rock aquifers; and,
- groundwater levels are to stabilise approximately 2.5-5 m (depending on the abstraction rate) lower than pre-mining levels;
- negligible drawdown would be observed at distances greater than approximately 2 km from the margin of the palaeochannel.

Refer to Section 5.15.3 for detailed modelling conclusions.

The predictive modelling was run for three different abstraction Scenarios with a maximum rate of extraction of 36 L/sec from 2024-2039. Modelling continued for 30 years post- mining to assess the extent and rate of recovery after the wellfield is decommissioned. Since 2011 J-A Project area operations have significantly increased water recovery from tailing and processing, this has reduced the requirement for water to be abstracted from the palaeochannel aquifer for processing. A water recovery efficiency rate is determined and recorded in a site water balance, with an average site water recovery efficiency of 60 to 70%. The maximum drawdown predictions will most likely not be realised based on reduced abstraction from the palaeochannel, with drawdown impacts on the palaeochannel aquifer reduced as compared to original model predictions.

Based on the high salinity of the groundwater, limited beneficial uses other than industrial use (i.e. pastoral, irrigation or drinking water) and the absence of potential users of the groundwater within 50 km of the palaeochannel, it is anticipated that any drawdown impacts will not affect any beneficial users of the aquifer. The potential for mining operations to impact or prevent the beneficial use by other parties is therefore considered extremely low. Additionally, no localised springs were identified within 50 km radius of the borefield location.

Based on the above, the likelihood of groundwater abstraction activities adversely impacting on groundwater aquifers is considered rare. If an impact were to occur, the consequence is considered moderate. The inherent level of risk associated with the impact is therefore considered **low**.

Adverse impacts to groundwater quality

Given the generally similar properties of the palaeochannel aquifer and groundwater at the mine – and with operational controls in place – the likelihood that process water seepage will adversely change the quality of groundwater systems within the extent of mine workings is considered possible. However, preliminary geochemical assessments predict the quality change will be confined to the mine working area. Given the absence of other beneficial users of the mine area aquifer the consequence of this impact would be negligible for an overall residual risk level of **low**. It is therefore not considered that this would be an adverse impact.

Hyper saline groundwater rise (salinity) impacting soils and vegetation within the extent of mine workings

The vegetation health (groundwater) monitoring program has reported a recent decline in plant health across both impact sites and non-impact sites with a general increase in dieback that may be attributed to the drier and hotter than average conditions recorded at J-A during the 2015-2016 period. Impact sites are defined as areas where the groundwater mound has been recorded within 30 m of the surface, with non-impact sites defined as all other areas.

Individuals at impact sites, particularly Mallee individuals, presented higher rates of dieback than individuals at non-impact sites. It is possible that these individuals are responding to the additional stresses of being close to the J-A Project area (i.e. groundwater mounding) or the cumulative impacts of a range of environmental variables.

Overall there appears to be some response by some plant species to mining impacts, and these may have been influenced further by recent hot and dry climatic conditions. The majority of affected individuals are within the mine path and therefore anticipated to be cleared as part of mining activities (i.e. included in SEB estimates). In addition, the attenuation of the groundwater mound over time and periods of higher rainfall may also encourage a positive response from affected plants. To date, no plant death can be attributed to the groundwater mound.

Based on the monitoring to date and the continued implementation of the current tailings management plan and recent dewatering and drainage programs, it is considered unlikely that any unapproved death of vegetation would occur. Nevertheless, monitoring of the vegetation within the impact zone will continue to determine longer term responses to groundwater mounding.

The residual risk to vegetation (and soils) within the extent of mine workings is considered **moderate**.

Hyper saline groundwater rise (salinity) impacting soils and vegetation beyond the extent of mine workings

Groundwater mounding has the potential to develop beyond the extent of mine workings. The local maximum groundwater elevation occurs under the off-path TSF and Mining Cells 2, 3A and 3B. Groundwater flows away from this area to the north west and south east towards Lake Ifould. Significant mounding is present at the off-path TSF, approximately 25 m above pre-mining levels in well MB02D (see Appendix Q).

As outlined above, there appears to be some response by plant species to mining impacts. This includes vegetation beyond the extent of mine working, which may have been influenced further by recent hot and dry climatic conditions.

The attenuation of the groundwater mound over time and periods of higher rainfall may encourage a positive response from affected plants. To date, no plant death can be attributed to the groundwater mound.

The most recent IGS (2020) report outlines that 100 years post-mining, the groundwater mound will migrate westwards, towards Lake Ifould, with a predicted expansion of the 5 m to 10 m depth to groundwater area near the lake. Given the high uncertainty of these modelled results, the residual risk ranking has not been altered. However, a forward work plan has been developed to further investigate the results of this model to determine the predicted impacts (if relevant) to Lake Ifould and surrounding soil quality and vegetation. The IGS (2020) report is located at Appendix Q.

Recent studies (IGS 2020, RGS 2019) prompted the amendment of four groundwater outcome measurement criteria and/or associated leading indicators (C41, C43, C44 and C45) to incorporate potential groundwater quality and quantity impacts. These studies and subsequent amendments (see Table 68) provided an opportunity to reassess and update GW3 wording to better suit operational and closure phases of mine. GW3 wording now incorporates no adverse changes to groundwater quantity and quality within aquifers outside of the mine workings zone. This has been updated to reflect the focus of no adverse change to groundwater (aquifer) dependant ecosystems outside of the mine workings zone.

Based on monitoring to date, it is considered unlikely that any death of vegetation would occur beyond the extent of mine workings. Nevertheless, monitoring of the vegetation within the impact zone will continue to determine longer term responses to groundwater mounding.

The residual risk to vegetation (and soils) within the extent of mine workings is considered **moderate**. The GW3 outcome has been updated to incorporate

The residual risks are considered to be as low as reasonably practicable (**low** to **moderate**) and for this reason are considered by Iluka to be acceptable for the project. Based on the results of the residual risk assessment all two of these impact events (reduction in groundwater levels and associated impacts to the paleochannel aquifer due to groundwater abstraction and impacts to groundwater quality) have been found to have a low residual risk, do not require an outcome. However outcomes, measurement criteria and monitoring requirements have been developed for all impact events as per the requirements of the Second Schedule Lease Conditions (Table 37); these are outlined in Section 0. The residual risk assessment is provided in Table 69 .

Table 69: Summary of residual risk assessment in relation to Project impacts on groundwater and soil/vegetation systems

Impact ID	Possible Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
GW1	Adverse drawdown effect on the paleochannel aquifer or beneficial users	Unlikely	Moderate	Moderate	• *Groundwater Management and Monitoring Plan* • Monitoring of groundwater abstraction rates and groundwater levels • Increased water return efficiency within mine processing reducing palaeochannel aquifer demand • J-A borefield palaeochannel abstraction predictive model • Annual aquifer review and biennial update of groundwater predictive model with operational abstraction and groundwater level data, plus tailings schedule	Rare	Moderate	Low	Future palaeochannel aquifer demand associated with mine operations	All potential changes in mining operations to consider demand on palaeochannel aquifer and potential implications (i.e. run scenario in model to confirm)	The extraction and use of groundwater does not adversely affect environmental processes or beneficial users that are reliant on that groundwater system
GW2	Adverse impacts to the quality of the in-situ mine-site groundwater aquifer due to tailings water seepage	Possible	Minor	Moderate	• *Groundwater Management and Monitoring Plan* • Monitoring of mine site groundwater chemistry • Detailed assessment of mine site groundwater quality • Sampling and analysis of process water • Reduction of the use of flocculant in operations, where feasible	Possible	Negligible	Low	Long term impact of tailing water seepage on groundwater chemistry and geochemistry	Routine monitoring of groundwater chemistry per *Groundwater Management and Monitoring Plan* Further monitoring of the process water circuit to continue to better understand the geochemical processes which are occurring at the site. Groundwater monitoring on a 'for-cause' basis to further investigate identified groundwater data quality changes. Geochemical modelling to better understand the potential long term impact to groundwater quality as a result of updated groundwater monitoring data. Refer to Aspect: Lake Ifould for further details. Conduct geochemical test work of proposed monitoring well drill cores as per RGS (2019) recommendations. Develop methodology and report structure for verification report of water quality data using US EPA 2009 (US EPA, 2009) guidance to meet C43.	Groundwater systems outside of the extent of the mine workings are not adversely altered by the disposal of process water in the pit.

GW3	Hyper saline groundwater rise (salinity) impacting soils and vegetation within the extent of mine workings	Almost Certain	Moderate	Very High	• *Groundwater Management and Monitoring Plan* • J-A mine regional Groundwater Predictive Model • Management trigger levels (depth from surface, mBGL) (Figure 56) • *Tailings Management Plan* • Tailings water recovery infrastructure (sub-surface drainage and extraction systems) • Monitoring of groundwater levels (tailings cell Vibrating Wire Piezometer networks, monitoring wells) • Monitoring volume of water being disposed as tails • Active return of water from tails stream • Use of water efficient tails methods to reduce volume of water disposed in tailings plant standard operating procedures <u>Soils:</u> • Controls and management strategies as per Impact S5 <u>Native Vegetation:</u> • Comparison of annual aerial photography to ensure vegetation clearance is within approved internal permit limits • Monitoring of vegetation health in impact zones	Unlikely	Minor	Moderate	Volume of water disposed in tails, end fate and associated mounding impacts Plant response to saline water stress	Application of Groundwater Management and Monitoring Plan, active monitoring of water efficiency Vegetation stress monitoring Undertaking a groundwater drilling program in 2021 to install up to eight new groundwater wells and undertake hydraulic tests. These wells will all be located in the western portion of the model domain heading towards Lake Ifould where there is no data to date. Collection of field data for a minimum of 12 months from the eight new wells, which will then be incorporated into the model. Undertake a review of the JACMIN2.0 model including: • Investigating the potential role of mapped faults on the groundwater flow on and around the mine site. • Expansion upon the sensitivity analysis undertaken by EMM (2019). • Investigating the basis for varying aquifer parameters spatially (i.e. if data is available), particularly in areas where the model underpredicts. • Investigating the potential reasons for the observation of a vertical hydraulic gradient between the Marine Sands and Granite Basement Units. • Consideration of the salinity driver density effects including incorporation of density corrections. • Recalibrating and rerunning the model	The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities. All clearance of native vegetation is authorised under appropriate legislation Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.

Impact ID	Possible Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
										inclusive of changes above with a minimum 12 months of data from the eight new groundwater wells. The updated model reporting is to include: • A regional potentiometric surface to support boundary and initial conditions. • An assessment of the western fault which is currently speculative to determine any potential impacts to groundwater mounding and Lake Ifould. • An analysis of confidence in K, Sy and recharge data and whether uncertainty analysis is appropriate. • Commentary on water balances including steady state. • An assessment of aquifer surface parameters (e.g. geophysics). • Explanatory notes for any outlier features in depth to water plots. • Evidence to inform vegetation impact depth.	
GW4	Hyper saline groundwater rise impacting soils and vegetation beyond the extent of mine workings due to groundwater mound migration	Possible	Minor	Moderate	• All controls and management strategies per above for GW3	Unlikely	Minor	Moderate	As above	As above	As above

5.15.6 Measurement criteria and monitoring requirements

Table 70 outlines the measurement criteria and monitoring requirements for each outcome in relation to groundwater.

Table 70: Measurement criteria and monitoring requirements for outcomes in relation to groundwater

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
The extraction and use of groundwater does not adversely affect environmental processes or beneficial users that are reliant on that groundwater system **This outcome relates only to Domain 3 (MPL 110) (Jacinth borefield palaeochannel aquifer)** No relevant sensitive environmental receptors or beneficial uses of the palaeochannel aquifer exists other than the J-A mine (refer Section 2.12 and 5.15.5)	C37	NA	Operations	Standing water levels (SWLs) (mAHD) measured using calibrated water level meter (dipper) and groundwater abstraction rates (kL or m^3) recorded using flow meters Desktop review of observed SWLs against Jacobs (2020) borefield palaeochannel aquifer model predictions up to the current operating year	Borefield groundwater production and monitoring wells (Figure 55) including: • Monitoring wells (MB1, MB2, MB3, MB4, MB5 and MB6) and; • Production wells (JWB1, JWB2, JWB3, JWB4, JWB5, JWB6, JWB7, JWB8, JWB9, JWB10, JWB11 and JWB12). Domain 3 (MPL 110)	SWL drawdowns are not greater than Jacobs (2020) modelled predictions	Monthly	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008)	Environmental Specialist
	C38	NA	Operations	Desktop review of observed SWLs against Jacobs (2020) borefield palaeochannel aquifer model predictions up to the current operating year	Borefield groundwater production and monitoring wells (Figure 55) including: • Monitoring wells (MB1, MB2, MB3, MB4, MB5 and MB6) and; • Production wells (JWB1, JWB2, JWB3, JWB4, JWB5, JWB6, JWB7, JWB8, JWB9, JWB10, JWB11 and JWB12). Domain 3 (MPL 110)	Desktop aquifer review, model validation and model update (recalibration to occur if deemed required) undertaken at required intervals	Annual aquifer review Annual model validation Biennial model update (recalibration) pending validation outcomes	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Aquifer drawdown model developed by Jacobs (2020)	Environmental Specialist
	C39	NA	Closure	SWLs (mAHD) measured using calibrated water level meter (dipper)	Borefield groundwater monitoring wells (Figure 55) including: • Monitoring wells (MB1, MB2, MB3, MB4, MB5 and MB6). Domain 3 (MPL 110)	Aquifer total drawdown is not greater than Jacobs (2020) model post closure predictions	Quarterly, for a minimum of three years post closure	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008)	Environmental Specialist Rehabilitation Specialist
	C40	NA	Closure	Desktop review of observed SWLs against Jacobs (2020) borefield palaeochannel aquifer closure model predictions	Borefield groundwater production and monitoring wells (Figure 55) including: • Monitoring wells (MB1, MB2, MB3, MB4, MB5 and MB6) and; • Production wells (JWB1, JWB2, JWB3, JWB4, JWB5, JWB6, JWB7, JWB8, JWB9, JWB10, JWB11 and JWB12). Domain 3 (MPL 110)	Desktop closure model validation and closure model update (recalibration) undertaken at required intervals only	Biennial model validation Biennial model update (recalibration) pending validation outcomes	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Aquifer drawdown model developed by Jacobs (2020)	Environmental Specialist Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and groundwater quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities. **This outcome relates only to Domain 4 (ML6315)**	C41	NA	Operations	Groundwater levels (mAHD/mBGL)	Inclusion of groundwater monitoring data from the following wells: • Canberra, MBN07, MB08D, MBN11, IH06, MBN01D, MBN02, MBN03, MBN04, MB10D, MBN06, MBN09, MBN10, MB05D, MB06D, MB07, MBN08D, MB16S, MB16D, MB17D, MB18S, MB18D, AMB01S, AMB01D, ABMB01D-old, AMB02, AMB03, AMB05, AMB06, MB018, MB02S & D, MB01, MBN12, IH39, MB04 &/or IH58, MB11S & D, and MB09S & D. • 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b. (preliminary locations to be installed in 2021).	The site groundwater model (JACMIN2.0) is updated and validated.	Every two years (or sooner if there has been a major change to the operation)	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Site groundwater model updated by Jacobs (2017), EMM (2019) and IGS (2020)	Environmental Specialist Rehabilitation specialist
	C42	Groundwater standing water levels (SWLs) in the mine workings zone and outside this zone (background zone) do not exceed the maximum ('impact') site-specific risk trigger levels (SSTLs) for those zones (see Figure 56, Table 71). Note: trigger levels will be revised following development of the J-A regional model.	Operations	Groundwater levels (mAHD/mBGL)	Groundwater monitoring wells, production bores and vibrating wire piezometers within the mine working zone and outside this zone (background zone) of Domain 4 (ML 6315) (refer Figure 54 and Figure 56).	Groundwater SWL are not greater than IGS (2020) modelled predictions	Monthly monitoring points with SWLs in the green-trigger zone. Fortnightly monitoring points with SWLs in the yellow trigger-level zone.	J-A numerical groundwater modelling undertaken by IGS (2020). Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008)	Environmental Specialist
	C43	Water quality analysis (as per the measurement criteria) shows that there is no statistically significant* increasing trend for wells sampled **<u>inside</u>** the Mine Workings Zone, that act as Leading Indicator (LI) wells. To be measured at the following groundwater wells located inside the mine workings area. • Canberra, MBN07, MB08D, MBN11, IH06, MBN01D, MBN02, MBN03, MBN04, MB10D, MBN06, MBN09, MBN10, MB05D, MB06D, MB07, MBN08D, MB16S, MB16D, MB17D, MB18S, MB18D, AMB01S, AMB01D, ABMB01D-old, AMB02, AMB03, AMB05 and AMB06.	Operations	Water quality samples collected and analysed at a NATA accredited laboratory for pH, EC, TDS, temperature, major cations (Ca, Mg, K, Na,), major anions (Cl, SO_4, Alkalinity, CO_3, HCO_3) , dissolved organic carbon and dissolved metals (Fe, Mn Al, Cd, Cu and Ni) Verification report of water quality data to be prepared by a suitably qualified and experienced person, to DEM's satisfaction Statistical analysis of water quality data in accordance with US EPA Statistical analysis of groundwater monitoring data at RCRA facilities (EPA 2009). *NOTE: 'Significant' is defined as a statistical change and/or	Groundwater monitoring wells located outside of the Mine Working Zone (see Figure 56), including: • 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b. (preliminary locations to be installed in 2021). *Note: Locations and names of new monitoring wells to be confirmed and yet to be drilled at time of writing*	A verification report of water quality data by a suitably qualified and experienced person demonstrates either: • statistically significant evidence of a decreasing* trend; or • insufficient statistical evidence of a significant trend over time (assessed using a robust statistical assessment method)	Six-monthly (water quality) Annual (verification report)	LWC (2016) J-A Geochemical analysis Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) MP5 Database (historical water quality data)	Environmental Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
				increasing trend assessed using a 95th percentile assessment utilising all data. In the event that new data falls outside the 95th percentile range, this will form a trigger. An alternative assessment (e.g. Mann Kendall trend analysis) will be used to verify results.		Non-compliance with this outcome occurs when: • the assessment finds statistically significant evidence of an increasing* trend at wells **outside** the Mine Workings Zone **Note: This is the opposite case for pH and alkalinity (i.e. decreasing trend would result in a non-compliance)* Where a statistically significant trend is observed (in accordance with US EPA 2009 Guidance) investigation of the source of change, assessment of potential impacts and recommendations to address are to be provided to Iluka by a suitably qualified person.			
The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and groundwater quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities.	C44	Annual review of observed SWLs against the predicted quarterly modelled SWL trends for closure (JACMIN2.0)	Closure	Groundwater levels (mAHD/mBGL)	Groundwater monitoring wells, including: • Canberra, MBN07, MB08D, MBN11, IH06, MBN01D, MBN02, MBN03, MBN04, MB10D, MBN06, MBN09, MBN10, MB05D, MB06D, MB07, MBN08D, MB16S, MB16D, MB17D, MB18S, MB18D, AMB01S, AMB01D, ABMB01D-old, AMB02, AMB03, AMB05, AMB06, MBC2, MBC3, MBC4, MBC5, MB018, MB02S & D,	Groundwater levels are recovering towards pre-mining levels in line with most recent modelled predictions post closure.	Once, at the completion of three years of groundwater monitoring	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Site groundwater model updated by Jacobs (2017),	Environmental Specialist Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
This outcome relates only to Domain 4 (ML6315)					MB01, MBN12, IH39, MB04 &/or IH58, MB11S & D, and MB09S & D. • 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b. (preliminary locations to be installed in 2021).			EMM (2019) and IGS (2020)	
	C45	Annual review of observed SWLs against the predicted quarterly modelled SWL trends for closure (JACMIN2.0)	Closure	Groundwater levels (mAHD/mBGL)	Groundwater monitoring wells, including: • Canberra, MBN07, MB08D, MBN11, IH06, MBN01D, MBN02, MBN03, MBN04, MB10D, MBN06, MBN09, MBN10, MB05D, MB06D, MB07, MBN08D, MB16S, MB16D, MB17D, MB18S, MB18D, AMB01S, AMB01D, ABMB01D-old, AMB02, AMB03, AMB05, AMB06, MBC2, MBC3, MBC4, MBC5, MB018, MB02S & D, MB01, MBN12, IH39, MB04 &/or IH58, MB11S & D, and MB09S & D. • 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b. (preliminary locations to be installed in 2021).	Groundwater levels are recovering towards pre-mining levels in line with most recent modelled predictions post closure.	Quarterly, for a minimum of three years post closure	Baseline hydrogeological investigations completed by SKM (2006b) and PB (2005, 2007 & 2008) Site groundwater model updated by Jacobs (2017), EMM (2019) and IGS (2020)	Environmental Specialist Rehabilitation Specialist
	Refer to C19	Apply C19, which measures that groundwater levels do not impact upon soil quality for rehabilitation purposes	Closure	Refer to: Section 5.9.6 (C19)					

Figure 54: Groundwater monitoring and production wells

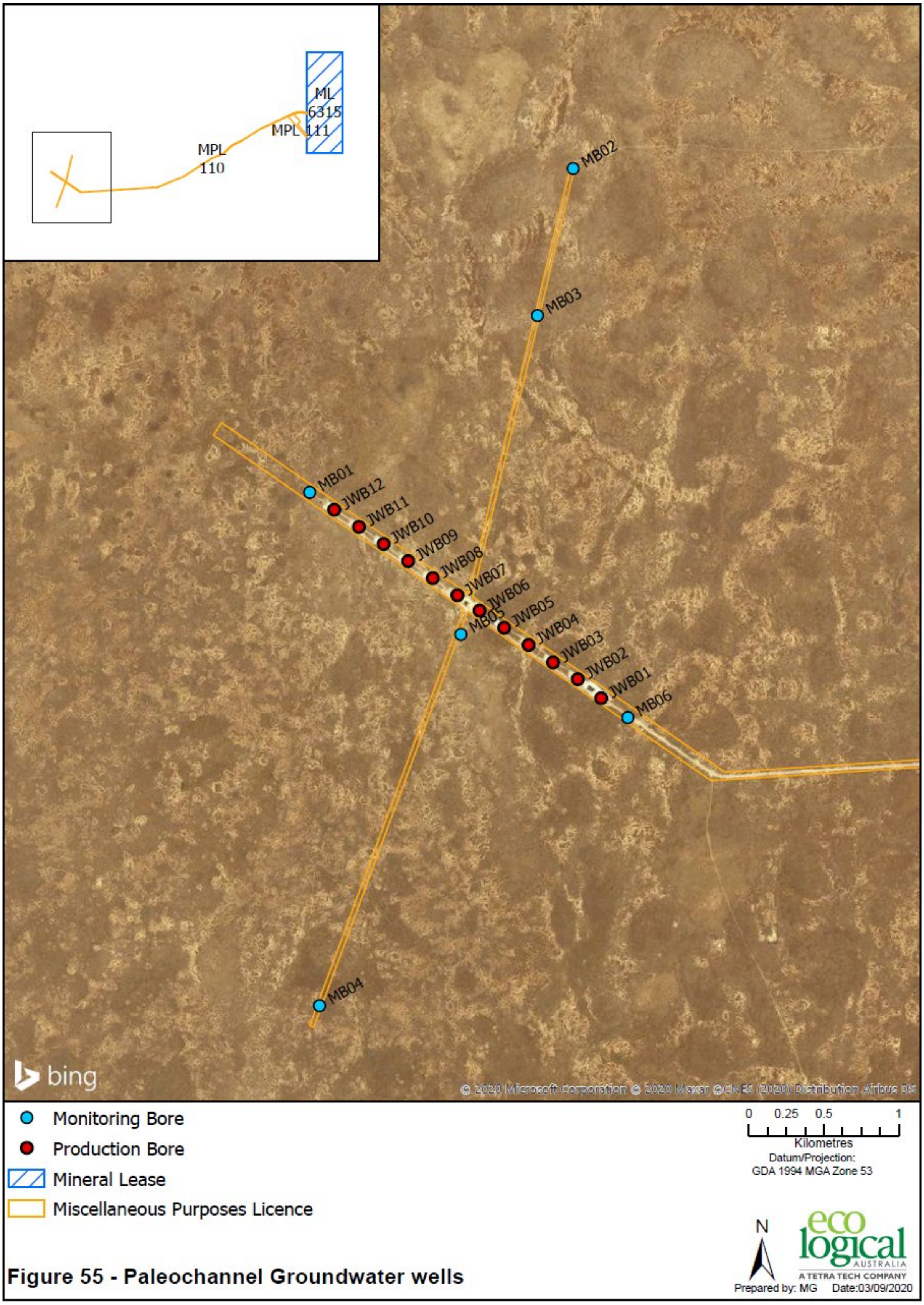

Figure 55: Paleochannel groundwater monitoring and production wells

5.15.7 Groundwater management zones and groundwater depth trigger levels

Groundwater management at J-A has typically been divided into two primary zones; the *Mine Workings Zone* (with Leading Indicator triggers) and *Background Zone* (all areas outside the mine workings zone) (refer Figure 56). Each zone related to specific monitoring and intervention trigger levels for groundwater depth from surface (mBGL) as defined in Table 71. These trigger levels may be varied according to mine predictive modelling outcomes per the J-A Groundwater Model and/or vegetation stress monitoring. The mine working zone represents the life-of-mine disturbance footprint plus a 150 m offset to account for the water table contour of any elevated groundwater.

The Iluka (2012) study developed groundwater level trigger levels (that were adopted in the 2015 PEPR) to determine potential impacts to the environment outside of the mine workings zone.

There is no proposed change to the groundwater level trigger levels in this PEPR.

Table 71 Groundwater Management Trigger Levels (Depth, mBGL)

Trigger Level	Mine Workings Zone	Background Zone	Notes
Red Zone (‘impact’) Requires urgent action. Soils and vegetation under immediate threat.	Depth to groundwater < 6 mBGL^	Depth to groundwater ≤ 20 mBGL	Also refer related Impact ID S5 (capillary break) in Section 5.9.3 Soils – management criteria for phreatic level below tails surface.
Yellow Zone (‘Warning’) Requires action. Soils and vegetation at risk if groundwater rise continues.	Depth to groundwater between 6 to 10 mGBL	Depth to groundwater between 20 to 27.5 mBGL	None
Green Zone (‘Safe’) Requires no action. Soils and vegetation not at risk.	Depth to groundwater > 10 mBGL	Depth to groundwater > 27.5 mBGL	None

^mBGL = metres below ground level

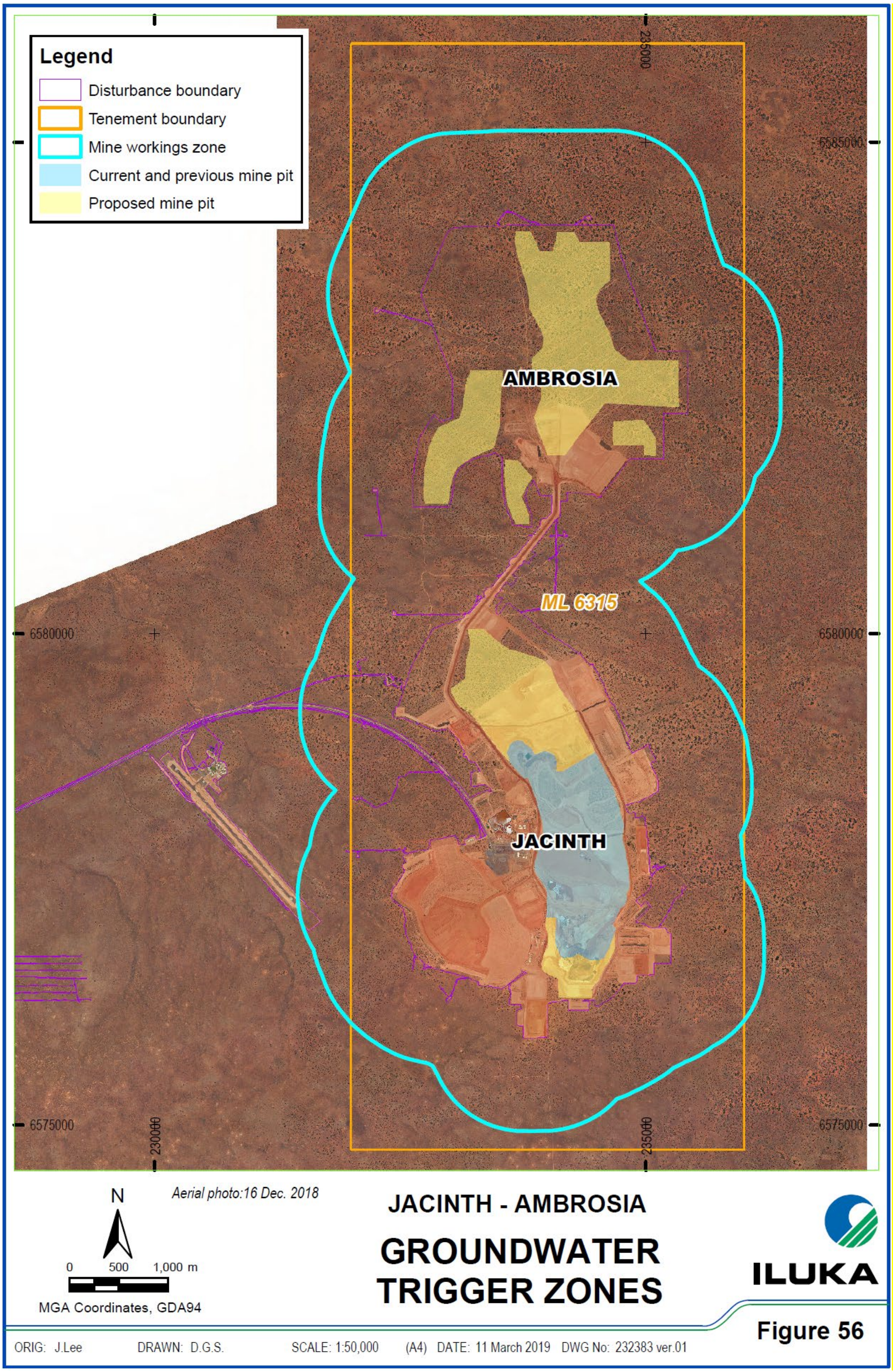

Figure 56: Groundwater Trigger Zones

5.16 Hazardous materials

5.16.1 Context

Hazardous materials are substances that, because of their chemical, physical or biological properties, can cause harm to people, property or the environment. These include hazardous substances (classified on the basis of their health effects), dangerous goods (classified based on their immediate physical or chemical effects such as fire, explosion, and corrosion and poisoning) and hazardous wastes which may possess one or both characteristics.

Hazardous materials are a necessary element of mining operations. Examples include hydrocarbons (fuels and grease), process chemicals, paints and solvents, liquid petroleum gas (LPG), pesticides and herbicides, resins/adhesives and other materials.

Environmental impacts can occur both in the course of their normal use and as a result of inappropriate/uncontrolled storage, segregation, handling and disposal.

During operations hazardous materials will be managed in accordance legislation, codes, standards and guidelines relevant to the materials used on-site.

5.16.2 Applicable legislation and standards

The following national and South Australian legislation, policies and guidelines are applicable:

- AS 1596-1997: Storage and handling of Liquid Petroleum Gas;
- AS 1692-2006: Steel tanks for flammable and combustible liquids;
- AS 1940-2004: Storage and handling of Flammable and Combustible Liquids;
- AS 2507-1998: The storage and handling of agricultural and veterinary chemicals;
- AS 3780-2008: The storage and handling of corrosive substances;
- AS 4452B-1997: The Storage and Handling of Toxic Substances;
- Australian Dangerous Goods Code, Volume 7 (ADG7);
- *Dangerous Substances Act 1979 (Regulations 2002) (SA);*
- *Environment Protection (Water Quality) Policy 2015 (SA);*
- EP Act *(Regulations 2009) (SA);*
- EPA Guideline: Bunding and Spill Management;
- EPA Guideline: Disposal of used hydrocarbon absorbent materials;
- Hazardous Substances Information System (HSIS);
- HB 76-2010: Dangerous Goods - Initial emergency response guide ;SafeWork Australia: Model Code of Practice – Labelling of Workplace Hazardous Chemicals;
- SafeWork Australia: Model Code of Practice – Managing Risks of Hazardous Chemicals in the Workplace 2012; and
- *Work Health and Safety Act 2011 (Regulations 2011).*

5.16.3 Potential impacts

Potential project-related impacts associated with hazardous materials are summarised in Table 72 and described below.

Table 72: Potential impacts associated with hazardous materials

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
HZ1	Hazardous materials – storage and handling	Spill or release due to inappropriate uncontrolled storage and handling	Soils, surface water and groundwater	Contamination of soil, surface water and groundwater	Yes – hazardous goods are stored for use in Project activities and might impact on soils, surface and groundwater if not appropriately contained/bunded.
HZ2	Hazardous materials storage and handling	Accidental spill or release (normal use, handling and storage)	Soils, surface water and groundwater	Contamination of soil, surface water and groundwater	Yes – hazardous goods are used in Project activities and their accidental spilling or release could impact on soil, surface water and groundwater if appropriate controls are not in place.

Contamination of soil, surface water and groundwater due to inappropriate/uncontrolled storage and handling of hazardous materials

Inappropriate or uncontrolled storage and handling may include the co-storage of incompatible dangerous goods classes, storage without bunding/containment, poor management of inventory and unsafe handling practice. Without preventative measures in place the likelihood of impact to soils, surface and groundwater is possible, with **moderate** consequence and high environmental risk.

Contamination of soil, surface water and groundwater due to accidental spill or release (normal use and handling)

It is considered likely that the accidental spill or release of hazardous materials will occur during their normal use (e.g. hydraulic systems, pipes and infrastructure) and handling (e.g. transfers, refuelling). Without preventative and remedial controls in place the consequence (impact to soils, surface water and groundwater) is considered minor, with a **high** inherent risk.

5.16.4 Control and management strategies

Control and management strategies that have been implemented to minimise the potential impacts of hazardous materials are outlined below.

Construction and operations

- Implementation of a *Hazardous Materials Management Plan* that includes:
  - Requirements for the storage, handling, bunding/containment and transport of dangerous goods (DG) and hazardous substances (including hazardous commercial and industrial waste) per relevant legislation, guidelines and standards;
  - Hazardous Materials Approval procedure; and
  - Inventory management, monitoring and inspection requirements.
- Implementation of a *Waste Management Plan* that includes:

  - Requirements for storage and handling of hazardous and listed wastes to mitigate impacts to soil, surface water and groundwater.
- Implementation of a *Surface Water Management Plan* that includes:
  - Requirements for site and facility drainage/catchment design to prevent or minimise releases to the surrounding environment.
- Vehicle, plant and infrastructure preventative maintenance programs.
- Spill response/clean-up procedures.
- Emergency Response Team trained in fire and hazmat emergency response, including spill response trailer.
- Site induction content and awareness training on hazardous materials.
- Loss Control reporting system.

Closure

- As per construction and operations controls.
- Assessment of areas used for the storage and handling of hazardous wastes for potential legacy site contamination, 2013 amended NEPM (NEPC,1999).

5.16.5 Residual risk

Contamination of soil, surface water and groundwater due to inappropriate/ uncontrolled storage and handling of hazardous materials

With the implementation of operational controls outlined in Section 5.16.4 the likelihood of impact to soils, surface water and groundwater due to inappropriate/uncontrolled storage and handling is unlikely, with negligible consequence and a **low** residual risk.

Contamination of soil, surface water and groundwater due to accidental spill or release (normal use and handling)

With preventative and remedial controls in place the likelihood of accidental spills/release during normal activities involving hazardous materials resulting in impact to soils, surface water and groundwater is possible, with negligible consequence and **low** residual risk

This residual risk is considered to be as low as reasonably practicable (low) and for this reason is considered by Iluka to be acceptable for the operation. Whilst the results of the residual risk assessment was low there is a requirement to have outcomes, measurement criteria and monitoring requirements as per the Second Schedule Lease Conditions (Table 37) as such these have been developed and are outlined in Section 5.16.6. The residual risk assessment is provided in Table 73.

Table 73: Summary of residual risk assessment in relation to Project impacts from hazardous materials

Impact ID	Possible Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
HZ1	Spill or release due to inappropriate or uncontrolled storage and handling – Contamination of soil, surface water and groundwater	Possible	Moderate	High	• Implementation of a *Hazardous Materials Management Plan*. • Implementation of a *Waste Management Plan* that covers management of hazardous wastes • Implementation of *Surface Water Management Plan* including site and facility drainage/catchment design • Bunding and containment of dangerous goods and hazardous substances per relevant legislation, guidelines and Australian/New Zealand standards • Hazardous Materials Approval procedure • Inventory management, monitoring and inspection requirements • Spill response/clean-up procedures • Emergency Response Team trained in fire and hazmat emergency response, including spill response trailer • Site induction inclusive details on-site hazardous materials management • Hazardous materials management training awareness program • Planned workplace inspections • Loss Control reporting system	Unlikely	Negligible	Low	Potential legacy soil contamination in areas used for storage and handling of hazardous materials	Closure soil assessments as per ASC NEPM	Fuel and liquid chemical (hazardous materials) storage are adequately bunded to capture and prevent the migration and infiltration of any spillage or leakage to the surrounding environment in conformance with relevant EPA guidelines
HZ2	Accidental spill or release during normal use and handling – Contamination of soil, surface water and groundwater.	Likely	Minor	High	• All controls as above • Vehicle, plant and infrastructure preventative maintenance programs • Vehicle and equipment pre-start checks	Possible	Negligible	Low	Not Applicable	Not Applicable	Fuel and liquid chemical (hazardous materials) storage are adequately bunded to capture and prevent the migration and infiltration of any spillage or leakage to the surrounding environment in conformance with relevant EPA guidelines

5.16.6 Measurement criteria and monitoring requirements

Table 74 outlines the measurement criteria and monitoring requirements for each outcome in relation to hazardous materials.

Table 74: Measurement criteria and monitoring requirements for outcomes in relation to hazardous materials

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
Fuel and liquid chemical (hazardous materials) are bunded and managed in accordance with relevant EPA guidelines to prevent spillage and leakage to the environment.	C46	Quarterly review of the incident register for spillages and leaks and the results of visual observations of hazardous materials storage facilities, including the identification of any procedural changes required	Operations	Visual observations and incident investigation (report stored in Iluka Incident Management System, Cintellate)	Designated hazardous material storage areas	All hazardous materials storage facilities comply with SA EPA Bunding Guidelines, or to a design agreed with the SA EPA to prevent spillage and leakage to the environment	Monthly	NA	Environmental Specialist Safety Specialist
	C47	Quarterly review of the incident register for spillages and leaks and the clean-up and disposal of contaminated material, including the identification of any procedural changes required	Operations	Visual monitoring and recording of the appropriate clean-up and disposal of contaminated material	Various, depending on location of contaminated material	Records indicate that all spills are managed in accordance with Spill Response/Clean Up Procedure and Iluka *HSEC Group Standard – Hazard, Incident and Emergency Classification*	On event	NA	Environmental Specialist
				Reporting in ACR to DEM	Various, depending on location of contaminated material	Summary provided of all Level 2 or higher hazardous material spill events, response and clean-up (as ranked according to the Iluka *HSEC Group Standard - Hazard, Incident and Emergency Classification*)	Annually	NA	Environmental Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
	C48	NA	Closure	Domain audit Soil sampling of target sites and management of any impacted soils in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999 ('ASC NEPM')* Classification for off-site disposal as per SA EPA Information Sheet (March 2010): *Current criteria for the classification of waste – including Industrial and Commercial Waste (Listed) and Waste Soil*	Village/Aerodrome Domain 2 (MPL 111) Mine Site Domain 4 (ML 6316) (refer Figure 44) Example target sites for assessment during Domain audit: • Hazardous materials storage areas • Workshop areas • Waste storage areas • Refuelling areas • Wash bay areas	No soil contamination in areas used for storage and handling of hazardous materials	At closure and/or site relinquishment	NA	Environmental Specialist Rehabilitation Specialist

5.17 Visual amenity

5.17.1 Context

The J-A Project area is located remotely and within a regional reserve. The nearest populated centre is more than 200 km south of the J-A Project area. Hence there are no direct visual receptors (the public or neighbours) for which views would be impacted.

Visual changes to the landscape in the medium term have occurred due to implementation of infrastructure, pit development and construction of an off-path TSF. Following completion of mining operations, closure activities will be undertaken to remove site equipment, infrastructure and the landscape rehabilitated to a sustainable ecosystem consistent with surrounding topography.

5.17.2 Applicable legislation and standards

The key legislation which pertains to visual amenity is the Mining Act. Interpretation of amenity value of an area includes any quality or condition of the area that contributes to its enjoyment.

5.17.3 Potential impacts

Potential visual amenity impacts during the operation and closure phases of the Project are described in Table 75 below.

Table 75: Potential impacts associated with visual amenity

Impact ID	Event/Source	Pathway	Receptor	Potential Impact	Confirmation of S-P-R linkage?
VA1	Mining infrastructure Vegetation clearance Establishment of TSF	Earthworks Construction Altered landscape	Visual amenity	Reduced visual amenity due to development of mining operation	Yes – it is possible that the construction and operation of the mine could reduce visual amenity in the project area locally and regionally.
VA2	Rehabilitation	Altered landscape	Visual amenity	The post mining topography does not adequately integrate with the surrounding 'natural' topography	Yes – the post-mining landform could impact the visual amenity at site closure.

Reduced visual amenity due to development of mining operation

It is considered possible that the construction and operation of the mine will reduce visual amenity in the J-A Project area both locally and regionally. Given the remoteness of the J-A Project area, this will have a minor consequence. The resulting inherent environmental risk is considered to be **low**.

The post mining topography does not adequately integrate with the surrounding 'natural' topography (visual amenity)

It is possible that if not adequately designed and successfully implemented the post-mining landform and vegetation will have an impact on the visual amenity of the J-A Project area at site closure. Although the area is remote, the J-A Project area is located within two regional reserves which are considered to have high natural and wilderness values and as a result the consequence has been considered to be moderate. This provides a **high** inherent risk level.

5.17.4 Control and management strategies

Control and management strategies implemented to minimise potential visual amenity impacts are outlined below.

Operations and closure

- Progressive implementation of rehabilitation.
- Design of landform for rehabilitation compatible with surrounding topography.
- Implementation of *Mine Closure Plan* (Appendix G) which includes:
    - Requirements for soil and stockpile management;
    - Removal of mining infrastructure; and
    - Proposed post-disturbance design.
- Consultation with land managers and FWC on proposed post-disturbance landform design.
- Erosion and surface water assessment on proposed design.

5.17.5 Residual risk

Reduced visual amenity due to development of mining operation

It is recognised some visual amenity impacts may continue during the construction and operation of the Project however these impacts are limited to the life of the operation and will be mitigated upon completion of the project. Due to the remote location of the J-A Project area, the residual risk is considered **low** and is acceptable.

The post mining topography does not adequately integrate with the surrounding 'natural' topography (visual amenity)

The design of the proposed final rehabilitated land surface has been prepared and presented in the J-A PEPR. The design represents an example of the likely final topography of the rehabilitated J-A Project area. It has been prepared in consultation with key stakeholders. A reduction in visual amenity would result in reputational loss for Iluka and damage to stakeholder relations, the consequence is considered to be moderate. The resultant residual risk is **low**.

This residual risk is considered to be as low as reasonably practicable (**low**) and for this reason is considered by Iluka to be acceptable for the operation. However, despite the low residual risk rating (and lack of specific visual amenity requirements contained in the Second Schedule Lease Conditions) Iluka, in consultation with the FWC, have resolved to ensure the site is rehabilitated to an agreed landform (i.e. that the reconstructed landform is consistent with the surrounding topography).

The residual risk assessment is provided in Table 76.

Table 76: Summary of residual risk assessment for visual amenity impacts

Impact ID	Possible Impact	Inherent risk level			Controls and management strategies	Residual risk level			Uncertainties	Commitments to Address Uncertainties	Outcome
		L	C	R		L	C	R			
VA1	Reduced visual amenity due to development of mining operation	Possible	Negligible	Low	• Implementation of progressive rehabilitation • *Stockpile Management Plan* • Consultation with land managers and FWCAC on proposed post-disturbance landform design. • *Rehabilitation Management Plan* (Appendix T)	Possible	Negligible	Low	Not Applicable	Not Applicable	Predicted outcomes and assessment criteria have only been developed for environmental aspects with an IRL of moderate or higher
VA2	The post mining topography does not adequately integrate with the surrounding 'natural' topography (visual amenity)	Possible	Moderate	High	• Consultation with land managers and FWCAC on proposed post-disturbance landform design. • *Rehabilitation Management Plan* (Appendix T) • *Mine Closure Plan* (Appendix G) • Erosion (SIBERIA and WEPP), Appendix F) and surface water assessment (Appendix H) on proposed design	Rare	Moderate	Low	Not Applicable	Not Applicable	The reconstructed landform is consistent with surrounding topography.

5.17.6 Measurement criteria and monitoring requirements

Table 77 outlines the measurement criteria and monitoring requirements for each outcome in relation to visual amenity.

Table 77: Measurement criteria and monitoring requirements for outcomes in relation to visual amenity

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
The reconstructed landform is consistent with surrounding topography	C49	NA	Closure	Topographic survey of rehabilitated site compared with approved design (comparison of RLs)	Domain 4A (Jacinth Pit)	No point in the rehabilitated landscape greater than 178 mAHD (+1 m of the highest designed mAHD) for Domain 4A No point in the rehabilitated landscape less than 124 mAHD (the lowest designed mAHD) for Domain 4A	At closure and/or site relinquishment. (repeat after remedial work, if necessary)	NA	Mining Engineer Rehabilitation Specialist

Outcome	Criteria ID	Leading Indicator Criteria	Project Phase	Measurement Criteria					
				What will be measured and form (method) of measurement	Locations	Outcome achievement	Frequency	Control or baseline data	Responsibility
	C50				Domain 4C (off-path TSF)	No point in the rehabilitated landscape greater than 178 mAHD (+1 m of the highest designed mAHD) for Domain 4C			
	C51				Domain 4B (Ambrosia Pit)	No point in the rehabilitated landscape greater than 160 mAHD (+1 m of the highest designed mAHD) for Domain 4B No point in the rehabilitated landscape less than 118 mAHD (the lowest designed mAHD) for Domain 4B			

5.18 Summary of measurement criteria and uncertainties schedule

A summary of all proposed environmental outcomes and criteria for the operations and closure phase is provided in Table 78.

Table 78: Summary of all environmental outcomes and leading indicator criteria for J-A

Aspect	Impact ID	Outcome	Measurement Criteria ID	Leading Indicator Criteria	Applicable phase O = Operations C = Closure A = All
Public Safety and Traffic	PST1 PST2	No public injuries or deaths resulting from mine operations traffic or unauthorised access that could have been reasonably prevented	C1	Annual review of incidents related to traffic or unauthorised access	O
			C2		O
			C3		C
			C4		C
	PST3	No public injuries or deaths resulting from uncontrolled fire that could have been reasonably prevented	C5	Quarterly review of incidents audits and hazards related to fire	O
			C6		O
Heritage	HE1	No disturbance to aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained	C7		O
			C8		A
			C9		C
Pest Species	PS1	No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations	C10	Annual review of the pest flora survey and weed management register (comprising results of field monitoring and visual observations) considering trends that could indicate population increase or introduction of new weed species	O
			C11		C
	PS2	No increase in abundance of pest animal species in the lease area and adjacent areas caused by mining operations	C12	Annual review of register of pest animal sightings considering trends that could indicate population increase	O
			C13		C
Soils	S1 S2 S3 S4	Soil profile and function is restored and capable of supporting agreed land use	C14		O
			C15		C
			C16		O
			C17		C

Aspect	Impact ID	Outcome	Measurement Criteria ID	Leading Indicator Criteria	Applicable phase O = Operations C = Closure A = All
			C18		O
			C19		C
			C20		C
			C21		C
			C22		C
			C23		C
Waste	WD1 WD2	No demolition, industrial or solid domestic wastes (other than treated sewage) are to be disposed on-site	C24	Quarterly review of site waste register containing records of all waste movements from site	O
			C25		A
			C26		A
Dust and air quality	DA2	All fuel burning equipment is operated in accordance with the requirements of the EPA	Not applicable (low inherent risk)		
Native vegetation	NV1 NV2 NV3	All clearance of native vegetation Is authorised under appropriate legislation	C27		O
			C28		O
	NV1	Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	C29		A
	NV4	No uncontrolled fires caused by mining activities	Apply C5-C6		
Native Fauna	NF1 NF2 NF3	No net adverse impacts from site operations on native fauna abundance or diversity within the lease area and adjacent areas	C30	Quarterly review of the incident register for the occurrence of injured or deceased fauna, including the identification of any procedural changes required	O
			C31		C
			Apply C29		
	NF2 NF3	All sick and injured fauna are managed as per the requirements of the *Animal Welfare Act 1985*	C32	Quarterly review of the incident register for the management of sick or injured fauna, including the identification of any procedural changes required	O
Surface Water	SW1	Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	C33		O
			C34		C

Aspect	Impact ID	Outcome	Measurement Criteria ID	Leading Indicator Criteria	Applicable phase O = Operations C = Closure A = All
			C35		A
		The Tenement Holder must ensure mining related activities related to Canberra Road do not decrease the quantity of surface water available to water dependent ecosystems on or off the Land	C36		O
Groundwater	GW1	The extraction and use of groundwater does not adversely affect environmental processes or beneficial users that are reliant on that groundwater system	C37		O
			C38		O
			C39		C
			C40		C
	GW2, GW3, GW4	The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and groundwater quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities.	C41		O
			C42		O
			C43	Water quality analysis (as per the measurement criteria) shows that there is no statistically significant increasing trend for wells sampled **<u>inside</u>** the Mine Workings Zone that act as Leading Indicator (LI) wells.	O
	GW3, GW4	The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and groundwater quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities.	C44	Annual review of observed SWLs against the predicted quarterly modelled SWL trends for closure (JACMIN2.0)	C
			C45	Annual review of observed SWLs against the predicted quarterly modelled SWL trends for closure (JACMIN2.0)	C
			Apply C19		
Hazardous Materials	HZ1 HZ2	Fuel and liquid chemical (hazardous materials) storage are adequately bunded to capture and prevent the migration and infiltration of any spillage or leakage to the surrounding environment in conformance with relevant EPA guidelines	C46	Quarterly review of the incident register for spillages and leaks and the results of visual observations of hazardous materials storage facilities, including the identification of any procedural changes required	O
			C47	Quarterly review of the incident register for spillages and leaks and the clean-up and disposal of contaminated material, including the identification of any procedural changes required	O

Aspect	Impact ID	Outcome	Measurement Criteria ID	Leading Indicator Criteria	Applicable phase O = Operations C = Closure A = All
			C48		C
Visual Amenity	VA2	The reconstructed landform is capable of supporting the land use	C49		C
			C50		C
			C51		C

A summary of the anticipated schedule for commencement and completion of tasks to address uncertainties is provided in Table 79.

Table 79: Summary of commitments to address uncertainties

Aspect	Impact ID	Uncertainties	Commitments to Address Uncertainties	Commencement	Anticipated Completion
Heritage	HE1	Potential presence of unknown, lost or hidden sites/relics within approved tenement boundaries	Existing control – Iluka J-A Indigenous Site/Relic Discovery Procedure	Already commenced	Ongoing
Pest Species	PS1	Weed introduction via uncontrolled public vehicles using haul road (public access area) Intensity of weed management by DEW in the greater Yellabinna Reserve area (outside of the tenement boundaries)	Regular monitoring of haul road for weed outbreaks. See *Pest Species Management Plan* for further details. Liaison with DEW	Already commenced	Ongoing
	PS2	Intensity of pest animal management by DEW in the greater Yellabinna Reserve area (outside of the tenement boundaries)	Liaison with DEW	Already commenced	Ongoing
Soil	S1	Stability of topsoil and subsoil stockpiles Stability of rehabilitated soil surface	Stockpile monitoring program Annual stockpile balance	Already commenced	Ongoing
	S2	Seed longevity beyond previously examined 17 months. Microorganism availability in long-term (> 5 years) stockpiles	Biological viability testing of topsoils and subsoil with stockpile age and height to be commenced	2020	Ongoing

<table>
<tr><th>Aspect</th><th>Impact ID</th><th>Uncertainties</th><th>Commitments to Address Uncertainties</th><th>Commencement</th><th>Anticipated Completion</th></tr>
<tr><td rowspan="2"></td><td>S3</td><td>Depth of salinity in soils where saline water used for dust suppression</td><td>Ongoing salinity monitoring at depth of haul roads</td><td>2016</td><td>Ongoing</td></tr>
<tr><td>S4</td><td>Rooting depth requirements for deep rooted plant species</td><td>Adelaide University ARC Linkage Project (Cell 1 Trial). Refer to J-A research and monitoring summary (JARMS) 2012 and 2014 for more information

Rehabilitation trials. Refer to JARMS (2012, 2014)</td><td>Already commenced</td><td>2016 ARC Project completion.
Sacrificial tree monitoring concluded in 2019.</td></tr>
<tr><td rowspan="4">Waste management</td><td rowspan="4">WD2</td><td>Potential legacy soil contamination in areas used for storage and handling of hazardous and listed substances</td><td>Closure soil assessments as per ASC NEPM</td><td>At closure</td><td>At closure</td></tr>
<tr><td rowspan="3">Potential groundwater contamination associated with on-site disposal of hydrocarbon soils</td><td>Assessment and disposal of soils as per ASC NEPM and SA EPA guidelines</td><td>As required</td><td>N/A</td></tr>
<tr><td>Groundwater quality monitoring per Groundwater Management and Monitoring Plan</td><td>Already commenced</td><td>Ongoing</td></tr>
<tr><td>Assessment of groundwater impacts as per ASC NEPM (if/where an impact or threat to groundwater is identified)</td><td>As required</td><td>N/A</td></tr>
</table>

Aspect	Impact ID	Uncertainties	Commitments to Address Uncertainties	Commencement	Anticipated Completion
Native vegetation	NV1	Plant growth response to reconstructed soil profiles Soil seed bank response to disturbance and stockpiling	Adelaide University and ARC linkage project (Cell 1 Trial). Refer to J-A research and monitoring summary (2010 -2011) and (2012 – 2013) for more information.	Already commenced	2016 ARC Project completion. Soil bank monitoring will remain ongoing
	NV3	Unknown how vegetation health, in particular *Maireana sedifolia,* is impacted by smothering of foliage with dust generated by project activities	Dust monitoring program in place, which incorporates a series of transects to examine health of vegetation within proximity of mining activities	Already commenced	Ongoing
Surface Water	SW1	Impacts to downstream waterways due to temporary interruption of upstream sediment sources	Monitoring of creeks for evidence of erosion, upstream and downstream	2015	Ongoing
Groundwater	GW1	Future palaeochannel aquifer demand associated with mine operations	All potential changes in mining operations to consider demand on palaeochannel aquifer and potential implications (i.e. run scenario in model to confirm)	As required	N/A
			Develop recovery model predictions for palaeochannel aquifer	Prior to closure	2023
			Assessment of the salinity driver density effects including incorporation of density corrections into groundwater flow model.	During next update 2021	2022
	GW2	Long term impact of tailing water seepage on groundwater chemistry and geochemistry	Routine monitoring of groundwater chemistry per *Groundwater Management and Monitoring Plan*	Already commenced	Ongoing
			Further monitoring of the process water circuit to continue to better understand the geochemical processes which are occurring at the site.	2019	2021

Aspect	Impact ID	Uncertainties	Commitments to Address Uncertainties	Commencement	Anticipated Completion
			Geochemical assessments to better understand the potential long term impact to groundwater quality as a result of updated groundwater monitoring data. Refer to uncertainties for GW3 and GW4 for further details.	As required	As required
			Conduct geochemical test work of proposed monitoring well drill cores as per RGS (2019) recommendations.	2021	2023
			Develop methodology and report structure for verification report of water quality data using US EPA 2009 (US EPA, 2009) guidance to meet C43.	2021	2022
	GW3 and GW4	Volume of water disposed in tails, end fate and associated mounding impacts	Application of the *Groundwater Management and Monitoring Plan*, active monitoring of water efficiency	Already commenced	Ongoing
		Adverse impact (or otherwise) of hypersaline groundwater on vegetation	Vegetation stress monitoring	Already commenced	Ongoing

		The current model JACMIN2.0 predicts that the groundwater mound will move westwards towards Lake Ifould. It is uncertain the extent of potential impacts to Lake Ifould, soil quality and vegetation health.	Undertaking a groundwater drilling program in 2021 to install up to eight new groundwater wells and undertake hydraulic tests. These wells will all be located in the western portion of the model domain heading towards Lake Ifould where there is no data to date. Collection of field data for a minimum of 12 months from the eight new wells, which will then be incorporated into the model. Undertake a review of the JACMIN2.0 model including: • Investigating the potential role of mapped faults on the groundwater flow on and around the mine site. • Expansion upon the sensitivity analysis undertaken by EMM (2019). • Investigating the basis for varying aquifer parameters spatially (i.e. if data is available), particularly in areas where the model underpredicts. • Investigating the potential reasons for the observation of a vertical hydraulic gradient between the Marine Sands and Granite Basement Units. • Consideration of the salinity driver density effects including incorporation of density corrections. • Recalibrating and rerunning the model inclusive of changes above with a minimum 12 months of data from the eight new groundwater wells. The updated model reporting is to include: • A regional potentiometric surface to support boundary and initial conditions. • An assessment of the western fault which is currently speculative to determine any potential impacts to groundwater mounding and Lake Ifould.	2021	2023

Aspect	Impact ID	Uncertainties	Commitments to Address Uncertainties	Commencement	Anticipated Completion
			• An analysis of confidence in K, Sy and recharge data and what form of uncertainty analysis is appropriate. • Commentary on findings from the appropriate uncertainty analysis. • Commentary on water balances including steady state. • An assessment of aquifer surface parameters (e.g. geophysics). • Explanatory notes for any outlier features in depth to water plots. • Evidence to inform vegetation impact depth. • A conceptual scaled cross-section of the Jacinth Ambrosia hydrogeological stratigraphy based on drill hole data.		
Hazardous Materials	HZ1	Potential legacy soil contamination in areas used for storage and handling of hazardous materials	Closure soil assessments as per ASC NEPM	At closure	At closure

5.19 Completion risk assessment

The J-A *Mine Closure Plan* (Appendix G) is a stand-alone document that provides a systematic approach for Iluka to follow through the closure planning process for the J-A operations. It is intended as a site-based management plan (Appendix N), incorporating all measurement criteria, outcomes and risks described in this PEPR. Specifically, the Plan provides a process to ensure:

- all statutory obligations are fulfilled, and successful relinquishment of all relevant leases/tenements/licenses/authorities is achieved;
- disturbed land is effectively rehabilitated to a condition that supports a sustainable post-mining land use;
- Iluka's 'social license to operate' is maintained whereby opportunities to enhance the environmental values of the land are maximised and potential social implications are identified and adequately addressed post-closure;
- site closure activities are undertaken in a cost-effective and timely manner;
- relevant stakeholders are consulted to provide feedback throughout the closure planning process; and
- potential social impacts related to closure are minimised where reasonably practical.

Mine closure planning is a continuous process throughout the life of the mine. The *Mine Closure Plan* is therefore intended to be reviewed and updated throughout the life of the mine to ensure that continuous improvement principles apply to closure planning. The closure measurement criteria and subsequent outcomes from this PEPR are also contained in the closure plan and have been developed based on the current understanding of the J-A environment and rehabilitation trials to date. Section 6 of the *Mine Closure Plan* (Appendix G) provides further discussion on potential environmental impacts from closure activities.

A summary of residual risks associated with not meeting the stated mine completion criteria is shown in Table 80. A discussion of each of the residual risks is provided below and referenced in Table 80.

CR1 Loss of information (cultural heritage site locations)

The J-A *Cultural Heritage Management Plan* (CHMP) outlines the ongoing monitoring and management of cultural heritage. The plan outlines procedures when cultural heritage objects are identified and the management of culturally significant sites. Cultural heritage objects in areas of disturbance have been identified and relocated in accordance with the CHMP and all areas identified in the cultural heritage Geographic Information Systems (GIS) database. Areas of cultural heritage significance will be rehabilitated to the original land use.

The likelihood of unauthorised damage to cultural heritage object or sites would be considered rare, and the consequence moderate. The residual risk is **low**.

CR2 Mining related infrastructure not required for the post mining land use remains on-site without approval

Iluka maintain, review and update closure liabilities throughout mine life for each project. It is considered rare that mining infrastructure would remain on-site without approval or unless specifically requested by the landholder. If remaining infrastructure was not removed the cost imposed on Iluka to remove the assets would be moderate (1M – 10M). The residual risk is **low**.

CR3 Mining related infrastructure required for the post mining land use is not safe for hand over to landowner

All Iluka infrastructure is engineered and designed to Australian Standards (where appropriate) and designed to withstand heavy vehicle traffic (Ooldea Road and Access Road) and regular use (airfield). Ongoing maintenance of remaining infrastructure will become the responsibility of the landowner however Iluka will ensure that the any infrastructure left on-site is in suitable condition for immediate use and any supporting infrastructure (i.e. drains, borrow pits) will be safe and stable.

The likelihood that remaining infrastructure is not safe for use is rare and any remedial works would be considered minor. The residual risk is **low**.

CR4 Unapproved disposal of demolition and waste materials on-site

The J-A *Waste Management Plan* outlines the management of waste disposal at J-A during operations and annual waste movements are reported annually in the ACR. Further, removal of waste and demolition materials as part of closure activities are planned and budgeted.

It is rare that any unapproved waste or demolition materials would remain on-site at closure. Any materials that remained would be removed at minor cost. The residual risk is **low**.

CR5 Groundwater levels result in salt migration into clean overburden

Migration of salt into clean overburden would be a result of hydraulic connection between the saline water table (in tails) and the soil surface. Without that connection, drained tails will not be recharged with infiltrating water to such an extent that it poses salinisation risk to overburden placed above it.

The likelihood of salt migration into clean overburden is unlikely given the management measures outlined in the *Rehabilitation Management Plan*. Areas affected by capillary rise would be limited to discreet locations; however, these locations may require further rehabilitation earthworks, resulting in a moderate consequence. The residual risk is **moderate**.

CR6 Failure to reduce radiation (gamma) to pre-operational levels at surface

The J-A ore body has low levels of U and Th. These concentrations are not high enough for the ore to be considered radioactive; however, the concentration process concentrates the U and Th in the final product (HMC). The J-A *Radiation Management Plan* identifies management measures associated with radioactive materials. At closure all HMC would have been removed from the J-A Project area as product and any contaminated material (soils) collected and buried at depth in the pit (with tailings).

Given the ongoing radiation management and closure cleanup activities it would be considered rare that radiation levels would exceed outcome criteria. Any residual contaminated material would require cleanup at minor expense. The residual risk is **low**.

CR7 The post mining topography does not adequately integrate with the surrounding 'natural' topography (visual amenity)

The design of the anticipated final rehabilitated land surface is shown in Section 3.12. The design represents an example of the likely final topography of the rehabilitated J-A Project area; there may be some minor variations to the land surface presented in the PEPR.

Although variation from the current anticipated landform design is expected it would be rare that the variation would be outside the completion criteria requirements, and would likely restricted to a single rehabilitated J-A Project area. A reduction in visual amenity would result in reputational loss for Iluka and damage to stakeholder relations, the consequence is considered to be moderate. The residual risk is **low**.

CR8 Landform surface creates ongoing/unacceptable soil erosion

Final landform design for each rehabilitation cell and the off path TSF is designed and modelled for stability prior to rehabilitation. Modelling considers long term surface water flows and general landform erosion rates. Further progressive rehabilitation of the mining pit offer opportunities for continuous improvements as results from monitoring and research are identified.

Given the ongoing design, modelling and monitoring it is unlikely that a stable landform is not achieved. The consequence of not achieving this outcome is considered to be moderate as progressive rehabilitation allows for early detection of any stability issues and therefore areas that require reworking are likely to be a small portion of the mine and rectifiable during operations. The residual closure risk is **moderate**.

CR9 Reduction in surface water quality

Surface water systems in the J-A area are a product of ongoing cycles of erosion and sedimentation generally associated with high levels of turbidity. Due to progressive rehabilitation carried out at J-A rehabilitated surface water systems will have some time to stabilise before upstream and downstream reconnection and stream flow is limited to high rainfall occurrences (25 years Average Interval Occurrence). Further, the surfaces rehabilitated at mine closure will comprise areas of shallow disturbance (subsoil and topsoil) and minor portions of surface water systems (i.e. where haul roads cross creeks).

All surface water system designs are modelled for stability prior to implementation and monitored post rehabilitation.

Given the limited occurrence of surface water flows and progressive rehabilitation it is unlikely that surface water quality downstream will be impacted. Any impacts (if they occur) will be likely limited to surface soils in exposed areas which will require some additional stabilization. The consequence for downstream environments will be negligible (limited to clean soils in the creek beds). The residual risk is **low**.

CR10 Surface water flows are not restored in final landform

Surface water flows for the anticipated rehabilitated landform have been modelled to ensure suitable flows, and final landform designs for individual rehabilitation-sites will be reassessed where required. All surface water systems will be progressively rehabilitated prior to catchment connection. Although final performance of the rehabilitated creeks surface water systems cannot be confirmed until reconnection and flow the performance of the rehabilitated unconnected surface water system will be monitored and remedial works carried out as required.

Given progressive rehabilitation and ongoing monitoring it is unlikely that surface water flows will not be restored. Further remedial works are likely to be limited to discrete portions of the surface water systems at moderate cost to Iuka. The residual risk is **moderate**.

CR11 Inadequate volumes of overburden, subsoil or topsoil

A materials movement inventory and LOM backfill schedule has been prepared and is routinely reviewed. The inventory ensures enough material to supply the anticipated final landform design. Further a soil balance is prepared annually and presented in the ACR.

The J-A *Vegetation Clearance Procedure* outlines the way in which soil materials are managed. A potential deficit in topsoil has been identified due to soil loss and current J-A Project area research is investigating options to manage material stripping to reduce losses and develop additional topsoil material from subsoil and brown loam.

Given the current soils management and ongoing research it is unlikely that there will be a deficit of overburden, subsoil or topsoil to achieve the anticipated rehabilitated landform. Any soils deficit is likely to be restricted to discrete rehabilitation-sites requiring moderate remedial works. The residual risk is **moderate**.

CR12 Contamination of soils (salinity, hydrocarbons, metals)

All contaminated soils (due to spills) during operations are collected and managed on-site and/or disposed of off-site, and any HMC contaminated material will be collected and returned to the production system of disposed of in pit. The J-A *Hazardous Materials Management Plan* outlines the procedures related to spill management.

It is unlikely that contaminated areas will remain at closure. Further any contamination would likely be limited to discrete areas and dealt with on an ongoing basis (negligible costs). The residual risk is **low**.

CR13 Failure of BSC to regenerate

The BSCs are important for soil stability at the J-A Project area. Completed research and ongoing monitoring of stockpiles and rehabilitated areas indicate that the BSC readily return and has been recorded on rehabilitated areas within one year. Further research programs will investigate the potential for broad scale inoculation of BSC in rehabilitated areas.

It would be considered rare that BSC did not regenerate in rehabilitated areas, however the consequence to soil stability would be significant although limited to discrete areas requiring additional stabilization works, therefore of moderate consequence. The residual risk is **low**.

CR14 Unstable soil surfaces resulting in erosion (wind)

The topsoil of rehabilitated sites has shown to develop a physical crust immediately after the application of potable water, and the BSC develops very quickly and early stage (Class 1) crusts have been recorded in rehabilitated sites after two years. Both the physical crust and biological crusts have been shown to withstand wind speeds gusting up to 50 km/h (site observations) with no fugitive dust emissions evident.

It would be unlikely that soil surfaces were unstable and prone to wind erosion after rehabilitation. Any erosive events which occur would be limited to minor areas and rectified with applications of water (or sealant additives) at negligible expense. The residual risk is **low**.

CR15 Reduction in species richness (recalcitrant species) and vegetation densities

Research and rehabilitation trials for J-A have been continuous from start of operations and gap analysis has outlined opportunities for further investigations to ensure rehabilitation outcomes. Further progressive rehabilitation provides early opportunity for rectifying areas where outcome criteria are not likely to be met.

Given current research and progressive research it is considered unlikely that the required vegetation diversity and abundance will not be achieved at closure. The consequence of not achieving this outcome is considered to be minor as progressive rehabilitation allows for early detection of rehabilitation and therefore areas that require reworking are likely to be a small portion of the mine and rectifiable during operations. The residual closure risk is **low**.

CR16 Reduction in species richness and densities due to introduced species

The J-A *Pest Species Management Plan* outlines the ongoing management and monitoring of introduced vegetation and fauna species. The presence of all introduced species are mapped and managed throughout operations and reported annually in the ACR.

It is important to note that some weed incursion into rehabilitated sites from upstream of J-A is expected and will be managed until site relinquishment.

It is unlikely that densities of introduce species will impact on the species richness and densities of native flora in rehabilitation areas. Further any records will likely be restricted to drainage lines (due to water availability) and managed at minor cost. The residual risk is **low**.

CR17 Reduction in fauna habitat

The establishment and management fauna habitat relates directly to vegetation species richness and densities through the provision of food and shelter resources (refer to Impact ID PS2).

Table 80: Completion risk assessment

<table>
<tr><th>Aspect</th><th>Outcome</th><th>Risk ID</th><th>Risk to achieving outcome</th><th>Likelihood</th><th>Consequence</th><th>Residual Risk</th><th>Domain</th><th>CCID</th></tr>
<tr><td>Heritage</td><td>No disturbance to aboriginal artifacts or sites of significance unless prior approval under the relevant legislation is gained</td><td>CR1</td><td>Loss of information (cultural heritage site locations)</td><td>Rare</td><td>Moderate</td><td>Low</td><td>All</td><td>C9</td></tr>
<tr><td rowspan="2">Public safety and traffic</td><td rowspan="2">No public injuries or deaths resulting from mine operations traffic or unauthorised access that could have been reasonably prevented</td><td>CR2</td><td>Mining related infrastructure not required for the post mining land use remains on-site without approval</td><td>Rare</td><td>Moderate</td><td>Low</td><td>All</td><td>C3</td></tr>
<tr><td>CR3</td><td>Mining related infrastructure remaining in situ is not safe for hand over to land owner (e.g. borefield pipeline)</td><td>Rare</td><td>Moderate</td><td>Low</td><td>1C, 2A, 2C, 3D</td><td>C4</td></tr>
<tr><td rowspan="2">Waste management</td><td rowspan="2">No demolition, industrial or solid wastes disposed of within rehabilitated site</td><td rowspan="2">CR4</td><td rowspan="2">Unapproved disposal of demolition and waste materials on-site</td><td rowspan="2">Rare</td><td rowspan="2">Minor</td><td rowspan="2">Low</td><td>All</td><td>C25</td></tr>
<tr><td>All</td><td>C26</td></tr>
<tr><td rowspan="4">Groundwater</td><td rowspan="4">The Tenement Holder must during construction, operation and post completion ensure that there is no adverse change to groundwater quantity and quality within aquifers outside of the defined mine working zone as a result of mining operations or mining-related activities.</td><td rowspan="4">CR5</td><td rowspan="4">Groundwater levels result in salt migration into clean overburden</td><td rowspan="4">Unlikely</td><td rowspan="4">Moderate</td><td rowspan="4">Moderate</td><td>3</td><td>C39</td></tr>
<tr><td>3</td><td>C40</td></tr>
<tr><td>4</td><td>C44</td></tr>
<tr><td>4</td><td>C45</td></tr>
</table>

Aspect	Outcome	Risk ID	Risk to achieving outcome	Likelihood	Consequence	Residual Risk	Domain	CCID
Visual amenity	The reconstructed landform is consistent with surrounding topography	CR7	The post mining topography does not adequately integrate with the surrounding 'natural' topography	Rare	Moderate	Low	4A	C49
							4C	C50
							4B	C51
Surface water	Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	CR10	Surface water flows are not restored in final landform	Unlikely	Moderate	Moderate	All	C34
		CR9	Reduction in surface water quality	Unlikely	Negligible	Low	All	C35
Soil	Soil profile and function is restored and capable of supporting agreed land use	CR11	Inadequate volumes of overburden, subsoil or topsoil	Unlikely	Moderate	Moderate	4	C15
		CR6 CR12	Contamination of soils (salinity, hydrocarbons, NORM)	Unlikely	Negligible	Low	2,4	C48
							All	C22
							4	C20
							3,4	C21
		CR13	Failure of BSC to regenerate	Rare	Moderate	Low	All	C17
		CR14	Unstable soil surfaces resulting in erosion (wind)	Rare	Negligible	Low	2,3,4	C23

Aspect	Outcome	Risk ID	Risk to achieving outcome	Likelihood	Consequence	Residual Risk	Domain	CCID
Native vegetation	Post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved	CR16	Reduction in species richness and densities due to introduced species	Unlikely	Minor	Low	All	C29
Fauna	No net adverse impacts from site operations on native fauna abundance or diversity within the lease area and adjacent areas	CR17	Reduction in habitat and resources resulting in decreased diversity and/or abundance of native fauna.	Unlikely	Minor	Low	All	C31
Pest species	No introduction of new weeds or plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations	CR15	Reduction in species diversity and abundance (recalcitrant species)	Unlikely	Minor	Low	All	C11
	No increase in abundance of pest animal species in the lease area and adjacent areas caused by mining operations	CR16	Increased diversity and/or abundance of pest animal species	Rare	Minor	Low	All	C13

6 Operator Capability

6.1 Environmental Management System

The approach to environmental management at J-A is underpinned by Iluka's HSECMS. The HSECMS governs the management of potential environmental impacts throughout all phases of operations – from exploration through to mine closure. The system consists of policies, standards, procedures, guidelines and plans. Routine audits are conducted to measure the company's compliance and effectiveness in managing sustainability performance, and to drive continual improvement in the area.

The system is hierarchical, where documents and systems meet and support the requirements of higher levels, demonstrated in Figure 57.

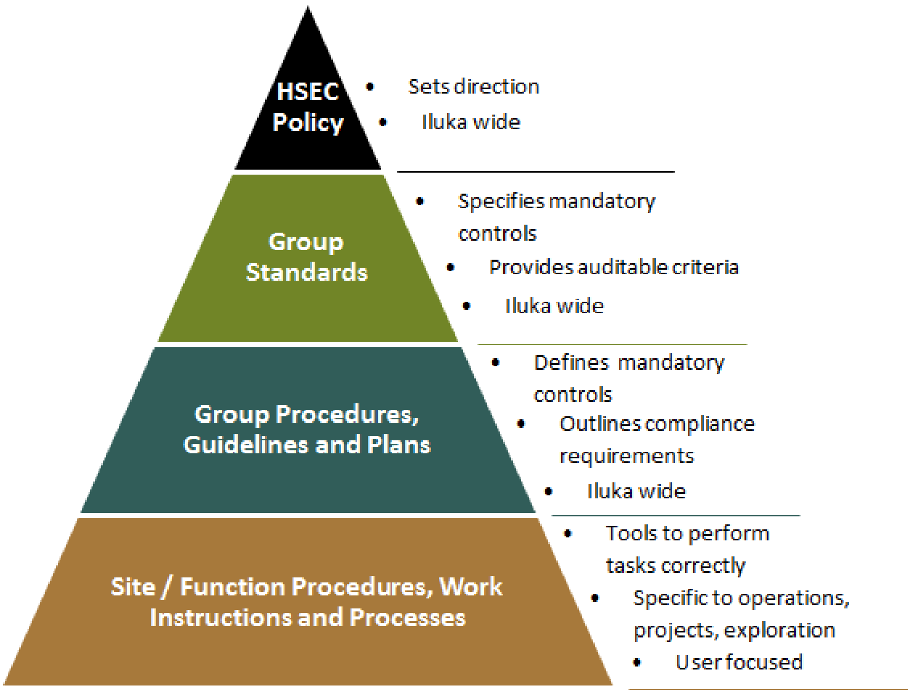

Figure 57: Management System documentation hierarchy

Within the HSEC policy, compliance with legislative requirements is recognised as the minimum standard to achieve. This is demonstrated in Figure 58.

Health, Safety, Environment & Community Policy

Within Iluka we believe that maintaining high levels of performance and pursuing leading practice in the areas of health, safety, environment and community reflects our values of acting with Integrity, demonstrating Respect, and taking Accountability.

We will:

- protect the health and safety of our people by identifying and taking appropriate action to mitigate workplace fatalities, injuries and illnesses;
- assess and manage the people, environment and community risks associated with our activities;
- engage early, inclusively and meaningfully, and incorporate stakeholder views into our decision-making processes;
- seek to make a positive difference to the social and economic development of the areas in which we operate;
- acknowledge and respect the histories, cultures, customs and values of indigenous people and communities where we operate;
- develop effective and timely plans for the cessation of operations, rehabilitation and relinquishment of mined areas;
- use resources efficiently, in particular energy, water and land;
- maintain a product stewardship approach towards the use of our products;
- comply with all legislative requirements, which we recognise as the minimum standard;
- set clear, achievable and measurable performance targets;
- seek to continuously improve performance;
- maintain a HSEC management system covering all areas of the business; and
- provide appropriate HSEC training to our people.

Tom O'Leary
Managing Director
June 2020

Figure 58: Health, Safety, Environment and Community Policy

The HSEC standards (see Figure 59) contained within the system specify uniform mandatory performance requirements which govern decisions and behaviour in support of the HSEC policy. They provide a basis for verifying compliance through audits and assessments.

EHS STANDARDS

Standard 1	Risk & Hazard Management
Standard 2	Stakeholder Relations
Standard 3	Training & Awareness
Standard 4	Contractor Management
Standard 5	Design, Construction & Operations
Standard 6	Process Safety
Standard 7	Environmental Management
Standard 8	Rehabilitation & Closure
Standard 9	Carbon & Energy
Standard 10	Radiation Management
Standard 11	Workplace Health & Hygiene
Standard 12	Incident Reporting & Investigation
Standard 13	Emergency & Crisis Preparedness
Standard 14	Audit & Assurance

Figure 59: Iluka HSEC standards

The individual environmental requirements of each site are considered and site-specific management plans, procedures and work instructions are developed. The J-A environmental plans capture all PEPR outcomes and measurement criteria and assign controls, monitoring, measurement and reporting responsibilities.

All on-site contractors at J-A are required to maintain an effective HSEC management system and demonstrate they can meet Iluka's HSEC requirements. This is assessed at both pre-qualification stage and ongoing validation and management provided through documented inspections and audits.

6.2 Resources

The HSECMS contains the commitment for adequate resources to be allocated commensurate with the requirements of the management system, legislative requirements and including those of the PEPR.

Accountability of adherence to the Iluka HSECMS, inclusive of legislative compliance, is resourced through:

Directors

- Endorse the HSEC policy;
- Endorse the annual Sustainability strategy;

- Seek assurance that there is effective compliance with the HSEC policy and Group standards;
- Ultimately accountable for sustainability performance at Iluka; and
- Regularly review sustainability performance, risks and strategic issues.

Managing Director

- Approves the HSEC policy and reviews every three years with the Executive Team;
- Establishes sustainability performance targets and ensure that they are disseminated and cascaded through the company; and
- Ensures all levels of management meet the requirements of the HSECMS.

Head of Resource Development

- Recommends the annual sustainability strategy for consideration by the Executive Team;
- Maintains adequate levels of sustainability expertise within the company; and
- Incorporates sustainability threats, opportunities and risks into the annual planning process.

Manager Sustainability

- Identifies sustainability threats, opportunities and risks;
- Develops the annual sustainability strategy;
- Maintains the HSECMS;
- Audits the implementation of the management system, legislative and obligation compliance;
- Provides guidance on the development of targets and performance indicators;
- Develop and implement programs to promote HSEC awareness;
- Maintains the HSEC pages on Iluka;
- Provides management with support and advice on meeting objectives and targets;
- Ensures that external Sustainability reporting accurately reflects performance;
- Conducts Group level analysis and trending on sustainability related data; and
- Custodian of Group Sustainability data systems.

General Manager Human Resources

- Implements systems to enable effective recognition of positive team and individual performance;
- Incorporates sustainability leadership into training programs for management and supervisory employees and contractors; and
- Establishes and maintains a training management system, which supports sustainability requirements.

Manager Procurement

- Integrates and maintains sustainability evaluation in the supply contracts system; and

- Supports processes for HSEC pre-qualification and on-going validation of vendor performance within the procure-to-pay systems and process.

General Manager Finance, Investor Relations & Corporate Affairs

- Supports sustainability aspects in external reporting;
- Engages sustainability team members when dealing with relevant shareholder concerns and information dissemination; and
- Approves reports to regulators, statutory authorities, general public and other interested parties where relevant.

Executive, Heads of Department and General Managers

- Communicate and apply the Iluka HSEC policy;
- Implement the requirements of the HSECMS within their areas of responsibility;
- Encourage recognition of positive team and individual performance;
- Report to the Executive on sustainability performance for their areas;
- Allocate adequate resources commensurate with the requirements of the management system, legislative requirements and other obligations;
- Act upon audit findings; and
- Maintain associations with relevant industry bodies and government agencies.

Operations and Functional Managers

- Develop business plans that align with wider sustainability objectives and targets;
- Promote a culture of accountability and risk awareness, ensuring corrective and preventive actions are completed;
- Promote active participation in HSEC matters in general;
- Provide effective resources to implement the management system within the operation/function;
- Ensure overall compliance to the HSECMS within the operation/function;
- Consistently apply counselling and disciplinary procedures related to HSEC aspects/non-conformances; and
- Conducts site or functional level analysis and trending on sustainability related data.

Managers, Coordinators, Supervisors

- Develop and reinforce positive behaviours and communication accountabilities among employees, contractors and visitors;
- Encourage employee involvement in HSEC processes;
- Counsel employees and contractors about poor performance;
- Ensure HSEC requirements are embedded in process maps and procedures; and
- Manage HSEC issues associated with their operation or function.

Specialists, Principals and Managers in HSEC related disciplines

- Promote leading practice and coordinate continuous improvement activities;

- Provide specialist advice and guidance on sustainability aspects, issues, improvements and performance;
- Analyse and trend data for their operation or site and implement programs to address problem areas;
- Support the Operations or Function Manager in implementing the HSECMS; and
- Develop and implement management plans and/or approaches that address specific operational and project risks.

Employees and Contractors

- Understand the Iluka HSEC policy and supporting standards;
- Accept accountability to ensure personal safety and the health and safety of others, and protect the environment;
- Identify, assess and control risks prior to undertaking any activity;
- Actively challenge or refuse to work in unsafe conditions or where unacceptable impact to the environment or community may occur;
- Intervene to prevent incidents;
- Actively participate in HSEC meetings, initiatives, risk assessments and monitoring programs;
- Report all incidents and near hits immediately to a supervisor;
- Correct or isolate hazardous situations in the workplace;
- Understand and follow the local emergency procedures; and
- Comply with and suggest improvements to site documentation, processes and procedures.

Specifically, at J-A there is a dedicated HSEC team to support compliance with the HSECMS, which includes meeting prescribed commitments contained in the PEPR. The Iluka corporate organisational structure is shown in Figure 60 and the J-A mine organisational structure is shown in Figure 61.

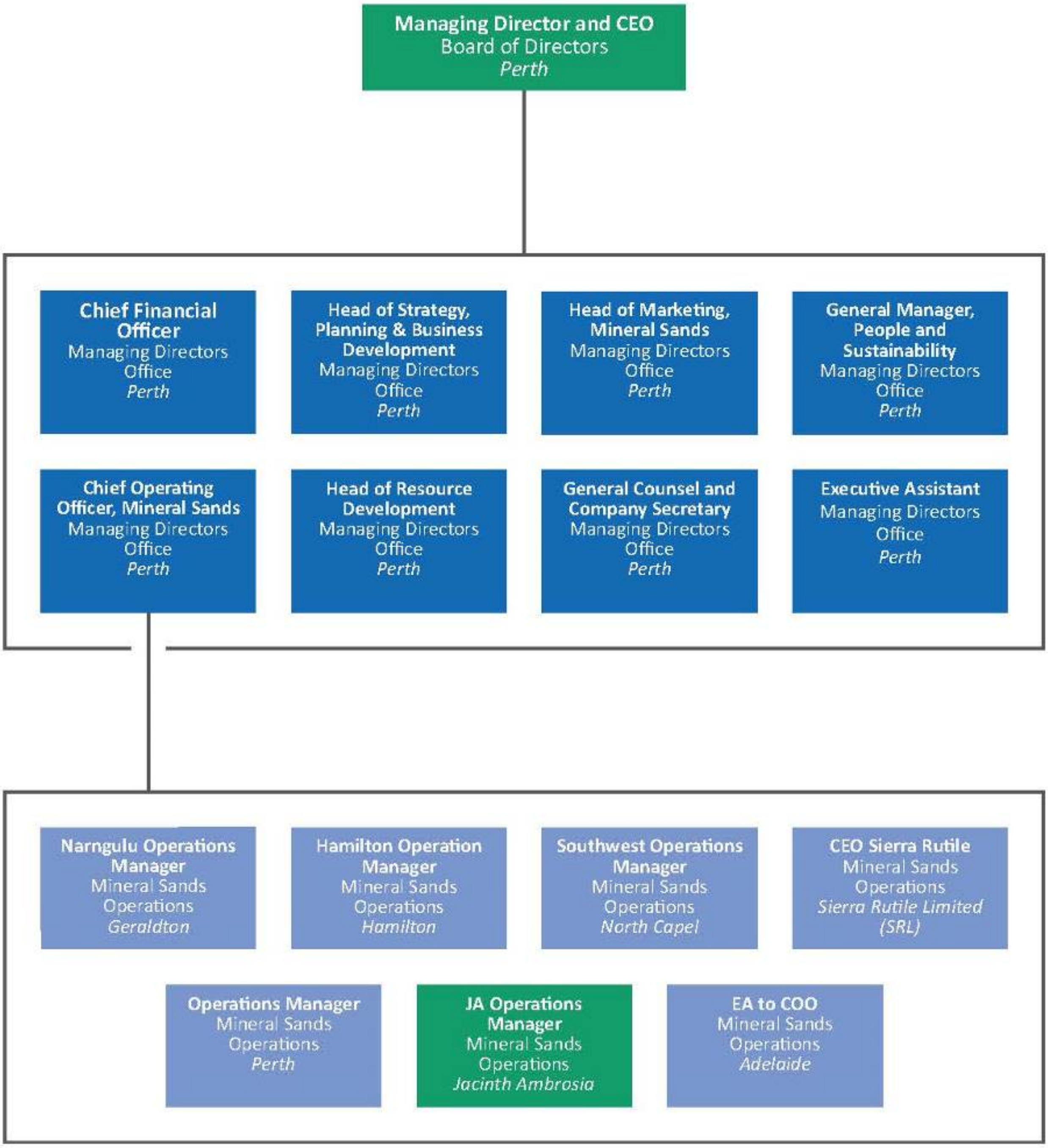

Figure 60: Iluka Corporate Organisational Structure

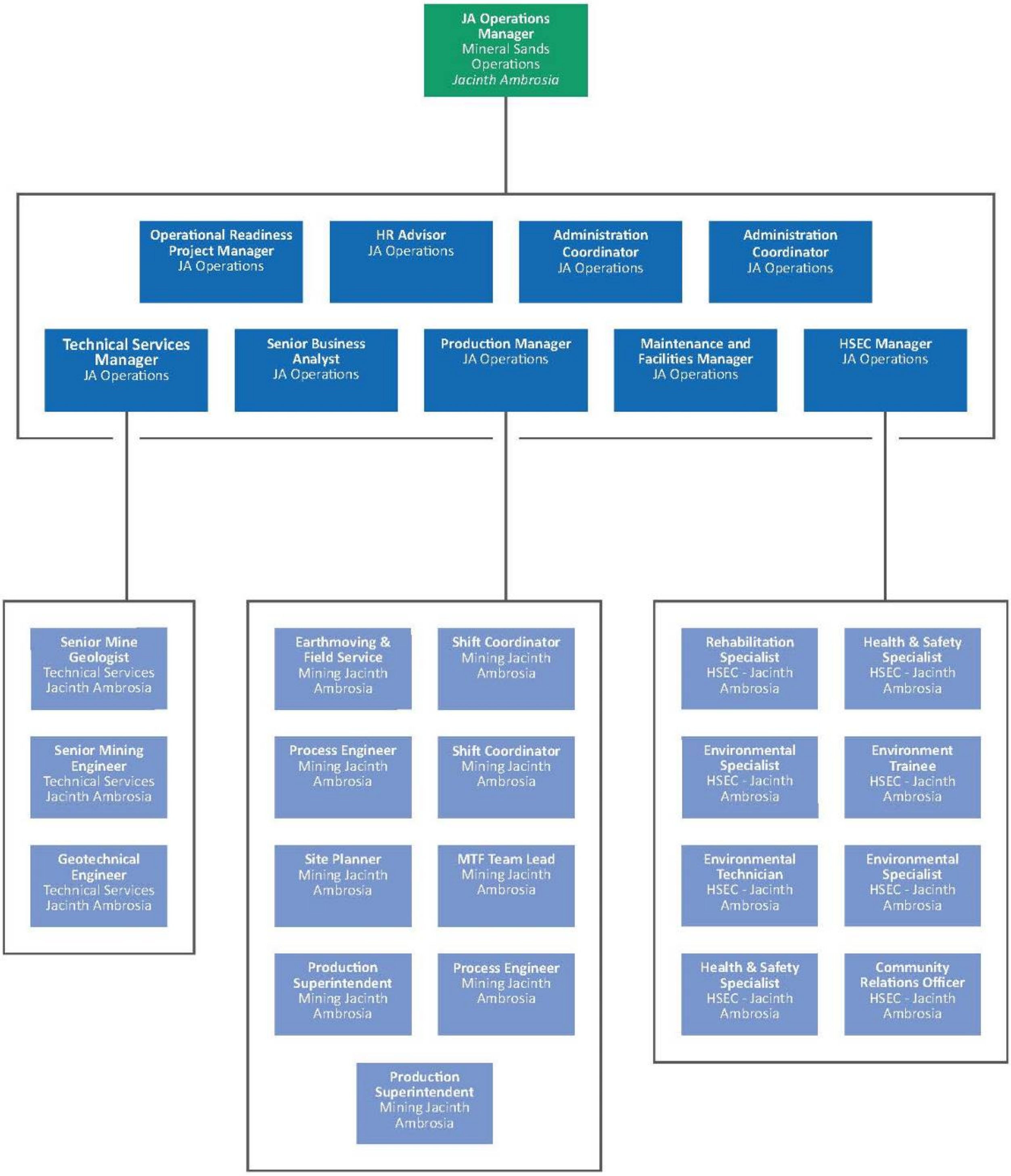

Figure 61: J-A Mine Operations Organisational Structure

6.3 Communication

The J-A Operations Manager is responsible for ensuring the J-A Project area environmental aspects and impacts, and policies and procedures to manage those impacts, are communicated to all employees, contractors and visitors. Communication is achieved by various methods including daily pre-start meetings, inductions, toolbox meetings, training sessions, e-mails, reports, newsletters and notice boards.

External stakeholder communication is managed as per Section 4.

6.3.1 Site induction

All employees, contractors and visitors are required to undergo a comprehensive induction to ensure they have appropriate knowledge of:

- Legislative obligations of both the individual and the company;
- Key environmental issues associated with the mine operations;
- Overview of Iluka HSECMS;
- Site environmental management policies and procedures;
- Responsibilities to minimise the environmental impacts associated with operational activities;
- Hazard and incident reporting and management;
- Legislative obligations of both the individual and the company; and
- Emergency services and procedures.

6.3.2 Training

Additional to general inductions, ongoing training is provided to reinforce management of environmental impacts and maintaining compliance with legislation. This comprises both toolbox meetings and specific workshops which include:

- Notification of any changes to policies and procedures;
- Environmental incident awareness (identification, response and reporting);
- Key risk awareness e.g. dust, groundwater, flora and fauna, rehabilitation and other;
- Vehicle hygiene management; and
- Emergency response training.

6.3.3 Health, Safety, Environment and Community Committee

The HSEC committee consists of elected representatives from across the J-A Project area and includes contractors as well as employees. The committee aims to:

- Facilitate the consultation, cooperation and awareness of all employees on safety issues;
- Assist with the efficient flow of information and communications through all levels of the workplace;
- Conduct reviews of standards, procedures and other initiatives pertaining to safety on-site and recommend actions;
- Conduct and assist with inspections and audits and recommend actions;
- Recommend site HSEC training needs; and

- Review any changes or intended changes to the site that may impact on the safety and health of employees.

6.4 Risk Management System

Iluka is committed to maintaining a whole of business approach to the management of risks, which is governed by the Risk Management Policy and associated standards and procedures, contained within the Risk Management System. The system ensures risks are:

- systematically identified and appropriately treated; and
- communicated to the appropriate levels.

The risk management process, adopted from ISO31000, is shown in Figure 62.

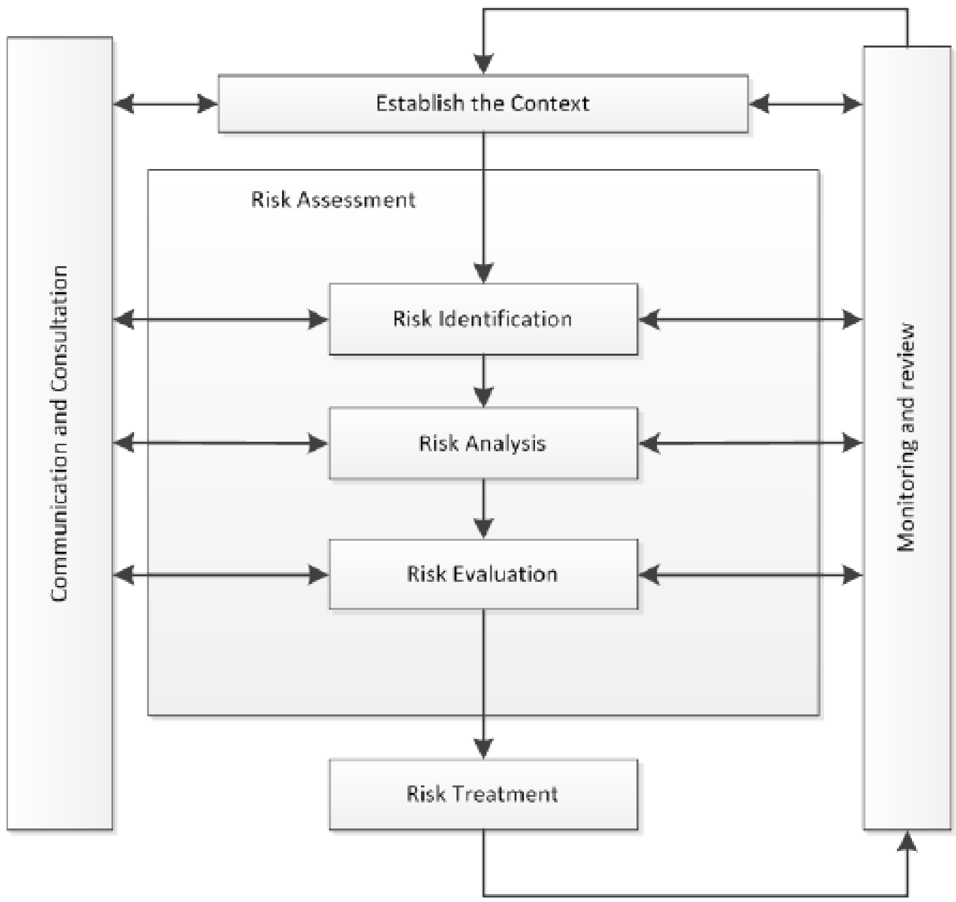

Figure 62: Iluka risk management process

The J-A environmental risk assessment was completed in accordance with Iluka's risk management framework. An environmental risk register is maintained on-site, it us updated annually as a minimum or when there is a change in activity.

6.5 Emergency response plan

The J-A *Eucla Basin Emergency Response Plan* has been prepared to assist personnel to prepare for and manage and incident at the J-A Project area. It defines site incident response plans for all situations identified in the emergency preparedness risk assessment.

The emergency and crisis management flowchart is provided in Figure 63.

The plan is designed to:

- define roles, responsibilities, and actions of personnel in the event of an incident occurring at J-A;
- clearly specify incident response plans for all situations identified in the risk assessment;
- provide a method of controlling and minimising injury to persons, damage to property, prevent and mitigate environmental impacts in the event of a site related emergency and or disaster;
- ensure the safety of all personnel during an incident or emergency;
- ensure incident response equipment and personnel are maintained in a state of readiness at all times;
- define a process for the continued review and update of incident response plans;
- support recovery post incident, returning the site to normal operations; and
- ensure that personnel are aware of their responsibilities in the event of an incident.

An Emergency Response Team is on duty for all shifts, with routine training provided.

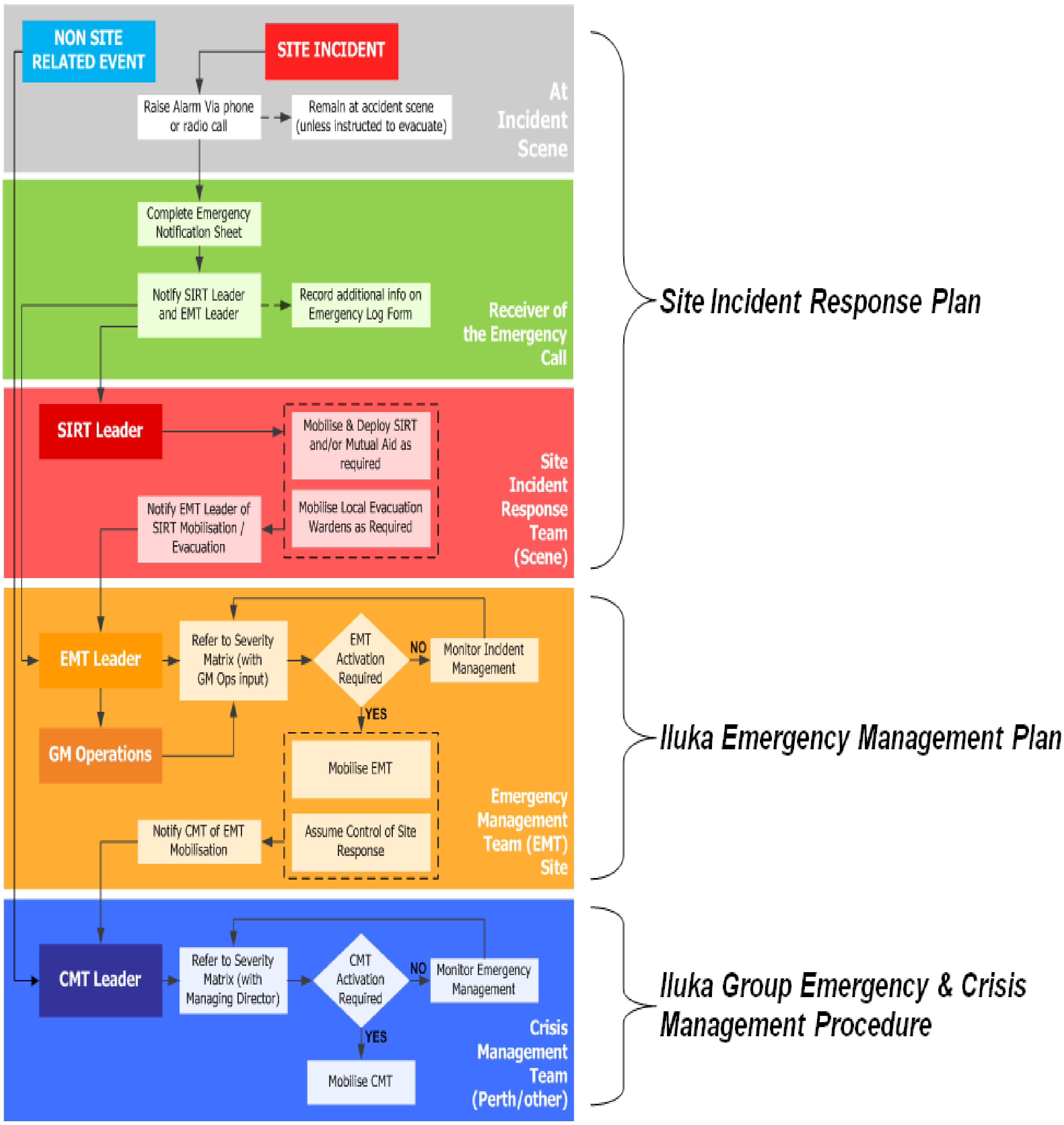

Figure 63: Emergency crisis management process

6.6 Monitoring, auditing and review

6.6.1 Monitoring

Section 5 describes the monitoring program for the J-A Project area which includes compliance monitoring, leading indicator monitoring and operational monitoring.

6.6.2 Audits and inspections

The Iluka HSECMS group standard for auditing and assurance establishes the requirement for routine verification audits, technical audits and regular inspections. Verification audits, to assess compliance with the HSECMS, inclusive of the PEPR obligations, are conducted at least annually. They are also periodically completed by an independent third party audit team. Compliance with the PEPR is reported annually to the Minister via the ACR.

Regular inspections are maintained at J-A to ensure that behaviours are consistent with Iluka's systems and standards of performance to maintain compliance with the PEPR requirements.

6.6.3 Management review

A review of the HSECMS and environmental performance is conducted annually. The review considers:

- suitability of the HSECMS policies and standards;
- impacts of changes to company obligations and commitments;
- sustainability targets and key performance indicators;
- organisational changes including changes to structure, products and activities;
- compliance and technical audit findings; and
- areas for improvement.

6.6.4 Non-compliances

If any non-compliance with the Mining Act occur at J-A, Iluka will verbally notify the Director of Mines, via the DEM Principal Regulator Mining within 24 hours, after it first becomes aware of the non-compliance. A written report will be provided within seven days of such time period.

In the event a non-conformance with the PEPR or associated management plans, a non-conformance and/or corrective action request (or similar) outlining the details of the non-conformance will be issued.

Follow up and verification of the implementation of the associated corrective action that was required will also be undertaken.

Details of all non-conformances and corrective action requests associated with the PEPR and associated management plans will be maintained on project files and reported as required in the ACR.

6.7 Previous experience of the Operator

Iluka has been operating in South Australia at the J-A mine since 2009. The company (and its predecessors) also has extensive mineral sands mining experience demonstrated through operations in Western Australia, Victoria and the United States for over 60 years.

In 2014 Iluka was awarded the South Australian Premier's Award in Mining and Energy for Environmental Excellence. This was in recognition of the *Pro-Activity Beyond Compliance* initiative at J-A and ongoing research work. The award for Excellence in Social Inclusion was awarded to Iluka in 2017 and 2018 for successful social inclusion and indigenous initiatives at J-A.

7 Lease and Licence conditions

Table 81 to Table 85 detail the conditions of the ML, EML and MPLs that have been addressed with this PEPR.

Table 81: Lease conditions – Mining Lease 6315

Condition Number and Requirement	Relevant Section of PEPR or Comment
FIRST SCHEDULE	
1. Mining operations authorised by this lease must be only for the recovery of Heavy Mineral sands.	Addressed in summary information table (inside cover).
2. The Lessee must keep accurate records of the quantity, value and manner of disposition of all minerals mined and, whenever required to do so, submit the records for inspection by any person authorised by the Director of Mines.	Acknowledged – not specifically addressed in the PEPR.
3. The Lessee must not conduct any mining operations on the land until a, Mining and Rehabilitation Program (MARP) has been approved by the Minister following referral to, and assessment and endorsement by the Minister for Environment and Conservation.	This PEPR addresses the requirement associated with this condition. Previous versions of the MARP are addressed in Section 0.
4. The MARP must comply with the requirements of guidelines approved by the Director of Mines and include environmental outcomes and criteria that are developed in consultation with relevant stakeholders.	The PEPR has been prepared in accordance with Ministerial Determination 005; Outcomes and criteria are provided in Section 5.
5. The Lessee agrees to the approved MARP being made available for public inspection.	Acknowledged – not specifically addressed in the PEPR.
6. The Lessee must demonstrate upon request and to the Director of Mines, the Lessee's capability and competence to comply with the requirements of the Mining Act, 1971, the conditions of this lease, and the MARP.	Acknowledged – not specifically addressed in the PEPR.
7. The Lessee must provide to the Director of Mines a Mining and Rehabilitation Compliance Report (MARCR) on operations carried out on the lease and compliance with the approved MARP. The MARCR must be submitted every year, within 2 months after the anniversary of the date the lease was granted, or at some other time agreed with the Director of Mines in accordance with guidelines approved by the Director of Mines. The lessee agrees to the MARCR being made available for public inspection.	An Annual Compliance Report (formerly known as a MARCR) will be prepared in accordance with the requirement as outlined in Section 5 of the PEPR.
8. The Lessee must, if requested by the Director of Mines, undertake an independent audit of achievement of the environmental and/or closure outcomes in the MARP, by an independent expert approved, in writing, by the Director of Mines. The written audit report will be made available to the public, in a manner and form as determined by the Director of Mines.	Acknowledged – not specifically addressed in the PEPR.
9. Prior to lease relinquishment, the Lessee must provide to the Minister and the Minister for Environment and Conservation a satisfactory Mine Completion Report which demonstrates achievement of the closure criteria as specified in the current MARP. The Lessee must undertake an independent audit of achievement of the closure outcomes detailed in the Report, by an independent expert approved by the Director of Mines and the Minister for Environment and Conservation. The audit will be made available to the public, in a manner and form as determined by the Director of Mines and the Minister for Environment and Conservation.	Acknowledged - A Mine Completion Report will be prepared in accordance with the requirement.

Condition Number and Requirement	Relevant Section of PEPR or Comment
10. The Lessee must, prior to commencing operations under this lease and for the duration of the lease: (a) maintain public liability insurance to cover all operations under the lease (including sudden and accidental pollution) in the name of the lessee for a sum of not less than $50 million or such greater sum as specified by the Director of Mines, and make such amendments to the terms and conditions of the insurance as the Director of Mines may require (b) effect and maintain compulsory third party insurance in respect of all motor vehicles used in relation to this lease (c) effect and maintain any other policy of insurance required by law. A copy of the cover note of certificate of currency for the insurances must be provided to the Director of Mines upon request. If requested by the Director of Mines, the lessee must engage a independent and reputable risk assessor to prepare a risk assessment report detailing the public liability risks arising out of the conduct of mining operations on the lease, and recommending the level of amount of public liability cover (in respect of any one occurrence) that should be effected and maintained by the lessee. In preparing the risk assessment report, the assessor must consult with the landowner and the Director of Mines. In specifying the level of insurance required, the Director of Mines accepts no liability for the completeness, adequacy of the sum insured, the limit of liability, the scoped coverage, the conditions or exclusions of the insurance in respect of how the lessee may or may not respond to any loss, damage or liability.	Acknowledged – not specifically addressed in the PEPR.
11. The Lessee must report any non-compliant criteria that demonstrate a breach of the environmental outcomes to be achieved (as detailed in the MARP) to the Director of Mines.	Section 6.6
12. A report must be provided after the Lessee becomes aware of the non- compliance, within five business days or such time period as specified in the MARP.	Section 6.6
13. The Lessee must, before commencing operations under this lease, lodge a bond in accordance with section 62 of the *Mining Act, 1971* of such an amount of the surety as determined from time to time by the Minister, to cover the full cost of rehabilitation liability assessed by an independent third party at any time.	Section 3.12
14. In requesting a review of the bond, the Minister may request that written quotes from a third party are obtained by the lessee for the cost of rehabilitating the site to the requirements specified in the approved MARP.	Acknowledged – not specifically addressed in the PEPR.
15. The Lessee must meet all the charges and costs in obtaining and maintaining the Bond.	Acknowledged – not specifically addressed in the PEPR.
16. The Lessee must abide by the *National Parks and Wildlife Act 1972* and its associated Regulations and Plans of Management (both amended and subsequent) adopted under Section 38 of the *National Parks and Wildlife Act 1972* for the Yellabinna Regional Reserve and the Nullarbor 'Regional Reserve.	Section 5

Condition Number and Requirement	Relevant Section of PEPR or Comment
SECOND SCHEDULE	
1. The Lessee must ensure that groundwater systems outside of the extent of mine workings are not altered by the disposal of process water in the pit.	Section 5.15
2. The Lessee must ensure that the post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	Sections 5.12 and 5.14
3. The MARP must include a set of leading indicators to demonstrate that the closure outcome (post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved) is likely to be achieved.	Section 5
4. The Lessee must, in constructing and operating the lease, ensure that all clearance of native vegetation is authorised under appropriate legislation.	Section 5.12
5. The Lessee must in constructing and operating the lease ensure that there are no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	Section 5.12
6. The Lessee must in constructing and operating the lease ensure that there are no public injuries and or deaths resulting from unauthorised entry to the site that could have been reasonably prevented.	Section 5.6
7. All sick and injured fauna must be managed as per the requirements of the Prevention of Cruelty to Animals Act 1985.	Section 5.13
8. The Lessee must take responsibility for developing and operating a stakeholder engagement plan, as a part of the MARP, which ensures effective communication and exchange of information between the operator and stakeholders including but not restricted to the landowner, Ceduna community and Aboriginal groups or individuals.	Section 4
9. The Lessee must ensure that fuel and liquid chemical storage is adequately bunded to capture spillage and to prevent the migration or infiltration of any spillage or leakage to the surrounding environment in conformance with relevant Environment and Protection Authority guidelines.	Section 5.16
10. The Lessee must in constructing and operating the lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the lease area and adjacent areas caused by mining operations.	Section 5.8
11. The Lessee must in constructing and operating the lease ensure that there are no uncontrolled fires caused by mining operations.	Section 5.6
12. The Lessee must in constructing and operating the lease, ensure that there is no disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.	Section 5.7
13. The Lessee must ensure that the pre-existing soil profile and function are reinstated.	Section 5.9

Condition Number and Requirement	Relevant Section of PEPR or Comment
14. The lessee must ensure that no demolition, industrial or solid domestic (other than treated sewage) wastes are to be disposed of within the lease.	Section 5.10
15. The Lessee must take responsibility for developing an operating protocol with the Director of National Parks and Wildlife to articulate operating procedures between mining operations and park management	Section 4; Appendix K

Table 82: Lease conditions – Extractive Mineral Lease 6316

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
FIRST SCHEDULE	
1. Mining operations authorised by this lease must be only for the recovery of Extractive Minerals.	Addressed in summary information table (inside cover).
2. The Lessee must keep accurate records of the quantity, value and manner of disposition of all minerals mined and, whenever required to do so, submit the records for inspection by any person authorised by the Director of Mines.	Acknowledged – not specifically addressed in the PEPR.
3. The Lessee must not conduct any mining operations on the land until a, Mining and Rehabilitation Program (MARP) has been approved by the Minister following referral to, and assessment and endorsement by the Minister for Environment and Conservation.	This PEPR addresses the requirement associated with this condition. Previous versions of the MARP are addressed in Section 1.
4. The MARP must comply with the requirements of guidelines approved by the Director of Mines and include environmental outcomes and criteria that are developed in consultation with relevant stakeholders.	The PEPR has been prepared in accordance with Ministerial Determination 005; Outcomes and criteria are provided in Section 5.
5. The Lessee agrees to the approved MARP being made available for public inspection.	Acknowledged – not specifically addressed in the PEPR.
6. The Lessee must demonstrate upon request and to the Director of Mines, the Lessee's capability and competence to comply with the requirements of the Mining Act, 1971, the conditions of this lease, and the MARP.	Section 6
7. The Lessee must provide to the Director of Mines a Mining and Rehabilitation Compliance Report (MARCR) on operations carried out on the lease and compliance with the approved MARP. The MARCR must be submitted every year, within 2 months after the anniversary of the date the lease was granted, or at some other time agreed with the Director of Mines in accordance with guidelines approved by the Director of Mines. The lessee agrees to the MARCR being made available for public inspection.	An Annual Compliance Report (formerly known as a MARCR) will be prepared in accordance with the requirement as outlined in Section 5 of the PEPR.
8. The Lessee must, if requested by the Director of Mines, undertake an independent audit of achievement of the environmental and/or closure outcomes in the MARP, by an independent expert approved, in writing, by the Director of Mines. The written audit report will be made available to the public, in a manner and form as determined by the Director of Mines.	Acknowledged – not specifically addressed in the PEPR.

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
9. 9. Prior to lease relinquishment, the Lessee must provide to the Minister and the Minister for Environment and Conservation a satisfactory Mine Completion Report which demonstrates achievement of the closure criteria as specified in the current MARP. The Lessee must undertake an independent audit of achievement of the closure outcomes detailed in the Report, by an independent expert approved by the Director of Mines and the Minister for Environment and Conservation. The audit will be made available to the public, in a manner and form as determined by the Director of Mines and the Minister for Environment and Conservation.	Acknowledged - A Mine Completion Report will be prepared in accordance with the requirement.
10. The Lessee must, prior to commencing operations under this lease and for the duration of the lease: (a) maintain public liability insurance to cover all operations under the lease (including sudden and accidental pollution) in the name of the lessee for a sum of not less than $50 million or such greater sum as specified by the Director of Mines, and make such amendments to the terms and conditions of the insurance as the Director of Mines may require (b) effect and maintain compulsory third party insurance in respect of all motor vehicles used in relation to this lease (c) effect and maintain any other policy of insurance required by law. A copy of the cover note of certificate of currency for the insurances must be provided to the Director of Mines upon request. If requested by the Director of Mines, the lessee must engage a independent and reputable risk assessor to prepare a risk assessment report detailing the public liability risks arising out of the conduct of mining operations on the lease, and recommending the level of amount of public liability cover (in respect of any one occurrence) that should be effected and maintained by the lessee. In preparing the risk assessment report, the assessor must consult with the landowner and the Director of Mines. In specifying the level of insurance required, the Director of Mines accepts no liability for the completeness, adequacy of the sum insured, the limit of liability, the scoped coverage, the conditions or exclusions of the insurance in respect of how the lessee may or may not respond to any loss, damage or liability.	Acknowledged – not specifically addressed in the PEPR.
11. The Lessee must report any non-compliant criteria that demonstrate a breach of the environmental outcomes to be achieved (as detailed in the MARP) to the Director of Mines.	Section 6.6.4
12. A report must be provided after the Lessee becomes aware of the non-compliance, within five business days or such time period as specified in the MARP.	Section 6.6.4
13. The Lessee must, before commencing operations under this lease, lodge a bond in accordance with section 62 of the *Mining Act, 1971* of such an amount of the surety as determined from time to time by the Minister, to cover the full cost of rehabilitation liability assessed by an independent third party at any time.	Bond calculations for the works have been prepared and will be submitted as required.

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
14. In requesting a review of the bond, the Minister may request that written quotes from a third party are obtained by the lessee for the cost of rehabilitating the site to the requirements specified in the approved MARP.	Acknowledged – not specifically addressed in the PEPR.
15. The Lessee must meet all the charges and costs in obtaining and maintaining the Bond.	Acknowledged – not specifically addressed in the PEPR.
16. The Lessee must abide by the *National Parks and Wildlife Act 1972* and its associated Regulations and Plans of Management (both amended and subsequent) adopted under Section 38 of the *National Parks and Wildlife Act 1972* for the Yellabinna Regional Reserve and the Nullarbor Regional Reserve.	Section 5
SECOND SCHEDULE	
1. The Lessee must ensure that the post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	Sections 5.12 and 5.14
2. The MARP must include a set of leading indicators to demonstrate that the closure outcome (post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved) is likely to be achieved.	Section 5
3. The Lessee must, in constructing and operating the lease, ensure that all clearance of native vegetation is authorised under appropriate legislation.	Section 5.12
4. The Lessee must in constructing and operating the lease ensure that there are no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	Section 5.13
5. The Lessee must in constructing and operating the lease ensure that there are no public injuries and or deaths resulting from unauthorised entry to the site that could have been reasonably prevented.	Section 5.6
6. All sick and injured fauna must be managed as per the requirements of the Prevention of Cruelty to Animals Act 1985.	Section 5.13
7. The Lessee must take responsibility for developing and operating a stakeholder engagement plan, as a part of the MARP, which ensures effective communication and exchange of information between the operator and stakeholders including but not restricted to the landowner, Ceduna community and Aboriginal groups or individuals.	Section 4
8. The Lessee must ensure that fuel and liquid chemical storage is adequately bunded to capture spillage and to prevent the migration or infiltration of any spillage or leakage to the surrounding environment in conformance with relevant Environment and Protection Authority guidelines.	Section 5.16
9. The Lessee must in constructing and operating the lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the lease area and adjacent areas caused by mining operations.	Section 5.8

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
10. The Lessee must in constructing and operating the lease ensure that there are no uncontrolled fires caused by mining operations.	Section 5.6
11. The Lessee must in constructing and operating the lease, ensure that there is no disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.	Section 5.7
12. The Lessee must ensure that the pre-existing soil profile and function are reinstated.	Section 5.9
13. The lessee must ensure that no demolition, industrial or solid domestic (other than treated sewage) wastes are to be disposed of within the lease.	Section 5.10
14. The Lessee must take responsibility for developing an operating protocol with the Director of National Parks and Wildlife to articulate operating procedures between mining operations and park management.	Section 4, Appendix K

Table 83: Licence conditions – Miscellaneous Purposes Licence 111 – Airstrip and Village Accommodation

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
FIRST SCHEDULE	
1. The Miscellaneous Purposes Licence (MPL) is granted for the purpose of Airstrip and Village Accommodation specifically for use in association with the mining operation known as Jacinth- Ambrosia.	Sections 1.5 and 3.11
2. If in the opinion of the Minister the scope of operations associated with this MPL have been significantly modified, the Minister may review the licence conditions of this MPL, including any bond under this MPL, and impose new licence conditions as necessary.	Acknowledged – not specifically addressed in the PEPR
3. The Licensee must not undertake any operations on the land under the MPL until a MARP related to the associated mining operations has been amended to include the MPL operations or a new MARP consistent with any existing relevant MARP has been approved by the Minister following in consultation with the Minister for Environment and Conservation.	This PEPR addresses the requirement associated with this condition
4. The MARP must comply with the requirements of guidelines approved by the Director of Mines and include environmental outcomes and criteria that are developed in consultation with relevant stakeholders.	The PEPR has been prepared in accordance with MD005 (Appendix M)
5. The Licensee agrees to the approved MARP being made available for public inspection.	Acknowledged – not specifically addressed in the PEPR
6. The Licensee must demonstrate upon request and to the Director of Mines, the Licensee's capability and competence to comply with the requirements of the Mining Act, 1971, the conditions of this Licence, and the MARP.	Section 6

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
7. The Licensee must provide to the Director of Mines a Mining and Rehabilitation Compliance Report (MARCR) on operations carried out on the Licence and compliance with the approved MARP. The MARCR must be submitted every year, within 2 months after the anniversary of the date the Licence was granted, or at some other time agreed with the Director of Mines in accordance with guidelines approved by the Director of Mines. The Licensee agrees to the MARCR being made available for public inspection.	An Annual Compliance Report (formerly known as a MARCR) will be prepared in accordance with the requirement as outlined in Section 5 of the PEPR.
8. The Lessee must, if requested by the Director of Mines, undertake an independent audit of achievement of the environmental and/or closure outcomes in the MARP, by an independent expert approved, in writing, by the Director of Mines. The written audit report will be made available to the public, in a manner and form as determined by the Director of Mines	Acknowledged – not specifically addressed in the PEPR
9. Prior to Licence relinquishment, the Licensee must provide to the Minister and the Minister for Environment and Conservation a satisfactory Mine Completion Report which demonstrates achievement of the closure criteria as specified in the current MARP. The Licensee must undertake an independent audit of achievement of the closure outcomes detailed in the Report, by an independent expert approved by the Director of Mines and the Minister for Environment and Conservation. The audit will be made available to the public, in a manner and form as determined by the Director of Mines and the Minister for Environment and Conservation.	Acknowledged – not specifically addressed in the PEPR
10. 10. The Licensee must, prior to commencing operations under this Licence and for the duration of the Licence: (a) maintain public liability insurance to cover all operations under the Licence (including sudden and accidental pollution) in the name of the Licensee for a sum not less than $50 million or such greater sum as specified by the Director of Mines, and make such amendments to the terms and conditions of the insurance as the Director of Mines may require. (b) effect and maintain compulsory third party insurance in respect of all motor vehicles used in relation to this Licence (c) effect and maintain any other policy of insurance required by law A copy of the cover note of certificate of currency for the insurances must be provided to the Director of Mines upon request. If requested by the Director of Mines, the Licensee must engage a independent and reputable risk assessor to prepare a risk assessment report detailing the public liability risks arising out of the conduct of mining operations on the Licence, and recommending the level of amount of public liability cover (in respect of any one occurrence) that should be effected and maintained by the Licensee. In preparing the risk assessment report, the assessor must consult with the landowner and the Director of Mines. In specifying the level of insurance required, the Director of Mines accepts no liability for the completeness, adequacy of the sum insured, the limit of liability, the scoped coverage, the conditions or	Acknowledged – not specifically addressed in the PEPR

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
exclusions of the insurance in respect of how the Licensee may or may not respond to any loss, damage or liability.	
11. The Licensee must report any non-compliant criteria that demonstrate a breach of the environmental outcomes to be achieved (as detailed in the MARP) to the Director of Mines.	Section 6.6.4
12. A report must be provided after the Licensee becomes aware of the non-compliance, within five business days or such time period as specified in the MARP.	Section 6.6.4
13. The Licensee must, before commencing operations under this Licence, lodge a bond in accordance with section 62 of the *Mining Act, 1971* of such an amount of the surety as determined from time to time by the Minister, to cover the full cost of rehabilitation liability assessed by an independent third party at any time.	Section 3.12
14. In requesting a review of the bond, the Minister may request that written quotes from a third party are obtained by the Licensee for the cost of rehabilitating the site to the requirements specified in the approved MARP.	Acknowledged – not specifically addressed in the PEPR
15. The Licensee must meet all the charges and costs in obtaining and maintaining the Bond.	Acknowledged – not specifically addressed in the PEPR
16. The Licensee must abide by the *National Parks and Wildlife Act 1972* and its associated Regulations and Plans of Management (both amended and subsequent) adopted under Section 38 of the *National Parks and Wildlife Act 1972* for the Yellabinna Regional Reserve and the Nullarbor 'Regional Reserve.	Section 5
SECOND SCHEDULE	
1. The Licensee must ensure that the post mining ecosystem and landscape function is resilient, self sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	Sections 5.12 and 5.14
2. The MARP must include a set of leading indicators to demonstrate that the closure outcome (post mining ecosystem and landscape function is resilient, self sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved) is likely to be achieved.	Section 5
3. The Licensee must, in constructing and operating the Licence, ensure that all clearance of native vegetation is authorised under appropriate legislation.	Section 5.12
4. The Licensee must in constructing and operating the Licence ensure that there are no net adverse impacts from the site operations on native fauna abundance or diversity in the Licence area and in adjacent areas.	Section 5.13
5. The Licensee must in constructing and operating the Licence ensure that there are no public injuries and or deaths resulting from unauthorised entry to the site that could have been reasonably prevented.	Section 5.6
6. All sick and injured fauna must be managed as per the requirements of the Prevention of Cruelty to Animals Act 1985.	Section 5.13

Condition Number and Requirement	Relevant Section of MARP(Ops) or Comment
7. The Licensee must take responsibility for developing and operating a stakeholder engagement plan, as a part of the MARP, which ensures effective communication and exchange of information between the operator and stakeholders including but not restricted to the landowner, Ceduna community and Aboriginal groups or individuals.	Section 4
8. The Licensee must ensure that fuel and liquid chemical storage is adequately bunded to capture spillage and to prevent the migration or infiltration of any spillage or leakage to the surrounding environment in conformance with relevant Environment and Protection Authority guidelines.	Section 5.16
9. The Licensee must in constructing and operating the Licence ensure no 'introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Licence area and adjacent areas caused by mining operations.	Section 5.8
10. The Licensee must in constructing and operating the Licence ensure that there are no uncontrolled fires caused by mining operations.	Section 5.6
11. The Licensee must in constructing and operating the Licence, ensure that there is no disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.	Section 5.7
12. The Licensee must ensure that the pre existing soil profile and function are reinstated.	Section 5.9
13. The Licensee must ensure that no demolition, industrial or solid domestic (other than treated sewage) wastes are to be disposed of within the licence.	Section 5.10
14. The Licensee must take responsibility for developing an operating protocol with the Director of National Parks and Wildlife to articulate operating procedures between mining operations and park management.	Section 4, Appendix K

Table 84: Licence conditions – Miscellaneous Purposes Licence 110 – Borefield Pipeline and Access Road

Condition Number and Requirement	Relevant Section of PEPR
FIRST SCHEDULE	
1. The Miscellaneous Purposes License (MPL) is granted for the purpose of Borefield, Pipeline and Access road specifically for use in association with the mining operation known as Jacinth- Ambrosia.	Section 1.5
2. If in the opinion of the Minister the scope of operations associated with this MPL have been significantly modified, the Minister may review the licence conditions of this MPL, including any bond under this MPL, and impose new licence conditions as necessary.	Acknowledged – not specifically addressed in the PEPR
3. The Licensee must not undertake any operations on the land under the MPL until a MARP related to the associated mining operations has been amended to include the MPL operations or a new MARP consistent with any existing relevant MARP has been approved by the Minister following in consultation with the Minister for Environment and Conservation.	This PEPR addresses the requirement associated with this condition. Previous versions of the MARP are addressed in Section 1

Condition Number and Requirement	Relevant Section of PEPR
4. The MARP must comply with the requirements of guidelines approved by the Director of Mines and include environmental outcomes and criteria that are developed in consultation with relevant stakeholders.	The PEPR has been prepared in accordance with Ministerial Determination 005; Outcomes and criteria are provided in Section 5.
5. The Licensee agrees to the approved MARP being made available for public inspection.	Acknowledged – not specifically addressed in the PEPR
6. The Licensee must demonstrate upon request and to the Director of Mines, the Licensee's capability and competence to comply with the requirements of the *Mining Act, 1971*, the conditions of this Licence, and the MARP.	Section 6
7. The Licensee must provide to the Director of Mines a Mining and Rehabilitation Compliance Report (MARCR) on operations carried out on the Licence and compliance with the approved MARP. The MARCR must be submitted every year, within 2 months after the anniversary of the date the Licence was granted, or at some other time agreed with the Director of Mines in accordance with guidelines approved by the Director of Mines. The Licensee agrees to the MARCR being made available for public inspection.	An Annual Compliance Report (formerly known as a MARCR) will be prepared in accordance with the requirement as outlined in Section 5 of the PEPR.
8. The Lessee must, if requested by the Director of Mines, undertake an independent audit of achievement of the environmental and/or closure outcomes in the MARP, by an independent expert approved, in writing, by the Director of Mines. The written audit report will be made available to the public, in a manner and form as determined by the Director of Mines	Acknowledged - If requested, an independent audit will be undertaken.
9. Prior to Licence relinquishment, the Licensee must provide to the Minister and the Minister for Environment and Conservation a satisfactory Mine Completion Report which demonstrates achievement of the closure criteria as specified in the current MARP. The Licensee must undertake an independent audit of achievement of the closure outcomes detailed in the Report, by an independent expert approved by the Director of Mines and the Minister for Environment and Conservation. The audit will be made available to the public, in a manner and form as determined by the Director of Mines and the Minister for Environment and Conservation.	Acknowledged - A Mine Completion Report will be prepared in accordance with the requirement.

Condition Number and Requirement	Relevant Section of PEPR
10. The Licensee must, prior to commencing operations under this Licence and for the duration of the Licence: (a) maintain public liability insurance to cover all operations under the Licence (including sudden and accidental pollution) in the name of the Licensee for a sum not less than $50 million or such greater sum as specified by the Director of Mines, and make such amendments to the terms and conditions of the insurance as the Director of Mines may require. (b) effect and maintain compulsory third party insurance in respect of all motor vehicles used in relation to this Licence (c) effect and maintain any other policy of insurance required by law A copy of the cover note of certificate of currency for the insurances must be provided to the Director of Mines upon request. If requested by the Director of Mines, the Licensee must engage a independent and reputable risk assessor to prepare a risk assessment report detailing the public liability risks arising out of the conduct of mining operations on the Licence, and recommending the level of amount of public liability cover (in respect of any one occurrence) that should be effected and maintained by the Licensee. In preparing the risk assessment report, the assessor must consult with the landowner and the Director of Mines. In specifying the level of insurance required, the Director of Mines accepts no liability for the completeness, adequacy of the sum insured, the limit of liability, the scoped coverage, the conditions or exclusions of the insurance in respect of how the Licensee may or may not respond to any loss, damage or liability.	Acknowledged – not specifically addressed in the PEPR.
11. The Licensee must report any non-compliant criteria that demonstrate a breach of the environmental outcomes to be achieved (as detailed in the MARP) to the Director of Mines.	Section 6.6.4
12. A report must be provided after the Licensee becomes aware of the non- compliance, within five business days or such time period as specified in the MARP.	Section 6.6.4
13. The Licensee must, before commencing operations under this Licence, lodge a bond in accordance with section 62 of the *Mining Act, 1971* of such an amount of the surety as determined from time to time by the Minister, to cover the full cost of rehabilitation liability assessed by an independent third party at any time.	Section 3.12
14. In requesting a review of the bond, the Minister may request that written quotes from a third party are obtained by the Licensee for the cost of rehabilitating the site to the requirements specified in the approved MARP.	Acknowledged – not specifically addressed in the PEPR
15. The Licensee must meet all the charges and costs in obtaining and maintaining the Bond.	Acknowledged – not specifically addressed in the PEPR
16. The Licensee must abide by the *National Parks and Wildlife Act 1972* and its associated Regulations and Plans of Management (both amended and subsequent) adopted under Section 38 of the *National Parks and Wildlife Act 1972* for the Yellabinna Regional Reserve and the Nullarbor 'Regional Reserve.	Appendix K
SECOND SCHEDULE	

Condition Number and Requirement	Relevant Section of PEPR
1. The Licensee must ensure that the extraction and use of groundwater does not adversely affect any environmental processes which are reliant on that groundwater system.	Section 5.15
2. The Licensee must ensure that the post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	Sections 5.12 and 5.14
3. The MARP must include a set of leading indicators to demonstrate that the closure outcome (post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved) is likely to be achieved.	Section 5
4. The Licensee must, in constructing and operating the Licence, ensure that all clearance of native vegetation is authorised under appropriate legislation.	Section 5.12
5. The Licensee must in constructing and operating the Licence ensure that there are no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	Section 5.13
6. The Licensee must in constructing and operating the Licence ensure that there are no public injuries and or deaths resulting from unauthorised entry to the site that could have been reasonably prevented.	Section 5.6
7. All sick and injured fauna must be managed as per the requirements of the Prevention of Cruelty to Animals Act 1985.	Section 5.13
8. The Licensee must take responsibility for developing and operating a stakeholder engagement plan, as a part of the MARP, which ensures effective communication and exchange of information between the operator and stakeholders including but not restricted to the landowner, Ceduna community and Aboriginal groups or individuals.	Section 4
9. The Licensee must ensure that fuel and liquid chemical storage is adequately bunded to capture spillage and to prevent the migration or infiltration of any spillage or leakage to the surrounding environment in conformance with relevant Environment and Protection Authority guidelines.	Section 5.16
10. The Licensee must in constructing and operating the Licence ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the lease area and adjacent areas caused by mining operations.	Section 5.8
11. The Licensee must in constructing and operating the Licence ensure that there are no uncontrolled fires caused by mining operations.	Section 5.6
12. The Licensee must in constructing and operating the Licence, ensure that there is no disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.	Section 5.7
13. The Licensee must ensure that the pre-existing soil profile and function are reinstated.	Section 5.9
14. The Licensee must ensure that no demolition, industrial or solid domestic (other than treated sewage) wastes are to be disposed of within the licence.	Section 5.10

Condition Number and Requirement	Relevant Section of PEPR
15. The Licenses must take responsibility for developing an operating protocol with the Director of National Parks and Wildlife to articulate operating procedures between mining operations and park management.	Section 4, Appendix K

Table 85: Licence conditions – Miscellaneous Purposes Licence 161 - Canberra Road

Condition Number and Requirement	Relevant Section of PEPR
FIRST SCHEDULE	
1. The grant of the Mining Tenement authorises activities for the purpose of construction, operation, maintenance, rehabilitation and closure of a haul road directly related to the conduct of mining operations authorised under Mineral Lease 6315.	Section 1.5
2. Authorised activities on the Land must be consistent with the activities described in the Miscellaneous Purposes Licence Management Plan dated 4 December 2019 and subsequent Response Document dated 20 April 2020.	Acknowledged – not specifically addressed in the PEPR
SECOND SCHEDULE	
1. The Tenement Holder agrees to the Approved PEPR, any compliance reports and reportable incident reports submitted in accordance with the Regulations, and any reports required by Second Schedule Conditions 3 and 3.3 being made available for public inspection.	An Annual Compliance Report will be prepared in accordance with the requirement as outlined in Section 5 of the PEPR.
2. The Tenement Holder must not conduct any mining operations on the Land until a Proposed PEPR has been approved by the Minister and endorsed by the Minister for Environment and Water (or subsequent equivalent Minister).	Acknowledged – not specifically addressed in the PEPR
3. Prior to Tenement expiry, surrender or partial surrender, the Tenement Holder must provide to the satisfaction of the Minister and the Minister for Environment and Water (or subsequent equivalent Minister), a report which demonstrates achievement of the completion outcomes as specified in the Approved PEPR. 3.1 The achievement of completion outcomes detailed in the report required by Condition 3 must be audited by a suitably qualified independent expert approved by the Director of Mines or other authorised officer. 3.2. The expert must prepare a report of the findings of the audit. 3.3. The audit report must be provided to the Director of Mines (or other authorised officer) and the Minister for Environment and Water (or subsequent equivalent Minister).	Acknowledged - A Mine Completion Report will be prepared in accordance with the requirement

<table>
<tr><th>Condition Number and Requirement</th><th>Relevant Section of PEPR</th></tr>
<tr><td>4. The Tenement Holder must comply with all State and Commonwealth legislation and regulations applicable to the activities undertaken pursuant the grant of the Mining Tenement including (but not limited to) the:
4.1. Environment Protection and Biodiversity Conservation Act 1999;
4.2. Planning, Development and Infrastructure Act 2016;
4.3. Development Act 1993;
4.4. Dangerous Substances Act 1979;
4.5. National Parks and Wildlife Act 1972;
4.6. Natural Resources Management Act 2004;
4.7. Public and Environmental Health Act 1987;
4.8. Radiation Protection and Control Act 1982;
4.9. Aboriginal Heritage Act 1988;
4.10. Heritage Places Act 1993;
4.11. Work Health and Safety Act 2012;
4.12. Environment Protection Act 1993;
4.13. Native Vegetation Act 1991;
4.14. Mines and Works Inspection Act 1920; and
4.15. Road Traffic Act 1961.</td><td>Section 5</td></tr>
<tr><td colspan="2">THIRD SCHEDULE</td></tr>
<tr><td>1. All that part of the State of South Australia, bounded by a line joining the points of coordinates set out in the following table:
<table>
<tr><td>Point</td><td>Easting</td><td>Northing</td></tr>
<tr><td>1</td><td>232002mE</td><td>6579605mN</td></tr>
<tr><td>2</td><td>232002mE</td><td>6579556mN</td></tr>
<tr><td>3</td><td>231907mE</td><td>6579554mN</td></tr>
<tr><td>4</td><td>231878mE</td><td>6579552mN</td></tr>
<tr><td>5</td><td>231849mE</td><td>6579545mN</td></tr>
<tr><td>6</td><td>231506mE</td><td>6579439mN</td></tr>
<tr><td>7</td><td>231224mE</td><td>6579340mN</td></tr>
<tr><td>8</td><td>231075mE</td><td>6579341mN</td></tr>
<tr><td>9</td><td>231447mE</td><td>6579465mN</td></tr>
<tr><td>10</td><td>231756mE</td><td>6579568mN</td></tr>
<tr><td>11</td><td>231868mE</td><td>6579600mN</td></tr>
<tr><td>12</td><td>231894mE</td><td>6579603mN</td></tr>
</table>
Area: 4.19 ha
Based on information provided by the applicant.</td><td>Section 1</td></tr>
<tr><td colspan="2">FOURTH SCHEDULE</td></tr>
</table>

Condition Number and Requirement	Relevant Section of PEPR
1. Where the Minister is of the view that there may be grounds to consider whether to suspend the grant of the Mining Tenement, the Minister shall give written notice to the Tenement Holder, which shall: 1.1. Specify the provision of the Act or the Regulations, or the term or condition of the grant of the Mining Tenement, that the Minister believes the Tenement Holder has contravened or failed to comply with; and 1.2. Give the Tenement Holder thirty (30) Business Days from the date of the written notice to show cause why the grant of the Mining Tenement should not be suspended ("the Suspension Show Cause Notice").	Acknowledged – not specifically addressed in the PEPR
2. If the Tenement Holder does not respond to the Suspension Show Cause Notice within thirty (30) Business Days, the Minister may suspend the grant of the Mining Tenement without further notice (in accordance with the process outlined below).	Acknowledged – not specifically addressed in the PEPR
3. If the Tenement Holder responds to the Suspension Show Cause Notice within thirty (30) Business Days, the Minister will consider the Tenement Holder's submission and decide whether to suspend the grant of the Mining Tenement (in accordance with the process outlined below).	Acknowledged – not specifically addressed in the PEPR
4. The Minister shall give written notice to the Tenement Holder of the Minister's decision; 4.1. If the decision is to suspend the grant of the Mining Tenement, the written notice shall be called "Notice of Decision: Suspended". 4.2. If the decision is to not to suspend the grant of the Mining Tenement, the written notice shall be called "Notice of Decision: Not Suspended".	Acknowledged – not specifically addressed in the PEPR
5. A Notice of Decision: Not Suspended, may contain any information that the Minister considers relevant.	Acknowledged – not specifically addressed in the PEPR
6. A Notice of Decision: Suspended, shall: 6.1. Specify the reason for suspension; 6.2. Specify the period of suspension; 6.3. Specify the action (if any) the Tenement Holder may be required to take for the Minister to consider revoking the suspension, and the time frame for taking that action; 6.4. Inform the Tenement Holder of their right of appeal to the Environment, Resources and Development Court in accordance with subsection 56(3) of the Act.	Acknowledged – not specifically addressed in the PEPR
7. If the Tenement Holder takes the action specified by the Minister under paragraph 6.3, the Minister will consider revoking the suspension.	Acknowledged – not specifically addressed in the PEPR
8. If the Minister revokes the suspension, the Minister will, within a reasonable time write to the Tenement Holder informing the Tenement Holder of the revocation.	Acknowledged – not specifically addressed in the PEPR
9. If the Tenement Holder appeals to the Environment, Resources and Development Court the Minister will consider exercising the discretion under section 56(4) of the Act, to stay the operation of the suspension until the appeal is finally disposed of.	Acknowledged – not specifically addressed in the PEPR
10. If the Environment, Resources and Development Court, or a court of further appeal finally determines it is satisfied that there is no proper ground for the suspension, and so orders, the Minister will reinstate the grant of the Mining Tenement in accordance with section 56(5) of the Act.	Acknowledged – not specifically addressed in the PEPR

Condition Number and Requirement	Relevant Section of PEPR
11. All of the stages in the suspension process shall be recorded on the Mining Register by way of appropriate memoranda, for example: 11.1. A memorandum Notice of Decision: Suspended; 11.2. A memorandum Notice of Decision: Not Suspended; 11.3. A memorandum of Minister's Decision to Revoke the Suspension; 11.4. A memorandum of Appeal; 11.5. A memorandum of Stay of Suspension by the Minister; 11.6. Memoranda of all of the courts' orders (whether the Environment, Resources and Development Court or subsequent appeal courts).	Acknowledged – not specifically addressed in the PEPR
FIFTH SCHEDULE	
1. Where the Minister is of the view that there may be grounds to consider whether to cancel the grant of the Mining Tenement, the Minister shall give written notice to the Tenement Holder, which shall: 1.1. Specify the provision of the Act or the Regulations, or the term or condition of the grant of the Mining Tenement, that the Minister believes the Tenement Holder has contravened or failed to comply with; and 1.2. Give the Tenement Holder sixty (60) Business Days from the date of written notice to show cause why the grant of the Mining Tenement should not be cancelled ("the Cancellation Show Cause Notice").	Acknowledged – not specifically addressed in the PEPR
2. If the Tenement Holder does not respond to the Cancellation Show Cause Notice within sixty (60) Business Days, the Minister may cancel the grant of the Mining Tenement without further notice (in accordance with the process outlined below).	Acknowledged – not specifically addressed in the PEPR
3. If the Tenement Holder responds to the Cancellation Show Cause Notice within sixty (60) Business Days, the Minister will consider the Tenement Holder's submission and decide whether to cancel the grant of the Mining Tenement (in accordance with the process outlined below).	Acknowledged – not specifically addressed in the PEPR
4. The Minister shall give written notice to the Tenement Holder of the decision. 4.1. If the decision is to cancel the grant of the Mining Tenement, the written notice shall be called "the Notice of Decision: Cancelled". 4.2. If the decision is not to cancel the grant of the Mining Tenement, the written notice shall be called "the Notice of Decision: Not Cancelled".	Acknowledged – not specifically addressed in the PEPR
5. A Notice of Decision: Not Cancelled may contain any information that the Minister considers relevant.	Acknowledged – not specifically addressed in the PEPR
6. A Notice of Decision: Cancelled shall: 6.1. Specify the reason for cancellation; 6.2. Specify the date from which cancellation is effective; and 6.3. Inform the Tenement Holder of their right of appeal to the Environment, Resources and Development Court in accordance with subsection 56(3) of the Act.	Acknowledged – not specifically addressed in the PEPR

Condition Number and Requirement	Relevant Section of PEPR
7. If the Tenement Holder appeals to the Environment, Resources and Development Court the Minister will consider exercising his discretion under section 56(4) of the Act, to stay the operation of the cancellation until the appeal is finally disposed of.	Acknowledged – not specifically addressed in the PEPR
8. If the Environment, Resources and Development Court or a court of further appeal finally determines that it is satisfied that there is no proper ground for the cancellation, and so orders, and the cancellation has not been stayed by the Minister under section 56(4) of the Act, or by order of the Environment, Resources and Development Court, the Minister will reinstate the grant of the Mining Tenement in accordance with section 56(5) of the Act.	Acknowledged – not specifically addressed in the PEPR
9. All stages in the suspension process shall be recorded on the Mining Register by way of appropriate memoranda, for example: 9.1. A memorandum Notice of Decision: Cancelled; 9.2. A memorandum of Notice of Decision: Not Cancelled; 9.3. A memorandum of Minister's Decision to Revoke the Cancellation; 9.4. A memorandum of Appeal; 9.5. A memorandum of Stay of Cancellation by the Minister; 9.6. Memoranda of all of the courts' orders (whether the Environment, Resources and Development Court or subsequent appeal courts).	Acknowledged – not specifically addressed in the PEPR
SIXTH SCHEDULE	
1. The Tenement Holder must ensure the soil profile and function is restored and capable of supporting the future land use agreed by the Director of Mines or another authorised officer.	Section 5.9
2. The Tenement Holder must, during construction and operation, ensure there is no damage, disturbance or interference to Aboriginal and non-Aboriginal heritage sites, objects or remains as a result of mining related activities unless it is authorised under the relevant legislation.	Section 5.7
3. The Tenement Holder must ensure there are no adverse impacts on the abundance and diversity of native fauna species as a result of mining related activities.	Section 5.13
4. The Tenement Holder must ensure there is no loss of abundance and/or diversity of native vegetation on or off the Land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.	Section 5.12
5. The Tenement Holder must ensure the post completion ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	Section 5
6. The Tenement Holder must, during construction, operation and post completion, ensure no introduction of new species of environmental weed, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Land.	Section 5.8

Condition Number and Requirement	Relevant Section of PEPR
7. The Tenement Holder must ensure mining related activities related to Canberra Road do not decrease the quantity of surface water available to water dependent ecosystems on or off the Land.	Section 5.14

8 Acronyms and Short Titles

ABS – Australian Bureau of Statistics

ACHM – Australian Cultural Heritage Management Pty Ltd

ACR – Annual Compliance Report

AEM – Airborne Electromagnetic

AH Act – *Aboriginal Heritage Act 1988*

ANZECC – Australian and New Zealand Environment Conservation Council Guidelines

BOM – Bureau of Meteorology

BSC – Biological Soil Crust

CFS – South Australian Country Fire Service

DEH – Department for Environment and Heritage (now DEW)

DEHAA - Department for Environment, Heritage and Aboriginal Affairs

DEM – Department for Energy and Mining (formerly DSD and DMITRE)

DEW – Department for Environment and Water (formerly DEWNR and DEH)

DMITRE – Department of Manufacturing, Innovation, Trade, Resources and Energy (now DEM)

DSD – Department of State Development (now DEM)

EBS – Ecological Biodiversity Services

EC – Electrical Conductivity

EML – Extractive Minerals Lease

EP Act – *Environment Protection Act 1993*

EPA – Environmental Protection Authority

EPBC Act – *Environment Protection and Biodiversity Conservation Act 1999*

FWCAC – Far West Coast Aboriginal Corporation

FWC – Far West Coast

GDE – Groundwater Dependent Ecosystem

GIS – Geographic Information Systems

ha – Hectares

HMC – Heavy Mineral Concentrate

HSEC – Health, Safety, Environment and Community

HSECMS – Health, Safety, Environment and Community Management System

Iluka – Iluka Resources Limited

J-A – Jacinth-Ambrosia

Km – Kilometre(s)

Landscapes Act – *Landscapes South Australia Act 2019*

LOM – Life of Mine

m – Metre(s)

MAP – Mean Annual Precipitation

MARP – Mining and Rehabilitation Program

MARP (Ops) – Mining and Rehabilitation Plan for Operations 2009

mAHD – Metres with respect to the Australian Height Datum

mBGL – Metres Below Ground Level

MD005 – Ministerial Determination 005

mg/L – Milligrams per Litre

ML – Mining Lease

mm – Millimetres

MoDCoD – Modified Co-Disposal

MPL – Miscellaneous Purposes Licences

mS/m – Millisiemens per metre

nSv/h – Nanoseiverts per hour

MUP – Mining Unit Plant

NEPM – National Environment Protection Measure

NORM – Naturally Occurring Radioactive Material

NPW Act – *National Parks and Wildlife Act 1972*

NRM Act – *Natural Resources Management Act 2004* (replaced by the *Landscapes South Australia Act 2019*)

NV Act - *Native Vegetation Act 1991*

PAWC – Plant Available Water Capacity

PEPR – Program for Environment Protection and Rehabilitation

PIRSA – Primary Industries and Regions South Australia

SA – South Australia

SAR – Site Access Request

SEB – Significant Environmental Benefit

Sp. – Species

Ssp. – Sub species

TDS – Total Dissolved Solids

TSF – Tailings Storage Facility

Var. – Variety

WCP – Wet Concentrator Plant

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