



Balranald Mineral Sands Project Modification 1

Extension of mining trial

Modification report (SSD-5285_MOD1)

Prepared for Iluka Resources Limited
March 2022



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Balranald Mineral Sands Project Modification 1

Extension of mining trial modification report (SSD-5285_MOD1)

Report Number

S200529 Balranald MOD1

Client

Iluka Resources Limited

Date

9 May 2022

Version

v5 Final

Prepared by	**Approved by**
	
Paul Gibbons Director 9 May 2022	**Brett McLennan** Director 9 May 2022

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Executive Summary

ES1 Approved Project overview

Iluka Resources Limited (Iluka) have approval to develop a mineral sand mine in south-western New South Wales (NSW), known as the Balranald Project. It includes construction, mining, primary processing, and rehabilitation of two linear mineral sand deposits, known as the West Balranald and Nepean deposits, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald, respectively.

Development Consent No. SSD-5285 (the consent) was granted by a delegate of the NSW Minister for Planning under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 5 April 2016. The consent included approval to undertake a bulk sampling activity of up to 100,000 tonnes(t) of mineral ore at the West Balranald deposit to test the removal of the ore using underground mining methods.

Since the consent was granted, Iluka has undertaken the approved bulk sampling activity involving the extraction of the mineral ore from depth, using trial underground mining methods within the approved disturbance area of the West Balranald deposit.

The outcome of the bulk sampling activity confirmed the effectiveness of the underground mining method, validated key elements of the mining unit design and have been used to guide future life-of-mine (LOM) operational conditions and inform the potential suitability (commerciality and potential reduced environmental impacts) of underground mining as an alternative method for resource extraction.

ES2 Proposed modification

Iluka is seeking to modify the consent (MOD1) under Section 4.55(1A) of the EP&A Act to extend the approved underground mining trial for up to six years.

Iluka propose no change to the open cut mining method for the West Balranald and Nepean mines approved under the consent.

The proposed MOD1 involves:

- continuing the underground mining trial within a portion of the approved disturbance footprint of the West Balranald deposit pursuant to the consent; and
- development of approved mineral processing surface infrastructure and a portion of the access road outside of the approved disturbance footprint and excising a corresponding area from the approved disturbance footprint.

The majority of the surface infrastructure would be required regardless of the mining method.

Key characteristics of MOD1 are outlined in Table ES1 with further descriptions provided in this modification report.

Table ES1 Key modification characteristics

Project element	Approved project – open cut mining and *bulk sampling* activity	Approved Project incorporating Modification
Mining method	Open cut mining of West Balranald and Nepean deposits and bulk sampling extraction of up to 100,000 t of mineral ore by non-conventional methods (ie underground mining).	No change with continuation of underground mining trial at West Balranald deposit.
Project footprint	Up to 5,346 hectares (ha) comprising native vegetation, non-native vegetation and disturbed areas.	Minor change to the project footprint to accommodate the relocation of processing plant and associated surface infrastructure (Revised Balranald Project Area) with no net change in biodiversity impacts.
Mining production (predicted)	Open cut mining of approximately 1,100,000 tonnes per annum (tpa) and Bulk sampling activity of 100,000 t total.	No greater than approved for open cut mining.
Processing method	Dry mining with the mining unit plant (MUP) screening extracted ore to remove oversize material. The ore is then slurried with water and pumped via pipeline to the processing plant. Oversize material is returned directly into the mine pit. The processing plant concentrates the ore to generate two primary product streams; HMC and ilmenite. The processing plant has a number of components, including the Primary Concentrate Plant (PCP), Wet Concentrate Plant (WCP), Wet High-Intensity Magnetic Separation (WHIMS) plant and Ilmenite Separation Plant (ISP). HMC would be stockpiled on site and transported to an off-site location for downstream processing. A Bulk sampling activity with mineral ore extracted via a process of underground mining and pumping slurried ore to the surface for primary separation and stockpiling. Mining by-product injected underground. HMC stockpiled on site and not transported off-site, without consent from the Secretary of DPE.	Addition of a flotation plant.

Table ES1 Key modification characteristics

Project element	Approved project – open cut mining and *bulk sampling* activity	Approved Project incorporating Modification
Processing rate	Ore processing rate of 475 tonnes per hour (tph) and a rougher head feed of 440 tph. Bulk sampling activity and processing rate of approximately 50 and 200 tph.	No change.
Duration of Mining	Operations may be carried out for 16 years from the date of commencement of the West Balranald Mine.	No change to duration of open cut mining. Continuation of underground mining trial at West Balranald deposit for up to 6 years.
Operating hours	24 hours per day, 7 days per week for construction, mining and processing.	No change.
Tailings and mining by-products	Tailings generated at the MUP and processing plant returned to the pit. A portion of sand tailings generated at the processing plant would be disposed using a process known as modified co-disposal with slurried sand tails and slimes placement in the tailings storage facility (TSF). A Bulk sampling activity with tailings injected underground.	Sand tailings from underground mining trial would be placed on surface directly above the mining panels ahead of mining. Topsoil and overburden would be pre-stripped from these emplacement areas to allow successful rehabilitation. Slimes and flotation tails would be reinjected underground.
Power source	Electricity supplied to the mine by connection to the existing electricity supply network. The construction and operation of a transmission line would form part of a separate approval process, if required.	Initial electricity may be supplied by diesel generators.
Raw water sources	During construction and operation, brackish water abstracted from the Olney Formation. During operation, water sources would include: • Surface runoff – generated by direct rainfall within the surface water catchment areas in the Project area. • Groundwater: – minor inflows to the pit; and – groundwater extracted from the Loxton-Parilla Sands (LPS) during dewatering. • Fresh water – supplied from the Murrumbidgee River by the water supply pipeline.	Groundwater reinjected during mining operations. Alternative fresh water supplies including a reverse osmosis plant and/or trucked in from Balranald.

Table ES1 Key modification characteristics

Project element	Approved project – open cut mining and *bulk sampling* activity	Approved Project incorporating Modification
Accommodation	Accommodation facility would provide up to approximately 550 single rooms/quarters to accommodate peak construction and operational workforces. The facility itself would be operated by a staff of about 10 to 20, including administration, cleaning, food preparation, maintenance and security staff.	No change.
Access roads	There are two primary access; the West Balranald access road and Nepean access road. Internal roads within the Project area would also be constructed to minimise interaction between mining equipment and haul trucks, and general light vehicle traffic on-site. A car park would be established at the processing area at the West Balranald mine. Internal roads would be constructed using suitable overburden and gravel sourced from within the Project area, and external sources.	Minor change in alignment of northern section of West Balranald access road outside of project footprint with no net change in biodiversity impacts.

ES3 Engagement

Iluka has engaged with the local community during the preparation of this modification report. Community engagement was undertaken in consideration of COVID safe protocols with engagement carried out via community newsletters and website updates. This engagement will continue as part of the ongoing Balranald Project.

Iluka have engaged with government agencies and Balranald Shire Council (BSC) in regard to MOD1.

ES4 Impact assessment

Section 7 of this modification report provides a summary of noise, air quality, traffic, surface water, groundwater, subsidence, biodiversity, Aboriginal cultural heritage, social, economics and rehabilitation technical assessments carried out to assess the potential impacts associated with MOD1. These assessments have been appended to this modification report.

Key findings of the impact assessments are:

- Noise:
  - Estimated noise levels of MOD1 (construction noise, operational noise and road traffic noise) are predicted to satisfy relevant noise emission criteria at all assessment locations (Section 7.1).
- Air quality:
  - Estimated emissions of MOD1 for total suspended solids (TSP), particulate matter 10 micrometres or less in diameter (PM_{10}) and particulate matter 2.5 micrometres or less in diameter ($PM_{2.5}$) are predicted to satisfy relevant air quality emission criteria at all assessment locations (Section 7.2).
  - Estimated greenhouse gas (GHG) emissions of MOD1 are predicted to satisfy relevant emission criteria (Section 7.2).
- Transport:
  - The MOD1 product haulage route is unchanged from the approved route for the Balranald Project (Section 7.3).
- Surface water:
  - The potential surface water impacts MOD1 is within the impact levels assessed for the approved Balranald Project (Section 7.4).
- Groundwater:
  - Groundwater impacts of MOD1 are predicted to be negligible and would not impact the beneficial use of the groundwater resource (Section 7.5).

- Subsidence:
  - Subsidence is identified as an impact of the proposed MOD1 underground mining method and is predicted to extend up to 200 m laterally from the underground mining area.
  - Post mining impacts will be mitigated through the implementation of rehabilitation and final landform management measures with residual impacts expected to be minimal (Section 7.6).
- Biodiversity:
  - There will be no net change in the area of vegetation to be disturbed as a result of MOD1.
  - The additional MOD1 disturbance footprint of 119 ha is proposed to be managed by excising approximately 119 ha of equivalent/like-for-like vegetation from the approved Balranald Project to ensure no net increase in impact to biodiversity (Section 7.7).
- Aboriginal cultural heritage:
  - Aboriginal cultural heritage values in the form of surface and potential subsurface archaeological artefacts exist with potential impacts to be managed and mitigated in accordance with Iluka's approved *Aboriginal Cultural Heritage Management Plan* (Section 7.8).
- Rehabilitation
  - Iluka propose to implement the RCS strategies and methods prior to and during operations for MOD1 in order to facilitate an effective rehabilitation program. It is anticipated that as mining and rehabilitation progresses, changes may be required to optimise rehabilitation success. Further detail on specific rehabilitation will be provided and updated annually in the Rehabilitation Reform process administered by the NSW Resource Regulator under the Mining Amendment (Standard Conditions of Mining Leases – Rehabilitation) Regulation 2021 (Section 7.13).

This modification report presents management measures to minimise impacts from MOD1. These are summarised in Appendix D.

ES5 Conclusion

This modification report has assessed and determined that the continuation of the underground mining trial as proposed in MOD1 will have a minimal impact on the environment, whilst contributing to an improvement in social and economic outcomes. As such, the residual impacts for the underground mining trial can continue to be managed in accordance with the consent as modified.

As the potential environmental impacts can be managed and mitigated and there are a range of immediate and longer-term economic benefits, approval of the proposed modification is considered warranted and therefore recommended.

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1 Introduction

1.1 Overview

Iluka Resources Limited (Iluka) have approval to develop a mineral sand mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). It includes construction, open-cut mining, primary processing, and rehabilitation of two linear mineral sand deposits, known as the West Balranald and Nepean deposits, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald (Balranald town), respectively. The Balranald Project also included undertaking an approved bulk sampling activity at the West Balranald deposit with the removal of up to 100,000 tonnes (t) of mineral ore to trial the use of underground mining methods.

Development Consent No. SSD-5285 was granted for the Balranald Project by a delegate of the NSW Minister for Planning under the NSW *Environmental Planning and Assessment Act 1979* (EP&A) Act on 5 April 2016 (herein referred to as the consent). A copy of the consent can be found on the NSW Government's planning portal at https://www.planningportal.nsw.gov.au/major-projects/projects/balranald-mineral-sands-mine.

Approval was also granted under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act 2012/6509) by a delegate of the Commonwealth Minister for the Environment on 6 January 2017 for the open-cut mining operations (herein referred to as the Commonwealth approval).

Since the consent was granted, Iluka has undertaken the approved bulk sampling activity involving the extraction of the mineral ore from depth using trial underground mining within the approved disturbance area of the West Balranald deposit.

The outcome of the bulk sampling activity confirmed the effectiveness of the underground mining method, validated key elements of the mining unit design and have been used to help guide future life-of-mine (LOM) operational conditions and inform the potential suitability (commerciality and potential reduced environmental impacts) of underground mining as an alternative method for resource extraction.

Iluka now propose to expand the underground mining trial which will include an additional area of disturbance to the approved Balranald Project area to enable primary processing of the ore into heavy mineral concentrate (HMC) and transport of HMC offsite for secondary processing at Iluka's facilities in Victoria and/or Western Australia (WA).

This modification report has been prepared to accompany an application to modify the consent under Section 4.55(1A) of the EP&A Act and has been prepared in accordance with the State significant development guidelines – preparing a modification report (Appendix E to the state significant development guidelines). The proposed modification is the first modification to the consent and is herein referred to as MOD1. It would involve:

- continuing the underground trial mining within a portion of the approved disturbance footprint of the West Balranald deposit; and
- development of approved mineral processing surface infrastructure and a portion of the access road outside of the approved disturbance footprint, and excising a corresponding area from the approved disturbance footprint.

1.2 Project need

MOD1 will enable Iluka to continue the underground mining trial to confirm the sustainability of the underground mining method at a larger scale as an alternative to open cut mining for the Balranald Project.

MOD1 would allow for the social and economic benefits realised during the previous mining trials to continue through the employment of up to 200 persons during construction and up to 170 persons during operation, whilst also supporting local and regional suppliers. MOD1 would also contribute to stability and certainty in the local and regional communities which have experienced social and economic impacts as a result of historic population decline and the recent COVID-19 pandemic. Economic benefits would extend to state and national levels through royalty payments and export sales.

MOD1 aligns with the strategic policies for the region, including the *Murray Regional Strategy 2009–2036*, *Far West Regional Plan 2036* and *Local Strategic Planning Statement*, and would assist the state deliver a project that will create jobs and contribute to regional economic growth. Proposed road intersection upgrades and improvements will support objectives around maintaining local and regional road networks.

This modification report has assessed and determined that the continuation of the underground mining trial proposed in MOD1 will have a minimal impact on the environment, whilst contributing to an improvement in social and economic outcomes.

The proponent of MOD1 is Iluka Resources Limited (Iluka).

A summary of the proponent details is provided in Table 1.1. Further details on Iluka can be found at www.iluka.com.

Table 1.1 Proponent details

Full name	Iluka Resources Limited
Postal address	GPO Box U1988 Perth WA 6845
ABN	34 008 675 018
Project Manager	Andrew Porter Balranald Project Manager
Nominated contact	Vicki Hood Balranald Environment and Community Superintendent
Contact details	Iluka Resources Limited – Corporate Office Level 17, 240 St Georges Terrace Perth WA 6000 Phone: 08 9360 4700

1.3 Study team

This modification report has been prepared by EMM Consulting Pty Limited (EMM) on behalf of, and in consultation with, Iluka. It is accompanied by a number of technical assessments which are summarised in Section 7 of this modification report.

1.4 Consent authority

In accordance with Section 4.5(a) of the EP&A Act and Section 2.7(2) of the *State Environmental Planning Policy (Planning Systems) 2021* (the Planning Systems SEPP), the consent authority for applications to modify a SSD consent is the NSW Minister for Planning (or delegate) or the IPC if the applicant has disclosed a reportable political donation.

Iluka has not made any reportable political donations, and therefore, the consent authority for MOD1 is the NSW Minister for planning (or delegate).

2 Background

2.1 Underground mining trials

As part of the approved bulk sampling activity, Iluka has undertaken a series of underground mining trials involving the extraction of the mineral ore from depth within the approved disturbance area of the West Balranald deposit. The trials were conducted as follows:

- proof of concept undertaken between February and May 2015;
- commerciality test Phase 1 undertaken between May to October 2016; and
- commerciality test Phase 2 undertaken between June to November 2020.

Key learnings of the underground mining trials that have informed MOD1 include:

- Mine stope development – volumes removed were less from the western edge of the ore body where surf zone sand wedge is present which has required the reorientation of mining and relocation of surface infrastructure to the eastern side of the West Balranald deposit.
- Reinjection – limited success in subsurface discharge which has led to the proposed surface emplacement of treated sand tails ahead of mining.

2.2 The site and surrounds

The Balranald Project and proposed MOD1 project area are located in the Murray Basin in south-western NSW, near the town of Balranald (Balranald town), within the Balranald Local Government Area (LGA).

The project area and surrounding land is zoned for primary production under the *Balranald Local Environment Plan 2010* (Balranald LEP).

The regional setting and approved EIS project area are shown in Figure 2.1.

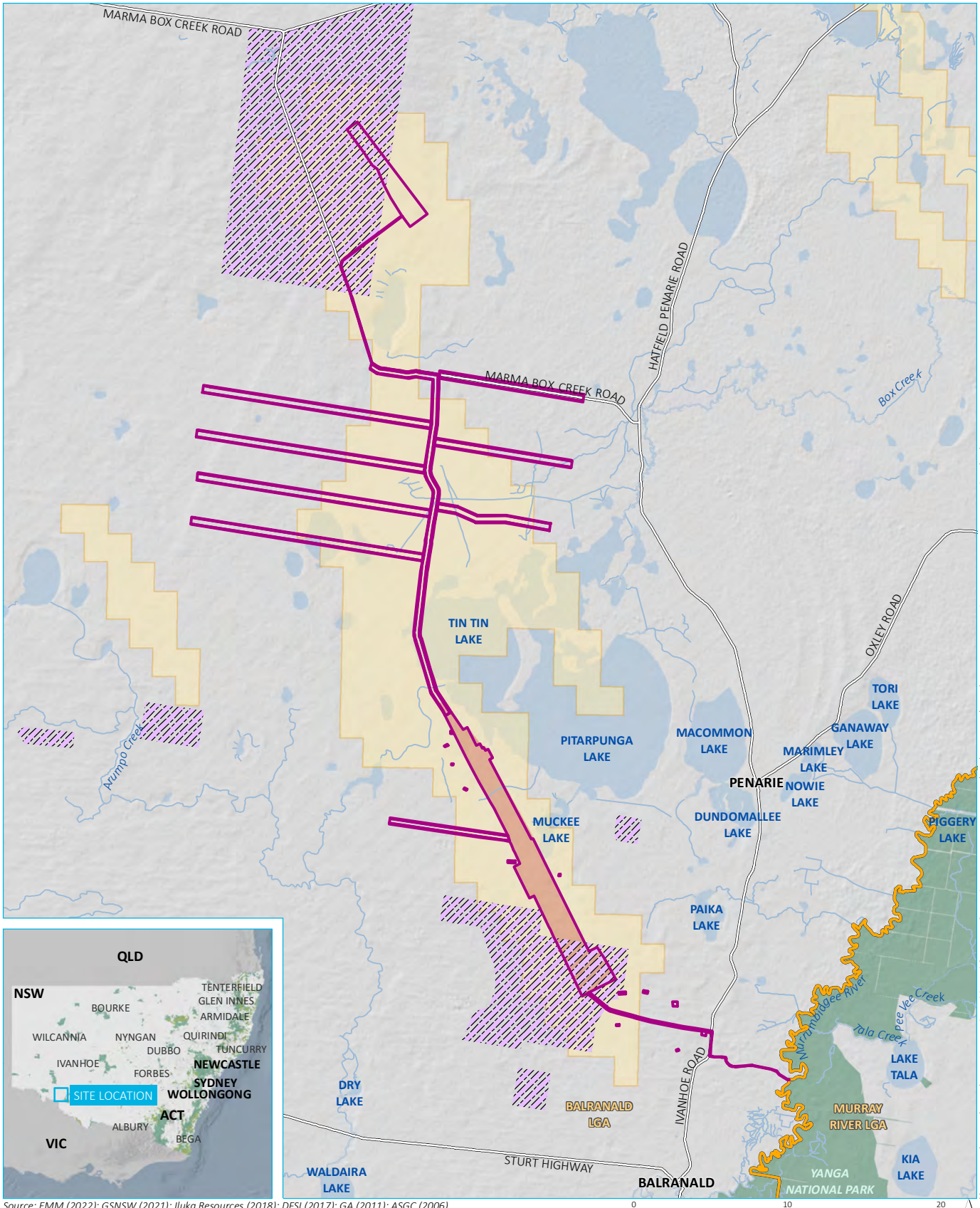
Land uses within the Balranald LGA comprise mostly of agricultural pastoral activities with some fruit growing. Grazing utilises approximately 95% of all agricultural land with dryland cropping comprising a minor portion of agricultural activities at 1%. The primary crops grown are cereals for grain, mainly wheat and barley. Irrigation occurs over only 0.4% (approximately 8,000 ha) of the total agricultural area (ABS 2011).

There are several areas of mallee vegetation in and adjoining the MOD1 project area which are managed in accordance with the conditions of western lands leases (WLL) under the former NSW *Western Lands Act 1901* (WL Act) and NSW *Crown Lands Management Act 2016* (CLM Act). These conditions relate to management of certain areas of mallee vegetation, known as 'southern mallee', referred to herein as southern mallee conservation areas (SMCAs).

SMCAs are to be managed by lease holders in such a way that conserves vegetation. SMCAs are subject to special conditions under WLLs that were originally established to protect habitat loss associated with agricultural land uses including clearing and grazing. As with much of the project area, SMCAs have been grazed by feral animals, resulting in degradation of the shrub and ground vegetation layers.

The Yanga National Park and Murrumbidgee River are approximately 13 km south-east of the West Balranald deposit. Mungo National Park and Willandra Lakes Region World Heritage Area (WLRWHA) are approximately 39 km from the northern extent of the West Balranald deposit.

No substantial mining land use currently exists within the Balranald LGA, although there are a number of mineral titles. A small gypsum mining operation is located to the east of the project area. An approved mineral sands mine, known as the Atlas-Campaspe Mineral Sands Project, is located approximately 40 km north of MOD1, with approval granted in 2014. This project is currently under construction and operations are expected to commence later in 2022.



Source: EMM (2022); GSNSW (2021); Iluka Resources (2018); DFSI (2017); GA (2011); ASGC (2006)

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Exploration Licence (EL7450)
- Mining Lease (ML1736)
- Southern Mallee Conservation Area (2015)
- Major road
- Watercourse/drainage line
- Waterbody
- NPWS reserve
- Local government area

INSET KEY

- NPWS reserve
- State forest

Regional Setting and EIS Approved Balranald Project Area (SSD-5285)

Balranald Mineral Sands Project
Modification report
Figure 2.1

EMM creating opportunities

2.3 Relationship to other major projects and/or developments

Cumulative impacts as a result of the Balranald Project were assessed as part of the original EIS and have been reviewed during the preparation of this modification report. Cumulative impacts can arise from the compounding activities of a single operation when considering past, current and future activities in an area. Cumulative impacts assess the total impact resulting from incremental impacts (including both direct and indirect impacts) from the project when added to other existing and proposed developments in the locality and region.

There are a number of mining tenements for mineral sand deposits in the Murray Basin in NSW, one of these is the Atlas-Campaspe Mineral Sands Project. Cumulative impacts of MOD1 in relation to the Atlas-Campaspe Mineral Sands Project are described further in Section 7.

3 Proposed modification

3.1 Overview

MOD1 is seeking to modify the consent under Section 4.55(1A) of the EP&A Act to extend the approved underground mining trial for six years.

Iluka propose no change to the open cut mining method for the West Balranald and Nepean mines approved under the consent as part of this modification.

MOD1 involves:

- continuing the underground trial mining within a portion of the approved disturbance footprint of the West Balranald deposit pursuant to the consent; and
- development of approved mineral processing surface infrastructure and a portion of the access road outside of the approved disturbance footprint, and excising a corresponding area from the approved disturbance footprint.

The majority of the infrastructure would be required regardless of the mining method.

3.2 Land tenure

The MOD1 is located on Western Land Lease (WLL) properties “Karra”, “Tin Tin”, “Hugh Dale”, “Pine Lodge” and Crown Reserve contained within the Balranald Project area with allotment and folio identifiers outlined in Table 3.1 and illustrated on Figure 3.1.

Table 3.1 Land details in the MOD1 project area

Lot number	Deposited plan number	Tenure
1175	762586	WLL – Karra
1	751182	WLL – Karra
4	751182	WLL – Tin Tin
5	751182	WLL – Tin Tin
1225	762710	WLL – Hugh Dale
1226	762711	WLL – Hugh Dale
1224	762709	WLL – Hugh Dale
1223	762708	WLL – Hugh Dale
88	760470	WLL – Pine Lodge
102	751214	WLL – Pine Lodge
6654	769427	Crown Reserve

3.3 Key modification characteristics

Key characteristics of the modification are outlined in Table 3.2 with further descriptions provided in the following sub-sections.

Table 3.2 Key modification characteristics

Project element	Approved project – open cut mining and *bulk sampling* activity	Approved Project incorporating Modification
Mining method	Open cut mining of West Balranald and Nepean deposits and bulk sampling extraction of up to 100,000 t of mineral ore by non-conventional methods (ie underground mining).	No change with continuation of underground mining trial at West Balranald deposit.
Project footprint	Up to 5,346 hectares (ha) comprising native vegetation, non-native vegetation and disturbed areas.	Minor change to the project footprint to accommodate the relocation of processing plant and associated surface infrastructure (Revised Balranald Project Area) with no net change in biodiversity impacts.
Mining production (predicted)	Open cut mining of approximately 1,100,000 tonnes per annum (tpa) and Bulk sampling activity of 100,000 t total.	No greater than approved for open cut mining.
Processing method	Dry mining with the mining unit plant (MUP) screening extracted ore to remove oversize material. The ore is then slurried with water and pumped via pipeline to the processing plant. Oversize material is returned directly into the mine pit. The processing plant concentrates the ore to generate two primary product streams; HMC and ilmenite. The processing plant has a number of components, including the Primary Concentrate Plant (PCP), Wet Concentrate Plant (WCP), Wet High-Intensity Magnetic Separation (WHIMS) plant and Ilmenite Separation Plant (ISP). HMC would be stockpiled on site and transported to an off-site location for downstream processing. A Bulk sampling activity with mineral ore extracted via a process of underground mining and pumping slurried ore to the surface for primary separation and stockpiling. Mining by-product injected underground. HMC stockpiled on site and not transported off-site, without consent from the Secretary of DPE.	Addition of a flotation plant.
Processing rate	Ore processing rate of 475 tonnes per hour (tph) and a rougher head feed of 440 tph. Bulk sampling activity and processing rate of approximately 50 and 200 tph.	No change.
Duration of Mining	Operations may be carried out for 16 years from the date of commencement of the West Balranald Mine.	No change to duration of open cut mining. Continuation of underground mining trial at West Balranald deposit for up to 6 years.
Operating hours	24 hours per day, 7 days per week for construction, mining and processing.	No change.

Table 3.2 Key modification characteristics

Project element	Approved project – open cut mining and *bulk sampling* activity	Approved Project incorporating Modification
Tailings and mining by-products	Tailings generated at the MUP and processing plant returned to the pit. A portion of sand tailings generated at the processing plant would be disposed using a process known as modified co-disposal with slurried sand tails and slimes placement in the tailings storage facility (TSF). A Bulk sampling activity with tailings injected underground.	Sand tailings from underground mining trial would be placed on surface directly above the mining panels ahead of mining. Topsoil and overburden would be pre-stripped from these emplacement areas to allow successful rehabilitation. Slimes and flotation tails would be reinjected underground.
Power source	Electricity supplied to the mine by connection to the existing electricity supply network. The construction and operation of a transmission line would form part of a separate approval process, if required.	Initial electricity may be supplied by diesel generators.
Raw water sources	During construction and operation, brackish water abstracted from the Olney Formation. During operation, water sources would include: • Surface runoff – generated by direct rainfall within the surface water catchment areas in the Project area. • Groundwater: – minor inflows to the pit; and – groundwater extracted from the Loxton-Parilla Sands (LPS) during dewatering. • Fresh water – supplied from the Murrumbidgee River by the water supply pipeline.	Groundwater reinjected during mining operations. Alternative fresh water supplies including a reverse osmosis plant and/or trucked in from Balranald.
Accommodation	Accommodation facility would provide up to approximately 550 single rooms/quarters to accommodate peak construction and operational workforces. The facility itself would be operated by a staff of about 10 to 20, including administration, cleaning, food preparation, maintenance and security staff.	No change.
Access roads	There are two primary access; the West Balranald access road and Nepean access road. Internal roads within the Project area would also be constructed to minimise interaction between mining equipment and haul trucks, and general light vehicle traffic on-site. A car park would be established at the processing area at the West Balranald mine. Internal roads would be constructed using suitable overburden and gravel sourced from within the Project area, and external sources.	Minor change in alignment of northern section of West Balranald access road outside of project footprint with no net change in biodiversity impacts.

3.3.1 Construction

For MOD1 construction, clearing of approximately 119 ha outside the approved Balranald Project footprint is required with the following infrastructure proposed to be located within this area:

- processing plant infrastructure, comprising WCP, flotation plant and WHIMS plant;
- product and tails pad(s);
- process water, potassium amyl xanthate (PAX) and fines dams;
- hardstand and laydown areas;
- site offices, warehousing, workshops, amenities and carparking;
- services and utilities infrastructure;
- fuel storage and dispensing area;
- telecommunications tower;
- portion of access road outside the approved EIS boundary; and
- internal access tracks and roadways.

A conceptual site layout is provided in Figure 3.1.

3.3.2 Operation

i Underground mining method and processing pathway

Iluka propose to extract mineral ore via a process of pumping slurried ore to the surface.

The predicted processing rate is anticipated to be between 50 and 200 tph, consistent with the previous bulk sampling activity.

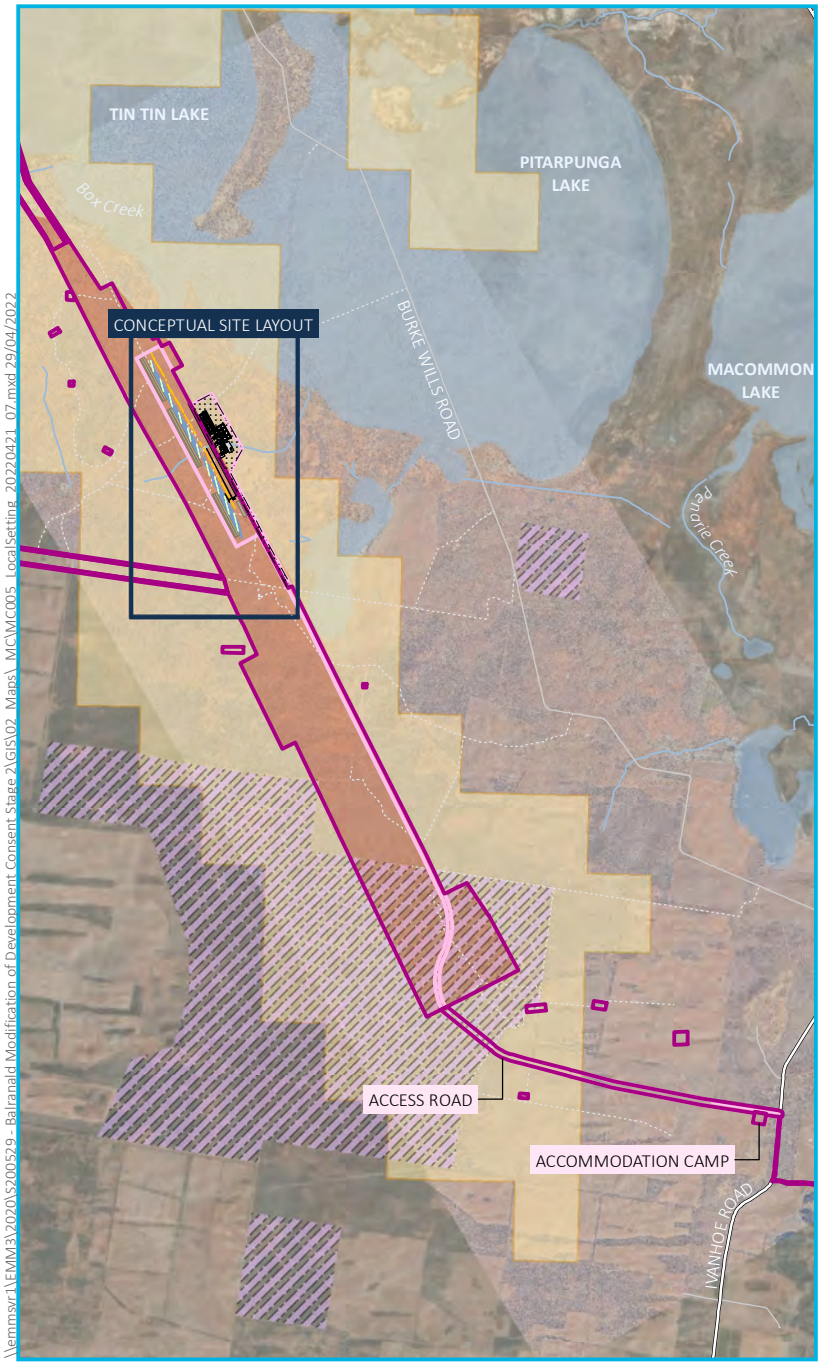
The processing plant has a number of components including the screening plant, WCP, flotation plant and WHIMS plant.

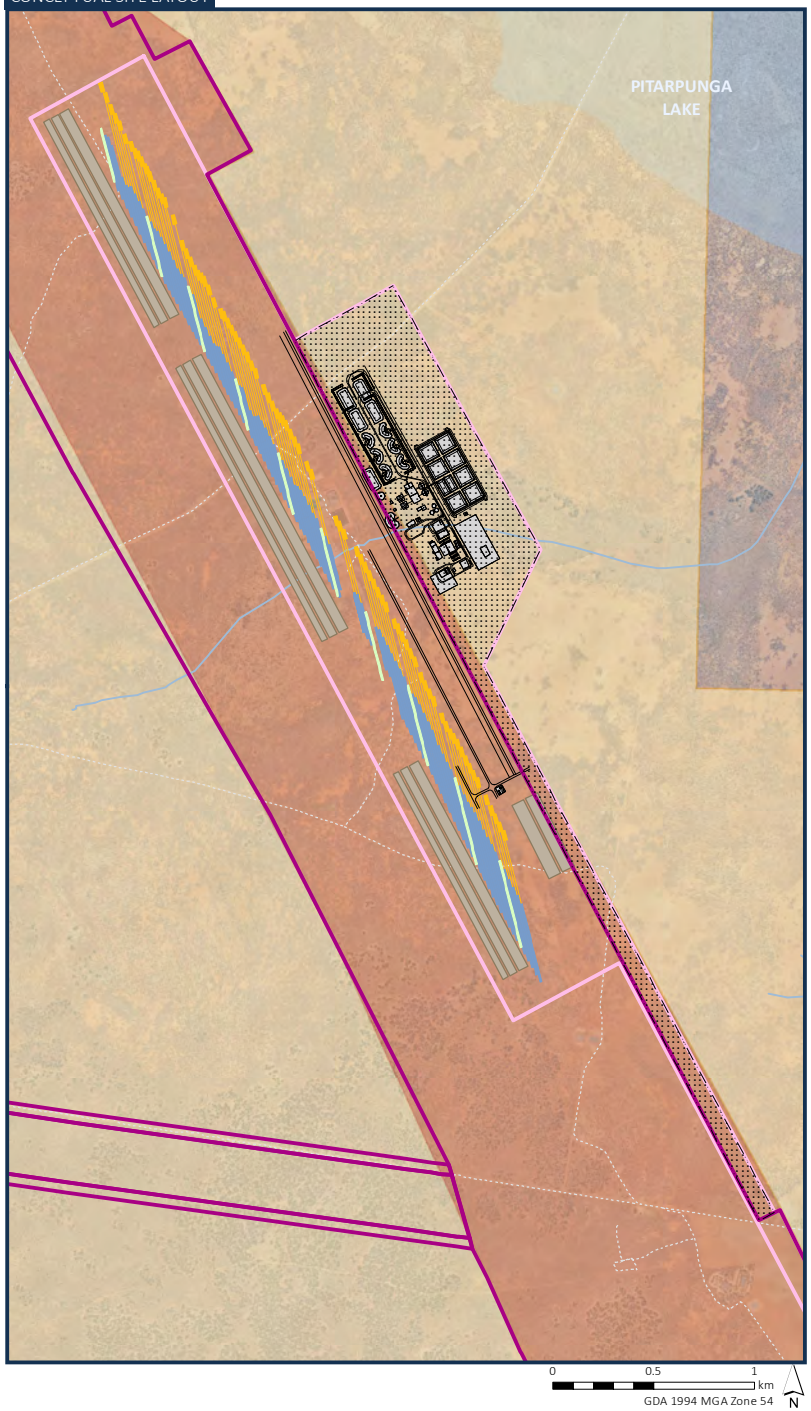
The ore is concentrated through the processing plant to generate two primary product streams, magnetic HMC and non-magnetic HMC.

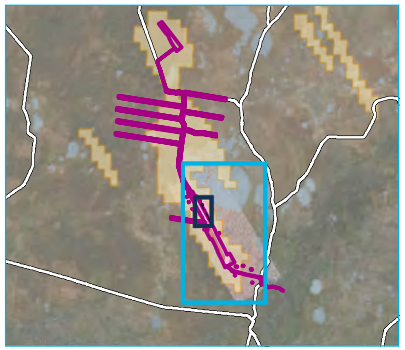
HMC would be stockpiled on site and transported to an off-site location for processing. Underground mining operations are proposed to be undertaken for a period of approximately six (6) years.

Tailings generated at the processing plant would include fine sand slimes and courser sand tails. The coarse sand tailings would be placed on surface directly above the panels ahead of mining. The topsoil and subsoil would be pre-stripped from these areas prior to the emplacement of the coarse sand tails and then returned for rehabilitation.

The majority of the fine sand slimes and a portion of the finer sand tails resulting from the flotation process will be reinjected underground.







KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification study area
- Proposed modification extension to Balranald Project Area boundary
- Processing area infrastructure
- Subsoil stockpile
- Drill pad and string to underground stope
- Underground stope
- Underground pillar
- Major road
- Minor road
- Existing track
- Watercourse/drainage line
- Waterbody
- Southern Mallee Conservation Area (2015)
- Exploration Licence (EL7450)
- Mining Lease (ML1736)

Proposed modification study area and conceptual site layout

Balranald Mineral Sands Project
Modification report
Figure 3.1

EMM creating opportunities

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ii Management of mining by-product

Iluka propose surface emplacement of treated sand tails prior to the commencement of mining within each panel area.

Surface emplacement would involve:

- treated sand tails would be stacked and shaped above the cleared panels; and
- subsoil and topsoil replaced.

iii Management of PAF

Potentially acid forming (PAF) material, derived from reactive sulphides contained in the sand, clay and mineral processing tailings, would be stockpiled and treated, as per the consent, prior to sand tails emplacement and slimes reinjection. Details on PAF management is provided in Section 7.5.

iv Water usage

Anticipated water demands for MOD1 are described in Table 3.3 below.

The largest component of the water requirement is the mining water supply. It is anticipated that approximately 3,400 megalitres per year (ML/year) would be required for mining, with the majority (2,865 ML/year) of this then recovered and recycled through the mining process.

The total water imports to the site per year would be about 1,216 ML of saline groundwater from the LPS Aquifer, about 153 ML/year brackish groundwater from LRG Aquifer and about 15 ML/year potable water sourced from Balranald town.

At the time of preparing this report, a decision to construct and operate the approved fresh water supply pipeline from the Murrumbidgee River has not been determined by Iluka. If constructed the Murrumbidgee water supply would supplement a portion of the brackish groundwater and potable water demands.

The MOD1 project site is located in a low rainfall area, and rainfall is not expected to influence the water balance. Wherever possible, rainfall runoff would be diverted around mining areas rather than captured.

Table 3.3 Anticipated operational phase water demands and sources (ML/year)

Demands		Sources				
Water use	**Volume (ML)**	**Saline groundwater**	**Brackish groundwater**	**Ore body groundwater**	**Floc and reagents**	**Reverse osmosis/potable water truck**
		Imported	**Imported**	**Recovered with ore**	**Imported**	**Imported**
Mining						
Mining water supply	3,400	536	-	2,864		-
Processing	714	616	68	-	26	-
Water in Tails	*689*					
Water in Product	*26*					
Site operation						
Dust suppression	85	-	85	-	-	-
Evaporation from dams	60	64	-	-	-	-
Potable use	15	-	-	-	-	15
Total demand	**4,274**	**1,216**	**153**	**2,864**	**26**	**15**

v Progressive rehabilitation

Iluka propose to implement the strategies and methods contained in the *2015 Rehabilitation and Closure Strategy* (RCS) (EMM, 2015) in accordance with the NSW *Mining Act 1992* prior to and during operations for MOD1.

Conceptual mine progression and rehabilitation is outlined in Section 7.13.

vi Decommissioning and demolition of bulk sampling infrastructure

The existing bulk sampling activity site infrastructure will be decommissioned by suitably qualified workers.

3.4 MOD1 schedule

MOD1 would have a construction and operational life of between seven and eight years.

Subject to MOD1 approval, construction activities associated with the extended underground mining trial are planned to commence in Quarter 2, 2023, with underground mining operations expected to commence in Quarter 2, 2024.

Year 1 of the operational phase would overlap with the completion of construction by approximately four months. The operational phase would be approximately six years in duration.

The surface infrastructure associated with the extended underground mining trial would be used for open cut mining under the consent and decommissioned at the end of LOM is accordance with the consent.

Should the extended underground mining trial be successful Iluka may seek approval for a LOM operation of the Balranald Project using the underground mining method. Should Iluka consider extending the underground mining method to LOM, then Iluka would aim to obtain the required approvals within a timeframe so as to enable the underground mining operations to continue after the end of the extended underground mining trial under the consent.

If the underground mining method is considered not successful, Iluka would retain the right to mine the Balranald Project under the currently approved open cut method.

3.5 Exploration activities

Exploration activities are proposed within the boundaries of ML 1736 as required as an ancillary activity to construction and mining activities.

4 Strategic context

This section addresses the strategic context of MOD1, with consideration of government plans and policies, social and economic trends, and the existing and future natural and built environment. This section also outlines the project's strategic need and potential benefits, in accordance with the State significant development guidelines – *preparing a modification report* (DPE 2021).

4.1 Introduction

The Balranald Project is located within the Balranald LGA in the Far West Region of NSW. This region covers 40% of the State, stretching from Lightning Ridge and Walgett near the Queensland border, to the mining settlements of Cobar and Broken Hill and along the South Australian border, to the Murray River townships of Wentworth and Balranald.

4.2 Draft Murray Regional Strategy 2009–2036

The *Draft Murray Regional Strategy* (the Strategy) was originally prepared in 2009 by the then NSW Department of Planning (now DPE) and identified key priorities for the Murray Region. The region is composed of ten LGAs including Balranald.

Mining is recognised by the Strategy as one of the key drivers of rural and regional economies in the region. The Murray Region has valuable resources with mineral sands being recognised as the most valuable of these commodities. In particular, the Strategy notes that mining of mineral sands in the Balranald LGA is a potentially significant contributor to the subregional economy.

The Strategy identifies a key action as being the protection of land uses for primary production, including mining, and to facilitate related industries with appropriate zones and planning provisions.

MOD1 is consistent with the aims and objectives of the Strategy, as it would allow the region to realise the economic potential and benefits of the mineral sand resources that would be mined as part of the Balranald Project.

4.3 Far West Regional Plan 2036

The NSW Government's *Far West Regional Plan 2036* (the Regional Plan) (DPE 2015) is a 20-year blueprint for the future of the Far West region. The region is recognised for its diversified regional economy including a sustainable mining sector. The Regional Plan sets out a number of goals to achieve the blueprint for the region. One of these goals, Goal 1, is applicable to MOD1.

Goal 1 acknowledges the contribution that the sustainable management of mineral resources has on supporting a regionally diverse economy.

Direction 3 of Goal 1 identifies that the sustainable management of mineral resources must 'consider and balance' the acknowledged community benefits and impacts of the mining lifecycle to produce 'long term sustainable economic, social and environmental outcomes'.

The mining of mineral sands is specifically acknowledged by the Regional Plan as being an operation within the Balranald LGA.

Action 3.3 of the Regional Plan protect areas of mineral and energy resources potential through local land use strategies and local environmental plans.

4.4 National Water Initiative

The NSW government is a partner to an intergovernmental agreement, the *National Water Initiative* (NWI), which was signed by the Council of Australian Governments (CoAG) in June 2004. The NWI recognises the continuing imperative to increase the productivity and efficiency of Australia's water use, the need to service rural and urban communities, and to ensure the health of river and groundwater systems by establishing clear pathways to return all systems to environmentally sustainable levels of extraction.

The NWI sets outcomes, guidelines and timelines for water plans and planning processes. The National Water Commission (NWC) is an independent statutory body responsible for providing advice to CoAG on the implementation of the NWI and national water issues and undertakes a biennial assessment of each state's progress on implementing the NWI.

NSW's primary vehicles for implementation of the NWI are through the preparation and implementation of the various water sharing plans (WSPs) and the NSW *Aquifer Interference Policy* (AIP).

MOD1 has been assessed in accordance with the relevant WSP applicable to the project area and the AIP with further detail provided in Section 7.5.

4.5 Local government strategies

Balranald is recognised as a local centre of employment with the mining sector identified as one of three main economic drivers.

The economic benefits of mining and the skilled employment opportunities provided by the sector are identified as key priorities of local government. Additionally, areas with mineral potential are identified as a priority for the establishment of new mining operations.

The Balranald Shire Council (BSC) undertook the *Local Strategic Planning Statement* (LSPS) to implement directions and actions of the Regional Plan at a local level. It works with the *Community Strategic Plan* (CSP) to identify how the BSC proposes to meet community needs through land use planning.

The LSPS acknowledges that the BSC has experienced an increase in economic development interest in regard to proposed mining operations. Extensive engagement has been undertaken in conjunction with the development of the CSP and included a community economic forum and workshops for BSC Councillors. The outcomes of the engagement resulted in a vision statement to deliver the following broader aims of the Regional Plan:

- strengthen the capacity and opportunities for the economy;
- make Balranald Shire the best possible place to live, work and invest; and
- achieve outstanding results in managing, enhancing, and improving our natural and built environment.

The LSPS supports 'new and existing extractive industries in locations with safe access to well-maintained local and regional road networks and minimal impacts on surrounding residents and agricultural lands'. Mineral exploration and mine development is identified as being under the remit of the Mining Act, however acknowledges Council needs to ensure it has a 'broad-based, collaborative process for planning issues which arise'.

MOD1 is considered to align with the Council's strategic objectives in delivering a project that will create jobs and contribute regional economic growth. Proposed road intersection upgrades and improvements will support objectives around maintaining local and regional road networks.

4.6 Conclusion

The Balranald Project has undertaken a series of underground mining trials since approval of the 2015 EIS and is now seeking MOD1 approval to proceed with a continuation of the trials for a further six years within a portion of the approved West Balranald deposit.

The MOD1 is strongly aligned with the strategies and plans put in place for the Balranald LGA and the region.

5 Legislative framework

5.1 General

This section provides a summary of the legislative framework that applies to MOD1, including the statutory planning approval process under the EP&A Act. A detailed description of the legislative framework can be found in Appendix A.

5.2 NSW Environmental Planning and Assessment Act 1979

Development Consent No. SSD-5285 for the Balranald Project was granted by a delegate of the NSW Minister for Planning under the EP&A Act on 5 April 2016. The project included undertaking an underground mining trial at the West Balranald deposit with the removal of up to 100,000 t of ore to trial the use of underground mining methods.

Under Section 4.55 of the EP&A Act, a consent authority can modify a consent provided the development to which the consent as modified relates, is substantially the same as the development for which the consent was originally granted. Modifications can fall into one of three categories, including modifications involving minimal environmental impact – Section 4.55(1A).

On 17 December 2019, EMM, on behalf of Iluka, provided correspondence to the former NSW Department of Planning, Industry and Environment (DPIE), now DPE, on the scope of MOD1 and the approach to the assessment of its potential impacts. The letter also sought confirmation from DPIE that it could be considered to be substantially the same development as the development for which the consent was originally granted (ie the Balranald Project) and that it could be considered under Section 4.55(1A) of the EP&A Act.

On 15 January 2020, DPIE wrote to EMM confirming that MOD1 can be considered under Section 4.55 of the EP&A Act. It also confirmed that DPIE was satisfied with the approach to assessing potential impacts. The letter, which is provided in Appendix B, stated:

> I can confirm that the appropriate approval pathway for the modification application would be under section 4.55 of the EP&A Act.
>
> I can also confirm that the Department is generally satisfied with the proposed scope of the environmental assessment to be outlined in the Modification Report, subject to the inclusion of:
>
> - consideration of the social and economic benefits of the proposed modification; and
> - justification for the modification application being assessed under section 4.55(1A) of the EP&A Act.

A number of technical assessments have been undertaken to assess the potential impacts of MOD1, including social and economic assessments. These assessments are summarised in Section 7. They demonstrate that the environmental impacts of the proposed modification are considered to be minor and no greater or more significant to those approved under the existing SSD consent for the Balranald Project. As such, the technical assessments demonstrate that MOD1 does have minimal impacts and therefore can be considered under Section 4.55(1A) of the EP&A Act.

5.3 Other NSW legislation

5.3.1 Mining Act 1992

A mining lease (ML 1736) under *the* Mining Act was granted for the Balranald Project in May 2016 for a period of 21 years. If the proposed modification is approved, the mining lease boundary will be extended around the MOD1 infrastructure area.

Under Section 4.42 of the EP&A Act a mining lease must be issued in terms that are substantially consistent with a development consent for SSD, including a consent as modified.

5.3.2 Protection of the Environment Operations Act 1997

An environment protection licence (EPL 20795) was initially granted for the Balranald Project under the NSW *Protection of the Environment Operations Act 1979* (POEO Act) in June 2016. It was updated in 2021 and is currently valid until June 2026. The EPL allows for mineral processing between 30,000 and 100,000 tpa and mining for minerals between 50,000 and 100,000 tpa.

If the modification application is approved, the EPL would need to be varied to allow for greater volume and rate of mineral processing and mining. It may also need to be varied to allow for waste disposal (application to land) and waste storage. Under Section 4.42 of the EP&A Act, the variation of the EPL would need to be substantially consistent with the modified development consent.

5.3.3 Water Management Act 2000

Iluka currently have two water access licences (WAL 31101 and 31102) issued under the NSW *Water Management Act 2000* (WM Act).

As part of the proposed modification, Iluka will continue to use one or both of the WALs to assign future groundwater allocations, while additional WALs may be applied for in accordance with the WM Act.

Potential impacts to groundwater resulting from MOD1 are discussed in Section 7.5 of this modification report.

5.3.4 National Parks and Wildlife Act 1974

Under the NSW *National Parks and Wildlife Act 1974* (NPW Act), a person must not harm or desecrate an Aboriginal object or place without an Aboriginal heritage permit under Section 90 of the NPW Act. However, a Section 90 permit is not required for SSD approvals by virtue of Section 4.41 of the EP&A Act.

Potential impacts to Aboriginal heritage objects resulting from MOD1 are discussed in Section 7.8 of this modification report.

5.3.5 Biodiversity Conservation Act 2016

The potential impacts of MOD1 on biodiversity are discussed in Section 7.7 of this modification report.

The assessment demonstrates that the proposed modification will have no net increase in biodiversity impacts compared to those of the approved Balranald Project and therefore a Biodiversity Development Assessment Report (BDAR) in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act) is not required.

5.3.6 Roads Act 1993

The potential impacts of MOD1 on the existing road network and the proposed road safety improvement works to accommodate any additional traffic are discussed in Section 7.3 of this modification report.

The proposed modification will require approvals under Section 138 of the NSW *Roads Act 1993* from BSC and Transport for NSW (TfNSW) for the proposed road safety improvement works, including connecting the proposed access road to the Balranald Ivanhoe Road.

Under Section 4.42 of the EP&A Act, an approval under Section 138 of the Roads Act is to be issued in terms that are substantially consistent with a development consent for SSD.

5.3.7 Crown Land Management Act 2016

As stated in Section 3, MOD1 is located on four WLL properties "Karra", "Tin Tin", "Hugh Dale" and "Pine Lodge", and a Crown Reserve.

The WLLs for the four properties include a condition that allows mining to be carried out, subject to securing the required approvals under environmental, planning and mining legislation.

There are two WLLs (Hugh Dale and Pine Lodge) which include conditions relating to management of SMCAs. These areas are subject to conditions which require the areas to be managed by current lease holders in such a way that conserve vegetation in certain areas of the lease holding. Changes to these WLLs will be required for the project to proceed. The biodiversity assessment contained in Section 7.7 of this modification report has considered impacts to the SCMAs and associated biodiversity offsetting for MOD1 and demonstrates that there no increase to impact on biodiversity.

The Crown Reserve is required to be crossed to connect the mine access road to the Balranald Ivanhoe Road. The area to be crossed is the same as approved for the Balranald Project. An easement or licence for this access road will be sought through Crown Lands.

5.3.8 Heritage Act 1977

Approvals under Part 4 or an excavation permit under Section 139 of the NSW *Heritage Act 1977* are not required for SSD by virtue of Section 4.41 of the EP&A Act.

The potential heritage impacts of MOD1 are discussed in Section 7.8.

5.3.9 Rural Fires Act 1997

A bushfire safety authority under Section 100B of NSW *Rural Fires Act 1997* is not required for SSD by virtue of Section 4.41 of the EP&A Act.

A bushfire assessment has been undertaken and is provided in Section 7.11 of this modification report.

5.3.10 Radiation Control Act 1990

A radiation assessment (refer to Section 7.14) indicates that no mining materials, including the overburden, ore, HMC, mineral concentrates and mining by-products are classified as regulated material. As such, Iluka are not required to obtain licences under the NSW *Radiation Control Act 1990*.

6 Engagement

6.1 Introduction

This section provides an overview of the community and stakeholder (including agency) engagement, and the outcomes of the consultation undertaken during the preparation of this modification report.

A social assessment (SA) has been prepared for MOD1 to examine the likely impacts on the nearby local and regional communities (Section 7.9).

6.2 Engagement approach and requirements

The MOD1 engagement approach has been informed by the SA and in accordance with the *Social impact assessment guideline: For State significant mining, petroleum production and extractive industry development* (SIA Guideline) (DPE 2017).

The local community was informed of MOD1 via community newsletter drops to local residents and also made available via the Iluka Balranald Project website. Government agencies were consulted during the pre-lodgement process, as detailed in Section 6.4. The BSC was kept informed of MOD1 via briefings during regularly scheduled meetings and via direct email of newsletters.

6.3 Community engagement

6.3.1 Community engagement approach

Stakeholder engagement used several different communications methods to consult, record and respond to the community as outlined in Section 7.9. The variety of methods used ensure the community were informed of the proposed MOD1 and could use at least one of several options to provide feedback during the preparation of the modification report.

Table 6.1 Overview of community engagement tools

Engagement activity	Description
Emails	Emails were sent to the Registered Aboriginal Communities (RAPs) inviting them to participate in face-to-face/online consultation meetings, field survey work and review of the draft Aboriginal Cultural Heritage Assessment Report.
Website	The project's website was updated (https://iluka.com/operations-resource-development/engagement-hub/balranald) to include a project update, planning and approvals pathway, engagement material, an interactive project map that allowed for comments, input and feedback and Iluka contact details.
Community newsletter	• Three community newsletters have been issued to date. • May 2021 – provided update on the status/outcome of the underground mining trial with data collected to be analysed and a decision on next steps to follow. • November 2021 – advised the outcomes of trial and confirmed the effectiveness of the underground mining method. • May 2022 – provided an update, overview of proposed extended mining trail and accommodation village, and details for employment enquiries.
Dedicated email address and telephone line	• An email address and telephone line were provided as part of the consultation process, both on the website and in the newsletters distributed.

6.3.2 Community engagement outcomes

The results of the engagement actions and SA research are summarised in Table 6.2.

Table 6.2 Participation by engagement activity

Stakeholders	Method	Administered	Invited	Participation outcomes
BSC	Meeting	Face-to-face/online	CEO and General Manager	• Balranald Project timing. • Haulage route, road upgrades and maintenance. • Economic and social benefits for Balranald township. • Employee and contractor accommodation. • Voluntary Planning Agreement.
Wider community	1st community newsletter	Online via MOD1 website	Wider community	• General community interest and support for the underground mining trials. • Employment opportunities enquiries. • Balranald Project timing.
	2nd community newsletter	Online via MOD1 website	Wider community	
	3rd community newsletter	Online via MOD1 website Posted hardcopy	Wider community	
	Balranald Project website	Online	Wider community	
RAPs	Site survey and draft review	Face-to-face	All RAPs	• All RAPs were invited to attend surveys and provided a copy of the draft heritage assessment to confirm it reflects the survey methodology and assessment findings. • Consultation with RAPs was undertaken in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010). • 5 individual RAPs registered interest in Balranald Project and were consulted.

Iluka recognises the importance of community engagement and consultation and will continue to provide the local community with opportunities to comment on MOD1.

6.4 Agency consultation

Agency consultation during the preparation of this modification report, and consultation outcomes, are outlined in Table 6.3.

Table 6.3 Summary of government agency consultation

Stakeholder	Consultation methods	Outcomes	Response
DPE – Water	Iluka met via videoconference with DPE-Water on: • 26 July 2021 on the proposed MOD1. • 31 March 2022 for the MOD1 groundwater assessment findings.	• DPE-Water representatives were introduced to proposed MOD1. • DPE-Water advised that the groundwater modelling parameters would need to be justified/substantiated in the supporting groundwater impact assessment. • DPE-Water advised they would be supportive of the proposed independent review of the groundwater modelling design.	• MOD1 groundwater assessment addresses modelling parameters, AIP, water quality, geochemistry and provides an independent review by Hugh Middlemis (Section 7.5).
DPE – Biodiversity and Conservation Division (BCD)	Iluka met via videoconference with BCD on: • 27 July 2021 for the proposed MOD1. • 9 March 2022 for the MOD1 supplementary biodiversity assessment findings and offset strategy. • 8 April 2022 for the MOD1 site visit.	• BCD representatives were introduced to proposed MOD1 and environmental assessment outcomes. • Iluka outlined extent of field surveys to support MOD1 and confirmed no Biodiversity Development Assessment Report (BDAR) would be required. • Iluka outlined the supplementary biodiversity assessment methodology to support MOD1 and demonstrate that the activity will have no net change to biodiversity impacts (eg vegetation communities, threatened and migratory species, heritage places). • BCD requested an opportunity for a site visit.	• MOD1 supplementary biodiversity assessment addresses field survey methodology, recorded threatened State listed vegetation communities and species and offset requirements (Section 7.7). • A site visit was held with BCD on 8 April 2022.
DPE - Mining, Exploration and Geoscience (MEG)	Iluka met via videoconference with MEG on: • 28 July 2021 for the proposed MOD1. • 9 March 2022 for the MOD1 environmental assessments outcomes.	• MEG representatives were introduced to proposed MOD1 and environmental assessment outcomes. • MEG advised that as of July 2021 a new Mining Rehabilitation and Securities Panel (RASP) has been established for proponents to seek comments/feedback on the adequacy of proposed rehabilitation and post-mining land uses. • MEG advised that MOD1 would need to be supported by a resource and economics assessment.	• MOD1 economic assessment completed (refer Section 7.12). • A site visit is scheduled to be held with MEG in late May/June 2022 to discuss the resource and economic assessment.

Table 6.3 Summary of government agency consultation

Stakeholder	Consultation methods	Outcomes	Response
DPE – Planning and Assessment	Iluka met via videoconference with DPE on: • 2 August 2021 for the proposed MOD1. • 28 October 2021 on revised site layout. • 8 April 2022 for the MOD1 site visit.	• DPE representatives were introduced to proposed MOD1 and environmental assessment outcomes. • DPE advised 'in principle' support for MOD1 approval pathway under Section 4.55(1A) of the EP&A Act and reiterated the need for the modification report to include: – consideration of the social and economic benefits; and – justification for the modification being assessed under Section 4.55(1A). • DPE requested the modification report outline consultation with government agencies.	• MOD1 report addresses noise, air quality and greenhouse gas, traffic and transport, surface water, groundwater, biodiversity, Aboriginal cultural heritage, subsidence, bushfire, economic, social and rehabilitation impact assessments (refer Section 7). • A site visit was held with DPE representatives on 8 April 2022.
EPA	Iluka met via videoconference with EPA on: • 27 July 2021 for the proposed MOD1. • 11 March 2022 for MOD1 environmental assessments outcomes.	• EPA representatives were introduced to proposed MOD1 and environmental assessment outcomes. • EPA acknowledged the previously provided groundwater monitoring results were encouraging from an impact perspective. • EPA queried the process chemicals used in underground and noted the fate and transport modelling results for PAX. EPA advised that Iluka's EPL would need to be varied to enable extraction and processing, which could occur concurrent to MOD1.	• MOD1 groundwater assessment addresses modelling parameters, AIP, water quality, geochemistry and provides an independent review by Hugh Middlemis (Section 7.5).
Heritage NSW	Iluka met via videoconference with Heritage NSW on: • 15 December 2021 for the proposed MOD1.	• Heritage NSW representatives were introduced to proposed MOD1. • Iluka outlined extent of field surveys to support MOD1 and confirmed proposed test pitting/methodology. • Iluka outlined the Aboriginal cultural heritage assessment methodology to support MOD1 in accordance with the approved Aboriginal Cultural Heritage Management Plan.	• MOD1 Aboriginal cultural heritage assessment addresses field survey methodology, recorded Aboriginal heritage and management plan requirements (Section 7.8).

Table 6.3 Summary of government agency consultation

Stakeholder	Consultation methods	Outcomes	Response
Transport for NSW (TfNSW)	Iluka met via videoconference with TfNSW on: • 14 October 2021 for the proposed MOD1. • 10 March 2022 for MOD1 environmental assessments outcomes.	• TfNSW representatives were introduced to proposed MOD1 and environmental assessment outcomes. • TfNSW confirmed Tooleybuc is the approved EIS haulage route. • TfNSW advised that additional traffic and transport assessment would be required for MOD1 if Iluka proposed an alternative haulage route (eg via Robinvale, as this would likely generate significant stakeholder and community interest). • TfNSW advised they would be interested in visiting Balranald site.	• MOD1 traffic and transport assessment addresses proposed traffic volumes, haulage route and intersection/road upgrades (Section 7.3). • TfNSW were invited to the site visit on 8 April 2022 but could attend.
Resources Regulator	Iluka met via videoconference with the Resources Regulator on: • 27 July 2021 for the proposed MOD1. • 9 March 2022 for the MOD1 environmental assessments outcomes.	• Resources Regulator representatives were introduced to proposed MOD1.	• A site visit is scheduled to be held with the Resources Regulator on 9 May 2022.

6.5 Ongoing consultation

The community and stakeholder (including agency) engagement undertaken for MOD1 is part of a wider ongoing engagement program, which commenced during the preparation of the EIS for the open cut method and will continue over the life of the mine.

Regular community newsletters will be provided and community queries and concerns will be responded to promptly.

7 Assessment of impacts

An assessment of the potential environmental impacts of MOD1 were completed for the preparation of technical assessment reports and are summarised in this section. The technical assessment reports are provided as Appendices.

7.1 Noise

A noise impact assessment (NIA) was undertaken by EMM, on behalf of Iluka, and is presented in Appendix E.

The NIA consisted of:

- an update to the noise assessment methodology consistent with the EPA's *Noise Policy for Industry* (NPfI) (2017). The NPfI supersedes the *Industrial Noise Policy* (INP) (2000), which was used for the 2015 NIA;
- an operational noise assessment as per the NPfI with worst-case noise predictions for MOD1;
- an assessment of noise from construction activities associated with MOD1 in accordance with the NSW Department of Environment and Climate Change (DECC) *Interim Construction Noise Guideline* (ICNG) (2009);
- an assessment of road traffic noise in accordance with the NSW Department of Environment, Climate Change and Water (DECCW) *Road Noise Policy* (RNP) (2011); and
- comparison of noise impacts for the approved Balranald Project and MOD1.

7.1.1 Assessment approach

The NIA examined predicted construction and operational noise emissions from MOD1 given the minor change to the project footprint to accommodate the relocation of the processing plant and associated surface infrastructure.

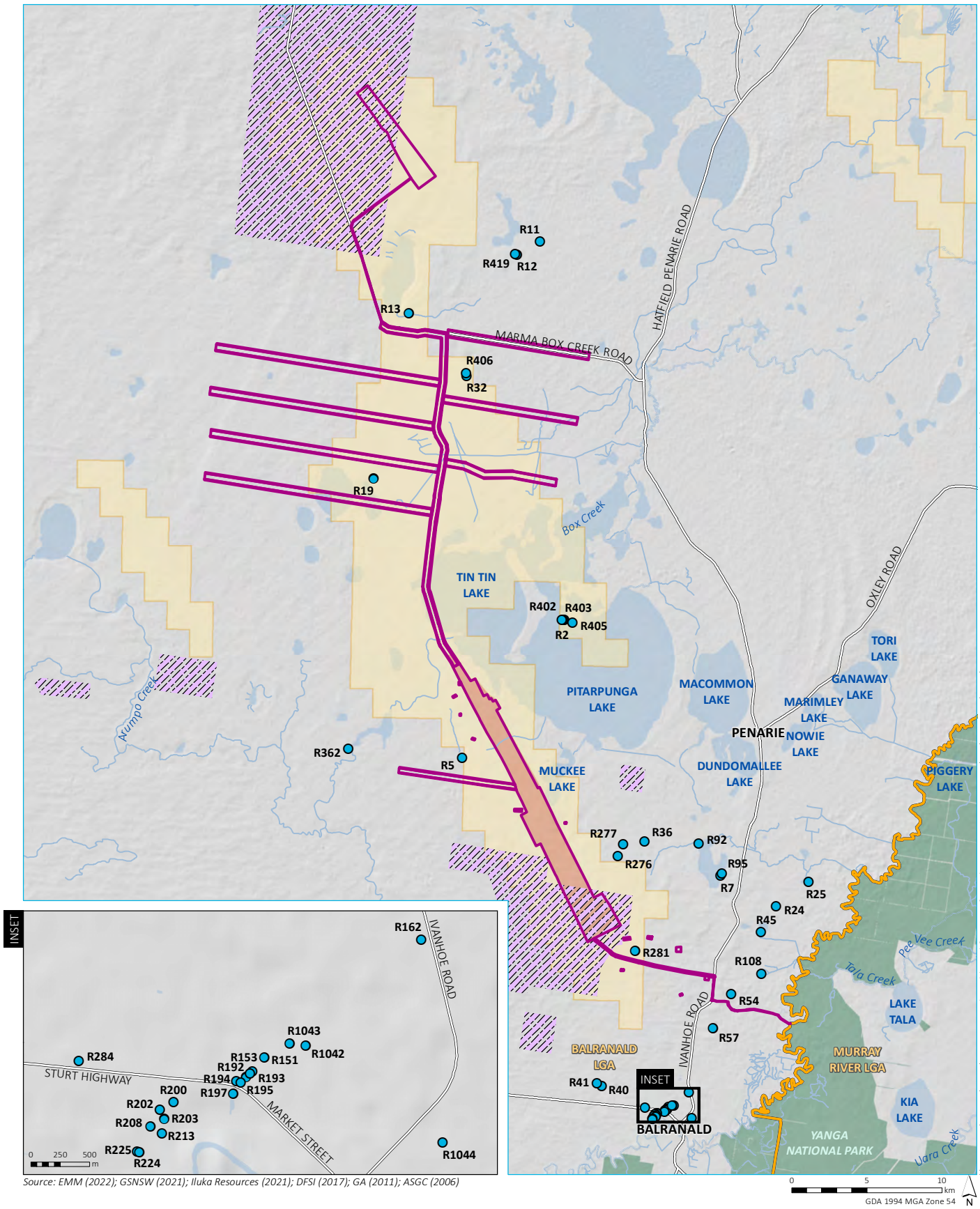
Noise modelling for MOD1 was based on three-dimensional digitised ground contours of the project area and surrounding land for one worst-case stage of the proposed modification. The noise model represents snapshots, with plant and equipment placed at various locations and heights, representing realistic operational and construction scenarios.

i Assessment locations

Noise from MOD1 mining operations has been predicted for privately-owned assessment locations (residences and habitable buildings) surrounding the Balranald Project (Figure 7.1). No other sensitive land uses were identified within the site noise catchment which has been conservatively defined as 10 km from any noise source.

ii Background noise surveys

Information gathered from the NIA for the Balranald Project was used to provide the Rating Background Level (RBL) for the NIA. Background noise levels in the surrounding community were identified as being below the NPfI minimum RBL of 35 decibels (dB) for the day period, and 30 dB for the evening and night periods. These minimum RBLs have been adopted for all assessment locations in the NIA.



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Source: EMM (2022); GSNSW (2021); Iluka Resources (2021); DFSI (2017); GA (2011); ASGC (2006)

KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Exploration Licence (EL7450)
- Mining Lease (ML1736)
- Southern Mallee Conservation Area (2015)
- Noise assessment location
- Major road
- Watercourse/drainage line
- Waterbody
- NPWS reserve
- Local government area

Assessment locations

Balranald Mineral Sands Project
Modification report
Figure 7.1

EMM creating opportunities

iii Compliance noise monitoring

Iluka maintained an ongoing monitoring program during the previous underground mining trials with monthly operator-attended noise monitoring completed at the nearest assessment location or residence (R5 – Karra Homestead).

Monitoring during the day and night periods was undertaken between June and September 2016, and June and November 2020 to assess compliance with the relevant noise limits.

A review of attended noise monitoring data identified that site noise contributions satisfied the relevant noise limits at R5. The attended noise monitoring data also demonstrated that modifying factor corrections for low frequency noise and other annoying noise characteristics were found to be not relevant at R5 and all other assessment locations in accordance with Fact Sheet C of the NPfI.

iv Meteorological conditions

Noise propagation over distance can be significantly affected by meteorological conditions. Of most interest are source-to-receiver wind, the presence of a temperature inversion or the combination of both, as these conditions can enhance received noise levels. To account for these phenomena, the NPfI specifies the following two options:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur (conservative approach).

1. Determine the significance of noise-enhancing conditions, which is based on a 30% threshold of occurrence.

The NIA used the NPfI's first option in adopting the noise-enhancing meteorological conditions for all assessment periods for the modelling. Furthermore, 'very noise-enhancing' meteorological conditions for the night period (ie G class temperature inversion) were adopted for modelling.

The meteorological conditions adopted for modelling are presented in Table 7.1 Meteorological conditions adopted for modelling.

Table 7.1 Meteorological conditions adopted for modelling

Assessment period	Meteorological conditions	Air temperature	Relative humidity	Wind speed[1]	Wind direction	Stability category
Day	Winds	20°C	90%	3 m/s	All	D class
Evening/night	Winds	10°C	90%	3 m/s	All	D class
Night	Strong temperature inversion	10°C	90%	0 m/s	All	G class[2]

1. Worst-case 3 m/s wind speed was assumed for all wind directions in accordance with the NPfI.
2. Temperature inversion value of 4°C/100 m.
3. Day period: 7.00 am to 6.00 pm Monday to Saturday and 8 am to 6 pm Sundays and public holidays. Evening period: 6.00 pm to 10.00 pm every day. Night period: 10.00 pm to 7.00 am Monday to Saturday and 10.00 pm to 8.00 am Sundays and public holidays.

The area surrounding the site is generally flat with noise sources typically at a similar elevation to surrounding assessment locations. The potential for source-to-receiver drainage flow winds to occur is therefore not relevant and has not been considered in the assessment.

7.1.2 MOD1 assessment

Since the NIA for the Balranald Project (dated May 2015), the *Industrial Noise Policy* (INP) (EPA 2000) has been superseded by the NPfI (EPA 2017).

In accordance with the EPA's Implementation and transitional arrangements for the NPfI, for the purpose of MOD1 the NIA adopted the NPfI approach and hence assessment requirements for operational noise and modelling methodologies were updated where applicable.

i Noise assessment criteria

a Operational noise trigger levels

The objectives of noise trigger levels for industry are to protect the community from excessive intrusive noise and preserve amenity for specific land uses.

Noise from industrial sites or processes in NSW is regulated by the local council, DPE and/or the EPA, and generally have a licence and/or development consent conditions stipulating noise limits (refer to Appendix E).

The NIA for the Balranald Project was completed in accordance with the INP. Since the INP has been superseded by the NPfI, the assessment of operational noise for the proposed MOD1 was revised in accordance with the NPfI assessment requirements. Updated noise criteria for MOD1 (referred herein as 'project noise trigger levels' as per the NPfI) are outlined below.

b Intrusiveness noise levels

The intrusiveness noise levels require that $L_{Aeq,15min}$ noise levels from MOD1 during the relevant operational periods do not exceed the RBL by more than 5 dB at residential assessment locations. The day RBL for all assessment locations has been updated to align with the NPfI minimum RBL of 35 dB for the day period. The evening and night RBLs are based on the NPfI minimum RBLs of 30 dB and are consistent with those adopted in the NIA for the Balranald Project.

Table 7.2 presents the intrusiveness noise levels determined for MOD1 based on the adopted RBLs.

Table 7.2 Project intrusiveness noise levels

Assessment location	Assessment period	Adopted RBL[1], dB(A)	Project intrusiveness noise level (RBL + 5 dB), $L_{Aeq,15min}$, dB
All residential assessment locations	Day	35[2]	40
	Evening	30[3]	35
	Night	30[3]	35

Notes: Referenced from the 2015 noise assessment. Updated to align with the NPfI minimum RBL for the day period (ie 35 dB). Based on the NPfI minimum RBL of 30 dB for this period and is consistent with the RBL adopted in the 2015 noise assessment. Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; evening: 6.00 pm to 10.00 pm; night: remaining periods.

c Amenity noise levels

Amenity noise assessment is based on noise levels specific to the land use. The noise amenity area for residential assessment locations surrounding the site have been categorised as 'rural' amenity category based on existing background noise levels (referenced from the NIA for the Balranald Project) and contributing noise sources in accordance with the definitions provided in Table 2.3 of the NPfI.

As per Table 2.3 of the NPfI, a 'rural' residential area is defined as "an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse".

The project amenity noise levels are provided in Table 7.3. A conservative approach of adopting the minus 5 dB method was used for all assessment locations, although in reality only noise from site is likely to be experienced at all assessment locations and hence site could 'take up' the whole of the amenity target at some locations.

Table 7.3 Project amenity noise levels

Assessment locations	Amenity area	Time period[1]	Project amenity noise level dB, $L_{Aeq,period}$ (Amenity noise level minus 5 dB)
All assessment locations (eg residences, habitable buildings)	Rural	Day	45
		Evening	40
		Night	35

Notes: Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; evening: 6.00 pm to 10.00 pm; Night: 10.00 pm to 7.00 am Monday to Saturday; 10.00 pm to 8.00 am Sundays and public holidays.

d Project noise trigger levels

The project noise trigger levels (PNTLs) are the lower of the calculated intrusiveness or amenity noise levels.

It is commonly acknowledged and accepted amongst agencies and industry that average noise levels from industrial sites measured over a number of hours are typically 3 dB higher over a 15-minute worst-case assessment period. To standardise the time periods for the intrusiveness and amenity noise levels, the NPfI states that the $L_{Aeq,15min}$ is equivalent to the $L_{Aeq,period}$ + 3 dB, unless robust evidence is provided for an alternative approach for the particular development being considered. This approach has been adopted for this assessment.

The PNTLs adopted for all residential assessment locations are provided in Table 7.4.

Table 7.4 Adopted PNTLs

Assessment location	Assessment period	Intrusiveness $L_{Aeq,15min}$, dB	Amenity[1] $L_{Aeq,15min}$, dB	Adopted PNTL[2] $L_{Aeq,15min}$, dB
All residential assessment locations	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35

Notes: Project amenity $L_{Aeq,15min}$ noise level is the project amenity noise level $L_{Aeq,period}$ plus 3 dB as per the NPfI. PNTL is the lower of the calculated intrusiveness or amenity $L_{Aeq,15min}$ noise levels. Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; evening: 6.00 pm to 10.00 pm; night is the remaining periods.

It is noted that the adopted PNTLs shown in Table 7.4 are based on the intrusiveness noise levels and largely unchanged from those limits contained in the consent and EPL. The only changes are for the less sensitive day period due to NSW EPA policy changes.

For the purpose of MOD1, noise limits (in the consent and EPL) will be varied in accordance with the findings of the NIA and the NPfI.

ii Sleep disturbance screening criteria

The site will operate during the night period as part of MOD1 and therefore, in accordance with the NPfI, the potential for sleep disturbance has been assessed. Noise from proposed night-time construction works have also been considered in the assessment of sleep disturbance.

The NPfI states that a detailed maximum noise level event assessment should be undertaken where the development/premises night-time noise levels at a residential location exceed the following screening criteria:

1. $L_{Aeq,15min}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or

2. L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

The sleep disturbance screening criteria for all residential assessment locations are provided in Table 7.5. The L_{Amax} trigger level can be compared to the $L_{A1,1min}$ noise limit listed in the consent for all residential assessment locations. Although, the L_{Amax} trigger level in Table 7.5 is 7 dB higher than the 45 dB $L_{A1,1min}$ limit stated in the consent, it is the 'standard' minimum L_{Amax} trigger level in accordance with the NPfI. The NPfI L_{Amax} trigger level has been adopted for this assessment of sleep disturbance from maximum noise levels.

Table 7.5 Maximum noise level event screening criteria for sleep disturbance

Assessment locations	Adopted (night) RBL[1], dB(A)	Maximum noise level event screening criteria, dB	
		RBL +5 dB or standard[2] $L_{Aeq,15min}$	RBL +15 dB or standard[2] L_{Amax}
All residential assessment locations	30	40	52

1. Referenced from the 2015 noise assessment.
2. Whichever is greater.

iii Construction noise management levels

The assessment of noise from proposed construction works for MOD1 was completed using the ICNG. The ICNG provides two methods for the assessment of construction noise emissions:

- quantitative: suited to major construction projects with typical durations of more than three weeks; and
- qualitative: suited to short term infrastructure maintenance (three weeks or less).

In summary, the noise management levels for assessment locations as per the ICNG are:

- 10 dB above the existing background levels (RBL + 10 dB) for standard construction hours; and
- 5 dB above the existing background levels (RBL + 5 dB) outside of the standard construction hours.

Where noise levels from construction works are predicted above the noise management levels (NMLs) during or outside the recommended standard hours, all feasible and reasonable noise management and mitigation measures should be implemented.

The site is located in a relatively remote area and is approximately 12 km at its closest point to Balranald town. Properties outside Balranald town are typically large rural land holdings, and dwellings are sparsely located on these properties. The nearest residence to the site (ie active mining operations) is assessment location R5 located approximately 2.8 km to the south-west. Other buildings such as sheds, shearers quarters and outbuildings are also sparsely located.

A 24-hour, seven day per week construction schedule has been assessed (ie worst case scenario noise emissions).

The construction NMLs adopted for the project during the ICNG recommended standard hours and outside of the standard construction hours (out-of-hours) are presented in Table 7.6.

Table 7.6 Adopted NMLs

Assessment location	Assessment period	Adopted RBL[3], dB(A)	NML $L_{Aeq,15min}$, dB
All residential assessment locations	Standard hours[1]	35	45 (RBL + 10)
	Out-of-hours[2]	30	35 (RBL + 5)

1. EPA recommended standard hours between Monday to Friday 7.00 am to 6.00 pm and Saturday 8.00 am to 1.00 pm (excluding public holidays).
2. Outside the recommended standard hours including the night period.
3. Based on the NPfI minimum RBLs.

iv Road traffic noise criteria

The principal guidance to assess the impact of road traffic noise on assessment locations is in the NSW Road Noise Policy (RNP). The road noise assessment criteria for residential land uses (ie residential assessment locations), reproduced from Table 3 of the RNP for road categories relevant to MOD1 are presented in Table 7.7.

Table 7.7 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria	
		Day (7 am-10 pm)	Night (10 pm-7 am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	60 dB $L_{Aeq,15hr}$ (external)	55 dB $L_{Aeq,9hr}$ (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	55 dB $L_{Aeq,1hr}$ (external)	50 dB $L_{Aeq,1hr}$ (external)

Source: RNP

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2 dB.

Further to meeting the assessment criteria shown in Table 7.7, any significant increase in total traffic noise at assessment locations must be considered. Assessment locations experiencing increases in total traffic noise levels above those presented in Table 7.8 should be considered for mitigation as per the RNP.

Table 7.8 Relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase	
		Day (7.00 am – 10.00 pm)	Night (10.00 pm – 7.00 am)
Freeway/arterial/ sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic +12 dB $L_{Aeq,15hr}$ (external)	Existing traffic +12 dB $L_{Aeq,15hr}$ (external)

7.1.3 Impact assessment

i Operational noise

Modelling results showed that site noise levels for MOD1 are predicted to satisfy the adopted PNTLs at all assessment locations for the day, evening and night periods during worst-case meteorological conditions. Predicted noise levels from proposed operations are shown in Table 7.9.

Table 7.9 Predicted noise levels from proposed worst-case operations

Assessment location ID	Predicted worst-case $L_{Aeq,15min}$ noise levels, dB		Adopted PNTLs, $L_{Aeq,15min}$, dB			
	Day	Evening	Day	Evening	Day	Evening
R2	<35	<30	<30	40	35	35
R5[1]	36	33	33	N/A	N/A	N/A
R7	<35	<30	<30	40	35	35
R11	<35	<30	<30	40	35	35
R12	<35	<30	<30	40	35	35
R13	<35	<30	<30	40	35	35
R19	<35	<30	<30	40	35	35
R24	<35	<30	<30	40	35	35
R25	<35	<30	<30	40	35	35
R32	<35	<30	<30	40	35	35
R36	<35	<30	<30	40	35	35
R40	<35	<30	<30	40	35	35
R41	<35	<30	<30	40	35	35
R45	<35	<30	<30	40	35	35
R54	<35	<30	<30	40	35	35
R57	<35	<30	<30	40	35	35
R92	<35	<30	<30	40	35	35
R95	<35	<30	<30	40	35	35
R108	<35	<30	<30	40	35	35

Table 7.9 Predicted noise levels from proposed worst-case operations

Assessment location ID	Predicted worst-case $L_{Aeq,15min}$ noise levels, dB		Adopted PNTLs, $L_{Aeq,15min}$, dB			
	Day	Evening	Day	Evening	Day	Evening
R151	<35	<30	<30	40	35	35
R153	<35	<30	<30	40	35	35
R162	<35	<30	<30	40	35	35
R192	<35	<30	<30	40	35	35
R193	<35	<30	<30	40	35	35
R194	<35	<30	<30	40	35	35
R195	<35	<30	<30	40	35	35
R197	<35	<30	<30	40	35	35
R200	<35	<30	<30	40	35	35
R202	<35	<30	<30	40	35	35
R203	<35	<30	<30	40	35	35
R208	<35	<30	<30	40	35	35
R213	<35	<30	<30	40	35	35
R224	<35	<30	<30	40	35	35
R225	<35	<30	<30	40	35	35
R276	<35	<30	<30	40	35	35
R277	<35	<30	<30	40	35	35
R281	<35	<30	<30	40	35	35
R284	<35	<30	<30	40	35	35
R362	<35	<30	<30	40	35	35
R402	<35	<30	<30	40	35	35
R403	<35	<30	<30	40	35	35
R405	<35	<30	<30	40	35	35
R406	<35	<30	<30	40	35	35
R419	<35	<30	<30	40	35	35
R1042	<35	<30	<30	40	35	35
R1043	<35	<30	<30	40	35	35
R1044	<35	<30	<30	40	35	35

1. Residence currently uninhabited and subject to 'Acquisition upon request' as per the development consent.

A comparison of predicted operational noise levels from MOD1 and approved site noise levels was also completed. The comparison showed there was no overall increase in noise levels at all assessment locations.

Furthermore, based on the noise levels shown in Table 7.9, noise levels from MOD1 are predicted to satisfy the requirements of the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP) (NSW Government 2018) on all privately-owned land. This finding is consistent with that of the NIA for the Balranald Project.

ii Construction noise

The construction scenarios, plant and equipment, associated sound power levels and quantities considered in the construction noise assessment are generally consistent with those adopted in the NIA for the Balranald Project.

All scenarios were considered to occur simultaneously 24 hours a day and therefore represent worst-case noise levels throughout the construction phase.

The only difference with the NIA for the Balranald Project is the location of the MOD1 processing area infrastructure which is now proposed to be constructed and operated approximately 6 km to the north-west (closer to R5).

Potential impacts for sleep disturbance from proposed construction activities during the night period (10.00 pm to 7.00 am Monday to Saturday, and 10.00 pm to 8.00 am on Sundays) were also assessed.

Predicted noise levels from proposed construction during the recommended standard hours and out-of-hours (including the night period) are shown in Table 7.10.

Table 7.10 Predicted construction noise levels

Assessment location	Predicted construction $L_{Aeq,15min}$ noise levels, dB		Construction NMLs, dB	
	Standard hours	Out-of-hours	Standard hours	Out-of-hours
R281[1]	<40	35	45	35
R5	<40	<35	45	35
All other assessment locations	<40	<35	45	35

1. This assessment location has been identified as a shed.

a Sleep disturbance

Maximum noise levels of proposed night operations with the potential to cause sleep disturbance at nearby assessment locations were assessed in accordance with the NPfI. This included maximum night-time noise levels from proposed construction activities.

Maximum predicted $L_{Aeq,15min}$ noise levels for the night period during construction were compared against the relevant sleep disturbance trigger levels. Modelling results showed that $L_{Aeq,15min}$ noise levels from proposed construction during the night period are predicted to satisfy the relevant sleep disturbance screening criteria at all residential assessment locations during worst-case meteorological conditions.

Maximum L_{Amax} noise level events from proposed construction activities, such as truck pass-by, material handling and loading activities are assessed against the L_{Amax} sleep disturbance screening criteria. Typical L_{Amax} noise levels from such events as measured on similar projects are summarised in Table 7.11.

Table 7.11 Maximum noise levels from typical L_{Amax} sources

Noise source or activity	Measured L_{Amax} noise level, dB
Haul truck or road truck	125
FEL loading haul trucks	125
Dozer or FEL with reversing alarm	115
Reverse alarm	105-115[1]

1. Including a maximum modifying factor adjustment of 10 dB for tonal and intermittent noise as per Fact Sheet C of the NPfI.

The highest maximum noise levels from construction activities would likely result from handling, loading or transporting of material. The maximum sound power level (at source) for such events has previously been measured to be typically 125 dB L_{Amax}. Maximum noise levels at each assessment location were modelled under worst-case meteorological conditions for the night.

Predicted L_{Amax} noise levels at assessment locations were based on typical mobile plant and equipment positions during construction. Predictions were based on a single event, rather than the simultaneous operation of a number of plant items, because of the low probability of more than one maximum L_{Amax} noise event occurring concurrently.

Predicted L_{Amax} noise levels for the night period during worst-case meteorological conditions are provided in Table 7.12.

Table 7.12 Predicted maximum L_{Amax} noise levels

Assessment location	Predicted L_{Amax} noise levels, dB	L_{Amax} criterion, dB
R54	38	52
R57	37	52
All other assessment locations	<30	52

Note: these properties have been identified as sheds and therefore sleep disturbance impacts do not apply.

Predictions in Table 7.13 show that L_{Amax} noise levels for MOD1 during construction during the night period are expected to be well below the 52 dB L_{Amax} screening criteria at all residential assessment locations during worst-case meteorological conditions. Therefore, it is unlikely that MOD1 will cause sleep disturbance at any residential receivers and no further detailed assessment of sleep disturbance is required as per the NPfI. This finding is consistent with that of the NIA for the Balranald Project.

iii Road traffic noise

A review of the road traffic data from the Traffic Impact Assessment report (TIA) prepared by EMM for MOD1 (2022) and the TIA for the Balranald Project was completed.

The review indicated that traffic volumes associated with MOD1 during construction will be less than what is approved under the Balranald Project. Furthermore, transport routes associated with MOD1 will remain unchanged from the Balranald Project.

The approved and MOD1 road traffic volumes for construction are compared in Table 7.13. The predicted noise levels for MOD1 are also provided in Table 7.13 for all relevant roads.

Table 7.13 Comparison of road traffic volumes (construction)

Road	Approved daily traffic volumes		MOD1 daily traffic volumes		Increase in road traffic noise level
	All traffic	Heavy vehicles	All traffic	Heavy vehicles	$L_{Aeq,period}$, dB
Balranald-Ivanhoe Road (north of Oxley Road)	179	24	130	26	Nil
Balranald-Ivanhoe Road (5 km north of Sturt Highway)	755	264	481	102	Nil
Balranald-Ivanhoe Road (north of Moa Street)	878	289	616	130	Nil
Mayall Street (north of Market Street)	913	100	919	96	Nil
McCabe Street (southern end)	309	193	216	110	Nil
Sturt Highway (1 km south of Balranald)	1,782	677	1,786	601	Nil
Sturt Highway (east of MR 67 Balranald-Tooleybuc Rd)	1,282	449	1,386	485	0.3
Sturt Highway (Euston, east of Murray Bridge Road)	1,710	580	1,740	610	0.2
Balranald-Tooleybuc Road (northern section)	751	272	711	198	Nil
Balranald-Tooleybuc Road (southern section)	560	224	466	111	Nil
Balranald-Tooleybuc Road (at existing Tooleybuc Bridge)	1,226	321	1,199	218	Nil
Arumpo Road (western section)	33	3	36	3	0.1
Arumpo Road (eastern section)	22	2	24	2	0.3
Burke and Wills Road (northern end)	33	13	12	1	Nil
Burke and Wills Road (southern end)	44	14	24	2	Nil
Piper Street (at Sturt Highway)	102	33	91	15	Nil
Moa Street (at Sturt Highway)	501	22	448	22	Nil
Moa Street (north of O'Connor Street)	241	38	139	18	Nil
O'Connor Street (west of Moa Street)	157	38	151	20	Nil
Market Street Sturt Highway (west of Mayall Street)	3,274	606	3,575	660	0.3

The approved and MOD1 road traffic volumes for operations are compared in Table 7.14. The increase in predicted noise levels for MOD1 is also provided in Table 7.14 for all relevant roads.

Table 7.14 Comparison of road traffic volumes (operations)

Road	Approved daily traffic volumes		MOD1 daily traffic volumes		Increase in road traffic noise level
	All traffic	Heavy vehicles	All traffic	Heavy vehicles	$L_{Aeq,period}$, dB
Balranald-Ivanhoe Road (north of Oxley Road)	186	37	139	26	Nil
Balranald-Ivanhoe Road (5 km north of Sturt Highway)	798	298	600	197	Nil
Balranald-Ivanhoe Road (north of Moa Street)	929	324	741	225	Nil
Mayall Street (north of Market Street)	956	104	1,042	122	0.5
McCabe Street (southern end)	354	226	266	149	Nil
Sturt Highway (1 km south of Balranald)	1,893	732	1,946	706	Nil
Sturt Highway (east of MR 67 Balranald-Tooleybuc Rd)	1,334	465	1,459	517	0.4
Sturt Highway (Euston, east of Murray Bridge Road)	1,753	600	1,831	650	0.3
Balranald-Tooleybuc Road (northern section)	813	310	775	239	Nil
Balranald-Tooleybuc Road (southern section)	613	261	556	184	Nil
Balranald-Tooleybuc Road (at existing Tooleybuc Bridge)	1,310	362	1,322	296	Nil
Arumpo Road (western section)	59	16	38	3	Nil
Arumpo Road (eastern section)	47	14	25	2	Nil
Burke and Wills Road (northern end)	12	1	13	1	0.7
Burke and Wills Road (southern end)	23	2	25	2	0.2
Piper Street (at Sturt Highway)	105	32	89	9	Nil
Moa Street (at Sturt Highway)	503	23	455	23	Nil
Moa Street (north of O'Connor Street)	228	38	127	13	Nil
O'Connor Street (west of Moa Street)	162	38	152	15	Nil
Market Street Sturt Highway (west of Mayall Street)	3,401	630	3,744	696	0.4

On the roads where traffic volumes associated with MOD1 are predicted to increase when compared to the Balranald Project, during either construction or operations, the increase in noise levels are predicted to be negligible (up to 0.7 dB).

The increase in road traffic noise levels shown in Table 7.13 and Table 7.14 are unlikely to cause total road traffic noise levels (from baseline and proposed modification traffic combined) to exceed the relevant RNP noise criteria (refer to Table 7.8) at all nearest assessment locations. This is consistent with the findings of the road traffic noise assessment presented in the NIA for the Balranald Project.

Therefore, no additional road traffic noise impacts are anticipated from traffic associated with MOD1 when compared to the NIA for the Balranald Project.

7.1.4 Mitigation measures

i Operational noise

The MOD1 NIA identified that the noise management measures approved for the Balranald Project for operations based on the NIA for the Balranald Project were feasible, reasonable, and considered still valid for implementation on MOD1.

The proposed strategies to manage and mitigate potential noise impacts for MOD1 are consistent with the approved management and mitigation measures for the Balranald Project and contained in Appendix D.

ii Construction noise

Construction related noise management measures identified in the NIA for the Balranald Project were also considered to be feasible and reasonable and are proposed for implementation in MOD1.

7.1.5 Conclusion

The NIA completed for MOD1 addressed operational noise, construction noise, sleep disturbance and road traffic noise.

Worst-case operational noise levels were predicted to satisfy the PNTLs at all assessment locations during noise-enhancing meteorological conditions for the day, evening, and night periods. When compared to approved site noise levels (NIA for the Balranald Project), the modelled overall noise levels predicted at all assessment locations for MOD1 is less than the approved Balranald Project.

Noise levels from proposed worst-case construction works during and outside the ICNG recommended standard construction hours (including the night period) were predicted to satisfy the relevant NMLs at all assessment locations during noise-enhancing meteorological conditions.

Maximum night-time noise levels from MOD1 have been predicted to satisfy the relevant sleep disturbance screening levels at all assessment locations.

Road traffic noise levels during operations and construction for MOD1 were predicted to satisfy the relevant noise criteria at all nearest assessment locations for all assessed roads.

Noise management and mitigation measures for the Balranald Project will be implemented during construction and operations for MOD1.

7.2 Air quality and greenhouse gas

An air quality impact assessment (AQIA) was undertaken by EMM, on behalf of Iluka, and is presented in Appendix F.

The AQIA consisted of:

- estimated particulate matter emissions for one worst-case year of the proposed modification;
- a greenhouse gas (GHG) assessment; and
- comparison of particulate matter and GHG emissions for MOD1 and the Balranald Project.

7.2.1 Assessment approach

The AQIA examined predicted concentrations of airborne particulates, toxic pollutants, dust deposition and estimated GHG emissions from MOD1 against the Balranald Project.

i Operational dust assessment

Assessment criteria for MOD1 was consistent with the AQIA for the Balranald Project (prepared in May 2015) with particulate matter (PM) emissions quantified for the three size fractions – total suspended particles (TSP), coarse particles (PM_{10}) and fine particles ($PM_{2.5}$). Emission rates for PM_{10} and $PM_{2.5}$ were estimated using ratios for the different particle size fractions available in the literature (principally the US-EPA AP-42).

Due to MOD1 adopting a proposed underground mining method, as opposed to the approved open cut method, predicted metal trace concentrations were well below the impact assessment criteria identified in the AQIA for the Balranald Project and were not reassessed for MOD1.

ii Greenhouse gas assessment

The estimation of GHG emissions for MOD1 was based on the Department of Industry, Science, Energy and Resources (DISER) (2021) *National Greenhouse Accounts Factors* (NGAF) workbook.

The methodologies in the NGAF workbook follow a simplified approach, equivalent to the 'Method 1' approach outlined in the *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines* (Technical Guidelines) (DoE 2014). The Technical Guidelines are used for the purpose of reporting under the Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act).

The GHG emission sources are listed in Table 7.15, representing the most significant sources associated with MOD1.

Table 7.15 Scope 1, 2 and 3 GHG emission sources

Scope 1	Scope 2	Scope 3
Direct emissions from diesel combustion.	Indirect emissions associated with the consumption of purchased electricity.	Indirect emissions from the extraction, production and transport of diesel.
Direct emissions from LPG use.	-	Indirect emissions from the extraction, production and transport of LPG.
-	-	Indirect emissions from electricity lost in delivery in the transmission and distribution network.
-	-	Indirect emissions associated with the transport of product via truck, rail and ship.
-	-	Indirect emissions from fuel for employee travel.

Estimates of fuel and electricity consumption associated with MOD1 were provided by Iluka. The adopted activity data for the emission estimates is presented in Table 7.16.

Table 7.16 Indicative annual activity data

Operational year	Diesel consumption (litres - L)	LPG consumption (litres per year - L/yr)	Electricity consumption (megawatt hours - MWh)
Annual	904,196	446,204	21,900

7.2.2 MOD1 assessment

i Operational dust - estimated emissions

As MOD1 does not propose open cut mining techniques, particulate emissions have been identified as being the most dominant during the handling of soil and overburden.

The total topsoil/subsoil, overburden and ore handled during MOD1 is shown in Figure 7.2. The graph shows that the amount of topsoil/subsoil and overburden handled is highest during construction. The volume of ore processed is highest in Year 2, but only higher than Year 1 by approximately 50,000 t.

Year 1 was used for the purpose of assessment as Year 1 will see more handling of topsoil/subsoil and overburden than subsequent years of operation.

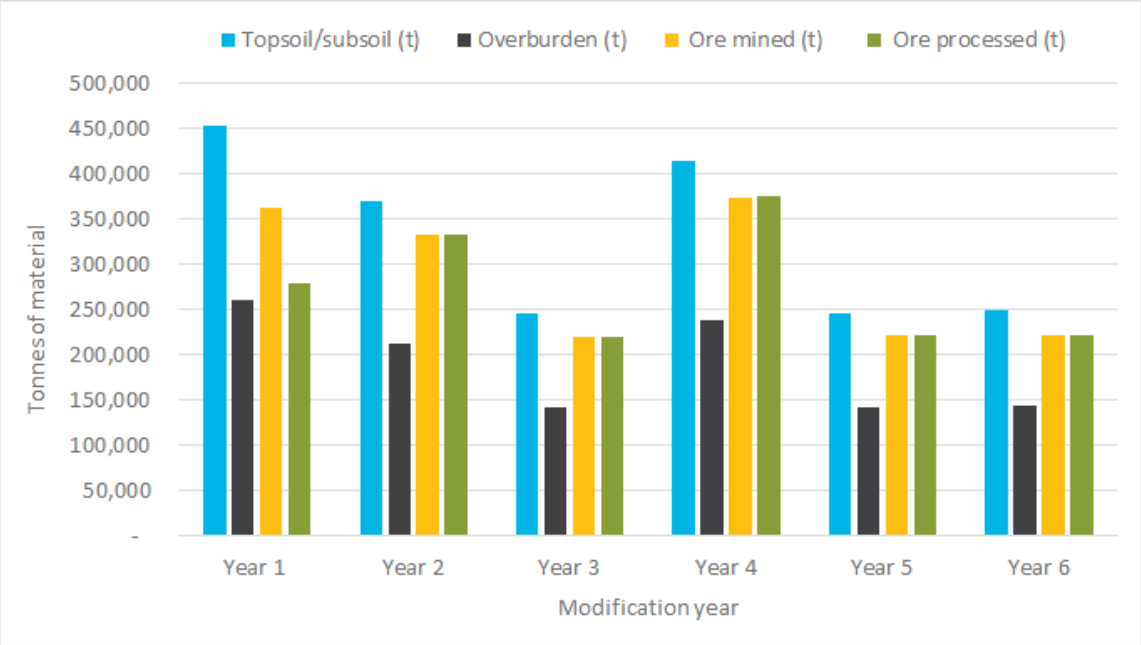


Figure 7.2 Total material handled by year of MOD1

The calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions for each activity in Year 1 are shown in Table 7.17. Further detail on the assumptions and emission factors used in the development of the emissions inventory is provided in the AQIA (Appendix F).

A graphical summary of the contribution to annual dust emissions by source type is provided in Figure 7.3. As previously stated, the most significant source of particulate matter emissions from Year 1 of MOD1's operation is associated with material handling. The next highest emission sources are wheel-generated dust from hauling and stack emissions (associated with the product drying process).

Table 7.17 Estimated emissions (kg/year) – Year 1

Activity	TSP emissions (kilograms per year - kg/yr)	PM_{10} emissions (kg/yr)	$PM_{2.5}$ emissions (kg/yr)
Soil and overburden stripping and re-handling			
Dozer on soil and OB	17,866	3,838	1,876
Scraper stripping topsoil/subsoil/OB	20,671	12,403	641
Scraper unloading topsoil/subsoil/OB	142,561	85,537	4,419
Excavator loading soil and OB to truck	740	350	53
Trucks hauling soil and OB to stockpiles	16,801	4,731	473
Trucks unloading soil and OB to emplacement area	740	350	53
Product and waste			
HMC - loading stockpiles	131	62	9
HMC - loading trucks	41	20	3
HMC - haul off-site	19,818	3,804	920
WHIMS product drying (baghouse stack)	28,382	28,382	28,382
WHIMS product screening	205	69	5
Tailings - unload to tailings stockpile	113	54	8
Wind erosion			
Topsoil/subsoil/OB stockpile	2,401	1,201	180
HMC stockpile	59	29	4
Rougher head feed stockpile	306	153	23
Sand tails stockpiles	527	264	40
Miscellaneous			
Grader	809	565	50
Other			
Site diesel combustion	543	543	497
Total	**252,715**	**142,353**	**37,638**

Note: OB = overburden, HMC = heavy metal concentrate, WHIMS = wet high intensity magnetic separators

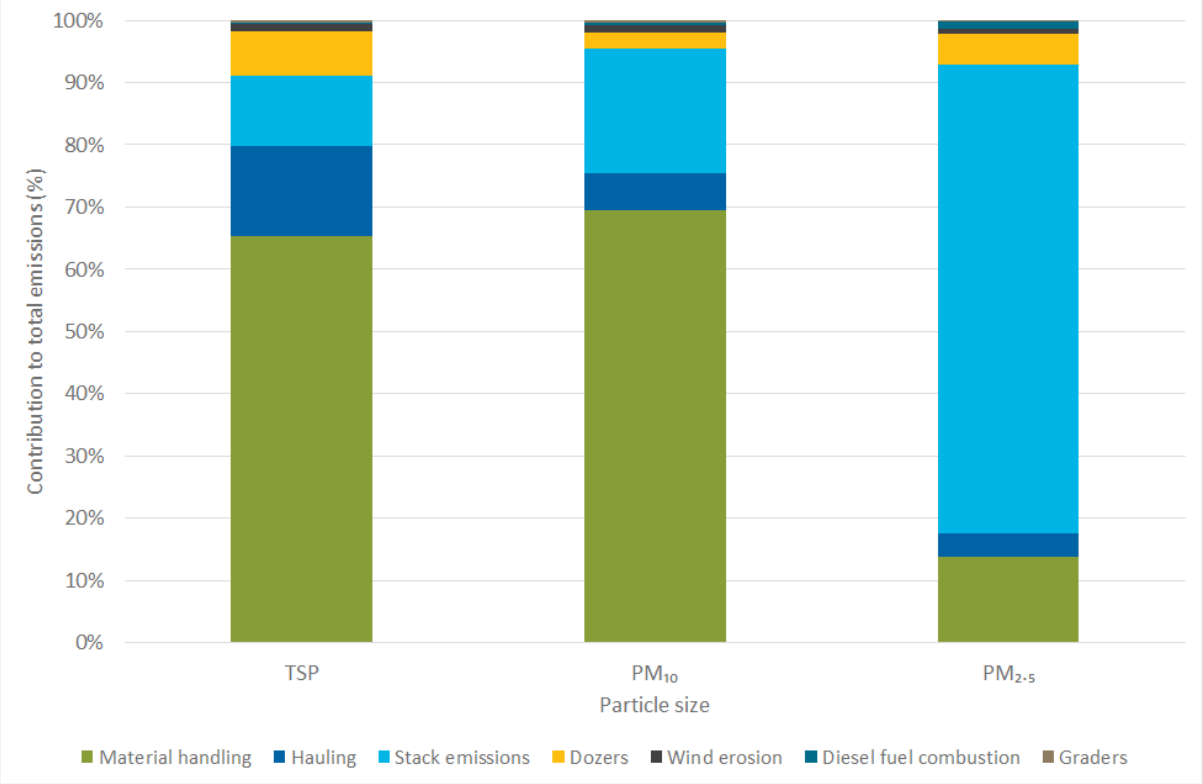


Figure 7.3 Contribution to annual emissions by emissions source type and particle size – Year 1

A comparison of emission estimates from the AQIA for the Balranald Project worst-case year (Year 8) and MOD1's worst-case year (Year 1) is shown in Table 7.18.

The comparison shows that estimated emissions for MOD1 will be less than the approved Balranald Project by 92%, 86% and 75% in TSP, PM_{10} and $PM_{2.5}$ emissions respectively. A large proportion of the reduction in emissions is due to the fact that MOD1 will be completed using underground mining methods as opposed to open-cut mining as assessed in the AQIA for the Balranald Project. Emission estimates for MOD1 also include additional dust control measures.

Table 7.18 Comparison of estimated particulate matter emissions

	TSP emissions (kg/yr)	PM_{10} emissions (kg/yr)	$PM_{2.5}$ emissions (kg/yr)
AQIA for the Balranald Project – Year 8	3,190,476	1,007,639	152,553
MOD1 emissions – Year 1	252,715	142,353	37,638
Decrease with MOD1	**92%**	**86%**	**75%**

7.2.3 Mitigation measures

The proposed strategies to manage and mitigate potential air quality and greenhouse gas impacts for MOD1 are consistent with the approved Balranald Project and contained in Appendix D.

7.2.4 Greenhouse gas assessment

The estimated annual GHG emissions for each emission source in each year are presented in Table 7.19. Details of the GHG emissions calculations are provided in the AQIA (Appendix F).

The significance of MOD1's GHG emissions relative to State and National GHG emissions is made by comparing annual average GHG emissions against the most recent available total GHG emissions inventories (calendar year 2019[1]) for NSW (136,579 kt CO_2-e) and Australia (529,298 kt CO_2-e). The significance of emissions has been calculated for each year of the proposed modification and is shown in Table 7.20.

Annual average GHG emissions (Scope 1) generated by MOD1 represent 0.0016% of total GHG emissions for NSW and 0.0004% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2018. Annual average GHG emissions (Scopes 2 and 3) generated by MOD1 represent a maximum of 0.0407% of total GHG emissions for NSW and 0.0105% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2019.

Table 7.19 Estimated annual GHG emissions (all scopes)

Operational year	Scope 1 (t CO_2-e/year)	Scope 2 (t CO_2-e/year)	Scope 3 (t CO_2-e/year)	Total
Year 1	2,241	17,301	32,508	**52,050**
Year 2	2,241	17,301	38,343	**57,885**
Year 3	2,241	17,301	25,969	**45,511**
Year 4	2,241	17,301	13,682	**33,224**
Year 5	2,241	17,301	26,043	**45,585**
Year 6	2,241	17,301	26,002	**45,544**

Table 7.20 Significance of emissions

Operational year	NSW		Australia	
	Scope 1	Scope 2 and 3	Scope 1	Scope 2 and 3
Year 1	0.0016%	0.0365%	0.0004%	0.0094%
Year 2	0.0016%	0.0407%	0.0004%	0.0105%
Year 3	0.0016%	0.0317%	0.0004%	0.0082%
Year 4	0.0016%	0.0227%	0.0004%	0.0059%
Year 5	0.0016%	0.0317%	0.0004%	0.0082%
Year 6	0.0016%	0.0317%	0.0004%	0.0082%

A comparison of GHG emission estimates from the AQIA for the Balranald Project worst-case year MOD1's worst-case year is shown in Table 7.21. The comparison shows that estimated emissions for MOD1 will be less than the approved Balranald Project by 97% for Scope 1 emissions and 94% for Scope 2 and 3 combined emissions.

Table 7.21 Comparison of GHG emissions estimates

	Scope 1 (t CO_2-e/year)	Scope 2 and 3 (t CO_2-e/year)
2015 AQGHGA	86,813[a]	673,121[b]
Proposed MOD1 emissions	2,364	55,644[c]
Decrease with the proposed modification	**97%**	**92%**

Notes: [a] Year 7 in the 2015 AQIA
[b] Year 3 in the 2015 AQIA
[c] Year 2 of proposed modification emissions

7.2.5 Conclusion

The AQIA for MOD1 provides estimated emissions data which predicts that MOD1 emissions effecting air quality and contribution to national GHG emissions will be significantly less than the approved Balranald Project.

A GHG assessment has also been completed for proposed MOD1 and results were compared against those presented in the 2015 AQIA. The comparison showed that the estimated GHG emissions for the proposed modification will be less the approved Balranald Project.

7.3 Traffic and transport

A traffic impact assessment (TIA) was undertaken by EMM, undertaken on behalf of Iluka, and is presented in Appendix G.

The TIA consisted of:

- an estimation of the MOD1 construction and operational traffic generation and distribution;
- a comparison of MOD1 predicted traffic impacts against the Balranald Project; and
- assessment of the potential road and intersection upgrades required for MOD1.

7.3.1 Assessment approach

The TIA assessed the construction and operation traffic impacts of MOD1, potential traffic impacts associated with the Atlas-Campaspe Mineral Sands Project to the north and consideration of the road safety audit (RSA) report prepared by Traffic Works Pty Ltd.

The approved construction and operation haulage routes for the Balranald Project are shown in Figure 7.4 and Figure 7.5 with MOD1 proposing to use the same routes.

i Assessment criteria

MOD1 will generate traffic during the construction and operational phases. Key assessment criteria for the TIA considered:

- construction traffic (oversize over mass vehicles (OSOM), workforce movements, delivery of construction materials, cumulative construction traffic);
- operations traffic (product haulage and delivery of mine supplies, workforce movements, consumables, waste removal and other miscellaneous deliveries product haulage);
- road and intersection upgrades; and
- traffic management and mitigation.

7.3.2 Existing environment

This section outlines the existing road network and the existing traffic volumes and includes a cumulative assessment of the Atlas-Campaspe Minerals Sands Project based on the Transport Planning Partnership (TPP) report.

i Road hierarchy

The NSW administrative road hierarchy comprises the following road classifications, which align with the generic road hierarchy and are as follows:

- State roads – freeways and primary arterials (managed by TfNSW);
- regional roads – secondary or sub arterials (managed by BSC and part funded by the State); and
- local roads – collector and local access roads (managed by BSC).

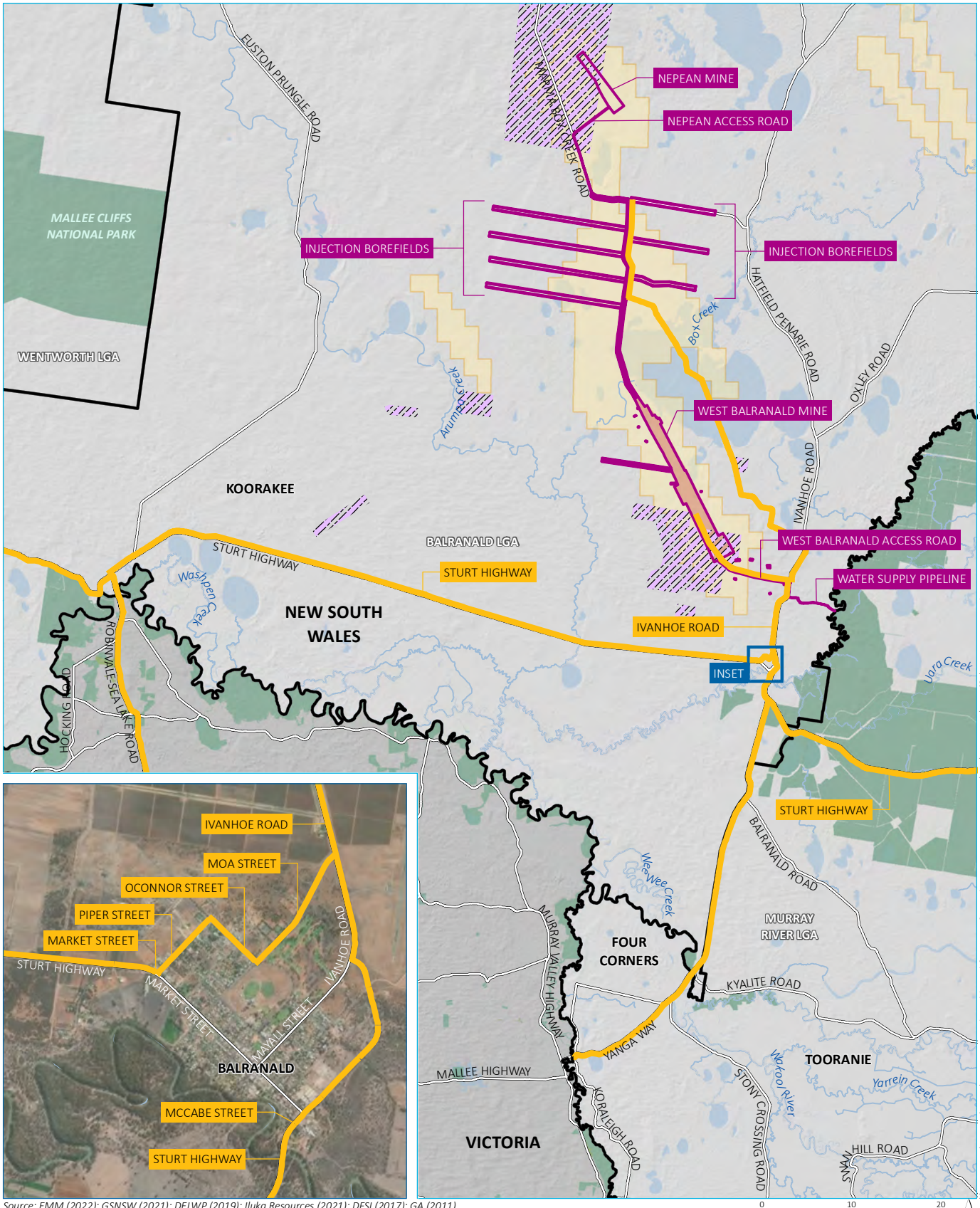
ii Existing road network

The existing road network is shown in Figure 7.4 and Figure 7.5 with the key roads including:

- Sturt Highway (named Market Street within Balranald town);
- Balranald-Ivanhoe Road (known as Mayall Street within Balranald town);
- Balranald-Tooleybuc Road (also known as Mallee Highway and Yanga Way);
- McCabe Street;
- Piper Street;
- O'Connor Street; and
- Moa Street.

iii Baseline traffic volumes

Baseline traffic volumes (daily and peak hourly) have been extracted from the TIA for the Balranald Project (EMM 2015). A linear growth rate of 2.5% per annum has been applied to estimate the predicted baseline volumes at the commencement of construction (in 2023) and commencement of operation (in 2024).



Source: EMM (2022); GSNSW (2021); DELWP (2019); Iluka Resources (2021); DFSI (2017); GA (2011)

0 10 20 km

GDA 1994 MGA Zone 54

N

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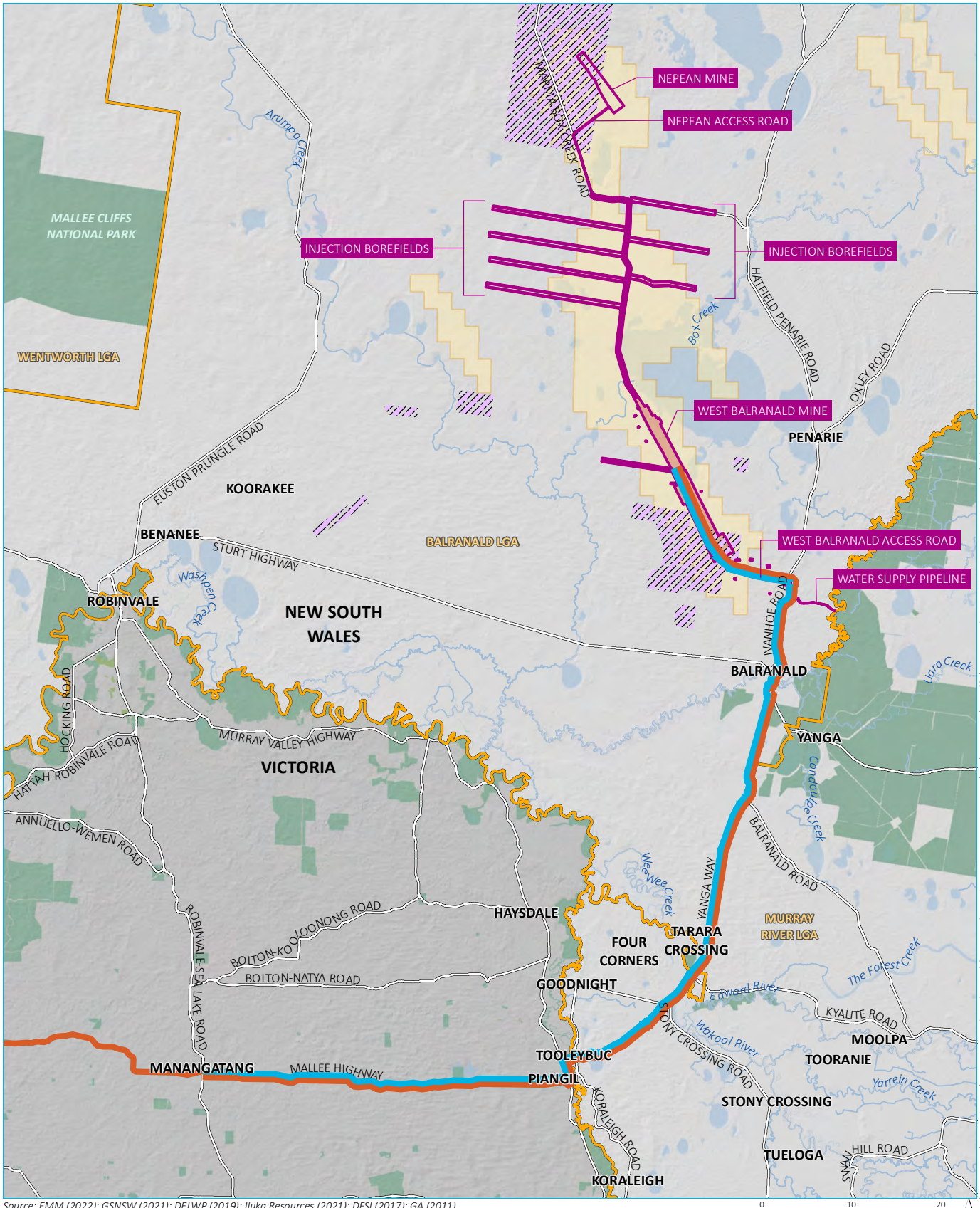
KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Approved EIS construction route
- Exploration Licence (EL7450)
- Mining Lease (ML1736)
- Southern Mallee Conservation Area (2015)
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest
- Local government area

Approved EIS construction routes

Balranald Mineral Sands Project
Modification report
Figure 7.4

EMM creating opportunities



Source: EMM (2022); GSNSW (2021); DELWP (2019); Iluka Resources (2021); DFSI (2017); GA (2011)

0 10 20 km

GDA 1994 MGA Zone 54

N

KEY

- EIS Approved Balranald Project Area (SSD-5285)
- HMC transport to Hopetoun or Hamilton
- Ilmenite transport to Manangatang
- Exploration Licence (EL7450)
- Mining Lease (ML1736)
- Southern Mallee Conservation Area (2015)
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest
- Local government area

Approved EIS operation haulage route

Balranald Mineral Sands Project
Modification report
Figure 7.5

EMM
creating opportunities

For road sections where peak hour traffic volumes were not available, it has been assumed that peak hour volumes would be 10% of the daily traffic volumes.

The baseline daily traffic volumes, heavy vehicles and peak hours for the assessment of 2023 construction and 2025 operations traffic for MOD1 are presented in Figure 7.4 and Figure 7.5 of Appendix G.

iv Atlas-Campaspe traffic

There is the potential for cumulative traffic impacts associated with the Atlas-Campaspe Mineral Sands Project, which is currently in the construction phase. These impacts would comprise increased traffic on certain roads, primarily on Balranald-Ivanhoe Road and Sturt Highway.

Traffic volumes associated with the construction and operation of the Atlas-Campaspe Mineral Sands Project have been extracted from the TPP report.

7.3.3 MOD1 assessment

The key intersections and road upgrade requirements for MOD1 include:

- Balranald-Ivanhoe Road/McCabe Street (MR67);
- West Balranald mine access road/Balranald-Ivanhoe Road;
- Sturt Highway/Balranald-Tooleybuc Road; and
- McCabe Street widened to at least 7.2 m (sealed).

i Balranald-Ivanhoe Road/McCabe Street intersection

The Balranald-Ivanhoe Road/McCabe Street intersection is shown in Plate 7.1.



Plate 7.1 Balranald-Ivanhoe Road/McCabe Street intersection

The current configuration of the intersection is 110 kilometres per hour (km/h) design speed T-junction with no intersection turn treatment for either northbound or southbound traffic on Balranald-Ivanhoe Road.

Based on the MOD1 cumulative construction and operation traffic volumes for the Balranald-Ivanhoe Road/McCabe Street intersection (Table 7.22 and Table 7.23), the following turn treatments, consistent with the approved Balranald Project, will be required:

- a basic right turn treatment (Austroads Type BAR) on the Balranald-Ivanhoe Road northbound approach; and
- a basic left turn treatment (Austroads Type BAL) on the Balranald-Ivanhoe Road southbound approach.

Table 7.22 Intersection turn treatment warrant for Balranald-Ivanhoe Road/McCabe Street (cumulative construction)

Movement	Peak hour	Major road traffic volume	Turning traffic volume	Turn treatment required
Left turn from major road	AM	51	29	BAL
	PM	64	28	BAL
Right turn from major road	AM	131	0	BAR
	PM	156	0	BAR

Table 7.23 Intersection turn treatment warrant for Balranald-Ivanhoe Road/McCabe Street (cumulative operations)

Movement	Peak hour	Major road traffic volume	Turning traffic volume	Turn treatment required
Left turn from major road	AM	69	42	BAL
	PM	76	41	BAL
Right turn from major road	AM	180	0	BAR
	PM	193	0	BAR

ii Balranald-Ivanhoe Road/West Balranald mine access intersection

The Balranald-Ivanhoe Road/West Balranald mine access intersection does not exist and is approved to be constructed as part of the Balranald Project.

As the Balranald-Ivanhoe Road has a posted speed limit of 100 km/h, the intersection should be designed for 110 km/h.

Based on the MOD1 cumulative construction and operation traffic volumes (Table 7.24 and Table 7.25) for the Balranald-Ivanhoe Road/West Balranald mine access intersection, the following turn treatments, consistent with the approved Balranald Project, will be required:

- a basic right turn treatment (Austroads Type BAR) on the Balranald-Ivanhoe Road southbound approach; and
- a basic left turn treatment (Austroads Type BAL) on the Balranald-Ivanhoe Road northbound approach.

Table 7.24 Intersection turn treatment warrant for Balranald-Ivanhoe Road/West Balranald mine access (construction)

Movement	Peak hour	Major road traffic volume	Turning traffic volume	Turn treatment required
Left turn from major road	AM	41	26	BAL
	PM	41	26	BAL
Right turn from major road	AM	108	0	BAR
	PM	108	0	BAR

Table 7.25 Intersection turn treatment warrant for Balranald-Ivanhoe Road/West Balranald mine access (operations)

Movement	Peak hour	Major road traffic volume	Turning traffic volume	Turn treatment required
Left turn from major road	AM	61	28	BAL
	PM	54	28	BAL
Right turn from major road	AM	150	0	BAR
	PM	136	0	BAR

iii Sturt Highway/Tooleybuc Road (Mallee Highway) intersection

The Sturt Highway/Tooleybuc Road (Mallee Highway) intersection is shown in Plate 7.2.



Plate 7.2 Sturt Highway/Tooleybuc Road intersection

As the Sturt Highway has a posted speed limit of 90 km/h, the intersection should be designed for 100 km/h.

The intersection peak hourly turning traffic volumes for the warrant assessment for the MOD1 cumulative construction and cumulative operations is summarised in Table 7.26.

The existing intersection has AUL/AUR turn treatment for northbound and southbound traffic on Sturt Highway. Based on the MOD1 cumulative construction and operations traffic volumes (Table 7.26) a channelised right turn (short) treatment (Austroads Type CHR(S)) will be required for the Sturt Highway/Balranald-Tooleybuc Road intersection prior to operations stage for right turning traffic on the Sturt Highway southbound approach.

Table 7.26 Intersection turn treatment warrant for Sturt Highway/Tooleybuc Road

Movement	Peak hour	Major road traffic volume	Turning traffic volume	Turn treatment required
Right turn from major road (construction)	AM	98	50	BAR
	PM	128	62	BAR
Right turn from major road (operation)	AM	125	62	BAR
	PM	157	74	CHR(S)

iv Warrant for rural road upgrades

To determine the need for rural road upgrades (eg road widening), EMM considered whether the predicted daily traffic movements would exceed the design standard in terms of road width, as per the *Austroads Guide to Road Design Part 3: Geometric Design* (Austroads, 2016). The existing road widths, predicted daily traffic movements for the MOD1 and warrant for rural road upgrades are outlined in Table 7.27.

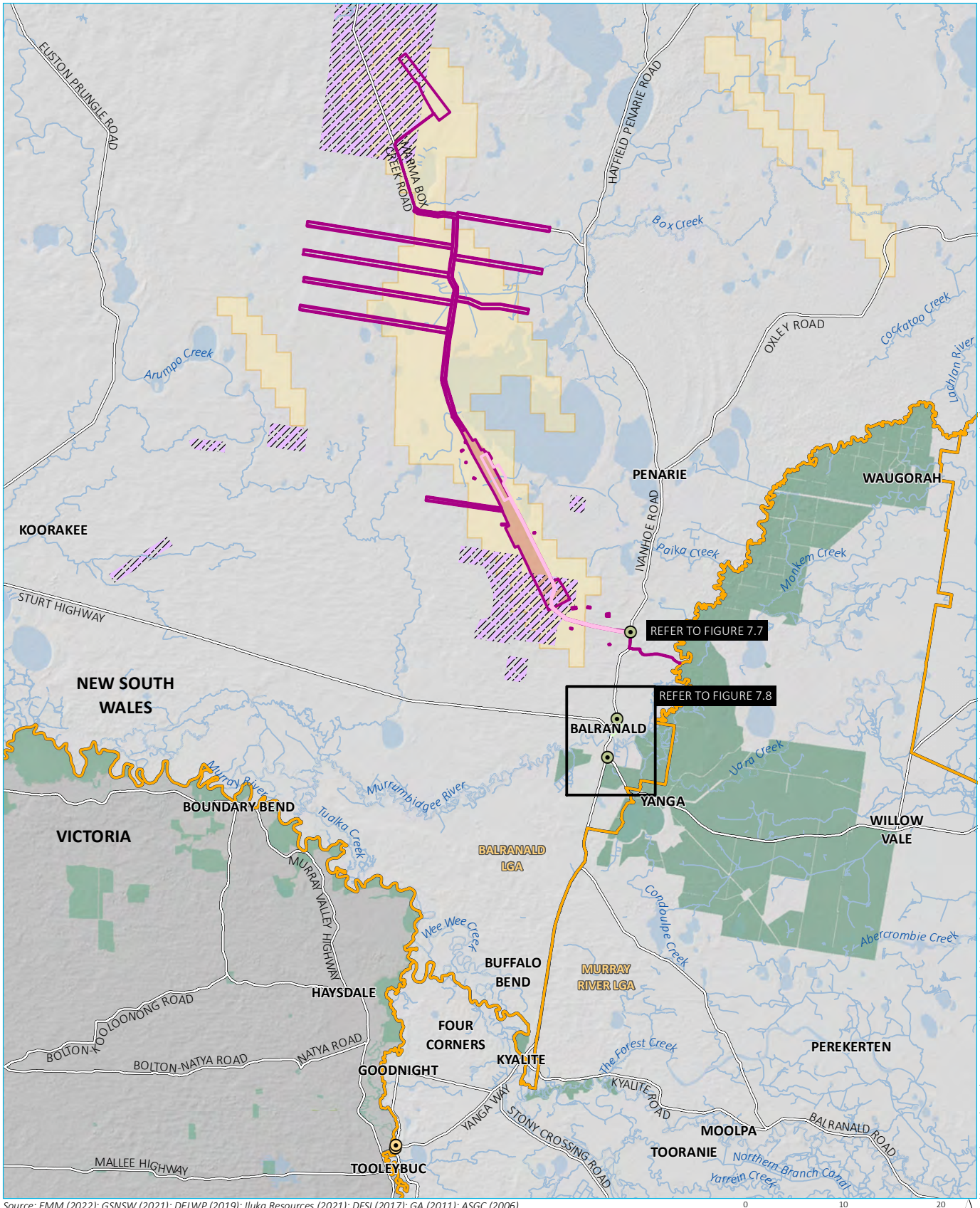
Table 7.27 Cumulative construction and operation daily traffic volumes and corresponding design standards

Road	Description of road	Cumulative construction daily traffic volume	Cumulative operation daily traffic volume	Existing road width (approximate)	Austroads Guide to Road Design standard in accordance with daily traffic volume	Will meet Austroads design standard?
McCabe Street	Local road between Balranald-Ivanhoe Road (north) and Sturt Highway (south)	216	266	Narrow two-lane seal approximately 6.6 m to 7 m	Minimum 7.2 m wide seal	No

For MOD1, based on the cumulative construction and operation traffic volumes, a minimum 7.2 m sealed width, consistent with the approved Balranald Project, will be required on McCabe Street.

v Mitigation measures

The proposed strategies to manage and mitigate potential traffic and transport impacts for MOD1 are consistent with the approved Balranald Project and are shown on Figure 7.6 to Figure 7.8 and contained in Appendix D.



Source: EMM (2022); GSNSW (2021); DELWP (2019); Iluka Resources (2021); DFSI (2017); GA (2011); ASGC (2006)

0 10 20 km

GDA 1994 MGA Zone 54

N

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification study area
- Exploration Licence (EL7450)
- Mining Lease (ML1736)
- Southern Mallee Conservation Area (2015)
- Major road
- Watercourse/drainage line
- Waterbody
- NPWS reserve
- State forest
- Local government area

Intersection upgrade

- Asphalt wearing course
- Turn treatment

Road upgrade

- 100 m seal
- Asphalt resurfacing 7m sealed width

Proposed MOD1 traffic management and mitigation

Balranald Mineral Sands Project
Modification report
Figure 7.6

EMM creating opportunities



Source: EMM (2022); Iluka Resources (2021); DCS-SS (2021); DFSI (2017); GA (2011); ASGC (2006)

0 50 100 m

GDA 1994 MGA Zone 54

N



KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Major road
- Vehicular track
- Cadastral boundary

Intersection upgrade

- Turn treatment

Road upgrade

- 100 m seal

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Proposed MOD1 traffic management and mitigation

Balranald Mineral Sands Project
Modification report
Figure 7.7

EMM creating opportunities



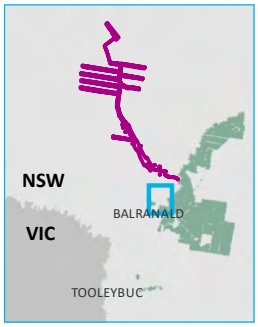
Source: EMM (2022); ESRI (2021); Iluka Resources (2021); DCS-SS (2021); DFSI (2017); GA (2011); ASGC (2006)

0 0.5 1 km

GDA 1994 MGA Zone 54

N

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- NPWS reserve

Intersection upgrade

- Turn treatment

Road upgrade

- Asphalt resurfacing 7m sealed width

Proposed MOD1 traffic management and mitigation

Balranald Mineral Sands Project
Modification report
Figure 7.8

EMM creating opportunities

7.3.4 Conclusion

The TIA assessed the construction and operational traffic associated with MOD1. The key assessment findings for MOD1 include:

- The haulage route for MOD1 is the same route that was approved for the Balranald Project.
- The following intersection upgrades are required for the MOD1:
  - McCabe Street/Balranald-Ivanhoe Road (MR67) intersection requires basic right turn (BAR) and a basic left turn (BAL) treatment;
  - West-Balranald mine access road/Balranald-Ivanhoe Road intersection requires BAR and BAL treatment; and
  - Sturt Highway/Balranald-Tooleybuc Road intersection requires CHR (S) treatment.
- The following road upgrades are required for the MOD1:
  - McCabe Street to be widened to at least 7.2 m (sealed).

With the proposed modification to approved operations, the TIA demonstrates that the traffic levels from MOD1 (construction, operational) are predicted to be lower or similar to predictions in the TIA for the Balranald Project.

7.4 Surface water

A surface water impact assessment (SWIA) of MOD1 was conducted by EMM, on behalf of Iluka, and is provided in Appendix H.

The SWIA consisted of:

- assessment of surface-water related impacts for MOD1 (eg loss of surface water catchment area, site inundation risk, interference with flooding, water quality effects due to mine affected runoff and mine water discharges, site water balance); and
- comparison of predicted impacts of MOD1 against the Balranald Project as provided in the *Surface Water Management Report* (SWMR) prepared by WRM Water and Environment Pty Ltd (WRM) (2015).

7.4.1 Assessment approach

The results of the flood model prepared as part of the SWMR were used to assess flood impacts associated with MOD1. WRM (2015) used the TUFLOW hydraulic model to simulate flow behaviour of Box Creek and its floodplain (including Muckee Lake, Pitarpunga Lake and Tin Tin Lake) to investigate the possibility of the site becoming inundated by floodwater.

7.4.2 Existing environment

There are several permanent and non-permanent (or ephemeral) water features located within the Project area's regional setting.

The Lachlan River is located 3.5 km north-west of the Project area. The Murrumbidgee River is approximately 13 km south-east of the Project area. It flows in a south-westerly direction toward its confluence with the Murray River, approximately 60 km south-west of the Project area. These rivers contain fresh water and are frequently used for town water supply and irrigation purposes.

During high flooding events, the Lachlan River can also flow into the Murrumbidgee River via the Great Cumbung Swamp. The swamp is a wetland connected to both the Murrumbidgee and Lachlan Rivers and is located approximately 42 km east of the Project area. The swamp is approximately 16,000 ha and is listed on the Directory of Important Wetlands in Australia. It consists of a series of dry lakes and lunettes which supports large areas of reeds and riverine woodland species and to numerous waterbird species.

Other riparian environments near the Project area include Yanga Lake and the Lowbidgee Floodplain, which are both listed on the Directory of Important Wetlands in Australia. Yanga Lake is an ephemeral waterbody located 35 km south-east of the Project area. The Lowbidgee Floodplain is located in the lower reaches of the Murrumbidgee River catchment and south-west of the Cumbung Swamp.

The Murrumbidgee, Murray and Lachlan rivers are regulated by major dams in their headwaters. Water is also diverted to Balranald Weir and Paika Levee for irrigation purposes in addition to the artificial filling of lakes which would otherwise be dry (eg Waldaira, Yanga and Paika Lakes).

Box Creek is the main waterway within the Project area. It is an ephemeral watercourse and a distributary of the Lachlan River. Box Creek flows only during periods of heavy rainfall or flooding events, which has only occurred on several occasions in the past 60 years. Tin Tin, Pitarpunga and Muckee Lakes previously functioned as overflow lakes via Box Creek but have been predominantly dry for at least the last few hundred to thousand years. These dry lakes may receive water from Box Creek infrequently during flood events.

There is little locally derived runoff in the Project area due the dry climate, flat landscape, permeable soils and lack of permanent water sources.

The Loxton-Parilla Sands and Olney Formations lie beneath the Project area. Groundwater within these formations is predominately recharged from flows originating from areas east of the Project area rather than direct rainfall. This is due to the high evaporation rate within the Project area.

7.4.3 MOD1 assessment

MOD1 assessed:

- proposed activities:
  - the surface disturbance area; and
  - site water demands and proposed water sources (ie water balance);
- predicted impacts; and
- proposed mitigation (ie water management strategy).

The results of the flood model prepared for the SWMR were used for assessing the flooding aspects of the proposed modification; new modelling was not undertaken.

7.4.4 Proposed activities

i Surface disturbance area

The proposed above ground activities are shown in Figure 3.1 and include:

- construction and operation of mineral processing infrastructure;
- stockpiling of topsoil, subsoil and overburden;
- construction of drill pads and operation of mining infrastructure; and
- construction and use of mining access tracks and haul road.

ii Site water demand and proposed water sources

Project water demands for MOD1 are described in Table 7.28.

The largest component of the water balance is the mining water supply. It is proposed that 3,400 ML/year would be used to mobilise ore, with the majority (2,865 ML/year) of this then recovered. The total water imports to the site per year would be approximately 1,216 ML saline groundwater, 153 ML/year brackish groundwater, and 15 ML/year potable water.

At the time of preparing this modification report, a decision to construct and operate the approved fresh water supply pipeline from the Murrumbidgee River had not been made by Iluka. If constructed the Murrumbidgee water supply would supplement a portion of the brackish groundwater and potable water demands.

As MOD1 project site is located in a low rainfall area, rainfall is not expected to influence the water balance.

Table 7.28 Proposed operational phase water demands and sources (ML/year)

Demands		Sources				
Water use	**Volume**	**Hyper saline groundwater**	**Brackish groundwater**	**Ore body groundwater**	**Floc and reagents**	**Potable water truck**
		Imported	**Imported**	**Recovered with ore**	**Imported**	**Imported**
Mining						
Mining water supply	3,400	536	-	2,864		-
Processing	714	616	68	-	26	-
Water in Tails	689					
Water in Product	26					
Site operation						
Dust suppression	85	-	85	-	-	-
Evaporation from dams	60	64	-	-	-	-
Potable use	15	-	-	-	-	15
Total demand	**4,274**	**1,216**	**153**	**2,864**	**26**	**15**

7.4.5 Predicted impacts

MOD1 will not result in any new or additional impacts to those identified in the SWMR as summarised below.

a Loss of catchment area

The loss of catchment area associated with Box Creek for MOD1 will be no more than for the approved Balranald Project.

The Balranald Project would result in 52 ha of the Box Creek catchment area being lost to the voids associated with open cut mining. As MOD1 will involve underground mining technique, this will limit the loss of catchment area to bunded areas within the Project area, such as stockpile areas and processing infrastructure.

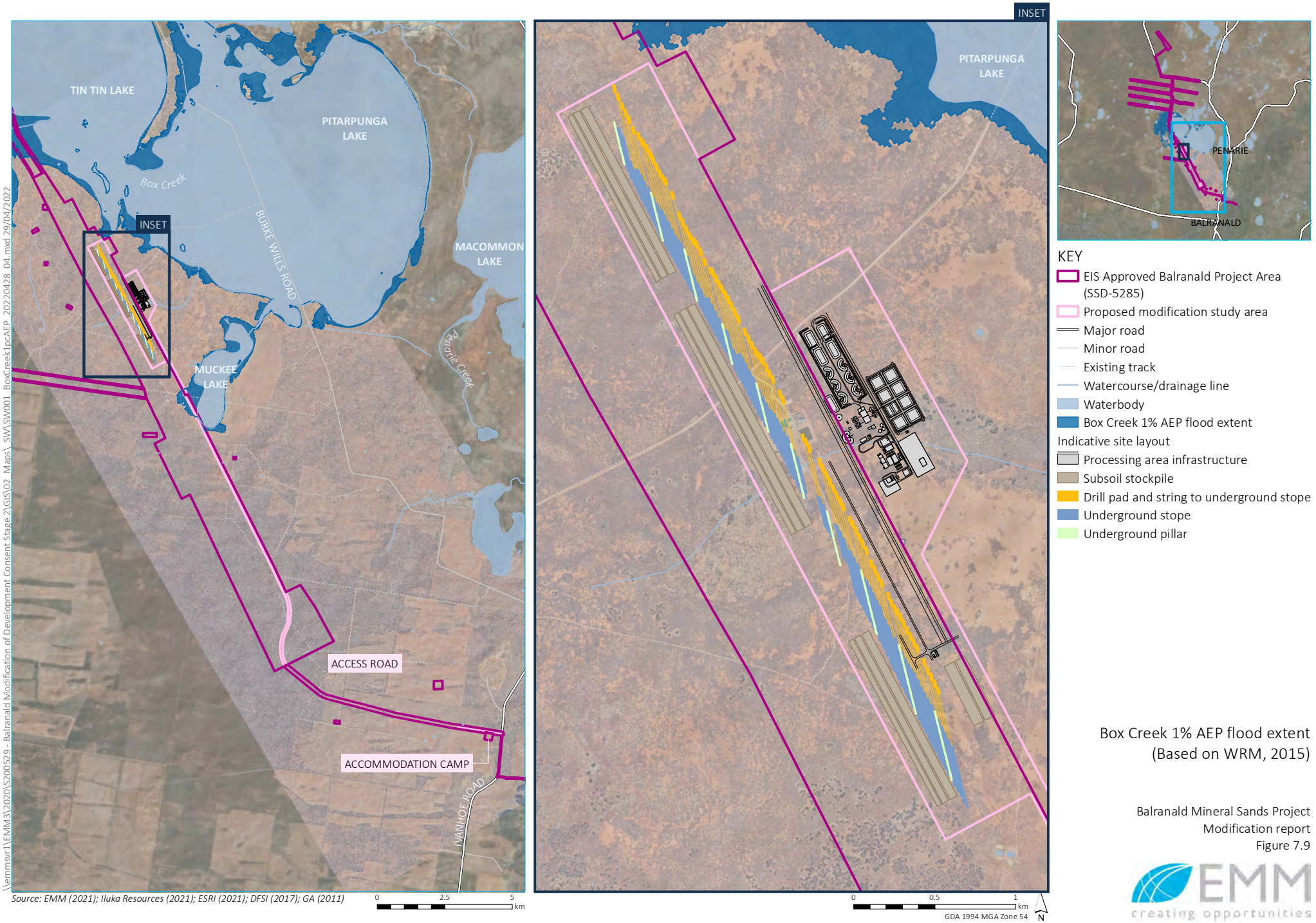
It is predicted that there will be no change between loss of catchment area associated with pre or post mining conditions.

b Site inundation

MOD1 would result in a reduced site inundation risk as there will be a reduced surface footprint.

Flood modelling indicates that parts of the MOD1 project area may be affected by local flooding (Figure 7.9). MOD1 mining infrastructure may require bund walls to exclude unaffected runoff from the site.

Part of the haul road could also be inundated by flooding of Muckee Lake via Box Creek (Figure 7.10). The access road would be constructed, with culverts at local low points to allow runoff to pass under the road.

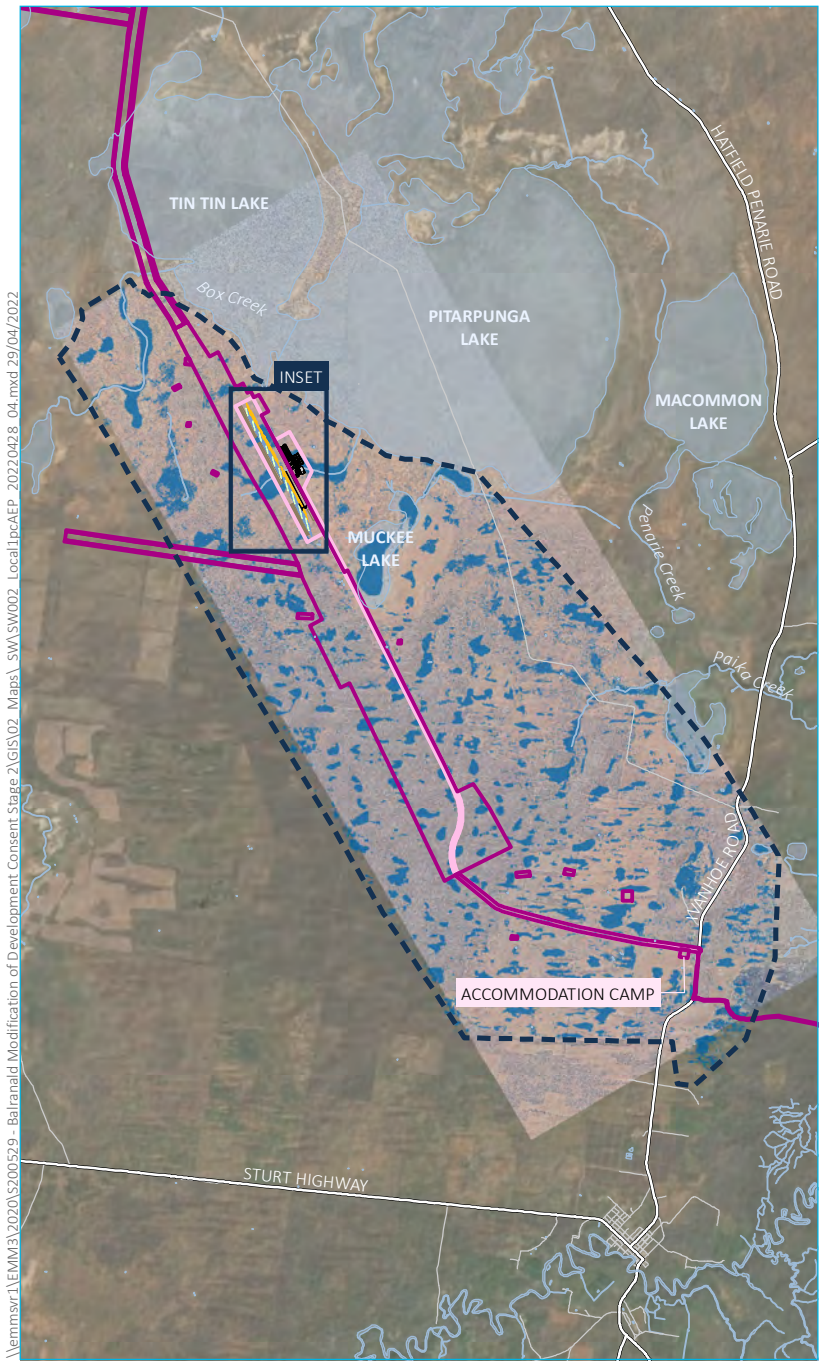


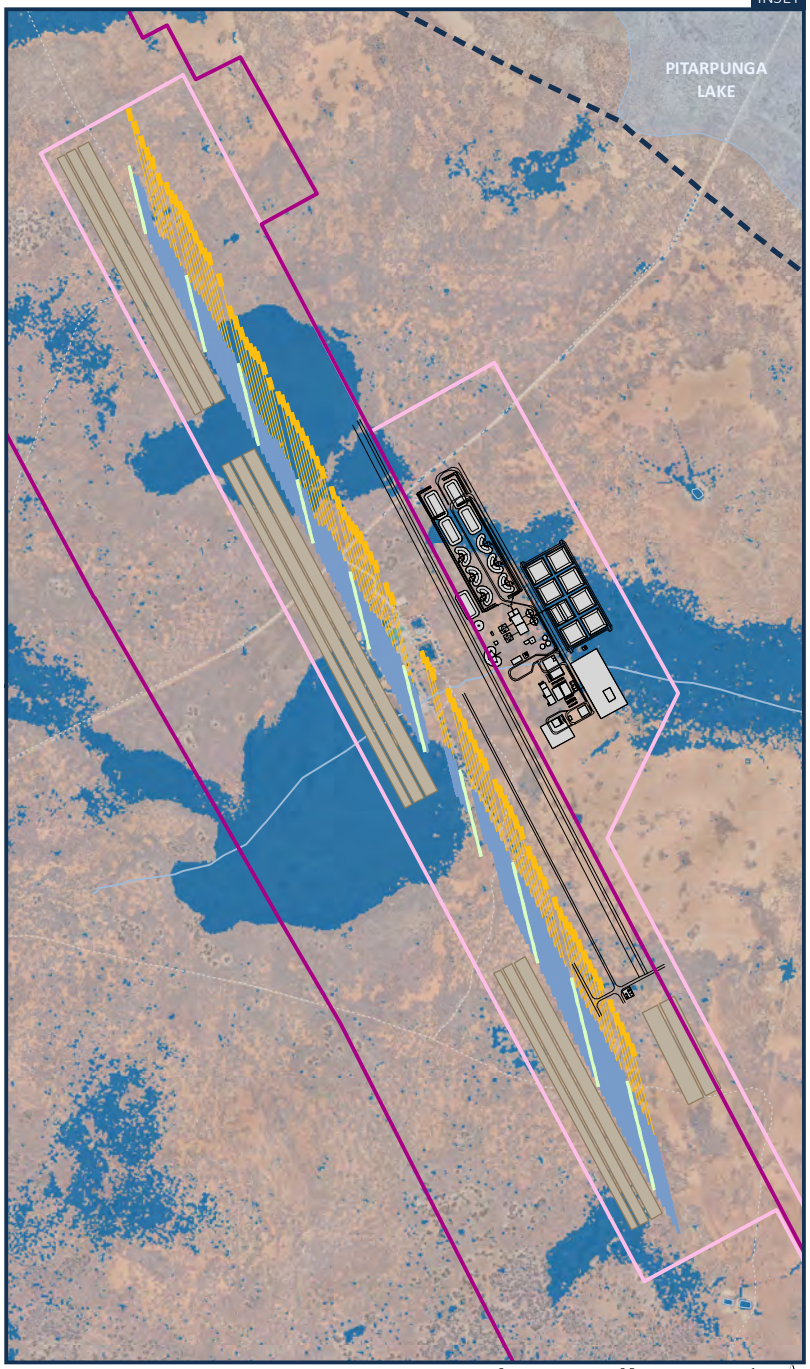
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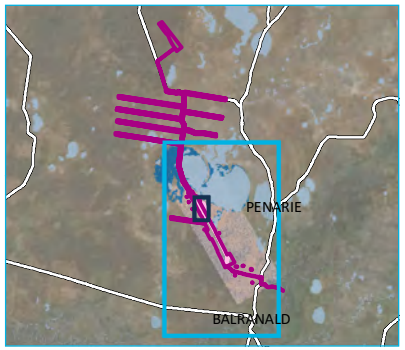
Box Creek 1% AEP flood extent
(Based on WRM, 2015)

Balranald Mineral Sands Project
Modification report
Figure 7.9

EMM
creating opportunities







KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification study area
- Major road
- Minor road
- Existing track
- Watercourse/drainage line
- Waterbody
- Limit of reporting

Local 1% AEP rainfall runoff flood extent

- > 0.15 m

Indicative site layout

- Processing area infrastructure
- Subsoil stockpile
- Drill pad and string to underground stope
- Underground stope
- Underground pillar

Local 1% AEP rainfall runoff extent

Source: EMM (2021); Iluka Resources (2021); ESRI (2021); DFSI (2017); GA (2011)

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Balranald Mineral Sands Project
Modification report
Figure 7.10

EMM creating opportunities

ii Interference with flooding

The SWIA notes that most of the processing infrastructure will be located outside of the predicted flood extent of Box Creek. For infrastructure located within flood prone land, flood waters are not expected to be impacted due to factors listed below.

- the haul road would be constructed with culverts at local low points to allow runoff to pass under the road. During large floods, flood waters may pass over the road; and
- surface diversion channels and bunds would be constructed to divert surface water runoff around process infrastructure, stockpiles and drill pads.

iii Mine affected runoff

As with the approved Balranald Project, it is unlikely that surface water runoff from MOD1 would contaminate the surrounding environment. This is primarily due to a lack of surface water within the Project area.

Regardless, there is still potential for minor amounts of contaminated surface water runoff to enter the surrounding environment, which would be prevented through the implementation of a Water Management Plan (WMP). Uncontaminated surface water runoff from undisturbed areas would be discharged off-site.

Surface water runoff from disturbed areas (ie processing infrastructure, stockpiles and drill pads) would be captured and stored as part of the water management strategy. No run-off from disturbed areas would be released from the site.

iv Mine water overflow

MOD1 will not change the probability of mine water overflow. The SWIA predicts that the annual probability of overflow from mine water management ponds would be less than 1% due to:

- the ponds having sufficient freeboard to prevent overfilling during a 1% annual exceedance probability (AEP) storm event; and
- process water flows into and between ponds would be pumped, with optional pump shut-off in the case of failure or high water level conditions.

v Regional water availability

If the fresh water pipeline from the Murrumbidgee River is constructed, it would be used to supply part or all of the 'brackish water' demand and potable water demand for MOD1 (see Table 7.28). During site operations it is expected that these demands would total 163 ML/year, representing approximately 0.04% of the total high security water licenses, or approximately 0.01% of general security licenses.

It is proposed that, if required, licenses to extract this volume would be obtained via water trading following the rules described in the relevant WSP. Water trading following the trading rules described in the WSP is not expected to affect river flow regime or ecology. The volumes proposed are minor in the context of the total volumes licensed and would not be expected to distort prices for other water users.

vi Mitigation measures

The proposed strategies to manage and mitigate potential surface water impacts for MOD1 are consistent with the approved Balranald Project and contained in Appendix D.

7.4.6 Conclusion

The magnitude and/or extent of the potential surface water impacts of MOD1 is within the impact levels assessed for the approved Balranald Project. The mitigation and management measures for the approved Balranald Project are expected to be effective and appropriate for MOD1.

7.5 Groundwater

A groundwater impact assessment (GIA) and groundwater modelling report were prepared by EMM, on behalf of Iluka, and are presented in Appendix I and Appendix J.

The purpose of the GIA is to assess the extent and significance of predicted groundwater-related impacts associated with MOD1.

A standalone groundwater modelling report, included as Appendix A to the GIA, has also been prepared as part of this assessment and independently peer reviewed by Hugh Middlemiss of HydroGeoLogic Pty Ltd (HydroGeologic 2022a).

7.5.1 Assessment approach

The assessment of project-related impacts to groundwater resources and associated receptors considers the requirements of the WM Act, the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources Order 2020* (MDB Porous Rock WSP 2020), and the minimum impact considerations that are outlined in the AIP.

Some of the key water affecting activities associated with MOD1 that have the potential to impact groundwater resources and associated receptors are limited to the interception of groundwater via underground mining, groundwater extraction via production bores and seepage from sand tails.

A groundwater risk assessment framework was adopted to categorise and characterise risk in-line with the National Water Commission's (NWC) mining risk framework (NWC 2010). The groundwater risk assessment framework uses a source-pathway-receptor model to characterise the significance of a water-affecting activity, grouping these as either 'direct' or 'indirect' impacts.

Changes to current groundwater conditions caused by the interception of groundwater for mining purposes (direct impacts) potentially include:

- changes in groundwater quantity, including changes in groundwater levels/pressures and flow; and
- changes in groundwater quality, including changes in salinity and concentrations of other water quality parameters (such as pH, major ions, metals, hydrocarbons and nutrients).

The following summarises groundwater receptors that have the potential to be affected by the mining activities (indirect effects):

- changes to water access and quality for ecosystems that potentially rely on groundwater;
- changes to surface water and groundwater interaction for watercourses, swamps and springs that receive baseflow; and
- changes to water access and quality at third party groundwater users (bores).

The results of the groundwater modelling have been used to assess direct and indirect impacts associated with MOD1 (Section 7.5.3).

i Assessment criteria

The GIA considers the geological and hydraulic properties of the area of MOD1 and surrounds, and uses the assessment criteria provided in the guidelines, technical and policy documents.

The predicted impacts of activities affecting groundwater resources (and associated receptors) has been assessed against the minimum impact considerations outlined in the AIP. Impacts to groundwater are assessed via the consideration of high priority groundwater dependent ecosystems (GDEs), high priority culturally significant sites, and third-party bores.

a Existing environment

A detailed description of the groundwater-related environment, extending principally to the MOD1 area and surrounds, is described in Section 3 of the GIA with key elements summarised below.

Hydrology

On a regional scale, the Murrumbidgee and Murray rivers are the major permanent surface water features in the vicinity of the Balranald Project area. The Murrumbidgee and Murray rivers provide key water resources for large populations within the Murray Darling Basin including town water supplies, agriculture and the environment.

As discussed previously in Section 7.4, locally, the main surface water feature within the Balranald Project area is Box Creek. Most of the Balranald Project is located within the Box Creek catchment, however the creek only flows during and immediately following heavy local rainfall or large flooding events. Permanent surface water flows are confined to the major rivers and their associated backwaters outside of the Balranald Project area.

Hydrogeology

The three main aquifer units in the immediate vicinity of MOD1 are:

- the Shepparton Formation (SFM);
- the ore-hosting Loxton-Parilla Sands (LPS); and
- the Lower Renmark Group Formation (also known as the Olney Formation; Brown and Stephenson, 1991).

The SFM consists of a thick layer of unconsolidated to poorly consolidated clay sand silty clays with interbedded sand lenses. This unit is highly variable across the West Balranald deposit and drilling has defined two dense clay layers (locally up to 4 to 6 m thick). Moderately to strongly indurated iron cemented rock layers are also present within the sand dominant lenses between the clay layers. The thickness of the unit varies from approximately 19 m at the northern end to more than 36 m through central and southern areas of the West Balranald deposit.

The upper LPS marine sequence (referred to as LPS1) varies in thickness along the strike of the deposit from 16–20 m in the north to more than 60 m at the southern end. The sequence typically consists of three upper beach facies: foreshore, surf zone and lower shore; the different facies have varying horizontal hydraulic conductivities. A marine transgression marks the boundary between the LPS1 and the lower (older) marine sequence. The lower marine sequence (LPS2) is host to the West Balranald deposit and also consists of three facies (foreshore, surf zone and lower shore), with the mineral sands deposit typically lying within the foreshore facies of LPS2.

Within other geologic units, sediments are observed to be heterogeneous in nature and can act as localised and temporal aquifers. The Olney Formation is the regionally extensive early-Tertiary lacustrine system, specifically underlying the wider Balranald Project, and consists of the Upper, Middle and Lower Renmark Group.

Groundwater levels and flow direction

Regional groundwater level measurements obtained during 2014 from the dedicated groundwater monitoring network and prior to any large-scale site activities, have been used to develop plan-view unstressed potentiometric surfaces for the SFM, LPS and Olney Formation aquifers of interest (Figure 7.11).

The Geera Clay forms a hydraulic barrier to lateral flow in the middle Olney Formation, forcing westerly groundwater flow lines in the middle and upper Olney Formation to converge.

A strong vertical upwards gradient is pronounced at GW036866 (40 km north of Balranald) and GW036674 (68 km north of Balranald) where there is approximately 9 m and 5 m difference, respectively, in potentiometric head pressure between the LPS, and the Geera Clay and Olney Formation. It is likely that the Geera Clay prevents artesian pressures in the Olney Formation from equilibrating with the shallower units. Upward vertical head gradients are consistent with the monitoring sites being at the discharge end of the Balranald trough and near where basement rises, causing upward groundwater flow.

Although heads in the SFM and LPS are very similar, the results of pumping and injection trials during the 2014 site activities related to the GIA for the Balranald Project, indicate that the two units are poorly connected (Iluka 2015) and that significant head differences may be created when water is extracted from or injected into one or other of these units. This is likely to be associated with the clay lens observed throughout the Shepparton Formation, particularly near its base.

Hydraulic properties

Hydraulic conductivity in the SFM is highly variable, due to the heterogeneous nature of this Formation with sand and clay lenses throughout. Continual lateral flow through geological formations is not common. A range of bulk hydraulic conductivity is observed in the LPS, and this is due to the differences in the hydraulic conductivities of the surf and offshore zones. The stratification in this unit is likely to cause considerable vertical anisotropy in hydraulic conductivity measurements (WRM, 2015).

Horizontal hydraulic conductivity in the Olney Formation decreases proportionally with distance from the eastern to western Riverine Plain (Kellet 1994). Typically, the vertical hydraulic conductivity is at least an order of magnitude lower than horizontal hydraulic conductivity (Evans and Kellet 1989). The Geera Clay creates a steeper hydraulic gradient in the Olney Formation in response to the notable decrease in permeability.

The hydraulic properties in the MOD1 numerical groundwater model are presented in Table 7.29. The anisotropy in the LPS is represented by five layers, from shallow to deep: LPS1 foreshore, LPS1 surf zone, LPS1 lower shore + LPS2 foreshore, LPS2 surf zone and LPS2 lower shore. The SFM is modelled with two layers and isotropic hydraulic properties. The calibrated modelled aquifer properties are consistent with the parameters derived from historic hydrogeological field assessments.

Table 7.29 MOD1 modelled aquifer hydraulic properties

Formation	Kh (m/d)[1]	Kv (m/d)[2]	Sy[3]	Ss (m^{-1})[4]
Shepparton Formation	1	0.001	0.15	3×10^{-5}
LPS1 foreshore	0.9	0.001	0.15	3×10^{-5}
LPS1 surf zone	16–24	0.1	0.15	3×10^{-5}
LPS1 lower shore/LPS2 foreshore	0.9	0.001	0.15	3×10^{-5}
LPS2 surf zone	10–40	0.1	0.15	3×10^{-5}
LPS2 lower shore	0.9	0.001–0.13	0.15	3×10^{-5}
Geera Clay	0.0001	0.00001	0.15	3×10^{-5}
Olney Formation	3	0.3	0.15	3×10^{-5}

Notes: 1. Horizontal hydraulic conductivity
2. Vertical hydraulic conductivity
3. Specific yield
4. Specific storage

Groundwater quality

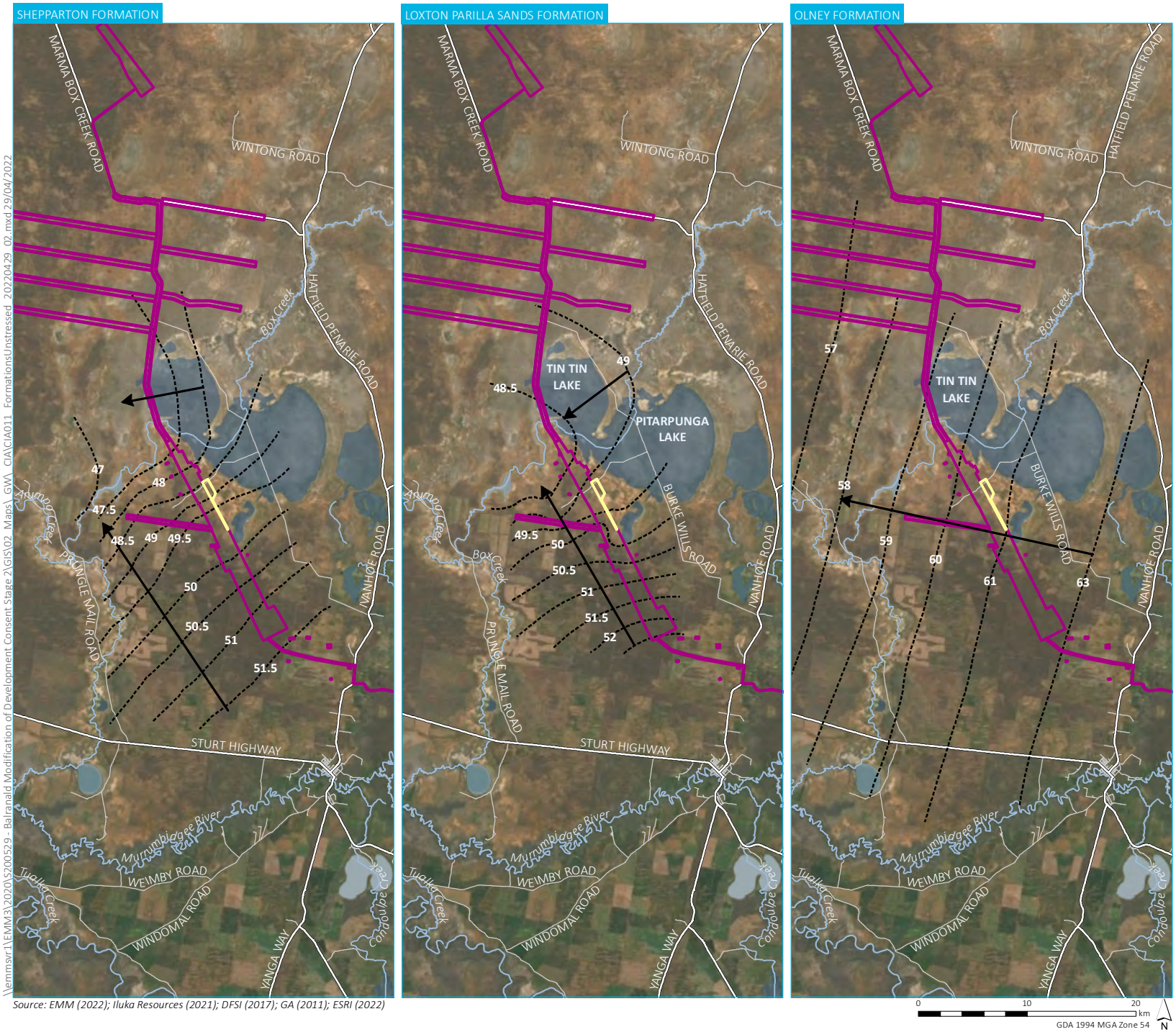
Groundwater chemistry reports were collected from Earth Systems (2015), LWC (2017) and Iluka (2015a) to inform the T3 Groundwater Management Plan. This information provided a summary of the groundwater quality at the Balranald Project, on the whole indicating that all groundwater samples obtained across the MOD1 area are sodium chloride type, consistent with regional (ie third party) bore signatures.

- The SFM aquifer is characterised as saline to hypersaline (Median TDS = 39,650 mg/L), with total dissolved solids (TDS) ranging between 19,700 and 57,200 milligrams per litre (mg/L) and is deemed unsuitable for irrigation and stock and domestic purposes (ANZG, 2018). The median pH is neutral (7.13), but ranges between 3.85 and 8.1, whilst the redox (oxidation-reduction potential) is considered denitrifying to oxidising (-2 to 253 millivolts (mV); Stumm and Morgan, 1981).

- The LPS aquifer is characterised as saline to hypersaline (Median TDS = 33,000 mg/L), with TDS ranging from between 8,870 and 48,200 mg/L and is deemed unsuitable for irrigation. Certain bores are identified as a tolerable drinking source for sheep (ANZG, 2018); however, these bores are located adjacent to the Murrumbidgee River and similar to the SFM, may be influenced by proximity to the comparatively fresher Murrumbidgee River. The median pH is neutral (7.16), but ranges between 6.19 and 8.40, whilst the redox condition is considered denitrifying to moderately reducing (-6 to 193 mV).

- Within the Balranald Project area, the Geera Clay has no representative chemical analyses. Pore-water samples extracted from the Geera Clay in bores drilled near Piangil in northern Victoria yielded TDS concentrations of approximately 200,000 mg/L (Evans 2014) and electrical conductivity (EC) concentrations of ~37,000 microsiemans per centimetre (µS/cm), comparative with the Middle Renmark Group.

- Brackish to saline groundwater is observed in the Lower Renmark Group Aquifer (Median TDS = 4,349 mg/L), with TDS ranging between 2,490 and 10,265 mg/L and is deemed suitable for irrigation of salt tolerant crops and as a tolerable drinking source for most stock purposes (ANZG, 2018). The median pH is circum-neutral (7.50), but ranges between 5.70 and 9.63, whilst the redox condition is considered denitrifying to slightly reducing (-1 to 254 mV).



KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification extension to Balranald Project Area boundary
- Flow line
- Potentiometric surface (m AHD)
- Major road
- Minor road
- Named watercourse
- Ephemeral lake
- Perennial lake

SFM, LPS, OF (unstressed) potentiometric surface (m AHD)

Balranald Mineral Sands Project
Modification report
Figure 7.11

Source: EMM (2022); Iluka Resources (2021); DFSI (2017); GA (2011); ESRI (2022)

\\emmsvr1\EMM3\2020\S200529 - Balranald Modification of Development Consent Stage 2\GIS\02 Maps\ GW\ CIA\CIA011 FormationsUnstressed 20220429 02.mxd 29/04/2022

b Groundwater receptors

Groundwater receptors characterised below as both environmental receptors (natural environment) and third-party users (ie stock and domestic water supply use, neighbouring mines), of significance to this GIA and specifically MOD1 have been described below.

High priority GDEs

NSW WSPs include schedules with lists of high priority GDEs which are required to be assessed using the minimal impact criteria outlined in the AIP. Groundwater WSPs were previously reviewed for reference to GDEs and only the Lower Murrumbidgee Groundwater WSP identified high priority GDEs. There were no high priority GDEs identified in the Western Murray Porous Rock Groundwater Source of the MDB Porous Rock WSP (WRM 2015).

Ecosystems that potentially rely on groundwater

The baseline investigations (SKM 2011), undertaken as part of the Preliminary Feasibility Study for the Balranald Project identified the occurrence of ecosystems that potentially rely on groundwater in the vicinity of the Balranald Project area. This investigation mapped and characterised ecosystems that potentially rely on groundwater into two broad categories:

1. wetlands and vegetation associated with the Murrumbidgee, Lachlan and Murray River Floodplain environments, as per the Lower Murrumbidgee Groundwater WSP for the vegetation to the south and west of the Murrumbidgee River; and

2. vegetation (primarily Black Box woodland) outside the floodplain and permanent streams, in topographic depressions where the watertable may be shallow enough and not too saline.

The study found that potential groundwater reliance associated with these environments is likely to be opportunistic. Groundwater use in the region is influenced by two main factors: the depth of the watertable and groundwater salinity. The ecosystems that potentially rely on groundwater associated with the floodplain environments include the high value River Red Gum forests and the Great Cumbung Swamp. The Black Box woodlands away from the floodplain are less significant assets in terms of their ecological value, but they provide locally valuable shade and shelter for fauna (and stock) in a landscape sparsely populated by trees (WRM, 2015).

Rainfall and the periodic flooding of the Murrumbidgee River are more likely sources of water for vegetation (URS 2012). Thus, floodplain environments are considered to have a low susceptibility to altered groundwater conditions due to the close presence of the Murrumbidgee River, a regular flow regulated water source. Further from floodplains, vegetation may have a greater reliance on groundwater as there are no permanent water sources in these environments.

In 2014, an investigation was undertaken to establish where the Black Box vegetation was accessing water from the SFM (CDM Smith 2015). This study found that rainfall and episodic surface water (irregular flooding and/or pooling from heavy rainfall) provided the dominant water source for Black Box, although there was some potential for these trees to use groundwater opportunistically to supplement their water needs. Previous studies have shown Black Box to be a hardy, resilient species capable of sustaining droughts and quite saline conditions (up to 60 mS/cm). The River Red Gum is more tolerate to water logging than the Black Box community.

The spatial distribution of ecosystems that rely on groundwater, updated from the baseline investigation to include the areas of Black Box that were mapped in 2014 by CDM Smith (EMM 2015) and is shown on Figure 7.12.

c Third party use

Landholder bores

Several landholders in the area rely on groundwater, sourced from the brackish Lower Renmark Group Aquifer (part of the Olney Formation), for stock, irrigation, and domestic use. These landholder bores are located throughout the Balranald Project area and shown in Figure 7.13.

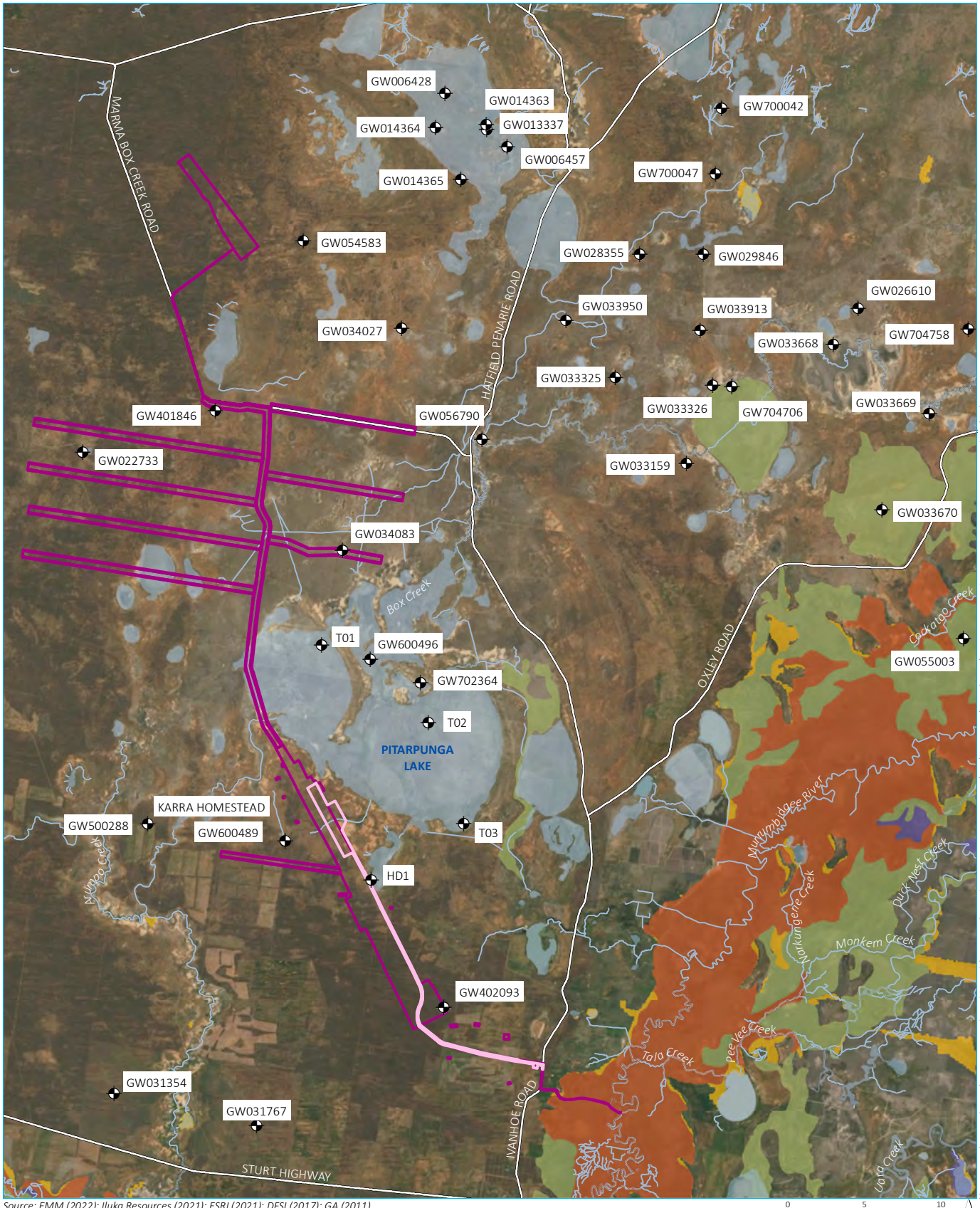
The only aquifer with beneficial use is the Olney Formation due to its brackish salinity. This water is used for stock and domestic purposes. Within the Balranald Project vicinity, bores that could be impacted by mine related activities are summarised in Table 7.30.

Table 7.30 Olney Formation bores in the vicinity of the Balranald Project

Local name	Easting	Northing
HD1	726012	6185773
T01	722791	6201029
T02	729721	6195973
T03	732061	6189404
Karra Homestead	720430	6188310

Atlas Campaspe Mineral Sands Project

The Atlas Campaspe Mineral Sands Project is located approximately 20 km north of Iluka's Nepean deposit and will comprise of extracting ore from two parallel deposits from the LPS. Water effecting activities on site include mine dewatering of two open cut mines and supplementary water supply from the LPS. Previous assessments undertaken by EMM (EMM 2015), considered the interactions between the Balranald and Atlas-Campaspe mines to be negligible from a hydrogeological perspective.



Source: EMM (2022); Iluka Resources (2021); ESRI (2021); DFSI (2017); GA (2011)

0 5 10 km

GDA 1994 MGA Zone 54

N

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Groundwater users

KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification study area
- Major road
- Watercourse/drainage line
- Waterbody

Groundwater bore formation

- Olney

Groundwater dependent ecosystem

- Black Box woodland
- Floodplain wetlands
- Lignum and Chenopodium shrub land
- Riverine Forest

Balranald Mineral Sands Project
Modification report
Figure 7.12

EMM creating opportunities

ii Conceptual groundwater model

A series of conceptual models have been developed to support previous studies and this GIA. These have been tested through various field trials and are graphically represented for each mining stage in Figure 7.14, Figure 7.15, Figure 7.16, and Figure 7.17.

a Underground mining process

The local stratigraphy shown below provide a conceptualised interpretation based on logging data acquired during hydrogeological studies (Iluka 2015 and 2016b) and data collected during the installation of monitoring infrastructure to support the T2 bulk sampling activity during 2016.

A summary of the hydrogeological conceptualisation related to the underground mining process and its associated effect on groundwater resources is described below.

Pre-mining

- The ore is hosted within the LPS aquifer, generally located below the LPS1 package and within the LPS2 package.
- High grade ore targets, predominantly consisting of ilmenite, are approximately 5 m thick and are located approximately 70 mBGL.
- The watertable is hosted within the SFM aquifer at approximately 14 mBGL. The LPS potentiometric surface is also measured at around 14 mBGL, and thus the LPS is confined at the Site.
- The water quality of the LPS and SFM aquifers is neutral, with mean pre-mining pH measurements of 6.98 and 7.20, respectively. The groundwater in these aquifers is saline (51,000–56,000 µs/cm).

During mining

- Increased pressure within the LPS aquifer may occur during the mining phase, a consequence of injecting high-pressure water into the mine stope to facilitate the mining process. The pressure increase and subsequent recovery is likely to be rapid due to the confining nature and high transmissivity of the LPS.
- Pressure impacts within the SFM aquifer should remain insignificant if a sufficient aquitard exists between the SFM and the underlying LPS. However, pressure increases within the SFM could occur in areas where a hydraulic connection occurs between the SFM and underlying LPS aquifer.
- Subsidence events are not unexpected, with predictions of systemic subsidence across the mining zone. To date, there have been no long-term impacts on groundwater quality or the groundwater level in the area. If the ground surface subsides more than the maximum levels being predicted, it is possible this may impact the natural groundwater level.
- Groundwater quality is not expected to be significantly affected by mining. The main source of potential contamination during mining would be drilling muds. LWC (2017a) reviewed the drilling mud mixture and concluded that the substances used are environmentally benign and unlikely to cause any significant change to groundwater quality.

Reinjection

- Reinjection activities may result in significant pressure responses within the LPS aquifer, a consequence of injecting tailings into the mined cavity initially, with pressure impacts propagating throughout the aquifer thereafter. Pressure build-up is dependent on the stope dimensions, stope continuity and aquifer transmissivity. These parameters may vary between stopes or along the strike.

- Reinjection activities should not result in significant pressure responses within the SFM aquifer if a sufficient aquitard exists between the SFM and LPS aquifers in the trial area. This is generally represented by multiple clay horizons within the SFM itself, and commonly by a highly plastic clay located at the base of the SFM which represents naturally occurring bentonite along with the occasional ferricrete.

- Pressure impacts (both drawdown to supply process water and mounding due to mining/reinjection) are expected to be rapid, due to the confining and semi-confining nature of the LPS and SFM aquifers respectively.

- Some subsidence events are expected, with predictions of systemic subsidence across the mining zone. Some local subsidence may occur directly above the stopes. It is anticipated that a combination of successful reinjection and strategic sand tailings placement will reduce potential impacts from subsidence.

- Reactive sulfide minerals within the extracted material may oxidise and generate acid and metalliferous drainage while stockpiled and exposed to atmospheric conditions. If reinjected without proper management or treatment, the pH of the groundwater system could be reduced leading to the mobilisation of metals. Aerated injected slurry or water could also react with in-situ sulfides within the aquifer itself.

Post-mining

- The post mining pressure impacts within the LPS aquifer are expected to recover to, or close to, the pre-mining groundwater pressure levels. Depending on the variability and level of reinjection achieved and thus the in-situ material density of the final stopes, final LPS groundwater pressures in close proximity of the stopes may be more subdued than the pre-mining levels. This would be caused by an area of the LPS which would exhibit higher transmissivities and porosity, compared to its pre-mining state.

- Large scale subsidence events are not unexpected beyond the stope footprint, with predictions of systemic subsidence across the mining zone. It is anticipated that successful reinjection will reduce future potential subsidence. In the event of localised subsidence, Iluka will backfill the surface expression with benign material.

Post-mining, any changes to groundwater quality that occurred in and adjacent to the stopes during reinjection are expected to return to baseline conditions over time as the aquifer recovers and mixes with more regional groundwater.

7.5.2 MOD1 assessment

As previously stated, the predicted impacts of activities affecting groundwater resources (and associated receptors) has been assessed against the minimum impact considerations outlined in the AIP. Impacts to groundwater are assessed via the consideration of high priority GDEs, high priority culturally significant sites, and third-party bores.

i Groundwater quantity assessment

a Water supply

Water will be available to be sourced from three bores. The process water is supplied from a bore screened across the whole LPS group and located adjacent to the process water dam (PWD). This bore pumps at an average rate of 12 L/s continuously, and will start three months prior to the commencement of mining to initially fill the PWD and finishing at the conclusion of slimes reinjection.

The two other bores are screened in the deeper, more saline, Olney Formation. One is located adjacent to the process plant to provide water to the flotation plant during mining and the other is located near the vehicle wash/workshop area for dust suppression and vehicle cleaning. The bores have a combined average extraction rate of 12 L/s, and this is modelled by each bore pumping at 6 L/s with the same timing as the main LPS aquifer production bore.

The Balranald Project predicted to have a surplus of water due to the large dewatering requirements and thus only required water during the mine construction phase. Three bores were proposed to be installed within the Olney Formation with a pumping capacity of 2.4 L/s. The maximum rate pumped at any one time was 4.8 L/s. At the end of the construction period, a localised drawdown impact of 0.2 m was modelled, which was constrained to a small area within the West Balranald mine disturbance footprint.

The predicted drawdown in the Olney Formation is larger for MOD1 as shown in Figure 7.13, with a drawdown of more than 0.2 m extending for 15 km from the Balranald Project area. A maximum drawdown of just over 4 m is predicted at the two Olney water supply bores, and a drawdown impact of greater than 2 m is localised to the site and does not reach any third-party bores.

The modelled drawdown within the LPS is discussed in Section 7.5.3i below.

b Groundwater drawdown

A series of modelled drawdown plots for mine years 1, 2, 3 and at the end of mining for MOD1 for the SFM, LPS and Olney Formation, respectively. Within these figures, a positive value represents drawdown, and a negative value represents mounding above pre-mining conditions.

In summary, the results indicate that:

- at all third-party Olney bores, drawdown is less than the 2 m decline threshold defined by the AIP for minimal impact (Figure 7.13); and
- MOD1 results in the 0.2 m drawdown contour extending no more than a few hundred metres within the SFM (Figure 7.14) and no more than 2 km within the LPS (Figure 7.15).

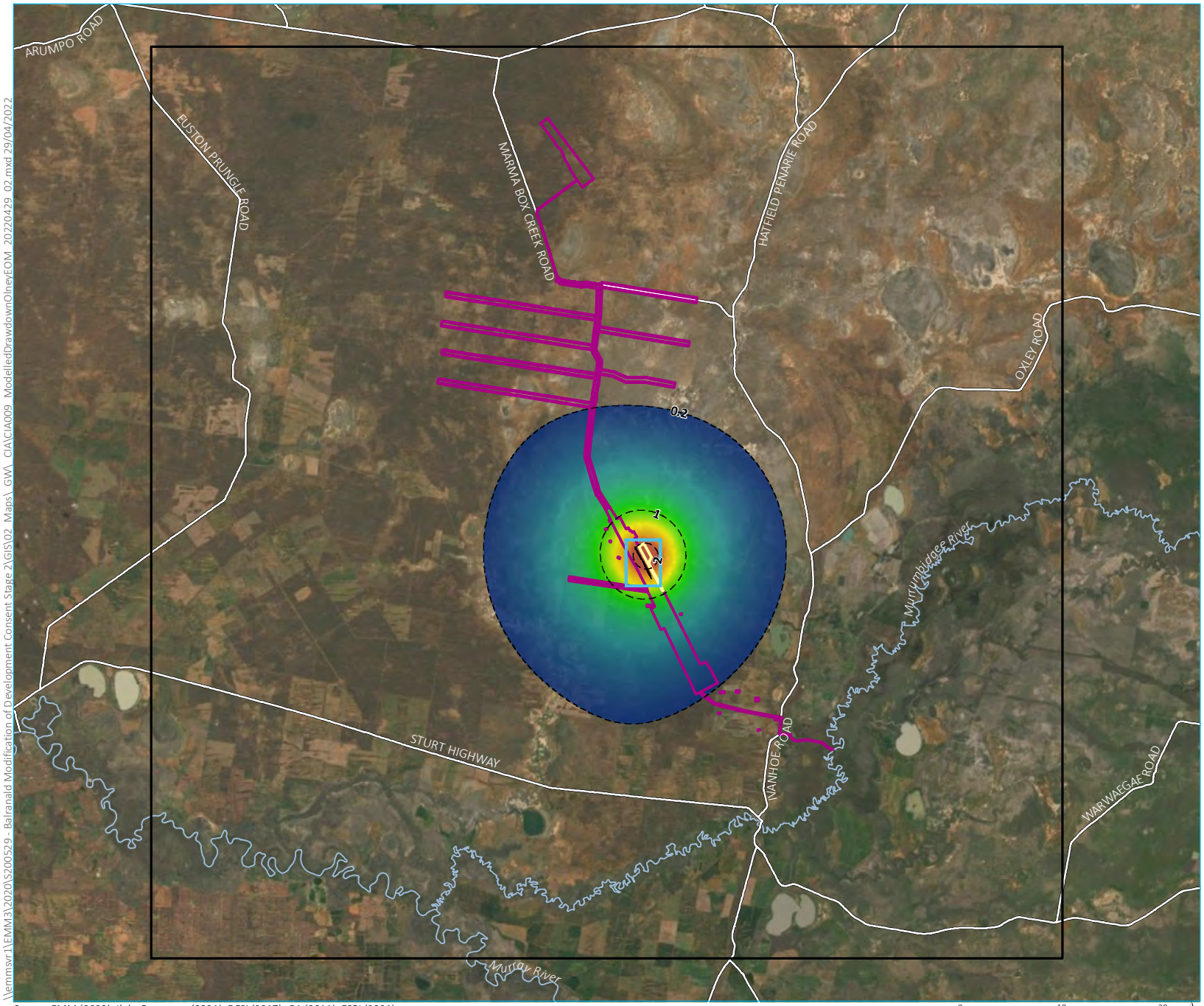
Since the underground mining method is intended to be pressure neutral at the active mining stope, with the volume of sand-water slurry removed balanced by the volume of injected process water, the mining process is not modelled explicitly. Therefore, the modelled drawdown is purely attributed to the water supply requirements.

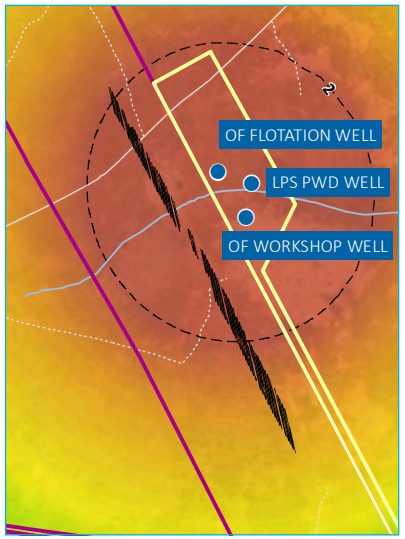
c Groundwater mounding

Referring to the same set of figures referenced above, the groundwater mounding indicates:

- The predicted mounding for MOD1 is constrained to the stresses applied to the system during the reinjection of fines into the mined stopes, since it is assumed that the stopes are maintaining a net zero stope pressure. Mounding within the LPS is expected to be less than 1 m in the vicinity of the stopes, and not extend beyond a few hundred metres based on the 0.1 m mounding contour during mining. The mounding at the water table is predicted to be even smaller in magnitude.

- Mounding caused by seepage from sand emplacement at the surface has also been simulated in BAL3.0. This will elevate recharge, above the natural rate due to rainfall, to the groundwater system. This is expected to produce localised and insignificant mounding of the water table in the SFM.





KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification extension to Balranald Project Area boundary
- Model domain
- MOD1 stope
- Mine water supply well
- Major road
- Named watercourse
- Drawdown (m)

Modelled drawdown (m)

High : 2

Low : 0.2

0 10 20 km

GDA 1994 MGA Zone 54

N

Source: EMM (2022); Iluka Resources (2021); DFSI (2017); GA (2011): ESRI (2021)

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MOD1 modelled drawdown in the Olney Formation at the end of mining

Balranald Mineral Sands Project
Modification report
Figure 7.13

EMM creating opportunities



Source: EMM (2022); Iluka Resources (2021); ESRI (2021); DFSI (2017)

0 0.5 1 km
GDA 1994 MGA Zone 54
N

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification extension to Balranald Project Area boundary
- MOD1 stope
- Mine water supply well
- Drawdown (m)
- Minor road
- Vehicular track
- Watercourse/drainage line

Modelled drawdown (m)

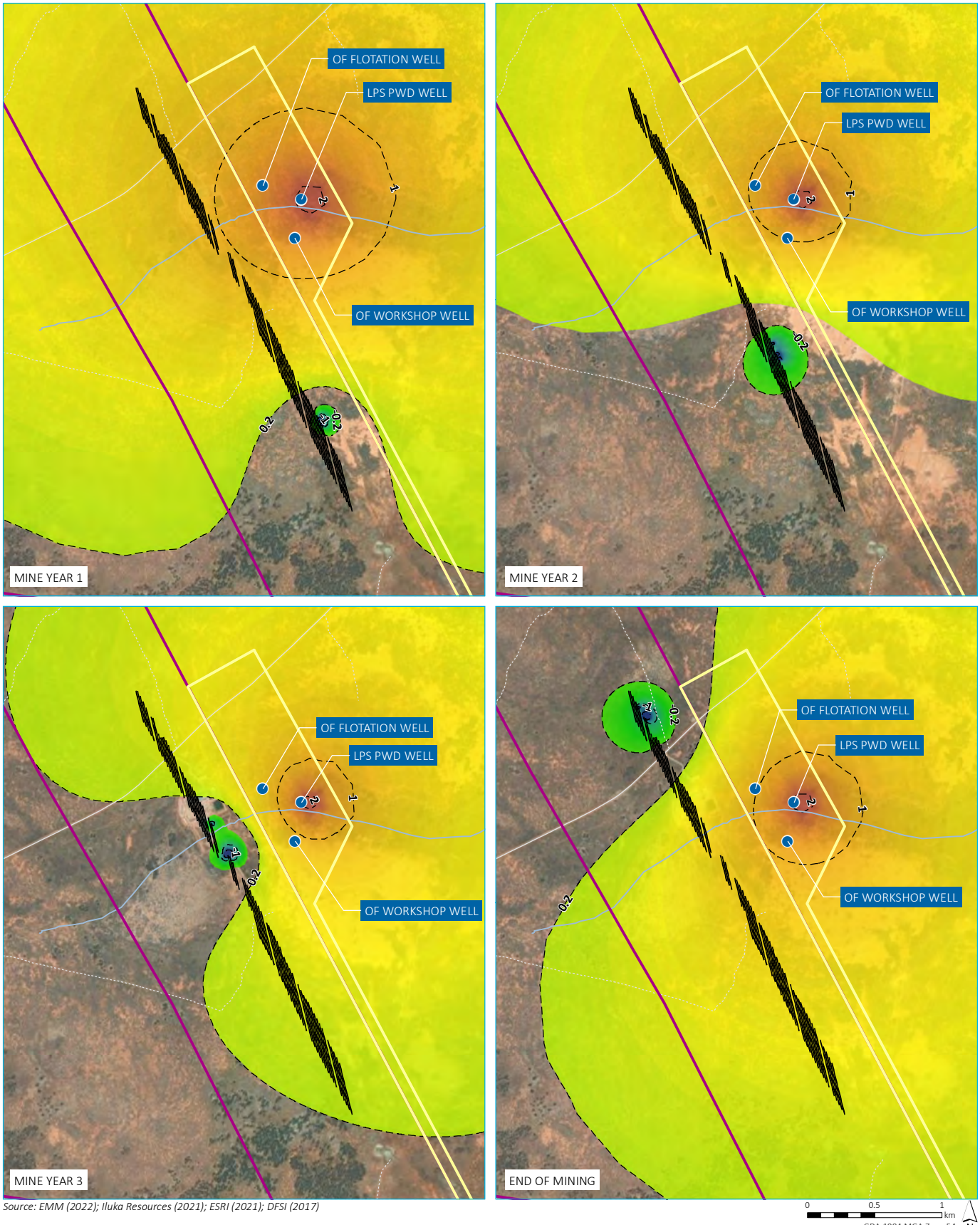
>2

<-2

MOD1 modelled drawdown at the water table during mining

Balranald Mineral Sands Project
Modification report
Figure 7.14

EMM creating opportunities



Source: EMM (2022); Iluka Resources (2021); ESRI (2021); DFSI (2017)

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification extension to Balranald Project Area boundary
- MOD1 stope
- Mine water supply well
- Drawdown (m)
- Minor road
- Vehicular track
- Watercourse/drainage line

Modelled drawdown (m)

>2

<-2

Modelled drawdown in LPS1 lower shore/LPS2 foreshore during mining

Balranald Mineral Sands Project
Modification report
Figure 7.15

EMM creating opportunities

ii Sensitive receivers

a Third party bores

As previously stated, the updated modelled responses show a greater drawdown response at key third party bores due to larger makeup water demands required from the Olney Formation (EMM 2022). However, all modelled drawdown impacts are below the 2 m water level decline minimal impact threshold criteria, as stipulated in the AIP.

b Aquatic ecosystems

For MOD1 model (BAL3.0), the water balance indicates that the rivers are dominantly a losing system within the model domain. The previous model (BAL2.0) showed smaller fluctuations associated with river leakage volumes with the predicted drawdown not reaching the Murray and Murrumbidgee rivers. In comparison, the MOD1 model (BAL3.0) shows significantly less drawdown and mounding effects on the groundwater system.

c Terrestrial ecosystems

Modelled hydrographs were assessed at the nominated GDE sites, with the largest drawdown response (<0.1 m) predicted at location number 4; a community of Black Box associated with Box Creek.

Given the modelled drawdown for MOD1 shows drawdown less than 0.1 m at this location, the risk to terrestrial impacts is considered low to insignificant.

d Atlas Campaspe Mineral Sands Project

The MOD1 modelling results (refer Figure 7.15) show insignificant drawdown and mounding effects north of the Balranald mining area. It is therefore unlikely that groundwater affecting activities will have any interaction with the mining activities at the Atlas Campaspe Mineral Sands Project, located approximately 20 km north of Iluka's Nepean deposit.

iii Groundwater quality assessment

Groundwater in the LPS aquifer is too saline to be used for human consumption, stock watering or irrigation. Geochemical testing and water quality assessments are, however, being conducted to assess potential groundwater quality impacts (Earth Systems 2020, 2021a, b, c). Two potential risks to water quality have been identified and include:

1. geochemical oxidation of sulfide minerals in ore, products and mining by-products which may generate acid mine drainage (AMD); and

2. reinjection of process water and fine sand tailings which contain process chemicals, in particular PAX.

a Salinity

The proposed reinjection of water, which is a combination of LPS and Olney source water, is not considered to present a risk of changing the salinity and lowering the beneficial use of the LPS aquifer.

The LPS aquifer has an approximate TDS of 33,000 mg/L at the project site and is the source aquifer to supply the PWD. The Olney Formation has an approximate TDS of 4,300 mg/L and is used for the floatation system. Based on the assumed pumping rates, a mixed water quality with a TDS of ~23,500 mg/L would potentially report to the HBF tank prior to reinjection into the LPS, assuming no other dissolution processes occur.

The reinjected water therefore is likely to be of better quality than the ambient groundwater quality of the LPS. The LPS aquifer has no beneficial use and even if freshening was to occur, the water quality still exceeds the ANZECC//ARMCAZ 2000 guideline for livestock.

b Acid mine drainage

The mining method for the Balranald Project proposed co-disposal is by reinjection of fine sand tails and emplacement of courser sand tails above ground. In the underground mining method proposed for MOD1, sulphide minerals will be concentrated within the fine sand tails which will be reinjected into the LPS aquifer. The ore in the LPS aquifer naturally contains sulphides but the neutral pH of the aquifer indicates that in-situ oxidation is not occurring. The geochemical conditions in the LPS aquifer are therefore not conducive to further oxidation of sulphide minerals and AMD is not expected to occur once the fine sand tails have been reinjected into the aquifer.

Mining by-products will contain some sulfide minerals which may generate AMD during storage or permanent placement above ground. For instance, sand tails will be placed above mined stopes to raise the ground surface following expected subsidence and ground settlement, and oversized material will be used for road construction. To minimise the risk of AMD generation and to neutralise potentially generated acid, these materials will be amended with limestone. Geochemical testing is being performed on these materials so that lime dosing can be designed. After implementation of AMD mitigation techniques, the presence of sulphide minerals in products, ore and mining by-products is not considered to pose risk to groundwater quality.

The underground mining method eliminates the need for long-term above ground storage of fine tails. The MOD1 is therefore not considered to increase the AMD risk to groundwater quality.

c Process chemicals

The below ground mining method will include injection of process chemicals into the LPS aquifer, as shown on Figure 7.16. Reinjection of process water was not included in the mining method for the Balranald Project. Of the process chemicals, PAX will be present at the greatest concentration in the slurry that will be reinjected into the mined stopes. This chemical is commonly used in mining processing and has been shown to break down in water storage dams and in mining process circuits. PAX is expected to break down in the aquifer once injected and the PAX concentration in groundwater will decrease over time.

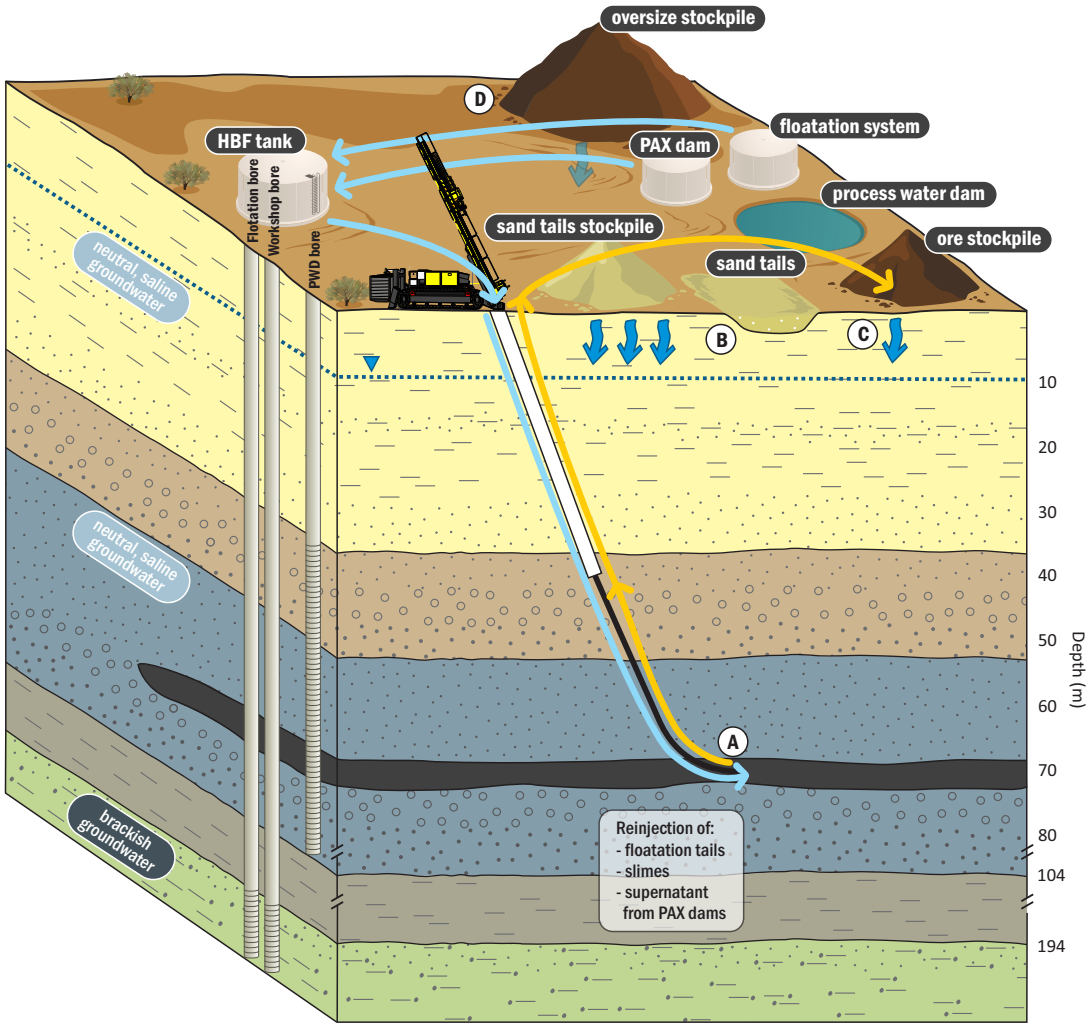
Preliminary and ongoing testing of process water at bench scale level indicate that the PAX concentration in the reinjected water will be significantly lower than the parameters used in the transport model.

A groundwater fate and transport model was developed to simulate the transport and migration of PAX if it were to be reinjected at 110 mg/L, with an assumed half-life of 12 weeks. When the PAX was assumed to degrade and break down to innocuous products, the model results showed that PAX-impacted groundwater did not extend to the project boundary during mining. In the model, the PAX concentration and the spatial extent of the PAX plume decreased over time post injection and further decreased at the cessation of mining (Figure 7.17 and Figure 7.18).

An alternative model was developed to simulate the migration of PAX assuming that PAX would not degrade in the aquifer. The results of this highly conservative model indicated that the PAX impacted groundwater would only migrate 1,000 m to the west of the injection point 100 years following injection. Both models conservatively assumed that PAX would not sorb to aquifer surfaces, which is highly likely to occur and would further reduce the concentration and extent of PAX in groundwater.

Both third-party bores and the Atlas-Campaspe Minerals Sands Project are also located spatially beyond the PAX plume, and therefore the risk for PAX to reach these receivers is considered negligible.

There are no aquatic ecosystems within the area affected by PAX injection to the LPS, and PAX-impacted groundwater will not migrate and discharge to ecosystems associated with the Murray and Murrumbidgee rivers. The risk to aquatic ecosystems is therefore considered negligible.



Potential sources of water quality impacts

- (A) Reinjection of tails and water that contains PAX and sulfides
- (B) Seepage of water containing PAX from sand tails. AMD unlike to occur because tails will be amended with lime.
- (C) Potential AMD seepage from ore stockpile containing sulfides.
- (D) Potential AMD seepage from oversize stockpile. Addition of lime will neutralise AMD.

Sand tails

Shepparton Formation

Clay
Clayey Sand
Sand

Loxton Parilla Sands 1

Fore-shore
Surf Zone
Lower-shore

Loxton Parilla Sands 2

Fore-shore
Surf Zone
Lower-shore

Geera Clay

Olney Formation

Ore

Water table

Reinjection phase

Mining phase

Note: ore extraction and reinjection happens at different times

Geochemical conceptual model

Iluka Resources

Balranald Groundwater Impact Assessment

Figure 7.16

EMM creating opportunities



Source: EMM (2022); Iluka Resources (2021); ESRI (2021); DFSI (2017)

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification extension to Balranald Project Area boundary
- MOD1 stope
- Mine water supply well
- Minor road
- Vehicular track
- Watercourse/drainage line

Modelled PAX (mg/L)

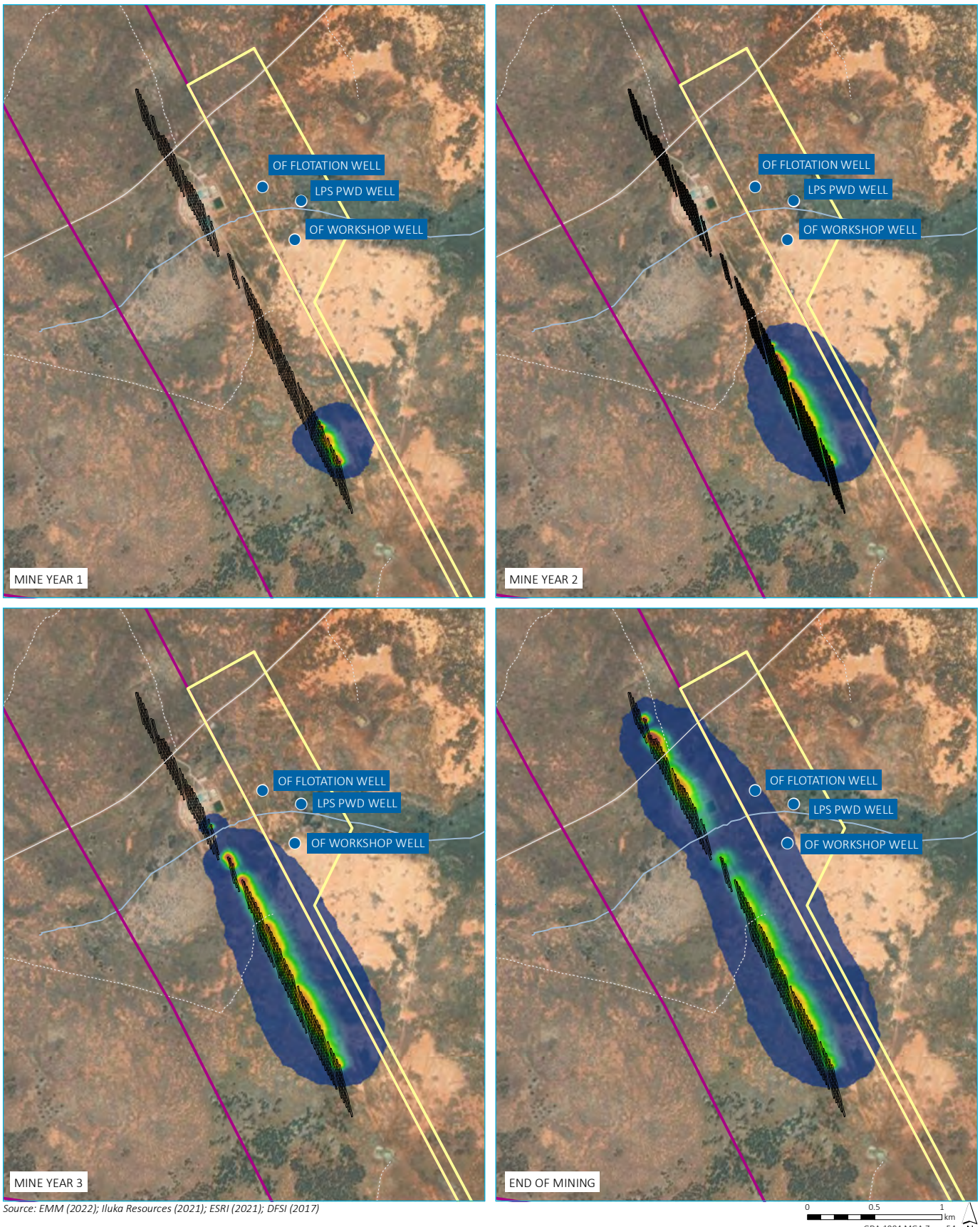
100

0.0005

Modelled PAX concentration in the Shepparton Formation during mining

Balranald Mineral Sands Project
Modification report
Figure 7.17

EMM creating opportunities



Source: EMM (2022); Iluka Resources (2021); ESRI (2021); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 54

N

\\emmsvr1\EMM3\2020\S200529 - Balranald Modification of Development Consent Stage 2\GIS\02_Maps_GW\GW034_ModelledPAXLPS1MiningNoDecay_20220429_03.mxd 4/05/2022

KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification extension to Balranald Project Area boundary
- MOD1 stope
- Third party well
- Minor road
- Vehicular track
- Watercourse/drainage line

Modelled PAX (mg/L)

100

0.0005

Modelled PAX concentration
LPS1/2 during mining

Balranald Mineral Sands Project
Modification report
Figure 7.18

EMM
creating opportunities

7.5.3 Conclusion

A GIA has been undertaken to provide an assessment of predicted groundwater impacts of MOD1 which are considered to be low to negligible with the proposed strategies to manage and mitigate potential groundwater impacts for MOD1 consistent with the approved Balranald Project and contained in Appendix D.

7.6 Subsidence

A subsidence impact assessment (SIA) was completed by Mine Advice Pty Ltd, on behalf of Iluka, and is provided in Appendix K.

The SIA comprises an assessment of the potential subsidence impacts of MOD1, during and post-mining, on the natural and built environment.

7.6.1 Assessment approach

The SIA considers the relevant geological structures beneath the Project area and whether these aspects have the potential to create any subsidence effects given the proposed underground mining method. It also considers:

- results of previously completed underground mining trials;
- the proposed mine plan, disturbance boundary and sensitive features (ie Aboriginal cultural heritage, ecology, access tracks, powerlines, existing infrastructure) within and surrounding the Project area; and
- results of previously completed geotechnical surveys and subsidence monitoring.

i Previous underground mining trials

Underground mining was previously trialled within the Project area and included the development of six stopes across three trials between 2014 and 2020.

The observations of these trials were used to determine the potential future impacts of underground mining as part of the proposed modification, including:

- instability of pilot holes and stopes; and
- development or sporadic sinkholes at the surface above the stopes.

ii Postulated geotechnical mechanisms related to mining activities

When a void (eg tunnel, cavern or mining stope) is excavated in soils the pre-existing stress conditions are disturbed. For the resultant void to remain stable the stresses must redistribute around the opening in such a way that the remaining in situ material can accommodate the modified stress regime – this process is known as arching.

If arching develops and the stope remains stable, then negligible subsidence propagates to surface, the subsidence in this instance being related to elastic compression of the supporting pillars (and foundations). If no arching develops and the stope/panel fully collapses, then discernible subsidence propagates to surface. This is particularly important in terms of the active mining stope where mining productivity and resource recovery are both a function of stope stability in the immediate area of mining.

Stability of arches in soil is generally a function of:

- Soil properties – primarily this relates to the shear strength of a soil, which in turn is a function of both its cohesion and friction angle. Notably, cohesionless soils (sand) are less stable as compared to those soils that are cohesive (clay). More broadly, stability is also a function of soil density in that loose/unconsolidated soils are generally less stable than dense/consolidated soils.

- Groundwater conditions – moisture content plays an integral part in the stability of soil arches. In some instances moisture may be advantageous (ie capillary action in damp sands resulting in improved cohesion) but conversely, a saturated state results in increased porewater pressures that reduce soil shear strength. Other factors such as low soil liquid limit and propensity for liquefaction can also have an adverse impact on the stability of arches in soils.

The stability of the MOD1 mine stopes (and panels) can be categorised as either stable, metastable or unstable.

If the mined stopes and resultant mining panels are large (and wide) enough and the material properties are such that a stable arch above a series of stopes is inhibited, then the overlying soil mass is judged to fail and migrate downwards into the excavated area. The resultant enmasse downwards movement of material culminating in subsidence at surface (ie unstable).

The SIA noted that the timing of maximum subsidence (due to differential settlement and long-term consolidation attributes associated with soil) cannot be predicted with any degree of certainty, therefore only the likely final maximum subsidence (S_{max}) (in perpetuity) can be determined as part of this assessment. Equally, the detailed determination of the resultant subsidence trough may only be readily predicted following the learnings from mining a number of different panels.

iii S_{max} assessment methodology

When full overburden collapse occurs (Panel S_{max}) the quantification of maximum subsidence is primarily a function of the excavation volume, and more generally this is related to the excavation height.

Simplistically, the volume of the subsidence trough at surface can never be larger than the excavated volume underground, and a worst-case scenario S_{max} is therefore approximately equivalent to the excavation (or stope) height. Ultimately, the proportion of stope height that manifests as S_{max} at surface is also a function of the overburden material and how this material behaves, settles and compacts having collapsed into the underground excavation – the factor to be applied here is essentially a 'bulking factor' which quantifies whether the material dilates, maintains the same volume or contracts post-failure.

iv Angle of draw

The 'angle of draw' is another important subsidence assessment parameter which is taken to quantify the likely lateral extent of vertical subsidence outside of the mined-out area.

7.6.2 Existing environment

The Project area is located within the Murray Basin, which consists of marine and fluvio-lacustrine formations formed during the late Tertiary period (refer Figure 7.19).

The LPS is the main stratigraphic host unit of heavy mineral sand within the basin. This is overlain by the SFM in the northern part of the basin, which consists of mixed lake, fluvial channel, floodplain sediments in addition to aeolian sands. Underground mining as part of the proposed modification would target the LPS.

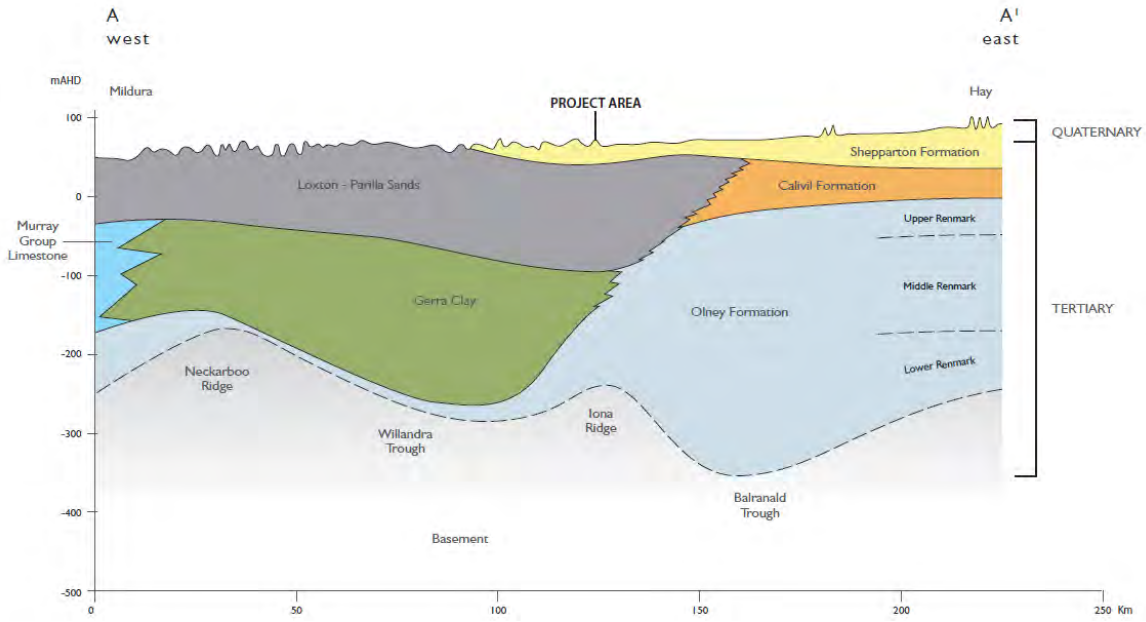


Figure 7.19 Regional geological cross section (EMM 2015)

a Geological characterisation

The SFM consists of thick sequence of unconsolidated to poorly consolidated clay and silty clay with interbedded sand lenses.

The Loxton Parilla Sands Formation is a thick sequence of marine sands deposited during two marine regression events identified as upper LPS1 and lower LPS2. Underground mining as part of MOD1 would target an ore zone within LPS2. LPS1 varies in thickness from 10 to 25 m in northern and more than 60 m in the southern ends of the formation and contains fine to medium grey sands. The thickness of LPS2 varies from 4 to 18 m and contains fine to medium grey silty sand.

The target ore zone contains fine to medium grain grey/black silty sand or sand. Previous exploration shows that the ore zone ranges in thickness from 2 m to 5.8 m.

b Geological structure

Defects or joints with small measurable displacement have occasionally been observed in cemented sediments. Small (and potentially on-going) geological fault movements may have occurred through to recent times resulting in topographic depressed troughs that accumulate fluvial and lake sediments. Evidence exists of major faulting (with displacements of at least 30 m) several kilometres to the south of MOD1.

c Cementation

Occurrences of both weak to strong cementation have been found within both the SFM and LPS. Cementation within the SFM tends to occur as broad and sometimes thick silcrete patches formed by groundwater and near surface lateritic processes.

Strongly cemented bands are mostly iron-stained red brown and are found near the base of the SFM. Within the LPS1, relatively thin discontinuous cemented horizons are occasionally present, often associated with sand beds that may have been more permeable prior to cementation. Cementation within the LPS1 is highly variable.

d Material consistency and density

Clay within the SFM has a stiff to very stiff consistency. Sand within the LPS has a dense to very dense consistency, with the density increasing with depth. Zones of medium dense sand are located within and above the ore zone.

e Depth of cover

The depth of underground mining will range from approximately 65 to 75 m.

f Overburden bulking factors

The overburden of the underground mine area consists of unconsolidated fine grain sand. If overburden collapse were to occur within the stopes, the sand would settle to the bottom of any fluid filled voids. Following settlement into the void, the sand would re-compact due to the weight of the incumbent failed overburden. Collapsed overburden material would inevitably exhibit a final volume that is similar in magnitude to that prior to failure. This would represent a Bulking Factor of approximately one.

g Propensity for liquefaction

Sediment with high silt content is susceptible to liquefaction. This is important to consider, as it may impact stope stability. Liquefaction triggers could include soil saturation and increased vibration due to mining processes.

7.6.3 MOD1 assessment

Based upon previous mining experience and the resultant geotechnical characterisation the SIA observed that subsidence predictions relating to the proposed underground mining method is complex and that the observed subsidence is likely to exhibit high variability (over both space and time) and is therefore difficult to quantify to a high level of accuracy.

Notwithstanding this, the following key considerations were noted in the SIA:

1. Typical S_{max} within a panel is conservatively judged to range between 95% and 100% of the mined thickness of ore body. At a nominal mining height of 4 m, this equates to an S_{max} of approximately 3.8 m. Given the t the strand thickness may vary between 2 m (along the edges of the strand) to a maximum of 5.8 to 6.0 m – should the full height of the strand be extracted then the S_{max} may approach approximately 5.7 m. Table 6.1 summarises the typical strand thickness, depth, and potential S_{max} within a particular panel.

2. The excavation of individual stopes is not envisaged but in instances where isolated stopes occur (ie when mining the first stope or in areas along the edge of the saw-tooth shaped panels), the predicted Smax is expected to be much reduced to less than a few hundred millimetres. However, in such situations the likelihood of subsequent sinkhole occurrence is judged to be high based on previous site experience. It is important to note that the anticipated S_{max} values relate to conventional subsidence and do not apply to a sinkhole scenario. The maximum depth of a sinkhole may exceed the nominal extraction thickness (possibly due to flow of material into remnant voids or localised over-excavation) and as a result Smax may exceed the aforementioned values in some localised areas.

3. Based on an angle of draw of 30°, diminishing levels of surface subsidence could extend to approximately 43 m from a panel edge (based on a maximum ore body depth of 75 m). Angle of draw values can be used to:

   a) identify any surface features that may be located within the anticipated subsidence trough;

   b) demarcation of exclusion zones preventing personnel access and the implementation or continued use of any infrastructure; and

   c) determine the extents of subsidence monitoring.

The resultant subsidence trough trends from the north-west to the south-east of the Project area with its depth ranging between 3.8 m and 5.7 m if the full ore body thickness is extracted. If all stopes are extracted within a panel, then the subsidence trough may extend up to approximately 200 m wide laterally (refer Figure 7.20).

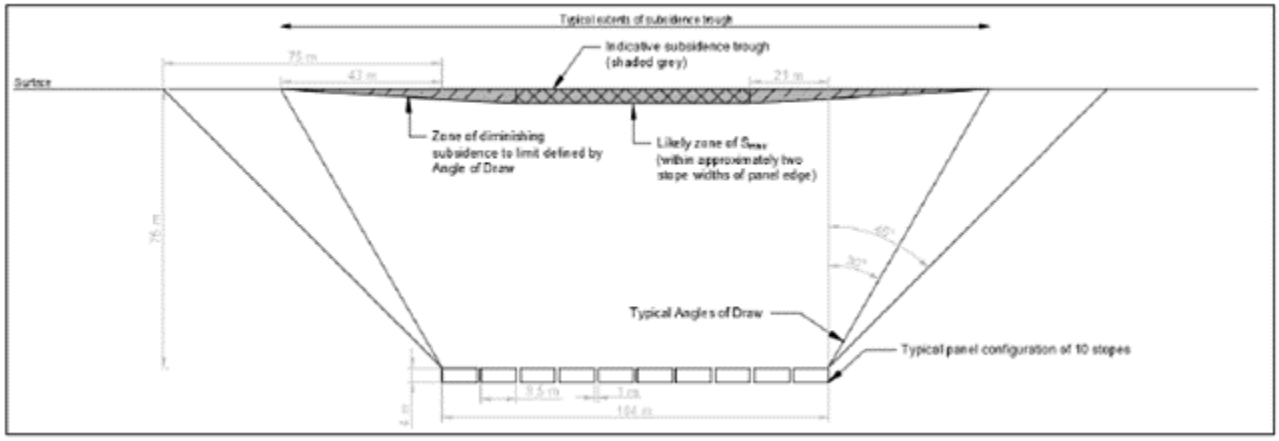


Figure 7.20 Schematic illustrating typical subsidence parameters and zones of influence

The SIA assumes that the MOD1 mining stopes side-by-side fundamentally increases the width of the 'excavated' area to a point that the overburden changes from being in a metastable state to an unstable state. It is therefore considered that total overburden collapse will occur.

The forming of underground stopes side by side is considered a primary control in minimising the random development of sinkholes which occurred during the previous mining trials.

Figure 7.21 illustrates indicative areas of likely subsidence (ie 'exclusion zone') for MOD1 demarcated within the projected angle of draw of 30° which translates to a lateral distance on surface of approximately 40–50 m away from a mining panel and associated panel boundary (ie approximately 200 m wide laterally).

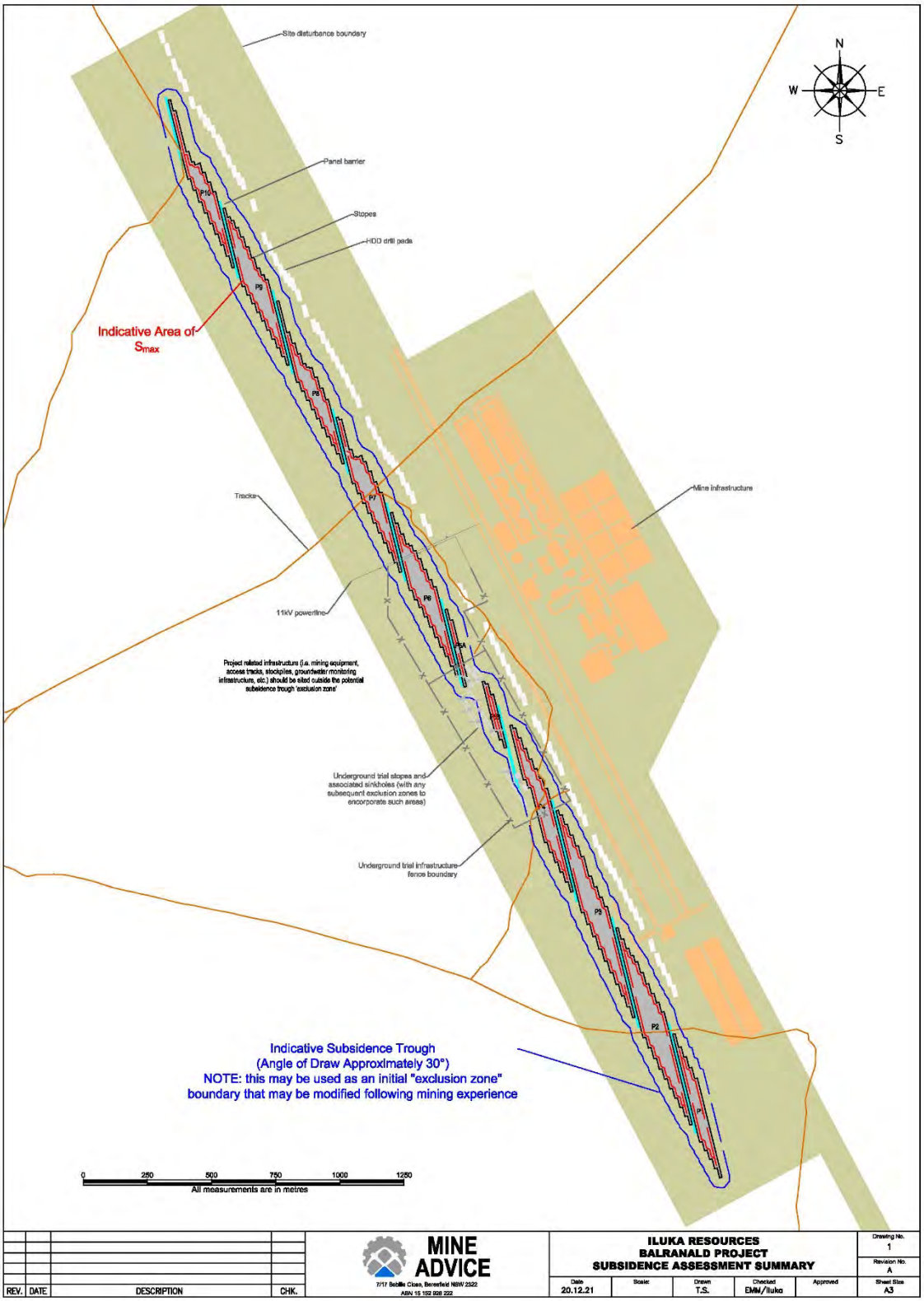


Figure 7.21 Predicted subsidence parameters and zones of influence

i Surface placement

Due to the predicted subsidence, Iluka propose surface placement of treated sand tails and overburden/subsoil ahead of mining (ie material placement above each panel into the area created by the stripping of topsoil, subsoil and overburden) prior to the resultant subsidence trough.

Surface placement would enable:

- pre-loading of areas susceptible to subsidence;
- placing treated sand tails within a stable location below natural ground level; and
- reducing the overall scale of the post-mining surface void to better reflect the surface topography and thereby limiting any impacts associated with the final landform.

ii Final void

Consistent with the Balranald Project there would be a net volume loss between the material excavated versus that emplaced within the subsided surface emplacement areas with a predicted remnant depression or final voids of approximately 52 ha at the mined northern panel.

7.6.4 Proposed management and mitigation measures

Proposed subsidence mitigation measures include:

- surface emplacement of treated sand tails and overburden/subsoil to pre-load areas susceptible to subsidence;
- implementation of exclusion zones, comprising barricading or fencing, so as to prevent access to active mining areas;
- the exclusion zones can potentially be removed with progressive mining experience, monitoring that establishes maximum surface settlement has been reached and there is no latent risk of any further sinkhole formation and relevant mining and coarse reject disposal areas having been fully rehabilitated;
- decommissioning or moving existing Iluka infrastructure overlying or traversing the predicted subsidence trough to areas outside the subsidence trough; and
- development of a Subsidence Management Plan, including monitoring, prior to the commencement of underground mining.

7.6.5 Conclusion

The SIA concludes that MOD1 would result in minimal subsidence impacts, comprising in depth of between 3.8 m and 5.7 m if the full ore body thickness is extracted and a trough extending up to approximately 200 m wide laterally.

Management and mitigation would include surface placement of treated sand tails and overburden/subsoil ahead of mining to pre-load areas susceptible to subsidence and to reduce the overall scale of the post-mining surface void to reflect the surface topography and thereby limiting any impacts associated with the final landform.

The implementation of exclusion zones and subsidence monitoring for active underground mining areas would form part of the Subsidence Management Plan for proposed MOD1 (Appendix D).

7.7 Biodiversity

A supplementary biodiversity assessment (SBA) was prepared to assess the potential biodiversity impacts of MOD1 and is presented in Appendix L.

7.7.1 Legislative context

The SBA has been conducted with consideration of key biodiversity legislation and government policy, including:

- EP&A Act;
- BC Act;
- NSW *Biodiversity Conservation (Savings and Transitional) Regulation 2017;*
- FM Act; and
- NSW *Biosecurity Act 2015* (BS Act).

The BC Act is the key piece of legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act was introduced in 2016 following the repeal of the TSC Act.

The NSW Biodiversity Conservation (Savings and Transitional) Regulation 2017 sets out the approval pathway for modifications of major projects. In accordance with Section 30A 2C of the Regulation, as MOD1 and the Revised Balranald Project will not increase the impact on biodiversity values, a BDAR, prepared in accordance with the BC Act and the Biodiversity Assessment Method (DPIE, 2020), is not required.

7.7.2 Assessment approach

EMM met with the DPE and the BCD in July 2021, March 2022 and held a site visit in April 2022 to discuss the biodiversity assessment pathway for MOD1 and confirmed a BDAR is not required. Instead, an SBA has been prepared with a focus on quantifying impacts of MOD1 on vegetation community types with comparative areas to be excised from the Revised Balranald Project as modified to demonstrate no net increase in biodiversity impact.

The previous vegetation mapping in Niche (2015) has been retained in this report, however has been contemporised by converting the Biometric Vegetation Types to their equivalent Plant Community Types (PCTs).

The SBA builds on the previous biodiversity assessment (Niche 2015) and aims to determine the equivalence of vegetation condition in the MOD1 additional disturbance area and proposed areas to be excised from the approved Balranald Project, to demonstrate no net increase in impacts on biodiversity values.

The SBA of the MOD1 additional disturbance area comprised:

- a search of the BioNet Atlas of NSW Wildlife for threatened species and communities listed under the BC Act to identify any newly listed or recorded species not assessed in Niche (2014);
- a review of vegetation mapping and previous studies including:
  - Ecotone_Niche_Vis917_20141031 vegetation layer (Ecotone 2014);
  - Balranald Mineral Sands Project Biodiversity Assessment for the Environmental Impact Statement (Niche, 2015);
  - conversion of mapped BVTs from Niche (2015) to Plant Community Types (PCTs), to contemporise the vegetation mapping dataset;
- NSW DPI Weedwise website to determine priority weeds for the Riverina;
- field survey to characterise vegetation types and condition;
- determining if the MOD1 additional disturbance area falls within the mapped important areas for the Plains-wanderer (*Pedionomus torquatus)*; and
- assessment of biodiversity impacts.

The SBA of the proposed areas to be excised from the approved Balranald Project comprised:

- a review of vegetation mapping and previous studies including:
  - Ecotone_Niche_Vis917_20141031 vegetation layer (Ecotone 2014);
  - Balranald Mineral Sands Project Biodiversity Assessment for the Environmental Impact Statement (Niche, 2015); and
  - comparison of Niche (2015) vegetation zones and plot data to EMM vegetation zones and plot data to determine equivalency.

7.7.3 Existing environment

i Native vegetation

a MOD1 additional disturbance area

Field surveys in November 2021 confirmed the presence of three PCTs within the MOD1 additional disturbance area, comprising:

- 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW;
- 159 – Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW); and
- 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains.

Impacts on PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion) within the MOD1 additional disturbance area will be avoided, and accordingly are not discussed further in this report.

A description of the PCTs and their condition is provided in Table 7.31 and shown on Figure 7.22.

None of the PCTs in the MOD1 additional disturbance area represent a threatened ecological community (TEC), accordingly, these are not discussed further in this report.

Table 7.31 MOD1 PCT vegetation description and condition

BVT	Equivalent PCT	Vegetation description and condition	Condition	Area impacted (ha)
Flat Open Claypan/Derived Sparse Shrubland/Grassland (LM124)	166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	**Description:** A disturbed and probably derived open chenopod, herbland or grassland dominated by annual saltbushes such as Baldoo (*Atriplex lindleyi*), *Atriplex eardleyae* and *Atriplex angulata* along with and Babbagia (*Osteocarpum acropterum* var. *deminuta*). Atriplex holocarpa is often present. Many species of copperburr may be present including *Sclerolaena divaricata, Sclerolaena intricata, Sclerolaena brachyptera, Sclerolaena decurrens, Sclerolaena diacantha, Sclerolaena stelligera, Sclerolaena ventricosa* and *Sclerolaena bicornis*. Cottonbush (*Maireana aphylla*) common in places. Other Maireana species include *Maireana ciliata, Maireana coronata* and *Maireana turbinata*. Forbs include daisies such as *Rhodanthe floribunda* and *Brachyscome ciliaris*. Swainsona peas - *Swainsona affinis* and *Swainsona campylantha* may be present after rain. Neverfail grass (*Eragrostis setifolia*) is common in northern areas. The main weeds species are the grasses *Hordeum marinum* and *Hordeum leporinum* along with Capeweed (*Arctotheca calendula*) and Ward's Weed (*Carrichtera annua*). This community occurs on clay and loam clay soils on dry lake-beds and alluvial floodplains in the semi-arid and arid zones - mainly in south-western NSW but also to the north. This is probably a derived community from previous perennial chenopod shrublands, although some areas may be similar to a natural state where regular flooding is a feature. **Disturbance**: Dominated by exotic grass. Erosion from rabbits. Animal runs present.	Poor	28.1

Table 7.31 MOD1 PCT vegetation description and condition

BVT	Equivalent PCT	Vegetation description and condition	Condition	Area impacted (ha)
Old Man Saltbush Shrubland (LM137)	159 – Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)	**Description:** Shrubland up to 1.5 metres high, dominated by Old Man Saltbush (A*triplex nummularia*) with a lower chenopod shrub layer dominated by bluebushes such as *Maireana microcarpa, Maireana appressa, Maireana pyramidata* and *Maireana brevifolia*, Thorny Rhagodia (*Rhagodia spinescens*), Bladder Saltbush (*Atriplex vesicaria*) and Nitre Goosefoot (*Chenopodium nitrariaceum*). Low ground shrubs include *Dissocarpus biflorus, Atriplex lindleyi* and a number of copperburr species (*Sclerolaena* spp.). Forb species include *Senecio runcinifolius, Brachyscome lineariloba, Geococcus pusillus, Calandrinia eremaea, Bulbine bulbosa, Tetragonia tetragonioides, Crassula colorata* var. *colorata*, *Crassula sieberiana* subsp. *sieberiana* and *Osteocarpum acropterum* var. *deminuta*; grass species include *Chloris truncata, Austrodanthonia caespitosa, Austrostipa nodosa* and *Walwhalleya prolut*. Exotic species may be common in places and include *Hordeum marinum, Hordeum leporinum, Schismus barbatus, Xanthium spinosum, Heliotropium europaeum* and *Schismus barbatus*. Eastern occurrences in the Riverina Bioregion often contain scattered Myall trees (*Acacia pendula*). Occurs on cracking grey and brown clay or brown loam soils that are sometimes gilgaied on floodplains in drainage depressions in the Riverina and Murray Darling Depression Bioregions. Prior to European occupation this community would have been extensive. Continuous grazing by stock and rabbits, and perhaps the devastating droughts of the late 19th Century eliminated most of this community leaving "derived" grasslands or shrublands. Most of the remaining areas have been severely degraded and salinity is an increasing problem in the Riverina. Over the last few decades Old Man Saltbush has been planted in restoration projects for fodder and as a means of reducing rising saline watertables. In assessing its status, it is important to exclude these planted areas. Due to its reduction in extent, this community is considered to be an endangered community and as of 2005 it is poorly represented in conservation reserves. This community grades into Black Box (ID13 or ID15) on floodplains and into Weeping Myall woodland (ID26) or bluebush communities on the outer floodplains. This community shares some species with the Old Man Saltbush shrubland community of north western NSW (1D158). **Physiography and site features:** Plain, sandy soil/minor clay influence, small cleared patches of clay. **Disturbance**: *M. pyramidata* is dying off, but consequently regenerating. Possible senescence. Grazed. Sparsely vegetated.	Moderate[1]	3.6

Table 7.31 MOD1 PCT vegetation description and condition

BVT	Equivalent PCT	Vegetation description and condition	Condition	Area impacted (ha)
Pearl Bluebush Low Open Shrubland (LM138)	154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	**Description:** Mid-high (1-2m) open chenopod shrubland dominated by Pearl Bluebush (*Maireana sedifolia*) often with a number of other bluebushes including Black Bluebush (*Maireana pyramidata*), *Maireana sclerolaenoides, Maireana erioclada, Maireana georgei* and *Maireana ciliata*. Bladder Saltbush (Atriplex vesicaria) and Thorny Saltbush (*Rhagodia spinescens*) are usually present. Inland Rosewood (*Alectryon oleifolius* subsp. *canescens*), Black Oak (*Casuarina pauper*) and Sugarwood (*Myoporum platycarpum*) may occur as scattered small trees. Tall shrubs are rare but may include various forms of Senna artemisioides. The ground cover is sparse and more so in drought. It is dominated by shrubs such as *Enchylaena tomentosa, Sclerolaena obliquicuspis*, *Sclerolaena patenticuspis, Sclerolaena bicornis* var. *bicornis*, *Sclerolaena brachyptera*, *Sclerolaena diacantha, Atriplex stipitata, Atriplex eardleyae* and *Atriplex lindleyi*. Grass species include *Austrostipa nitida*, *Austrodanthonia caespitosa* and *Chloris truncata*. Daisies are common after rain and include *Rhodanthe corymbifolia*, *Brachyscome lineariloba, Pogonolepis muelleriana* and *Minuria cunninghamii*. This community occurs on lime-rich red-brown loam or duplex sand/clay soils sometimes derived from limestone on rises on the plains in the semi-arid and arid zones of far western NSW extending into Victoria and South Australia. In NSW it is most common in the Murray Darling Depression Bioregion with smaller stands elsewhere including to the north. Often occurs upslope of ID153 (Black Bluebush shrubland). In some areas this community may have been derived from Bladder Saltbush-dominated communities and the saltbush has been grazed out. Wards weed (*Carrichtera annua*) is a common weed. Grades into Bladder Saltbush (*Atriplex vesicaria*) shrubland, grassland or mallee communities. Continuous, heavy grazing may cause bluebush to disappear to be replaced by grasses and forbs. **Physiography and site features:** Clay shrubland plain. Clay soil. Poor drainage. **Disturbance**: Moderate to heavy grazing. Drought affected.	Moderate	87.9

Notes: 1. As plot data was not available for this area, the condition mapping used in Figure 8a of Niche (2015) has been used as a surrogate.

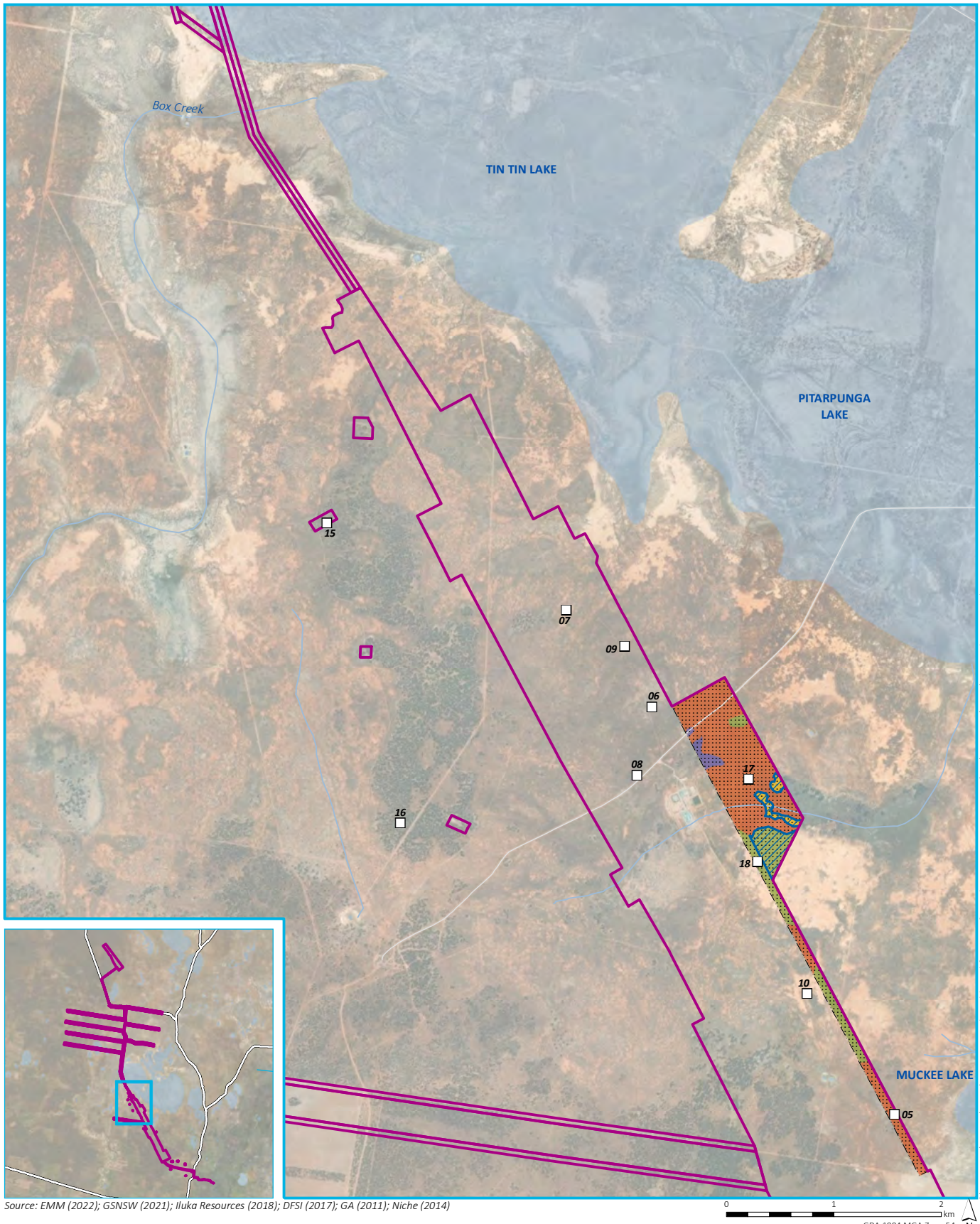
b Proposed areas to be excised from the approved Balranald Project footprint

Following field surveys, equivalent areas of native vegetation (PCT, condition and extent) were selected to be excised from the approved Balranald Project area to compensate for the native vegetation impacts in the MOD1 additional disturbance area and demonstrate no net increase in native vegetation impact.

A description of the equivalent areas selected is provided in Table 7.32 and shown on Figure 7.22.

Table 7.32 PCTs and condition in the proposed areas to be excised

PCT	Equivalent PCT	Vegetation description	Condition	Area to be excised (ha)
166 Flat Open Claypan/Derived Sparse Shrubland/Grassland (LM124)	166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	See Error! Reference source not found.Table 7.31 for vegetation description. The community is highly disturbed and heavily grazed, evidenced by many areas having sparse or no vegetative cover.	Poor	28.1
159 Old Man Saltbush Shrubland (LM137)	159 – Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south-western NSW)	See Error! Reference source not found.Table 7.31 for vegetation description. High cover abundance of weeds. Remnant saltbush plants are often over-mature to senescent. Common species include Nothoscordum inodorum and Hordeum spp.	Moderate	3.6
154 Pearl Bluebush Low Open Shrubland (LM138)	154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	See Error! Reference source not found.Table 7.31 for vegetation description. Disturbances include light grazing and erosion from stock and feral animals. Weeds generally absent or light and include mainly medics and minor exotic herbs except at edges of cleared areas.	Moderate	87.91



Source: EMM (2022); GSNSW (2021); Iluka Resources (2018); DFSI (2017); GA (2011); Niche (2014)

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KEY

- Revised Balranald Project Area
- Proposed MOD1 additional disturbance area
- Proposed MOD1 avoidance area
- Plot location
- Major road
- Minor road
- Watercourse/drainage line
- Waterbody

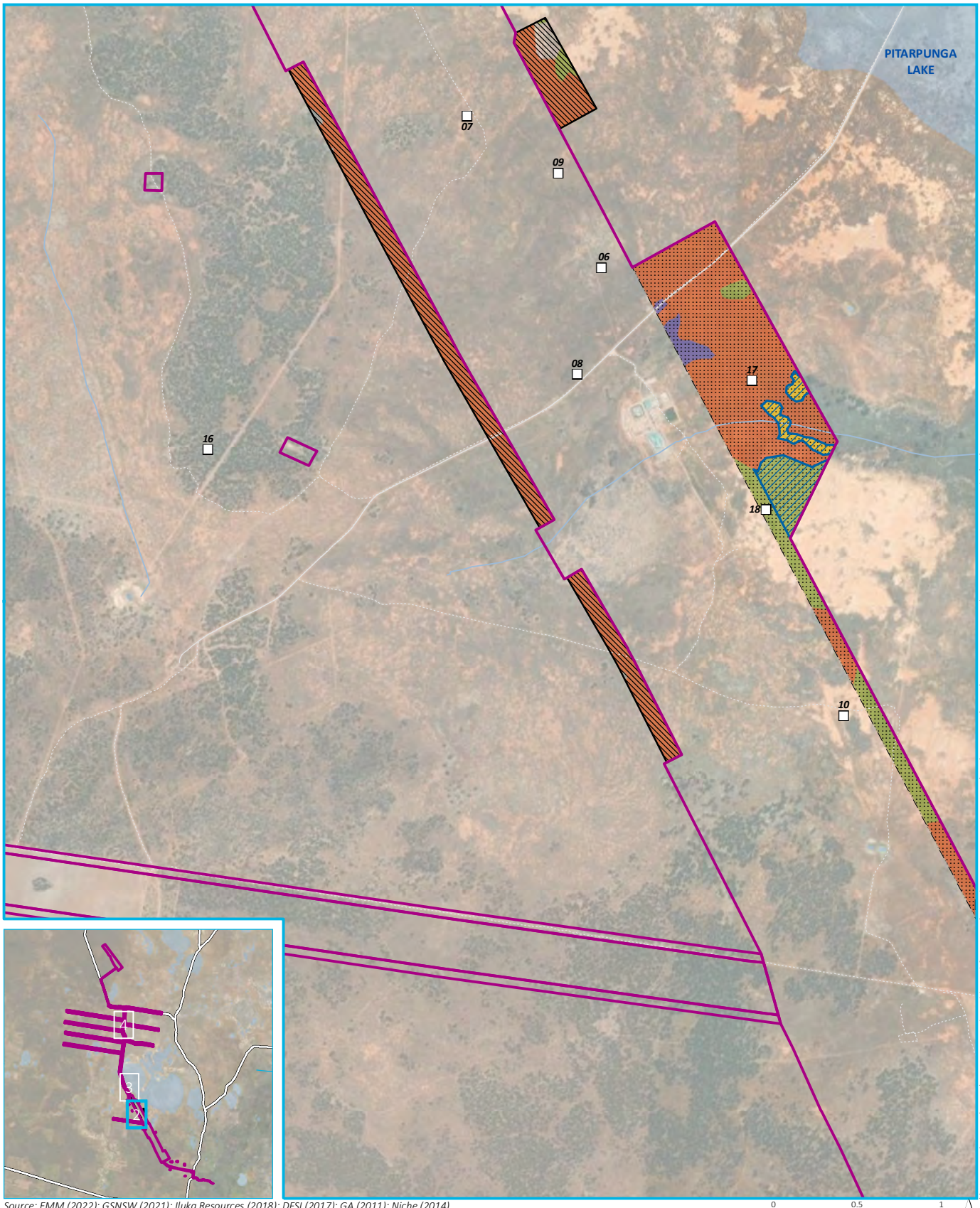
Plant community type

- 166 | Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW
- 154 | Pearl Bluebush low open shrubland of the arid and semi-arid plains
- 159 | Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)
- 15 | Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

PCTs in the study area
Map 1 of 4

Balranald Mineral Sands Project
Modification report
Figure 7.22

EMM creating opportunities



Source: EMM (2022); GSNSW (2021); Iluka Resources (2018); DFSI (2017); GA (2011); Niche (2014)

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KEY

- Revised Balranald Project Area
- Proposed MOD1 additional disturbance area
- Proposed MOD1 excise area
- Proposed MOD1 avoidance area
- Plot location
- Minor road
- Existing track
- Watercourse/drainage line
- Waterbody

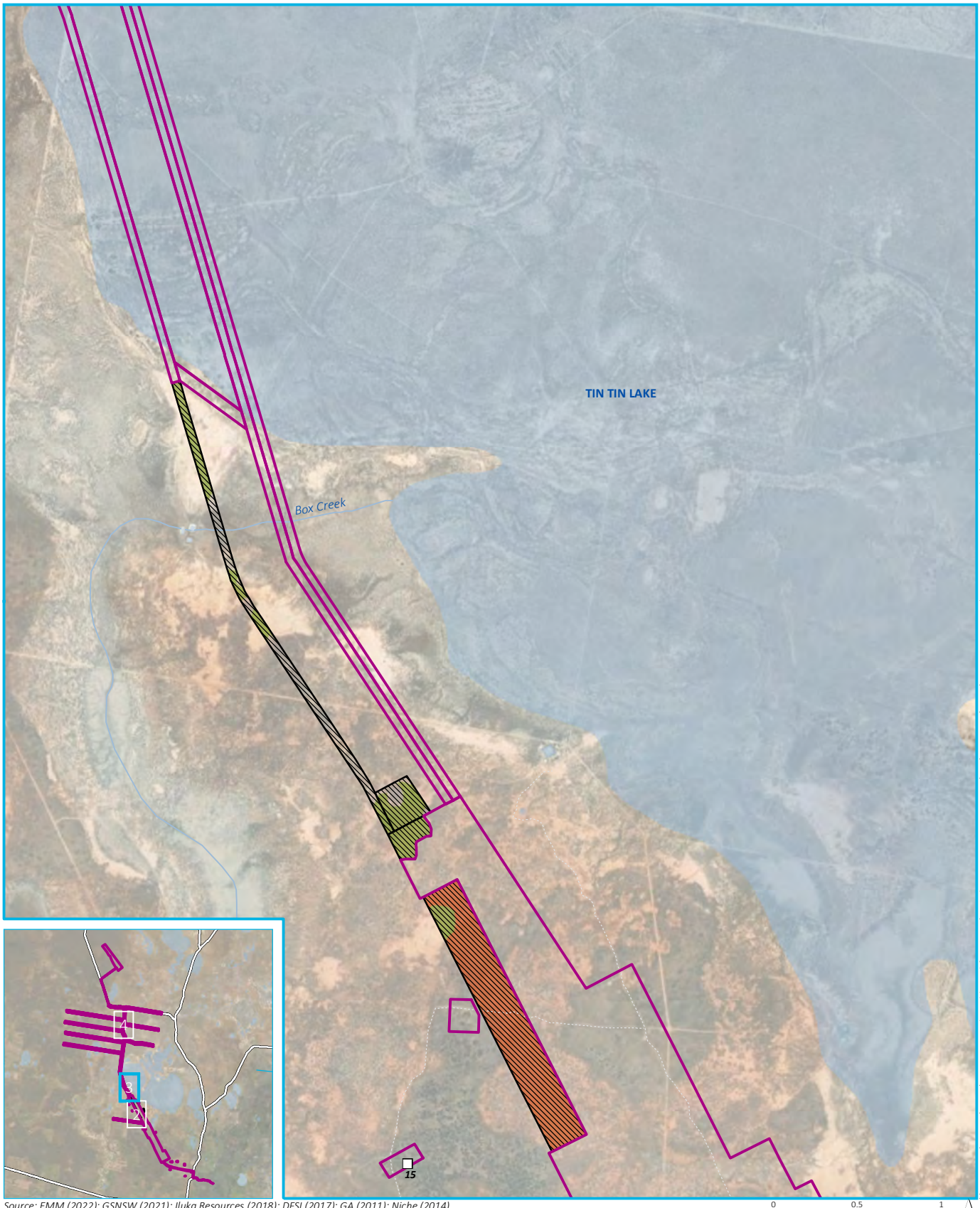
Plant community type

- 166 | Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW
- 154 | Pearl Bluebush low open shrubland of the arid and semi-arid plains
- 159 | Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)
- 15 | Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)

PCTs in the study area
Map 2 of 4

Balranald Mineral Sands Project
Modification report
Figure 7.22

EMM
creating opportunities



Source: EMM (2022); GSNSW (2021); Iluka Resources (2018); DFSI (2017); GA (2011); Niche (2014)

0 0.5 1 km

GDA 1994 MGA Zone 54

N

KEY

- Revised Balranald Project Area
- Proposed MOD1 excise area
- Plot location
- Existing track
- Watercourse/drainage line
- Waterbody

Plant community type

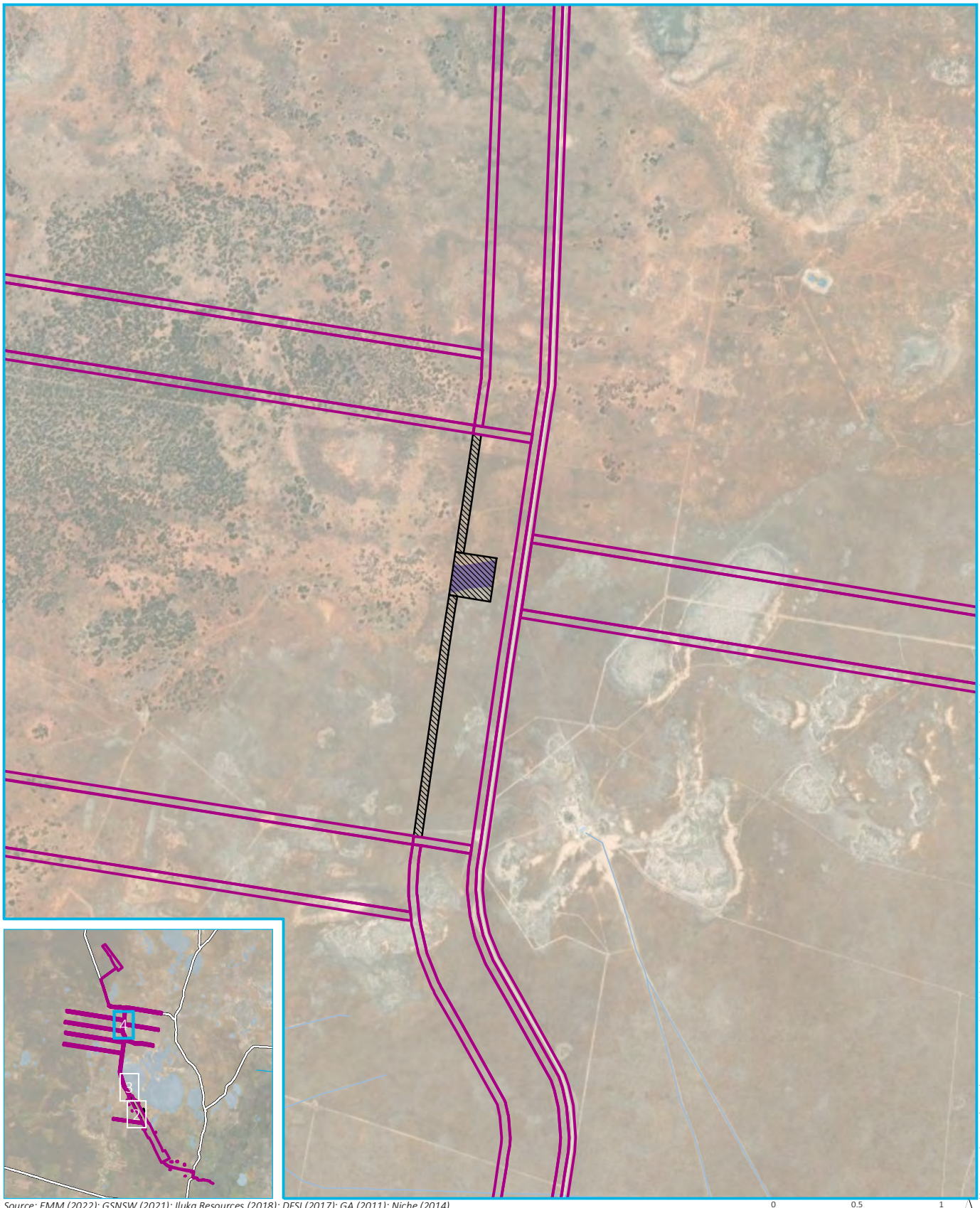
- 166 | Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW
- 154 | Pearl Bluebush low open shrubland of the arid and semi-arid plains

PCTs in the study area
Map 3 of 4

Balranald Mineral Sands Project
Modification report
Figure 7.22

EMM creating opportunities

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Source: EMM (2022); GSNSW (2021); Iluka Resources (2018); DFSI (2017); GA (2011); Niche (2014)

0 0.5 1 km

GDA 1994 MGA Zone 54

N

KEY

- Revised Balranald Project Area
- Proposed MOD1 excise area
- Minor road
- Watercourse/drainage line
- Waterbody

Plant community type

- 159 | Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)

PCTs in the study area
Map 4 of 4

Balranald Mineral Sands Project
Modification report
Figure 7.22

EMM creating opportunities

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c Condition comparison

Plot data, previous condition mapping from Niche (2015) and PCT benchmarks were reviewed to assess equivalence in vegetation condition (Table 7.33). Condition of all PCTs was determined to be equivalent between the MOD1 additional disturbance area and proposed areas to be excised.

Table 7.33 Condition comparison of PCTs

PCT	Equivalent PCT	Condition equivalency assessment
166 Flat Open Claypan/Derived Sparse Shrubland/Grassland (LM124)	166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	Occurs in poor condition in both the MOD1 additional disturbance area and the areas proposed to be excised. Plot 18 was completed in this PCT in the MOD 1 additional disturbance area, and Plot 10 was completed directly adjacent to one of the proposed areas to excised, within the same patch of vegetation, and therefore provides a basis for direct comparison of condition. These areas have a roughly equivalent shrub species richness (6 and 5, respectively) and are both heavily grazed and/or cleared. Additionally, Niche (2015) mapped this community in poor condition throughout the approved Balranald project area, including an area directly adjacent to MOD1 forms part of a continuous patch of this PCT. Accordingly, the condition of PCT 166 is equivalent in the MOD1 additional disturbance area and proposed areas to be excised.
159 Old Man Saltbush Shrubland (LM137)	159 – Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south-western NSW)	Occurs in moderate condition in both the MOD1 additional disturbance area and the areas proposed to be excised. The Niche (2015) condition mapping determined that all patches of the community in the approved Balranald project area occurred in moderate condition, including the MOD1 additional disturbance area. Plot 6 was completed adjacent to the MOD1 additional disturbance area and shows that although the community retains high levels of native species diversity when compared with benchmark values, the PCT is heavily grazed and disturbed, reducing shrub cover (eg 28% compared to benchmark of 49%), and is therefore in moderate condition. Accordingly, the condition of PCT 159 is equivalent in the MOD1 additional disturbance area and proposed areas to be excised.
154 Pearl Bluebush Low Open Shrubland (LM138)	154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	Occurs in moderate condition in both the MOD1 additional disturbance area and the areas proposed to be excised. Plot 17 was completed in this PCT in the MOD 1 additional disturbance area, and Plot 7 was completed directly adjacent to one of the proposed areas to excised, within the same patch of vegetation, and therefore provides a basis for direct comparison of condition. Data from both plots show that although the PCT retains high levels of native species diversity when compared to benchmark values, the PCT is heavily grazed and disturbed, reducing shrub cover (eg 28% compared to benchmark of 21.5 and 44.3% compared with a benchmark of 78%), and is therefore in moderate condition. Accordingly, the condition of PCT 154 is equivalent in the MOD1 additional disturbance area and proposed areas to be excised.

d Threatened species

Niche undertook database searches and a literature review as part of the EIS (Section 2 of the biodiversity assessment (Niche, 2015)). Extensive targeted surveys were undertaken as a part of the biodiversity assessment (Section 3 of the biodiversity assessment (Niche, 2015). No threatened flora species were recorded and 26 threatened fauna species were recorded. All threatened fauna species recorded are ecosystem credit species, and therefore their impacts are accounted for by ecosystem credit generation. Accordingly, as the PCTs in the MOD1 additional disturbance area and the proposed areas to be excised are equivalent, they do not require further assessment or consideration during the development of the offset package.

One additional species credit species not assessed in Niche (2015), the Spike-Rush (*Eleocharis obicis*), is now associated with PCT 159 which is present in the MOD1 additional disturbance area and proposed areas to be excised. However, this species has been excluded from further assessment as there are no previous records in the locality, and the habitat is not suitably wet in the study area for Spike-Rush to occur.

e Serious and irreversible impacts (SAII)

The spatial data layer for the Plains Wanderer mapped important area was reassessed and determined that it does not overlap with the MOD1 study area. Accordingly, the study area does not contain important habitat for the species.

7.7.4 MOD1 assessment

As a part of this Supplementary Biodiversity Assessment, Iluka has reviewed the disturbance footprint required to construct and operate proposed MOD1, as well as refining the project footprint for the approved Balranald Project to ensure no increase in biodiversity impacts.

i Native vegetation

The PCTs mapped across MOD1 and the proposed equivalent, like-for-like areas to be excised for the Revised Balranald Project as modified are outlined in Table 7.34 and shown on Figure 7.22.

Table 7.34 PCTs within MOD1 and the Revised Balranald Project as modified

PCT	Condition	Approved Balranald Project Area (ha)	MOD1 Additional Disturbance Area (ha)	Revised Balranald Project Area as modified (ha)	Net biodiversity impact (ha)
Flat Open Claypan/Derived Sparse Shrubland/Grassland (LM124)	Poor	73.6	+28.1	-28.1	0
Old Man Saltbush Shrubland (LM137)	Moderate	19.8	+3.6	-3.6	0
Pearl Bluebush Low Open Shrubland (LM138)	Moderate	1,072.1	+87.9	-87.9	0
		1,172.4	**+119.6**	**-119.6**	**0**
Cleared/Developed/Exotic agricultural	N/A	186.1	+0.4	-0.4	0
		1,358.5	**+119.2**	**-119.2**	**0**

ii Direct impacts

Proposed MOD1 direct impacts comprise:

- loss of native vegetation; and
- loss and degradation of native fauna habitats.

The proposed MOD additional disturbance and associated vegetation clearing will result in no net increase in biodiversity impacts (+119.2 ha MOD1; -119.2 ha Revised Balranald Project as modified) as shown in Table 7.34.

iii Indirect impacts

Potential MOD1 indirect impacts, such as increased noise, dust and light from mine construction and operational activities and erosion or sedimentation, are discussed in detail in the Niche (2015) biodiversity assessment. There will be no change to indirect impacts relating to MOD1.

The key measures to avoid, minimise and mitigate impacts, as outlined in Section 5 and 6 of the biodiversity assessment (Niche, 2015) remain relevant to the MOD1 and Revised Balranald Project as modified.

iv Threatened species

MOD1 will not result in additional impacts on biodiversity values, as:

- there has been no change to the key measures to avoid, minimise or mitigate impacts;
- the PCTs in the MOD1 additional disturbance area and the proposed areas to be excised are equivalent (Section 4.1.3); and
- no additional species credit species were recorded or are predicted to occur since assessed in Niche (2015).

v SAII

As the MOD1 study area does not contain important habitat for the species, the project as modified will not result in a serious or irreversible impact on the Plains Wanderer. Additionally, as the project is a major project, it would not have been refused on the basis of an SAII occurring.

7.7.5 Offset strategy

Iluka's credit liability for the approved Balranald Project will not change as a result of proposed MOD1 given no increase in biodiversity impacts.

In accordance with Schedule 3 Condition 16 of Balranald Project development consent (SSD-5285) Iluka will therefore retire the biodiversity offset credits for the West Balranald mine within 3 years of the commencement of construction.

To meet the offset obligations of the Balranald Project as modified Iluka intend to retire offset credits in stages with an Offset Management Strategy to be prepared in accordance with the NSW Biodiversity Offsets Policy for Major Projects.

Iluka will engage with relevant stakeholders, including DPE and BCD, on the proposed offset strategy following approval of MOD1 being granted.

7.7.6 Conclusion

The SBA assessed potential biodiversity impacts of the proposed MOD1 and confirmed there would be no net increase in overall impacts for the approved Balranald Project as modified.

Projected clearing will result in no net increase in biodiversity impacts (+119.6 ha MOD1; -119.6 ha Revised Balranald Project area). Approved mitigation measures associated with direct and indirect impacts will be implemented through the preparation of a Biodiversity Management Plan (BMP).

A Biodiversity Offset Package will be prepared in consultation with relevant stakeholders to meet the Balranald Projects offset obligation in accordance with SSD-5285 with Iluka intending to retire these credits in stages.

As concluded in the biodiversity assessment (Niche 2015), through the implementation of avoidance measures, mitigation measures and the development of a biodiversity offset strategy, biodiversity values in the surrounding region and the viability of threatened species and communities that are impacted by the proposed MOD1 and Revised Balranald Project will be maintained over the medium to long term.

7.8 Aboriginal heritage

An Aboriginal cultural heritage assessment (ACHA) was prepared by EMM, on behalf of Iluka, to assess the potential Aboriginal cultural heritage impacts of MOD1 and is provided in Appendix M.

The ACHA:

- identifies Aboriginal cultural heritage values relevant to the MOD1 study area;
- assesses the impact of MOD1 on identified Aboriginal cultural heritage values; and
- proposes appropriate management measures for potentially impacted Aboriginal cultural heritage values in response to their assessed significance.

7.8.1 Assessment approach

The ACHA aligned with the assessment methods, commitments and management measures set out in the ACHA contained in the EIS for the Balranald Project (Niche 2015) and the approved Aboriginal Cultural Heritage Management Plan (ACHMP) (Niche 2016).

The approach to the ACHA was undertaken in consultation with Heritage NSW.

i Aboriginal consultation

In November 2021 the five Registered Aboriginal Parties (RAPs) for the approved Balranald Project were notified of the proposed MOD1 via letter. The letter outlined the proposed modification, assessment approach and requested any cultural information about the MOD1 investigation area.

In November and December 2021, EMM archaeologists conducted a five-day archaeological survey of the MOD1 investigation area with RAP representatives.

In February 2022, Iluka provided RAPs with a 28-day review period to gather feedback and comments about MOD1 and the ACHA. No responses were provided during or after this review period.

ii Archaeological survey

An archaeological field survey was conducted of MOD1 with the assistance of RAP representatives over five days between 29 November 2021 to 3 December 2021.

The primary aims of the survey were to:

- identify Aboriginal archaeological sites and/or Aboriginal places with the assistance of Aboriginal knowledge holders;
- characterise the landscape to aid predictions of archaeological potential;
- identify sites or areas that would require further investigation if planned for development as part of the proposed modification;
- identify sites or areas to be avoided by development, where possible; and
- identify areas with minor or negligible Aboriginal cultural heritage values that are most suitable for development.

7.8.2 MOD1 assessment

Broadly, the survey strategy was based on the predictive model for Aboriginal site location and focussed on land systems most likely to feature Aboriginal sites (areas of high archaeological sensitivity) while also gathering a representative sample of land systems less likely to feature Aboriginal sites to confirm predictions of low archaeological sensitivity. The three land systems surveyed were:

- Rata;
- Marma; and
- Condoulpe.

The extent of sampling within each land system was proportionate to its level of archaeological sensitivity as presented in the predictive model. Accordingly, greater survey effort was made within more archaeologically sensitive Rata and Marma land systems which comprise alluvial plains and playas and basins. The Condoulpe land system, a featureless sandplain with mallee scrub, was sampled to a lesser extent to confirm its predicted low risk for archaeological materials being present.

Examples of different landforms, ground surface visibility conditions and disturbance levels are shown in Plate 7.3 to Plate 7.8.



Plate 7.3 Rata land system showing varying levels of visibility and exposure, view north



Plate 7.4 Rata land system showing low-lying swampy terrain with low visibility and exposure, view east



Plate 7.5 Marma land system showing gilgai after rain event, view west



Plate 7.6 Marma land system showing varying levels of visibility and exposure, view north



Plate 7.7 Condoulpe land system showing disturbance and visibility of the Ivanhoe Road investigation area, view south



Plate 7.8 Condoulpe land system showing PAD associated with WB47, view south

i Archaeological sites

There were two previously recorded sites wholly within MOD1 (WB 47 and WB 102) and three previously recorded sites that partially extend across MOD1 and outside its boundaries (WB 40, WB 41 and WB 45).

These five sites were inspected during the survey where they intersected with MOD1. Additional cultural materials were found associated with four sites only; WB 40, WB 41, WB 45 and WB 102.

Updated information regarding these previously documented sites (Niche 2015) is provided in Table 7.35. Further information regarding the archaeological potential of these sites is provided in the ACHA (Appendix M).

Table 7.35 Extensions to previously documented Aboriginal sites

Site name	AHIMS #	Land system	Site type	Easting	Northing	Description
WB 40	47-2-0262	Rata/Marma	Artefact scatter, hearth, hearth scatter, scarred tree, PAD	725703	6186587	WB 40 was originally recorded as a high-density archaeological complex with a high volume and range of stone artefacts, hearths, a culturally modified tree and PAD. The site represents the most intense and diverse assemblage in the project area. The 2021 survey identified artefacts dispersed across the scald, with no discernible patterning. In total, an additional 25 silcrete flakes, a flaked river pebble and a few pieces of shell recorded. The area of PAD appears to extend slightly further north within the investigation area than previously mapped. The site extent of WB 40 is now 1,000 m x 815 m. No evidence of hearths was identified within the investigation area. There were very few trees within the survey area. Trees were inspected but no cultural scars were identified within the investigation area.
WB 41	47-2-0263	Marma	Artefact, hearth scatter, PAD	724739	6187662	WB 41 was initially recorded as a low to moderate artefact density, hearth and PAD. The 2021 survey identified an additional 20 silcrete flakes in association with WB 41 which extends across a large claypan. The site appears to extend further south within the investigation area than previously mapped. The site extent is now 750 m x 460 m. No evidence of the hearth was identified within the investigation area.

Table 7.35 Extensions to previously documented Aboriginal sites

Site name	AHIMS #	Land system	Site type	Easting	Northing	Description
WB 45	47-2-0267	Rata/Marma	Artefact scatter, hearth scatter, PAD	724430	6189065	Low density artefact scatter, dispersed heat retainers indicating a disturbed hearth, and PAD. WB 41 is situated on a highly eroded area. Artefacts are dispersed in low concentrations across the scald, with no discernible patterning. The 2021 survey identified an additional 30 silcrete flakes in association with WB45 which extends across a vast claypan. No evidence of disturbed hearth within the survey area. Site extent is now 1,000 m x 500 m.
WB 47	47-6-0607	Condoulpe	Artefact scatter, PAD			Small scatter of 6 silcrete artefacts, assessed as in poor condition (Niche 2015). The site is situated on soft sandy soils with scattered re-growth trees. The 2021 survey did not relocate any of the previously identified material.
WB 102	47-2-0310	Rata	Artefact scatter, PAD	723687	6189913	Low density, small artefact scatter. Further surface and subsurface artefact predicted to be present in remnant vegetation mounds and deeper soils. The 2021 survey identified a high concentration of surface artefacts on a highly eroded scald with fringing vegetation mounds, recording an additional 50 silcrete flakes in association with WB102. The site extends to the north of previously mapped area site extent is now 150 m x 90 m.

ii Aboriginal heritage impact

MOD1 represents a potential ground disturbance footprint of approximately 119 ha.

Although the proposed modified underground mining extraction method will not involve broad scale earthworks associated with open cut mining as previously approved, it is predicted that Aboriginal sites would still be impacted in the following ways:

- earthworks associated with the construction of infrastructure;
- ground surface disturbance and rehabilitation which will involve topsoil, subsoil and overburden stripping and vegetation clearance above underground mining areas; and
- potential subsidence impacts from underground mining including potential ground movement of soils and strata and through subsequent accelerated erosional secondary effects if not mitigated.

The proposed modification would impact all the Aboriginal sites within its disturbance footprint through topsoil stripping over underground mining areas and earthworks associated with the construction of surface infrastructure. It is unlikely that potential ground subsidence above the mining areas would increase Aboriginal heritage impacts, as these areas would experience topsoil stripping (ie removal of archaeological layers) prior to underground mining commencing.

Of the identified sites, 17 are within MOD1 (Table 7.36). The remaining sites are situated within the approved Balranald Project area.

Table 7.36 Archaeological significance and corresponding loss of value through impact within the proposed MOD1 investigation area

Archaeological significance	Total loss of value	Partial loss of value	No loss of value	Total number of sites
Within MOD1 (but outside approved Balranald Project area boundary)				
High	-	1	-	1
Moderate	-	1	-	1
Low	12	2	1	15
Total	**12**	**4**	**1**	**17**

The most significant site MOD1 would impact is WB 40. The significance of this site is rated as high due to the range of stone artefacts, the presence of hearths and a culturally modified tree, and the potential for archaeological deposits. However, only approximately 10% of WB 40 is within MOD1 and, when the site was inspected during survey, no evidence of the scarred tree or hearths was identified within the investigation area boundary. It is therefore likely that these site features will avoid impacts.

Similarly, two other sites WB 41 and WB 45 are also recorded as containing hearths, but only approximately 20% of each site are situated within the MOD1 and, similar to WB 40, no evidence of hearths was identified during survey.

Overall, the nature of the proposed direct archaeological impacts will remain the same to that of the approved Balranald Project and result in total removal of archaeological material within the MOD1 disturbance footprint.

iii Cumulative impacts and intergenerational loss/equity

Cumulative impacts have been considered by the level of additional impacts proposed by MOD1 in relation to the approved Balranald Project area.

The proposed modification would represent an approximate 119 ha increase in total where ground disturbance could occur, all of which is within the high archaeological risk layer (ie mining and surface infrastructure area and haul road north area).

Additional impacts proposed to known sites of low and moderate significance are not considered substantial, as such sites are relatively common in the local area.

There will be an increased impact to WB 40 which is considered to be of high archaeological significance, but which requires archaeological excavation for its true significance to be determined. A linear segment of WB 40 will be impacted by the proposed haul road north area in addition to approved impacts within the project area. Alternative route deviations to the haul road would not be beneficial, as the adjacent land to the east and west of its proposed alignment fall within a landscape of equal significance[2]. The main counterbalance to this proposed impact is that a significant portion of this site (approximately 50 ha) and the landscape surrounding Muckee Lake will remain avoided. Notwithstanding, WB 40 warrants particular investigative focus to determine appropriate mitigation to its additional impacts as part of MOD1.

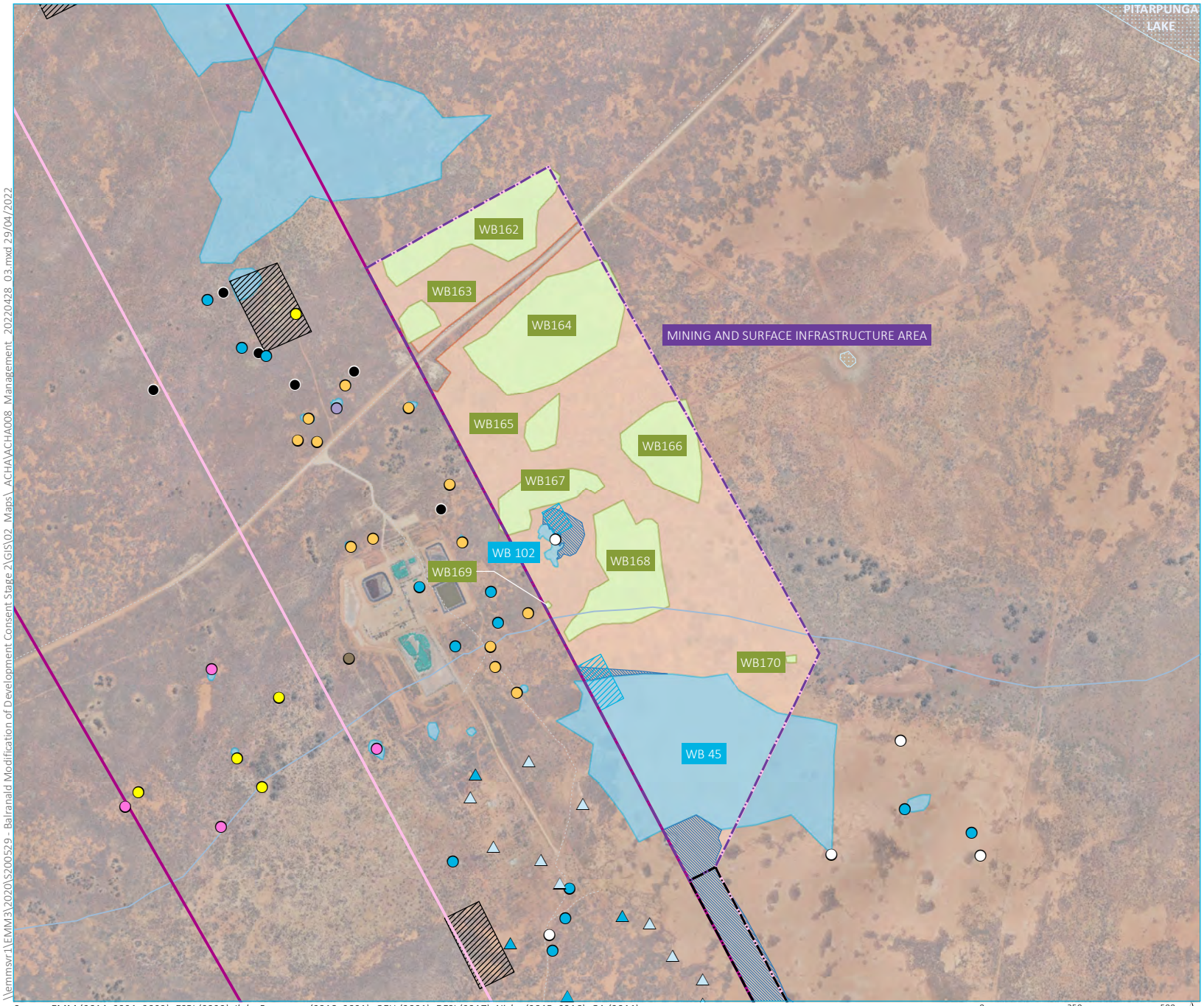
[2] WB 40 and the western edge of Muckee Lake continues to the east, and interconnected sites of potentially equal significance (WB 67 to WB 81) occur to the west within the approved project area.

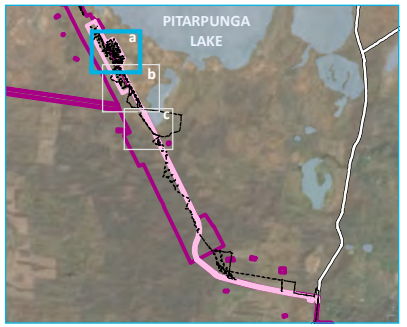
A substantial local archaeological resource will remain, as it is acknowledged key relict lakes in the region (Tin Lake, Pitarpunga Lake and Muckee Lake) and their western lunettes (featuring Pleistocene material such as WB 66) will remain avoided. A cross section of the archaeological resource occurs within and outside the study area, including stone artefact sites, middens, hearths, scarred trees and potential datable deposits. While it is acknowledged that MOD1 will cause impacts to Aboriginal heritage, the proposed management measures presented in Section 7.8 are anticipated to provide the local Aboriginal community with examples of site contents and opportunities to maintain a cultural connection with the landscape.

Additional investigation of sites and salvage measures in accordance with the ACHMP will also help to achieve intergenerational equity by allowing retention of cultural materials for the enjoyment and education of future generations.

7.8.3 Proposed management and mitigation

The proposed strategies to manage and mitigate Aboriginal sites for MOD1 will be consistent with the approved Balranald Project ACHMP and contained in Appendix D. The ACHMP (Niche 2016) will be updated in consultation with Heritage NSW and RAPs to reflect the changes of MOD1 illustrated on Figure 7.23 and 7.24.





KEY

EIS Approved Balranald Project Area (SSD-5285) (project area)
Proposed modification (study area)
Existing track
Watercourse/drainage line
Waterbody

Investigation area

Mining and surface infrastructure area
Haul road north area

2021 survey results

Extended site boundary (EMM 2021)
Newly identified Aboriginal site (EMM 2021)

Previously recorded sites

BAHD sites (not on AHIMS)

Artefacts
Isolated artefact

AHIMS (13/10/2021)

Art site
Artefact site
Artefact site: isolated find
Artefact site; hearth
Artefact site; hearth; PAD
Artefact site; PAD
Hearth
Hearth; PAD
Heritage site boundary (Niche 2015)

Approved management (ACHMP 2016)

Exploratory test pit

Proposed management: investigation area

Surface collection
Indicative test excavation area

Management recommendations (a)

Source: EMM (2014, 2021, 2022); ESRI (2022); Iluka Resources (2018, 2021); OEH (2021); DFSI (2017); Niche (2015, 2016); GA (2011)

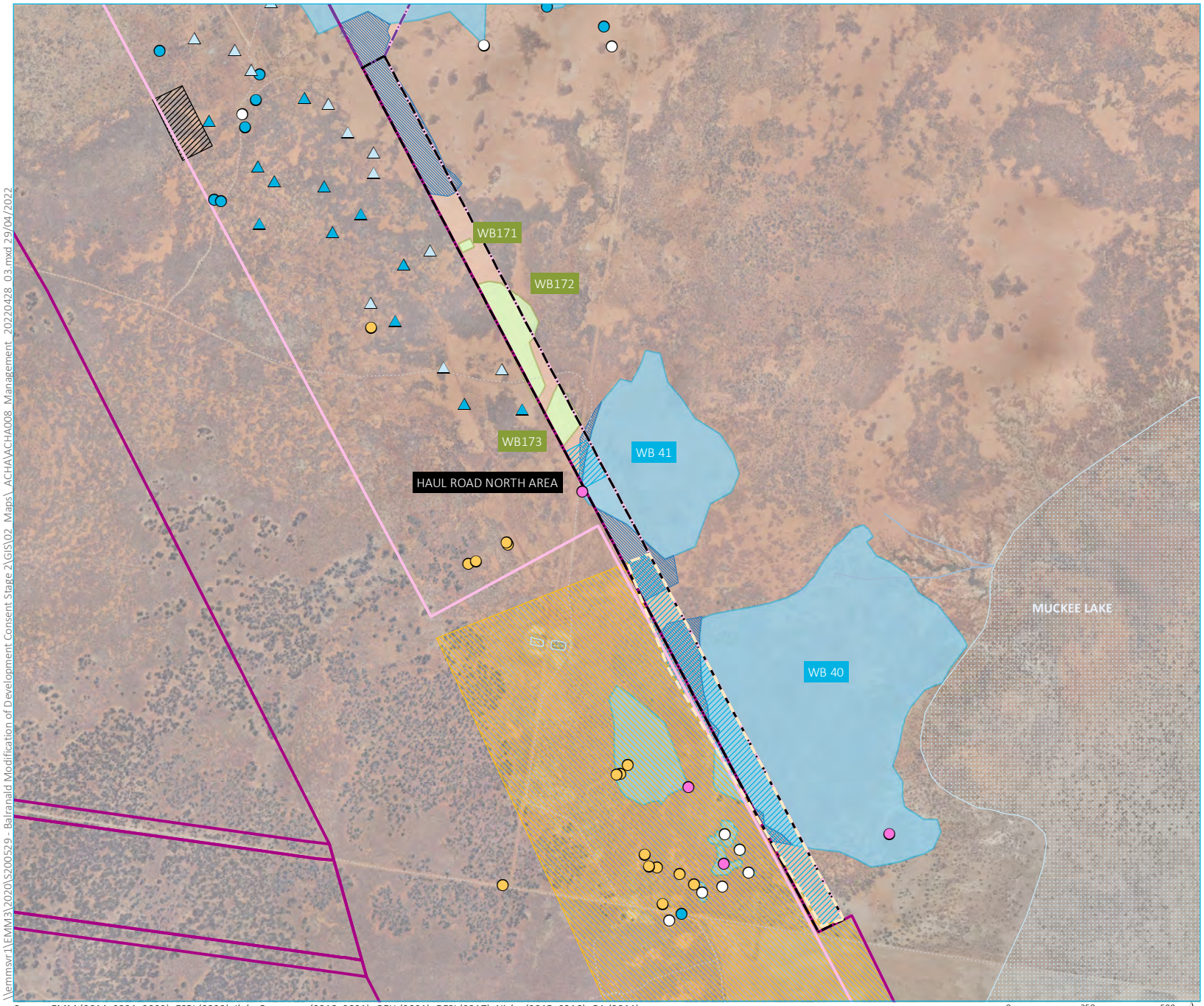
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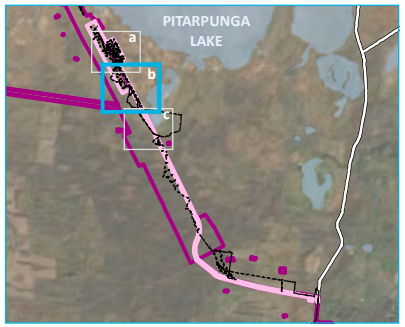
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Balranald Mineral Sands Project
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Figure 7.23

EMM creating opportunities

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KEY

EIS Approved Balranald Project Area (SSD-5285) (project area)
Proposed modification (study area)
Existing track
Watercourse/drainage line
Waterbody

Investigation area

Mining and surface infrastructure area
Haul road north area

2021 survey results

Extended site boundary (EMM 2021)
Newly identified Aboriginal site (EMM 2021)

Previously recorded sites

BAHD sites (not on AHIMS)
Artefacts
Isolated artefact

AHIMS (13/10/2021)
Artefact site
Artefact site: isolated find
Artefact site; hearth; PAD
Artefact site; PAD
Heritage site boundary (Niche 2015)

Approved management (ACHMP 2016)

Exploratory test pit

Approved management (ACHMP 2016)

Location 8 excavation area

Proposed management: investigation area

Surface collection
Indicative test excavation area
Location 8 proposed extension

Source: EMM (2014, 2021, 2022); ESRI (2022); Iluka Resources (2018, 2021); OEH (2021); DFSI (2017); Niche (2015, 2016); GA (2011)

0 250 500 m
GDA 1994 MGA Zone 54

N

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Management recommendations (b)

Balranald Mineral Sands Project
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Figure 7.24

EMM
creating opportunities

7.8.4 Conclusion

The ACHA included archaeological survey of MOD1 that extends beyond the currently approved boundaries of the Balranald Project area. These additional investigations have identified new Aboriginal cultural heritage values in the form of surface and potential subsurface archaeological remains. The surface remains are widely of low significance and will be managed by surface collection which is a method consistent with the ACHMP.

Archaeological test excavation is proposed to be undertaken within sites with PAD (WB 40, WB 41, WB 45 and WB 102) to characterise the nature of subsurface archaeology in the local area, which will determine appropriate management measures. Once test excavation is completed, the ACHMP will be updated in consultation with DPE and Heritage NSW.

7.9 Social

A social assessment (SA) was prepared by EMM, on behalf of Iluka, to assess the potential social impacts of MOD1 and is presented in Appendix N.

The SA:

- provides a comparison of potential social impacts of MOD1 against those of the Balranald Project; and
- identifies appropriate measures for managing potential adverse impacts and enhancing potential benefits.

7.9.1 Assessment approach

The assessment approach for the SA comprised providing:

- an overview of the key social characteristics of Balranald town and LGA;
- an overview of the predicted social impacts of the Balranald Project and how those impacts were proposed to be managed and mitigated;
- an assessment of the potential social impacts of MOD1 and recommended measures for managing and mitigating those impacts; and
- a comparative assessment of the predicted social impacts of MOD1 compared to those predicted in the SA for the Balranald Project, and a comparison of the recommended mitigation measures.

7.9.2 Existing environment

The SA identified two key areas of social influence for MOD1, including the local area, which is Balranald town, and the regional area, which is the Balranald LGA.

A baseline of key socio-economic characteristics of Balranald town and Balranald LGA was obtained from primary and secondary sources including surveys and data published by Commonwealth and NSW government agencies. Based on the surveys and data, the following conclusions can be drawn about Balranald's key socio-economic characteristics:

- The population of Balranald town and LGA has declined in the last 20 years. However, the rate of decline has decreased recently and predictions by DPE suggest that the population of the LGA is likely to grow slowly for the next 25 years.
- The median age of people in Balranald town and LGA is generally older compared to the state average, particularly in the town.
- The economic structure or participation rate in Balranald town is slightly disadvantaged when compared to the state. However, the economic structure or participation rate in Balranald LGA is similar to or slightly advantaged when compared to NSW.
- Employment in Balranald town reflects its role as a regional centre which provides support services for the Balranald LGA and broader area which is predominantly agriculturally based.

- While the unemployment rate in the Balranald LGA has increased recently it is lower than the NSW average. The COVID-19 pandemic began to have a significant negative impact on the Australian labour market from March 2020, when Australia recorded its 100th COVID-19 case and the initial shutdown of non-essential services and trading restrictions took effect.

- Data from the Australian Bureau of Statistics (ABS) indicates that the Balranald LGA was relatively disadvantaged in socio-economic terms in 2016 compared to other LGAs in Australia and NSW.

- For a remote town of its population, Balranald is well served by essential community services in the education, health, emergency services and sporting sectors in particular. Surveys indicate that in most community service sectors, there is a degree of spare capacity because of population decline but some services such as pupil/teacher ratios have been progressively scaled back in response to this decline.

- Balranald town is well serviced by recreational and sporting facilities.

- Balranald town is also well serviced by retail and commercial services.

- While some facilities are available for Balranald town and LGA's youth, there is a particular need for more facilities and services that cater for this age group.

- Of the 1,058 private dwellings within the Balranald LGA, approximately two thirds were owner occupied, with one third comprising the rental market. The housing market in Balranald town is relatively small with more sales in the lower price range than in higher price brackets. Currently there is a reasonable supply of dwelling houses on the market and reasonable supply of vacant residential lots, including half acre lots. However, discussions with relevant local stakeholders undertaken as part of the SA for the Balranald Project indicated that there is generally a shortage of affordable rental housing in Balranald.

- Being on the Sturt Highway and some distance from larger regional centres, there is a reasonable supply of temporary or short-term accommodation in Balranald town.

Overall, Balranald town and LGA exhibited a relative level of socio-economic disadvantage in 2016 compared with both state and national levels. Notwithstanding this, for a remote town of its population, Balranald is well served by essential community services in the education, health, emergency services and sporting sectors in particular. In most community service sectors, there is a degree of spare capacity as a result of historic population decline but some services such as pupil/teacher ratios have been progressively scaled back in response to this decline.

7.9.3 MOD1 assessment

The SA considered potential social impacts of MOD1 by project phases, including:

- the planning, feasibility and approvals phase;

- the construction and operations phase; and

- the rehabilitation and decommissioning phase.

Potential impacts are summarised in relation to the following parameters:

- duration – related generally to the length of the construction and operations phases;
- significance – whether the impact is considered to be of 'high', 'medium' or 'low' significance;
- extent – the area, people, facilities and/or services potentially affected;
- potential to mitigate the impact – availability of measures which can reduce or mitigate negative impacts; and
- other considerations – whether the impact is direct or indirect, positive or negative, or cumulative with impacts from other projects in the Balranald LGA.

A summary of the potential social impacts (positive and negative) that are predicted to occur as a result of MOD1 is presented in Table 7.37.

Table 7.37 Summary of potential social impacts during phases of MOD1

Potential social impacts by project phase	Duration	Significance	Extent	Potential to mitigate
Planning, feasibility and approvals				
Potential impacts on directly affected property owners.	Until negotiations with Iluka completed	Low	Directly affected property owners	Yes
Community concerns about the potential development of the Balranald Project.	Until project approval	Low	Balranald town and regional community	Yes
Construction and operations				
Workforce issues related to the limited number and availability of suitably skilled local workforce, requiring much of both workforces to be drawn from the wider regional area.	Construction and operational phases (about seven years)	High (positive)	Balranald LGA and regional area within 200 km	Yes
Increased demand for accommodation and housing (in addition to proposed accommodation village).	As above	Low for housing High (positive) for accommodation	Balranald LGA	Yes
Increased demand for community, retail, and business facilities or services.	As above	Low for community facilities High (positive) for retail and business facilities	Balranald town	Yes
Changes in social amenity.	As above	Low	Project area and Balranald town	Yes
Construction and operational traffic impacts.	As above	Low	Public roads	Yes
Cumulative impacts of the project with other mineral sands projects in the LGA (ie Atlas-Campaspe Mineral Sands Project).	As above	Low	Balranald LGA	Yes
Rehabilitation and decommissioning				
Loss of most project jobs.	Immediate post completion of mining operations	Low[1]	Balranald LGA and regional area within 200 km	Yes
Related impacts on community services and organisations.	As above	Low[1]	Balranald town	Yes

Notes: 1. Assumes that another Iluka project would replace the Balranald Project in the Murray Basin.

i Planning, feasibility and approvals phase

Two areas of potential impacts were identified during the planning, feasibility and approvals phase of MOD1; potential impacts on directly affected property owners, and community concerns about the potential development of the project.

Since the consent was granted for the Balranald Project, Iluka has purchased the majority of the land on which the project sits. For the land that Iluka does not own, it is in the process of negotiating purchase and/or lease agreements. In the interim, any activity undertaken on the properties, such as the previous trials, have been undertaken in accordance with negotiated commercial land access agreements.

Stakeholder engagement with affected property owners undertaken during the preparation of the SA for the Balranald Project indicated that they were not concerned about the direct impact of the Balranald Project, provided that appropriate commercial and functional arrangements had been negotiated. As indicated above, these commercial and functional arrangements have been negotiated and put in place.

Given the above, the impact of MOD1 on affected property owners is considered to be low.

Based on the results of stakeholder engagement during preparation of the EIS for the Balranald Project, it was apparent that there was general positive attitudes to the prospect of the Balranald Project proceeding within the local and regional community, particularly in relation to the employment and economic benefits that might result, particularly in Balranald town.

Feedback from community stakeholders after the consent for the Balranald Project was granted and during the mining trials indicates that the community is still positive towards the project because of the benefits it will have for the local and regional economy.

Given the continued supportive attitude of the local community, the scale of any concern about the proposed modification is considered to be low.

ii Construction and operations phase

a Workforce issues

A large part of the workforce would be accommodated within the accommodation village. Notwithstanding this, a small proportion of the workforce is likely to relocate with their families to the Balranald LGA to be closer to the mine site. In addition, MOD1 will generate flow-on (or indirect) jobs in the LGA as a result of demand for additional services generated by construction and mining activities. Modelling indicates that this could increase the population of the LGA by about 26 people. This increase is considered to be minor and could help partially reverse population decline that has been experienced in the area in the last 20 years.

Any movement of the existing local workforce to MOD1 may put pressure on the available labour pool for existing employers within the town. However, there may be a degree of ‘under employment’ in and around Balranald due to the limited size and range of the labour market, so some people may choose to move to full time work if suitable jobs become available either on the proposed modification or as a result of local jobs being vacated in preference to project jobs.

The impact of workforce issues is likely to be primarily experienced in Balranald LGA in the early stages of MOD1, particularly during the period when construction and operations are being undertaken concurrently. After these initial periods, employment patterns are likely to stabilise for the duration of operations.

This impact of workforce issues is considered to be of ‘high’ positive significance because of the extent of work opportunities generated by MOD1, particularly in the Balranald LGA and surrounding area. Any potential workforce issues can be mitigated by implementation of Iluka’s workforce recruitment and training policies and consultation with local training and employment agencies.

b Increased demand for accommodation

During the construction and operational phases of MOD1, it is expected that the majority project workforce would be accommodated in the accommodation facility. Notwithstanding this, some of the construction workforce would be required to use other accommodation in Balranald on a short-term basis while the accommodation facility is being constructed. This demand would increase the overall occupancy rates for tourist and temporary accommodation, including travellers. Short term stresses are considered possible during periods when there are long standing sporting or community events held in Balranald town such as race meetings, fishing competitions or the Balranald 5 Rivers Outback Festival that attract large numbers of visitors.

The maximum population increase potentially generated by MOD1 is predicted to generate demand for about 10 dwellings in the Balranald LGA. Given the existing availability of housing and temporary accommodation in Balranald, it is considered that this increased demand is unlikely to put short term stress on the availability and price for the wider community (both for properties for sale and rental properties).

Given Iluka's commitment to develop an accommodation facility that would cater for most of the direct workforce during the construction and operations periods, any impacts on wider accommodation resources in Balranald is considered to be of 'low' significance. Conversely 'high' positive impacts are expected for private accommodation providers due to increased demand during the early stages of both the construction and operational periods.

c Demands on community, retail and business services

There is unlikely to be any substantive demands during either the construction or operational phase on existing community facilities and services that cater principally for children and families as it is anticipated that there would only be a relatively small in-migration of people to the Balranald LGA as a result of MOD1. As discussed previously, there is generally sufficient capacity in most elements of the community infrastructure in Balranald town to readily meet any reasonable demands from new permanent residents.

Increased use of retail and business facilities and services could provide opportunities for the expansion of retail and business capabilities (diversification) or capacities (scale).

Generally, the significance of additional demands on hospitality and community services are considered to be 'low' because of the existing capacity in most community services sectors in Balranald town. 'High' positive impacts are expected on retail services due to predicted increased demand and spend with these services.

d Social amenity

During preparation of the SA for the Balranald Project some concerns were raised within the community around social amenity or cohesion impacts with fly-in-flyout (FIFO)/drive-in-drive-out (DIDO) workforces. While these concerns were raised, they were not prevalent, as the majority of those consulted during preparation of the SA stated that they were in favour of the Balranald Project. It was also noted that none of Iluka's existing operations at the time had experienced increases in anti-social behaviour from FIFO and DIDO workforces.

Since the consent was issued for the Balranald Project, two large solar farms have been constructed in the Balranald LGA and the town was used to 'house' their workforces. In addition to these, as previously discussed, Iluka has undertaken mining trials at the project site which included a DIDO and FIFO workforce. BSC has indicated that no adverse social issues were experienced with any of these workforces.

Therefore, the significance of impacts on the social fabric of Balranald town as a result of MOD1 is considered to be 'low'.

e Traffic impacts

During construction, a range of heavy vehicles would be used to transport construction materials and plant and equipment to the project area. It is expected all main roads would be utilised. During operations, large trucks would be utilised for all mine product transport within NSW. In addition to the above, there would be a number of light vehicle and bus traffic movements generated by the construction and operational workforce.

There is the potential that additional vehicle movements generated by the proposed modification would impact on some resident's amenity, such as potential noise impacts.

Two technical studies contained within this modification report address potential transport related impacts of MOD1; the NIA and TIA. Both assessments (refer to Section 7.1 and Section 7.3) conclude that impacts are minor and manageable. The TIA indicates that MOD1 would not be expected to have any significant traffic impacts in terms of level of service or traffic flow impacts for all transport routes. The NIA indicates that predicted road traffic levels would satisfy relevant road traffic noise criteria on all transport routes.

The significance of traffic impacts during the construction and operational phases is considered to be of 'low' because of the results of the TIA and NIA.

f Cumulative impacts

Tronox's Atlas-Campaspe Mineral Sands Project is currently being constructed and operations are expected to commence in 2022. It was estimated that the Atlas-Campaspe Mineral Sands Project could lead to a population increase of 36 people in the Balranald LGA (Resource Strategies 2014). This would generate demand for an additional 14 dwellings. Cumulatively, it is estimated that the two projects could increase the population of the Balranald LGA by 62 people and generate demand for 24 dwellings.

Similarly with workforce and accommodation impacts of MOD1 alone, cumulatively the two projects would help to offset population decline in the Balranald LGA and region, increase the overall occupancy rates for tourist and temporary accommodation, which could result in short term stresses during community events, and place some short term stress on the availability and price of accommodation for the wider community (both in the property market and rental properties).

Cumulative impacts are considered to be of 'low' significance. While there may be some short term stress on the provision of accommodation, cumulatively the projects would provide greater work opportunities and provide more potential for offsetting of population decline.

iii Rehabilitation and decommissioning

At the completion of mining activities, site infrastructure would be decommissioned and the mine site progressively rehabilitated until it is formally closed. As a result of the completion of the mining activities, most of the project's operational jobs would cease for both the non-local and local workforce components, together with related flow-on economic affects within the Balranald community.

However, the history of the mineral sands industry in the Murray Basin indicates that as one mining project is completed, another project generally comes on stream or is in development. This is particularly the case with Iluka as they aim to maintain availability of product to supply its processing and distribution facilities. As a result, a proportion of operational workers usually transfer to the next project in the region.

On the assumption that another mineral sand project would not be developed in the Murray Basin at the time of decommissioning of the Balranald Project, the significance of this impact was considered to be 'medium'. However, on the assumption that another mineral sands project is developed in the Murray Basin as the Balranald Project winds down, which is presumed to be the case, the significance of this impact is considered to be 'low'.

7.9.4 Mitigation measures

The proposed strategies to manage and mitigate potential social impacts for MOD1 are contained in Appendix D.

7.9.5 Conclusion

Based on the results of the SA, the net community benefit of MOD1 for the Balranald community is considered to be positive. The key social benefits of MOD1 as a result of employment and expenditure are considered to be:

- enhancement of the local and regional economies; and
- assisting to arrest long-term local and regional population decline, diminishing availability of services and facilities in the Balranald region and declining community sustainability.

Although MOD1 has the potential to have some negative social impacts as identified in this SA, these impacts are all deemed to be of low significance. As a result of the key social benefits of MOD1 identified above, it is expected that the proposed modification would have a net community benefit for the Balranald LGA and town and surrounding region.

7.10 Visual

A visual impact assessment (VIA) was prepared by EMM, on behalf of Iluka, to assess the potential visual impacts of MOD1 and is presented in Appendix O.

The VIA was completed with reference to relevant guidelines and policies to provide a comparison of predicted environmental impacts of MOD1 against the predicted impacts of the Balranald Project as follows:

- an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain;
- the temporary and permanent modification of the landscape; and
- minimising the lighting impacts of the development.

7.10.1 Assessment approach

An updated viewshed analysis was developed for MOD1 using spatial analysis in a geographical information system (GIS) platform for comparison against the viewshed analysis developed for the Balranald Project.

In accordance with the original EIS, visual impacts were considered in terms of the view type/context and the visual absorption capacity (VAC) of the existing landscape. VAC is a measure of the landscapes ability to absorb development without a significant change in the character and is measured as either low, moderate or high.

A high VAC would represent a modification/addition to the landscape area which would result in high visual contrast and a low level of visual integration with the surrounding landscape. A low VAC would represent a modification/addition to the landscape area which would result in minimal visual contrast and a high level of visual integration with the surrounding landscape.

The updated comparative viewshed analysis compared the MOD1 layout against the analysis undertaken for the EIS and identified areas of change between what has been approved and what is proposed for MOD1. Using a digital elevation model (DEM) within the area of interest, along with other parameters such as the curvature of the earth and the height of the built structure or object, it is possible to predict whether the structure or object has a line of sight with sensitive receptors.

The VIA to support MOD1 assessed six representative viewpoints (ie assessment locations, excluding the Nepean site to the north) surrounding the West Balranald site (Figure 7.25). The visual assessment utilised the EIS viewshed analysis using GIS to calculate the visibility of the proposed MOD1 surface infrastructure features at any point in surrounding the project area.

7.10.2 MOD1 assessment

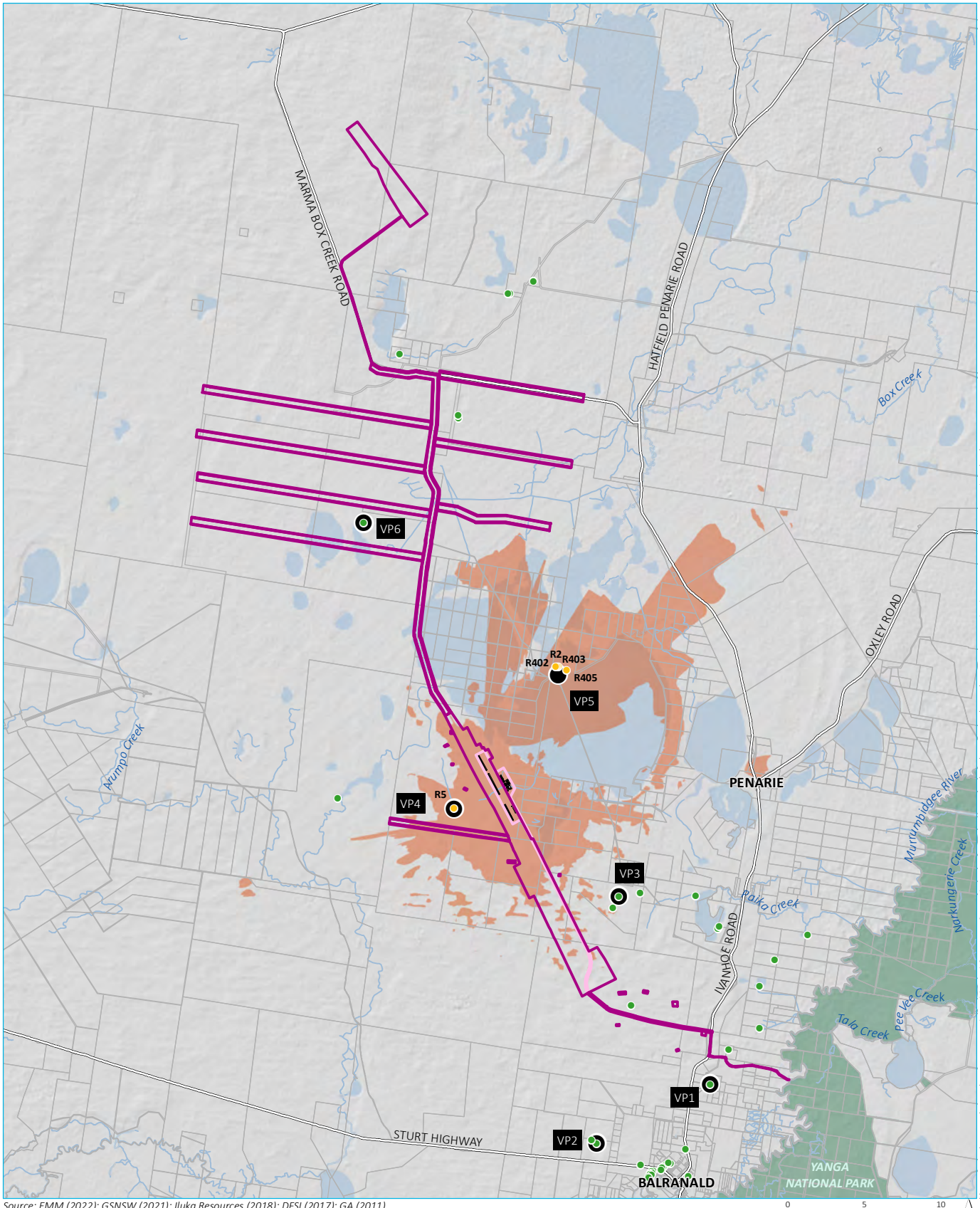
No additional impacts to the surrounding rural homesteads were identified with limited plant and equipment lighting on overburden stockpiles potentially able to be viewed on the horizon.

No additional impacts were identified for the Balranald-Ivanhoe Road and Sturt Highway.

No additional impacts were identified for the establishment of a telecommunications tower for MOD1 as it would not be visible from any sensitive receptors.

Visual impacts for MOD1 project are predicted to remain negligible to low when compared to the Balranald Project (Figure 7.25). As detailed in the VIA for the Balranald Project, this is largely due to the VAC of the existing landscape, the distance from which the visible elements would be observed, and the presence of existing vegetation that would provide screening and partial obstruction of views from observer locations. Lighting from processing plant, plant and equipment could be visible at night from some viewpoints which are proposed to be managed and mitigated in accordance with the Balranald Project conditions of consent.

MOD1 project infrastructure would not be visible from Balranald town and have no greater impact on the surrounding amenity than what has already been identified and approved.



Source: EMM (2022); GSNSW (2021); Iluka Resources (2018); DFSI (2017); GA (2011)

0 5 10 km

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification study area
- Site layout
- Major road
- Watercourse/drainage line
- Cadastral boundary
- Waterbody
- NPWS reserve
- Modelled viewshed

Viewshed analysis

- Viewpoint

Assessment location

- Visible
- Not visible

Viewshed analysis – MOD1

Balranald Mineral Sands Project
Modification report
Figure 7.25

EMM creating opportunities

7.10.3 Proposed mitigation measures

The proposed strategies to manage and mitigate potential visual impacts for MOD1 are consistent with the approved Balranald Project and contained in Appendix D.

7.10.4 Conclusion

Visual impacts for MOD1 are predicted to remain negligible to low and would have no greater impact on the surrounding amenity than what has already been identified and approved.

7.11 Bushfire

A bushfire assessment report (BAR) has been conducted by Bushfire Consulting Services (2021) (BCS), on behalf of Iluka, and is provided in Appendix P.

The BAR consisted of an assessment of bushfire related impacts for MOD1, in accordance with *Planning for Bushfire Protection 2019* (PBP) (NSW RFS).

7.11.1 Assessment approach

The BAR considered the requirements of the PBP, which focuses on protection of habitable buildings on bushfire prone land from bushfire.

To determine the potential bushfire threat to the Project area, the BAR considered the vegetation type, slope of the land, any other factors which may influence bushfire behaviour. The BAR has been assessed in accordance with the following factors:

- the aims and objectives of the PBP;
- issues listed for 'other development' as outlined in Chapter 8 of the PBP;
- implementation of an asset protection zone (APZ) for the proposed MOD1 accommodation building based upon a radiant heat threshold of 29 kilowatt per square metre (kW/m^2); and
- bushfire protection measures in accordance with PBP, Rural Fire Act and *Australian Standard 3959-2018 Construction of Buildings in Bushfire Prone Areas.*

Habitable buildings are defined in accordance with the Building Code of Australia (BCA) and include Class 1, 2, 3 and 4 buildings which are primarily used as residences, Class 5, 6, 7 and 8 buildings which are shops, warehouses, factories, offices and carparks and the like, and Class 9 buildings which include healthcare, community assembly buildings and aged care buildings.

7.11.2 MOD1 assessment

i Bushfire prone land

The MOD1 project area is mapped as bushfire prone land under the Balranald LEP. Vegetation near the MOD1 processing area and accommodation facility comprises a mixture of Category 1 vegetation and Category 2 vegetation (refer Figure 7.26 and Figure 7.27).

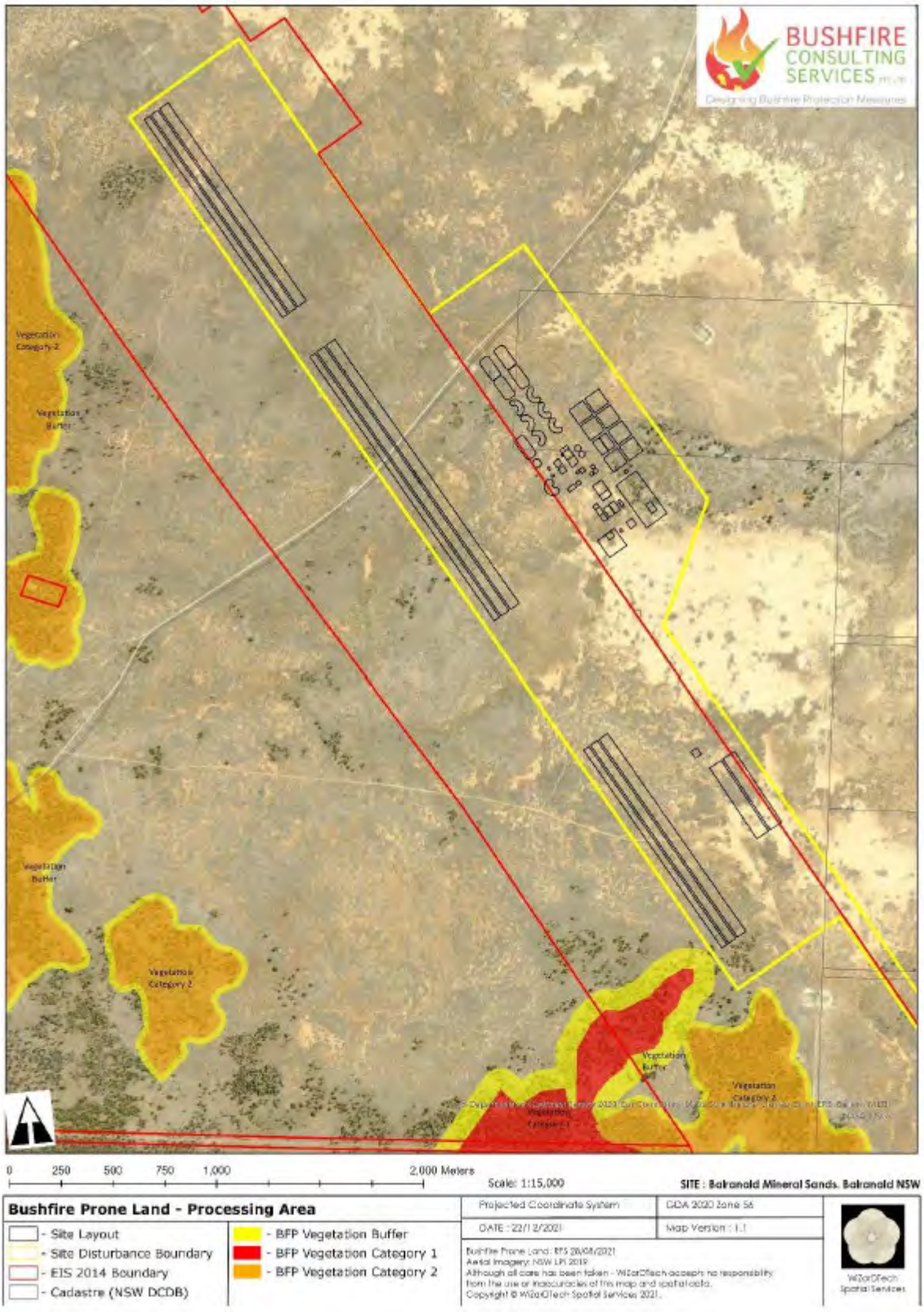


Figure 7.26 Bushfire prone land map – MOD1 processing area

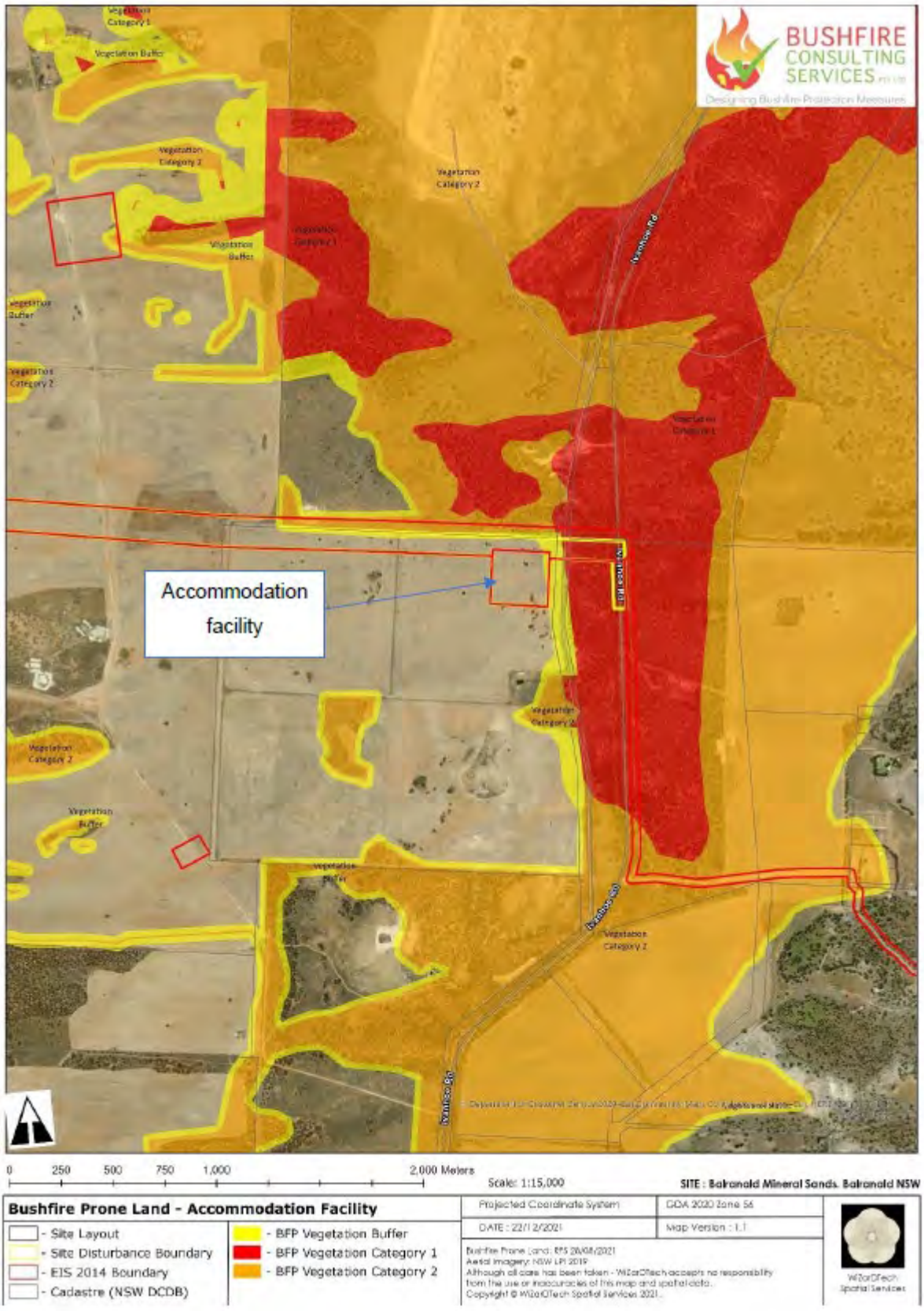


Figure 7.27 Bushfire prone land map – MOD1 accommodation facility

Category 1 vegetation is defined under *Guide for Bushfire Prone Land Mapping* (NSW RFS 2015) as:

- areas of forest, woodlands, heaths (tall and short), forested wetlands and timber plantations; and
- remnant and short fire run vegetation within 30 m of each other where the combined area is greater than 2.5 ha.

Category 2 vegetation is defined as:

- grasslands, freshwater wetlands, semi-arid woodlands, arid shrublands and rainforests; and
- remnant vegetation and short fire runs greater than 100 m lateral separation from Category 1 vegetation and 30 m from other Category 2 vegetation.

ii Lower Western Zone Bushfire Risk Management Plan

The RFS's Lower Western Zone Bushfire Management Committee has prepared a bushfire risk management plan for the Lower Western Zone which covers Balranald LGA (RFS 2009). The plan identifies community assets at risk from bushfire and describes treatment measures for those assets. There are no community assets identified in the plan or adjacent to the Project area. The nearest assets identified are the Homebush Hotel and a radio tower on Balranald Ivanhoe Road.

iii Asset protection zones

An APZ is a fuel-reduced area which provides a building setback from bushfire hazard vegetation. APZ's provide a buffer zone between a bushfire hazard and an asset. It also provides fire vehicle access and reduces radiant heat, convection winds, ember attacks and allows smoke to disperse.

a Vegetation

The PBP uses the Keith formations to classify bushfire hazard vegetation within 140 m of the processing area and accommodation facility assets. Based on the determination of vegetation formation using the Keith (2004) Identification Key and 2022 ecology surveys the primary bushland vegetation having the potential to affect the processing area is arid shrubland, while the accommodation facility is semi-arid woodland to north and east and grassland to the south and west.

b Slope

Slope is an important contributor to a bushfire's rate of spread. A bushfire will spread quicker up a steep slope compared to a gradual slope or flat land. Slopes are classified according to the PBP and are combined with vegetation classes in an area to determine appropriate APZs.

The BAR measured the effective slope over a distance of 100 m from the proposed MOD1 processing area and accommodation facility. The slope is relatively flat and represents class (ii) >0 to 5° downslope vegetation.

c Fire weather

The Project area has a Fire Danger Index (FDI) of 80.

d Required asset protection zone

To meet the requirements of the BPB, occupied buildings should not exceed radiant heat levels of 29 kW/m^2 to prevent flame contact during a bushfire.

The buildings within the processing area are considered Class 5–8 buildings. This includes the processing plant, maintenance areas and workshops, administration offices and amenities with the APZ required to be 5 m.

The APZ for the accommodation facility is required to be 10 to 11 m. The recommended APZs are summarised in Table 7.38 and displayed on Figure 6 and 7 of Appendix P.

There is no significant change to the APZs recommended for the processing area for the Balranald Project. The APZs are in excess of 7 m when considering the disturbance boundary, and therefore consistent with PBP. The bushfire assessment completed for the Balranald Project did not include APZ for the accommodation facility.

Table 7.38 Recommended APZs for MOD1

Aspect	Distance from hazard	Slope	Minimum APZ
Processing area			
North	282 m	Level to upslope	N/A
East	100 m	Level to upslope	5 m
South	198 m	Level to upslope	N/A
West	100 m	Level to upslope	N/A
Accommodation facility			
North	-	Level to slope	11 m
East	-	Level to slope	11 m
South	-	Downslope > 0-5°	11 m
West	-	Level to upslope	10 m

7.11.3 Proposed mitigation measures

The proposed strategies to manage and mitigate potential bushfire impacts for MOD1 are consistent with the approved Balranald Project and contained in Appendix D.

7.11.4 Conclusion

The BAR concluded that MOD1 is on designated bushfire prone land and the legislative requirements for development in bushfire prone areas are applicable. Following the implementation of approved mitigation measures MOD1 satisfies the aim, specific objectives, the intent and performance criteria of Chapter 8 of PBP.

7.12 Economic

An economic assessment (EA) was undertaken by Gillespie Economics (Gillespie Economics 2022).

The EA considered the economic efficiency of MOD1 (ie consideration of its economic costs and benefits) and its effect on the local economy compared to the Balranald Project.

7.12.1 Assessment method

The EA comprised two types of analysis to assess the economic impacts of MOD1:

- a cost benefit analysis (CBA); and
- a local effects analysis (LEA).

7.12.2 MOD1

i Cost benefit analysis

CBA of a project involves a comparison of the economic costs and benefits of a project, compared to what would happen in the absence of that project.

A CBA of the Balranald Project (Gillespie Economics 2015) estimated that it would have a net production benefit to NSW of $108 million (M). A CBA of MOD1 indicates that it would have lower net production benefits to NSW.

While a comparison of MOD1 to the Balranald Project accords with the assessment approach adopted for the proposed modification, from an economic perspective there are several limitations to this comparison. Predominantly this is because the projects have significantly different scopes.

The Balranald Project, would generate approximately 14.4 Mt of HMC and ilmenite over the 15 year project life, at production rates of up to 500,000 tonnes of HMC and 600,000 tonnes of ilmenite per year. It would generate up to 225 jobs during construction and up to 550 jobs during operations. Because MOD1 is a trial it will result in only a fraction of the approved production volumes over the six year operational life, and would generate up to 200 jobs during construction and 170 jobs during operations.

MOD1 also includes capital costs that will potentially be amortised over future projects (ie the mining of the remainder of the West Balranald deposit and the Nepean deposit should the trial be successful) whereas capital costs for the Balranald Project were amortised over the life of the project.

In addition, the projects are not undertaken at the same moment in time and therefore ignore real cost escalations and other changes in assumptions that would be made to a contemporary economic analysis of the Balranald Project.

MOD1, therefore, is not a complete mining project. It is a trial, aimed at discerning if there is a better approach to mining the mineral sand resource compared to the approved open cut method. Should the trial be successful, Iluka may seek a new LOM approval for the continued mining of the Balranald Project using the underground method, instead of the open cut method currently approved.

It should also be noted that the CBA is based on an economic analysis of MOD1 rather than a financial analysis. The main difference in the analyses is how capital costs are treated. In economic analysis, capital costs are included in the analysis when they occur. In financial analysis, depreciation and capital financing costs are included over time. From a financial analysis the modification is profitable.

ii Local effects analysis

The LEA compliments the CBA by translating effects identified at the NSW level to the potential impacts on the communities located near the MOD1 project area. The local area of impact has been defined as the LGAs within a 200 km radius of the project area (Balranald, Wentworth, Mildura, Swan Hill, Murray River, Edward River and Hay LGAs – see Figure 7.28). This area is envisaged to be the main source of labour and non-labour inputs for MOD1.

The local area of impact is also consistent with the area defined in the economic assessment of the Balranald Project (Gillespie Economics 2015).

MOD1 will provide direct economic activity, including jobs, to the local area. As previously stated, the peak construction and operational workforce are estimated at 200 and 170, respectively, with both phases having an average annual workforce of 150.

The direct revenue, expenditure and employment profiles of the construction and operation phases of MOD1 were modelled using an input-output (IO) model of the regional economy and the computer program EconImp to estimate the average annual direct and indirect output, value-added, income and employment impacts for the local area economy.

In total, the annual impact of the construction phase of MOD1 on the local area economy is estimated at up to:

- $93 M in annual direct and indirect output or business turnover;
- $38 M in annual direct and indirect value added;
- $21 M in annual direct and indirect household income (wages); and
- 288 direct and indirect jobs.

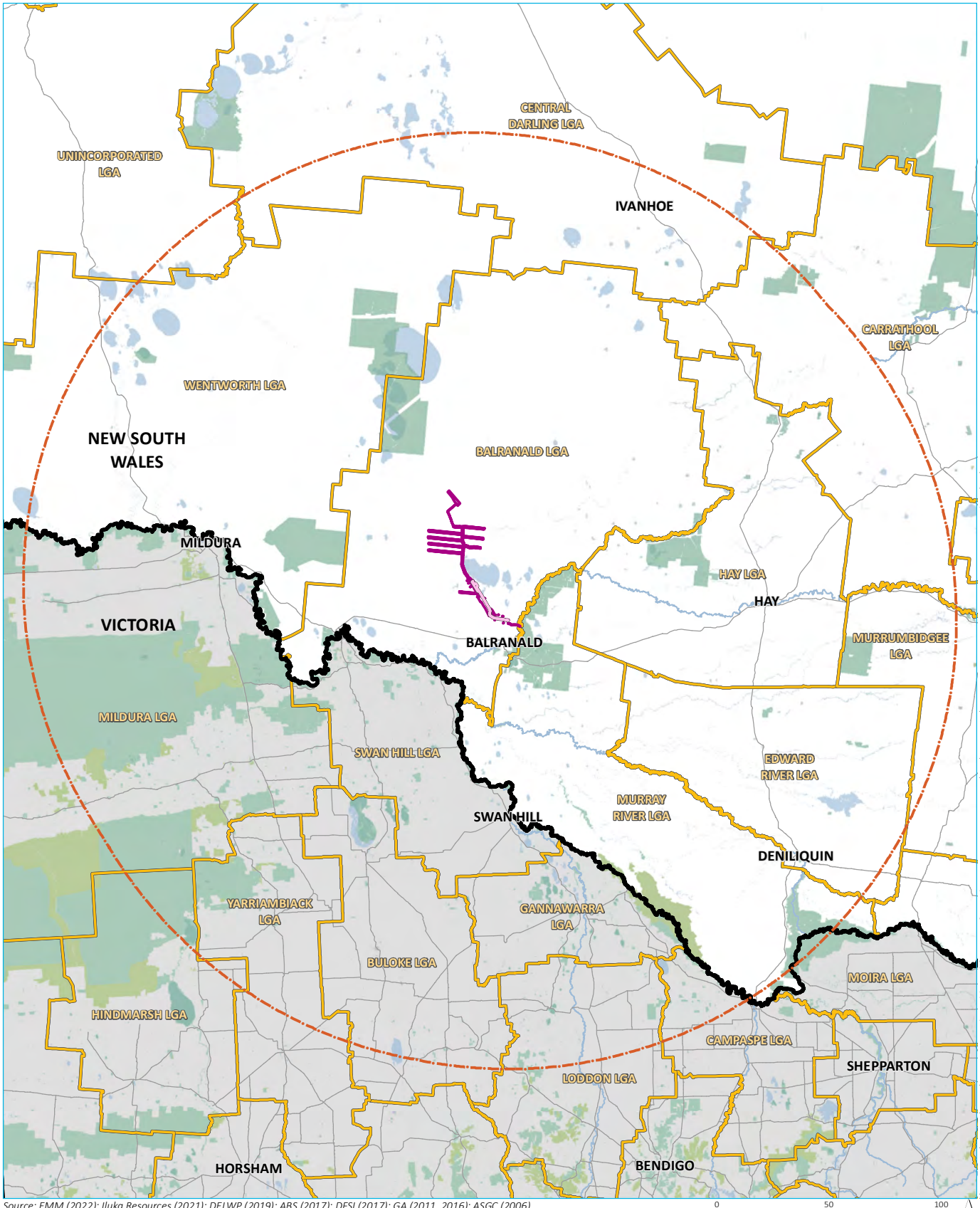
These figures are 68% to 88% of those that would arise from the Balranald Project. This is a result of lower construction costs and construction employment of MOD1.

The operational phase of MOD1 is estimated to make up to the following average annual contribution to the local area economy for a period of six years:

- $175 M in annual direct and indirect regional output or business turnover;
- $89 M in annual direct and indirect regional value added;
- $26 M in annual direct and indirect household income; and
- 329 direct and indirect jobs.

These figures are 18% to 32% of those that would arise from the Balranald Project. This is because of the lower levels of production during the trial mining operations and more efficient operational methods.

Notwithstanding the above, MOD1 would have positive economic benefits to the local area economy during both its construction and operational phases.



Source: EMM (2022); Iluka Resources (2021); DELWP (2019); ABS (2017); DFSI (2017); GA (2011, 2016); ASGC (2006)

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KEY

- EIS Approved Balranald Project Area (SSD-5285)
- Proposed modification study area
- Economic impact buffer - 200 km
- LGA boundary
- National/State road
- Major perennial watercourse
- Waterbody
- National park/reserve
- State forest

Local area of impact (economic impacts)

Balranald Mineral Sands Project
Modification report
Figure 7.28

EMM creating opportunities

7.12.3 Mitigation measures

The proposed strategies to manage and enhance economic benefits and mitigate against potential impacts for MOD1 are consistent with the approved Balranald Project and contained in Appendix D.

7.12.4 Conclusion

The CBA indicates that MOD1 would have a net production benefit to NSW. MOD1 is an underground mining trial aimed at discerning if there is a better approach to mining the mineral sand resource compared to the approved open cut method.

The CBA is based on an economic analysis of MOD1 rather than a financial analysis. The main difference in the analyses is how capital costs are treated. In economic analysis, capital costs are included in the analysis when they occur. In financial analysis, depreciation and capital financing costs are included over time. From a financial analysis the modification is profitable.

MOD1 will provide direct economic activity, including jobs, to the local area. This activity will provide significant economic benefits to the area during both the construction and operational phases. The stimulus effects would be much greater during the operational phase when expenditure is more substantial over a longer period of time. The economic benefits of MOD1 would be significant for the local area.

7.13 Rehabilitation

A rehabilitation and closure assessment (RCA) was undertaken by EMM, on behalf of Iluka, and is presented in Appendix Q.

The RCA consisted of:

- a summary of the original 2015 *Rehabilitation and Closure Strategy* (RCS) (EMM, 2015); and
- assessment of rehabilitation and closure objectives for MOD1.

7.13.1 Assessment approach

The assessment approach for the RCA was consistent with the RCS, comprising:

- describing the means by which acceptable post-mining land use suitability would be achieved;
- presenting the proposed stable post-mining landforms; and
- describing methods to preserve downstream water quality.

To achieve these objectives, the RCA outlines:

- rehabilitation strategies for areas that would be disturbed;
- objectives for the rehabilitation;
- a revegetation program;
- a monitoring program to assess performance of rehabilitated areas; and
- objectives and preliminary rehabilitation criteria for mine closure.

7.13.2 MOD1 assessment

MOD1 involves the continuation of the underground mining trial within a proposed modification extension area of approximately 119 ha whilst excising an equivalent 119 ha from the existing Balranald Project area.

i Project domains

A description of the disturbance areas and project domains is provided in Table 7.39 and outlined below.

Table 7.39 MOD1 disturbance area

Primary domain element	EIS approved disturbance area (ha)	Proposed MOD1 additional disturbance area (ha)	Purpose
West Balranald mine (domain 1)	2,987	As approved	Underground mining using horizontal directional drilling (HDD), mine stopes, majority of access roads, infrastructure corridors, maintenance, topsoil and other material stockpiles, internal road network and ancillary infrastructure.
Nepean mine (domain 2)	804	As approved	Not applicable to MOD1.
West Balranald processing/infrastructure area (domain 3)	71	95	Processing plant, portion of access roads, stockpiles, maintenance areas/workshops, water storage dams, ore stockpiles and truck load-out area, administration offices and amenities, internal road network and ancillary infrastructure.
Nepean infrastructure area (domain 4)	0.62	As approved	Not applicable to MOD1.
West Balranald access road (domain 5)	72	24	Greenfield access road.
Nepean access road (domain 6)	15	As approved	Not applicable to MOD1.
Injection borefield (domain 7)	1,348	As approved	Not applicable to MOD1.
Gravel extraction (domain 8)	42	As approved	Borrow material for construction and operation.
Water supply pipeline (domain 9)	11	As approved	Not applicable to MOD1.
Accommodation facility (domain 10)	7.1	As approved	Accommodation for workforce.
Total	**5,357.1**	**119**	

ii Material handling

Underground mining will produce the following overburden types, ore and mining by-products (MBP):

- Topsoil (of variable depth for use in the rehabilitation program).
- Subsoil (up to 0.4 m depth of excavation).
- Non-Saline Overburden (NSOB, up to 1.5 m depth of excavation) – defined as material below the topsoil/subsoil but above the groundwater table. Consists of Shepparton Formation sands, clayey sands and clays.
- Ore (up to 3–5m thick) – defined as the mineralised strand within the LPS2.
- Surface emplacement of treated sand tailings (up to 2 m levelled and averaged) and overburden/subsoil ahead of mining into the space created by the additional non-saline overburden stripping.

iii Rehabilitation strategy

Iluka propose to implement the RCS strategies and methods prior to and during operations for MOD1 in order to facilitate an effective rehabilitation program. It is anticipated that as mining and rehabilitation progresses, changes to the strategy may be required to optimise rehabilitation success. Further detail on specific rehabilitation will be provided and updated annually in the Rehabilitation Reform process administered by the NSW Resource Regulator under the Mining Amendment (Standard Conditions of Mining Leases – Rehabilitation) Regulation 2021.

The current proposed underground mining process would broadly comprise:

- clearing of vegetation/topsoil, subsoil and non-saline overburden from the proposed MOD1 disturbance area as follows:
    - vegetation/topsoil (variable depth down to about 0.1 m to 0.3 m) stripped;
    - excavation areas (eg for water storage dams, PAX dams) would remove subsoil (from about 0.1 m to 0.5 m); and
    - mining area (ie panels above underground stopes) would remove additional non-saline overburden (from about 0.5 m to 1.5 m);
- surface placement of treated sand tails (nominally up to 2 m depth of fill material) and overburden/subsoil ahead of mining into the space created by above stripping;
- replacement of subsoil and topsoil for rehabilitation and final landform;
- underground mining to progressively develop and mine stopes moving sequentially south to north; and
- rehabilitation monitoring.

MOD1 would have a life of approximately nine years, including the construction and operational phases, and if required, further rehabilitation and decommissioning phases.

Rehabilitation and decommissioning, if required, is expected to take a further two years following Year 6 of the operational phase while monitoring and maintenance may extend beyond this period. If the proposed MOD1 underground mining is successful, Iluka would seek a LOM approval for underground mining with associated final land form and closure deferred until after the LOM.

iv Rehabilitation strategies and methods

The following identifies the general strategies and methods that will be progressively implemented prior to and during operations as summarised below from the RCS. It is anticipated that as mining and rehabilitation progresses, changes to the methods may be required to optimise rehabilitation success. Further detail on specific rehabilitation will be provided in the Rehabilitation Reform process administered by the NSW Resource Regulator under the Mining Amendment (Standard Conditions of Mining Leases – Rehabilitation) Regulation 2021.

a Seed collection

Where possible, seed will be collected from within the MOD1 disturbance area prior to ground disturbing activities.

b Vegetation clearing

Clearing of native vegetation will be performed in compliance with Iluka policies and procedures. Vegetation clearing will be minimised as far as practicable to areas for mining operations and support activities. Cleared overstorey timber will be retained and stockpiled for habitat enhancement purposes (brushing, habitat creation). Clearing of overstorey species will be via chaining or pushing with a dozer, excavator or loader.

For low open shrubland areas where it is not practical due to vegetation height, health or density, it may be appropriate to clear the understorey with the top soil layer. In other areas, the understorey may be cleared separately to the top soil. A loader, dozer or grader will use their blade to cut off the shrubs close to ground level and push them into a windrow. The windrows will then be carted away for placement in stockpiles for later use. An alternate approach may be to mulch the chenopod shrubs, leaving a litter layer on the ground that can be stripped with the top soil. Alternatives will be considered for trialling during operations.

c Management of soils and topsoil

All areas to be disturbed as a result of construction and operations would require soil stripping for reuse in rehabilitation.

d Decommissioning

If required, decommissioning of MOD1 would involve the following activities:

- decommissioning of processing plant areas following removal of plant;
- decommissioning of mine services and infrastructure;
- removal of mining infrastructure, materials and rubbish;
- topsoil and sub soil testing of all potentially contaminated areas;
- removal of any contaminated topsoil and sub soils with provision for at least 1 m of cover following treatment (as may be required);
- topsoil and sub soil groundwater testing to validate potentially contaminated sites to ensure benign material is present before rehabilitation programs commence and potentially contaminated water is removed;
- contouring earthworks to rip up compacted areas and blend disturbed mining surfaces into surrounding topography; and
- application of topsoil and subsoil and/or collected seeds to promote establishment of endemic vegetation suitable for intermittent and low intensity grazing.

e Borrow pits

Borrow pits would be closed and rehabilitated earlier if the resource is exhausted prior to MOD1 closure. Rehabilitation of borrow pits will typically include:

- removal of all infrastructure from site;
- deep ripping of compacted areas;
- placement of any material that was not suitable for construction purposes back into the excavation;
- pit walls will be battered to an appropriate angle to ensure they are safe, stable and suitable for the surrounding land use;
- previously stockpiled topsoil will be spread over the final landform and disturbed areas; and
- revegetation, seeding and/or planting (depending on the final land use).

v Post mining land use

Iluka have proposed maintaining the RCS final land use option for MOD1 to establish native vegetation communities suitable for intermittent and low intensity grazing uses.

a Final landform design

MOD1 proposes to replicate the original landform as much as possible. The landform design will be modified compared to the pre-mining surface but is intended to be compatible with the surrounding environment. Areas disturbed for the construction of other infrastructure including access roads and accommodation facility will generally be the subject of superficial disturbance. Consequently, the objective for these areas will be to reinstate the pre-mining contours and drainage.

vi Domain selection

As defined in ESG3, a domain is defined as a land management unit within the proposed MOD1, usually with similar geophysical characteristics.

In accordance with ESG3, the process of identifying domains has been broken into three steps:

1. Identification of mining domains according to the way an area of land is managed in a mining context.
2. Identification of primary (operational) mining domains. These are management units within the MOD1 with a unique operational and functional purpose.
3. Identification of secondary (post mining land use) domains. These are land management units characterised by a similar post mining land use objective.

The four proposed primary domains and secondary domains and their respective areas in terms of operational impact and proposed final landform areas are listed in Table 7.40.

Table 7.40 Primary and secondary domains and final land use

Domain no.	Domain (primary)	Description of uses	Area (ha)	Secondary domain	Secondary domain description	Area (ha)	Pre-mining land use	Final land use
1	MOD1 mine path	Underground mine path	56	1a: Mine path – surface sand tails emplacement backfilled	Backfilled mine path – subject to ongoing consolidation –residual depression	56	Grazing on pasture and shrublands	Chenopod shrublands – not grazed (fenced) until stable
		Internal access roads, soil stockpiles and groundwater monitoring infrastructure	259	1b: Ancillary infrastructure	Internal access roads, stockpiles and groundwater monitoring infrastructure	259	Grazing on pasture and shrublands	Grazing on chenopod shrublands
3	MOD1 processing area	Processing plant, maintenance areas/workshops, final product stockpiles and truck load-out area, administration offices and amenities, internal road network and ancillary infrastructure	101	3b: Other infrastructure	Concentrator and all other infrastructure	101	Grazing on pasture and shrublands	Grazing on chenopod shrublands
5 and 8	West Balranald access road and accommodation facility	Access road and accommodation facility	301.1	n/a	n/a	301.1	Grazing on pasture and shrublands	Grazing on chenopod shrublands or access road left in place
10	Borrow pits	Borrow pits	42	n/a	n/a	42	Grazing on pasture and shrublands	Grazing on chenopod shrublands

vii Rehabilitation methods for closure

Iluka is committed to adopting a progressive approach to the rehabilitation of disturbed areas.

a Topsoil and sub soil reinstatement, compaction and remediation

Upon decommissioning of infrastructure and hardstand areas at closure, compacted topsoil and sub soil would be ripped under dry conditions to break up hard layers and provide a favourable root zone. These areas would be seeded with species appropriate to the identified post-mining land use. To alleviate any compaction that may have been caused by the movement of heavy machinery, all mined areas may be ripped to aid in reducing compaction of earth.

Topsoil and sub soil would be applied to landforms once they are re-contoured and drainage works are complete. Contour or diversion banks with stable discharge points would be constructed to limit slope lengths and control runoff. Collection drains and sedimentation dams would be installed to collect runoff and remove suspended sediment.

b Drainage and erosion control

Restored surfaces would be stabilised as soon as practicable to reduce potential wind erosion and subsequent dust.

All rehabilitation areas and stockpiles would require stabilisation to protect them against the risk of erosion from wind or water. The most effective strategy for stabilisation would be trialled during the early stages of mining.

Drainage zones would not receive special erosion control treatments due to the infrequency of rainfall and subsequent flow events. If excessive sediment movement occurs then supplementary earthworks would be undertaken to return the drainage channels to design levels.

c Control of surface water inflow to void

Surface water inflow would be directed away from the mined area through the construction of interceptor channel drains around the perimeter. Uncontrolled surface water has the potential to cause slope deterioration and ultimate failure.

d Revegetation

Disturbed areas would be revegetated predominantly from the topsoil seed store.

Direct seedling, planted seedlings and transplanting of seedlings may be introduced into the revegetation program if considered necessary, after assessment of rehabilitation germination success.

Species would be selected in order to encourage the re-establishment of the pre-agricultural vegetation communities in those areas defined for woody vegetation establishment. Areas identified for shrublands and chenopod re-establishment would have stock excluded until it can be demonstrated that the vegetation is stable and self-sustaining, and that gazing would not impact upon its establishment.

e Brush/timber spreading

Revegetation would include the spreading of brush and timber across the rehabilitated land, focussing on those areas where woody native vegetation is to be established. Subject to availability of material, the timber and or mulch would be spread thick enough to provide the desired benefits, but not so thick as to inhibit germination of seed.

Mulch may be spread following topsoil replacement and larger stockpiled timber may also be utilised to develop fauna habitat piles.

viii Rehabilitation schedule

The progressive formation of the post-mining landform and the establishment of a vegetative cover would vary throughout the life of MOD1.

If this proposed MOD1 underground mining is successful, Iluka would seek a LOM approval for underground mining with associated final land form and closure deferred until after the LOM.

Further detail on specific rehabilitation will be provided in the Rehabilitation Reform process.

7.13.3 Rehabilitation criteria

The proposed strategies to manage and mitigate rehabilitation for MOD1 will be consistent with the approved Balranald Project and contained in Appendix D. Throughout the life of MOD1, the rehabilitation criteria may be refined based on the results of ongoing rehabilitation monitoring.

Further detail on specific rehabilitation criteria will be provided in the Rehabilitation Reform process.

7.13.4 Conclusion

MOD1 will be progressively rehabilitated with monitoring of the rehabilitated areas to be undertaken to demonstrate whether the objectives of rehabilitation, closure and a sustainable and stable landform has been achieved. The rehabilitation program will be assessed against the approved Balranald Project success criteria.

7.14 Other hazards and risks

7.14.1 Radiation

A radiation risk assessment was prepared for the approved EIS for the Balranald Project utilising baseline soil and water radiation assessments by Earth Systems and Land & Water Consulting (LWC). The magnitude and/or extent of the potential radiation impacts of MOD1 is considered negligible and within the impact levels assessed for the approved Balranald Project. The mitigation and management measures for the approved Balranald Project are expected to be effective and appropriate for MOD1.

7.14.2 Hazardous development

Chapter 3 of *State Environmental Planning Policy (Resilience and Hazards) 2021* (the Resilience and Hazards SEPP) requires the consent authority to consider the hazard potential of proposed activities including the location of the development, the way in which it is to be carried out, and the storage of dangerous goods.

Mining of mineral sands is not identified as a potentially hazardous or offensive industry. However, the proposed modification may be determined to be a potentially hazardous development if the storage of dangerous goods such as diesel, petrol and oils exceeds the requirements of *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (DP&I 2011) (Applying SEPP 33). Note that the Resilience and Hazards SEPP replaced SEPP 33 on 1 March 2022. Therefore, applying SEPP 33 now relates to the application of the Resilience and Hazards SEPP.

An assessment of hazard potential of MOD1 has been undertaken against Applying SEPP 33 and is documented in Appendix A. It demonstrates that the storage of dangerous goods would comply with threshold quantities and distances to site boundaries specified in Applying SEPP 33. Subject to these setbacks being maintained and provided that dangerous goods are stored in accordance with relevant standards, MOD1 will not be a hazardous or offensive development.

7.14.3 Non-Indigenous heritage

A previous non-Indigenous (or historic) heritage assessment of the Balranald Project was undertaken by Landskape.

The non-Indigenous heritage assessment did not identify any historic heritage sites or values within close proximity to the MOD1 project area or with potential to be impacted by the Balranald Project. Accordingly, no items of non-Indigenous heritage is expected to impacted by MOD1.

i Management and mitigation

The proposed strategies to manage and mitigate Non-Indigenous for MOD1 will be consistent with the approved Balranald Project and contained in Appendix D.

7.14.4 Environmental management

Environmental management during MOD1 will be in accordance with an environmental management strategy (EMS).

The EMS would contain a suite of environmental management plans which detail the site-specific management measures and procedures to be implemented during construction and operation for mitigating and managing impacts identified in the EIS and this Modification Report.

The EMS would be developed to be consistent with the Rehabilitation Plan process to be prepared in accordance with legislative requirements and submitted to the NSW Resources Regulator. This would include development of plans consistent with the Rehabilitation Plan, and annual monitoring and reporting to the NSW Resources Regulator through the annual environmental management report (AEMR) process. The EMS would be prepared to allow it to integrate with the Rehabilitation Plan and AEMR for the Balranald Project.

Management plans under the EMS would be prepared in consultation with relevant government agencies where required. The EMS would be developed to be consistent with the conditions of the Balranald Project development consent (as modified) and other planning approvals, should they be granted.

8 Justification of modified project

A description of the need and justification for MOD1 is provided below with regard to biophysical, social and economic factors; the principles of ecologically sustainable development (ESD); and the consistency of MOD1 with the objects of the EP&A Act.

8.1 MOD1 impacts

This modification report assesses the potential impacts that may result from MOD1. The assessment of environmental issues has been multi-disciplinary and involved consultation with DPE and key stakeholders as outlined in Section 6 of this report.

MOD1 will not result in significant biophysical, social or economic impacts and the MOD1 report has identified that any residual impacts can be appropriately managed.

8.2 MOD1 benefits

MOD1 will enable the continuation of Iluka's underground mining trial for up to six years to help prove up the development in terms of:

- equipment suitability and reliability;
- tailings management processes to deliver a sustainable mining by-product management strategy; and
- further validation of environmental monitoring to support a future approval for a LOM operation should the continuation of the underground mining trial be successful.

MOD1 aligns with the strategic policies for the region, including the *Murray Regional Strategy 2009–2036*, *Far West Regional Plan 2036* and *Local Strategic Planning Statement*, and would assist the state deliver a project that will create jobs and contribute to regional economic growth. Proposed road intersection upgrades and improvements will support objectives around maintaining local and regional road networks.

MOD1 would allow for existing social and economic benefits of the Balranald Project to continue as a result of the continuation of mining by enabling the employment of up to 200 jobs during construction and 170 jobs (including operationally induced haulage contractors) during operation, while supporting local and regional suppliers. MOD1 would also provide stability and certainty to local and regional communities, contributing to negating possible social and economic impacts during a period of financial hardship caused by COVID-19. Economic benefits would extend to state and national levels with ongoing royalty payments and export sales.

8.3 Ecological sustainable development

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future. Iluka are committed to the principles of ESD and understand that biophysical, social and economic objectives are interdependent.

Iluka acknowledge that a well-designed and effectively managed operation will avoid significant and/or costly environmental impacts or degradation. Iluka understands the importance of maintaining ESD objectives on site and has extensive experience implementing ESD principles in all its development projects and assets.

The principles of ESD, for the purposes of the EP&A Act, are provided in Clause 193 of the EP&A Regulation. The four principles of ESD are:

- precautionary principle – the precautionary principle states that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

- inter-generational equity – the principle of inter-generational equity is that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

- conservation of biological diversity and maintenance of ecological integrity – the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and

- improved valuation and pricing of environmental resources – improved valuation, pricing and incentive mechanisms should be promoted.

MOD1 has been designed to reduce impacts to a level which is as low as is reasonably practicable and which are generally in accordance with the impacts of the Balranald Project. Each of the four principles of ESD are considered further below.

8.4 Precautionary principle

This modification report has assessed the potential biophysical, social and economic impacts of MOD1, including detailed technical assessments of the key potential issues. The assessments have found that MOD1 will not result in any significant biophysical, social or economic impacts and the residual impacts can continue to be managed in accordance with the modified consent, updated mitigation measures and management plans which will be revised as part of MOD1.

Iluka will continue environmental monitoring to confirm that the impacts of MOD1 are in accordance with the predicted impacts. Environmental management measures will be reviewed and, where required, updated if any impacts are greater than assessed.

8.5 Inter-generational equity

Iluka will continue to undertake ongoing environmental monitoring with mitigation measures to provide effective environmental management across its operation. This management is provided through planning, communication, documentation, review and feedback. These environmental management measures ensure that the health, diversity and productivity of the environment is maintained or enhanced for future generations.

As described above the modification would not obstruct future potential land uses, environmental outcomes or economic opportunities within the vicinity of the proposed mining activities.

Under the current conditions of its consent, the Balranald Project is approved to undertake mining operations on the site for 16 years from the date of commencement of the construction of the West Balranald mine. Therefore in the absence of MOD1, it is likely that the approved project and any future underground mining (subject to a future separate planning process and full merit assessment) would not proceed. The mine would be rehabilitated in accordance with conditions under the development consent. Should this occur, the economic and social benefits of the underground mining method would not be realised, nor that of future potential mining activities. Restricting the ability for both current and future generations to benefit from the Balranald Project.

8.6 Conservation of biological diversity and maintenance of ecological integrity

The potential environmental impacts of MOD1 are detailed in this modification report. MOD1 is not expected to cause direct impacts to threatened species or endangered ecological communities. A supplementary biodiversity assessment has been undertaken with potential ecological impacts, mitigation measures and offset requirements summarised in Section 7.6 and attached in the SBA (Appendix L).

8.7 Improved valuation and pricing of environmental resources

MOD1 will support the potential efficient operation and supply of mineral sand production from underground mining development and provide an economically viable pathway for Iluka to continue development of the Balranald Project. Furthermore, MOD1 allows for further assessment into the application of the underground mining method for the Balranald Project which would be subject to a future separate planning process and full merit assessment to demonstrate an alternative economically viable LOM method to extract the mineral resource from depth.

9 Conclusion

MOD1 will enable Iluka to continue underground mining development. The outcome of the bulk sampling activities confirmed the effectiveness of the underground mining method, validating key elements of the mining unit design and have been used to help guide the proposed modification to inform the potential suitability (ie commerciality and reduced environmental impacts) of underground mining as an alternative method for resource extraction for the Balranald Project.

This modification report has assessed and determined that the continuation of the underground mining trial proposed as part of MOD1 will not result in any significant biophysical, social and economic impacts. In fact, the modification report indicates that MOD1 will result in no increased impacts compared with the impacts for the approved Balranald Project. As such, the residual impacts can continue to be managed in accordance with the consent.

All aspects relating to environmental management will continue in accordance with the consent (as modified), EPL 20795 (as varied), site management plans and the mitigation measures consolidated in Appendix D. As the potential environmental impacts can be managed and mitigated and there are a range of immediate and longer-term economic benefits, approval of the proposed modification is considered warranted.

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11 Abbreviations

Abbreviation	Definition
µS/cm	Microsiemens per centimetre
mAHD	Australian Height Datum
AAQ NEPM	*National Environment Protection (Ambient Air Quality) Measure*
ABS	Australian Bureau of Statistics
AERMOD	Atmospheric dispersion modelling system
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
AQGHGMP	Air Quality and Greenhouse Gas Management Plan
AQIA	Air quality impact assessment
AQMS	Air quality monitoring station
BAM	Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BCD	Biodiversity and Conservation Division
BDAR	Biodiversity development assessment report
BoM	Bureau of Meteorology
CBA	Cost benefit analysis
CCL	Consolidated coal lease
CHL	Commonwealth Heritage List
CMP	Conservation management plan
Colliery	Wongawilli Colliery
Council	Wollongong City Council
COVID-19	Coronavirus disease
DA	Development approval
DAWE	Commonwealth Department of Agriculture, Water and the Environment
Db	Dust deposition gauges
DDGs	Dust deposition gauges
DoEE	Australian Government Department of the Environment and Energy (DoEE)
DoI	Department of Industry
DPE	NSW Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment
EA	Environmental assessment
EC	Electrical conductivity
ESD	Ecologically Sustainable Development

Abbreviation	Definition
EMM	EMM Consulting Pty Limited
EIS	Environmental Impact Statement
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPA	NSW Environment Protection Authority
EPI	Environmental planning instruments
EPL	Environmental Protection Licence
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EP&A Regulation	NSW Environmental Planning and Assessment Regulation 2000
ESD	Ecologically sustainable development
FEL	Front end loader
FTE	Full time equivalent
GHG	Greenhouse gas
Gujarat NRE	Gujarat NRE Coking Coal Limited
Ha	Hectares
ICNG	*Interim Construction Noise Guideline*
IEA	International Energy Agency
IECA	Illawarra Escarpment Conservation Area
INP	*NSW Industrial Noise Policy*
IPC	Independent Planning Commission
JSPL	Jindal Steel and Power Limited
IS Regional Plan	Illawarra Shoalhaven Regional Plan 2036
Km	Kilometres
Kg	Kilograms
kL	Kilolitres
kV	Kilovolt
LEA	Local effect analysis
LEP	Local Environmental Plan
LGA	Local government area
LOS	Level of Service
Mg/l	Milligrams per litre
ML	Mining leases
MNES	Matters of national environmental significance
Mining Act	NSW *Mining Act 1992*
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
Mm	Millimetres

Abbreviation	Definition
MOD1	Modification approved in December 2015
MOD2	The proposed modification (subject of this modification report)
Mt	Million tonnes
Mtpa	Million tonnes per annum
MOP	Mining Operations Plan
NEMP	National Environment Protection Measure
NGAF	National Greenhouse Accounts Factors
NGER Act	*National Greenhouse and Energy Reporting Act 2007*
NHL	National Heritage List
NMP	Noise Management Plan
NorBE	Neutral or beneficial effect
NPfI	*Noise Policy for Industry*
NPI	National Pollution Inventory
NSW	New South Wales
NVIA	Noise and vibration impact assessment
NWMD	North West Mains Development
OEH	Office of Environment and Heritage
Oz	Ounces
PA	Project approval
PAA	Project application area
PAC	Planning Assessment Commission
PCTs	Plant community types
$PM_{2.5}$	Particulate matter less than 2.5 µm in aerodynamic diameter
PM_{10}	Particulate matter less than 10 micrometres (µm) in aerodynamic diameter
POEO Act	NSW *Protection of the Environment Operations Act 1997*
POEO Regulation	Protection of the Environment Operations (Clean Air) Regulation 2010
RAPs	Registered Aboriginal Parties
RBL	Rating background level
RING	*Rail Infrastructure Noise Guideline*
RMS	Roads and Maritime Services (RMS)
RNP	*NSW Road Noise Policy*
ROM	Run-of-mine (coal)
SES	State Emergency Services
SEPP	State environmental planning policy
SEPP 33	*State Environmental Planning Policy No 33 – Hazardous and Offensive Development*

Abbreviation	Definition
SGA	Subsidence and geotechnical assessment
SHI	State Heritage Inventory
SHR	State Heritage Register
SIA	Social impact assessment
SIDRA	Signalised and unsignalised intersection design and research aid
SoHI	Statement of heritage impact
SSD	State significant development
SWA	Surface water assessment
TECs	Threatened ecological communities
TfNSW	Transport for NSW
TIA	Traffic impact assessment
TDS	Total dissolved solids
TIA	Traffic impact assessment
TMP	Traffic Management Plan
TSP	Total suspended particles
WAL	Water access licence
WCSP 2028	Wollongong 2028 Community Strategic Plan
WNSW Act	*WaterNSW Act 2014*
Wollongong Coal	Wollongong Coal Pty Ltd









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