



Appendix L

Supplementary biodiversity assessment

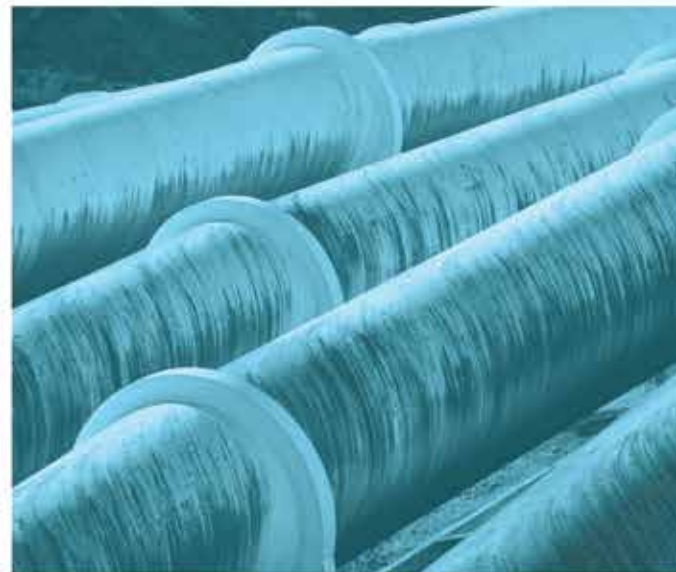




Balranald Mineral Sands Project Modification 1

Supplementary Biodiversity Assessment

Prepared for Iluka Resources Limited
May 2022





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Balranald Mineral Sands Project Modification 1

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1 Introduction

EMM Consulting Pty Limited (EMM) was commissioned by Iluka Resources Limited (Iluka) to undertake a Supplementary Biodiversity Assessment of the proposed modification (MOD1) for the approved Balranald Mineral Sands Project (the Balranald Project) in south-western New South Wales (NSW).

1.1 Project background

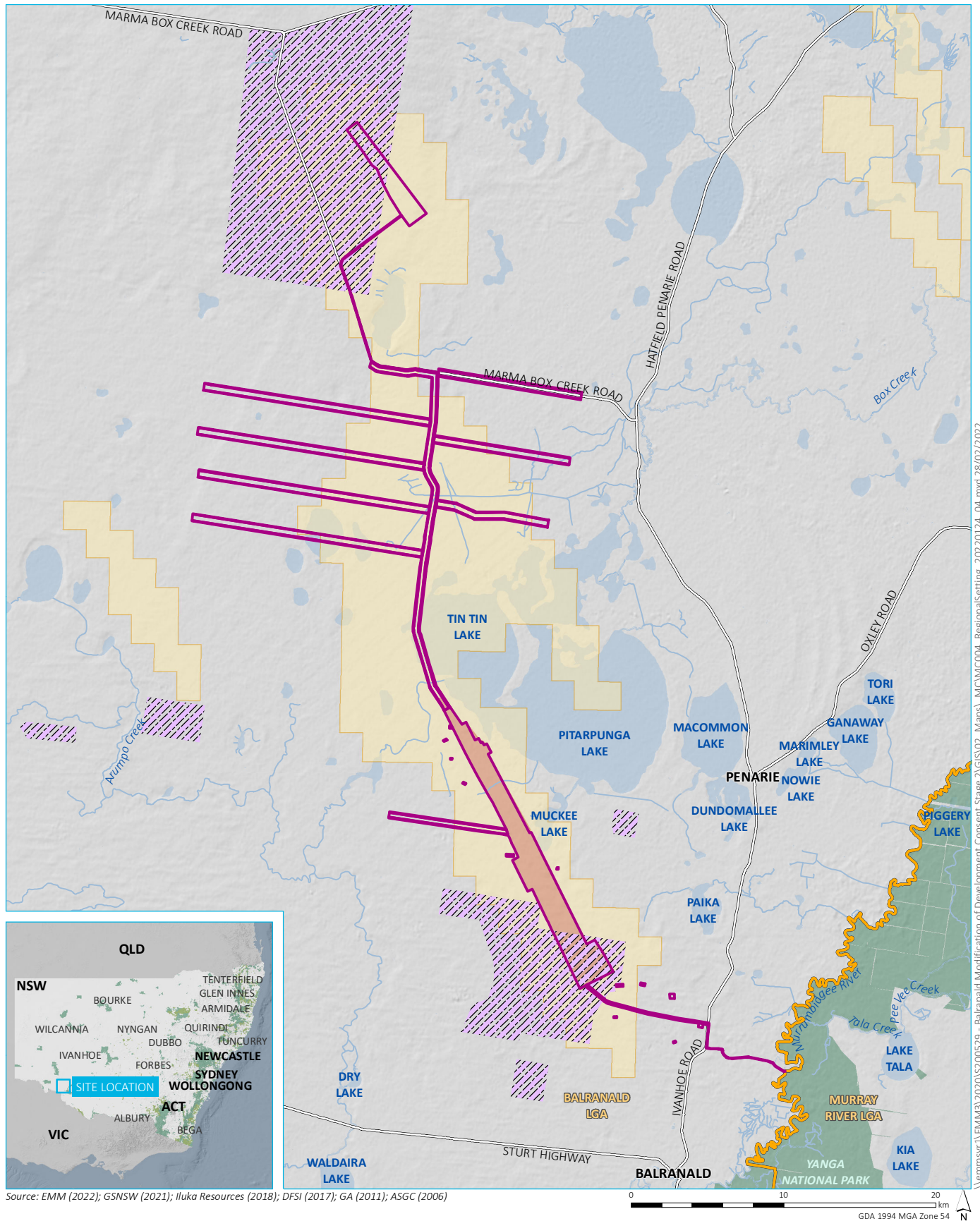
Iluka have approval to develop a mineral sands mine in south-western (NSW), known as the Balranald Project. It includes construction, mining, primary processing and rehabilitation of two linear mineral sand deposits, known as the West Balranald and Nepean deposits, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald (Balranald town), respectively. The regional setting and approved EIS project area are shown on Figure 1.1.

An environmental impact statement (EIS) was prepared and submitted in 2015 to accompany a State Significant Development (SSD-5285) application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) Act for an open cut, truck and shovel mining method. The Balranald Project also included undertaking a bulk sampling activity at the West Balranald mine to test the removal of ore using underground mining methods.

The Niche (2015) biodiversity assessment for the EIS assessed the ecological values within the project area and surrounds to determine whether the Balranald Project was likely to have a significant impact on threatened biodiversity listed under the former NSW *Threatened Species Conservation Act 1995* (TSC Act).

Development consent was granted by the Department of Planning, Infrastructure and Environment (DPIE) under Part 4 of the EP&A Act on 5 April 2016.

Since development consent was granted in April 2016, Iluka has undertaken the approved bulk sampling activity involving the extraction of mineralised material or ore, from depth within the approved disturbance area of the West Balranald mine. The outcome of the bulk sampling activities confirmed the effectiveness of the underground mining method, validated 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 Project.



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

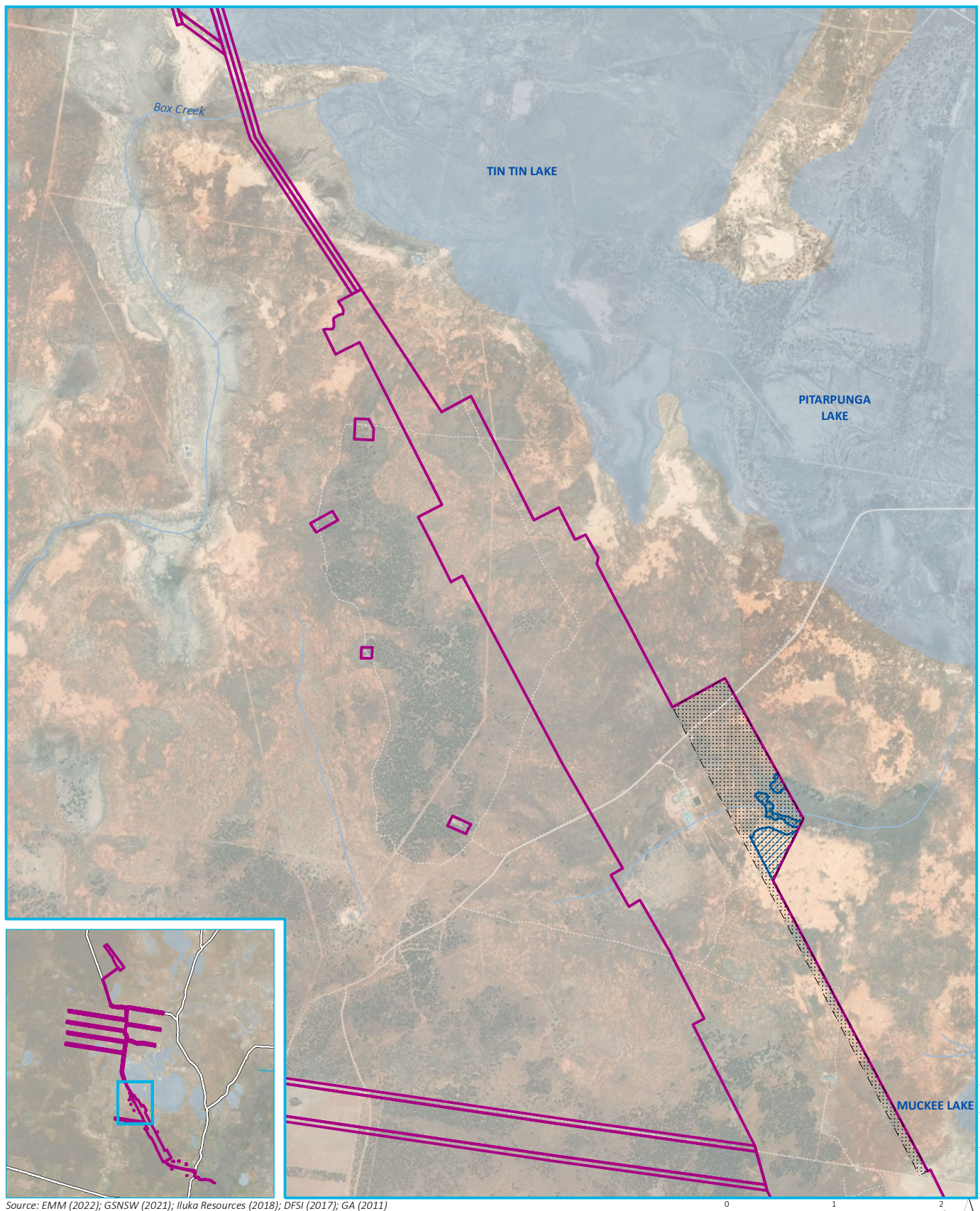
Balranald Mineral Sands Project
Supplementary biodiversity assessment
Figure 1.1

1.2 Description of modification

The proposed modification would involve:

- continuing underground mining within a portion of the approved disturbance footprint of the West Balranald mine pursuant to the consent;
- development of approved mineral processing infrastructure and a portion of the access road outside of the approved disturbance footprint, and excising a corresponding area from the approved disturbance footprint; and
- removal of previously approved areas from the disturbance footprint to demonstrate no net increase in overall biodiversity impacts for the Balranald Project.

The proposed MOD1 additional disturbance area is shown in Figure 1.2.



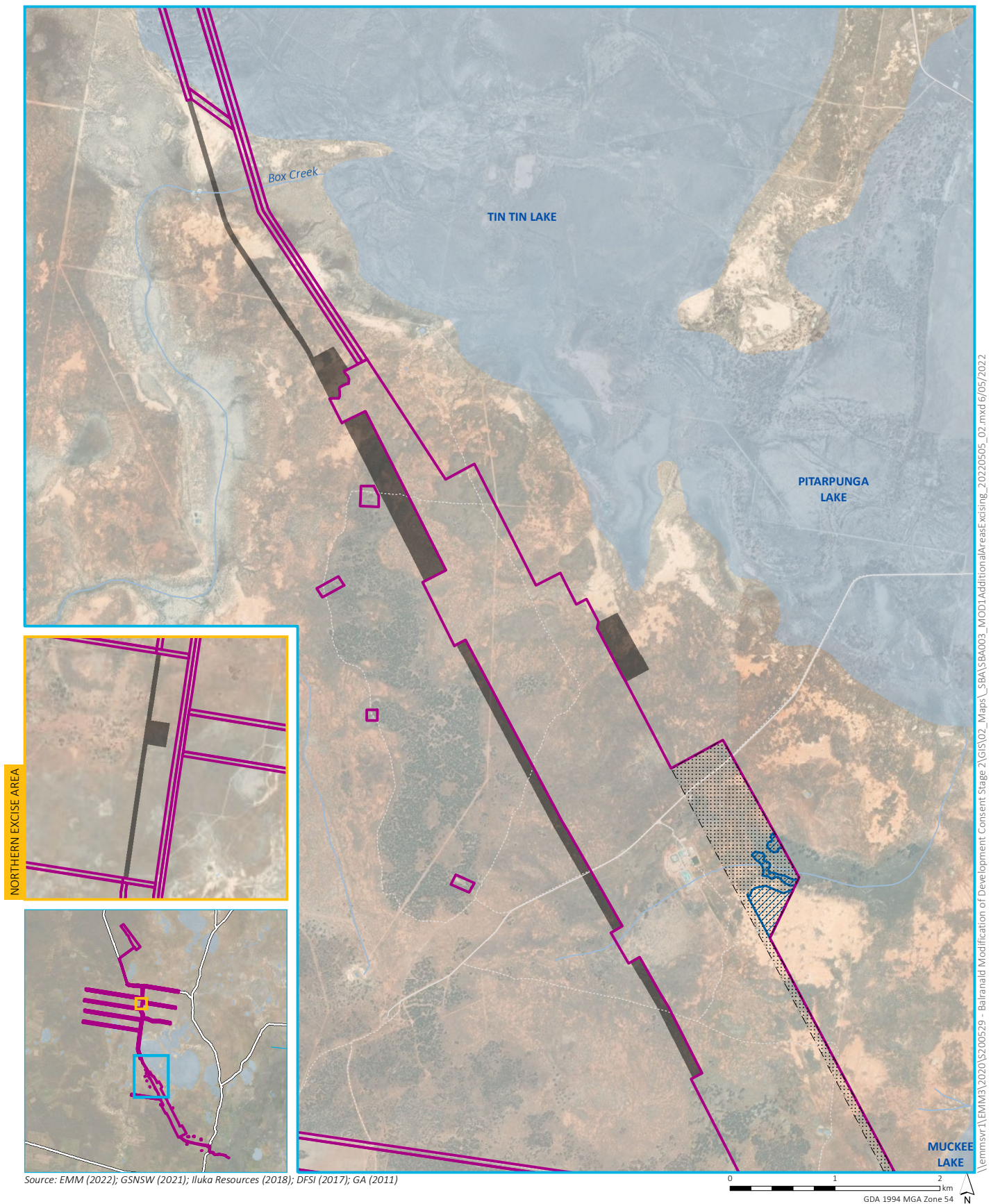
KEY

- Revised Balranald Project Area
- Proposed MOD1 additional disturbance area
- Proposed MOD1 avoidance area

- Major road
- Minor road
- Existing track
- Watercourse/drainage line
- Waterbody

Proposed MOD1 additional
disturbance and excising areas
Map 1 of 2

Balranald Mineral Sands Project
Supplementary biodiversity assessment
Figure 1.2



KEY

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

Proposed MOD1 additional
disturbance and excising areas
Map 2 of 2

Balranald Mineral Sands Project
Supplementary biodiversity assessment
Figure 1.2

1.3 Purpose of this report

The purpose of this Supplementary Biodiversity Assessment is to assess the predicted impacts of MOD1 and to demonstrate no net increase in biodiversity impacts for the Balranald Project as modified, by:

- Assessing the biodiversity values of the proposed MOD1 additional disturbance area, native vegetation condition, threatened species habitat and assessment of candidate entities for Serious and Irreversible Impacts (namely the Plains Wanderer) under the BC Act.
- Assessing the biodiversity values of the approved Balranald Project area to identify suitable equivalent, like-for-like areas, in terms of vegetation type and condition, to be excised from a Revised Balranald Project footprint to account for the proposed MOD1 additional disturbance area.
- Outlining Iluka's intent to retire biodiversity offset credits in stages for the West Balranald mine within 3 years of the commencement of construction in accordance with Schedule 3 Condition 16 of the consent.

On the basis that MOD1 will result in no proposed increase in biodiversity impacts for the Balranald Project and a Biodiversity Development Assessment Report (BDAR) is not required which was confirmed the Biodiversity Conservation Division (BCD) (Section 2.2). The Niche (2015) biodiversity assessment, along with 2022 field surveys, have been relied upon to confirm vegetation condition equivalency and like-for-like conditions to support this Supplementary Biodiversity Assessment.

2 Legislative context

This Supplementary Biodiversity Assessment has been conducted with consideration of key biodiversity legislation and government policy, including:

- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act);
- NSW *Biodiversity Conservation Act 2016* (BC Act);
- NSW Biodiversity Conservation (Savings and Transitional) Regulation 2017;
- NSW *Fisheries Management Act 1994* (FM Act); and
- NSW *Biosecurity Act 2015* (BS Act).

2.1 Biodiversity assessment pathway

The approved Balranald project area (SSD-5285) was assessed under Part 4, Division 4.1 of the EP&A Act (EMM, 2015). Part 4 of the EP&A Act relates to development assessment, with Division 4.1 specifically relating to the assessment of development deemed to be State Significant Development (SSD).

The biodiversity assessment (Niche, 2015) assessed the ecological values within the project area and surrounds to determine whether the Balranald Project was likely to have a significant impact on threatened biodiversity listed under the former NSW *Threatened Species Conservation Act 1995* (TSC Act).

The TSC Act has since been repealed and replaced with NSW *Biodiversity Conservation Act 2016* (BC Act). Part 7, Section 30A of the NSW Biodiversity Conservation (Savings and Transitional) Regulation 2017 (the Regulation) sets out the approval pathway for modifications of major projects that were approved prior to the commencement of the BC Act.

2.2 NSW Biodiversity Conservation Act 2016 and Biodiversity Conservation (Savings and Transitional) Regulation 2017

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.

EMM met with the Department for Planning and Environment (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 as outlined above. This Supplementary Biodiversity Assessment 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.

In accordance with Section 30A (2) e of the Regulation, this supplementary biodiversity assessment must determine if an application for the original development as proposed to be modified would have been refused because of serious and irreversible impacts (SAII) on biodiversity values.

2.3 Environment Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as Matters of National Environmental Significance (MNES) under the EPBC Act. These are:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DAWE for determination as to whether or not it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act and a decision made as to whether or not to grant approval.

Iluka is progressing separate discussions with the Department of Agriculture, Water and the Environment (DAWE) on Commonwealth approval requirements under EPBC 2012/6509 in accordance with *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Accordingly, this supplementary biodiversity assessment does not address EPBC matters.

2.4 NSW Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitat (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in Section 3.2.1 and 3.2.2 of the *Policy and Guidelines for Fish Conservation and Management* (DPI 2013).

The proposed MOD1 will not impact on any aquatic species, communities or key fish habitat and passage given its distance to the nearest aquatic environment, being the Murrumbidgee River located approximately 25 km to the south. Accordingly, impacts on aquatic environments are not addressed in this supplementary biodiversity assessment.

2.5 NSW Biosecurity Act 2015

The NSW *Biosecurity Act 2015* has superseded the *Noxious Weeds Act 1993*, which has now been repealed.

The primary objective of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

In accordance with the condition 17 of the approved Balranald Project consent, priority weeds will be managed in accordance with the approved Biodiversity Management Plan (BMP).

3 Methods

3.1 Study area

The study area for this assessment is the area encompassing the MOD1 additional disturbance area and excision areas, shown on Figure 3.1.

3.2 Overview of approach

The Niche 2015 vegetation mapping has been retained in this report given the substantial effort employed in the previous biodiversity assessment and to enable a comparison of the impacts of the approved Balranald Project with MOD1. The vegetation mapping however, has been contemporised by converting the Biometric Vegetation Types to their equivalent Plant Community Types (PCTs).

The biodiversity assessment of the MOD1 additional disturbance area comprised:

- a review of the Niche 2015 report to determine if any listed species were identified in the target area;
- 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); and
 - 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;
- field survey to assess microhabitats for threatened species;
- 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 biodiversity assessment 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.

3.3 Field survey methods

Ecotone and Niche undertook ecological surveys of the Balranald project with the survey effort ranging from October 2011 until December 2014 (refer Appendix 4 and 5 of the Niche 2015 biodiversity assessment). Details of these surveys are provided in Section 3 of the Biodiversity Assessment (Niche, 2015). These surveys covered the extent of the approved Balranald Project and MOD1 Additional Disturbance Area.

EMM undertook field surveys in the study area in November 2021. The purpose of the survey was to assess any changes in vegetation composition or condition from previously mapped vegetation (Niche, 2015).

Surveys for flora and vegetation communities were completed under Scientific Licence (SL100409) by ecologists Glenn Stuckey and Ross Davey. Climatic conditions prior to and during the EMM 2021 surveys included heavy rains, and above average monthly levels of rainfall (Bureau of Meteorology, 2022).

3.3.1 Vegetation mapping validation

The study area was traversed on foot and by vehicle to validate the Niche (2015) mapping. Vegetation was validated in the field using GPS-enabled tablet computers using Collector for ArcGIS™.

3.3.2 Vegetation condition assessment

Native vegetation was assessed using data obtained via a series of plots as per the methodology outlined in Section 5 of the Biodiversity Assessment Method (BAM) (DPIE 2020). The purpose of the assessment was to enable a comparison of condition between native vegetation in the MOD1 additional disturbance area and the approved Balranald project area.

At each plot location, the following was undertaken:

- one 20 x 20 m plot for assessment of composition and structure; and
- one 20 x 50 m plot for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1%-5%) or estimated to the nearest 5% (5%–100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 etc.

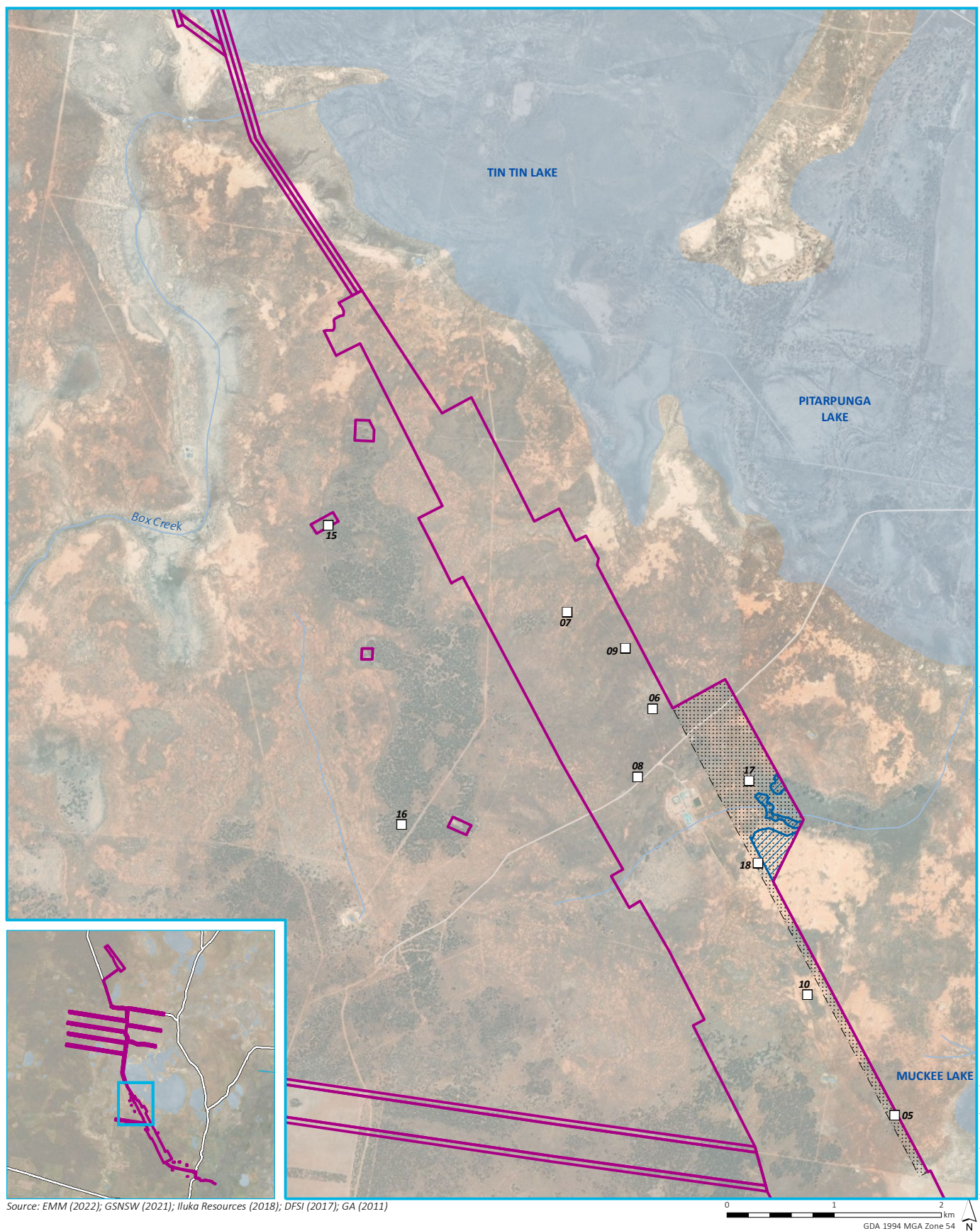
The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. A total of 6 plots were undertaken within study area, 4 of which are in the MOD1 additional disturbance area. BAM plot datasheets are provided in Appendix A.

A list of flora species was compiled for each plot and PCT. Records of all flora species will be submitted to BCS for incorporation into the Atlas of NSW Wildlife.

3.3.3 Limitations

The limitations of the previous biodiversity assessment are detailed in Section 3.7 of Niche (2015). As the proposed areas to be excised were determined by Iluka following field surveys, some of these areas (specifically those containing PCT 159 - Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)) have not been traversed on foot and plot data has not been collected for the purposes of direct condition comparison. This iterative process was necessary so that suitable and equivalent areas could be identified within the approved Balranald project to be excised and achieve no net increase in impacts on biodiversity values for MOD1.

To address this limitation for PCT 159, vegetation descriptions and plot data from Niche (2015) have been used to compare vegetation condition. Additional field surveys will be conducted in May 2022, in which additional vegetation verification and plot surveys will be conducted, to further address this limitation.

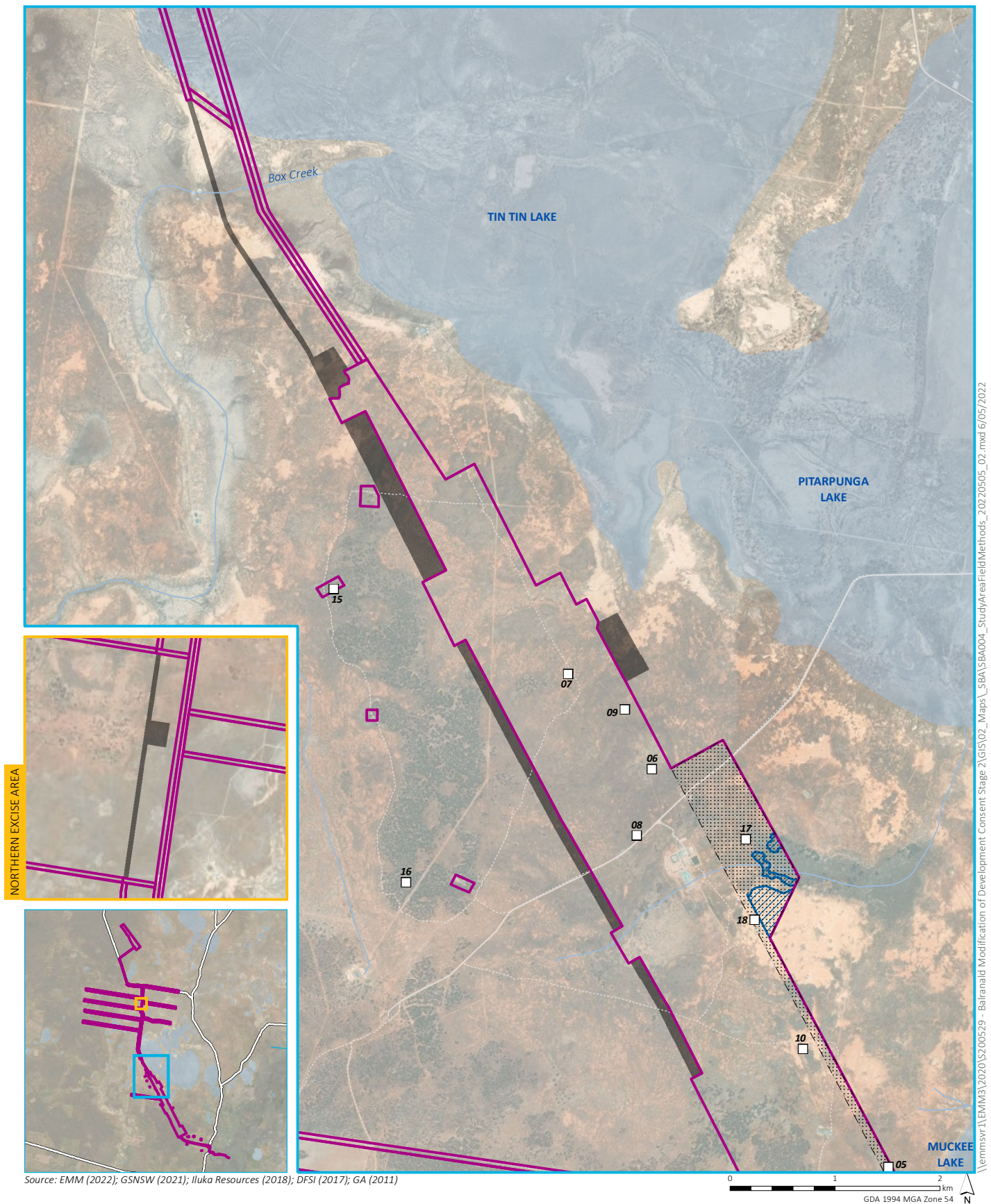


KEY

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

Study area and field methods
Map 1 of 2

Balranald Mineral Sands Project
Supplementary biodiversity assessment
Figure 3.1



KEY

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

Study area and field methods
Map 2 of 2

Balranald Mineral Sands Project
Supplementary biodiversity assessment
Figure 3.1

4 Results

4.1 Native vegetation

4.1.1 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.

No 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) will be avoided within the proposed MOD1 additional disturbance area, and accordingly are not discussed further in this report.

A description of the PCTs and their condition is provided in Table 4.1 and shown on Figure 4.1. A copy of the survey plot data is provided in Appendix A.

None of the PCTs in the MOD1 additional disturbance area represent a threatened ecological community (TEC), accordingly.

Table 4.1 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 (<i>Atriplex lindleyi</i>), <i>Atriplex eardleyae</i> and <i>Atriplex angulata</i> along with and Babbagia (<i>Osteocarpum acropterum</i> var. <i>deminuta</i>). <i>Atriplex holocarpa</i> is often present. Many species of copperburr may be present including <i>Sclerolaena divaricata</i>, <i>Sclerolaena intricata</i>, <i>Sclerolaena brachyptera</i>, <i>Sclerolaena decurrens</i>, <i>Sclerolaena diacantha</i>, <i>Sclerolaena stelligera</i>, <i>Sclerolaena ventricosa</i> and <i>Sclerolaena bicornis</i>. Cottonbush (<i>Maireana aphylla</i>) common in places. Other <i>Maireana</i> species include <i>Maireana ciliata</i>, <i>Maireana coronata</i> and <i>Maireana turbinata</i>. Forbs include daisies such as <i>Rhodanthe floribunda</i> and <i>Brachyscome ciliaris</i>. Swainsona peas - <i>Swainsona affinis</i> and <i>Swainsona campylantha</i> may be present after rain. Neverfail grass (<i>Eragrostis setifolia</i>) is common in northern areas. The main weeds species are the grasses <i>Hordeum marinum</i> and <i>Hordeum leporinum</i> along with Capeweed (<i>Arctotheca calendula</i>) and Ward's Weed (<i>Carrichtera annua</i>). 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. Current disturbances: Dominated by exotic grass. Erosion from rabbits. Animal runs present.	Poor	28.1

Table 4.1 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 (<i>Atriplex nummularia</i>) with a lower chenopod shrub layer dominated by bluebushes such as <i>Maireana microcarpa</i>, <i>Maireana appressa</i>, <i>Maireana pyramidata</i> and <i>Maireana brevifolia</i>, Thorny Rhagodia (<i>Rhagodia spinescens</i>), Bladder Saltbush (<i>Atriplex vesicaria</i>) and Nitre Goosefoot (<i>Chenopodium nitrariaceum</i>). Low ground shrubs include <i>Dissocarpus biflorus</i>, <i>Atriplex lindleyi</i> and a number of copperburr species (<i>Sclerolaena</i> spp.). Forb species include <i>Senecio runcinifolius</i>, <i>Brachyscome lineariloba</i>, <i>Geococcus pusillus</i>, <i>Calandrinia eremaea</i>, <i>Bulbine bulbosa</i>, <i>Tetragonia tetragonioides</i>, <i>Crassula colorata</i> var. <i>colorata</i>, <i>Crassula sieberiana</i> subsp. <i>sieberiana</i> and <i>Osteocarpum acropterum</i> var. <i>deminuta</i>; grass species include <i>Chloris truncata</i>, <i>Austrodanthonia caespitosa</i>, <i>Austrostipa nodosa</i> and <i>Walwhalleya prolut</i>. Exotic species may be common in places and include <i>Hordeum marinum</i>, <i>Hordeum leporinum</i>, <i>Schismus barbatus</i>, <i>Xanthium spinosum</i>, <i>Heliotropium europaeum</i> and <i>Schismus barbatus</i>. Eastern occurrences in the Riverina Bioregion often contain scattered Myall trees (<i>Acacia pendula</i>). 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). Current disturbances: <i>M. pyramidata</i> is dying off, but consequently regenerating. Possible senescence. Grazed. Sparsely vegetated.	Moderate ¹	3.6

Table 4.1 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 (<i>Maireana sedifolia</i>) often with a number of other bluebushes including Black Bluebush (<i>Maireana pyramidata</i>), <i>Maireana sclerolaenoides</i>, <i>Maireana erioclada</i>, <i>Maireana georgei</i> and <i>Maireana ciliata</i>. Bladder Saltbush (<i>Atriplex vesicaria</i>) and Thorny Saltbush (<i>Rhagodia spinescens</i>) are usually present. Inland Rosewood (<i>Alectryon oleifolius</i> subsp. <i>canescens</i>), Black Oak (<i>Casuarina pauper</i>) and Sugarwood (<i>Myoporum platycarpum</i>) may occur as scattered small trees. Tall shrubs are rare but may include various forms of <i>Senna artemisioides</i>. The ground cover is sparse and more so in drought. It is dominated by shrubs such as <i>Enchylaena tomentosa</i>, <i>Sclerolaena obliquicuspis</i>, <i>Sclerolaena patentiuspilis</i>, <i>Sclerolaena bicornis</i> var. <i>bicornis</i>, <i>Sclerolaena brachyptera</i>, <i>Sclerolaena diacantha</i>, <i>Atriplex stipitata</i>, <i>Atriplex eardleyae</i> and <i>Atriplex lindleyi</i>. Grass species include <i>Austrostipa nitida</i>, <i>Austrodanthonia caespitosa</i> and <i>Chloris truncata</i>. Daisies are common after rain and include <i>Rhodanthe corymbifolia</i>, <i>Brachyscome lineariloba</i>, <i>Pogonolepis muelleriana</i> and <i>Minuria cunninghamii</i>. 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 (<i>Carrichtera annua</i>) is a common weed. Grades into Bladder Saltbush (<i>Atriplex vesicaria</i>) shrubland, grassland or mallee communities. Continuous, heavy grazing may cause bluebush to disappear to be replaced by grasses and forbs. Current disturbances: 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.

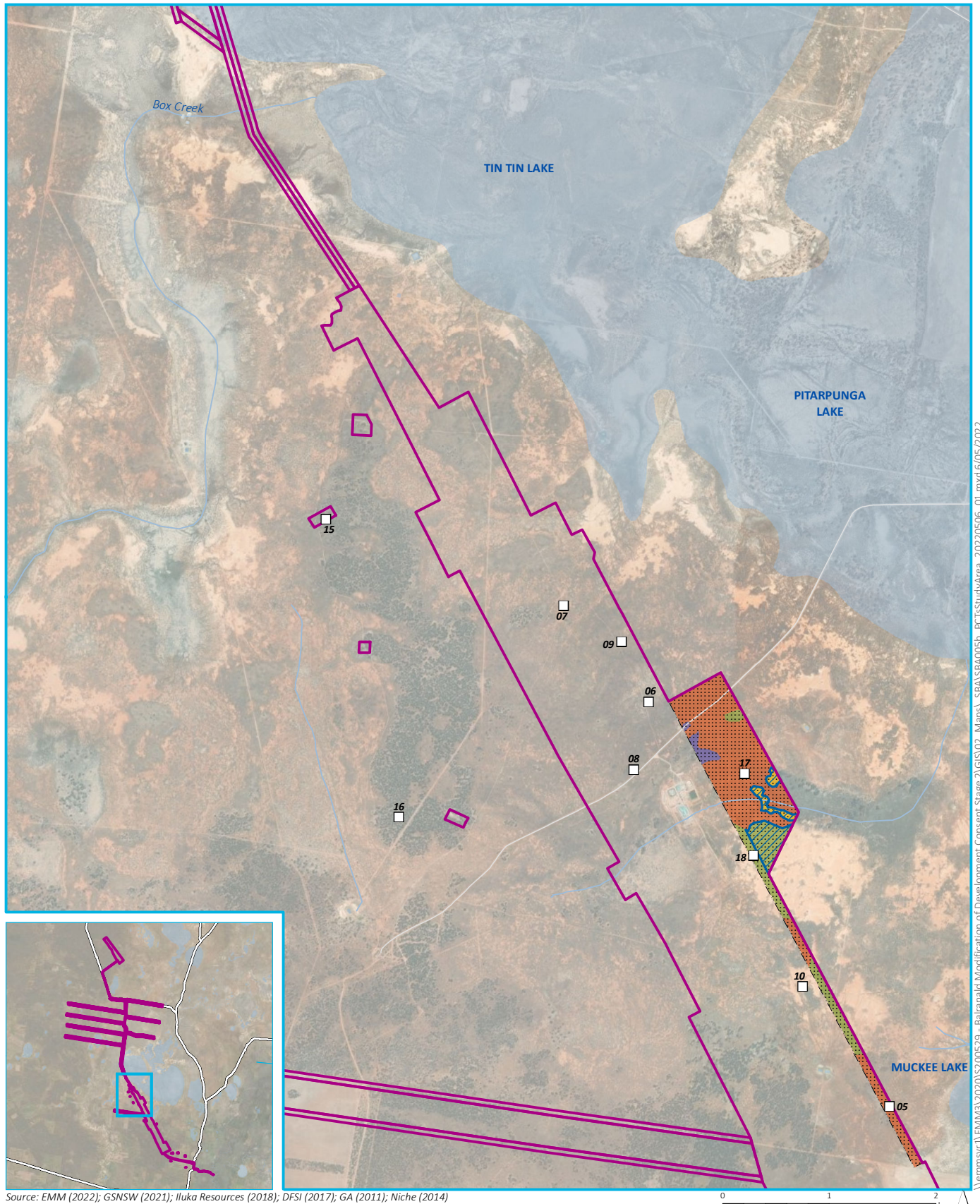
4.1.2 Proposed areas to be excised from the approved Balranald Project footprint

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 4.2 and shown on Figure 4.1.

Table 4.2 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 Table 4.1 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 Table 4.1 for vegetation description. High cover abundance of weeds. Remnant saltbush plants are often over-mature to senescent. Common species include <i>Nothoscordum inodorum</i> and <i>Hordeum</i> 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 Table 4.1 for vegetation description. Existing 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



KEY

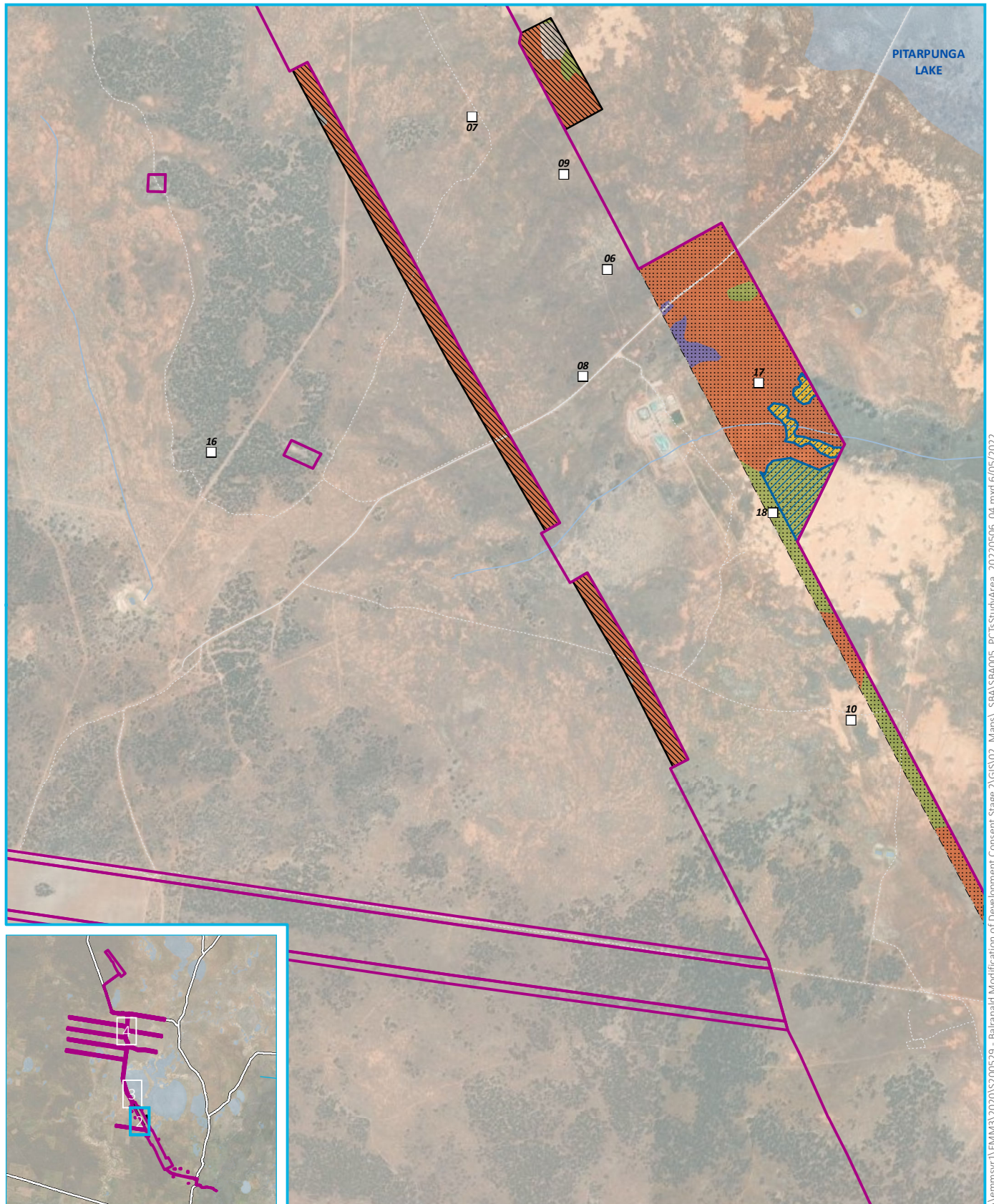
- Revised Balranald Project Area
- Proposed MOD1 additional disturbance area
- Proposed MOD1 avoidance area
- Plot location
- Major road
- Minor road
- Watercourse/drainage line
- Waterbody

Plant community type

- 166 | Disturbed annual saltbush forland 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
Supplementary biodiversity assessment
Figure 4.1



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

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

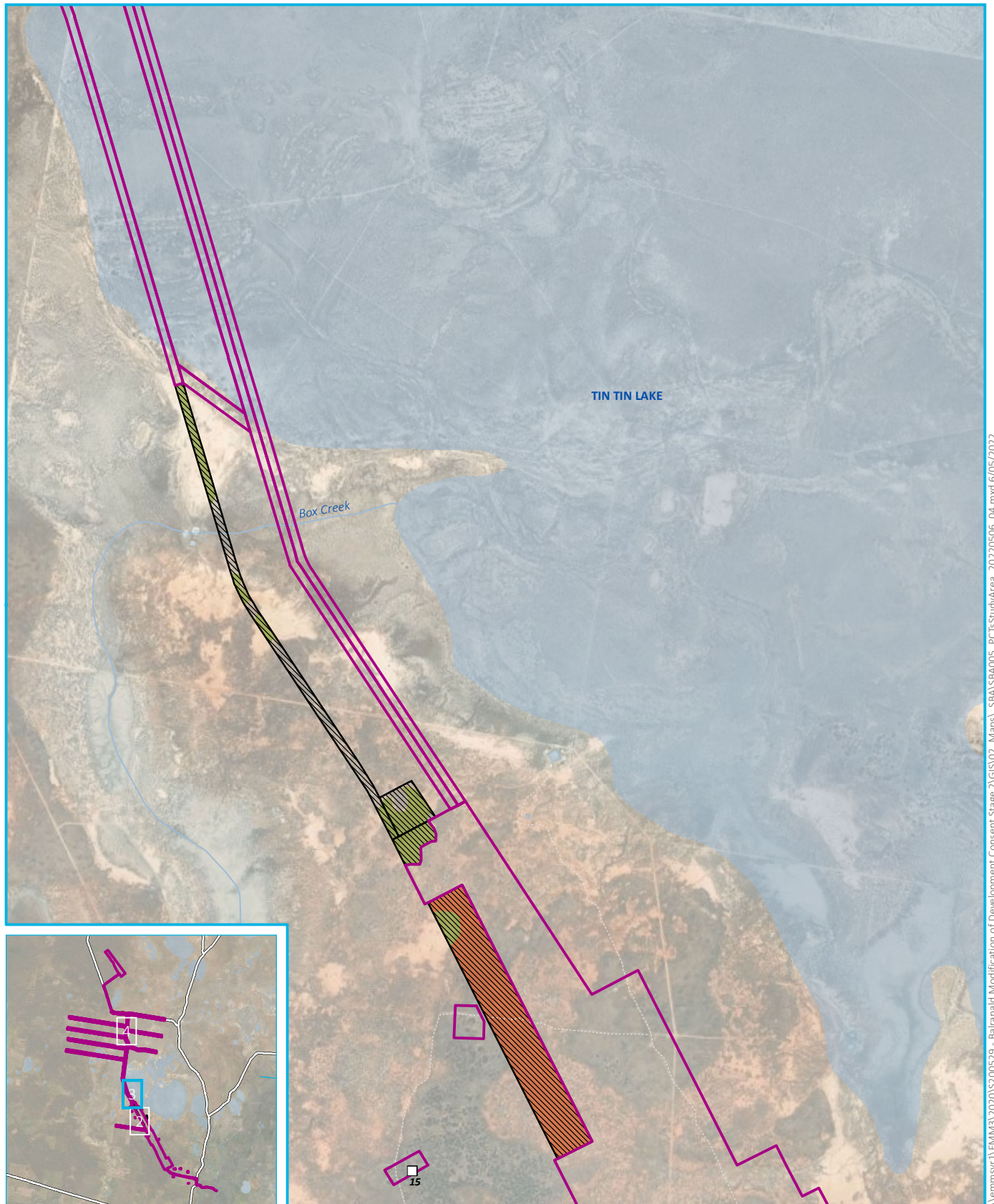
Plant community type

- 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
Supplementary biodiversity assessment
Figure 4.1





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

0 0.5 1 km
GDA 1994 MGA Zone 54

KEY

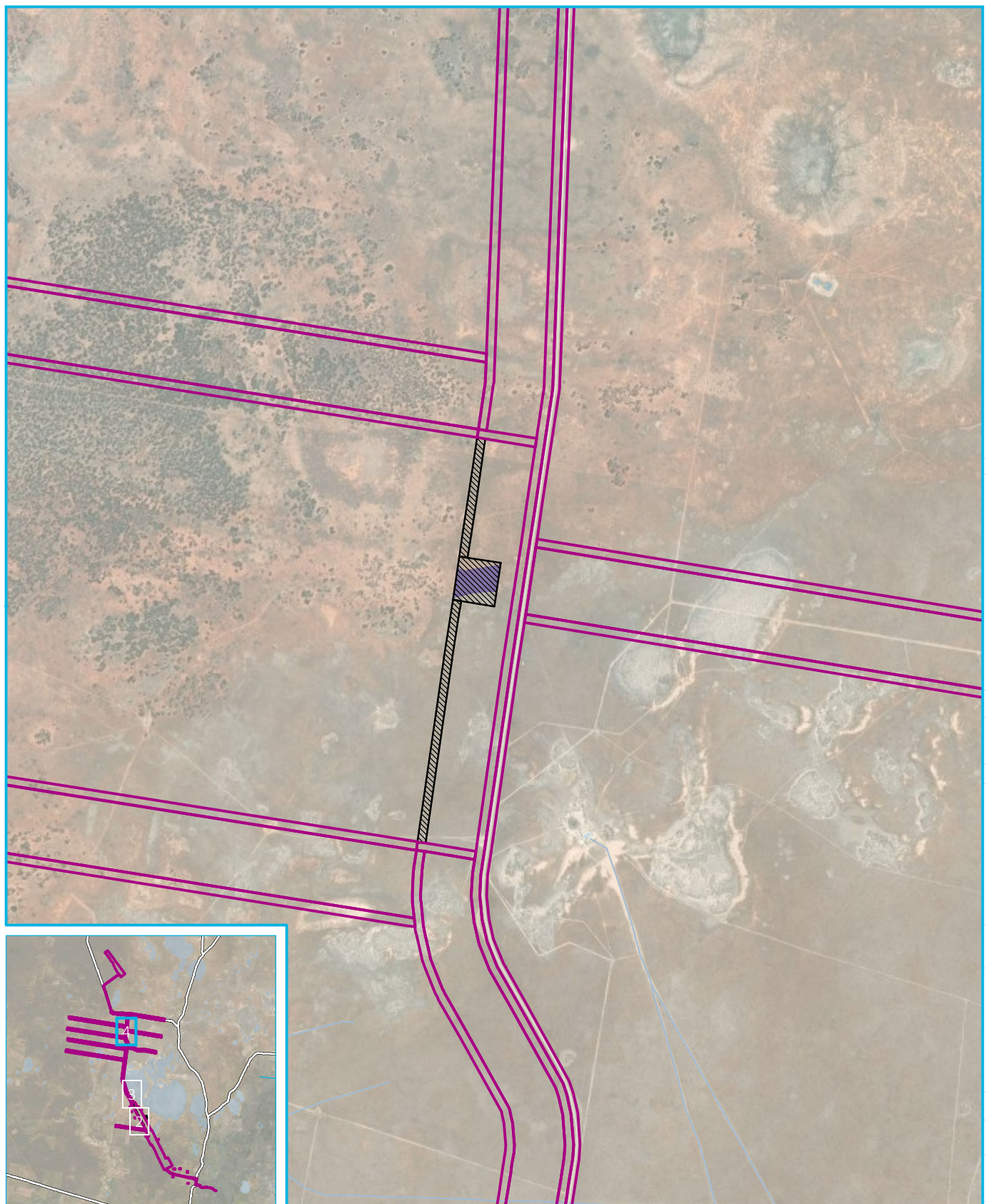
- Revised Balranald Project Area
- Proposed MOD1 excise area
- Plot location
- Existing track
- Watercourse/drainage line
- Waterbody

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
Supplementary biodiversity assessment
Figure 4.1



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
Supplementary biodiversity assessment
Figure 4.1

4.1.3 Condition comparison

Plot data (Appendix A), previous condition mapping from Niche (2015) and PCT benchmarks were reviewed to assess equivalence in vegetation condition (Table 4.3). Condition of all PCTs was determined to be equivalent in both the MOD1 additional disturbance area and proposed areas to be excised.

Table 4.3 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.

4.2 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 in the whole survey area (including the proposed MOD1 additional disturbance area). Twenty-six threatened fauna species were recorded in the entire survey area and two species, Redthroat (*Pyrrholaemus brunneus*) and Inland Forest Bat (*Vespadelus baverstocki*) were recorded within the proposed MOD1 additional disturbance area.

Two additional vulnerable species listed under the BC Act not assessed in Niche (2015), Spike-Rush (*Eleocharis obicis*) and Sandy Inland Mouse (*Pseudomys hermannsburgensis*) are predicted by the BAMC to be associated with PCT 159 and 154, respectively. These PCTs are present in both the MOD1 additional disturbance area and proposed areas to be excised. These species would not have been assessed in Niche (2015) as they were not associated with the original BVTs assessed. The species lists associated with each PCT have undergone a major revision by the Biodiversity and Conservation Division since the original assessment was completed.

Potential impacts on these species are discussed in Section 5.2.

4.3 SAIL

The spatial data layer for the Plains Wanderer mapped important area was reviewed and does not overlap with the study area. Accordingly, the study area does not contain important habitat for the species, or any other candidate entity for SAIL.

5 Impact 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.

5.1 Native vegetation

The PCTs mapped across MOD1 Additional Disturbance Area and proposed equivalent, like-for-like areas be excised for the Revised Balranald Project as modified are outlined in Table 5.1 and shown on Figure 4.1.

Table 5.1 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)	Change in vegetation clearing as a result of proposed modification (ha)
166 Flat Open Claypan/ Derived Sparse Shrubland/Grassland (LM124)	Poor	73.6	+28.1	-28.1	0
159 Old Man Saltbush Shrubland (LM137)	Moderate	19.8	+3.6	-3.6	0
154 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

5.1.1 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 5.1.

5.1.2 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 and 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.

5.2 Threatened species

All threatened fauna species recorded in Niche (2015), including the Redthroat and Inland Forest Bat recorded in MOD1 additional disturbance area were and 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 (Section 4.1.3), they do not require further assessment or consideration during the development of the offset package.

Sandy Inland Mouse is an ecosystem credit species not previously assessed by Niche (2015) that is now associated with PCT 154. As with the other ecosystem credit species, any impacts on the species and their habitats are accounted for with provision of ecosystem credits for PCT 154, and no further assessment is required.

Spike-rush is a species credit species not previously assessed by Niche (2015). When assessed for this report, this species was excluded from further assessment, as:

- there are no previous records in the locality; and
- when microhabitats were assessed in PCT 159 in the MOD1 additional disturbance area, it was determined that habitat is not suitably wet in the study area for Spike-Rush to occur.

Spike-rush typically grows in ephemerally wet situations such as roadside mitre drains and depressions, usually in low-lying grasslands. Sites include depressions with heavy clay soils on the Lachlan River floodplain, with *Eragrostis australasica*, *Atriplex vesicaria* and *A. nummularia* shrublands, low-lying claypans near an irrigation channel, and a shallow open ditch on a low ridge with *Eucalyptus populnea* in red sandy soil over clay (NSW Government 2022). Although *A. nummularia* shrublands are present (ie PCT 159), the ephemeral depressions it requires to occur are absent.

MOD1 will not result in additional impacts on threatened species, as:

- the key measures to avoid, minimise or mitigate impacts as defined in the EIS will be maintained;
- 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 identified (Niche 2015) or likely to occur in the proposed MOD1 additional disturbance area.

5.3 SAIL

As the study area does not contain important habitat for the Plains Wanderer, the project as modified will not result in a serious or irreversible impact on the species, or any other candidate entity for SAIL.

6 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 Conclusion

This Supplementary Biodiversity Assessment has been completed to assess potential biodiversity impacts of the proposed MOD1 and to confirm 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 and implementation of an approved 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.

8 References

Bureau of Meteorology 2022. www.bom.gov.au. Station, Balranald (Rsl).

Ecotone 2014, *Ecotone_Niche_Vis917_20141031* vegetation layer. prepared for Iluka Limited by Niche Environment and Heritage Pty Limited

EMM 2015, *Balranald Mineral Sands Project, NSW Environmental Impact Statement, EIS*, prepared for Iluka Limited by EMM Consulting Pty Limited.

EMM 2016, *Balranald Mineral Sands Project, Commonwealth Environmental Impact Statement, EIS*, prepared for Iluka Limited by EMM Consulting Pty Limited.

Niche 2015. *Balranald Mineral Sands Project, NSW Environmental Impact Statement, EIS Volume 3, Appendix F - Biodiversity Assessment*, prepared for Iluka Limited by Niche Environment and Heritage Pty Limited.

Niche 2016. *Balranald Mineral Sands Project, Commonwealth Environmental Impact Statement, EIS Volume 2, Appendix C - Biodiversity Assessment*, prepared for Iluka Limited by Niche Environment and Heritage Pty Limited.

NSW Government 2022, Threatened Biodiversity Data Collection, www.environment.gov.au, viewed May 2022



Appendix A

Survey results



BAM Site – Field Survey Form

Plot ID:	Plot 06	Date:	05/11/21	Project number:	S200529	Plot dimensions:	20 x 50	
Datum:	GDA94	Easting:	722,993	Recorders:	GS RD			
Zone:	54	Northing:	6,190,640	IBRA region:	Murray Darling Depression (South Olary Plain)	Midline bearing:	155	
Plant Community Type:	159: Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)				Condition class:	Medium	PCT confidence:	high
Vegetation Class:	Riverine Chenopod Shrublands				EEC:	no	EEC confidence:	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	8
	Grasses etc.:	2
	Forbs:	1
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	28.5
	Grasses etc.:	6
	Forbs:	0.1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	15
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.

For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	25	5	10	5	5
Average litter cover (%):	10				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat plain, brown clay soil

Plot Disturbance

Heavily grazed by stock and feral animals. Large amounts of dieback occurring.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	S200529				
Recorders:	GS RD	Plot ID:	Plot 06	Date:	05/11/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	<i>Atriplex nummularia</i> (Old Man Saltbush)	25	50	no	N
Shrub (SG)	<i>Maireana pyramidata</i> (Black Bluebush)	2	60	no	N
	<i>Hordeum leporinum</i> (Barley Grass)	20	5000	no	E
Grass & grasslike (GG)	<i>Austrostipa scabra</i> (Speargrass)	1	100	no	N
Grass & grasslike (GG)	<i>Rytidosperma setaceum</i> (Small-flowered Wallaby-grass)	5	1000	no	N
Shrub (SG)	<i>Maireana sedifolia</i> (Pearl Bluebush)	0.1	5	no	N
Shrub (SG)	<i>Maireana microphylla</i> (Small-leaf Bluebush)	0.1	50	no	N
Forb (FG)	<i>Calandrinia calyptрата</i>	0.1	15	no	N
Shrub (SG)	<i>Dissocarpus paradoxus</i> (Cannonball Burr)	0.1	10	no	N
Shrub (SG)	<i>Atriplex vesicaria</i> (Bladder Saltbush)	0.1	1	no	N
	<i>Sisymbrium erysimoides</i> (Smooth Mustard)	0.1	20	no	E
	<i>Medicago minima</i> (Woolly Burr Medic)	0.2	500	no	E
Shrub (SG)	<i>Maireana georgei</i> (Slit-wing Bluebush)	1	50	no	N
Shrub (SG)	<i>Sclerolaena patenticuspis</i>	0.1	21	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 07	Date:	05/11/21	Project number:	S200529	Plot dimensions:	20x50	
Datum:	GDA94	Easting:	722,194	Recorders:	RD, GS			
Zone:	54	Northing:	6,191,546	IBRA region:	Murray Darling Depression (South Olary Plain)	Midline bearing:	272	
Plant Community Type:	153: Lunette chenopod shrubland mainly of the Murray Darling Depression Bioregion				Condition class:	Moderate	PCT confidence:	high
Vegetation Class:	Aeolian Chenopod Shrublands				EEC:	no	EEC confidence:	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	7
	Grasses etc.:	2
	Forbs:	3
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	21.5
	Grasses etc.:	0.4
	Forbs:	0.3
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:			
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	20	5	10	8	30
Average litter cover (%):	14.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

This is actually Black blue bush PCT. Plain, sandy soil/minor clay influence, small cleared patches of clay.

Plot Disturbance

Pyramidata is dying off, but consequently regenerating. Possible sinecense. Grazed. Sparsely vegetated.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	S200529				
Recorders:	RD, GS	Plot ID:	Plot 07	Date:	05/11/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	<i>Thysanotus baueri</i> (Fringe-lily)	0.1	5	yes	N
Shrub (SG)	<i>Sclerolaena lanicuspis</i> (Woolly Copperburr)	0.1	50	yes	N
Shrub (SG)	<i>Sclerolaena patenticuspis</i>	0.2	50	no	N
Shrub (SG)	<i>Maireana pyramidata</i> (Black Bluebush)	20	100	no	N
Shrub (SG)	<i>Dissocarpus paradoxus</i> (Cannonball Burr)	0.5	100	no	N
Grass & grasslike (GG)	<i>Austrostipa scabra</i> (Speargrass)	0.2	1000	yes	N
Shrub (SG)	<i>Sclerolaena brachyptera</i> (Short-winged Copperburr)	0.5	400	yes	N
Forb (FG)	<i>Calandrinia calyptрата</i>	0.1	5	no	N
Forb (FG)	<i>Rhodanthe corymbiflora</i> (Small White Sunray)	0.1	5	yes	N
Shrub (SG)	<i>Sclerolaena tricuspis</i> (Giant Redburr)	0.1	1	yes	N
Shrub (SG)	<i>Atriplex</i> spp. (A Saltbush)	0.1	5	no	N
Grass & grasslike (GG)	<i>Rytidosperma</i> spp.	0.2	500	no	N
	<i>Hordeum</i> spp. (A Barley Grass)	0.1	500	no	E

BAM Site – Field Survey Form

Plot ID:	Plot 08	Date:	06/11/21	Project number:	S200529	Plot dimensions:	20 x 50	
Datum:	GDA94	Easting:	722,851	Recorders:	GS RD			
Zone:	54	Northing:	6,190,008	IBRA region:	Murray Darling Depression (South Olary Plain)	Midline bearing:	290	
Plant Community Type:	221: Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones				Condition class:	Medium	PCT confidence:	medium
Vegetation Class:	Semi-arid Sand Plain Woodlands				EEC:	no	EEC confidence:	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	9
	Grasses etc.:	3
	Forbs:	3
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	35
	Shrubs:	18.6
	Grasses etc.:	0.3
	Forbs:	0.3
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	5
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	3		
20 – 29 cm:	2	Tree hollow count	1
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	80	80	10	10	30
Average litter cover (%):	42				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Flat plain, clay soil. Poor to moderate drainage.

Plot Disturbance

Possible past clearing. Heavy stock and feral grazing. Limited weeds.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	S200529				
Recorders:	GS RD	Plot ID:	Plot 08	Date:	06/11/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina pauper</i> (Black Oak)	35	5	no	N
Shrub (SG)	<i>Maireana sedifolia</i> (Pearl Bluebush)	2	40	no	N
Shrub (SG)	<i>Maireana pyramidata</i> (Black Bluebush)	15	400	no	N
Grass & grasslike (GG)	<i>Austrostipa scabra</i> (Speargrass)	0.1	50	no	N
	<i>Schismus barbatus</i> (Arabian Grass)	5	1000	no	E
Shrub (SG)	<i>Dissocarpus paradoxus</i> (Cannonball Burr)	1	200	no	N
Shrub (SG)	<i>Sclerolaena patenticuspis</i>	0.1	50	no	N
Forb (FG)	<i>Zygophyllum aurantiacum</i> (Shrubby Twinleaf)	0.1	5	no	N
Shrub (SG)	<i>Sclerolaena brachyptera</i> (Short-winged Copperburr)	0.1	100	no	N
Shrub (SG)	<i>Maireana microphylla</i> (Small-leaf Bluebush)	0.1	30	no	N
Forb (FG)	<i>Calandrinia calyptрата</i>	0.1	60	no	N
Shrub (SG)	<i>Sclerolaena limbata</i>	0.1	20	no	N
Shrub (SG)	<i>Dissocarpus biflorus</i> var. <i>biflorus</i>	0.1	5	no	N
	<i>Sisymbrium erysimoides</i> (Smooth Mustard)	0.1	10	no	E
Grass & grasslike (GG)	<i>Rytidosperma setaceum</i> (Small-flowered Wallaby-grass)	0.1	12	no	N
Forb (FG)	<i>Einadia nutans</i> (Climbing Saltbush)	0.1	15	no	N
Shrub (SG)	<i>Atriplex vesicaria</i> (Bladder Saltbush)	0.1	3	no	N
Grass & grasslike (GG)	<i>Austrostipa elegantissima</i> (Feather Speargrass)	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 09	Date:	06/11/21	Project number:	S200529	Plot dimensions:	20x50	
Datum:	GDA94	Easting:	722,737	Recorders:	RD			
Zone:	54	Northing:	6,191,205	IBRA region:	Murray Darling Depression (South Olary Plain)	Midline bearing:	57	
Plant Community Type:	154: Pearl Bluebush low open shrubland of the arid and semi-arid plains				Condition class:	Moderate	PCT confidence:	high
Vegetation Class:	Aeolian Chenopod Shrublands				EEC:	no	EEC confidence:	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	2
	Forbs:	2
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	25.8
	Grasses etc.:	25.1
	Forbs:	0.2
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	25	30	10	15	1
Average litter cover (%):	16.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Mixture of sand and clay soil. Mostly sandy. Plain.

Plot Disturbance

Evidence of grazing. Vegetation sparsely distributed with clay patches in areas with no vegetation. Minimal Weeds.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	S200529				
Recorders:	RD	Plot ID:	Plot 09	Date:	06/11/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	<i>Calandrinia calyptрата</i>	0.1	10	no	N
Shrub (SG)	<i>Sclerolaena brachyptera</i> (Short-winged Copperburr)	0.5	100	yes	N
Shrub (SG)	<i>Maireana sedifolia</i> (Pearl Bluebush)	15	50	no	N
Grass & grasslike (GG)	<i>Austrostipa scabra</i> (Speargrass)	25	500	yes	N
Shrub (SG)	<i>Dissocarpus paradoxus</i> (Cannonball Burr)	0.2	50	no	N
Shrub (SG)	<i>Maireana pyramidata</i> (Black Bluebush)	10	50	no	N
Shrub (SG)	<i>Sclerolaena patenticuspis</i>	0.1	20	no	N
Forb (FG)	<i>Atriplex lindleyi</i> (Eastern Flat-top Saltbush)	0.1	5	yes	N
Grass & grasslike (GG)	<i>Rytidosperma setaceum</i> (Small-flowered Wallaby-grass)	0.1	500	yes	N

BAM Site – Field Survey Form

Plot ID:	Plot 17	Date:	08/11/21	Project number:	S200529	Plot dimensions:	20 x 50	
Datum:	GDA94	Easting:	723,890	Recorders:	GS RD			
Zone:	54	Northing:	6,189,970	IBRA region:	Murray Darling Depression (South Olary Plain)	Midline bearing:	121	
Plant Community Type:	159: Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)				Condition class:	Medium	PCT confidence:	high
Vegetation Class:	Riverine Chenopod Shrublands				EEC:	no	EEC confidence:	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	12
	Grasses etc.:	2
	Forbs:	6
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	44.3
	Grasses etc.:	3.1
	Forbs:	0.6
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	50	5	5	10
Average litter cover (%):	15				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Clay shrubland plain. Clay soil. Poor drainage

Plot Disturbance

Moderate to heavy grazing. Drought affected.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	S200529				
Recorders:	GS RD	Plot ID:	Plot 17	Date:	08/11/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	<i>Atriplex nummularia</i> (Old Man Saltbush)	18	35	no	N
Forb (FG)	<i>Einadia nutans</i> (Climbing Saltbush)	0.1	10	no	N
Forb (FG)	<i>Solanum esuriale</i> (Quena)	0.1	1	no	N
Shrub (SG)	<i>Sclerolaena tricuspis</i> (Giant Redburr)	4	40	no	N
Shrub (SG)	<i>Atriplex angulata</i> (Fan Saltbush)	2	30	no	N
	<i>Medicago minima</i> (Woolly Burr Medic)	0.1	50	no	E
Forb (FG)	<i>Alternanthera angustifolia</i>	0.1	12	no	N
Shrub (SG)	<i>Maireana microphylla</i> (Small-leaf Bluebush)	3	120	no	N
Shrub (SG)	<i>Sclerolaena brachyptera</i> (Short-winged Copperburr)	1	60	no	N
Grass & grasslike (GG)	<i>Austrostipa scabra</i> (Speargrass)	0.1	30	no	N
	<i>Hordeum leporinum</i> (Barley Grass)	0.1	60	no	E
Shrub (SG)	<i>Salsola australis</i>	0.1	5	no	N
Shrub (SG)	<i>Sclerolaena limbata</i>	8	100	no	N
Forb (FG)	<i>Chamaesyce drummondii</i> (Caustic Weed)	0.1	5	no	N
Grass & grasslike (GG)	<i>Eragrostis australasica</i> (Canegrass)	3	20	no	N
Shrub (SG)	<i>Atriplex leptocarpa</i> (Slender-fruit Saltbush)	1	30	no	N
Forb (FG)	<i>Oxalis radicata</i>	0.1	50	no	N
Shrub (SG)	<i>Chenopodium curvispicatum</i>	4	20	no	N
	<i>Sisymbrium erysimoides</i> (Smooth Mustard)	0.1	5	no	E
Shrub (SG)	<i>Atriplex vesicaria</i> (Bladder Saltbush)	0.1	10	no	N
	<i>Schismus barbatus</i> (Arabian Grass)	5	1000	no	E
Shrub (SG)	<i>Sclerolaena patenticuspis</i>	0.1	10	no	N
Shrub (SG)	<i>Nitraria billardierei</i> (Dillon Bush)	3	8	no	N
Forb (FG)	<i>Vittadinia pterochaeta</i> (Rough Fuzzweed)	0.1	20	no	N

BAM Site – Field Survey Form

Plot ID:	Plot18	Date:	08/11/21	Project number:	S200529	Plot dimensions:	20x50	
Datum:	GDA94	Easting:	723,974	Recorders:	RD, GS			
Zone:	54	Northing:	6,189,201	IBRA region:	Murray Darling Depression (South Olary Plain)	Midline bearing:	60	
Plant Community Type:	166: Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW				Condition class:	Poor	PCT confidence:	high
Vegetation Class:	Inland Saline Lakes				EEC:	no	EEC confidence:	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	6
	Grasses etc.:	0
	Forbs:	5
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	50.3
	Grasses etc.:	0
	Forbs:	0.5
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	15	1	0	0	0
Average litter cover (%):	3.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

50%clay pan and 50%vegetated shrubland. Plain. Vegetated area is higher up than clay pan (ie on a mound).

Plot Disturbance

Rabbit Warren within plot. Dominated by exotic grass. Erosion from rabbits. Animals runs present.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	S200529				
Recorders:	RD, GS	Plot ID:	Plot18	Date:	08/11/21

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	<i>Nitraria billardierei</i> (Dillon Bush)	5	40	no	N
Shrub (SG)	<i>Sclerolaena brachyptera</i> (Short-winged Copperburr)	20	500	no	N
Shrub (SG)	<i>Maireana turbinata</i>	5	200	yes	N
Shrub (SG)	<i>Maireana pyramidata</i> (Black Bluebush)	20	100	no	N
	<i>Schismus barbatus</i> (Arabian Grass)	60	20000	no	E
Shrub (SG)	<i>Dissocarpus paradoxus</i> (Cannonball Burr)	0.1	20	no	N
Forb (FG)	<i>Calandrinia calyptata</i>	0.1	10	no	N
	<i>Medicago minima</i> (Woolly Burr Medic)	0.1	50	no	E
Forb (FG)	<i>Bulbine semibarbata</i> (Wild Onion)	0.1	5	yes	N
Forb (FG)	<i>Erodium crinitum</i> (Blue Crowfoot)	0.1	50	yes	N
Shrub (SG)	<i>Maireana microphylla</i> (Small-leaf Bluebush)	0.2	20	yes	N
	<i>Sisymbrium erysimoides</i> (Smooth Mustard)	0.1	40	no	E
Forb (FG)	<i>Atriplex lindleyi</i> (Eastern Flat-top Saltbush)	0.1	20	yes	N
Forb (FG)	<i>Euphorbia</i> spp.	0.1	5	yes	N



