Section 6

Assessment and Management of Key Environmental Issues

PREAMBLE

This section describes the environmental setting within and surrounding the Mine Site and Rail Facility. Emphasis is placed in the initial subsection upon providing information on the regional and local topography and meteorology. Information in relation to local and regional communities, surrounding land uses, land ownership and residences, natural and built features and key risks and hazards are identified in Section 2.

Key environmental issues were identified and prioritised based on:

- *the results of the analysis of environmental risk presented in **Appendix 2**;*
- *feedback received during community and agency consultation (see Section 5.2);*
- *the results of the specialist consultant studies; and*
- *the experience of R.W. Corkery & Co. Pty Limited in preparing EIS and related documentation.*

*This section assesses each of the identified key environmental issues in turn. Information is provided on: existing conditions; potential impacts, relevant assessment criteria, where appropriate; the proposed management and mitigation measures to minimise or avoid the identified impacts; the assessment of residual impacts; and proposed monitoring strategies. The proposed management and mitigation measures for each of the following subsections have been collated and are presented in **Appendix 3**.*

6.1 Environmental Setting

6.1.1 Introduction

The assessment of the environmental impacts of the Project in this section is reliant upon background information common to many environmental issues. Key features of the Mine Site and Rail Facility and surrounding area and region, including community, surrounding land uses, land ownership, natural and built features, risks and hazards are described in Section 2.2. In this subsection, background information is provided on the topography, drainage and climate. Additional detail in relation to surface water drainage is presented in Section 6.7.

6.1.2 Topography and Drainage

6.1.2.1 Regional Topography and Drainage

Mine Site

The Mine Site is situated within a relatively flat area of the central Murray Darling Basin (**Figure 6.1.1**). Regional topography is characterised by sequences of ridges and lunettes that rise to elevations between 50m AHD and 70m AHD. These ridges are interspersed with broad swales and drainage depressions with elevations between 30m AHD and 40m AHD.

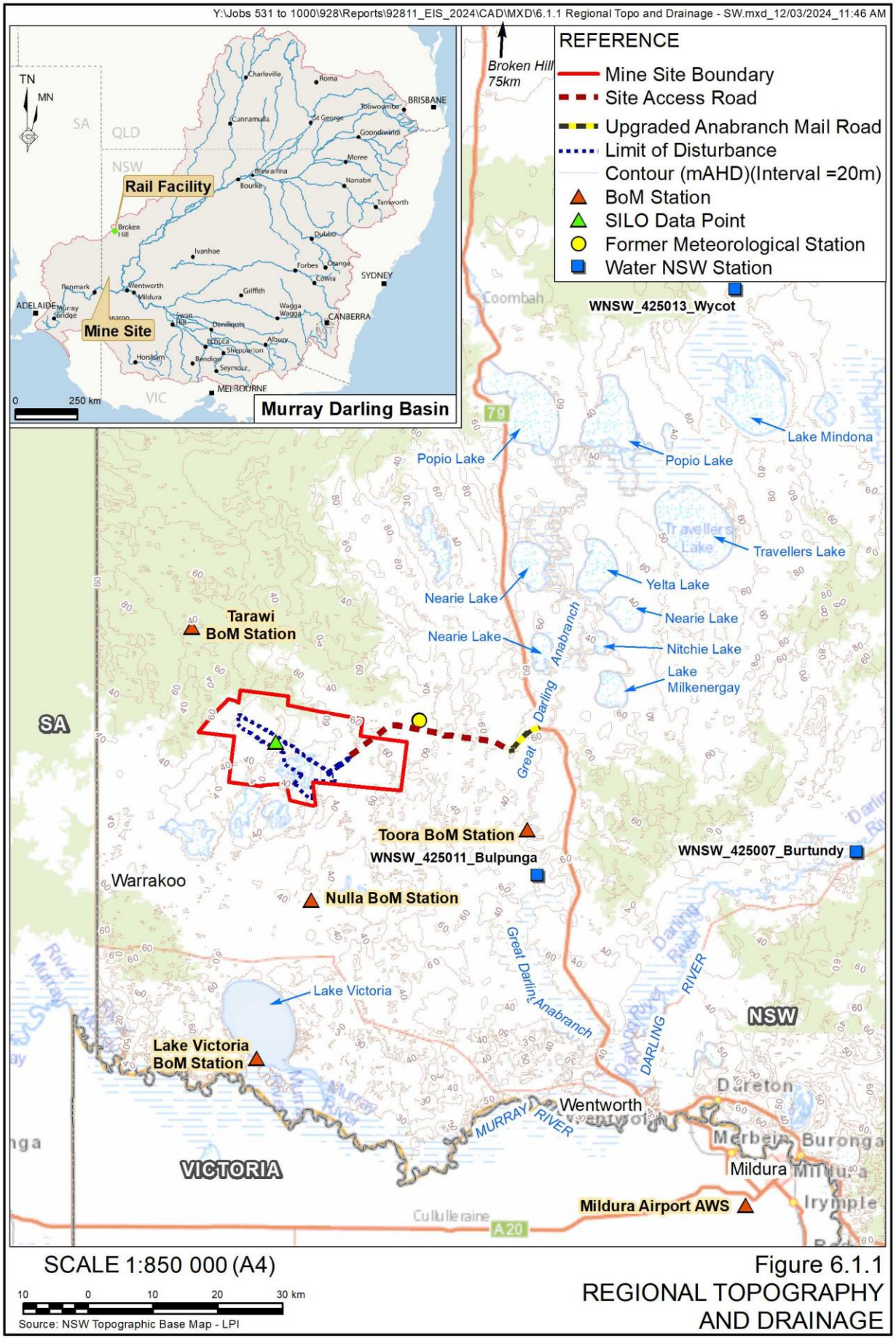
The Murray Darling Basin in the vicinity of the Mine Site is dominated by the Darling River. This river starts at the confluence of the Barwon and Culgoa Rivers, between Brewarrina and Bourke in northern NSW and flows in a southeasterly direction before merging with the Murray River at Wentworth (**Figure 6.1.1**). The Murray River then flows in a westerly and south-westerly direction before entering the Southern Ocean at Goolwa, in South Australia.

The Great Darling Anabranch, located approximately 20km east of the Mine Site, is a relict channel of the Darling River and flows in a generally southerly direction before also merging with the Murray River at Wentworth. The Great Darling Anabranch includes a series of large, shallow, typically dry lakes such as Yelta, Wialia, Pine, Popio and Popiltah Lakes (**Figure 6.1.1**). These lakes, and many smaller drainage depressions, are believed to have been formed by wind transportation of dry exposed sediments in the base of the depression. These sediments commonly form lunettes of wind-blown material on the northeastern and eastern margins of the lakes, a reflection the dominant south-westerly wind patterns.

Lake Victoria, located approximately 30km to the south of the Mine Site, forms an integral component of the regulated Murray River system, with water levels controlled by a series of embankments and locks.

Rail Facility

The Rail Facility is located in an elevated area where regional landforms predominantly comprise rolling hills and lowlands. The regional landscape is dominated by the Barrier Range which lies to the north, west and south-west of Broken Hill and forms the divide between the Murray Darling Basin to the southeast and the Lake Eyre Basin to the northeast.


Y:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\MXD\6.1.1 Regional Topo and Drainage - SW.mxd_12/03/2024_11:46 AM
REFERENCE
Mine Site Boundary
Site Access Road
Upgraded Anabranch Mail Road
Limit of Disturbance
Contour (mAHD)(Interval =20m)
BoM Station
SILO Data Point
Former Meteorological Station
Water NSW Station
Broken Hill 75km
WNSW_425013_Wycot
Rail Facility
Mine Site
Murray Darling Basin
Lake Mindona
Popio Lake
Travellers Lake
Yelta Lake
Nearie Lake
Nitchie Lake
Lake Milkenergay
Anabranch
Darling
Great
Tarawi BoM Station
SA
Toora BoM Station
WNSW_425011_Bulpunga
WNSW_425007_Burtundy
Warrakoo
Nulla BoM Station
Lake Victoria
Lake Victoria BoM Station
VICTORIA
NSW
MURRAY RIVER
DARLING RIVER
Wentworth
Mildura
Buronga
Dareton
Irymple
Mildura Airport AWS
Cullulleraine
A20
SCALE 1:850 000 (A4)
10 0 10 20 30 km
Source: NSW Topographic Base Map - LPI
Figure 6.1.1
REGIONAL TOPOGRAPHY AND DRAINAGE

6.1.2.2 Local Topography and Drainage

Mine Site

The Mine Site topography is a small-scale reflection of regional topography and is characterised by swales and drainage depressions. Within the Mine Site there are four depressions, the largest being the centrally situated Eastern and Western Salt Pans with two lesser depressions, the central and eastern depressions (**Figure 6.1.2**). The floors of the two Salt Pans are approximately 25m AHD whilst the floor of the central and eastern depressions are notably higher at between approximately 30m AHD and 40m AHD respectively. The Salt Pans are interpreted to have been formed by deflation, with wind-blown sediments deposited as lunettes on the eastern side of each structure. The Salt Pans are surrounded by gently sloping land that rises to approximately 60m AHD east of the Eastern Salt Pan and as high as approximately 70m AHD east of the Western Salt Pan. At greater distances from the salt pans, the landforms are typically flat to undulating, with rises and swales typically between 40m AHD and 70m AHD respectively. Slopes typically average <1%, with localised areas with slopes around 5% associated with the wind-blown lunettes adjacent to the Eastern and Western Salt Pans.

There are six surface water catchments either wholly or partly within the Mine Site boundary (**Figure 6.1.2**). The local drainage networks of the catchments direct runoff internally, with no catchment outlet or downstream linkages. These internal drainage networks are also indistinct and discontinuous, terminating in dams that were historically constructed to support stock watering (**Figure 6.1.2**). The land surface is also sandy which means that drainage depressions, such as the Eastern and Western Salt Pans, will typically only receive overland flow after substantial rainfall occurs.

A brief overview of all Mine Site catchments is as follows.

- Northwestern Catchment – the Mine Site covers a small section of this agricultural catchment which drains externally to the west.
- Southwestern Catchment – this catchment is partly situated within, and externally drains beyond, the southwestern and western sections of the Mine Site. Approximately 0.5km^2 of the northeastern section of this catchment would be disturbed by the Project.
- Western Salt Pan Catchment – this catchment is approximately 91km^2 in area as is mostly situated within the western section of the Mine Site and drains to the Western Salt Pan. Approximately 17km^2 of the central section of this catchment would be disturbed by Project-related activities.
- Central Depression Catchment– this catchment is approximately 36km^2 in area and is situated largely within the Mine Site. Project-related activities would disturb an approximately 5km^2 area in the southern section of this catchment.
- Eastern Salt Pan Catchment – this catchment is approximately 105km^2 in area and is situated in the central eastern section of the Mine Site. Catchment drainage is towards the Eastern Salt Pan. Approximately 33km^2 of this catchment would be disturbed by Project-related activities.
- Eastern Catchment – this catchment is approximately 42km^2 in area and is almost entirely within the easternmost section of the Mine Site with an approximately 0.6km^2 area within the proposed limit of disturbance.

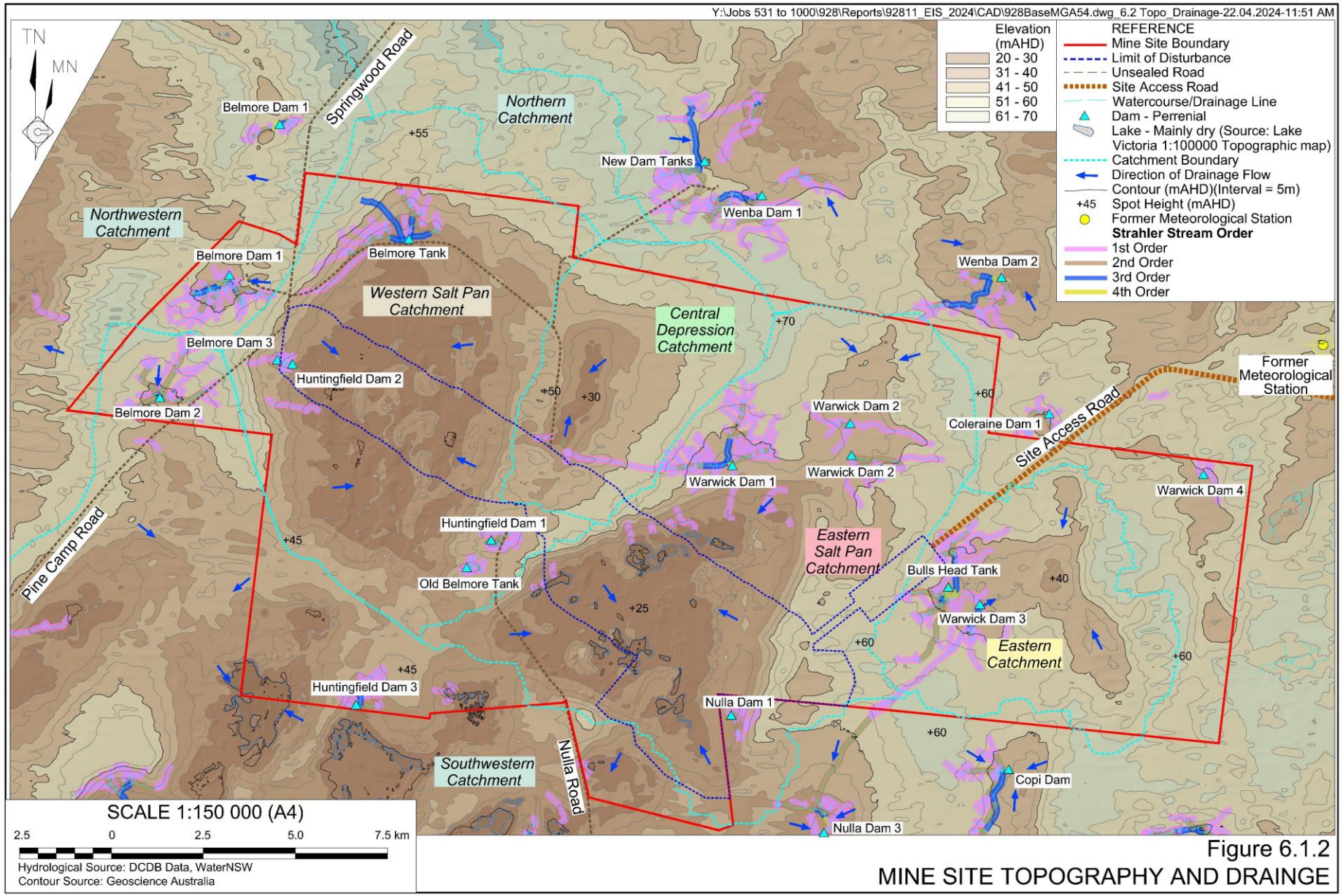


Figure 6.1.2
MINE SITE TOPOGRAPHY AND DRAINGE

Rail Facility

The Rail Facility is located in a heavily modified environment, with prior mining and quarrying activities extensively modifying the surrounding landforms (**Figure 6.1.3**). In summary, waste rock and tailings emplacements associated with the Broken Hill North Mine and the Rasp Mine are located to the east-northeast and north and west of the Facility. Additional quarry-related activities associated with Mawson's Broken Hill Quarry are located to the south of the Facility. A small rise with an elevation of approximately 300m AHD is located immediately to the west of the Rail Facility.

The Rail Facility is flat, with a very gentle fall to the southeast, parallel to the rail line. There are no natural surface drainage features.

6.1.3 Climate

6.1.3.1 Introduction and Data Sources

Meteorological conditions have the potential to influence a range of Project-related impacts on surrounding residences and the environment. This subsection provides a brief overview of the meteorological conditions surrounding the Mine Site focusing particularly on those aspects of the climate that are likely to influence the potential Project-related surface water impacts.

The Applicant installed a meteorological station adjacent to the Mine Site in March 2017 (**Figure 6.1.2**). This station operated intermittently until December 2019 when it was deemed inoperable. As a result, data from the following Bureau of Meteorology (BoM) stations within 50km of the Mine Site has been relied upon (**Figure 6.1.1**).

- Wentworth (Tarawi) – 22km from the Mine Site with rainfall records from 1 January 1966 until 15 February 2016;
- Wentworth (Nulla) – 25km from the Mine Site with rainfall records commencing 1 January 2017 until the present day;
- Wentworth (Toora) – 20km from the Mine Site with rainfall records from 1 January 1972 until 31 July 2016;
- Lake Victoria – 49km from the Mine Site with rainfall records commencing 1 January 1922 until the present day and evaporation data from 1965 onwards; and
- Mildura Airport Automated Weather Station (AWS) – 90km southeast of the Mine Site. This station has been used to verify the wind environment in the vicinity of the Mine Site.

In addition, climate data has been sourced from the Scientific Information for Landowners (SILO) database, managed by the Queensland Department of Environment and Science. SILO uses historic Bureau of Meteorology datasets and interpolation techniques to generate continuous daily time step synthetic climate data for any given location in Australia. The SILO dataset for the period 1 January 1889 to 31 December 2023 was generated for a point in the centre of the Mine Site (**Figure 6.1.1**) on 30 January 2024 (**Table 6.1.1**).

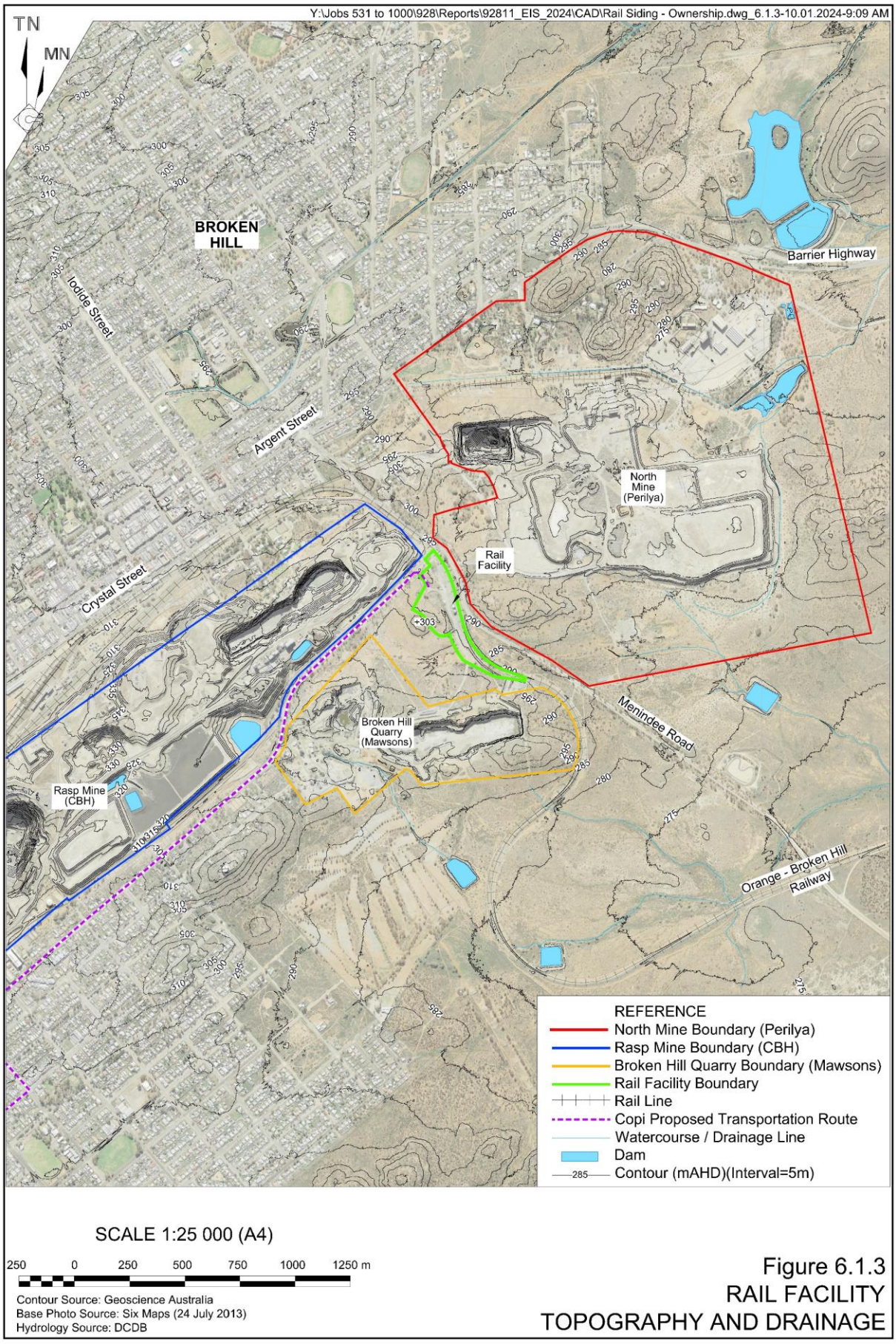


Figure 6.1.3
RAIL FACILITY
TOPOGRAPHY AND DRAINAGE

Table 6.1.1
SILO Climate Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Temperature (C°) – SILO (1889 to present)													
Mean maximum temperature	33.2	32.5	29.2	24.3	19.8	16.5	16.1	18.1	21.5	25.1	28.7	31.4	24.7
Mean minimum temperature	17.3	17.0	14.4	10.7	7.9	5.7	5.0	5.9	8.2	10.8	13.7	15.7	11.0
Rainfall (mm) – SILO (1889 to present)													
Mean rainfall	18.0	18.7	14.1	16.4	22.3	20.8	19.5	21.5	21.4	23.6	19.8	18.9	235.1
Highest rainfall	119.1	214.1	110.5	118.1	103.2	89.5	62.2	84.3	101.0	122.0	82.6	188.7	592.6
Lowest rainfall	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.4	0.0	0.0	0.0	53.1
Highest daily rainfall	53.4	93.8	53.7	32.8	35.6	37.3	27.0	31.7	37.1	48.1	49.4	111.7	111.7
Mean Monthly Evaporation (mm) – SILO (1889 to present)													
Class A Pan	314.3	254.8	213.9	131.2	78.7	54.1	61.4	92.1	135.9	194.7	244.7	297.9	2073.6
Source: Queensland Department of Environment and Science													

6.1.3.2 Temperature

January is typically the hottest month, with an average maximum temperature of 33.2ºC. July is the coldest month with a mean maximum temperature of 16.1°C and a mean minimum temperature of 5.0°C.

6.1.3.3 Rainfall

Figure 6.1.4 provides a comparison of the SILO rainfall data with rainfall data from the Tarawi and Lake Victoria BoM stations. Data from the Nulla and Toora BOM stations were deemed to be of too short a duration or incomplete and were not used. In summary, the mean monthly rainfall derived from the SILO rainfall data is generally more consistent with that from the Lake Victoria BOM station than that from the Tarawi BOM station. This is likely due to the longer-term (100-years) record for Lake Victoria compared with Tarawi (48 years) capturing a greater temporal range of observation. In addition, there is a close relationship between the SILO and Lake Victoria Pan A evaporation data.

Table 6.1.1 identifies that mean annual rainfall at the Mine Site is 235.1mm. Rainfall distribution is relatively even throughout the year, although the autumn months collectively contribute the lowest amount to total annual rainfall with approximately 22% of the total average annual rainfall. On average, the driest month is March with 14.1mm of rainfall whilst the wettest month on average is October with 22.6mm.

The driest year of the SILO record (1889 to 2023) is 2019 with 53.1mm of rainfall. This accords with Lake Victoria's 2019 total of 66.4mm and the 47.2mm recorded at Wentworth (Nulla) for the same year. By contrast, the wettest year on the SILO record was 1973 with 592.6mm which corresponds with the 603.6mm recorded at Lake Victoria for that year.

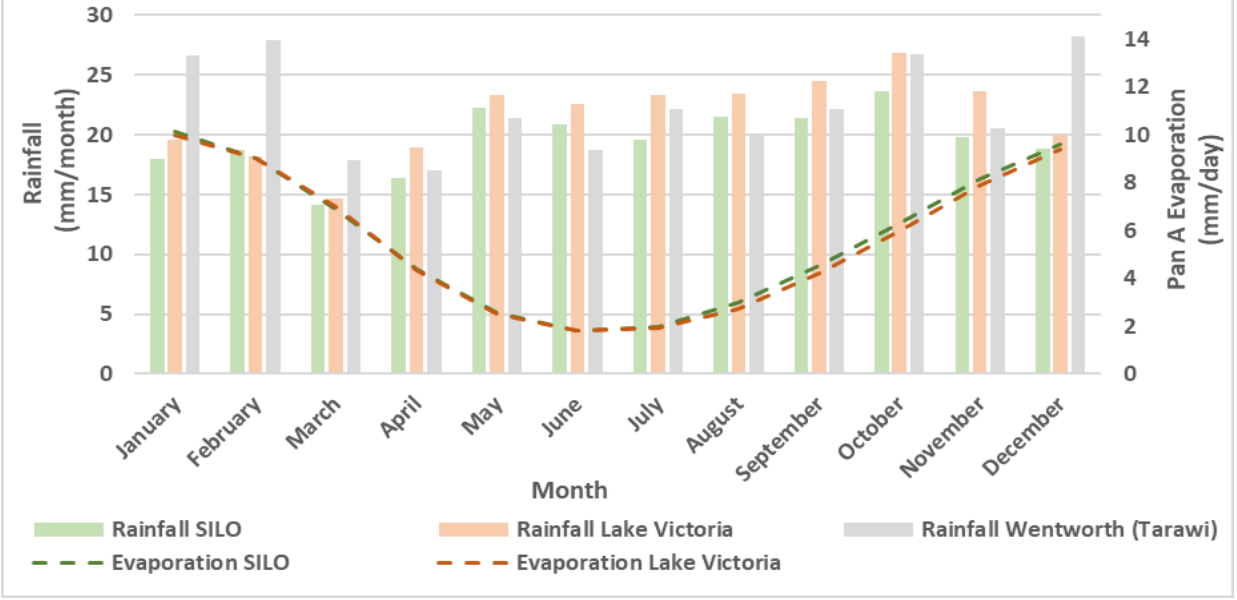


Figure 6.1.4
MEAN MONTHLY RAINFALL AND MEAN DAILY EVAPORATION

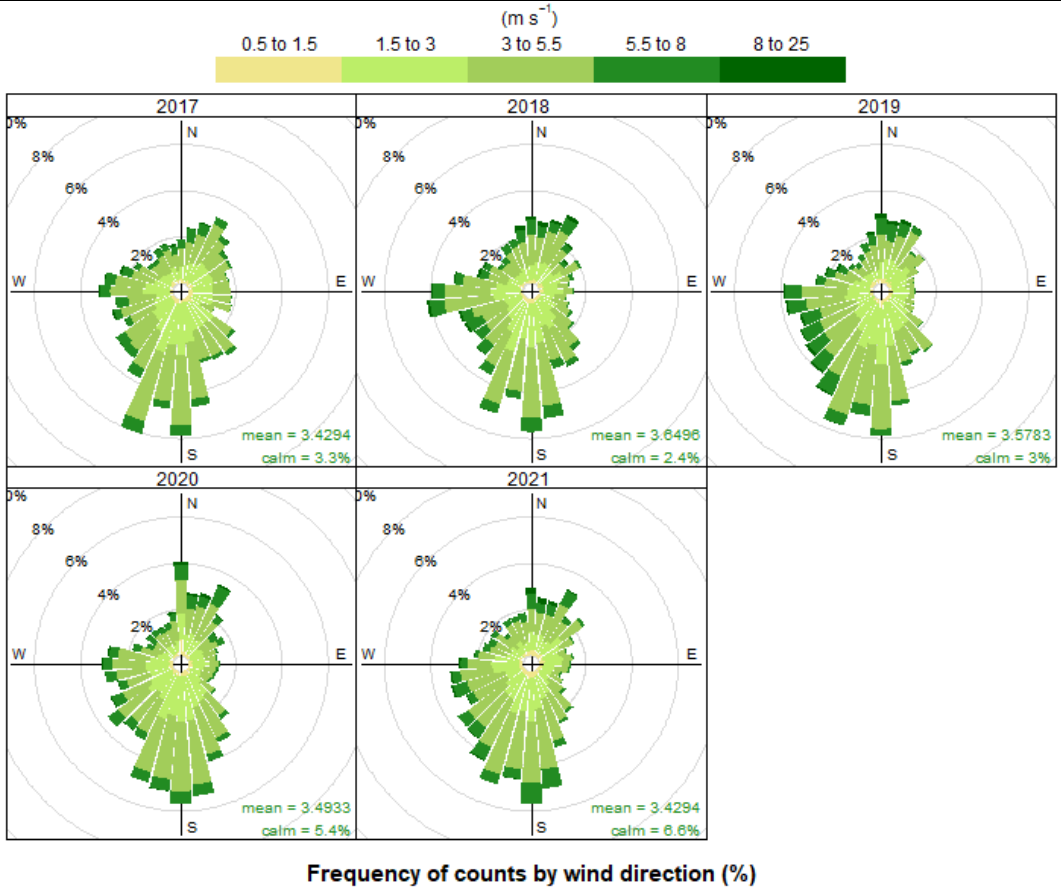
The SILO data contains a maximum daily rainfall of 111.7mm on 13 December 1975. Maximum daily rainfall exceeds monthly average rainfall for all months, indicating that high intensity storms over a relatively short duration may occur, particularly in the summer months of December to February.

6.1.3.4 Evaporation

The mean SILO-derived Class A Pan evaporation data presented in **Table 6.1.1**. Mean evaporation at the Mine Site is estimated to be approximately 5.7mm per day throughout the year or 2,079mm per year. This is slightly higher than the annual evaporation recorded at Lake Victoria. Mean daily evaporation varies between approximately 1.8mm per day (54.1mm/month) in June and 10.1mm per day (314.3mm/month) in January.

6.1.3.5 Wind

Northstar Air Quality Pty Ltd has prepared the air quality assessment for the Project. The resulting report is presented in Part 8 of the *Specialist Consultant Studies Compendium* and is referred to hereafter as Northstar (2024). As noted in Section 6.1.3.1, the Applicant intermittently operated an onsite meteorological station between 2017 and 2019. That station did not generate wind data of a suitable duration for use by Northstar. As a result, Northstar (2024) utilised wind data from the Mildura Airport AWS (**Figure 6.1.5**). In summary, winds in the vicinity of the Mine Site are predominantly from the south and southwest, with limited winds from the northeast.



Source: Northstar (2024) – Figure A2

Figure 6.1.5
WIND ROSES

6.2 Groundwater

6.2.1 Introduction

The SEARS identify "water" as a key issue for assessment in the EIS. Matters to be addressed for groundwater include:

- "a description of all works/activities that may intercept, extract, use, divert or receive groundwater. This includes the description of any development, activities or structures that would intercept with or remove groundwater, both temporary and permanent;
- details of all water take for the life of the development and the relevant water source where water entitlements are required to account for the water take. If the water is to be taken from an alternative source confirmation should be provided by the supplier that the appropriate volumes can be obtained; and
- details of Water Access Licences (WALs) held to account for any take of water where required, or demonstration that WALs can be obtained prior to take of water occurring. This should include an assessment of the current market depth where water entitlement is required to be purchased and details of any exemptions or exclusions to requiring approvals or licenses under the Water Management Act 2000;
- an assessment of impacts on groundwater sources (both quality and quantity), related infrastructure, water users, basic landholder rights, watercourses, riparian land, groundwater dependent ecosystems and groundwater levels; including measures proposed to reduce and mitigate these impacts, having regard to the *Aquifer Interference Policy*.
- a description of the measures proposed, including monitoring activities and methodologies, to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;"

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from DPE-Water, DPE-Crown Lands and the EPA. These requirements, where additional to those above, are summarised as follows.

- The identification of an adequate and secure water supply for the life of the Project.
- Identify appropriate measures that will be undertaken to mitigate any potential adverse impact.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

GEO-ENG prepared the *Groundwater Impact Assessment* for the Project. That report, hereafter referred to as GEO-ENG (2024), is presented as **Appendix 5**. A peer review of the groundwater assessment was undertaken by Mr James Williams of Hydro Consulting Services. A copy of the peer review is included as Appendix P of GEO-ENG (2024).

This subsection provides a summary of the *Groundwater Impact Assessment* and describes the management and management measures to be implemented by the Applicant.

6.2.2 Existing Environment

6.2.2.1 Introduction

The existing groundwater setting needs to be considered in determining the approach applied to the groundwater modelling which then informs the assessment of the Project's potential impacts on that setting. A comprehensive description of the existing environment used to inform the *Groundwater Impact Assessment* is provided in Sections 3 to 10 of GEO-ENG (2024). The following subsections provide an overview of the information presented in that document.

6.2.2.2 Hydrogeological Setting

Section 1.5.2 and **Figures 1.2** and **1.3** present an overview of the geological setting of the Mine Site. In summary, the Mine Site is located within the Lower Darling Basin with GEO-ENG (2024) identifying three principal aquifers (Upper, Middle and Lower). **Table 6.2.1** identifies, from shallowest to deepest, the stratigraphic units which variously comprise these aquifers.

Table 6.2.1
Stratigraphic Units of the Aquifer Systems

Name[1]	Stratigraphic Unit[2]	Description[2]
Upper Aquifer	Shepparton Formation	Fluvio-lacustrine sediments (clay and sand with minor gravel).
	Loxton-Parilla Sands	Fine to medium grained shallow marine, beach and estuarine sediments with coarser sediments associated with ore zones.
	Calivil Formation	Fine to medium grained fluvio-lacustrine sediments.
	Upper Olney Formation (Renmark Group)	Medium to fine grained sands with interbedded silts and micaceous clays.
Middle Aquifer	Middle Olney Formation (Renmark Group)	Fluvio-lacustrine clays and sands
	Murray Group Limestone Formation	Bioclastic limestone.
Lower Aquifer	Lower Olney Formation (Renmark Group);	Silts and sands
	Warina Sand	Coarse sands and gravels
Note 1: Source - GEO-ENG (2024)		
Note 2: Source - Geoscience Australia: Australian Stratigraphic Units Database		

The Loxton-Parilla Sands hosts the Copi orebody and therefore the Upper Aquifer is the principal groundwater system of interest for the Project. The Loxton-Parilla Sands comprises fine to coarse sands deposited within a paleo-shoreline environment, with deposits attributed to foreshore, surf zone, lower shore and offshore environments. This stratigraphic unit is typically 30m to 50m thick, with coarse sand typically occurring at depth, becoming finer grained at shallower depths. The Upper Aquifer is overlain in places by the Blanchetown Clay, resulting in a locally confined groundwater system. Within the Mine Site and its surrounding area, the Upper Aquifer is underlain by thick clays, including the Bookpurnong Beds and Geera Clay, that limit interaction between the Upper Aquifer and with the Middle and Lower Aquifers.

6.2.2.3 Regional Groundwater Setting

Regional Groundwater Levels

Various State government agencies and departments such as Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW), the Victorian Department of Environment, Land, Water and Planning and the South Australian Department for Environment and Water as well as mining companies operate monitoring bore networks in the region surrounding the Mine Site. **Figure 6.2.1** presents the location of the bores used by GEO-ENG (2024) and the regional groundwater levels for the Upper Aquifer. GEO-ENG (2024) state that of the 252 bores assessed, 173 bores are presumed to be screened within the Upper Aquifer.

Based on the information presented in GEO-ENG (2024) and **Figure 6.2.1**, regional groundwater levels can be summarised as follows.

- Regional groundwater gradients within the Upper (and Middle and Lower) aquifers are from the northeast to the southwest, albeit at a very low hydraulic gradient.
- The enhanced recharge effects of seepage from the Menindee Lakes and the irrigation areas along the Darling River are evident in **Figure 6.2.1**.

The elevation of the Upper Aquifer groundwater levels in the vicinity of the Great Darling Anabranch to the north and east of the Mine Site are typically between 30m AHD and 39m AHD. By contrast, groundwater levels in the vicinity of Lake Victoria and the Murray River are between 20m AHD and 25m AHD. Groundwater levels in the vicinity of the Mine Site are typically between 24m AHD and 26m AHD.

Regional Groundwater Quality

Measured groundwater quality in selected bores intersecting the Upper, Middle and Lower Aquifers are discussed in Section 5.3.3 of GEO-ENG (2024). Those results are summarised as follows.

- Groundwater salinity measured as total dissolved solids (TDS) increases with distance from major watercourses (i.e. Menindee Lakes, Great Darling Anabranch);
- Groundwater salinity as TDS in the Upper Aquifer within the Mine Site is approximately 61,000mg/L[1];
- Groundwater salinity is lower in the lower aquifers, with typical TDS values for the Middle and Lower Aquifers of 12,000mg/L and 10,350mg/L respectively (refer Table 8 of GEO-ENG, 2023).

Figure 9 of GEO-ENG (2024) presents a hydrogeochemical classification plot for the regional aquifers that identifies the major ion composition of all groundwaters as being dominated by sodium and chloride.

[1] Calculated by GEO-ENG (2024) using an average electrical conductivity of 90,900µS/cm.

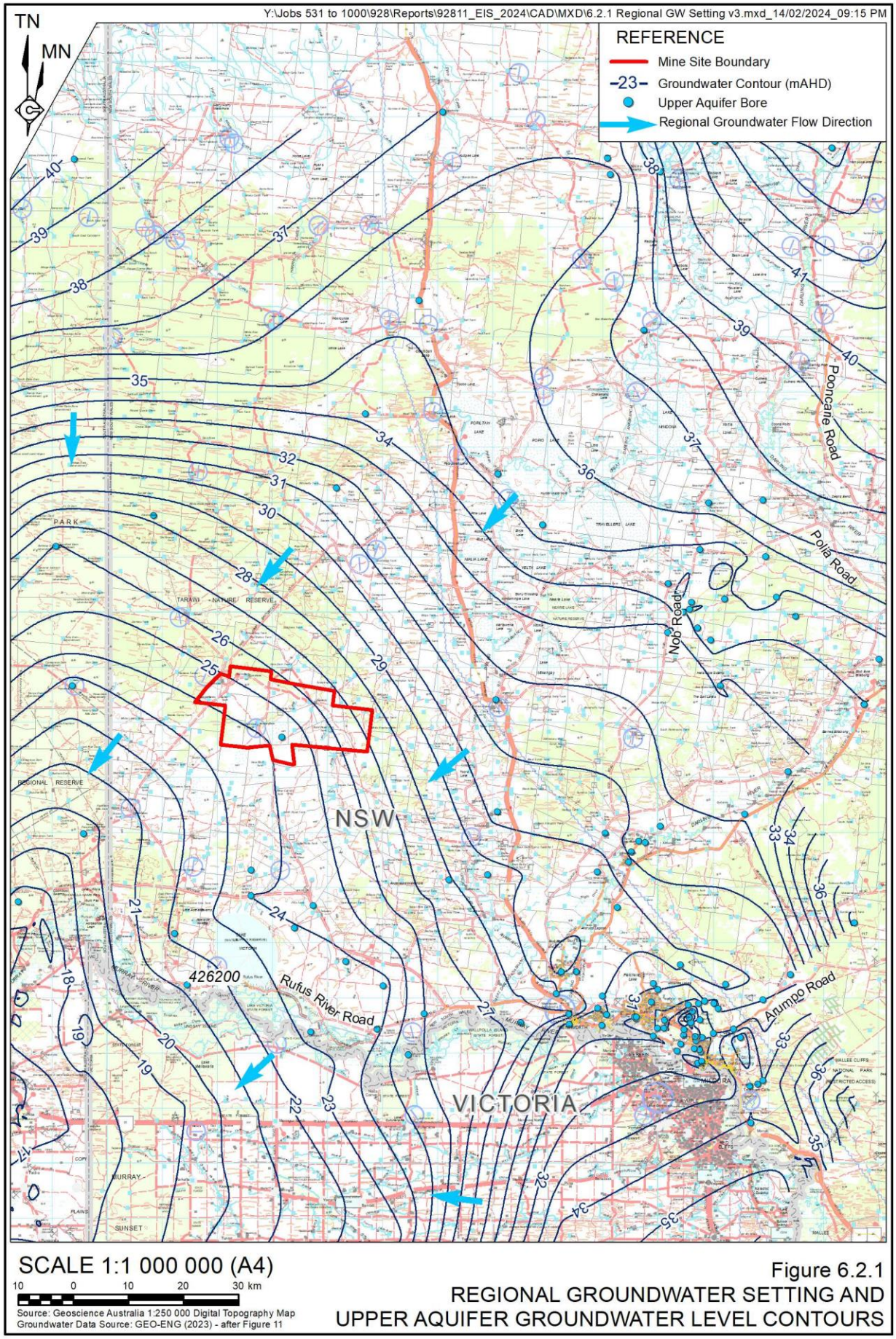


Figure 6.2.1
REGIONAL GROUNDWATER SETTING AND
UPPER AQUIFER GROUNDWATER LEVEL CONTOURS

Surrounding Groundwater Users

Section 8 of GEO-ENG (2024) provides a summary of regional groundwater usage. **Figure 6.2.2** and **Table 6.2.2** present the registered groundwater bores surrounding the Mine Site. In summary, seven registered bores have been identified within 15km of the Limit of Disturbance, with total depths ranging from 38m to 427m. Of these bores, four are identified as being for the purpose of stock or domestic water supply whilst one (GW036722) is for monitoring. The purpose of the remaining two bores is unknown. GEO-ENG (2024) notes that only two (GW004716 and GW036722) were considered active, with the remainder unable to be located.

Table 6.2.2
Surrounding Registered Bores

Registered number	Authorised / intended purpose	Total depth (m)	Notes
GW004701	Stock and domestic	Not recorded	Not found
GW004702	Stock	196	Not found
GW004716	Stock	182.9	Active
GW004746	Stock	199.3	Not found
GW009719	Unknown	381.3	Not found
GW009721	Unknown	324.3	Not found
GW036722[1]	Monitoring	42 / 231 / 421	Active
Note 1: GW036722 incorporates three separate bores cased in the upper, middle and lower aquifers respectively			
Source: GEO-ENG (2024) after Table 9			

Surrounding Groundwater Dependent Ecosystems

Schedule 2 of the *Water Sharing Plan for the NSW Murray Darling Basin (MDB) Porous Rock Groundwater Sources Order 2020* (NSW MDB Porous WSP) does not list any high priority groundwater dependent ecosystems (GDE) in the vicinity of the Mine Site. However, the *High Priority Groundwater Dependent Ecosystem Map* which accompanies the NSW MDB Porous WSP identifies the presence of groundwater dependent ecosystem vegetation within the Mine Site (**Figure 6.2.3**). This mapped vegetation is situated within the depressions of the Western and Eastern Salt Pans.

As the NSW MDB Porous WSP was updated in 2020, the high priority GDE mapping was developed using the high ecological value aquatic ecosystem (HEVAE) framework. Areas of high and high value GDEs identified under this framework are then considered as being high priority GDE in water sharing plans. The methods used under this framework include indirect indicators obtained from a range of data sources and a decision-rule spatial model prepared using the methods described in Dabovic *et al* (2019). Dabovic *et al* (2019) describes the use of NSW Government mapping to establish the presence of plant community types (PCT) as part of the methodology to establish the presence of high priority GDE vegetation within the spatial model. However, Dabovic *et al* (2019) also note that, when tested, the overall accuracy of the vegetation PCT data was 58.2%.

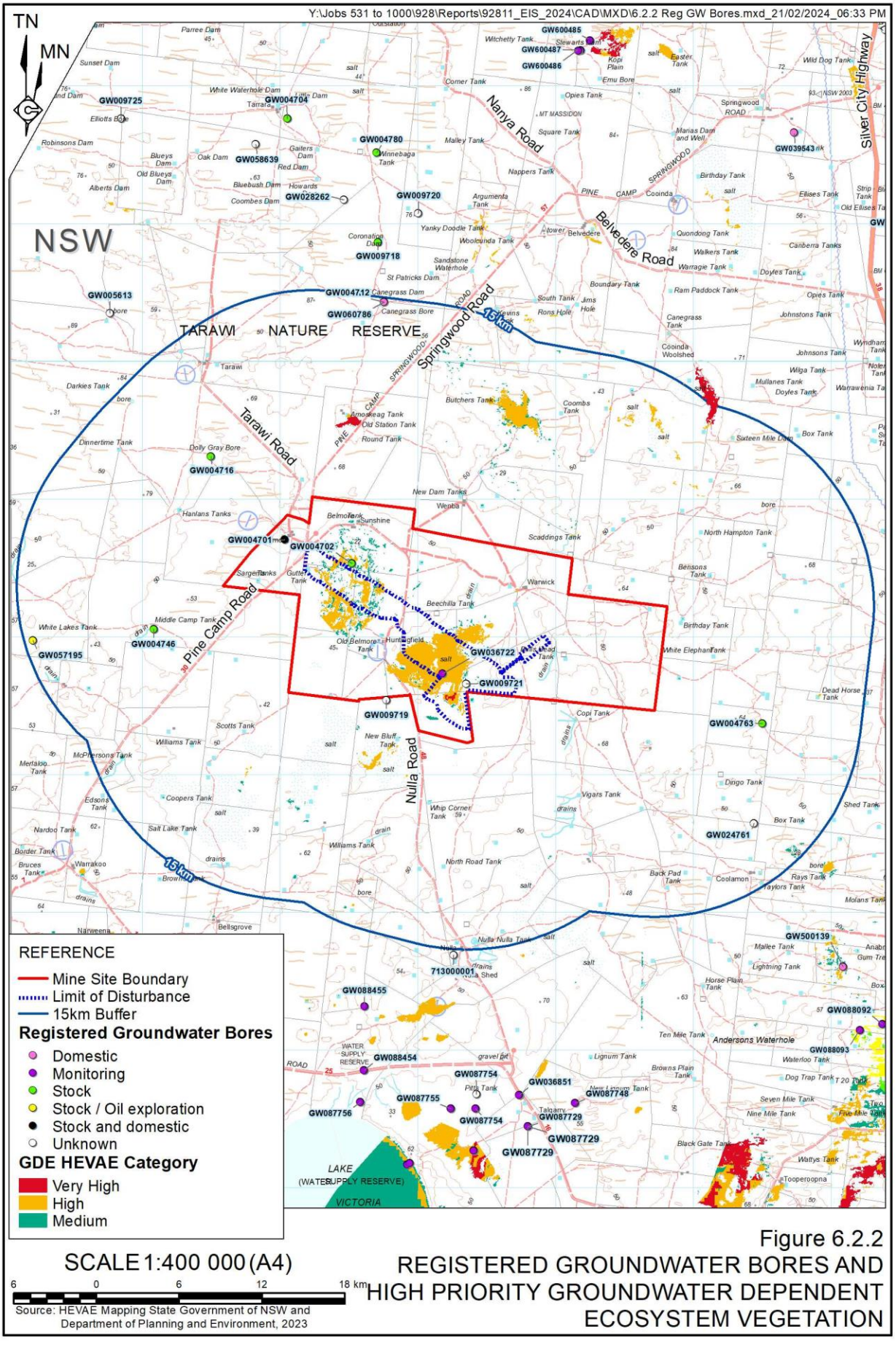


Figure 6.2.2
REGISTERED GROUNDWATER BORES AND HIGH PRIORITY GROUNDWATER DEPENDENT ECOSYSTEM VEGETATION

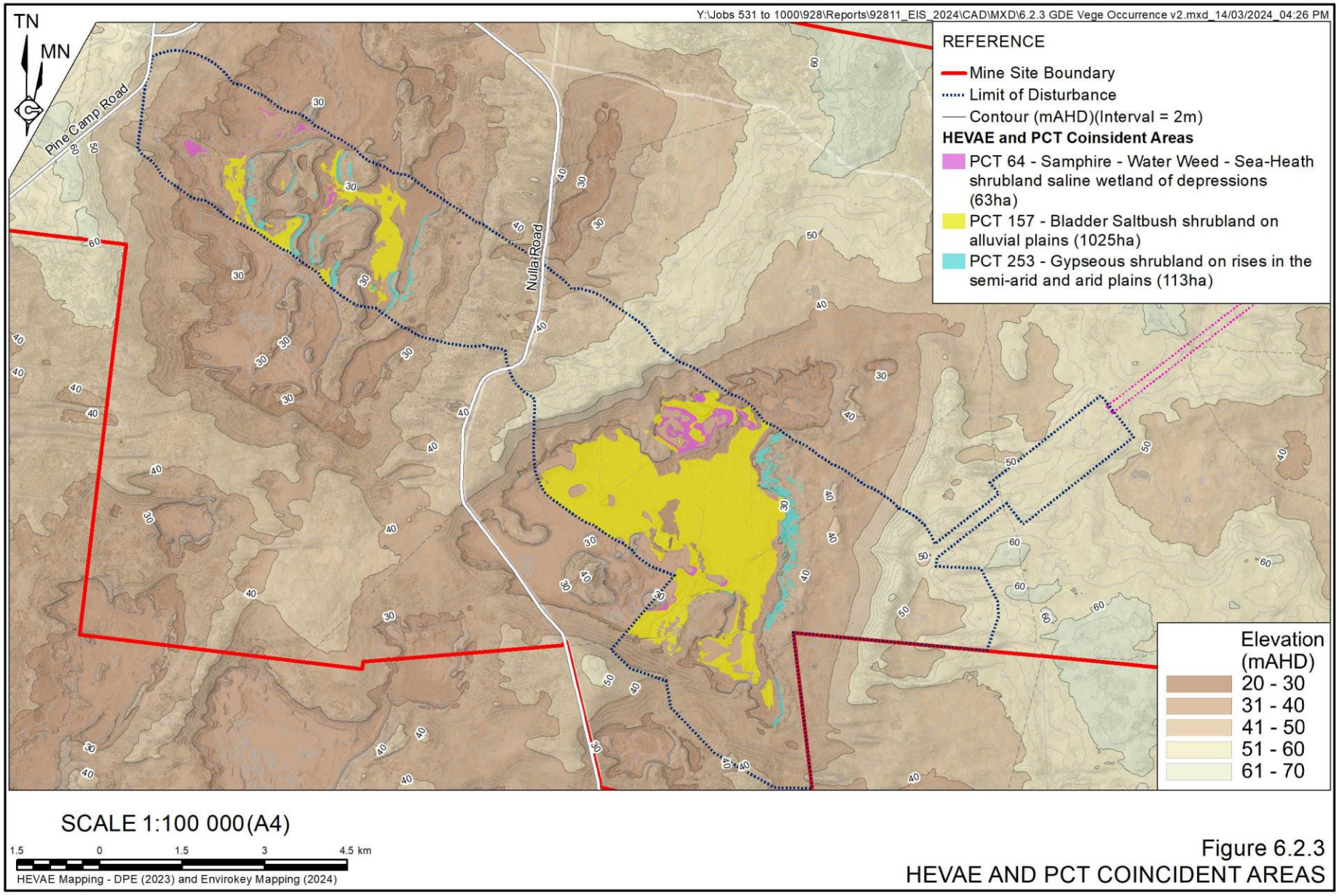


Figure 6.2.3
HEVAE AND PCT COINCIDENT AREAS

Review of the NSW MDB Porous WSP *High Priority Groundwater Dependent Ecosystem Map* identifies that, within and proximal to the Mine Site, the mapped high priority GDE vegetation corresponds to the *HEVAE Vegetation Groundwater Dependent Ecosystems Value - Western Division* (DPE, 2023) spatial dataset (HEVAE mapping). The HEVAE mapping includes information on the individual PCT that comprises the high priority GDE vegetation developed using the methods of Dabovic *et al* (2019). Therefore, to validate the presence of high priority GDE vegetation within and surrounding the Mine Site, the HEVAE mapping was compared with the PCTs identified by EnviroKey (2024) (see Section 6.3, **Figure 6.3.4** and **Appendix 6**).

In summary, the HEVAE mapping identified the following four potentially groundwater dependent PCTs within the Mine Site.

- PCT 64: Samphire - Water Weed - Sea-Heath shrubland saline wetland of depressions of the arid and semi-arid (warm) zones
- PCT 157: Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone including Riverina Bioregion
- PCT 221: Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones
- PCT 253: Gypseous shrubland on rises in the semi-arid and arid plains

Each of these were identified by EnviroKey (2024) within the BDAR Footprint, however, only PCT64, PCT157 and PCT253 were identified within the HEVAE mapped area (**Figure 6.2.3**).

GEO-ENG (2024) identifies that salinity of the Upper Aquifer groundwater is higher than the upper limits for almost all salt-tolerant species in the area, with the exception of Samphire which is reported to have an upper salinity tolerance limit of approximately 65,000mg/L. As a result, with the exception of limited areas of PCT64, it is unlikely that surface vegetation is reliant upon groundwater within the regional Upper Aquifer. In relation to Samphire, the salinity of the water within the Upper Aquifer is at the very upper limit for the species, meaning that the species is unlikely to be reliant on the Upper Aquifer. Rather, if there is any reliance on groundwater at all, it is likely that that would be limited to near surface, perched, lower salinity groundwater associated with local recharge following rainfall events.

6.2.2.4 Local Groundwater Setting

NSW DCCEEW Monitoring Bore Network

NSW DCCEEW operate a nested monitoring location within the Mine Site, namely GW036722, (**Figure 6.2.2**). This location comprises three separate monitoring bores, with screened intervals in the respective aquifers as follows.

- GW036722.1.1 – 16m to 32m below ground level (mbgl) in the Upper Aquifer
- GW036722.2.2 – 226mbgl to 231mbgl in the Middle Aquifer
- GW036722.3.3 – 411mbgl to 421mbgl in the Lower Aquifer

GEO-ENG (2024) notes that thick clay layers separate each of the aquifer systems monitored at GW036722 and that the pressure head in the Middle and Lower Aquifers is approximately 9.5m and 11m greater than the Upper Aquifer. As a result, GEO-ENG (2024) considers that the there is no significant interaction between any of the aquifers.

GW036722 would be removed during extraction operations (see Section 6.2.3 and 6.2.4.5).

Mine Site Monitoring and Test Bores

In addition to GW036722, the Applicant maintains a network of 55 monitoring bores that are screened in the Upper Aquifer within and surrounding the Mine Site (**Figure 6.2.4)**. This network is comprised of the following.

- Fifty-one monitoring bores.
- Four test bores screened at the base of the Loxton-Parilla Sands stratigraphic unit.

Construction details for the bores are presented in Appendix B of GEO-ENG (2024) .

Mine Site Standing Water Levels

Table 6.2.3 presents the standing water levels for a selection of the Mine Site monitoring bores. In summary, standing water levels of the Upper Aquifer within and surrounding the Mine Site are between 8.3mbgl and 19.7mbgl or between 24.2m AHD and 24.8m AHD with an average standing water level of 24.6m AHD. These consistent standing water levels demonstrate at the local scale the very low hydraulic gradient of the Upper Aquifer that is also evident regionally (refer to **Figure 6.2.1**).

Table 6.2.3
Mine Site Standing Water Levels

Bore ID	Standing Water Level		Bore ID	Standing Water Level		Bore ID	Standing Water Level	
	(mAHD)	(mbgl)		(mAHD)	(mbgl)		(mAHD)	(mbgl)
B1	24.5	9.8	M13S	24.7	14.2	M5S	24.6	9
B2	24.8	9.75	M13D	24.8	14.5	M5D	24.6	9.1
B3	24.7	14.58	M18S	24.8	19.7	M8S	24.2	14.6
M1S	24.8	9.92	M22D	24.5	11.3	M8D	24.3	14.5
M1D	24.8	9.9	M24S	24.7	9.6	M9S	24.5	13.3
M2S	24.8	9.79	M24D	24.6	9.8	M9D	24.2	13.9
M2D	24.6	10.02	M25S	24.6	9.9	M12S	24.5	12.5
M4S	24.4	8.64	M25D	24.6	9.9	M12D	24.7	12.7
M4D	24.8	8.3						

Source: GEO-ENG (2024) – modified after Table 5

Mine Site Groundwater Quality

Table 8 of GEO-ENG (2024) presents an overview of average groundwater quality as derived from the Applicant's monitoring bore network within and immediately surrounding the Mine Site for the Upper Aquifer. In summary, groundwater within the monitoring bores is hypersaline, with GEO-ENG (2024) indicating the average TDS concentration of groundwater is 61,000mg/L in the Upper Aquifer. For comparison, sea water has a TDS concentration of 35,000mg/L. The upper limit for watering of sheep, provided there is high quality feed, is 13,000mg/L (ANZECC, 2000)

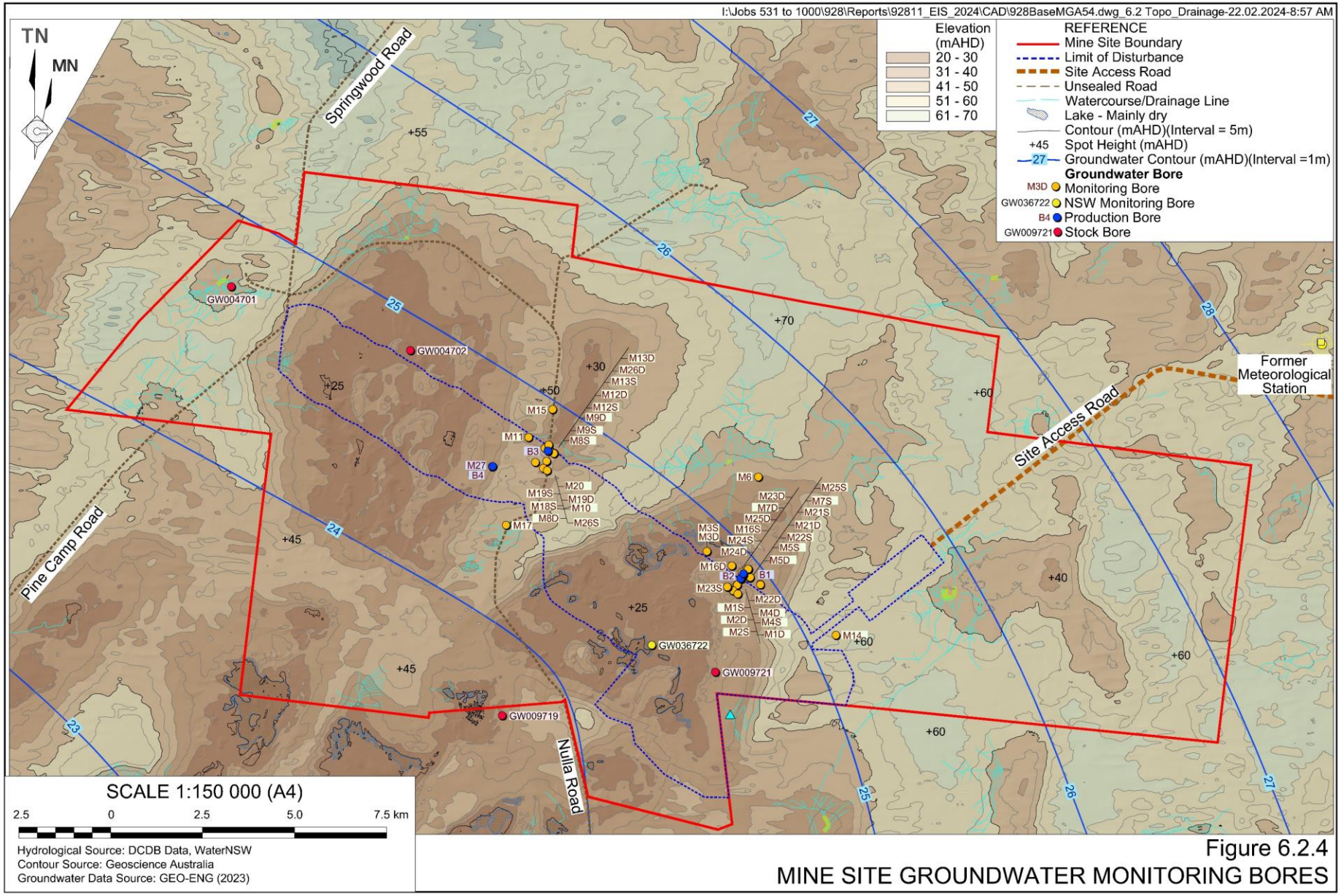


Figure 6.2.4
MINE SITE GROUNDWATER MONITORING BORES

Table 8 of GEO-ENG (2024) also indicates the Upper Aquifer water to have a neutral pH, with an average pH value of 7.1

Mine Site Hydraulic Properties – Pump Test Results

GEO-ENG (2024) re-assessed data collected during a pump testing program conducted in February 2020 using the production bores identified as B01, B02 and B03 on **Figure 6.2.4** and in **Table 6.2.3**. **Table 6.2.4** presents the combined results for a range of hydraulic parameters calculated by GEO-ENG (2024).

Table 6.2.4
Upper Aquifer Hydraulic Parameters

Parameter	Horizontal Hydraulic Conductivity (metres/day)	Specific Yield (%)	Wellbore Skin Factor
Minimum	15	10.4	22
Average	29	13.2	35
Maximum	42	20.3	49
Source: GEO-ENG (2024) After Table 7			

GEO-ENG (2024) considered these parameter values consistent with the expected range for fine to coarse sand aquifers and the results of similar studies within the Loxton-Parilla Sands.

6.2.3 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures to ensure that groundwater-related impacts associated with the Project are minimised to the greatest extent practicable. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual risk to groundwater presented in **Appendix 2**.

- Prepare and implement a *Groundwater Management Plan* that addresses the following matters.
  - A monitoring program within and surrounding the Mine Site, including suitable automated depth gauges on monitoring bores and flow meters on production bores and pumps, to record, amongst other matters, changes in the level of water within the Upper Aquifer and the volume of groundwater removed from the proposed production bores and the dredge pond.
  - A monitoring program that includes monitoring of groundwater and dredge pond water quality.
  - A monitoring program to ensure that there is not unintended surface seepage of groundwater from under the Off Path Storage Facility and a contingency plan to address any unanticipated seepage.
  - A program to estimate evaporation rates from the dredge pond using weather station data.
  - A program to verify the groundwater modelling predictions of GEO-ENG (2024) every three years.

  - Trigger Action Response Plans to address unanticipated groundwater impacts.
  - A program to report annually on the volume of water removed from the Upper Aquifer.
- Ensure prior to the removal of bore GW036722 that the bore casings accessing the middle and lower aquifers in are grouted and sealed in accordance with Section 18 of the document *Minimum Construction Requirements for Water Bores in Australia* (2020) or its latest version.
- Reestablish, if required by NSW DCCEEW, monitoring bore GW036722 as close as practicable to the current location or in an alternative location as instructed by NSW DCCEEW. The replacement bore would include separate screened intervals within each of the Upper, Middle and Lower aquifers.
- Attempt to relocate bore GW009721 (if it exists) prior to stripping the Year 1 Extraction Area and again during soil stripping and overburden removal operations. In the event that the bore exists and is replaced, ensure that its replacement is constructed in accordance with Section 18 of the document *Minimum Construction Requirements for Water Bores in Australia* (2020) or its latest version.
- Ensure that adequate water access licences and associated allocations are obtained for water used within the proposed mining operations, including:
  - a maximum of approximately 9.6GL/year that would be required in Year 1 of mining operations; and
  - an average of approximately 4.5GL/year that would be required across all years of construction and operations.
- Ensure that pumps and pipework are equipped as required with leak detection equipment and automatic shutdown mechanisms to prevent uncontrolled discharge of saline water to the natural land surface.
- Ensure that water transfer pipes are installed in-pit or, where that is not practicable, within bunded areas to ensure that any leakage that does occur is not permitted to flow to the natural land surface.
- Ensure that all chemicals and hydrocarbons are stored in accordance with the manufacturer's specifications or the relevant Australian Standard to prevent contamination of groundwater.

In addition to the above, the Applicant would implement the following contingency mitigation measures should the following triggers be exceeded.

- Groundwater drawdown or mounding or the volume of water taken from the Upper Aquifer is materially different to that modelled.
  - Review and revise the groundwater model based on updated monitoring data and calibration.
  - If required, obtain additional groundwater allocation to account for the additional take.

- Mounded groundwater under the Off Path Storage Facility results in actual or potential seepage of groundwater to the natural surface.
  - Install line(s) of shallow bores to remove groundwater and return it to the dredge pond and thereby prevent surface seepage until such time as the risk of surface seepage is removed.
  - Report and remediate any unplanned surface seepage should it occur.
- Unanticipated impacts to surrounding groundwater users or groundwater dependent ecosystems.
  - Provide immediate short-term makeup water or compensation to affected landholders.
  - Undertake further investigation(s) to determine if the observed impacts are Project-related.
  - Implement recommendations and remedial actions arising from the above investigation(s) in consultation with relevant landholders and agencies.

6.2.4 Assessment of Impacts

6.2.4.1 Introduction

GEO-ENG (2024) prepared a numerical model to determine the likely groundwater-related impacts associated with the Project. Section 11 of GEO-ENG (2024) provides a detailed description of the model's development whilst Section 12 describes the results of the assessment. The following subsections provide an overview of those sections. In addition, the groundwater assessment was the subject of a peer review by Mr James Williams of Hydro Consulting Services. Appendix P of GEO-ENG (2024) presents a copy of Mr Williams' review and Section 6.2.4.6 presents an overview of that document.

6.2.4.2 Conceptual Groundwater Model

The conceptual groundwater model is a descriptive representation of the groundwater system that forms the basis for the numerical groundwater flow model. Section 5, Figure 7 and Appendix A of GEO-ENG (2024) provides a conceptual groundwater model for the regional groundwater system. **Table 6.2.5** presents an overview of the key aspects of this model.

Table 6.2.5
Conceptual Hydrogeological Model

Page 1 of 2

Element	Regional Context	Localised Context
Groundwater Recharge	Low rates (0.1%) of direct rainfall recharge. Significant groundwater recharge from Darling River flooding and ephemeral stream bed loss in northern edges of basin.	Freshwater lenses over saline groundwater suggest localised instances of rainfall recharge. Enhanced recharge from: • Irrigation activities along the Murray River; and • Menindee Lakes seepage.
Groundwater Flow	Northeast to southwest for the Upper, Middle and Lower Aquifers, albeit with a very shallow gradient (1V:10,000H).	

Table 6.2.5 (Cont'd)
Conceptual Hydrogeological Model

Element	Regional Context	Localised Context
Groundwater Discharge	Saline groundwater seepage to Murray River. Limited evapotranspiration from water table due to sparse vegetation cover, high salinity, and significant depth to water table over much of the region. Pumping for: • salt interception schemes and industrial (mining) activities (saline groundwater); and • agriculture, environmental or human consumption (fresh groundwater).	Periodic discharge and evaporation of groundwater within salt pans where groundwater table intersect surface elevation.
Source: GEO-ENG (2024) – After Section 5, Figure 7 and Appendix A		

6.2.4.3 Numerical Model Design

GEO-ENG (2024) used FEFLOW (Version 8.0) to undertake the numerical modelling for the Project. Model parameters are described in detail in Section 11 of GEO-ENG (2024) and may be summarised as follows.

- Model extent – averages approximately 180km northwest to southeast and 320km northeast to southwest for an approximately 57,000km^2 model domain.
- Model grid – grid triangles ranging from 50m in the vicinity of the proposed dredge pond and other groundwater impacts (rivers and lakes) up to about 9km across in areas of uniform groundwater conditions. The maximum depth of the model is about 560 m/
- Model layers – The calibration model incorporated six layers to represent all aquifers and aquitards. Preliminary testing of the calibration model showed that there was no interaction between the Upper, Middle and Lower Aquifers at the mine site and thus a predictive model was developed using only the Upper Aquifer for the impact assessment.
- Model boundary conditions – constant head boundary conditions were applied at the northern, western and eastern model boundaries based on measured water levels at monitoring bore locations and interpolated between these points. The southern model boundary condition was based on interpolated average water levels between the locks of the Murray River.
- River and lake boundary conditions – seepage loss from the Darling River, Great Darling Anabranch, Menindee Lakes and Murray River lakes to the shallowest layer (Layer 1) was simulated using a fluid transfer boundary with a fixed head based on average water levels.

- Modelled hydraulic properties – Hydraulic properties were based on data from published records, previous groundwater assessments and models and pumping test information. **Table 6.2.6** presents the hydraulic conductivity values used in the numerical model.

Table 6.2.6
Numerical Model Layers and Applied Hydraulic Parameters

Layer	Model Zone	Stratigraphic Unit	Horizontal Hydraulic Conductivity (metres/day)
1	All	Quaternary Sediments (e.g. Blanchetown Clay, Yamba Formation, Woorinen Formation).	0.001 – 30
		Shepparton Formation	
		Loxton-Parilla Sands	
		Upper Renmark (Upper Olney) Formation	
2a	South and Central	Bookpurnong Beds	$1x10^{-8}$ – 0.01
		Geera Clay	
		Winnambool Formation	
2b	North	Middle Renmark (Middle Olney) Formation	$1x10^{-6}$ – 5
3a	South	Murray Group Limestone	0.01 – 5
3b	Central	Geera Clay	$1x10^{-8}$ – 0.05
3c	North	Middle Renmark (Middle Olney) Formation	$1x10^{-6}$ – 5
4a	South	Ettrick Clay	$1x10^{-8}$ – 0.05
4b	Central	Geera Clay	$1x10^{-8}$ – 0.05
		Winnambool Formation	
4c	North	Middle Renmark (Middle Olney) Formation	0.01 – 5
5	All	Lower Renmark (Lower Olney) Formation	0.01 – 30
6	All	Warina Sand	0.01 – 150
Source: GEO -ENG (2023) After Table 11			

- Modelled mining operations – the numerical model applied a fluid transfer boundary with varying water levels to simulate the moving mine path and interburden and reject return to the dredge pond based on the mining sequence presented in **Figure 3.4.3**. The Off Path Storage disposal of sand was simulated using an input flux based on planned pumping rates..
- Modelled bore pumping – The predictive models simulated groundwater extraction from two production bores screened in the Upper Aquifer. The nominal locations of these bores are shown on **Figures 6.2.5** to **6.2.7**. The bores were modelled initially with an extraction rate of 90L/s to allow for water level management in the dredge pond. After the initial years, the modelled production rate was 26.4L/s or 832ML/y to allow for processing, mining and reverse osmosis plant operation.
- Model exclusions – the model indicates that groundwater pumping at salt-water interception schemes or other mining areas and borefields would not significantly affect the Upper Aquifer at the Mine Site or be significantly affected by the Project. Therefore, these groundwater effects are not included in the model.

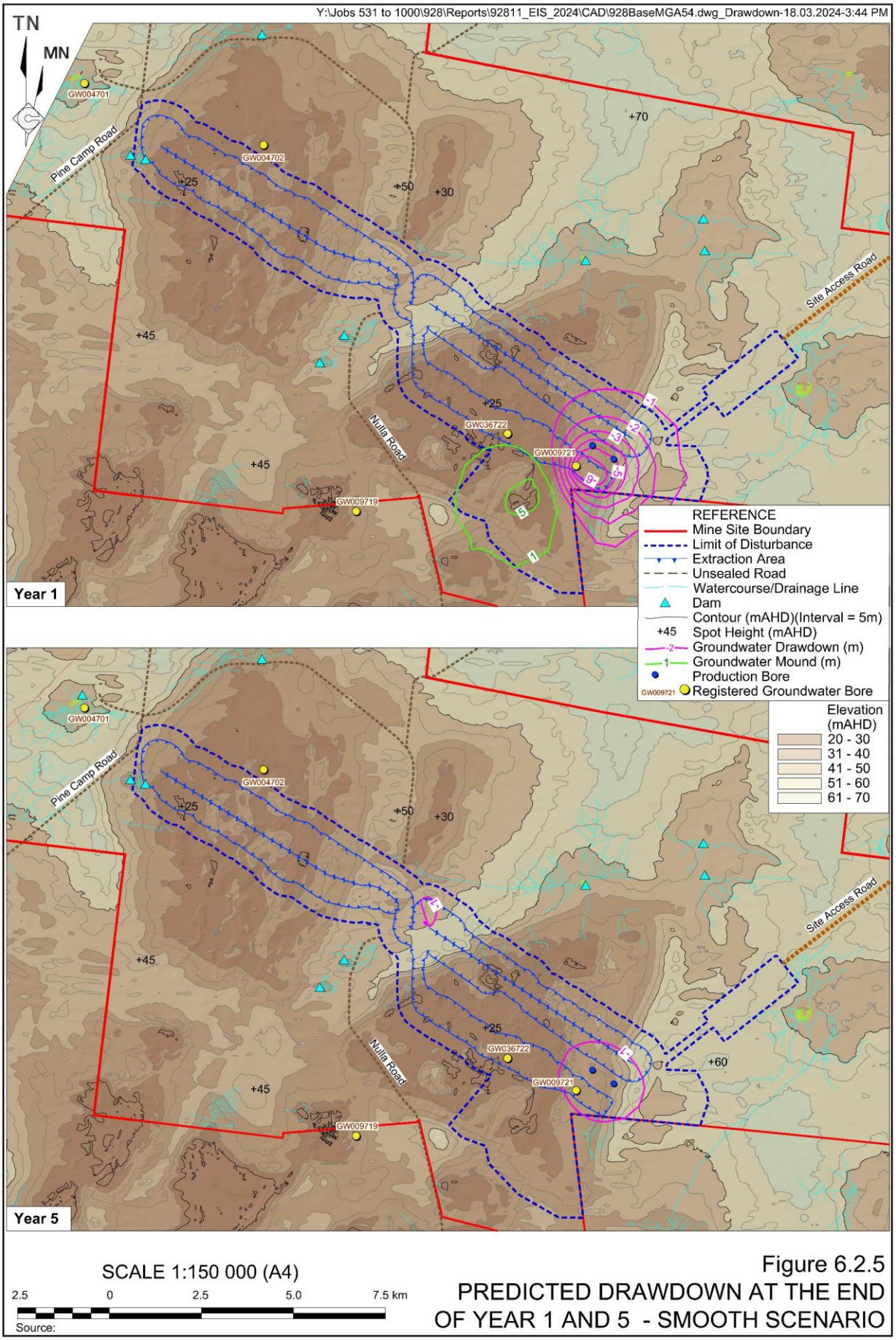


Figure 6.2.5
PREDICTED DRAWDOWN AT THE END OF YEAR 1 AND 5 - SMOOTH SCENARIO

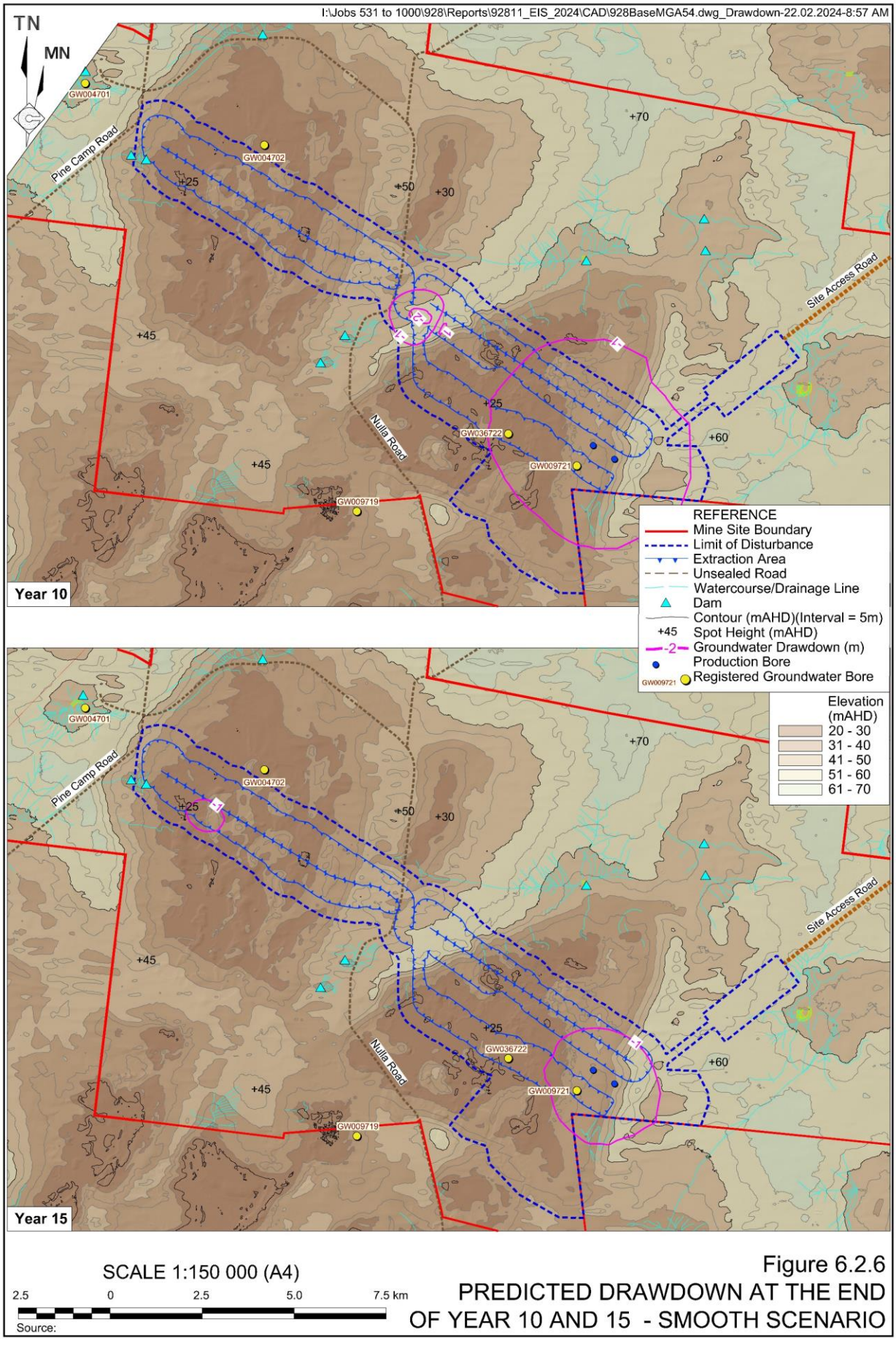


Figure 6.2.6
PREDICTED DRAWDOWN AT THE END OF YEAR 10 AND 15 - SMOOTH SCENARIO

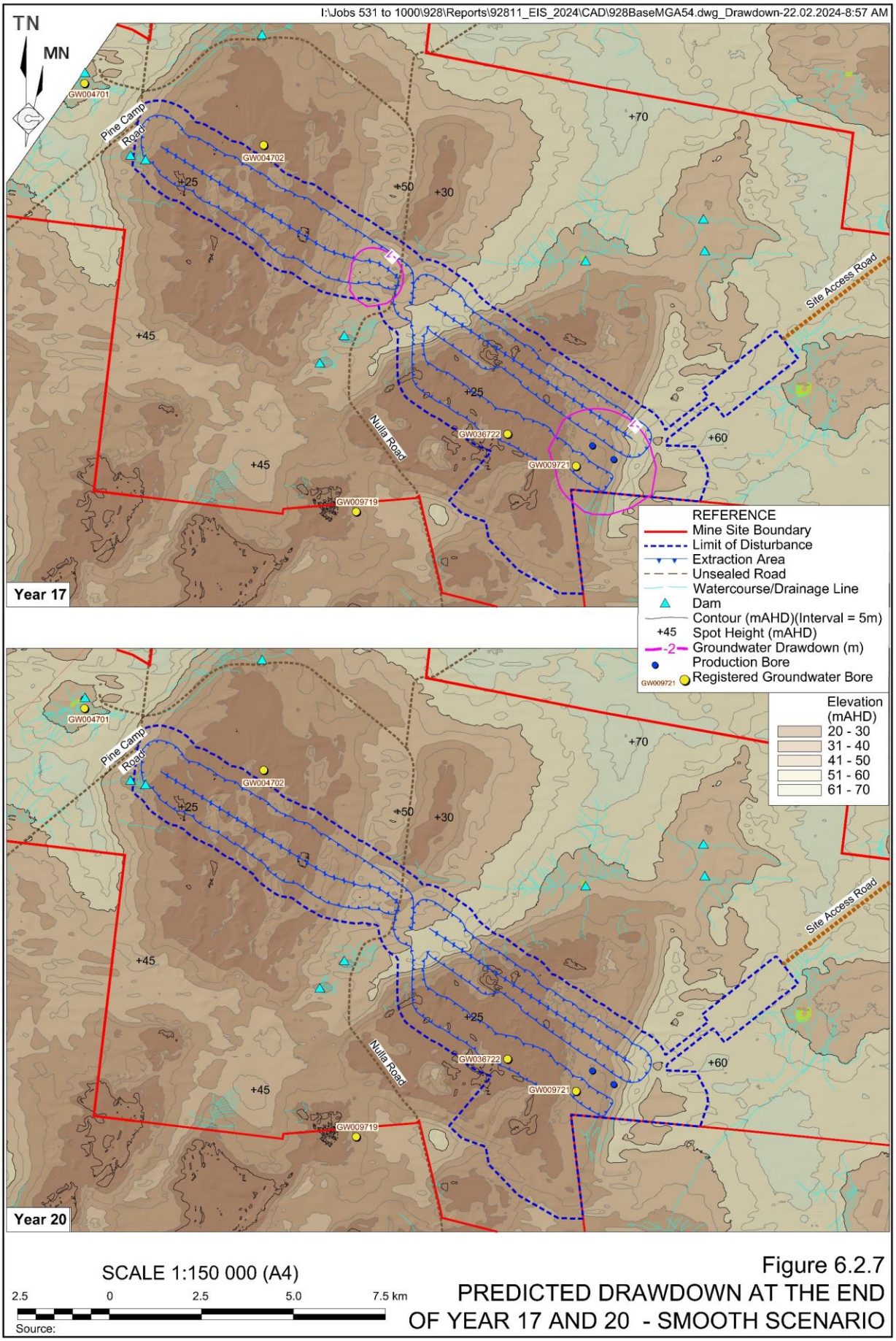


Figure 6.2.7
PREDICTED DRAWDOWN AT THE END OF YEAR 17 AND 20 - SMOOTH SCENARIO

- Smooth and sharp modelling scenarios – Two potential hydraulic conductivity scenarios were assessed as follows.
  - Smooth Scenario – where hydraulic conductivity was to vary smoothly between pilot points.
  - Sharp scenario – where the hydraulic conductivity was fixed to a nominated value for the strandline areas to better emulate the potentially sharp hydraulic conductivity contrast between the strandlines and the surrounding sand, which has been observed at other nearby mineral sand mine sites.

6.2.4.4 Model Calibration

GEO-ENG (2024) conducted an automated steady-state calibration of the numerical model using pilot points, PEST and recorded groundwater levels from 229 bores within the model domain. GEO-ENG (2024) identifies that two separate calibration scenarios were undertaken; one that allowed a smooth variation in hydraulic conductivity between pilot points (smooth scenario) and the other using fixed hydraulic conductivities for strandline (orebody) areas that contrast with the surrounding sand (sharp scenario).

The calibration statistics presented in Table 14 of GEO-ENG (2024) identify both model scenarios returning a good fit to measured data, each with a scaled root mean square error of less than 1.7%. As this performance measure is well below the recommended upper limited suggested by the Australian Groundwater Modelling Guidelines, both scenarios provided an acceptable calibration.

6.2.4.5 Predicted Impacts

Groundwater Inflows

Table 6.2.7 presents the anticipated annual volumes of water that would be extracted from the production bores to permit construction and processing operations, as well as the volumes of initial groundwater inflow to and subsequent evaporation from, the dredge pond.

Table 6.2.7
Predicted Project-related Groundwater Take

Year	Dredge Pond (ML/year)	Production Bores (ML/year)	Total (ML/year)	Year	Dredge Pond (ML/year)	Production Bores (ML/year)	Total (ML/year)
-2	635	1,742	2,376	9	3,987	832	4,817
-1	3,027	2,877	5,904	10	4,475	832	5,307
1	7,437	2,165	9,602	11	3,949	832	4,781
2	6,766	832	7,598	12	2,625	832	3,457
3	4,209	832	5,042	13	3,039	832	3,871
4	3,119	832	3,951	14	2,819	832	3,651
5	3,970	832	4,803	15	2,494	832	3,326
6	3,311	832	4,143	16	3,319	832	4,151
7	4,158	832	4,990	17	1,505	392	1,898
8	4,365	832	5,467	18	212	60	272

Note 1: Year 18 corresponds to the first year of post-mining rehabilitation prior to and during backfilling of the final void.

Source: GEO-ENG (2024) – After Table 17

Initial rates of groundwater extraction from production bores during construction and Year 1 are expected to be up to approximately 2,877ML/year. Once the dredge pond has been established, the extraction rate from the production bores would be reduced to approximately 832ML/year until Year 17 when extraction rates would decrease to 392ML/year then 60ML/year in Year 18 (first year post mining). GEO-ENG (2024) notes that during mining operations a significant proportion of groundwater extracted via the production bores would be subsequently returned to the dredge pond.

Groundwater inflow to the dredge pond is expected to increase to approximately 7,437ML/year in Year 2 as the pond water level is managed to facilitate dredging advance and disposal of interburden and sand rejects to the Off Path Storage Facility. Following this period, inflows to the dredge pond would reduce to between approximately 2,494ML/y and 4,635ML/year. During Years 17 and 18, inflows would be reduced to 1,505ML/year and 212ML/year, respectively. The dredge pond is progressively backfilled to a height that would be above the existing groundwater table, with inflows reducing dramatically as the final void is backfilled post-mining.

Groundwater Drawdown

Extraction of groundwater from production bores and dredge pond losses would result in drawdown of the standing water level within and adjacent to the Mine Site. GEO-ENG (2024) has modelled Project-related groundwater drawdown, with **Figures 6.2.5** to **6.2.7** presenting snapshots of the "smooth" scenario at the end of Years 1, 5, 10, 15, 17 and 20.

During Year 1 groundwater levels within the Upper Aquifer are drawn down in the vicinity of the starter pit, to manage the required dredge pond level and water requirements for disposal of interburden and sand rejects to the Off Path Storage Facility. A groundwater mound is also evident under the Off Path Storage Facility as a result of the placement of wet interburden and sand reject into the facility, with seepage of water from the unlined Facility raising the water table. By contrast, there is no mounding of the water table under the Water Storage Dam because the Dam is underlain by the Blanchetown Clay with its substantially lower hydraulic conductivity.

By Year 5, the mounding of the water table under the Off Path Storage Facility has dissipated and the amplitude of the dredge pond-related drawdown of the water table has reduced to between 1m and 2m because the pond is no longer being pumped to manage water levels and wet interburden and Wet Concentration Plant reject is returned directly to the trailing edge of the dredge pond. The production bores are expected to result in a drawdown of the water table of between 1m and 2m within approximately 1km of the bores.

A similar pattern is observed during Year 10, 15 and 17. During Year 10, the extent of drawdown associated with the production bores is expected to increase to approximately 2km from the bores as a result of mining operations passing close to the bores during Years 7, 8 and 9.

GEO-ENG (2024) estimates that by Year 20, or 3 years post mining, that the groundwater table will have recovered to near pre-mining levels for the smooth scenario.

Surrounding Groundwater Bores

Bores GW036722 would be located with the proposed dredge pond and would be removed in Year 3 (**Figure 6.2.5**). The bore is a monitoring bore operated by NSW DCCEEW. As stated in Section 6.2.3, the Applicant would implement the following to ensure that the Department's monitoring capacity is not downgraded by the loss of the bore.

- Grout and seal the bore casings accessing the middle and lower aquifers in accordance with Section 18 of the document *Minimum Construction Requirements For Water Bores In Australia* or its latest version.
- Reestablish, if required by NSW DCCEEW, a monitoring bore including separate screened intervals within each of the Upper, Middle and Lower aquifer, in a location to be determined by NSW DCCEEW.

Bore GW009721 would also be located with the proposed dredge pond and would be removed in Year 1 (**Figure 6.2.5**). GEO-ENG (2024) states that the bore could not be found. **Table 6.2.2** identifies that the recorded depth of the bore is 324.3m. It is uncertain whether the bore is screened and, if so, whether it is screened in the Middle or Lower Aquifer. The Applicant would attempt to identify the bore during construction operations and again during soil stripping and overburden removal. In the event that the bore is located, it would, if possible, be decommissioned in accordance with Section 18 of the document *Minimum Construction Requirements For Water Bores In Australia* or its latest version

Bores GW004702, GW004701 and GW009719 would be located adjacent to or within 3.2km or the Extraction Area (**Figure 6.2.5**). GEO-ENG (2024) states that none of these bores could be found. **Table 6.2.2** identifies that the recorded depths of GW004702 and GW009719 are 196m and 381.3m respectively. The depth of GW004701 is not recorded. Each of these bores, if they still exist are presumed to be screeded in the Lower or Middle Aquifers. As a result, drawdown within the hydraulically disconnected Upper Aquifer is not expected to adversely impact any of the bores.

In light of the above, GEO-ENG (2024) identifies that, as no groundwater bores accessing the groundwater resources of the Upper Aquifer are identified within 15km of the Mine Site, the Project would not result in adverse impacts on surrounding groundwater users.

Surrounding Groundwater Dependent Ecosystems

As noted in Section 6.2.2.3, four potentially groundwater dependent PCTs exist within the Mine Site, three of which are coincident with HAVAE mapping referenced by the NSW MDB Porous WSP. Each PCT was mapped by EnviroKey (2024) as either being in low or moderate-good condition.

There are two potential classes of impacts to potentially groundwater dependent PCTs as follows.

- Direct impacts – namely where the potentially groundwater dependent PCTs would be physically removed during mining operations. These impacts are accounted for under the biodiversity assessment (see Section 6.3) and residual impacts would be offset under the proposed biodiversity offset strategy (see Section 6.3.8.3).

- Indirect impacts – namely where the PCTs would not be disturbed by the Project but may be indirectly impacted due to reduced groundwater levels within the Upper Aquifer. Indirect impacts on potentially groundwater dependent PCTs are not considered to be likely for the following reasons.
  - The extent of drawdown within the Upper Aquifer is largely restricted to the Limit of Disturbance (see **Figures 6.2.5** to **6.2.7**). As a result, these is limited potential for indirect impacts to GDE's that would not already be directly impacted.
  - It is unlikely that the potentially groundwater dependent PCTs utilise water within the Upper Aquifer as the salinity level of that water exceeds salt-tolerance thresholds for all species with the exception of Samphire.
  - It is unlikely that Samphire would substantially rely on groundwater within the Upper Aquifer as water within that aquifer is at the upper limit of salt tolerance for the species.
  - As a result, any dependence on groundwater would be limited to rainfall recharge within the unsaturated zone that is unlikely to be affected by drawdown within the Upper Aquifer.
  - The Applicant would monitor potentially groundwater dependent PCTs within the anticipated zone of drawdown and would undertake rehabilitation of those PCT's in the unlikely event that adverse impacts were observed.

6.2.4.6 Peer Review Conclusions

The Peer Review for the groundwater assessment was undertaken by Mr James Williams of Hydro Consulting Services (HCS, 2024) and is presented as Appendix P of GEO-ENG (2024). GEO-ENG provided the conceptual groundwater model and the *Groundwater Impact Assessment* to Mr Williams at key points throughout their assessment to ensure review components were addressed. The results of the peer review may be summarised as follows.

- Overall, the groundwater assessment is comprehensive, and generally consistent with the requirements outlined in Table 9 of the *Minimum Groundwater Modelling Requirements for SSD / SSI Projects*. HCS (2024), recommended a number minor additions or amendments to GEO-ENG (2024) which were completed as recommended.
- The numerical groundwater model for both the smooth and sharp scenarios are well calibrated, with root mean square and scaled root mean square errors indicating an accurate fit to available data.
- The overall confidence level of the numerical groundwater model is Class 1 to Class 2 and the model is "fit for purpose" as:
  - there would be minimal predicted groundwater impacts beyond the Mine Site;
  - groundwater quality of the Upper Aquifer is hypersaline and of low value; and
  - there would be no significant impacts to environmental receptors or beneficial users.

Mr Williams concluded that the numerical groundwater model developed by GEO-ENG for the Project was consistent with the NSW *Aquifer Interference Policy* and the *Australian Groundwater Modelling Guidelines*.

6.2.4.7 Groundwater Quality

Section 12.8 of GEO-ENG (2024) states that the Project is not expected to significantly alter the groundwater quality of the hypersaline Upper Aquifer.

6.2.4.8 Aquifer Interference Policy Considerations

The *Aquifer Interference Policy* describes a series of acceptable thresholds for water level and quality changes that are known as "minimal impact considerations". The minimal impact considerations depend upon whether the water source is classed as "highly productive" or "less productive." As the groundwater within the Upper Aquifer has a TDS concentration of more than 1,500mg/L, the aquifer is defined as a "less productive" groundwater system.

Appendix O and Table 18 of GEO-ENG (2024) assesses the Project against the criteria identified by the *Aquifer Interference Policy*. **Table 6.2.8** presents an overview of that assessment. In summary, there are two levels of minimal impact considerations specified in the *Aquifer Interference Policy*. If the predicted impacts of the Project are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. Table 18 of GEO-ENG (2024) identifies the Project would, with the exception of the water table threshold for high priority groundwater dependent ecosystems, not exceed any Level 1 impact assessment thresholds.

Table 6.2.8
Aquifer Interference Policy Considerations

Page 1 of 2

Summary of *Aquifer Interference Policy* Requirements	How/where addressed in this document?
Predict the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity.	Section 6.2.4.5
Made these predictions in accordance with Section 3.2.3 of the AIP.	Section 6.2.4.4 and 6.2.4.6
Determined if there are sufficient water entitlements and water allocations that are able to be obtained for the activity?	Section 6.2.5
Considered the effect that activation of existing entitlement may have on future available water determinations?	The volume of water estimated to be taken by the Project, is considered an insignificant component of the available allocation under the *Western Murray Porous Rock Water Source* of 163.3GL/year.
Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the Project, and how these requirements will be accounted for?	Sections 6.2.3 and 6.2.6
Potential water level, quality or pressure drawdown impacts on nearby basic landholder rights water users or other users or groundwater dependent ecosystems.	Section 6.2.4.5

Table 6.2.8 (Cont'd)
Aquifer Interference Policy Considerations

Summary of *Aquifer Interference Policy* Requirements	How/where addressed in this document?
Potential for increased saline or contaminated water inflows to groundwater systems and highly connected river systems?	Section 6.2.4.7
Potential to cause or enhance hydraulic connection between groundwater systems?	Section 6.2.3 and 6.2.4.5
Source: GEO-ENG (2024) – modified after Appendix O	

The water table threshold for a Level 2 impact for high priority groundwater dependent ecosystems is "more than 10% variation in the water table." In this case GEO-ENG (2024) notes that the threshold would be a 5cm variation in the water table. However, for the reasons noted above, in particular, the toxicity of the groundwater within the Upper Aquifer to vegetation, impacts to groundwater dependent ecosystems would be minimal and that where directly impacted, potentially groundwater dependent PCTs would be re-established during rehabilitation. Furthermore, the Applicant has committed to monitor potentially groundwater dependent PCTs within the anticipated area of groundwater drawdown and would undertake rehabilitation operations in the very unlikely event that indirect impacts are observed. The Applicant contends that the proposed mitigation measures would not impact upon the long-term viability of the groundwater dependent ecosystems.

6.2.5 Licencing

The groundwater resources of the Upper Aquifer within the Mine Site are part of the Western Murray Porous Rock Groundwater Source of the NSW MDB Porous WSP. The long-term annual extraction limit for this Source identified in Clause 25(4) of the WSP is 226 GL/yr. GEO-ENG (2024) identifies that as of February 2023, there were 23.6 GL/year of allocation for Water Access Licences (WALs), primarily held by Tronox Mining Australia Ltd.

As identified in Section 6.2.4.5, the Project would require up to 9.6 GL of allocation in Year 1 of the mining operations, with much of that water returned to the dredge pond or the Upper Aquifer. GEO-ENG (2024) state that the Western Murray Porous Rock Water Source has an indicated available allocation of 163.3 GL/yr.

The Applicant has sought to obtain WALs and adequate allocation to account for the maximum direct and indirect take of groundwater from the Upper Aquifer, with discussions with DCCEEW ongoing at the time of finalisation of this document.

6.2.6 Monitoring

The proposed *Groundwater Management Plan* to be prepared prior to the commencement of mining operations would fully describe groundwater monitoring to be undertaken for the Project. In summary, the following monitoring would be undertaken.

- Groundwater levels – a network of groundwater monitoring bores would be established adjacent to the Extraction Area within the predicted drawdown area. Existing monitoring bores would also be incorporated into a long-term monitoring

bore network where practicable. Additional bores would be installed where required. The monitoring bores would be equipped with data loggers to record the standing water level within and surrounding the Mine Site. The number and location of proposed bores would be determined during preparation of the *Groundwater Management Plan.*

- Groundwater quality – the Applicant would undertake both field and laboratory monitoring of groundwater quality, as well as the quality of water extracted from the production bores and water within the dredge pond. The *Groundwater Management Plan* would describe the frequency of monitoring and the analyte suite to be analysed, however, the Applicant anticipates that field parameters and major ions would be assessed regularly.
- Groundwater quantity – water meters or other mechanisms for recording production bore extraction, water transfers within the Mine Site and evaporation would be installed at key locations. The monitoring network would be designed to enable the Applicant to record and report the volumes of water removed from the Upper Aquifer, including the volumes taken for mining-related purposes and then returned to the dredge pond with the interburden and Wet Concentration Plant reject.
- Groundwater Dependent Ecosystems – monitor groundwater dependent ecosystems in the vicinity of the dredge pond. In the very unlikely event that any adverse impacts are observed, undertake rehabilitation operations to re-establish pre-existing vegetation communities once the groundwater levels have been restored.

The Applicant would present the results of groundwater monitoring in the *Annual Review* required for the Project, as well as on its website.

6.2.7 Conclusion

The existing groundwater setting is well understood with the assessment of the Project utilising a calibrated numerical groundwater model that has been peer reviewed and deemed "fit for purpose".

Based on numerical modelling predictions, the key outcomes of the assessment of changes to the groundwater system arising from the Project include the following.

- The mining impact on the groundwater table would be limited to a few kilometres from the Mine Site.
- Over the Project-life, the average annual groundwater take is predicted to be approximately 4.5GL/year, with a maximum of 9.6GL/year in Year 1 of mining operations.
- The Applicant would seek allocations to account for the maximum direct groundwater take from production bores, plus the indirect take from evaporation.
- There would be no ongoing groundwater take following the cessation of Project-related activities.

- There would be no reduced access to groundwater for surrounding groundwater users.
- The Project would result in the removal of a NSW DCCEEW monitoring bore, namely GW036722. The Applicant would replace the bore in consultation with NSW DCCEEW.
- There would be direct impact to small areas of high priority groundwater dependent ecosystem vegetation, however, this would be accounted for and addressed through the biodiversity assessment and offsetting process. Indirect impacts to GDE's would be unlikely.
- As the Upper Aquifer at the Mine Site is hypersaline, no potential impacts to groundwater quality are anticipated.

Based on the outcomes of the numerical groundwater modelling and assessment by GEO-ENG (2024), it is considered that potential impacts to the groundwater setting are minimal and the Project is permissible under the *Aquifer Interference Policy*.

6.3 Biodiversity

6.3.1 Introduction

The SEARS identify "biodiversity" as a key issue for assessment in the EIS. Matters to be addressed include:

- "An assessment of the biodiversity values and the likely biodiversity impacts of the development in accordance with the Biodiversity Assessment Method (BAM), and documented in a Biodiversity Development Assessment Report (BDAR);
- Document the application of the avoid, minimise, offset and reporting framework including assessing all direct, indirect and prescribed impacts of the development over time in accordance with the BAM;
- a strategy to offset any residual impacts of the development in accordance with the offset rules under the *Biodiversity Offsets Scheme,* including details of any potential biodiversity stewardship sites for retiring biodiversity credits."

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from DPE – Biodiversity and Conservation Division, and Mining, Exploration and Geoscience. These requirements, where additional to those above, are as follows.

- "Identify the Plant Community Types (PCTs) found in the Project Area.
- The extent of [Threatened Ecological Communities] communities and disturbance that could potentially occur need to be clearly defined, in particular:
  - PCT 65 *Tecticornia lylei*, Wiry Glasswort, low open-shrubland in the Murray Darling Depression Bioregion
  - PCT 154 Pearl Bluebush low open shrubland of the arid and semi-arid plains
  - PCT 28 White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone.
- The EIS should confirm the vegetation communities that occur onsite and fully describe the impacts of the Project on threatened fauna, flora and ecological communities – including *Austrostipa nullanulla.*
- The EIS should identify any relevant Matters of National Environmental Significance
- Illustrate the location (including offsite locations) of any biodiversity offsets being considered for the Project and their spatial relationship to known and potential mineral and construction material resources and existing mining and exploration titles."

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

EnviroKey Pty Ltd (EnviroKey) prepared the *Biodiversity Development Assessment Report* (BDAR) for the Project. The BDAR, hereafter referred to as EnviroKey (2024), is presented as **Appendix 6**. This subsection provides a summary of the BDAR and describes the management and management measures to be implemented by the Applicant.

For the sake of clarity, the following terminology has been used in this subsection (**Figure 6.3.1**).

- BDAR Footprint – comprising two components as follows.
  - Mine Site BDAR Footprint – corresponding to the Limit of Disturbance plus a 50m buffer.
  - The Linear Corridor BDAR Footprint – corresponding to a corridor including the Site Access Road, 66kV transmission line and the realigned Anabranch Mail Road.
- Biodiversity Assessment Area – corresponds to the 'Assessment Area' identified in EnviroKey (2024), consisting of the BDAR Footprint plus
  - a 1,500m buffer around the Mine Site BDAR Footprint; and
  - a 500m buffer around the Linear Corridor BDAR Footprint.

Finally, it is noted that the following areas have been excluded from the BDAR for the following reasons.

- Rail Facility – The Rail Facility comprises an existing hardstand area and no additional areas of disturbance are proposed.
- Intersection upgrades within Broken Hill LGA – The proposed disturbance associated with each of the intersections would be undertaken within areas of prior disturbance, devoid of native vegetation.

6.3.2 Regional Setting and Mapping

The Biodiversity Assessment Area is located entirely within the Murray Darling Depression Interim Biogeographical Region of Australia (IBRA) and South Olary Plain IBRA subregion.

The following three NSW (Mitchell) Landscapes occur within the Biodiversity Assessment Area (**Figure 6.3.1**).

- Scotia Groundwater Basins – small sub-circular to irregular relict saline lakes and lunettes of Quaternary age with extensive associated sandplains and isolated dunes.
- Scotia Linear Dunes – parallel east-west trending Quaternary aged dunes and sandplains of deep loamy sand, with extensive undulating swales and isolated swales.
- Scotia Sandplains – slightly undulating Quaternary aged sandplains with areas of east-west trending sand dunes, broad swales and small depressions.

NSW Hydro Line mapping show a series of dendritic minor unnamed drainage lines within the Mine Site BDAR Footprint (**Figure 6.1.2**). EnviroKey (2024) determined these are ephemeral only and no permanent rivers or streams are present. No major watercourses are present within the Mine Site BDAR Footprint and no Protected Riparian Land occurs within that area (EnviroKey, 2024).

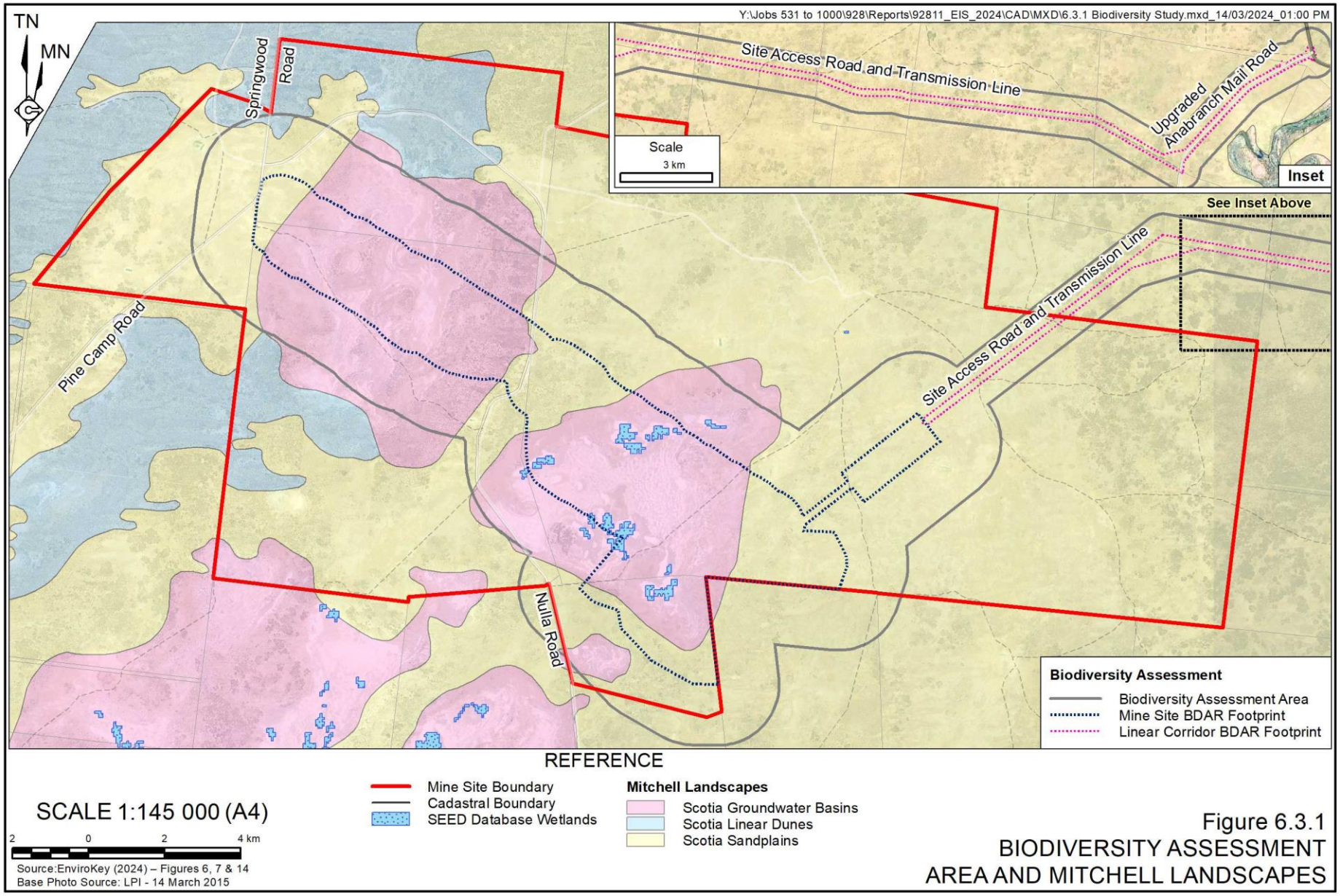


Figure 6.3.1
BIODIVERSITY ASSESSMENT AREA AND MITCHELL LANDSCAPES

NSW Government mapping (SEED Portal) indicates that wetlands are situated within the Biodiversity Assessment Area (**Figure 6.3.1**). These wetlands consist of evaporative salt pans which are generally unvegetated and contain water only immediately following rainfall events. No important local wetlands, national wetlands listed in the *Directory of Important Wetlands of Australia*, or wetlands designated under the Ramsar Convention as sites of international importance are located within the Biodiversity Assessment Area.

One issue of geological significance for biodiversity are gypsum soils associated with lunette rises on the eastern boundary of the Eastern and Western Salt Pans, as well as elsewhere within the Biodiversity Assessment Area. These soils are preferentially favoured by gypsum obligate species such as *Austrostipa nullanulla* and were found to correspond with the occurrence of Plant Community Type (PCT) 253 (see Section 6.3.4.2) (EnviroKey, 2024).

No areas of outstanding biodiversity value identified under the *Biodiversity Conservation Act 2016* (BC Act) are present within the Biodiversity Assessment Area (EnviroKey, 2024).

The landscape within and surrounding the Biodiversity Assessment Area has a high level of habitat connectivity due to native vegetation cover which is virtually continuous (EnviroKey, 2024).

6.3.3 Assessment Methodology

6.3.3.1 Introduction

EnviroKey (2024) undertook an extensive desktop assessment to identify known significant biodiversity values within and in the vicinity of the Biodiversity Assessment Area. This data was then used in part to select and design specific field survey methodologies in accordance with the *Biodiversity Assessment Method 2020* (BAM 2020). The following subsections present an overview of the desktop assessment and field survey component of the biodiversity assessment.

6.3.3.2 Desktop Assessment

EnviroKey (2024) undertook the following database searches for listed flora and fauna species, populations and communities within and surrounding the Biodiversity Assessment Area.

- BAM-Calculator (BAM-C) Tool.
- Sharing and Enabling Environmental Data (SEED).
- NSW State Vegetation Type Map.
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool.
- NSW DPE VIS Classification Web 2.1

EnviroKey (2024) also reviewed the most recent vegetation datasets for the locality including the State Vegetation Type Map: Western Region v1.0 (VIS ID4492) and the State Vegetation Type Map (which supersedes the Western Region map). Vegetation mapping was considered when reviewing and validating vegetation communities present within the Biodiversity Assessment Area.

Ecosystem Credit and Species Credit Species

Ecosystem Credit Species are defined by BAM 2020 as species for which the likelihood of occurrence or the presence of potential habitat can be predicted based on vegetation proxies and landscape features, or species for which targeted surveys have a low probability of detection.

Species Credit Species are defined by BAM 2020 as species for which the likelihood of occurrence or the presence of potential habitat cannot be predicted based on vegetation proxies or landscape features and which can be reliably detected by targeted surveys.

To identify a preliminary list of Ecosystem Credit Species and Species Credit Species which potentially occur within the Biodiversity Assessment Area, details of PCTs identified within the Biodiversity Assessment Area (e.g. patch size, native vegetation cover) are entered into the BAM-C.

Threatened flora and fauna species identified as candidate species in the BAM-C and those considered likely to occur and be potentially impacted by the Project were assessed by EnviroKey (2024) and either adopted or discarded as a candidate species (see Section 6.3.4). A habitat constraints assessment was undertaken by EnviroKey (2024) to determine the likelihood of occurrence for each candidate species.

Habitat Constraints Assessment

Prior to the commencement of field surveys, EnviroKey (2024) completed a likelihood of occurrence analysis for threatened flora and fauna species based on the following information.

- Presence, extent and condition of potential habitat.
- PCT associations in the Vegetation Information System (VIS).
- Known species occurrence within the Biodiversity Assessment Area and wider locality.
- Knowledge and experience of the Principal Ecologist.

6.3.3.3 Field Assessment

Flora and Fauna Surveys

Comprehensive field surveys were undertaken to assess biodiversity values within the Biodiversity Assessment Area on the following dates.

- 3 to 9 December 2014 (7 days)
- 2 to 4 November 2015 (3 days)
- 19 to 25 January 2018 (7 days)
- 11 to 15 May 2018 (5 days)
- 21 to 26 May 2018 (6 days)
- 17 to 23 February 2020 (7 days)
- 13 to 19 February 2021 (7 days)
- 26 October 2021 (1 day)
- 28 March to 3 April 2022 (6 days)
- 12 to 14 August 2022 (2 days)[2]

[2] Field survey from 12 to 14 August 2022 was undertaken by Greenloaning Biostudies Pty Ltd. All other biodiversity field surveys were undertaken by Envirokey Pty Ltd.

- 9 to 15 September 2018 (7 days)
- 4 to 8 December 2018 (5 days)
- 21 to 26 January 2020 (6 days)
- 25 to 29 September 2023 (5 days)
- 26 to 31 October 2023 (6 days)
- 1 to 2 February 2023 (2 days)

Flora field survey methods included a combination of VI Plots established in each identified PCT accordance with BAM 2020, threatened flora transects, and targeted searches.

Table 6.3.1 presents a summary of the fauna survey methods and survey effort employed by EnviroKey (2024) within the Biodiversity Assessment Area.

Table 6.3.1
Fauna Survey Methods

Fauna Survey Method	Details and Survey Effort
Diurnal bird surveys and call playback	• Active searches for birds during 20-minute bird survey periods. • Opportunistic bird surveys were also undertaken when traversing the Biodiversity Survey Area at other times. • Diurnal bird survey effort: 243 locations, total of 4,860 minutes (81 hours). • Call playback undertaken at the conclusion of each 20-minute bird survey period to elicit responses from predicted candidate species. • Call playback survey effort: 243 locations, total of 729 minutes (12.15 hours).
Elliot trap line	• Baited 'A' size Elliot traps were spaced approximately 5m apart in transects of 20 traps, left in situ for four nights, and checked each morning and afternoon. • Total survey effort: 11 locations, total of 880 trap nights.
Funnel trap line	• Six funnel traps were established along a 20m drift fence for a maximum of four nights to target frogs, reptiles and small mammals. • Survey effort: 10 locations, total of 120 trap nights.
Camera trap surveys	• Motion-activated infrared cameras were pointed at bait stations or water points. • Survey effort: 20 locations, total of 87 camera trap nights.
Reptile hand searches	• Sites searched systematically be an experienced herpetologist for a period of 30 minutes. • Fallen timber, spinifex grass, loose bark, tree and ground hollows, and loose soil and rocks searched by raking and lifting. • Survey effort: 74 locations, total of 2,220 minutes (37 hours).
Nocturnal Surveys	• Call playback of target species (Bush Stone Curlew) intermittently for 5 minute periods followed by 5 minute listening periods. • Spotlighting for minimum of 60 minutes following call playback searches. • Vehicular spotlighting while travelling across the Biodiversity Survey Area at night. • Echolocation call recording during 60 minute spotlight search periods. • Mobile echolocation call recording while travelling across the Biodiversity Assessment Area at night. • Stationary echolocation call recording unit set up at a water point. • Survey effort: 160 person minutes across eight sites, total of 800 minutes (13.3 hours).

Table 6.3.1 (Cont'd)
Fauna Survey Methods

Fauna Survey Method	Details and Survey Effort
Scat and Sign Search	• 10-minute searches at the conclusion of each diurnal bird survey. • Opportunistic inspection of scat and tracks during other surveys. • Survey effort: 243 searches, total of 2,430 minutes (40.5 hours) hours).
Song Meters	• Song meter acoustic recorded activated during sunrise and sunset periods. • Survey effort: 42 hours.
EnviroKey (2024) – after Section 2.4.3.	

The locations of all field surveys undertaken for the BDAR are shown on **Figure 6.3.2** and **6.3.3**.

Native Vegetation, Threatened Ecological Communities and Vegetation Integrity Assessment

Field surveys undertaken by EnviroKey (2024) between 2014 and 2024 were planned and undertaken based on reviews of available vegetation mapping, analysis of available aerial imagery, and the results of previous field surveys.

Vegetation Integrity (VI) Plots were implemented in surveyed areas from 2015 and used to assess vegetation in each of the identified PCTs. In accordance with the BAM, only those VI Plots surveyed within the most recent 5-year period were used by EnviroKey for the purposes of the BDAR.

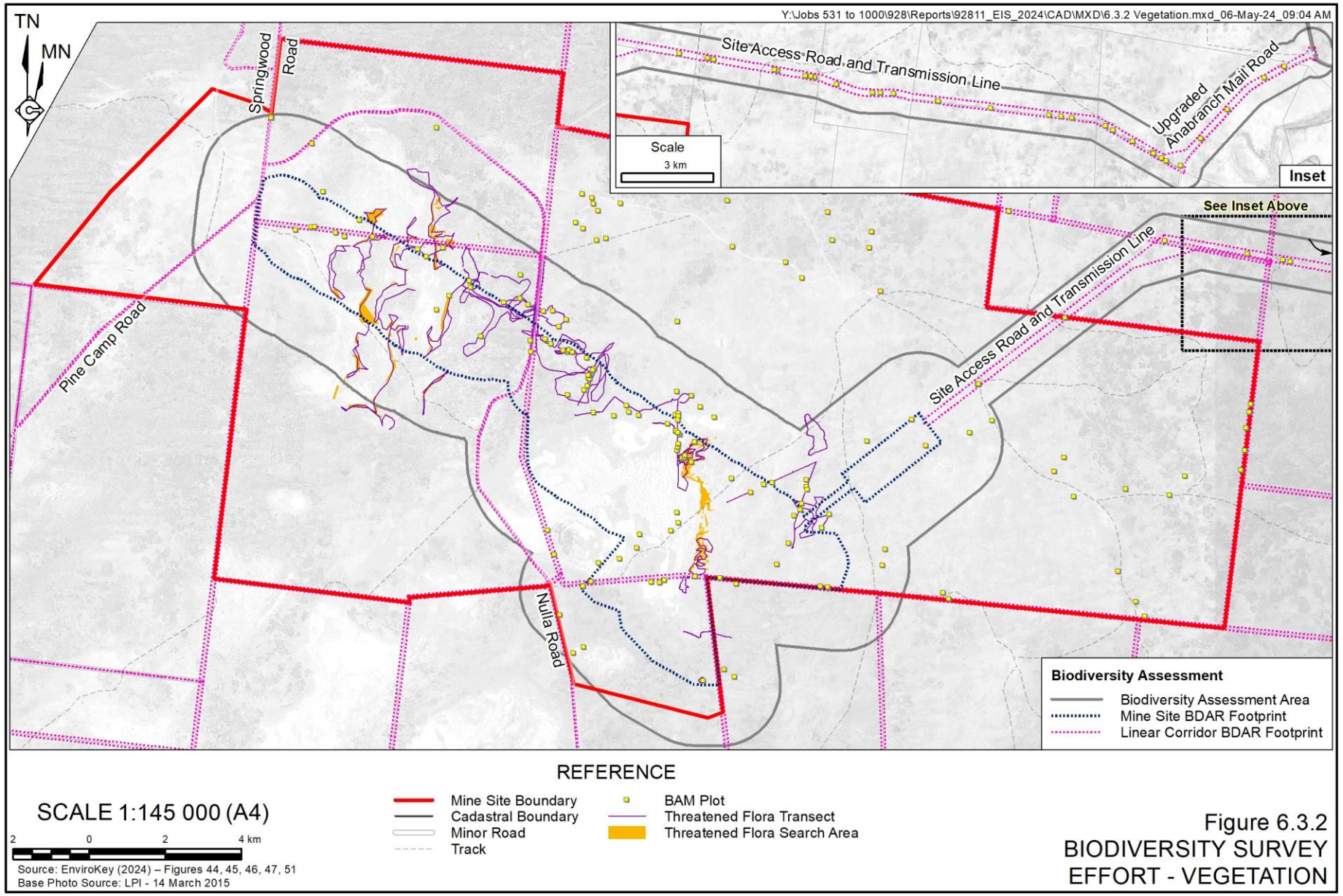
Floristic surveys were undertaken by EnviroKey (2024) in accordance with the BAM to inform the assessment of vegetation mapping, the verification of vegetation communities, and the presence of threatened ecological communities. PCTs were assigned to identified PCTs for the Western region through the comparison of surveyed attributes (e.g. dominant canopy species, landscape position) with published PCT descriptions in the online VIS classification database v2.1.

The locations of VI plots assessed for the BDAR are shown on **Figure 6.3.2**.

Targeted Threatened Species Surveys

Targeted surveys for threatened flora and fauna species identified as candidate species were conducted by EnviroKey (2024) over the following periods.

- January 2018:
- May 2018: 4 days
- September 2018: 3 days
- January 2020: 5 days
- February 2021: 5 days
- March 2022: 3 days
- September 2023: 5 days
- October 2023: 5 days
- February 2024: 2 days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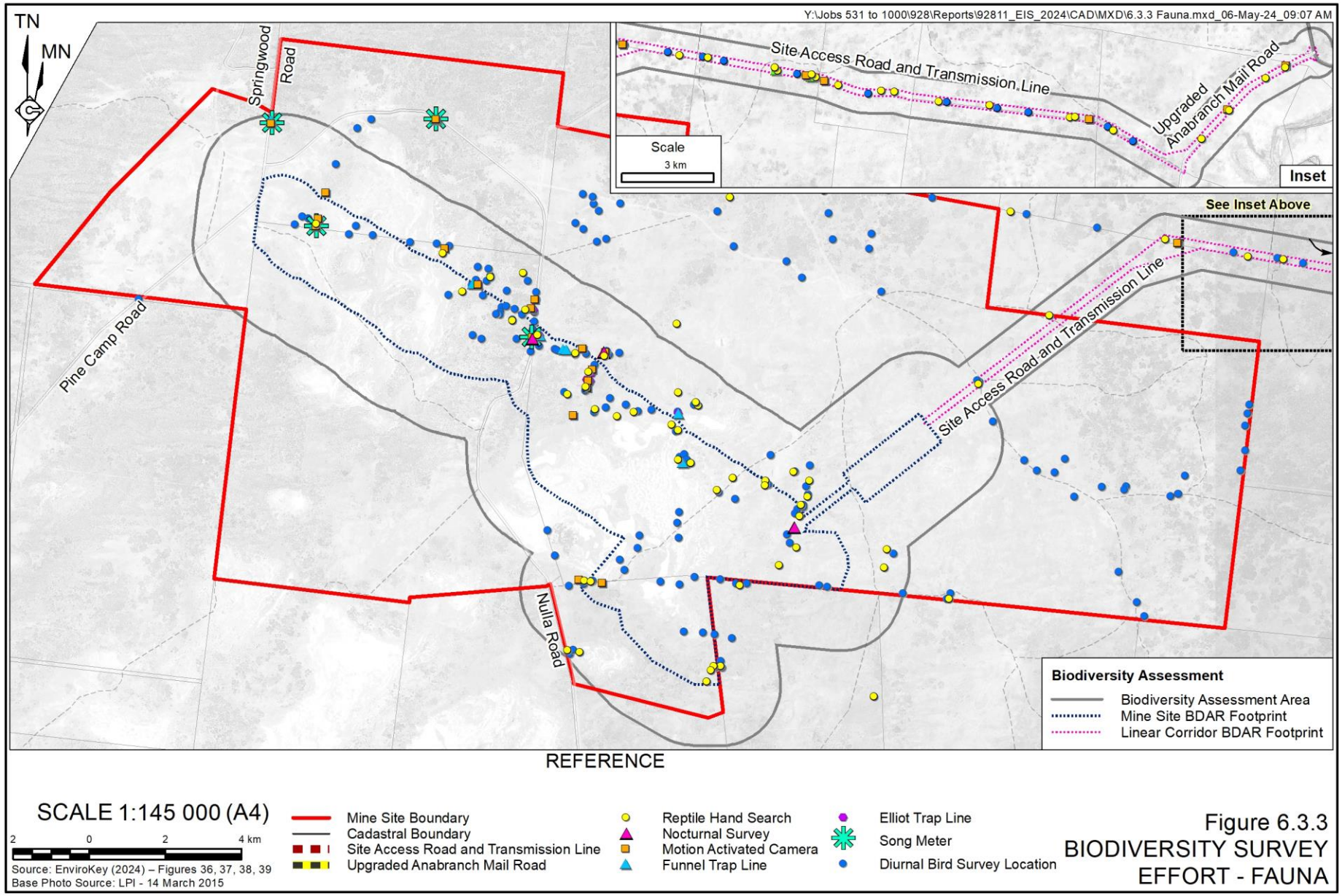
TN
MN
Springwood Road
Pine Camp Road
Nulla Road
Site Access Road and Transmission Line
Upgraded Anabranch Mail Road
Scale
3 km
Inset
See Inset Above
Site Access Road and Transmission Line
Biodiversity Assessment
Biodiversity Assessment Area
Mine Site BDAR Footprint
Linear Corridor BDAR Footprint
REFERENCE
Mine Site Boundary
Cadastral Boundary
Minor Road
Track
BAM Plot
Threatened Flora Transect
Threatened Flora Search Area
SCALE 1:145 000 (A4)
2 0 2 4 km
Source: EnviroKey (2024) – Figures 44, 45, 46, 47, 51
Base Photo Source: LPI - 14 March 2015
Figure 6.3.2
BIODIVERSITY SURVEY
EFFORT - VEGETATION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Springwood Road
Pine Camp Road
Nulla Road
Site Access Road and Transmission Line
Upgraded Anabranch Mail Road
Scale
3 km
Inset
See Inset Above
Biodiversity Assessment
Biodiversity Assessment Area
Mine Site BDAR Footprint
Linear Corridor BDAR Footprint
REFERENCE
SCALE 1:145 000 (A4)
2 0 2 4 km
Source: EnviroKey (2024) – Figures 36, 37, 38, 39
Base Photo Source: LPI - 14 March 2015
Mine Site Boundary
Cadastral Boundary
Site Access Road and Transmission Line
Upgraded Anabranch Mail Road
Reptile Hand Search
Nocturnal Survey
Motion Activated Camera
Funnel Trap Line
Elliot Trap Line
Song Meter
Diurnal Bird Survey Location
Figure 6.3.3
BIODIVERSITY SURVEY
EFFORT - FAUNA

Limitations

Weather conditions were conducive to the detection of all species, including threatened species, across a range of seasonal and yearly survey periods (EnviroKey, 2024).

EnviroKey (2024) note that, whilst the diverse range of survey methods and survey effort ensure that the BDAR is consistent with assessment requirements, potential limitations may include the following.

- Vegetation floristic plots completed in accordance with the BAM are not exhaustive and do not preclude the presence of other species.
- The Biodiversity Assessment Area has been subjected to drought conditions and agricultural activities for many decades which is likely to have influenced field survey results.
- Aerial photo interpretation, extrapolation of results from other areas of the Biodiversity Assessment Area and viewing from public access points, such as Nulla Nulla Road, has been relied upon where access to certain areas was constrained.

6.3.4 Desktop Assessment Results

6.3.4.1 Ecosystem Credit Species

Table 6.3.2 presents the preliminary list of predicted ecosystem credit species determined by the BAM Calculator as potentially occurring within the Biodiversity Assessment Area based on identified PCTs, patch sizes and native vegetation cover. A total of six species identified in this preliminary list were excluded from further assessment based on habitat constraints associated with PCT 28, with EnviroKey (2024) noting the following in relation to PCT 28 within the Biodiversity Assessment Area

- Patches are very small and highly fragmented and in extremely low condition.
- Suitable groundcover and mid-storey are absent.

One further species (*Polytelis anthopeplus monarchoides*, Regent Parrot) was completely excluded as suitable habitat associated with the Murray and Murrumbidgee Rivers is located more than 30km from the Biodiversity Assessment Area.

Table 6.3.2
Predicted Ecosystem Credit Species

Scientific Name	Common Name	Species for Further Assessment		Listing Status	
		Retained?	Reason for Exclusion	BC Act	EPBC Act
Antechinomys laniger	Kultarr	Yes	-	Endangered	-
Aprasia inaurita	Mallee Worm-lizard	Yes	-	Endangered	-
Artamus cyanopterus	Dusky Woodswallow	Yes	-	Vulnerable	-
Calamanthus campestris	Rufous Fieldwren	Yes	-	Vulnerable	-
Cercartetus concinnus	Western Pygmy Possum	Yes	-	Endangered	-
Certhionyx variegatus	Pied Honeyeater	Yes	-	Vulnerable	-
Chalinolobus picatus	Little Pied Bat	Yes	-	Vulnerable	-
Cinclosoma castanotum	Chestnut Quail-thrush	Yes	-	Vulnerable	-
Circus assimillis	Spotted Harrier	Yes	-	Vulnerable	-
Ctenotus brooksi	Wedgesnout Ctenotus	Yes	-	Vulnerable	-
Cyclodomorphus melanops elongatus	Mallee Slender Blue-tongue lizard	Yes	-	Endangered	-
Daphoenositta chrysoptera	Varied Sittella	Partial[1]	PCT 28 is in very poor condition and unable to support this species.	Vulnerable	-
Delma australis	Marble-faced Delma	Yes	-	Endangered	-
Drymodes brunneopygia	Southern Scrub-robin	Yes	-	Vulnerable	-
Echiopsis curta	Bardick	Yes	-	Endangered	-
Epthianura albifrons	White-fronted Chat	Yes	-	Vulnerable	-
Falco hypoleucos	Grey Falcon	Yes	-	Endangered	-
Falco subniger	Black Falcon	Yes	-	Vulnerable	-
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	Yes	-	Vulnerable	-
Grantiella picta	Painted Honeyeater	Yes	-	Vulnerable	Vulnerable
Haliaeetus leucogaster	White-bellied Sea-eagle (foraging)	Yes	-	Vulnerable	-
Hamirostra melanostemon	Black-breasted Buzzard (foraging)	Yes	-	Vulnerable	-
Hieraaetus morphnoides	Little Eagle (foraging)	Yes	-	Vulnerable	-
Hylacola cautus	Shy Heathwren	Yes	-	Vulnerable	-
Leipoa ocellata	Malleefowl	Yes	-	Endangered	Vulnerable
Lerista xanthura	Yellow-tailed Plain Slider	Yes	-	Vulnerable	-
Lichenostomus cratitus	Purple-gaped Honeyeater	Yes	-	Vulnerable	-
Lophochroa leadbeateri	Pink Cockatoo (foraging)	Yes	-	Vulnerable	-
Lophoictinia isura	Square-tailed Kite (foraging)	Yes	-	Vulnerable	-
Melanodryas cucullate	Hooded Robin	Partial[1]	PCT 28 is in very poor condition and unable to support this species	Vulnerable	Vulnerable
Neophema splendida	Scarlet-chested Parrot	Yes	-	Vulnerable	-
Ningaui yvonneae	Southern Ningaui	Yes	-	Vulnerable	-

Table 6.3.2 (Cont'd)
Predicted Ecosystem Credit Species

Scientific Name	Common Name	Species for Further Assessment		Listing Status	
		Retained?	Reason for Exclusion	BC Act	EPBC Act
Nyctophilus corbeni	Corbens Long-eared Bat	Yes	-	Vulnerable	Vulnerable
Pachycephala inornata	Gilbert's Whistler	Partial[1]	PCT 28 is in very poor condition and unable to support this species	Vulnerable	-
Polytelis anthopeplus monarchoides	Regent Parrot	No	Subject land is greater than 30 km from the Murray and Murrumbidgee Rivers	Endangered	Vulnerable
Pomatostomus temporalis	Grey-crowned Babbler	Partial[1]	PCT 28 is in very poor condition and unable to support this species	Vulnerable	-
Pseudomys bolami	Bolam's Mouse	Partial[1]	PCT 28 is in very poor condition and unable to support this species	Endangered	-
Psedumys hermannsburgensis	Sandy Inland Mouse	Yes	-	Vulnerable	-
Psedonaja modesta	Ringed Brown Snake	Yes	-	Endangered	-
Pyrrholaemus brunneus	Redthroat	Yes	-	Vulnerable	-
Rampotyphlops endoterus	Interior Blind Snake	Yes	-	Endangered	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Yes	-	Vulnerable	-
Sminthopsis macroura	Stripe-faced Dunnart	Yes	-	Vulnerable	-
Stagonopleura guttata	Diamond Firetail	Partial[1]	PCT 28 is in very poor condition and unable to support this species	Vulnerable	Vulnerable
Strophorus elderi	Jewelled Gecko	Yes	-	Vulnerable	-
Tiliqua occipitalis	Western Blue-tongued Lizard	Yes	-	Vulnerable	-
Vespadelus baverstocki	Inland Forest Bat	Yes	-	Vulnerable	-
Note 1: Species is retained within one vegetation zone but not another.					
Source: EnviroKey (2024) – modified after Table 26					

6.3.4.2 Species Credit Species

Table 6.3.3 presents the preliminary list of predicted species credit species determined by the BAM Calculator as potentially occurring within the Biodiversity Assessment Area based on an assessment of geographic and habitat features. For each predicted species, EnviroKey (2024) considered the likelihood of occurrence and the presence of suitable habitat to determine whether they should be retained or excluded from further assessment. In summary, one flora species and five fauna species were excluded from further assessment.

Table 6.3.3
Predicted Species Credit Species

Scientific Name	Common Name	Species for Further Assessment		Listing Status	
		Retained?	Reasons for Exclusion	BC Act	EPBC Act
Flora Species					
Acacia acanthoclada	Harrow Wattle	Yes	-	Endangered	-
Acacia carnerorum	Purple-wood Wattle	Yes	-	Vulnerable	Vulnerable
Atriplex infrequens	-	Yes	-	Vulnerable	Vulnerable
Austrostipa metatoris	-	Yes	-	Vulnerable	Vulnerable
Austrostipa nullanulla	Nulla Grass	Yes	-	Endangered	-
Brachyscome papillosa	Mossgiel Daisy	Yes	-	Vulnerable	Vulnerable
Calotis moorei	A burr daisy	Yes	-	Endangered	Endangered
Cratystylis conocephala	Bluebush Daisy	Yes	-	Endangered	-
Dodonaea stenozyga	Desert Hopbush	Yes	-	Critically Endangered	-
Kippistia suaedifolia	Fleshy Minuria	Yes	-	Endangered	-
Lasiopetalum behrii	Pink Velvet Bush	Yes	-	Critically Endangered	-
Leporhynchos waitza	Button Immortelle	Yes	-	Endangered	-
Pimelea serpyllifolia	Thyme Rice Flower	No	Subject land is more than 50km from Murray River	Endangered	-
Pterostylis cobarensis	Greenhood Orchid	Yes	-	Vulnerable	-
Santalum murrayanum	Bitter Quandong	Yes	-	Endangered	-
Swainsona colutoides	Bladder Senna	Yes	-	Endangered	-
Swainsona pyrophila	Yellow Swainson-pea	Yes	-	Vulnerable	-
Swainsona sericea	Silky Swainson-pea	Yes	-	Vulnerable	-
Fauna Species					
Amytornis striatus	Striated Grasswren	Yes	-	Critically Endangered	-
Ardeotis australis	Australian Bustard	No	Species is vagrant and habitat has been degraded by extensive grazing	Endangered	-
Burhinus grallarius	Bush Stone-curlew	Yes	-	Endangered	-
Haliaeetus leucogaster	White-bellied Sea-eagle	No	Species is vagrant and unlikely to breed in Biodiversity Assessment Area due to lack of regular food supply	Vulnerable	-
Hamirostra melanosternum	Black-breasted Buzzard	Yes	-	Vulnerable	-
Hieraaetus morphnoides	Little Eagle	Yes	-	Vulnerable	-
Lasiorhinus latiforns	Southern Hairy-nosed Wombat	No	Habitat is considered degraded and continues to be degraded by feral herbivores including goats and rabbits	Endangered	-
Lophochroa leadbeater	Pink Cockatoo	Yes	-	Vulnerable	-

Table 6.3.3 (Cont'd)
Predicted Species Credit Species

Scientific Name	Common Name	Species for Further Assessment		Listing Status	
		Retained?	Reasons for Exclusion	BC Act	EPBC Act
Fauna Species (Cont'd)					
Lophoictinia isura	Square-tailed Kite	Yes	-	Vulnerable	-
Lucasium stenodactylum	Crowned Gecko	Yes	-	Vulnerable	-
Manorina melanotis	Black-eared Miner	Yes	-	Critically Endangered	Endangered
Neobatrachus pictus	Painted Burrowing Frog	No	Habitat is considered degraded and continues to be degraded by feral herbivores including goats and rabbits, grazed extensively by sheep	Endangered	-
Pachycephala rufogularis	Red-lored Whistler	Yes	-	Critically Endangered	Vulnerable
Polytelis anthopeplus	Regent Parrot	No	Habitat and geographic limitations not met (Large River Red Gums with hollows not present/ subject land is not within 30km of the Murray River)	Endangered	Vulnerable
Pseudomys desertor	Desert Mouse	Yes	-	Critically Endangered	-

Note 1: When a species is retained within one vegetation zone but not another.

Source: EnviroKey (2024) – modified after Tables 27 and 28

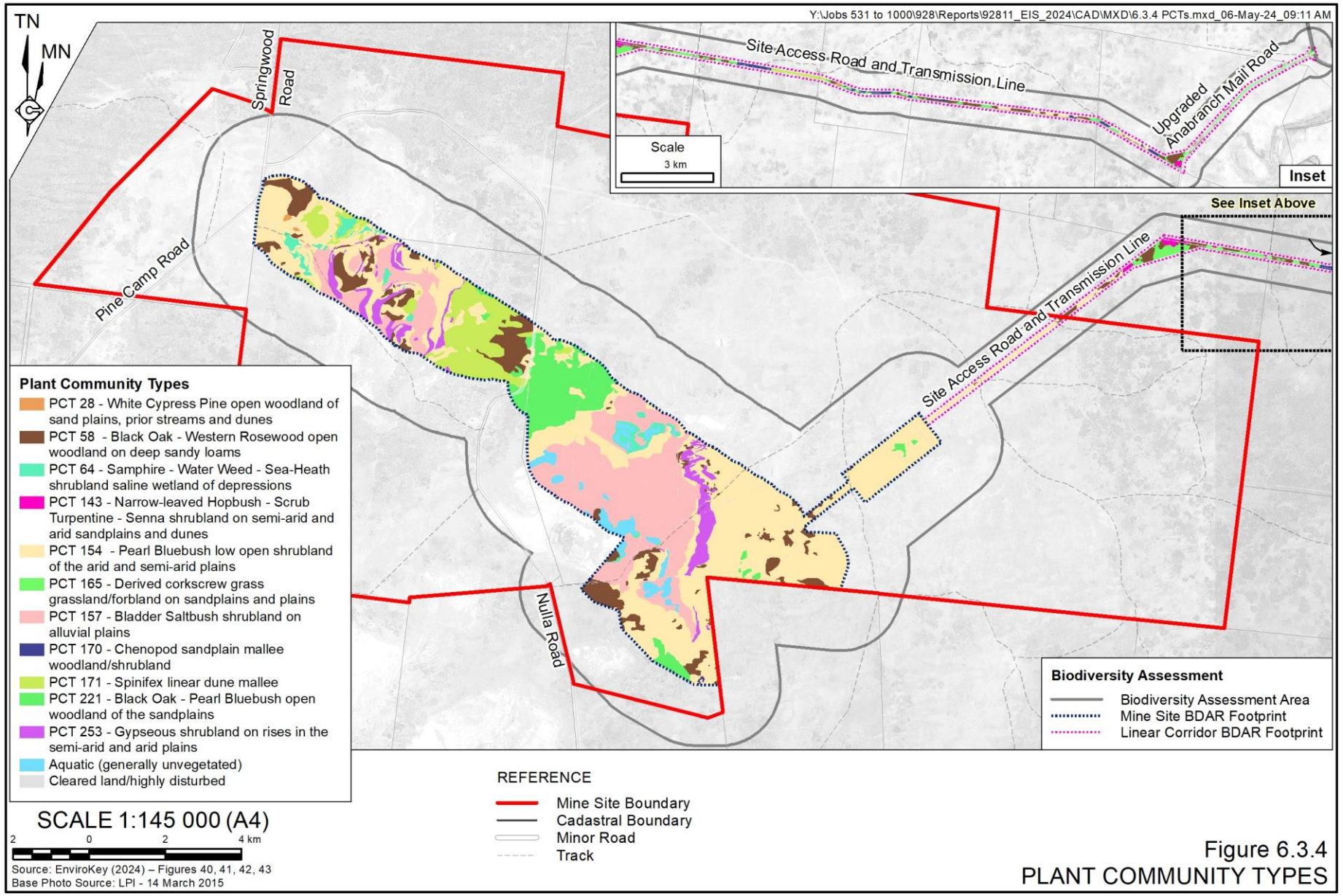
6.3.5 Field Survey Results

6.3.5.1 Plant Community Types

A total of eleven Plant Community Types (PCTs) as well as two unclassified communities were identified by EnviroKey (2024) within the Biodiversity Assessment Area (**Figure 6.3.4** and **Table 6.3.4**).

6.3.5.2 Vegetation Zones and Vegetation Integrity

The eleven PCTs identified as occurring within the BDAR Footprint were classified into vegetation zones for the purposes of credit calculations (**Figure 6.3.5** and **Table 6.3.4**). Given the condition of each PCT varied across the BDAR Footprint as a consequence of current and historic pastoral land uses (EnviroKey, 2024), vegetation zones were classified separately for the Mine Site BDAR Footprint and the Linear Corridor BDAR Footprint.


Y:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\MXD\6.3.4 PCTs.mxd_06-May-24_09:11 AM
TN
MN
Springwood Road
Pine Camp Road
Nulla Road
Site Access Road and Transmission Line
Upgraded Anabranch Mail Road
Scale
3 km
Inset
See Inset Above
Plant Community Types
PCT 28 - White Cypress Pine open woodland of sand plains, prior streams and dunes
PCT 58 - Black Oak - Western Rosewood open woodland on deep sandy loams
PCT 64 - Samphire - Water Weed - Sea-Heath shrubland saline wetland of depressions
PCT 143 - Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland on semi-arid and arid sandplains and dunes
PCT 154 - Pearl Bluebush low open shrubland of the arid and semi-arid plains
PCT 165 - Derived corkscrew grass grassland/forbland on sandplains and plains
PCT 157 - Bladder Saltbush shrubland on alluvial plains
PCT 170 - Chenopod sandplain mallee woodland/shrubland
PCT 171 - Spinifex linear dune mallee
PCT 221 - Black Oak - Pearl Bluebush open woodland of the sandplains
PCT 253 - Gypseous shrubland on rises in the semi-arid and arid plains
Aquatic (generally unvegetated)
Cleared land/highly disturbed
Biodiversity Assessment
Biodiversity Assessment Area
Mine Site BDAR Footprint
Linear Corridor BDAR Footprint
REFERENCE
Mine Site Boundary
Cadastral Boundary
Minor Road
Track
SCALE 1:145 000 (A4)
2 0 2 4 km
Source: EnviroKey (2024) – Figures 40, 41, 42, 43
Base Photo Source: LPI - 14 March 2015
Figure 6.3.4
PLANT COMMUNITY TYPES

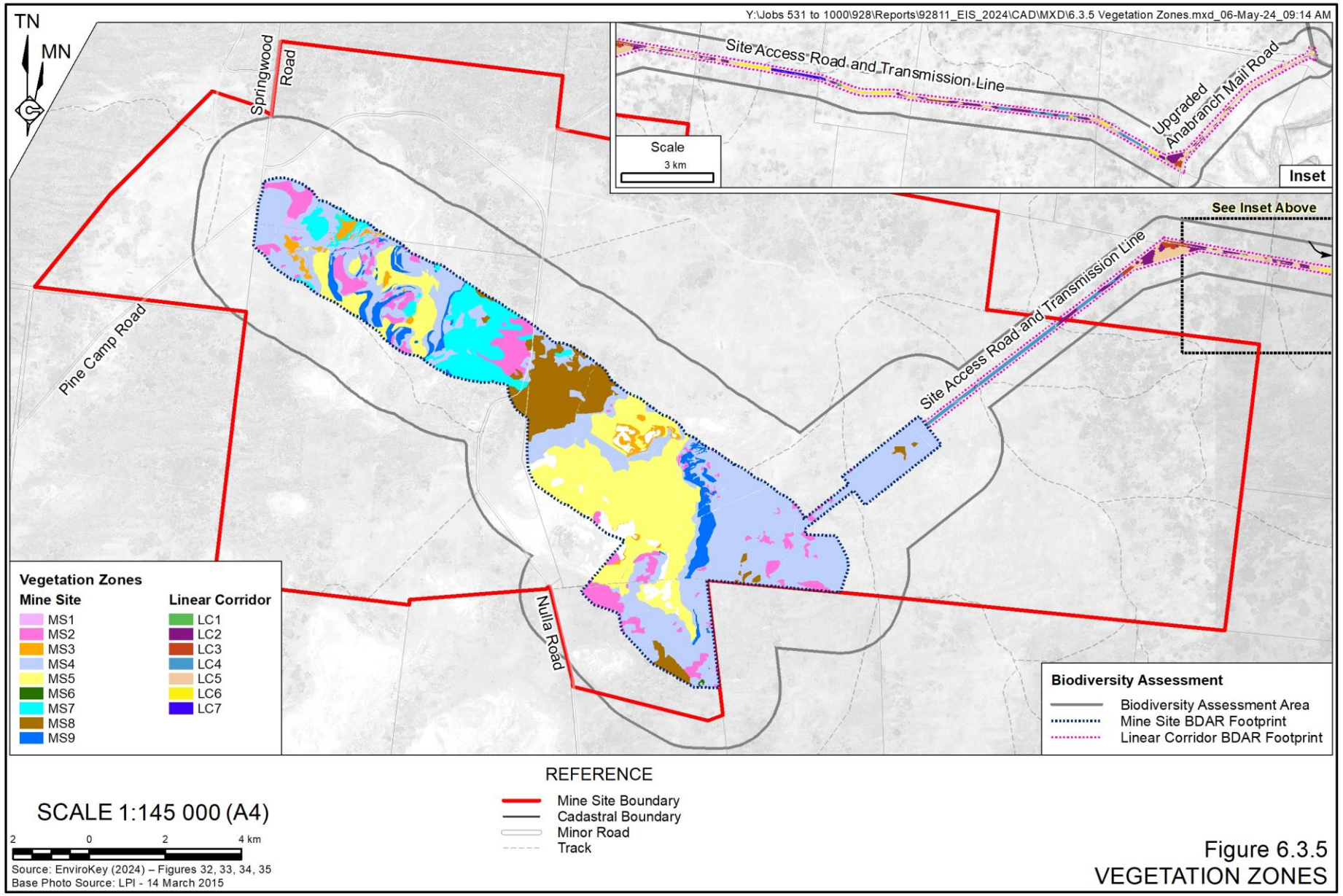


Figure 6.3.5
VEGETATION ZONES

Table 6.3.4
Plant Community Types within the Biodiversity Assessment Area

PCT		Condition	Mine Site BDAR Footprint (ha)	Linear Corridor BDAR Footprint (ha)
Code	Name			
28	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone	Low	4.18	1.71
58	Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	Moderate - Good	467.57	81.64
64	Samphire – Water Weed – Sea Heath shrubland saline wetland of depressions of the arid and semi-arid (warm zones)	Moderate - Good	104.40	-
143	Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes	Low	-	18.02
154	Pearl Bluebush low open shrubland of the arid and semi-arid plains	Moderate - Good	2461.32	69.23
157	Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone including Riverina Bioregion	Moderate - Good	1293.65	-
165	Derived corkscrew grass grassland/forbland on sandplains and plains	Moderate - Good	-	104.98
170	Chenopod sandplain mallee woodland/shrubland	Low	1.75	30.74
171	Spinifex linear dune mallee mainly of the Murray Darling Depression bioregion	Moderate - Good	418.0	15.52
221	Black Oak – Pearl Bluebush open woodlands of the sandplains of the semi-arid warm and arid climate zones	Moderate - Good	457.09	-
253	Gypseous shrubland on rises in the semi-arid and arid plains	Low	241.95	-
	Total area of native vegetation		**5,449.91**	**321.84**
N/A[1]	Cleared Land	-	31.97	30.01
N/A[1]	Saline aquatic (generally unvegetated)	-	140.01	-
	Total area of non-native vegetation		**172.17**	**30.01**
		Total Area	**5,621.89**	**351.85**

Note 1: Not required to be calculated in BAM calculator.
Note 2: Apparent arithmetic inconsistencies are due to rounding

Source: EnviroKey (2024) – modified after Table 9 and Section 4.2

Vegetation integrity scores were calculated for each of the vegetation zones within the BDAR Footprint based on the results from surveyed vegetation integrity plots (**Table 6.3.5**). For each PCT except PCT 28, the minimum number of vegetation integrity plots were sampled in accordance with the BAM (EnviroKey, 2024). Due to access constraints during field surveys, only one vegetation integrity plot was sampled for PCT 28. The minimum requirement for this community is two plots. Consequently, EnviroKey (2024) used local benchmark data as a substitute for the remaining vegetation integrity plot in the BAM Calculator calculations for the BDAR. A total of 65 plots were used for the Mine Site BDAR footprint spanning the most recent 5-year period, and 35 plots were used for the Linear Corridor BDAR footprint surveyed between 2023 and 2024.

Table 6.3.5
Vegetation Integrity Scores

PCT	Vegetation Zone ID	Composition Condition Score	Structure Condition Score	Function Condition Score[1]	Vegetation Integrity Score	Hollow-bearing Trees Present?
Mine Site BDAR Footprint						
28	MS1	73.5	86.5	52.6	69.4	No
58	MS2	50.1	96.2	48.9	61.8	No
64	MS3	48.4	79.8	-	62.2	Yes
154	MS4	64.7	8.7	-	23.7	No
157	MS5	7.6	78.7	-	77.7	No
170	MS6	68	62.5	39.5	55.2	Yes
171	MS7	40.7	73.3	44.8	51.1	Yes
221	MS8	41.6	8.4	-	18.7	No
253	MS9	47.2	65.2	36.2	48.1	Yes
Linear Corridor BDAR Footprint						
28	LC1	56.2	67.4	34.7	50.8	No
58	LC2	46.0	36.9	48.2	43.4	Yes
143	LC3	64.0	71.1	-	67.4	No
154	LC4	73.8	7.0	-	22.7	No
165	LC5	38.8	55.6	-	46.4	No
170	LC6	49.6	22.8	41.5	36.0	Yes
171	LC7	71.2	69.6	43.2	59.8	Yes

Note 1: Score provided where relevant for each vegetation zone.

Source: EnviroKey (2024) – Modified after Table 24, 25

6.3.5.3 Threatened Ecological Communities

Two Threatened Ecological Communities were identified by EnviroKey (2024) as occurring within the Biodiversity Assessment Area (**Figure 6.3.6** and **Table 6.3.6**).

Table 6.3.6
Threatened Ecological Communities

TEC Name	BC Act Status	EPBC Act Status	Associated PCTs	Area within Mine Site BDAR footprint (ha)	Area within Linear corridor BDAR footprint (ha)
Sandhill Pine Woodland	Endangered	-	PCT 28	4.18	1.71
Eastern Mallee Bird Community	-	Endangered	PCT 170 & PCT 171	419.75	46.26

Source: EnviroKey (2024) – after Table 21

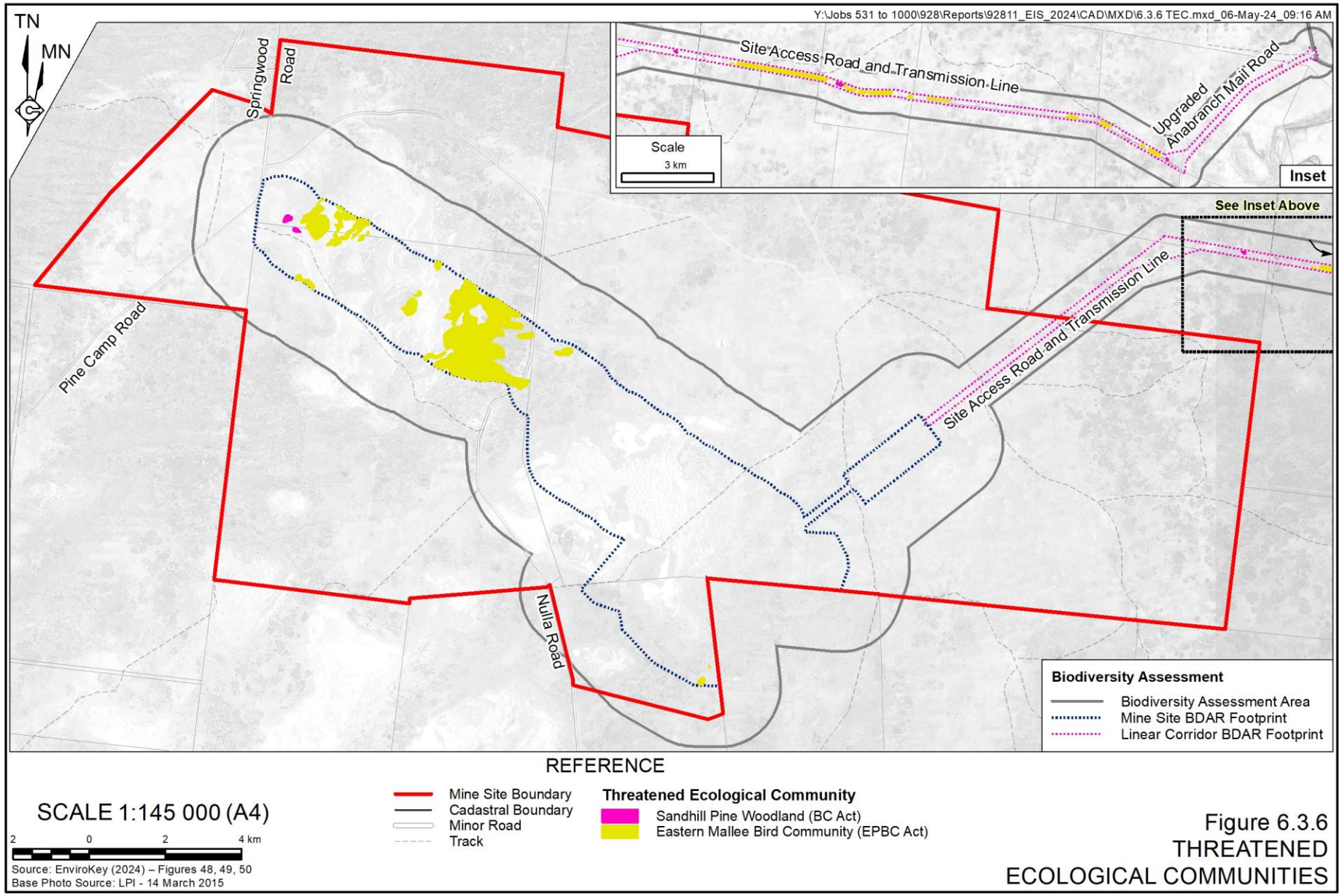


Figure 6.3.6
THREATENED
ECOLOGICAL COMMUNITIES

The Threatened Ecological Communities identified within the SEARs that are required to be addressed include the following.

- PCT 154 *Pearl Bluebush low open shrubland of the arid and semi-arid plains*
- PCT 28 *White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone*
- PCT 65 *Tecticornia lylei, Wiry Glasswort, low open-shrubland in the Murray Darling Depression Bioregion*

PCT 154 and PCT 28 are outlined in Section 6.3.5.1 and are discussed in detail in Section 4.2.6 and Section 4.2.2 of EnviroKey (2024), respectively.

PCT 65 identified in the 2018 scoping report was later confirmed not to be present and mapping determined it to be PCT 64, rather than PCT 65. Therefore, EnviroKey (2024) determined this Threatened Ecological Community is not present in the Biodiversity Assessment Area.

6.3.5.4 Species Credit Species

Table 6.3.7 lists the candidate species credit species determined to be present within the Biodiversity Assessment Area based on targeted threatened species field survey results (EnviroKey, 2024). In summary, EnviroKey (2024) recorded no threatened fauna species and one threatened flora species (*Austrostipa nullanulla*, Nulla grass) during field surveys of the Biodiversity Assessment Area. Additionally, one threatened flora species (*Pterostylis cobarensis*, Cobar Greenhood Orchid) was assumed to be present as targeted field surveys could not be undertaken during the appropriate season to determine presence or absence.

Table 6.3.7
Species Credit Species Field Survey Results

Common Name	Scientific Name	Listing Status		Survey Method	Present?	Further Assessment Required?
		BC Act	EPBC Act			
Flora Species						
Harrow Wattle	*Acacia acanthoclada*	Endangered	-	Targeted threatened species survey	No	No
Purple-wood Wattle	*Acacia carnerorum*	Vulnerable	Vulnerable	Targeted threatened species survey	No	No
-	*Atriplex infrequens*	Vulnerable	Vulnerable	Targeted threatened species survey	No	No
-	*Austrostipa metatoris*	-	-	Targeted threatened species survey	No	No
Nulla Grass	*Austrostipa nullanulla*	Endangered	-	Targeted threatened species survey	Yes	Yes
Mossgiel Daisy	*Brachyscome papillosa*	Vulnerable	Vulnerable	Targeted threatened species survey	No	No
A burr daisy	*Calotis moorei*	Endangered	Endangered	Targeted threatened species survey	No	No
Bluebush Daisy	*Cratystylis conocephala*	Endangered	-	Targeted threatened species survey	No	No

Table 6.3.7 (Cont'd)
Species Credit Species Field Survey Results

Common Name	Scientific Name	Listing Status		Survey Method	Present?	Further Assessment Required?
		BC Act	EPBC Act			
Flora Species (Cont'd)						
Desert Hopbush	*Dodonaea stenozyga*	Critically Endangered	-	Targeted threatened species survey	No	No
Fleshy Minuria	*Kippistia suaedifolia*	Endangered	-	Targeted threatened species survey	No	No
Pink Velvet Bush	*Lasiopetalum behrii*	Critically Endangered	-	Targeted threatened species survey	No	No
Button Immortelle	*Leporhynchos waitza*	Endangered	-	Targeted threatened species survey	No	No
Cobar Greenhood Orchid[1]	*Pterostylis cobarensis*	Vulnerable	-	Assumed present	Assumed present	Yes
Bitter Quandong	*Santalum murrayanum*	Endangered	-	Targeted threatened species survey	No	No
Bladder Senna	*Swainsona colutoides*	Endangered	-	Targeted threatened species survey	No	No
Yellow Swainson-pea	*Swainsona pyrophila*	Vulnerable	-	Targeted threatened species survey	No	No
Silky Swainson-pea	*Swainsona sericea*	Vulnerable	-	Targeted threatened species survey	No	No
Fauna Species						
Striated Grasswren	*Amytornis striatus*	Critically Endangered	-	Targeted threatened species survey	No	No
Bush Stone-curlew	*Burhinus grallarius*	Endangered	-	Targeted threatened species survey	No	No
Black-breasted Buzzard	*Hamirostra melanosternum*	Vulnerable	-	Targeted threatened species survey	No	No
Little Eagle	*Hieraaetus morphnoides*	Vulnerable	-	Targeted threatened species survey	No	No
Pink Cockatoo	*Lophochroa leadbeateri*	Vulnerable	-	Targeted threatened species survey	No	No
Square-tailed Kite	*Lophoictinia isura*	Vulnerable	-	Targeted threatened species survey	No	No
Crowned Gecko	*Lucasium stenodactylum*	Vulnerable	-	Targeted threatened species survey	No	No
Black-eared Miner	*Manorina melanotis*	Critically Endangered	Endangered	Targeted threatened species survey	No	No
Red-lored Whistler	*Pachycephala rufogularis*	Critically Endangered	Vulnerable	Targeted threatened species survey	No	No
Desert Mouse	*Pseudomys desertor*	Critically Endangered	-	Targeted threatened species survey	No	No

Note 1: The Applicant will undertake targeted survey for the Cobar Greenhood Orchid *(Pterostylis cobarensis*) during the assessment period for the Project and would amend or update the BDAR as required once complete.

Source: EnviroKey (2024) – After Tables 31 and 32

Austrostipa nullanulla

Austrostipa nullanulla generally occurs on gypseous lunettes, copi rises, the margins of relict lakes and on the crests and sides of lunettes (EnviroKey, 2024). The distribution of this species was thought to be restricted to Nulla Station in NSW, however, the species is now known to occur south of Nulla Station and north at Nunya Station. Extensive field surveys in the vicinity of the Biodiversity Assessment Area identified *A. nullanulla* occurring across approximately 48.14ha, with 30.14ha occurring within the Mine Site BDAR footprint (**Figure 6.3.7**). *A. nullanulla* was considered present if living or dead individuals were identified during field surveys (EnviroKey, 2024).

Cobar Greenhood Orchid

EnviroKey (2024) note that the presence of the Cobar Greenhood Orchid (*Pterostylis cobarensis*) was assumed within PCT 171 as no field surveys coincided with appropriate periods of detectability for this species. The Threatened Biodiversity Data Collection (TBDC) identifies both PCT 171 and PCT 28 as habitat associations for the Greenhood Orchid. However, given that PCT 28 within the Biodiversity Assessment Area is heavily degraded it is not considered suitable habitat for the Cobar Greenhood Orchid (EnviroKey, 2024), the occurrence of this species has been mapped as coinciding with PCT 171 only (**Figure 6.3.7**).

6.3.6 Assessment of Impacts

6.3.6.1 Introduction

This subsection presents an assessment of the anticipated Project-related impacts on flora and fauna species and communities. Both direct and indirect impacts are considered together with relevant legislative considerations.

6.3.6.2 Direct Impacts

Table 6.3.8 and **Table 6.3.9** identify the residual direct impacts to vegetation communities which would occur as a result of the Project. In summary, the Project would directly disturb 5771.75ha of native vegetation and 201.99 ha of non-native vegetation.

Table 6.3.10 identifies the residual direct impacts to threatened species and communities which would occur as a result of the Project.

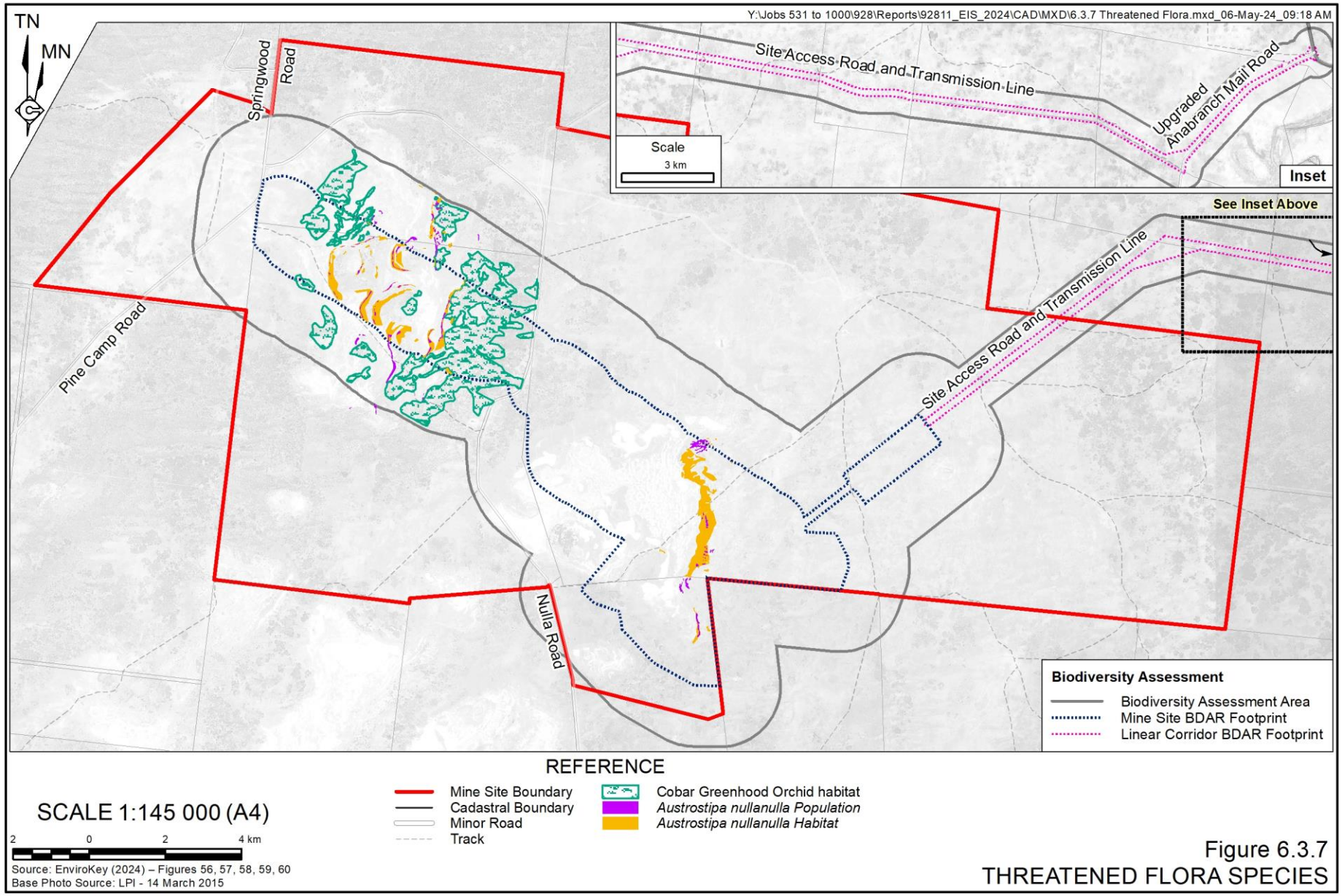


Figure 6.3.7
THREATENED FLORA SPECIES

Table 6.3.8
Residual Direct Impacts to Vegetation Communities – Mine Site BDAR Footprint

PCT ID	Direct Impact	Vegetation Integrity (VI) Score			Extent (ha)
		Pre-development	Post-development	Net change	
PCT 28	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone	69.4	0	-69.4	4.18
PCT 58	Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	61.8	0	-61.8	467.57
PCT 64	Samphire – Water Weed – Sea Heath shrubland saline wetland of depressions of the arid and semi-arid (warm zones)	62.2	0	-62.2	104.40
PCT 154	Pearl Bluebush low open shrubland of the arid and semi-arid plains	23.7	0	-23.7	2,461.32
PCT 157	Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone including Riverina Bioregion	77.7	0	-77.7	1293.65
PCT 170	Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	48.1	0	-48.1	1.75
PCT 171	Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	55.2	0	-55.2	418.00
PCT 221	Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	51.1	0	-51.1	457.09
PCT 253	Gypseous shrubland on rises in the semi-arid and arid plains	18.7	0	-18.7	241.95
				Subtotal (Native Vegetation)	**5,449.91**
Cleared Land					31.97
Saline aquatic (generally unvegetated)					140.20
				Subtotal (Non-native Vegetation)	**172.17**
				Total Impacted Area:	**5,621.89**

Source: EnviroKey (2024) – modified after Table 36, 38.

Table 6.3.9
Residual Direct Impacts to Vegetation Communities – Linear Corridor BDAR Footprint

PCT ID	Direct Impact	Vegetation Integrity (VI) Score			Extent (ha)
		Pre-development	Post-development	Net change	
PCT 28	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone	50.8	0	-50.8	1.71
PCT 58	Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	43.4	0	-43.4	81.64
PCT 143	Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes.	67.4	0	-67.4	18.02
PCT 154	Pearl Bluebush low open shrubland of the arid and semi-arid plains	22.7	0	-22.7	69.23
PCT 165	Derived corkscrew grass grassland/ forbland on sandplains and plains in the semi-arid (warm) climate zone	46.4	0	-46.4	104.98
PCT 170	Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	36.0	0	-36.0	30.74
PCT 171	Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	59.8	0	-59.8	15.52
				Subtotal (Native Vegetation)	**321.84**
Cleared Land					30.01
Saline aquatic (generally unvegetated)					0.00
				Subtotal (Non-native Vegetation)	**30.01**
				Total Impacted Area:	**351.85**
Source: EnviroKey (2024) – modified after Tables 37, 39					

Table 6.3.10
Direct Impacts on Threatened Species and Threatened Ecological Communities

Threatened Species / Community	Listing Status		Extent Mine Site BDAR Footprint (ha)	Extent Linear Corridor BDAR Footprint (ha)
	BC Act	EPBC Act		
Austrostipa nullanulla	Endangered	-	30.14	-
Pterostylis cobarensis (Cobar Greenhood Orchid)	Vulnerable	-	409.88[1]	-
White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone[2]	Endangered	-	4.18	1.71
Eastern Mallee Bird Community[3]	-	Endangered	419.75	46.26
Note 1: Assumed presence only. Associated with PCT 171. Note 2: Associated with PCT 28. Note 3: Associated with PCT 171.				
Source: EnviroKey (2024) – modified after Tables 36, 37				

Finally, the proposed disturbance would occur progressively throughout the life of the Project as mining operations progress, meaning that proposed disturbance would occur progressively. This would be accompanied by progressive rehabilitation and reestablishment of native vegetation communities, resulting in a gradual restoration of biodiversity values over the medium to long-term.

6.3.6.3 Indirect Impacts

Potential indirect impacts associated with the Project are outlined in **Table 6.3.11**. The identified indirect impacts would be managed as outlined in Section 6.3.7.

Table 6.3.11
Potential Indirect Impacts to Biodiversity Values

Indirect Impact	Impacted Entities	Extent	Frequency	Duration	Timing of Impact	Likelihood	Consequences
Accidental death of fauna during clearing	Spinifex-obligate species, hollow-dependent fauna	BDAR Footprint	During Clearing	Medium-term	Construction phase	Likely	Death or injury of fauna
Vehicle collision with fauna	All avifauna and terrestrial fauna	BDAR Footprint	Ongoing	Long-term	Clearing, operations & rehabilitation	Possible	Death or injury of fauna
Weed invasion	All retained vegetation	BDAR Footprint	Ongoing	Long-term	Clearing, operations & rehabilitation	Possible	Invasion of weeds into relatively weed-free areas
Closure of water points	All avifauna and terrestrial fauna	BDAR Footprint	Ongoing	Long-term	Clearing, operations & rehabilitation	Likely	Positive impact to native fauna, negative impact to goats
Source: EnviroKey (2024) – after Table 40.							

6.3.6.4 Prescribed Impacts

Table 6.3.12 presents the prescribed impacts which would occur as a result of the Project.

Table 6.3.12
Prescribed Impacts

Impact	Nature	Extent	Duration	Consequences	Mitigation
Karst, caves, crevices, cliffs, rocks or other geological features of significance	Gypsum soils associated with lunette rises removed.	Removal of 241.95ha of PCT253 which is associated with gypsum soil.	Temporary until rehabilitation.	Negative effects on *Austrostipa nullanulla* without adequate mitigation measures.	• Fence existing *Austrostipa nullanulla* populations. • Rehabilitate gypsum soils. • Remove grazing pressure.
Habitat connectivity	Limiting terrestrial movement as a result of the Mine.	Removal of 5771.72 ha of native vegetation.	Ongoing until rehabilitation is undertaken.	Impacts to genetic diversity without connectivity.	• Implement rehabilitation plan.
Waterbodies, water quality and hydrological processes	Two salt lakes present in the footprint would be impacted.	Removal of: eastern salt lake and a large section of western salt lake.	Permanent until final landscape is reprofiled.	Not limited in the wider landscape so consequences of removal are limited.	• Final landscape reprofiled to include two salt pans.
Vehicle strikes of threatened and protected fauna	Eastern Mallee Bird Community Other birds Microbats Ground-dwelling fauna	Possible likelihood of vehicle strike limited to the access track network within BDAR Footprint.	During construction and operation.	Decline in populations over time.	• Speed limits of 50km/hr within the Mine Site.
Source: EnviroKey (2024) – After Section 8.3					

6.3.6.5 Serious and Irreversible Impacts

Introduction

Principles for determining whether a Serious and Irreversible Impact would occur are provided by Clause 6.7(2) of the *Biodiversity Conservation Regulation 2017* and can be summarised as follows.

> *An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of an ecological community becoming extinct where it may:*
>
> – *accelerate the rate of decline for the community;*
>
> – *result in a decline in an already significantly reduced population size and/or geographic distribution; and/or*
>
> – *the community is unlikely to respond to measures to improve its habitat or integrity.*

It is noted that determination in relation to Serious and Irreversible Impact is a matter for the Biodiversity Conservation Division. This subsection presents information in relation to the matters for consideration by BCD.

Austrostipa nullanulla

EnviroKey (2024) identify impact from the Project on *A. nullanulla* as potentially a Serious and Irreversible Impact.

EnviroKey (2024) conducted a desktop assessment to identify the total mapped area of *A. nullanulla*. *A. nullanulla* is known to occur at Nulla Station, located south of Warwick and Huntingfield Station (**Figure 6.3.7**), with a presence of approximately 200,000 individuals on four sites. Enclosures have been established around approximately half of the known population in order to protect them from grazing pressure by sheep and feral goats (EnviroKey, 2024). Additional populations are known to occur at Nanya Station, located to the north of the Mine Site.

In addition, field surveys were used to ground truth and further identify and map the location and area of *A. nullanulla* within the Biodiversity Assessment Area. A total area of 47.15ha occupied by *A. nullanulla* was identified as a result of field surveys within the Biodiversity Assessment Area.

Since commencement of surveying conducted at the site, the Project has gone through various design iterations – namely for mineral extraction methodologies, minimising impacts to biodiversity, and land ownership. **Table 6.3.13** identifies the total known area of *A. nullanulla* within the Biodiversity Assessment Area, the area of *A. nullanulla* that would be impacted by the Project, and the area of *A. nullanulla* that would be avoided and a consequence of Project planning and design.

Table 6.3.13
***Austrostipa nullanulla* within 10km of the Biodiversity Assessment Area**

Total Area Identified by EnviroKey (2024) (ha)	Area Impacted by the Project (ha)	Area Avoided by the Project (ha)
48.14 (includes 0.99ha outside the Biodiversity Assessment Area)	30.14	17.01
Source: EnviroKey (2024)		

Potential Impacts

The Project would result in the clearing of up to 30.14ha of *A. nullanulla* habitat. Table 44 and 45 of EnviroKey (2024) provides a detailed assessment of the potential Serious and Irreversible Impact of the loss of *A. nullanulla* within the Biodiversity Assessment Area and is summarised as follows.

- Prior to the discovery of 47.15ha of *A. nullanulla* within the Biodiversity Assessment Area, the population was recorded at approximately 200,000 individuals.
  - It is uncertain what percentage of the total NSW population the Project would remove as the Threatened Biodiversity Data Collection calculates the abundance of this species by area, not by individuals. Notwithstanding this, the Project would result in removal of 30.14ha of habitat for the species, with 17.01ha of habitat within the BDAR Footprint to remain undisturbed, with additional areas within Nulla and Nanya Stations.
  - Further field surveys are likely to identify additional sub-populations outside of the BDAR Footprint and increase the total size of the NSW population.
- Based on the known NSW range for the species of <100km^2, with additional range within Victoria and South Australia, the impact on the geographic range would be less than approximately 0.29%.
- The Threatened Biodiversity Data Collection estimates the area of occupancy in NSW of <1,000ha. Based on an area of occupancy of 1,000ha, the impact on the total area or extent of occupancy is 2.851%
- Subpopulations are already highly fragmented throughout the Biodiversity Assessment Area. Proposed loss of available habitat is unlikely to isolate or fragment the existing population to an extent that would adversely disrupt the life cycle, genetic diversity, or long term evolutionary development of the species.
- Provided retained populations are managed through grazing exclusion, it is likely that *A. nullanulla* would continue to occur on site and occur in additional suitable habitat areas once grazing pressures are removed.

Actions to Avoid and Mitigate Impacts

The proposed Project layout has been refined to reduce the impact on *A. nullanulla* to 30.14 ha, excluding 17.01 ha which would be fenced and avoided (EnviroKey, 2024). In addition to this design planning, the Applicant would implement the following measures to avoid and mitigate impacts to *A. nullanulla*.

- Exclusion of grazing from known *A. nullanulla* habitat within proposed impact areas prior to disturbance to permit seed generation and subsequent collection activities.
- Rehabilitation of areas outside the limit of disturbance where suitable habitat occurs but *A. nullanulla* has not been identified as occurring to increase the area of occupancy.

- Fencing of known and rehabilitated *A. nullanulla* habitat areas exclude herbivores and reduce grazing pressure.
- Separate management of soils from areas of *A. nullanulla* habitat and placement of those soils back into similar landscape positions to maximise the area of habitat for the species on the final landform.
- Undertake trials of *A. nullanulla* seed harvesting and respreading to determine the preferred methodology for establishing the species on the final landform and in other areas within the landscape.
- Undertake additional surveys of Applicant-controlled land to identify additional populations of the species and protection of those areas.
- Fund surveys for *A. nullanulla* on surrounding lands, including non-project land, to better identify the distribution and abundance of the species.
- Assist surrounding landholders to manage *A. nullanulla* on their land.
- Work with other stakeholders to develop and implement a species recovery plan for *A. nullanulla.*

6.3.6.6 Matters of National Environmental Significance

The EPBC Act addresses 'Matters of National Environmental Significance' (MNES). Potentially relevant MNES to the Project include:

- listed threatened species and ecological communities; and
- listed migratory species protected under international agreements.

Under the EPBC Act, if a project has the potential to have a significant impact on MNES, it is required to be referred to the Commonwealth Government's Department of Agriculture, Water and the Environment for assessment as to whether it represents a 'controlled action' and therefore requires approval from the Commonwealth Minister for the Environment.

The following MNES were identified by EnviroKey (2024) as being potentially relevant within the BDAR footprint.

- Rainbow Bee-eater (*Merops ornatus*) – listed as 'Marine' under the EPBC Act.
- Mallee Bird Community of the Murray Darling Depression Bioregion – listed as an Endangered community under the EPBC Act.

Rainbow Bee-eater

The BDAR Footprint is not considered to comprise 'important habitat' for the Rainbow Bee-eater as it does not contain the following (EnviroKey, 2024).

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecological significant proportion of the population of the species.
- Habitat that is of critical importance to the species at particular life-cycle stages.

- Habitat used by a migratory species that is at the limit of the species' range.
- Habitat within an area where the species is declining.

Considering the above, the Project's impacts on the Rainbow Bee-eater are unlikely to be regarded as significant (EnviroKey, 2024). Referral to the Commonwealth Minister for this species is therefore not warranted.

Mallee Bird Community

The extensive field surveys completed within the Biodiversity Assessment Area identified only a single species of the eight species identified by the listing as a Mallee Specialist (Chestnut Quail-thrush), and four species of the 12 species identified by the listing as Mallee Dependents (Crested Bellbird, Jacky Winter, Splendid Fairy-wren and Yellow-plumed Honeyeater) (EnviroKey, 2024).

Field surveys confirmed that the Mallee-dependent species identified are widespread across vegetation communities within the Biodiversity Assessment Area that have overstory species (EnviroKey, 2024). Additionally, the extent of mallee within the BDAR Footprint is relatively small in the context of the broader mapped extent within a 50km radius of the Mine Site. At the locality scale, clearing of mallee vegetation as a result of the Project would impact less than 0.21% of the mallee extent. Further, the mallee community within the BDAR footprint has been heavily degraded as a result of historic and ongoing grazing and the absence of fire activity.

Considering the above, EnviroKey (2024) determined that the project is unlikely to have a significant effect on the Eastern Mallee Bird Community ecological community biota as listed by the EPBC Act. Referral to the Commonwealth Minister is therefore not warranted.

6.3.7 Avoidance, Management and Mitigation Measures

6.3.7.1 Introduction

The Applicant has designed the Project to avoid impacts to biodiversity values to the extent feasible, to mitigate unavoidable impacts, and to offset any residual impacts. The following subsections present the process followed to avoid impacts, outlines the proposed mitigation measures, and summarises the proposed biodiversity offset strategy.

6.3.7.2 Avoidance of Impacts

Biodiversity surveys were undertaken by EnviroKey (2024) between 2014 and 2024 have provided a comprehensive understanding of biodiversity values within the Biodiversity Assessment Area, including the occurrence of both native vegetation in terms of PCTs as well as threatened flora and fauna species.

The location of the ore body dictated the location of extraction activities which form part of the Project. Nonetheless, the assessment of biodiversity values within the Biodiversity Assessment Area allowed the design team to visualise and consider potential impacts on biodiversity during the planning phase. Consequently, a range of alterations to the Project were made including placing Mine infrastructure in areas of low biodiversity value or within the Mine path (e.g. the

Off Path Storage Facility, the Mine Office and Workshop and Soil Stockpile) to create a contiguous disturbance footprint where possible. This is a deliberate strategy to reduce the Project's overall vegetation disturbance footprint and minimise impacts on local habitat connectivity.

Table 6.3.14 presents the avoidance and minimisation measures adopted for direct, indirect and prescribed impacts to *A. nullanulla* associated with the Project. In total, approximately 30.14ha of *A. nullanulla* habitat would be directly impacted by the Project. Approximately 17.01ha of known *A. nullanulla* habitat would be avoided, as well as additional areas of extent beyond the assessment area. In addition, the applicant has committed to pre-mining exclusion to ensure adequate seed collection opportunities of those areas of *A. nullanulla* that would be impacted.

Table 6.3.14
Avoidance of Impacts on *Austrostipa nullanulla* Through Project Design

Action	Outcome	Timing	Responsibility
Avoid *A. nullanulla*	17.01ha of known *A. nullanulla* would be avoided.	Life of Mine	Applicant
Pre-mining exclusion of impacted *A. nullanulla*	Pre-mining exclusion of known *A. nullanulla* habitat to enable local seed collection prior to mining.	Pre-mining	
Post-mining reestablishment of *A. nullanulla*	Place gypsum-rich soils on the western margins of the Salt Pans during rehabilitation to provide specific habitat for *A. nullanulla* and maximise the potential for post-mining establishment of the species.	During rehabilitation	Applicant
Source: EnviroKey (2024) – after Table 34.			

6.3.7.3 Mitigation of Impacts

The Applicant would implement the following management and mitigation measures to minimise those residual impacts on biodiversity values which cannot be avoided. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual risk to biodiversity presented in **Appendix 2**.

Clearing of Native Vegetation

- Prepare and implement the following management plans prior to the commencement of construction operations.
  - A *Biodiversity Management Plan* to outline the management measures to be implemented throughout the life of the Project to minimise potential biodiversity-related impacts. The plan would include:
    - additional mitigation measures and implementation timeframes during construction and operation of the Project; and
    - an unexpected finds protocol for threatened species.
  - A *Rehabilitation Management Plan* in accordance with the latest NSW Resources Regulator requirements and guidelines.

- Avoid and minimise clearing of native vegetation through the implementation of planning and survey controls, where possible.
- Stage clearing to minimise the extent of clearing at any one time, where possible.
- Locate any ancillary infrastructure areas (e.g. vehicle parking, laydown yards, growth medium stockpiles) to avoid high value biodiversity areas, where possible.
- Install appropriate signage and/or barriers to delineate 'No Go Zones', 'Environmental Protection Area', and the limit of approved disturbance areas.
- Clearly identify limit of clearing areas in site inductions

Impacts to *Austrostipa Nullanulla*

Ensure that *A. nullanulla* is identified as a target species in the *Biodiversity Management Plan* and the *Rehabilitation Management Plan* and identify species-specific management and mitigation measures, including:

- pre-mining exclusion of grazing fauna from known habitat to enable adequate seed collection prior to clearing
- place gypsum-rich soils on the eastern margins of the Salt Pans during rehabilitation to provide specific habitat for *A. nullanulla* and maximise the potential for post-mining establishment of the species; and
- the construction of grazing enclosures around retained habitat areas.

Removal of Spinifex Grass

Develop a pre-clearing protocol which includes a requirement for detailed mapping of habitat features, and ensures that a suitably qualified and trained fauna handler is present during spinifex grass clearing to rescue and relocate any displaced fauna.

Impacts to Hollow-bearing trees

Develop a pre-clearing protocol which includes a requirement for detailed mapping of habitat features, and ensures that a suitably qualified and trained fauna handler is present during hollow-bearing tree clearing to rescue and relocate any displaced fauna.

Impacts to Surface and Groundwater

- Ensure that appropriate surface water and groundwater water controls are implemented (see Sections 6.2 and 6.7).
- Ensure site vehicles carry spill kits.
- Implement controls such as sediment fences, mulching or jute matting where appropriate.

Vehicle Collision with Fauna

- Establish a speed limit of 50km/h within the Mine Site.

Impacts on Native Flora and Fauna

- Ensure that soil and seed material is not transferred into the Mine Site to prevent weed invasion.
- Ensure that any weed infestations within the Mine Site are identified and mapped and appropriate weed management is implemented as outlined in the *Biodiversity Management Plan* and the *Rehabilitation Management Plan*.
- Implement a feral animal management program, and outline this program in the *Biodiversity Management Plan*, to reduce and/or manage populations of feral animals at the Mine Site including goats, rabbits, pigs, foxes and cats.
- Ensure that site-specific management plans consider measures to mitigate impacts to biodiversity values associated with noise, vibration, waste, lighting, and air pollution.

Contingency Measures

In addition to the above, the Applicant would implement the following contingency mitigation measures should the following triggers be exceeded.

- Unapproved clearing of areas of native vegetation.
  - Cease all activities in the area of unapproved clearing.
  - Report the unapproved clearing to the relevant government agency and undertake rectification or additional offsetting as required.
  - Review internal processes for ground disturbing activities implement improvements to prevent a recurrence.
- Monitoring indicates weed or pest abundance at unacceptable levels.
  - Amend and improve the existing weed and pest control strategy in consultation with surrounding landholders.
- Unanticipated or excessive fauna deaths or injuries associated with direct (i.e. vehicle strike, contamination) or indirect (i.e. light, noise, dust) causes.
  - Investigate the root cause of the unanticipated deaths or injuries and implement additional control measures as required.

6.3.8 Offsetting of Residual Impacts

6.3.8.1 Ecosystem Credit Requirements

EnviroKey (2024) determined the ecosystem credit requirements for the Project using the BAM Calculator. **Table 6.3.15** identifies the numbers and classes of credits required to be retired in accordance with the variation rules. The Applicant proposes to retire these biodiversity offset credits through a combination of mechanisms under the BC Act (see Section 6.3.8.3).

Table 6.3.15
Ecosystem Credit Requirements and Trading Groups

PCT	Offset Trading Group	Ecosystem Credits Required Mine Site BDAR Footprint	Ecosystem Credits Required Linear Corridor BDAR Footprint
28	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions. This includes PCT's: 19, 21, 28, 48, 75	145	43
58	Semi-arid Sand Plain Woodlands >=50% and <70%	12,639	1,549
64	Inland saline Lakes <50%	2,434	-
143	Sand Plain Mulga Shrublands <50%	-	456
154	Aeolian Chenopod Shrublands <50%	21,901	590
157	Riverine Chenopod Shrublands >=50% and <70%	43,989	-
165	Riverine Plain Grasslands <50%	-	1,829
170	Dune Mallee Woodlands <50%	32	415
171	Dune Mallee Woodlands <50%	8,648	348
221	Semi-arid Sand Plain Woodlands <50%	8,760	-
253	Inland Saline Lakes <50%	1,695	-
	Total Ecosystem Credits:	**100,243**	**5,230**
		105,473	
Source: EnviroKey (2024) – after Table 48, 49			

6.3.8.2 Species Credit Requirements

EnviroKey (2024) determined the species credit requirements for the Project using the BAM Calculator. **Table 6.3.16** identifies the numbers and classes of credits required to be retired in accordance with the variation rules. The Applicant proposes to retire these biodiversity offset credits through a combination of mechanisms under the BC Act (see Section 6.3.8.3).

Table 6.3.16
Species Credits for the Project

Name of Threatened Species	BC Act Status	EPBC Act Status	Species Credit
Austrostipa nullanulla	Endangered	-	444
Greenhood Orchid	Vulnerable	-	11,307
		Total Species Credits:	**11,751**
Source: EnviroKey (2024) – After Table 50			

6.3.8.3 Proposed Biodiversity Offset Strategy

The Applicant proposes to establish one or more Stewardship Sites within or surrounding the Mine Site to generate all required ecosystem and species credits for the Project. The location and size of the proposed Stewardship Sites have yet to be determined, however, it is the Applicant's preference that the Stewardship Sites would be located to the extent practicable within Project-related land, namely within Warwick Station or on nearby properties subject to suitable commercial arrangements with the relevant landholders (**Figure 5.1**).

Preliminary surveys undertaken within Warwick in 2020 indicated that a large portion of credits required by the Project as it was then understood would be available within that property. Additional credits would be required to be sourced from Stewardship Sites located on surrounding properties, subject to suitable commercial agreements with the relevant landholders.

The Applicant's least preferred option would be to retire any residual credits by paying into the Biodiversity Conservation Trust.

At the time of finalisation of this document (April 2024), the Applicant had sought proposals from suitably qualified ecologists to complete preliminary biodiversity credit availability assessments within Warwick Station and other nearby properties nominated by land holders during consultation.

A further consideration in establishing one or more Stewardships Sites is the mineral prospectivity of the surrounding land. The Applicant has since 2020 substantially extended the known extent of the mineral sand deposits and identified additional deposits. Exploration operations continue to be undertaken to better define the extent of those deposits, as well as to identify or "sterilise" areas where mineralisation does not occur.

In light of the above, the Applicant recognises an inherent tension between providing adequate biodiversity offsets for the Project while not sterilising mineral sands resources for future generations. As a result, the Applicant will implement the following during the assessment phase of the application.

- Undertake additional exploration drilling to confirm the presence/absence of mineral sand.
- Land that has been "sterilised" through this process would, subject to landholder consent, be assessed under BAM 2020 to determine biodiversity credits that may be available.
- Where biodiversity credits are identified on land not owned by the Applicant, suitable commercial arrangements to establish Stewardship Sites on those properties would be negotiated.

Finally, the Applicant would, prior to determination:

- identify staging for the retirement of the required biodiversity credits; and
- identify the likely source for credits for retirement of the Stage 1 biodiversity credits, including the location of proposed Stewardship Sites.

In addition, the Applicant would continue to liaise with Federation University, owner of "Nanya" station, located approximately 35km to the north of the Mine Site, in relation to a suitable partnership to:

- establish research projects related to management of biodiversity in the area surrounding the Mine Site; and
- the potential to utilise a portion of "Nanya" station as a Stewardship Site.

The Applicant would also implement a program to research and share knowledge and resources in relation to rehabilitation of disturbed landscapes within and surrounding the Mine Site and reestablishment of threatened species and communities within such landscapes. This would include establishing a seed harvesting, storage and spreading program and nursery.

6.3.9 Monitoring

The Applicant would implement a *Biodiversity Management Plan* prepared by a suitably qualified person in consultation with the relevant agencies. The *Biodiversity Management Plan* would encompass the following monitoring components.

- Ongoing monitoring to assess the impact of the Project on local fauna populations.
- Preparation of a decision-making framework setting out thresholds and specific actions in relation to impacts to fauna populations as identified by the monitoring.
- Maintaining a record of observed or unexplained species mortality that occurs within the Mine Site or as a result of vehicle strikes.
- Monitor vegetation plots surrounding the Mine Site on a long-term basis to provide information for rehabilitation analogue sites.
- Utilize the analogue sites to maintain a record of *A. nullanulla* populations and ensure that populations are stable.
- Identification of any additional management and mitigation measures where necessary during monitoring.

Monitoring results would be maintained in a suitable database and would be reported in the Annual Review to be prepared for the Project. In addition, all monitoring results would continue to be made available on request to relevant government agencies and surrounding residents.

6.3.10 Conclusion

EnviroKey (2024) has determined that the Project would result in the following biodiversity-related impacts.

- Direct impacts to approximately 5771.75ha of native vegetation including:
  - 5449.91ha located within the Mine Site BDAR Footprint
  - 321.84ha located within the Linear Corridor BDAR Footprint
- Various indirect impacts to vegetation and fauna.
- Prescribed impacts including disturbance of the following.
  - 5771.75 of native vegetation.
  - 241.95ha of PCT 253 and associated gypsum soils.
- Impacts to 30.14ha of habitat suitable for *A. nullanulla*
- 409.88ha of habitat assumed to be suitable for Cobar Greenhood Orchid.
- 5.89ha of habitat suitable for the White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone endangered ecological community.
- 466.01ha of habitat suitable for the Eastern Mallee Bird Community endangered ecological community.

The Applicant would retire 105,473 ecosystem credits and 11,751 species credits using one or more Stewardship Sites or through purchase of the required credits from third parties, with any residual credit requirements retired via a payment into the Biodiversity Conservation Fund.

Finally, EnviroKey (2024) states that the Project would not have a significant impact on a species or ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999*. As a result, referral under that Act would not be required.

6.4 Soil and Land Capability

6.4.1 Introduction

The SEARs identified "land and soil" as a key issue requiring assessment. The principal assessment requirements identified relating to Soil and Land capability included the following.

- "an assessment of the likely impacts of the development on the soils and land capability of the site and surrounds, and a description of the mitigation and management measures to prevent, control or minimise impacts of the development and to inform progressive rehabilitation."
- "the likely impact of the development on landforms (topography), including the long-term geotechnical stability of any new landforms on site."
- " the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements of Part 2.3 of *State Environmental Planning (Resources and Energy) 2021,* paying particular attention to the agricultural land use in the region"
- "consideration of potential land contamination consistent with the requirements of Chapter 4 Remediation of Land of the *State Environment Planning Policy (Resilience and Hazards) 2021."*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from the EPA and the Department of Primary Industries – Agriculture. These requirements, where additional to those above, are summarised as follows.

- Land and soil assessments to inform the progressive rehabilitation of the project area.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

The *Land and Soil Capability Assessment* for the Project was undertaken by Sustainable Soils Management Pty Ltd (SSM). The resulting report, hereafter referred to as SSM (2024), is presented as **Appendix 7**. This subsection provides a summary of SSM (2024) and describes the management and management measures to be implemented by the Applicant. For the purposes of this subsection, the area assessed by SSM (2024) is referred to as the Soil Survey Area.

In relation to potential land contamination, the Applicant notes the following in relation to Chapter 4 and Section 4.6(1) of the *State Environment Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP).

- The Mine Site has been used previously for agricultural purposes and, as a result is not considered to be contaminated.
- Similarly, the Rail Facility has been used previously for rail load out operations. To the Applicant's knowledge, no hydrocarbons, chemicals or other potential contaminants have been stored within the Rail Facility. In addition, while the Rail Facility is located adjacent to both the Rasp and the Broken Hill North Mines, each of which has historically extracted and processed lead ore, the Applicant contends that there is no reason to expect that the Rail Facility would be lead contaminated. As a result, the Rail Facility is not considered to be contaminated.

In light of the above, Chapter 4 of the Resilience and Hazards SEPP is not considered further.

6.4.2 Existing Environment

6.4.2.1 Mapped Land Systems and Land Capability

SSM (2024) note that the rangelands of western New South Wales were classified by Walker (1991) into Land Systems based on landform and vegetation. **Figure 6.4.1** and **Table 6.4.1** present the mapped Land Systems within the Soil Survey Area. In summary, 48% of the Soil Survey Area is mapped as the Huntingfield Land System. Walker (1991) refers to the Huntingfield Land System "groundwater discharge basins," with this land system largely confined to the Eastern and Western Salt Pans. The remainder of the Soil Survey Area is mapped as a series of land systems dominated by sand plains with varying proportions of dunes. The soil types in these Land Systems are predominantly Calcarosols, Chromosols in swales, and dunes with sandy Arenosols.

Land and soil capability is assessed under *The land and soil capability assessment scheme - second approximation* (OEH, 2012). That document identifies eight classes of land capability, relevantly including the following.

- Class 8 (extremely low capability land) – Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation.
- Class 6 (low capability land) - Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
- Class 5 (moderate to low capability land) – Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
- Class 4 (moderate capability land) – Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.

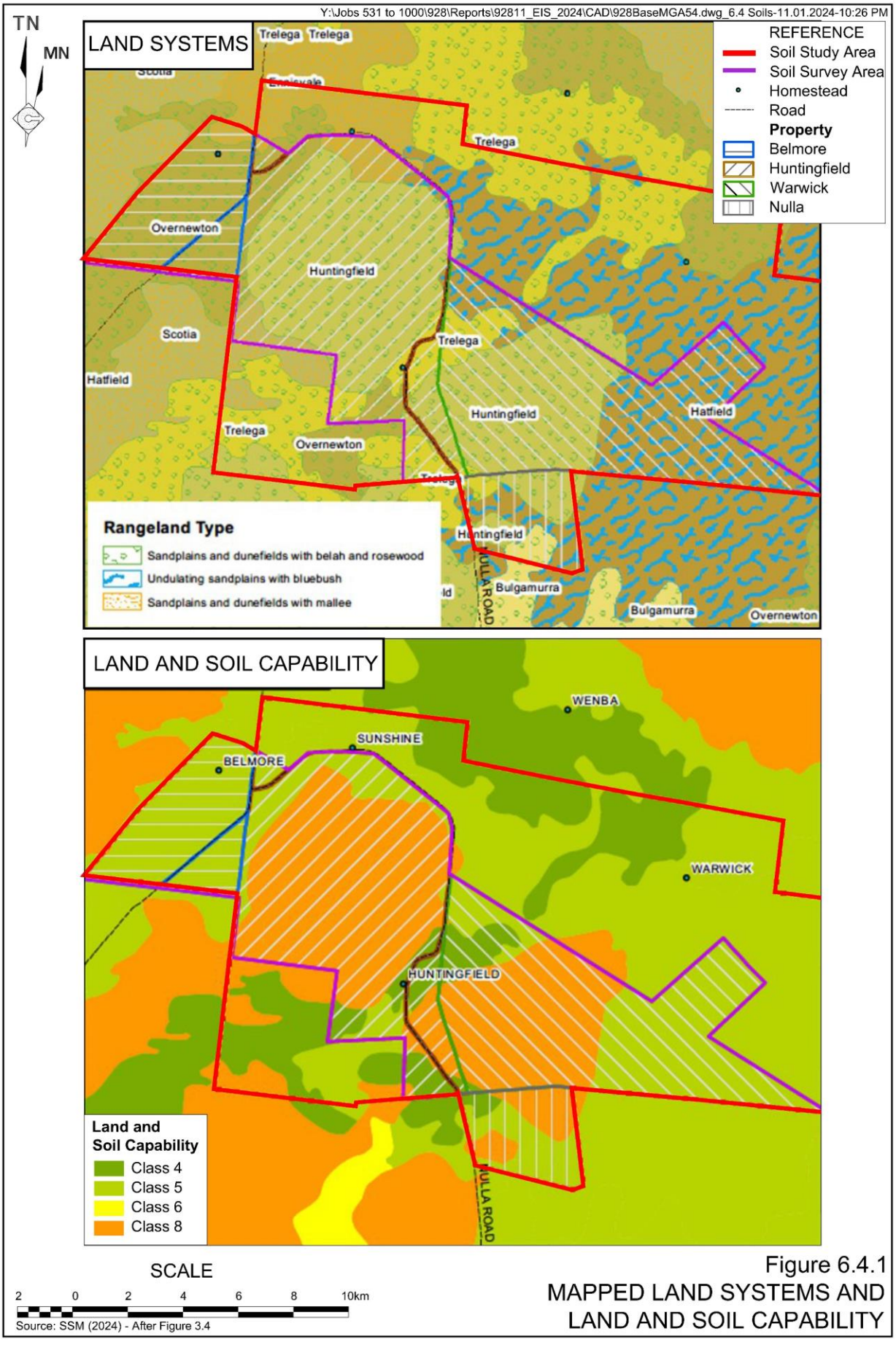


Figure 6.4.1
MAPPED LAND SYSTEMS AND LAND AND SOIL CAPABILITY

Figure 6.4.1 and **Table 6.4.1** present a summary of the land and soil capability of each Land System within the Soil Survey Area.

Table 6.4.1
Mapped Land Systems and Regional Land and Soil Capability within the Soil Study Area

Land System[1]	Area (ha)	Description[1]	Regional Land and Soil Capability[2]
Huntingfield Land System	7,836	Groundwater discharge basins with soils consisting of basin floors with a mosaic of gypseous or saline clays, islands of brownish soil underlain by powdery gypsum (copi), sandplains and lunettes of siliceous sand, and deep earthy sand underlain by gypsum.	LSC 8
Trelega Land System	1,160	Sandplains with dunes mostly oriented east west with soils consisting of plains and swales of highly calcareous Calcarosols with areas of deep earthy sand.	LSC 4
Hatfield Land System	3,514	Extensive undulating plains with bluebush and dunes mostly oriented east west with soils consisting of plains of Calcarosols, brown Chromosols and red Dermosols. Dunes of deep, brownish sand.	LSC 5
Overnewton Land System	2,775	Extensive open plains with isolated sandy hummocks and depressions with soils consisting of sandplain with Calcarosols including dunes and rises of deep brownish sand.	LSC 5
Scotia Land System	253	Sandplains and dunefields with mallee and consisting of dunefields with Calcarosols and Tenosols.	LSC 5
Ennisvale Land System	488	Sandplains and dunefields with mallee and consisting of dunefields with Calcarosols and Chromosols.	LSC 5
Bulgamurra Land System	172	Sandplains and dunefields with belah and rosewood, and consisting of dunefields with Calcarosols, and Arenosols.	LSC 5
Note 1: As per Walker (1991). Note 2: As per the *Land and Soil Capability Assessment Scheme – Second Approximation* (OEH, 2012).			
Source: SSM (2024) – modified after Table 3.1			

6.4.2.2 Mapped Landforms

The dominant surface features in the Soil Study Area are the Eastern and Western Salt Pans (see **Figure 6.1.4)** which are typically flat with raised gypsite[3] flats and lunettes.[4] Larger lunettes occur on the eastern border of the salt pans (SSM, 2024). Soils in and around the salt pans are expected to be saline.

The remaining approximately half of the Soil Study Area is variably mapped as Sand Plains and Dune Fields. These features occupy significant areas in the vicinity of the Soil Survey Area, with soil textures anticipated to be sand in the dunes and sandy with calcium rich subsoil in swales and sand plains.

The Soil Survey Area is characterised by a fine dendritic drainage pattern. The Soil Study Area landscape is generally undulating and is characterised by an average slope of 2% and maximum slopes of 5% where lunettes border the Salt Pan floor. Considering these characteristics, SSM (2024) concludes that the shape of the landscape is unlikely to drive erosion of soils by water. Land use in the area surrounding the Soil Study Area is typically low intensity grazing of native vegetation. This land use is consistent with the mapped land and soil capability Classes 4, 5, 6 and 8 (**Figure 6.4.1**).

[3] Gypsite is a mixture of fine-grained gypsum and sand that in the Soil Study Area forms raised landforms within and adjacent to the Salt Pans.

[4] A lunette is a crescent shaped dune comprising fine-grained materials on the down-wind side of ephemeral lakes or salt pans

SSM (2024) notes that water is likely to be the major limiting factor with regards to plant growth, with the average monthly potential evapotranspiration ranging from double the average monthly rainfall in July to up to 10 times the average rainfall in January and February. Soil properties are controlled by the water regime, with carbonate common in upland profiles and salt pans which are likely to be saline (SSM, 2024).

6.4.3 Assessment Methodology

6.4.3.1 Overview

The Land and Soil Capability Assessment for the Project was completed in accordance with the guidelines presented in *Guidelines for Surveying Soil and Land Resources* (Hewitt *et al*, 2008).

The Soil Study Area comprises an area of approximately 16,197ha including all areas of proposed disturbance within the Mine Site.

The soil and landscape assessment was undertaken as a stratigraphic survey, whereby correlations between soil properties and broad scale factors (e.g. geology and landscape position) are assumed and variations are linked to covariates which inform soil type mapping.

The soil and land capability survey occurred over three phases in each of 2020, 2022 and 2023.

The following key components were undertaken by SSM (2024) to complete the soil and land capability assessment for the Project.

- Desktop review and assessment of existing information relating to soils and landforms in the Soil Study Area.
- Field surveys, including an electromagnetic induction survey, soil sampling and laboratory analysis, and a preliminary assessment of potential acid sulphate soils.
- Analysis of results to assess land and soil capability, management and mitigation measures and the impact of the Project on agricultural soil resources.

6.4.3.2 Electromagnetic Induction Survey

The electromagnetic induction (EM) survey was undertaken by Terrabyte Services over the Soil Study Area using a DualEM21HS instrument which provides simultaneous conductivity measurements at 0.3m, 0.5m, 0.8m, 1.0m, 1.6m and 3.2m depths. Soil conductivity is a measure of salinity, with more saline soils having higher conductivities than less conductive soils. A description of how the EM operates and detailed methodology is included in **Appendix 7**.

During the 2020 survey, readings of soil conductivity were taken at approximately 5m spacings along 50m transects, resulting in an EM survey density of approximately 40 readings per hectare. For the 2022 surveys, the transect spacing was increased to 200m and was supplemented by cross transects aligned with boundaries in land shape at 200m spacings. For the 2023 survey, transect spacing was reduced to 100m.

6.4.3.3 Soil Sampling and Analysis

SSM (2024) selected soil sample sites using a conditioned Latin Hypercube method which considered variables including location, the results from the six layers of the EM survey, satellite imagery, elevation, slope and slope position, depth below the rim of closed depressions and Multi-resolution Valley Bottom Flatness (MrVBF). This selection process identified a total of 25 soil sample pit locations across the 2020 Soil Study Area. For the 2022 and 2023 surveys, 85 and 16 soil core locations were selected using a conditioned Latin Hypercube (Minasny and McBratney, 2006) method. This represents an average sample density of approximately 129ha per sample site. SSM (2024) notes that this sample density is appropriate for a 1:100,000 scale map which is appropriate for the purposes of strategic planning for intensive land use.

For the 2020 sampling period, each detailed soil sample pit was excavated using a backhoe to approximately 1.4m. For the 2022 and 2023 sampling campaigns, soil profiles were examined from three cores that were 1.4m deep per site. **Table 6.4.2** presents the soil properties examined at each sampling site and the analytes measured during subsequent laboratory testing of soil samples. Soil samples were collected from standard depths (0cm-15cm, 15cm-30cm, 30cm-60cm and 60cm-100cm) for all sites and laboratory analyses were completed by Incitec Pivot Laboratories. The laboratory is accredited by both the National Association of Testing Authority (NATA) and Australian Soils and Plant Analysis Council (ASPAC).

Table 6.4.2
Soil Properties and Analytes Assessed at Soil Sample Sites

Soil Properties	
Field Assessment	
• Depth of soil horizons	• Size and type of concretions.
• Texture	• Effervescence (indicates proportion of soft carbonates).
• Field pH	• Permeability and drainage (whole profile)
• Dispersion	• Nature of surface 2cm (e.g. hard setting).
• Root density	• Potential annual crop rooting depth (estimated based on structure, texture and pH).
• Proportion of soil occupied by gravel	• Volume of Readily Available Water (RAW) (Calculated based on rooting depth and estimates of available water for each texture class).
• Colour and degree of mottling	• Salinity (estimated by measuring the conductivity of soil in water at a 1:5 ratio).
• Grade, type of structure and ped size (2020 only)	• SOILpak score.
Laboratory Analysis	
• Anions of chloride, sulphate (KCl), and carbonate (% $CaCO_3$ equivalent)	• Electrical conductivity for saturated extract (ECe) (corrected for sulphate).
• pH (1:5 water), pH (1:5 $CaCl_2$) and electrical conductivity (1:5 water)	• Cations of calcium, magnesium, sodium, potassium and aluminium for 18 sites*
• Particle size distribution (hydrometer method) and proportion of clay, silt, fine sand and coarse sand	• Organic carbon, available phosphorus, and available micronutrients of zinc, copper, iron and manganese for 8 core sites (0 to 15 cm and 15 to 30 cm layers only)[1]
• Nitrate nitrogen and ammonium nitrogen	
Note 1: In addition, a further 18 observation sites and 8 test cores were described by SSM (2024) in less detail for use as observations sites to confirm the accuracy of soils mapping.	
Source: SSM (2024) – modified after Section 2.5.2 and 2.6.	

6.4.3.4 Acid Sulphate Soil Assessment

Measurements and observations made in the detailed soil sample pits and cores indicated that the Soil Study Area had the potential to contain acid sulphate soil. Acid sulphate soil is soil, typically from an anaerobic environment, that is not naturally acidic but has the potential to become so when disturbed and exposed to air or oxygen.

SSM (2024) assessed the presence and extent of potential acid sulphate soil in the Soil Study Area in accordance with the method provided in the *Acid Sulfate Soils Assessment Guidelines* (Ahern *et al.*, 1998) as outlined in the following steps.

1. Determine whether the Soil Study Area is mapped by the NSW government as having a risk of containing Acid Sulphate Soils.
2. Determine whether the Soil Study Area meets specific geomorphic or site criteria outlined in Ahern et al (1998).
3. Analyse soil and water indicators of acid sulphate soils.
4. Undertake chemical analyses to confirm acid sulphate soil presence and relevant action levels for acid sulphate soil management.

6.4.4 Field Assessment Results

6.4.4.1 Electromagnetic Survey Results

Figure 6.4.2 presents the results of the EM survey. In summary, apparent electrical conductivity values were lowest in the 0cm to 30cm layer and highest in the 0cm to 320cm layer. This trend is consistent with dry surface soil conditions and increasing soil moisture and salinity with depth. SSM (2024) notes that there was a very high correlation between relative electrical conductivity (ECa) for all depths, meaning that ECa at one depth can be predicted from measures of ECa at another depth.

In general, apparent electrical conductivity values were found to be in areas where elevation was lower than 30m, which are characterised as groundwater discharge basins and consistent with elevation of relict lake floors. In both the eastern and western relict lake floors, ECa was measured at >200mS/m. Measures of moderately high ECa were found at the eastern relict lake and along the northern boundary of the Soil Study Area in Warwick in small depressions. SSM (2024) notes that lower ECa was recorded near the eastern margin of dunes and lakes, that increased with distance eastward from the lakes.

6.4.4.2 Soil Associations

Soil tested within the Soil Study Area were typically sandy, with loamy sand occurring at depths between 0cm and 15cm and increasing clay content with depth. Soils were also found to be alkaline, with significant variation observed in concentrations of salts with anions of chlorine, sulphate and carbonate typically increasing with depth (SSM, 2024).

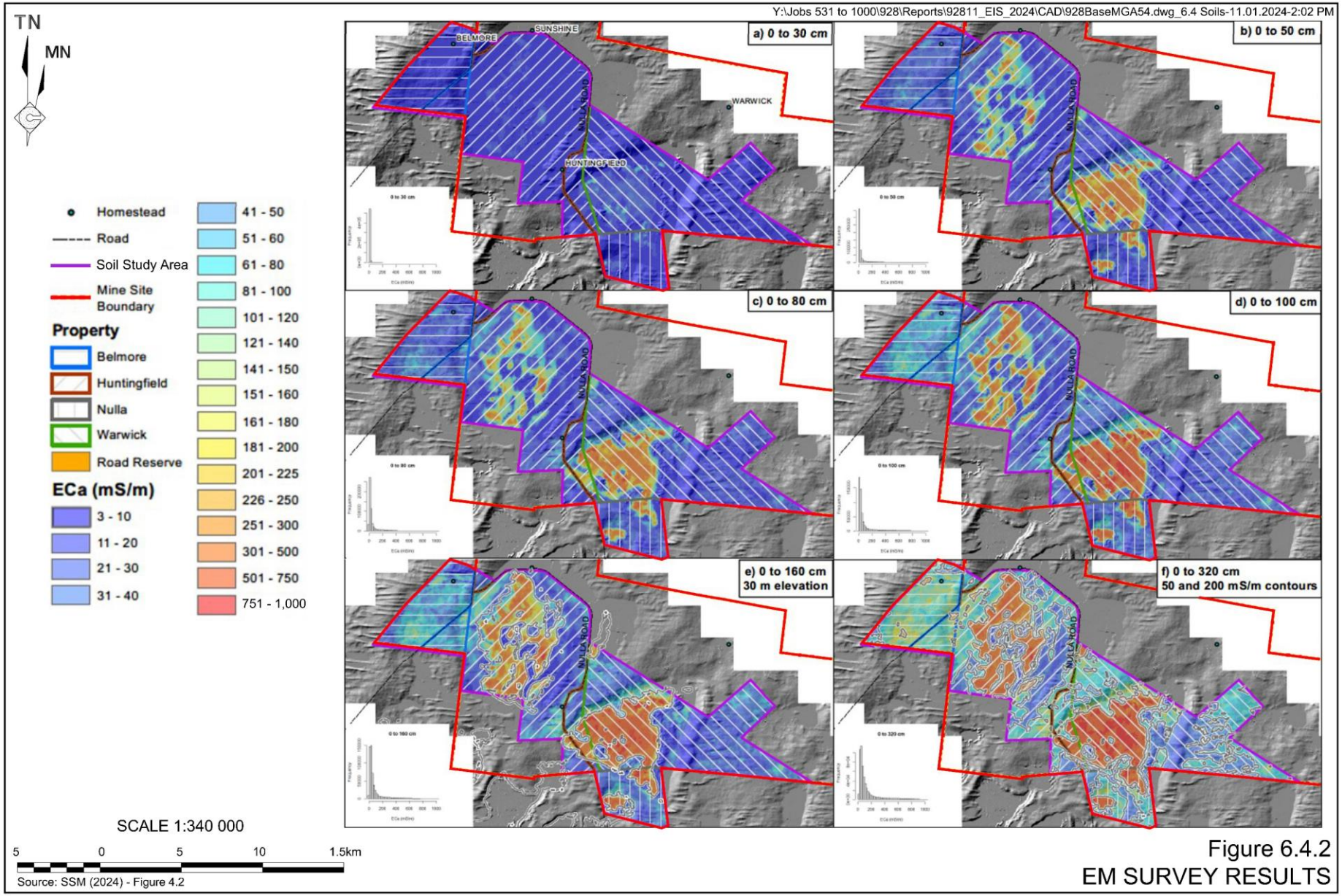


Figure 6.4.2
EM SURVEY RESULTS

SSM (2024) described six soil associations for the Soil Study Area (**Table 6.4.3** and **Figure 6.4.3**). In summary, the soil associations may be described as follows.

- Dunefield and Sand Plains – red sandy topsoil over sand to sandy clay loam subsoil. The landform ranged from undulating plains to dunes and swales. Profiles have low salinity, but carbonate is common. SSM (2024) further subdivided this soil association into two phases as follows.
  - Swales – well drained, high carbonate soil.
  - Dunes – well drained, high carbonate soil, higher in the landscape and had sandier surface soil than the Swales Phase.
- Blanchetown Clay – occupies low lying areas in the western portion of the Soil Survey Area and on the western slope of the eastern Salt Pan, as well as depressions elsewhere. The texture profile is sandy surface soil over moist, plastic clayey subsoil, which is associated with moderate salinity.
- Lunettes – occurred on the eastern side of the salt pans. SSM (2024) state that these lunettes contain a large proportion of material that has been blown from the salt pans.
- Lunettes with Copi – occurred either near or downwind of the salt pans, which are their likely source of the copi or flour gypsum. Profiles contain a mixture of salts of carbonate, sulphate and chloride.
- Lake Floor East – occurs within the Eastern Salt Pan. The soil is clayey and soil salt chemistry appears to be dominated by chloride and sulphate.

Lake Floor West – occurs in the Western Salt Pan. The soil is sandy and soil salt chemistry appears to be dominated by sulphate.

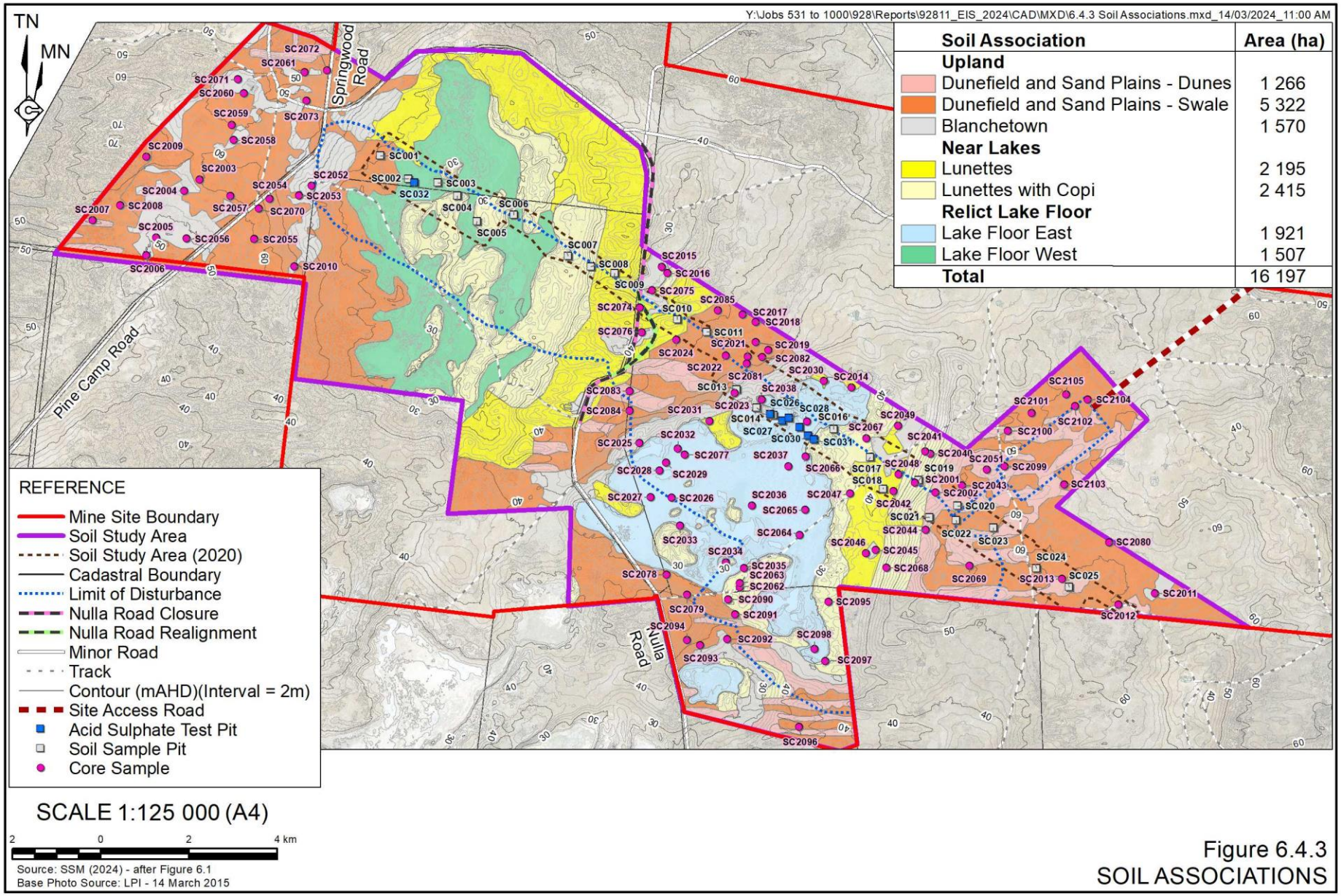


Figure 6.4.3
SOIL ASSOCIATIONS

Table 6.4.3
Soil Study Area Soil Associations

Australian Soil Classification		Average ECa[1] (mS/m)[2]	Drainage	Description
Order	**Sub Order**			
1. Dunefield and Sandplains (Sample Sites: 5 pits and 39 core sites; Area: 5,322ha)				
a) Swales Phase				
Calcarosol (34), Chromosol (8), Kandosol (1), Rudosol (1)	Supracalcic (8), Lithocalcic (2), Hypercalcic (10), Calcic (11), Hypocalcic (3), Red (9), Stratic (1)	79	Poorly (7%), Imperfectly (11%), Moderately well (36%), Well (43%), Rapidly (2%)	• Alkaline pH (increasing from 8.9 to 9.5 with depth). • Chloride concentrations low for all depths but the 60 to 90cm layer which were marginally high. • Sulphate concentrations very low in the upper layers and high in the 60cm to 100cm layer (538mg/kg). • Carbonate high throughout profile and increased from 11% to 18% with depth. • Average clay content increases from 15% to 30% with depth. • Coarse sand component decreases from 55% to ~40% with depth. • Suitable medium for plant growth but susceptible to wind erosion due sandy nature.
b) Dunes Phase				
Calcarosol (9), Chromosol (2)	Supracalcic (2), Lithocalcic (1), Hypercalcic (3), Calcic (1), Hypocalcic (2), Red (1), Brown (1)	46	Moderately well (55%), Well (36%), Rapidly (9%)	• Alkaline pH (increasing from 8.9 to 9.5 with depth). • Chloride concentrations low for all depths but the 60 to 90cm layer which were marginally high. • Sulphate concentrations low to moderate in the upper layers and high in the 60cm to 100cm layer (510mg/kg). • Carbonate high throughout profile and increased from 11% to 19% with depth. • Average clay content increases from 14% to 28% with depth. • Coarse sand component decreases from 55% to ~40% with depth. • Suitable medium for plant growth but susceptible to wind erosion due sandy nature.

Table 6.4.3 (Cont'd)
Soil Study Area Soil Associations

Australian Soil Classification		Average ECa[1] (mS/m)[2]	Drainage	Description
Order	**Sub Order**			
2. Blanchetown (Sample Sites: 3 pits and 16 core sites; Area: 1,570ha)				
Calcarosol (10), Chromosol (7), Kandosol (2)	Hypercalcic (4), Supracalcic (2), Calcic (2), Hypocalcic (1), Hypergypsic (2), Red (6), Brown (2)	155	Imperfectly (32%), Moderately well (53%), Well (16%)	• Alkaline pH – increase from 9.0 to 9.2 in the 40-60cm layer and then decreased to 8.9 in the 60-100cm layer. • Chloride concentrations increase from desirably low to high enough (2 400 mg/kg) to restrict plant growth in 60-100cm layer. • Carbonate concentrations averaged at 9-10% throughout profile. • Average clay content increased from 20% at the surface to 32% with depth. • Sulphate concentrations very low in 0 to 30cm layer, but increased to much greater concentrations by 60-100cm depth (3,062mg/kg). • Coarse sand component decreases from 45% to 40% with depth and had a wide range of grow sizes. • Soil productive in its natural state – will require care for use in rehabilitation.
3. Lunettes (Sample Sites: 3 pits and 6 core sites; Area: 2,195ha)				
Arenosol (2), Calcarosol (7)	Red (2), Lithocalcic (1), Hypercalcic (2), Supracalcic (3), Calcic (1)	65	Moderately well (44%), Well (33%), Rapidly (22%)	• Slightly alkalitic (8.7) at surface (0cm to 30cm) and alkaline (89.3) in deeper layers. • Chloride concentrations is desirably low. • Carbonate concentrations increase from 4% to 10% with depth. • Sulphate concentrations very low except 800 mg/kg in 60cm to 100cm layer. • Average clay content increased from 15% at the surface to 21% with depth. • Coarse sand component decreases from 55% to 50% with depth. • Could be used as topsoil during rehabilitation.
4. Lunettes with Copi (Sample Sites: 7 pits and 15 core sites; Area: 2,415ha)				
Calcarosol (18), Chromosol (3), Kandosol (1)	Supracalcic (3), Hypercalcic (3), Calcic (2), Hypergypsic (8), Red (3), Brown (1)	60	Imperfectly (5%), Moderately well (32%), Well (64%)	• pH was consistent (~8.5pH) with depth. • Chloride desirably low in 0 to 15cm layer. High enough to restrict plant growth in 30 to 100cm layers. • Carbonate increased from 4% to 7% with depth (variable). • Increase of clay from 15% to 25% with depth and a decrease of coarse sand from 45% to 35%% with depth. • Variable salt concentrations present due to wind moved from nearby saline lakes. In some areas, there is a layer of soil that supports vegetation and in others there is little soil to do so.

Table 6.4.3 (Cont'd)
Soil Study Area Soil Associations

Australian Soil Classification		Average ECa[1] (mS/m)[2]	Drainage	Description
Order	**Sub Order**			
5. Lake Floor West (Sample Sites: 3 pits; Area: 1,507ha)				
Arenosol (1), Rudosol (1), Calcarosol (1)	Brown (1), Hypersalic (2), Hypocalcic (1)	367	Poor (67%), Imperfect (33%)	• Average pH increases from 7.7 at surface to 8.3 with increased depth. Lowest pH compared to other soil associations. • Chloride desirably low between 0cm and 30cm but increases to levels which would restrict plant growth between 30cm to 100cm. • Sulphate and carbonate concentrations generally low (<2%). • Clay content increases from 5% between 0cm and 30cm to 10% in deeper layers. • Highest coarse sand component (~60%) compared to other soil associations. • Top 30cm suitable for rehabilitation purposes (talking care to avoid deeper saline soils).
6. Lake Floor East (Sample Sites: 1 pit and 14 core sites; Area: 1,921ha)				
Hydrosol (11), Calcarosol (3), Rudosol (1)	Hyposalic (12), Hypergypsic (3)	549	Very Poor (27%), Poor (53%), Imperfect (13%), Moderately well (7%)	• pH level increased marginally from 8.2 to 8.3 with depth. • Low concentrations of carbonate (2-3%) and chloride is toxic to most plants. • Sulphate concentrations are greater than 4,000 mg/kg • Coarse sand increases from 20 to 22% with depth. • Clay increased from 28% to 38% with depth. • Extremely salty- no agricultural value. Only salt tolerant plants can grow on it.

Note 1: Apparent electrical conductivity.

Note 2: Average for soil layers from surface to 3m.

Source: SSM (2024) – modified after Section 6.1.5 and Table 6.1

6.4.4.3 Acid Sulphate Soil Assessment

The Acid Sulphate Soil assessment for the Project was undertaken by SSM (2024) in accordance with the Acid Sulfate Soils assessment guidelines (Ahern *et al.*, 1998). The following presents a summary of the results of each of the assessment steps.

Step 1 – Acid Sulphate Soil Mapping

SSM (2024) state that the NSW Acid Sulphate Risk Maps available on eSPADE indicates that there is no acid sulphate soil within the Soil Survey Area. However, the Atlas of Australian Acid Sulphate Soils published by the CSIRO indicates that the Eastern Salt Pan has a high probability of Acid Sulphate Soil occurrence.

Step 2 – Geomorphic and Site Criteria

The Eastern Salt Pan is similar to landscape features described in the Ana Branch 1:250 000 Geological Sheet Explanatory Notes (Ray, 1996). Extrapolating the results of that study indicates that sulphides may occur in soil beneath the Eastern Salt Pan. Consequently, the Soil Study Area satisfies the following geomorphic criteria specified by Ahern *et al*. (1998).

> "Areas identified in geological descriptions or in maps as bearing sulfide minerals, coal deposits or former marine shales/sediments (geological maps and accompanying descriptions may need to be checked)."

Step 3 – Soil and Water Indicators

SSM (2024) assessed water chemistry results from nine available groundwater samples taken within the Mine Site. Average chloride concentrations were found to be 32,500mg/L, representing levels which are approximately 67% higher than average seawater concentrations (19,400mg/L). Average sulphate concentrations were found to be 10,241mg/L, representing levels which are equivalent to approximately 280% of average sulphate concentrations in seawater. SSM (2024) notes that the resulting chloride to sulphate ratio of 3.2:1 for groundwater samples collected within the Soil Study Area is not a definitive indicator of the presence or absence of sulphides.

Field peroxide soil tests were undertaken in accordance with the procedure outlined in Ahern *et al*. (1998) for soil samples from two sites within the Soil Study Area which had been collected from waterlogged areas of the Eastern (SC015) and Western (SC002) Salt Pans (**Figure 6.4.4**). The soil profile of sample pit SC015 contained layers of "soft, buttery green-grey mud" and were found to have a pH of 1.4 following mixing with 30% peroxide (SSM, 2024). While SSM (2024) notes that these results are indicative only due to a delay between sample collection and testing, the low pH result indicates that it is possible that acid sulphate soils are present within the Soil Study Area.

Step 4 – Chemical Analysis

In light of the above, SSM (2024) coordinated collection and analysis of seven samples **Table 6.4.4** presents the results of analysis of those samples as well as the results of soil salinity (electrical conductivity) testing which was measured in conjunction with acid sulphate testing. In summary, the combined results of the tests undertaken in accordance with Ahern *et al.* (1998) indicate that all samples display a very low likelihood of being acid sulphate soils or potential acid sulphate soils (SSM, 2024). SSM (2024) also notes that reactions observed during field peroxide texts are likely to indicate the presence of oxidised sulphur rather than reduced sulphur in soil samples due to the presence of gypsum observed in samples and the broader landscape.

Table 6.4.4
Acid Sulphate Soil Testing Results and Soil Salinity

Page 1 of 3

Acid Sulphate Soil Criteria	Sample Depth (cm)	Sample[1]						
		SC026	SC027	SC028	SC029	SC030	SC031	SC032
Field pH (pH_F)								
≤4	0 - 25	7.7	8.2	7.7	7.7	7.8	8.8	7.6
	25 – 50	8.4	7.8	7.7	8.1	7.4	8.6	7.1
	50 – 75	8.3	7.8	8.1	8.2	7.6	8.3	5.4
	75 – 100	8.2	7.9	7.9	7.9	8	8.4	5.3
	100 - 125	8.7	8.1	8	8	8.1	8.3	5.1

Table 6.4.4 (Cont'd)
Acid Sulphate Soil Testing Results and Soil Salinity

Acid Sulphate Soil Criteria	Sample Depth (cm)	Sample[1]						
		SC026	SC027	SC028	SC029	SC030	SC031	SC032
Field Peroxide pH (pH_{FOX})								
<3 & strong peroxide reaction, OR 3 – 4 with low, medium or strong peroxide reaction, OR 4 – 5 (inconclusive) OR >5 with small/no fall in pH but low, medium or strong peroxide reaction.	0 - 25	7.6	6.2	6.4	7.5	7	8.4	6.5
	25 – 50	8.5	5.9	5.9	8	6.5	8.2	7.7
	50 – 75	8.7	6	6.2	8.5	6	8.4	5.6
	75 – 100	8.3	8	7.7	8.2	8.3	8.6	5.7
	100 - 125	6.8	7.6	7.2	8.2	8	8.5	5.5
Decrease in pH (pH_F – pH_{FOX})								
pH_F – pH_{FOX} = >1	0 - 25	0.1	2	1.3	0.2	0.8	0.4	1.1
	25 – 50	-0.1	1.9	1.8	0.1	0.9	0.4	-0.6
	50 – 75	-0.4	1.8	1.9	-0.3	1.6	-0.1	-0.2
	75 – 100	-0.1	-0.1	0.2	-0.3	-0.3	-0.2	-0.4
	100 - 125	1.9	0.5	0.8	-0.2	0.1	-0.2	-0.4
Reaction to 30% Hydrogen Peroxide								
Extreme of Volcanic reaction	0 - 25	Extreme	Low	Medium	Extreme	Medium	Volcanic	Extreme
	25 – 50	Volcanic	Medium	Low	Volcanic	Medium	Extreme	Volcanic
	50 – 75	High	Low	Low	Extreme	Medium	Extreme	Low
	75 – 100	High	Extreme	Medium	Extreme	Extreme	Extreme	Low
	100 - 125	Medium	Low	Medium	Volcanic	Extreme	Extreme	Low
Soil Moisture Rating[2]								
Wet	0 - 25	Moist	Moist	Moist	Moist	Moist	Dry	Moist
	25 – 50	Moist	Moist	Moist	Moist	Moist	Dry	Moist
	50 – 75	Moist	Moist	Moist	Moist	Moist	Trace of Moisture	Moist
	75 – 100	Moist	Wet	Moist	Wet	Moist	Trace of Moisture	Moist
	100 - 125	Moist	Wet	Wet	Wet	Moist	Trace of Moisture	Wet
Soil Reaction to 1 Molar Hydrochloric Acid								
Carbonate absent (i.e. no reaction)	0 - 25	None	None	None	None	None	None	None
	25 – 50	Moderately	None	None	Slightly	None	None	None
	50 – 75	Moderately	None	None	None	None	Very Highly	None
	75 – 100	None	None	None	None	None	Very Highly	None
	100 - 125	None	None	None	None	None	Very Highly	None
Likelihood of Potential Acid Sulphate Soil								
All above criteria	0 - 25	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	25 – 50	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	50 – 75	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	75 – 100	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	100 - 125	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low

Table 6.4.4 (Cont'd)
Acid Sulphate Soil Testing Results and Soil Salinity

Acid Sulphate Soil Criteria	Sample Depth (cm)	Sample[1]						
		SC026	SC027	SC028	SC029	SC030	SC031	SC032
Electrical Conductivity (ECe) (dS/m)								
N/A	0 - 25	33	170	68	79	36	6	121
	25 – 50	45	66	61	39	81	6	74
	50 – 75	40	66	50	46	43	45	29
	75 – 100	33	109	71	102	44	42	46
	100 - 125	ND	ND	ND	ND	ND	33	ND

Note 1: Orange shading = indicative of the presence of Potential Acid Sulphate Soils or an inconclusive result based on the relevant Acid Sulphate Soil criteria.

Note 2: As per NSCT (2009).

Note 3: N/A = not applicable to determining the presence/absence of acid sulphate soil.
ND = not determined.

Source: SSM (2024) – modified after Tables 7.2 to 7.9.

SSM (2024) undertook an Acid Sulphate Soil Risk Assessment based on Table 3.1 of Ahern *et al.* (1998). The results of that assessment are presented in **Table 6.4.5**. Despite the high-risk rating assigned to several factors, SSM (2024) notes that the results of testing indicate that there is a low risk of acid sulphate soils degrading soils within the Soil Study Area.

Table 6.4.5
Acid Sulphate Soil Risk Assessment

Factor	Project Description	Project Risk Rating
Volume of material to be disturbed	1.36 billion tonnes of ore, interburden and overburden	High
Distance between Acid Sulphate Soils and depth of disturbance	0m	High
Change to surface drainage	Surface drains will not capture potentially acidic groundwater	Low
Duration of disturbance Case 1: Routine Mining	Overburden removed from advancing face and placed in retreating face	Low
Case 2: Tailings Storage Facility	Tailings stockpiled for 14 to 16 years	High
Level of certainty with mitigation strategy	High certainty that burying potential acid sulphate soils will prevent leachate from this material reaching the surface	Low
Likely severity of Acid Sulphate Soils based on peroxide reaction	Extreme to Volcanic	High
Likely severity of Acid Sulphate Soils based on peroxide final pH	Minimum pH 5.5	Nil
Connection to natural waterbodies or wetlands	Accepts local runoff, with limited connection to surface drainage network	Low

Source: SSM (2024) – modified after Table 7.10

6.4.4.4 Land and Soil Capability Assessment

The Land and Soil Capability (LSC) assessment classifies land into one of eight classes that provides an indication of what level of activity the land can support without experiencing land and soil degradation.

SSM (2024) has assessed the LSC classes of the Soil Study Area in accordance with the *Land and Soil Capability Assessment Scheme – Second Approximation* (OEH, 2012). LSC classes were assigned to each of the 25 sites assessed and cores based on their susceptibility to eight hazards, namely:

- water erosion;
- wind erosion;
- soil structure decline;
- soil acidification;
- salinity;
- waterlogging;
- shallow soils and rockiness; and
- mass movement.

The LSC class for each sample site was calculated as the maximum LSC class for each of the eight hazards assessed. **Table 6.4.6** and **Figure 6.4.4** presents the average LSC class for each of the eight hazards assessed for each Soil Association at the Soil Study Area. SSM (2024) determined that the most limiting hazards across the 25 sample sites was wind erosion followed by salinity and soil structure decline. As a result, the dominant hazard within the Soil Study Area is susceptibility to wind erosion.

SSM (2024) determined that the LSC class for soils within the Soil Survey Area ranged from Class 6 (low capability land) to Class 8 (extremely low capability land).

Table 6.4.6
Existing Land and Soil Classification

Soil Association	Water Logging	Acidification	Structure Decline	Wind Erosion	Water Erosion	Shallow Soils / Rockiness	Mass Movement	Salinity	Existing Land and Soil Classification
Dunes and Sand Plains - Swale	1.6	2.0	2.5	5.4	2.2	3.1	1.0	3.3	**6**
Dunes and Sand Plains - Dune	1.6	1.6	2.7	6.0	2.2	2.8	1.0	3.0	**6**
Blanchetown	2.3	1.4	2.8	4.8	1.9	4.1	1.0	5.6	**6**
Lunettes	1.8	1.9	2.1	5.5	2.3	1.9	1.0	2.9	**6**
Lunettes Copi	1.5	1.9	3.5	4.6	2.4	2.5	1.0	4.0	**6**
Lake Floor East	2.6	2.2	2.6	4.2	2.0	5.9	1.0	8.0	**8**
Lake Floor West	5.3	2.3	3.0	5.3	1.3	2.0	1.0	5.3	**7**
Site average	**2.4**	**1.9**	**2.8**	**5.1**	**2.1**	**3.2**	**1.0**	**4.6**	

Note: Orange Shading = most limiting hazard for each Soil Association.

Source: SSM (2024) – modified after Table 8.2

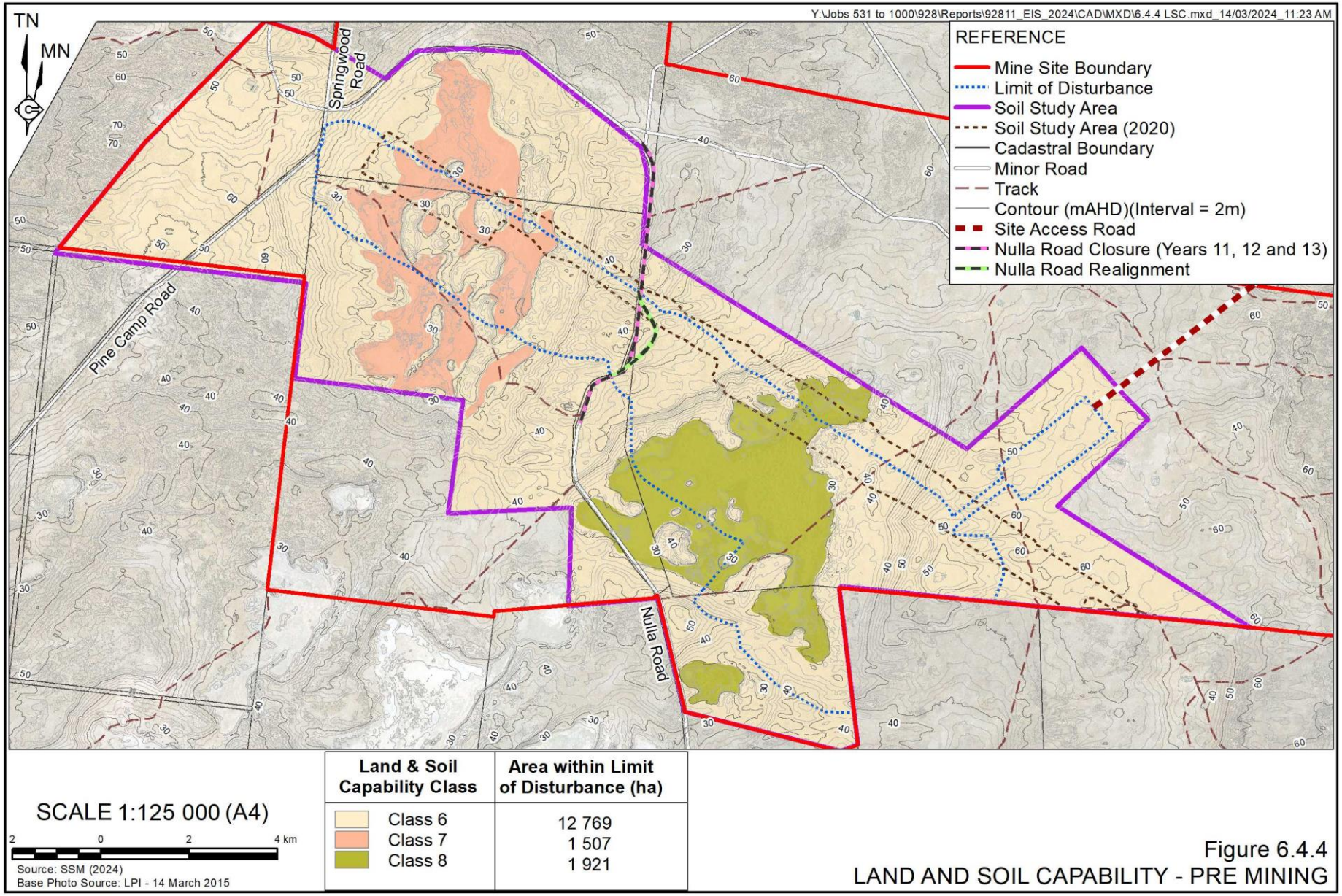


Figure 6.4.4
LAND AND SOIL CAPABILITY - PRE MINING

6.4.5 Soil Stripping and Placement Recommendation

6.4.5.1 Soil Stripping Recommendations

Table 6.4.7 presents the soil stripping depths recommended by SSM (2024). In summary between 0.2m and 0.4m of topsoil and 0.3m and 0.8m of subsoil would be stripped. No stripping of soils within the following soil associations is recommended.

- Lake Floor East Soil Association (topsoil and subsoil) – SSM (2024) determined that the soils of this soil association are toxic to plant life and, as a result, should not be stripped.
- Blanchetown Soil Association (subsoil only) – SSM (2024) determined that subsoils of the Blanchetown Soil Association were not suitable for stripping as the material was too saline and the Exchangeable Sodium Percentage was too low for use in rehabilitation operations.

Table 6.4.7
Recommended Soil Stripping Depths and Total Available Volume

Soil Association	Topsoil		Subsoil	
	Thickness (m)[1]	Volume (m^3)[2, 3]	Thickness (m)[1]	Volume (m^3)[2, 3]
Blanchetown	0.2	529,469	Nil[4]	-
Dunefield and Sand Plain-Dune	0.35	702,648	0.8	1,606,053
Dunefield and Sand Plain-Swale	0.2	916,916	0.8	3,667,664
Lake Floor East	Nil[5]	-	Nil[5]	-
Lake Floor West	0.3	1,212,949	0.3	1,212,949
Lunettes	0.4	1,714,632	0.6	2,571,948
Lunettes with Copi	0.3	2,951,089	0.7	6,885,874
Total		**8,027,703**		**15,944,487**

Note 1: Source – SSM (2024) – After Table 9.3
Note 2: Limited to the Soil Balance Area (see **Figure 6.4.5**)
Note 3: Source – RZ Resources Limited
Note 4: The Blanchetown Soil Association subsoil to too saline and has an Exchangeable Sodium Percentage that is too low. The material is therefore not recommended for stripping.
Note 5: The Lake Floor East soil association is toxic to plant life and is not recommended for stripping

SSM (2024) identified areas in which substantial landform reconstruction would be undertaken, including the following.

- Extraction Area.
- Off Path Storage Facility.
- Water Storage Area.

SSM (2024) identified that these areas will require soils to be "built". Based on this, the Applicant identified a Built Soils Area and calculated a detailed soils balance for that area (**Figure 6.4.5**).

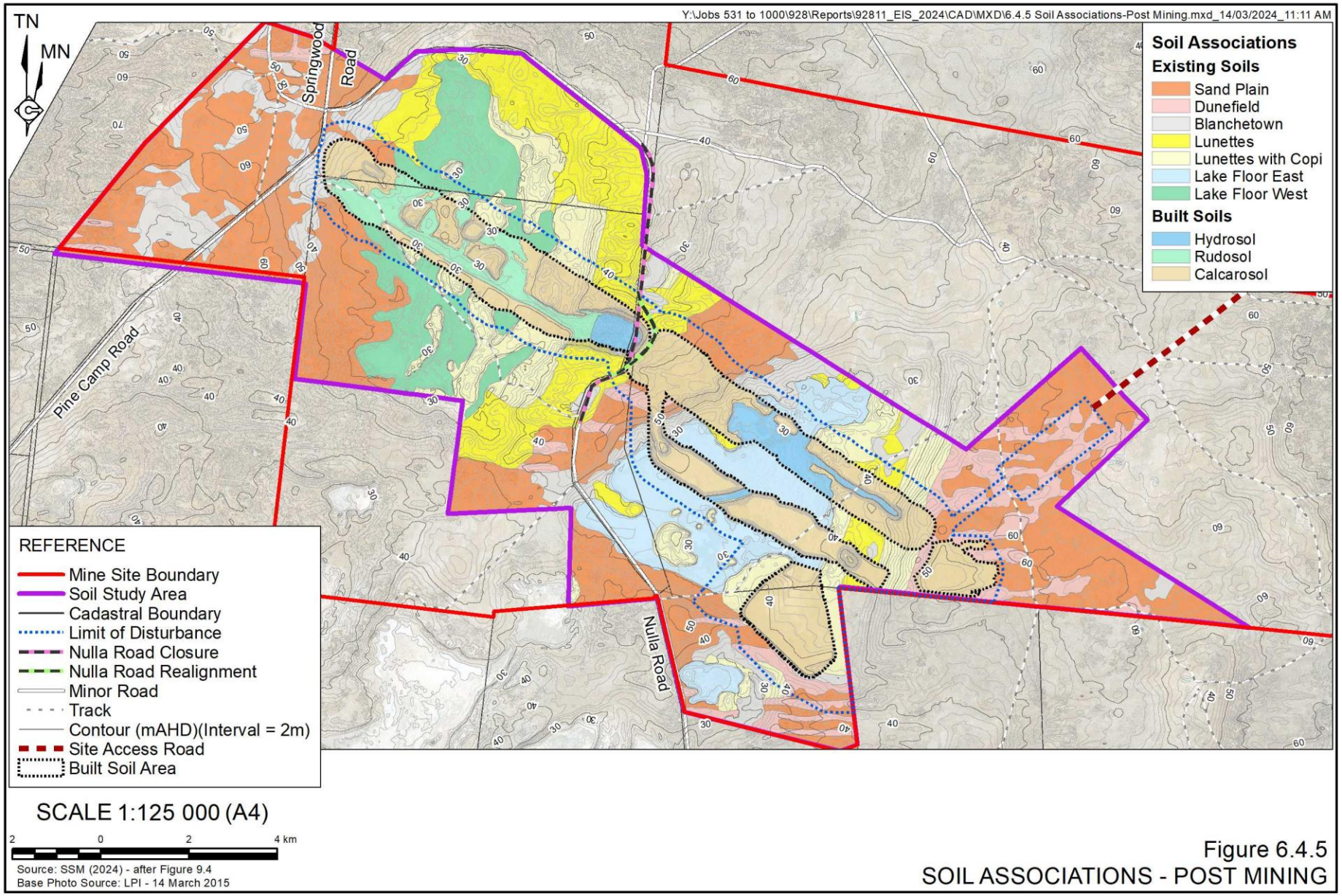


Figure 6.4.5
SOIL ASSOCIATIONS - POST MINING

Other areas of disturbance, including the Infrastructure Area, Soil Stockpile Area and buffer zone would be largely returned to the pre-mining landform. Soils from those areas would be stockpiled adjacent to the disturbance area and respread over the same area once no longer required for mining purposes. As a result, the soil availability and demand within these areas would be largely balanced.

Table 6.4.7 presents the volume of soil available to be stripped within the Built Soil Area determined by the Applicant based on the stripping depths recommended by SSM (2024).

6.4.5.2 Soil Placement Recommendations

SSM (2024) identified three classifications of "built" soils as follows (**Figure 6.4.5**).

- Calcarosol – or soils containing calcium salts. The Calcarosols would occupy more elevated sections of the final landform and would comprise a loamy topsoil and a clayey subsoil.
- Rudosol – or "young" soils. The Rudosols would occupy the floor of the Western Salt Pan.
- Hydrosol – or "wet' soils. The Hydrosols would occupy the floor of the Eastern Salt Pan and the backfilled final void within the Year 17 mining area. These soils would be in close proximity to the regional water table.

Table 6.4.8 presents the built soil placement depths recommended by SSM (2024). In summary, 0.23m of topsoil and 0.2m of subsoil would be placed in areas identified for Calcarosol and Rudosol Soil Associations. No placement of soils would be undertaken for the Hydrosol Soil Association because those soils would be in close proximity to the highly saline groundwater and would likely be devoid of plant life.

Table 6.4.8
Recommended Soil Placement Depths and Total Required Volume

Built Soil Association	Topsoil		Subsoil	
	Thickness (m)[1]	Volume (m^3)[2,3]	Thickness (m)[1]	Volume (m^3)[2,3]
Calcarosol	0.23	6,538,916	0.2	5,686,014
Hydrosol	Nil[4]	-	Nil[4]	-
Rudosol	0.23	1,368,061	0.2	1,189,618
Total		**7,906,976**		**6,875,632**

Note 1: Source – SSM (2024)

Note 2: Limited to the Soil Balance Area (see **Figure 6.4.5**)

Note 3: Source – RZ Resources Limited

Note 4: Hydrosols are expected to be saline and would not be subject to revegetation. As a result, that soil association does not require productive soils to be spread on the final landform

Table 6.4.8 also presents the volume of soil required for rehabilitation within the Built Soils Area determined by the Applicant based on the placement depths recommended by SSM (2024).

Soils within areas outside the Soil Balance Area would be respread to the same thickness and in the same areas that they were stripped.

6.4.5.3 Soil Balance

Tables 6.4.7 and **6.4.8** present a life of Project soil balance. Those calculations identify a small surplus of topsoil and a substantial surplus of subsoil within the Built Soil Area. However, as identified in Section 3.4.5.1, construction and mining operations would generate variable volumes of overburden, interburden and reject material throughout the life of the Project. Similarly, the volume of soil stripped, and volume required for rehabilitation would vary from year to year. To ensure adequate soil resources are available for rehabilitation operations when required, the Applicant has prepared an annual soil balance for the life of the Project based on the following.

- Areas to be disturbed each year within the Built Soil Area (see **Figure 3.4.2**).
- Areas to be rehabilitated each year within the Built Soil Area (see **Figure 3.12.2**).
- The pre- and post-mining soil associations determined by SSM (2024) (**Figures 6.4.3** and **6.4.5**).
- Soil stripping and placement depths determined by SSM (2024) (**Tables 6.4.7** and **6.4.8**).

Table 6.4.9 presents the annual soil balance, including the soil stockpile volumes, for the Built Soil Area prepared by the Applicant. In summary, adequate soil resources will be available for rehabilitation operations within the Built Soil Area during each year of the Project.

Topsoil stockpile volumes would increase progressively until Year 3 when rehabilitation of the Year 1 Extraction Area and Year 4 when rehabilitation of the Off Path Storage Facility would be undertaken. Stockpile volumes would increase again during Years 12 to 16 before being progressively drawn down as mining comes to an end, but rehabilitation is ongoing. A small surplus of approximately 121,000m^3 is predicted at the end of the life of the Project.

Subsoil stockpile volumes would progressively increase to a maximum of 10.3Mm^3 in Year 15, before decreasing slightly to approximately 9Mm^3 at the end of the life of the Project. The Applicant would manage the volume of subsoil in stockpile by either stripping less subsoil or placing a greater thickness of subsoil on the final landform.

The Applicant would maintain a soil inventory throughout the life of the Project, including the source, location, volume and planned destination of soils in stockpile and would include that information in the Annual Review to be prepared for the Project.

Table 6.4.9
Annual Soil Balance

Year	Soil Stripping			Cumulative Soil Stockpiles		Soil Spreading		
		Available Soil Volume (m^3)		Stockpile Volume (m^3)		Post Mining Soil Association	Required Soil Volume (m^3)	
	Pre mining Soil Association	Topsoil	Subsoil	Topsoil	Subsoil		Topsoil	Subsoil
Construction	Blanchetown	95,204	-	1,634,862	3,790,881	Calcarosol	-	-
	Dunefield and Sand Plain-Dune	297,988	681,115			Rudosol	-	-
	Dunefield and Sand Plain-Swale	251,166	1,004,664			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	247,291	370,936					
	Lunettes with Copi	743,214	1,734,165					
1	Blanchetown	-	-	1,634,862	3,790,881	Calcarosol	-	-
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	-	-					
	Lunettes with Copi	-	-					
2	Blanchetown	24,554	-	1,706,796	3,901,432	Calcarosol	-	-
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	-	-					
	Lunettes with Copi	47,379	110,552					
3	Blanchetown	28,725	-	1,637,773	4,169,933	Calcarosol	254,908	221,659
	Dunefield and Sand Plain-Dune	80,782	184,644			Rudosol	-	-
	Dunefield and Sand Plain-Swale	76,379	305,516			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	-	-					
	Lunettes with Copi	-	-					
4	Blanchetown	3,239	-	717,706	3,972,505	Calcarosol	1,273,972	1,107,802
	Dunefield and Sand Plain-Dune	127,028	290,350			Rudosol	-	-
	Dunefield and Sand Plain-Swale	113,827	455,308			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	109,811	164,716					
	Lunettes with Copi	-	-					
5	Blanchetown	88,012	-	1,142,902	5,100,739	Calcarosol	142,576	123,979
	Dunefield and Sand Plain-Dune	67,705	154,753			Rudosol	-	-
	Dunefield and Sand Plain-Swale	107,656	430,623			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	52,115	78,173					
	Lunettes with Copi	252,284	588,663					
6	Blanchetown	-	-	1,420,885	5,812,721	Calcarosol	215,919	187,756
	Dunefield and Sand Plain-Dune	41,615	95,119			Rudosol	-	-
	Dunefield and Sand Plain-Swale	719	2,877			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	302,300	453,450					
	Lunettes with Copi	149,268	348,292					

Table 6.4.9 (Cont'd)
Annual Soil Balance

Year	Soil Stripping			Cumulative Soil Stockpiles		Soil Spreading		
		Available Soil Volume (m^3)		Stockpile Volume (m^3)		Post Mining Soil Association	Required Soil Volume (m^3)	
	Pre mining Soil Association	Topsoil	Subsoil	Topsoil	Subsoil		Topsoil	Subsoil
7	Blanchetown	-	-	1,225,963	5,921,835	Calcarosol	443,857	385,963
	Dunefield and Sand Plain-Dune	37,897	86,622			Rudosol	-	-
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	100,761	151,142					
	Lunettes with Copi	110,277	257,314					
8	Blanchetown	11,676	-	1,203,074	6,146,663	Calcarosol	350,961	305,183
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	390	1,558			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	250,675	376,012					
	Lunettes with Copi	65,332	152,440					
9	Blanchetown	34,206	-	985,052	6,349,961	Calcarosol	484,334	421,160
	Dunefield and Sand Plain-Dune	49,634	113,449			Rudosol	-	-
	Dunefield and Sand Plain-Swale	94,921	379,684			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	87,550	131,325					
	Lunettes with Copi	-	-					
10	Blanchetown	40,443	-	932,343	6,678,302	Calcarosol	601,179	522,764
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	401,151	601,726					
	Lunettes with Copi	106,877	249,379					
11	Blanchetown	-	-	984,245	7,331,269	Calcarosol	661,569	575,277
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	327,391	327,391					
	Lunettes	-	-					
	Lunettes with Copi	386,080	900,853					
12	Blanchetown	-	-	1,272,431	8,052,728	Calcarosol	247,204	214,960
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	234,618	234,618					
	Lunettes	-	-					
	Lunettes with Copi	300,772	701,802					
13	Blanchetown	40,692	-	1,348,194	8,662,787	Calcarosol	272,017	236,537
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	179,836	719,343			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	127,252	127,252					
	Lunettes	-	-					
	Lunettes with Copi	-	-					

Table 6.4.9 (Cont'd)
Annual Soil Balance

Year	Soil Stripping			Cumulative Soil Stockpiles		Soil Spreading		
		Available Soil Volume (m^3)		Stockpile Volume (m^3)		Post Mining Soil Association	Required Soil Volume (m^3)	
	Pre mining Soil Association	Topsoil	Subsoil	Topsoil	Subsoil		Topsoil	Subsoil
14	Blanchetown	119,979	-	1,613,688	9,302,723	Calcarosol	349,504	303,917
	Dunefield and Sand Plain-Dune	-	-			Rudosol	-	-
	Dunefield and Sand Plain-Swale	92,023	368,092			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	273,423	273,423					
	Lunettes	-	-					
	Lunettes with Copi	129,574	302,339					
15	Blanchetown	-	-	1,886,837	10,347,677	Calcarosol	367,722	319,758
	Dunefield and Sand Plain-Dune	-	-			Rudosol	138,705	120,613
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	250,265	250,265					
	Lunettes	-	-					
	Lunettes with Copi	529,312	1,235,061					
16	Blanchetown	42,739	-	1,501,713	10,269,714	Calcarosol	549,659	477,964
	Dunefield and Sand Plain-Dune	-	-			Rudosol	171,903	149,481
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	162,978	244,467					
	Lunettes with Copi	130,721	305,015					
17	Blanchetown	-	-	743,844	9,610,698	Calcarosol	176,305	153,309
	Dunefield and Sand Plain-Dune	-	-			Rudosol	581,564	505,708
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	-	-					
	Lunettes with Copi	-	-					
18	Blanchetown	-	-	363,514	9,279,975	Calcarosol	81,113	70,533
	Dunefield and Sand Plain-Dune	-	-			Rudosol	299,217	260,189
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	-	-					
	Lunettes with Copi	-	-					
19	Blanchetown	-	-	120,726	9,068,856	Calcarosol	66,116	57,493
	Dunefield and Sand Plain-Dune	-	-			Rudosol	176,671	153,627
	Dunefield and Sand Plain-Swale	-	-			Hydrosol	-	-
	Lake Floor East	-	-					
	Lake Floor West	-	-					
	Lunettes	-	-					
	Lunettes with Copi	-	-					

Source: RZ Resources Limited

6.4.6 Avoidance, Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures to ensure that any soils and land capability impacts associated with the Project are avoided or minimised to the extent practicable. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual risk to soils and land capability presented in **Appendix 2**.

Soil Management

- Prepare a *Soil Management Plan* which details soil stripping, storage and placement practices with reference to individual Soil Associations and their suitability for use during rehabilitation activities. Incorporate Acid Sulphate Soil Management measures into the *Soil Management Plan*.
- Maintain a soil inventory, including the source, location, volume and planned destination of soils in stockpile and include that information in the Annual Review to be prepared for the Project.

Soil Stripping Operations

- Undertake clearing and grubbing of trees 12 months in advance of topsoil stripping to permit soil consolidation and seed set of annual plants. Retain shrub and groundcover vegetation until shortly before topsoil stripping commences.
- Minimise weed growth between vegetation clearing and soil stripping.
- Stockpile cleared timber for reuse during rehabilitation operations.
- Clearly delineate areas to be stripped prior to the commencement of stripping campaigns and communicate required topsoil and subsoil stripping depths to plant operators and supervisors.
- Utilise appropriate machinery for stripping operations, with machinery circuits to be located so as to minimise compaction of both undisturbed and stockpiled soil.
- Ensure that machinery utilised during soil stripping operations complies with any established weed management and biosecurity protocols for the Mine Site.
- Soil material should be maintained in a slightly moist condition during stripping. Material should not be stripped in either an excessively dry or wet condition.
- Ensure that soil is be pushed into windrows using graders or dozers for later collection by tractor scoops or loading into trucks by front-end loaders to minimise compaction of soil materials.
- Minimise handling and rehandling of soil to the greatest extent practicable.

Soil Stockpiling Operations

- Store topsoil and subsoil in separate stockpiles. In particular, ensure that saline subsoil is not incorporated with non-saline topsoil.

- Construct long-term soil stockpiles with a batter slope of 14% or 1:7 (V:H) or flatter to limit erosion potential.
- Construct topsoil stockpiles to a maximum height of 2m and subsoil stockpiles to a maximum height of 4m.
- Construct soil stockpiles with a rough surface to promote water infiltration and construct sediment controls (e.g. sediment fencing, bunds) downslope of stockpiles if required.
- Minimise overland flow across and onto soil stockpiles to the greatest extent practicable.
- Seed soil stockpiles with an appropriate mixture of grasses and forbs, together with a soil stabilisation agent within 3 months of construction, to encourage surface stabilisation, provide competition for weeds and minimise erosion and dust generation.
- Construct the upper surfaces of long-term stockpiles with a perimeter bund to direct runoff away from the face of the stockpile and protect against erosion.
- Restrict access of machinery to soil stockpile areas to minimise compaction.
- Monitor soil stockpiles for the establishment of weeds and/or erosion and implement weed and erosion control programs as required.
- Manage grazing pressure by both native and feral animals to prevent damage to vegetation on the soil stockpiles.

Soil Respreading Operations

- Loosen (rip) subgrade material in compacted areas (e.g. Infrastructure Area and haul roads) prior to soil replacement to facilitate drainage past the root zone and root growth into this layer.
- Shape subgrade surfaces to form appropriate landforms, including ensuring that upper surfaces are internally draining to minimise the potential for overland flow.
- Test topsoil and subsoil resources prior to spreading and apply any soil ameliorants, as required.
- Ensure, where possible, that soil resources are moist rather than wet or dry during respreading.
- Manage traffic patterns and vehicle access to minimise compaction of topsoiled areas.
- Apply soil stabilising agents to minimise the potential for erosion (wind or water) prior to establishment of vegetation.
- Place stockpiled timber resources onto exposed areas (e.g. upper dune slopes, overburden stockpile batters) to protect exposed soil surfaces, support emergent seedling survival and provide habitat for fauna.

- Implement appropriate erosion and sediment controls to protect respread soil resources.
- Manage total grazing pressure (including livestock, native and feral animals) and disturbance of the soil by animals with hard hooves to support vegetation establishment.

Seeding and Long-term Stabilisation

- Spread seed of suitable species using suitable equipment that applies surface stabilising mixture, seeds and leaves a rough surface to reduce wind erosion.
- Inoculate the rehabilitated surface with organisms suitable for forming cryptogram crusts (thin crusts of mosses, lichens, algae and bacteria) on the final rehabilitated landform.

Rehabilitation Trials and Research

- Continue existing and undertake further investigations and conduct research trials in order to reduce the susceptibility of rehabilitated areas to wind erosion by determining the following.
  - Best methods for improving the quality of biological cryptogram crusts in rehabilitated areas.
  - Best management practices for topsoil during the period between placement of topsoil and planting seed (e.g. desirable roughness, loose or consolidated surface texture, and efficacy of brush matting).
  - Appropriate selection of plant species and optimum planting periods (time of year, moisture regime) to maximise the success of revegetation.
- Collect seed from desirable native plant species from within the Mine Site or from areas from a similar geographic region. Seed from species with a range of germination moisture requirements should be collected preferentially to improve the likelihood of vegetation establishment.
- Investigate options and, if necessary, undertake trials to determine whether separate stockpiling or mulching and incorporation of shrubs into stockpiled topsoil is most effective in maintaining suitable soil resources and facilitating revegetation.
- Ensure that the result of all rehabilitation trials and research are incorporated into progressive rehabilitation operations and communicated to industry partners for use at surrounding operations.

Contingency Measures

In addition to the above, the Applicant would implement the following contingency mitigation measures should the following triggers be exceeded.

- Soil inventory identifies that the volume of stockpiled soil is insufficient for rehabilitation operations.
  - Undertake a study to identify additional sources of soil material, including:
    - modifying topsoil/subsoil stripping depths;

  - modifying topsoil/subsoil stripping depths; or
  - ameliorating subsoils to a condition suitable for use as topsoil

- Soil testing indicated soil quality is inadequate for rehabilitation operations.
  - Undertake a study to identify potential remedial actions and implement the recommendations of that study.
- Monitoring of the final landform identifies insufficient thickness of respread soil or the proposed thicknesses of respread soil resources are insufficient to achieve the desired rehabilitation outcomes.
  - Spread additional soil material, where available.
- Respread soil is subject to unacceptable levels of erosion (wind or water) or vegetation fails to become established on the final landform.
  - Undertake additional measures to stabilise the respread soil, including applying stabilising agents.
  - Reseed the final landform as required.
- Excessive grazing (feral or over abundant native fauna) pressure results in poor rehabilitation outcomes or destabilisation of the final landform.
  - Review and upgrade exclusion fencing as required.
  - Amend and improve the existing pest control strategy in consultation with surrounding landholders.

6.4.7 Assessment of Impacts

6.4.7.1 Soil Stripping, Stockpiling and Respreading

The major source of soil disturbance associated with the Project would be the stripping, stockpiling and respreading of soil. Successful rehabilitation of the Mine Site would therefore depend on the following.

- Stripping and stockpiling (or directly using) sufficient suitable topsoil and subsoil resources to provide for required rehabilitation operations.
- Preserving the quality of stockpiled soil resources by maintaining biological activity and adequate aeration in stockpiled soil.
- Respreading soils as recommended by SSM (2024).

Assuming that the management and mitigation measures identified in Sections 6.4.5 and 6.4.6 are implemented, SSM (2024) state that adequate soil resources would be available to rehabilitate the Mine Site. careful management of soil resources will be required during the early years of the Project to ensure adequate soil is available for rehabilitation of the initial sections of the final landform.

6.4.7.2 Land and Soil Capability

SSM (2024) estimated the pre- and post-mining land and soil capability based on the *Land Soil Capability Assessment guidelines* (OEH, 2012**)**. **Figures 6.4.4** and **6.4.6** and **Table 6.4.10** present the existing and anticipated areas of each land and soil capability class within the proposed Limit of Disturbance before and following mining operations.

Table 6.4.10
Land and Soil Capability Areas – Pre and Post Mining

Land and Soil Capability Class	Area within Limit of Disturbance (ha)		
	Pre-mining	Post-mining	Change
Class 6	3,782	4,195	+413
Class 7	550	592	+42
Class 8	1,289	834	-455
Note: Apparent arithmetic inconsistencies are due to rounding			
Source: SSM (2024) – After Table 9.6			

6.4.8 Monitoring

The Applicant would undertake the following soil-related monitoring throughout the life of the Project.

- Test soil and apply ameliorants as required prior to stripping and placing stripped soils into stockpiles and /or use of stripped soils.
- Maintain a soil register detailing the location and volume of each soil stockpile, including, the anticipated final use for the identified soil.
- Test soil and apply ameliorants as required prior to extracting from soil stockpiles and using for rehabilitation.
- Monitor and record soil movements to enable clear demonstration of the classification of soils used to rehabilitate the Mine Site.
- Maintenance of biological activity would require plants to be grown. The species and vigour of plants growing on the stockpiles should be monitored.

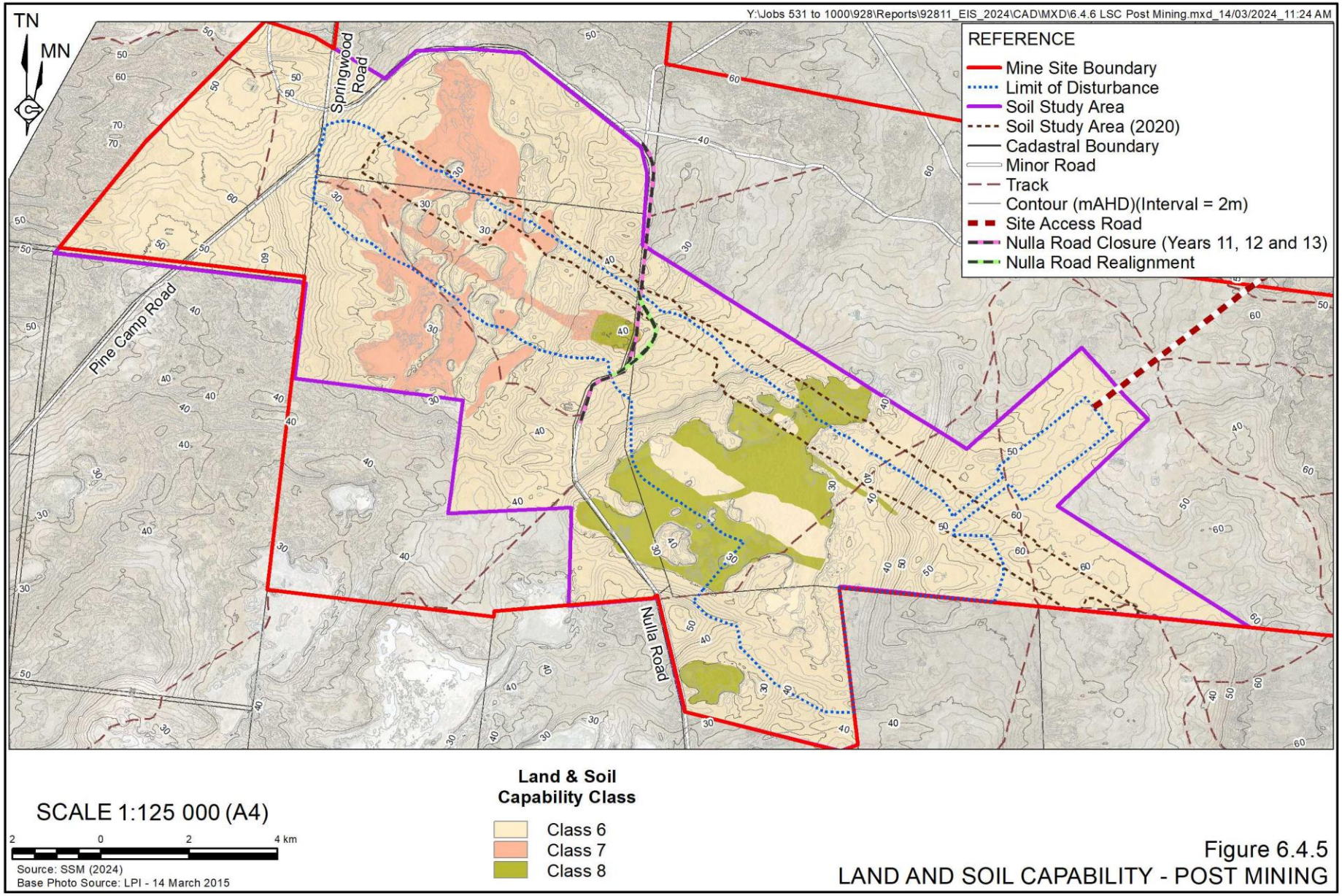


Figure 6.4.5
LAND AND SOIL CAPABILITY - POST MINING

6.4.9 Conclusion

The major source of soil disturbance associated with the Project would be continual excavation, movement and replacement of soil and overburden. The aim of soil management throughout the life of the Project would therefore be to minimise soil degradation through appropriate stripping, stockpiling and placement of that material. Providing that the management and mitigation measures outlined in Section 6.4.5 and 6.4.6 are implemented, SSM (2024) indicates that the following Project-related impacts upon soil resources, land capability and agricultural productivity would occur.

- There is a low risk of Acid Sulphate Soils degrading soil resources within the Mine Site.
- Estimated available topsoil and subsoil resources throughout the Mine Site would allow suitable soil profiles to be reconstructed during rehabilitation operations.
- Reconstructed soil profiles would be capable of supporting and increasing levels of land capability, agricultural productivity and vegetation coverage commensurate with the existing landscape.
- No Project-related soil resource impacts are anticipated on adjoining agricultural lands.

6.5 Aboriginal Heritage

6.5.1 Introduction

The SEARS, identify "Aboriginal heritage" as a key issue for assessment in the EIS. Matters to be addressed include:

- "an assessment of the potential impacts of the development on Aboriginal heritage (cultural values and archaeological), including adequate consultation with relevant Aboriginal stakeholders having regard to the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010) and documented in an Aboriginal Cultural Heritage Assessment Report (ACHAR) including the significance of cultural heritage values for Aboriginal people who have a cultural association with the land;
- results of a surface survey (and test excavations, if required) undertaken by a qualified archaeologist to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record;
- avoiding and mitigating impacts on cultural heritage values and identify any conservation outcomes, including mitigation measures and procedures for accidental finds at any stage of the development."
- During the preparation of the EIS, you must consult with relevant Registered Aboriginal Parties (RAPs)

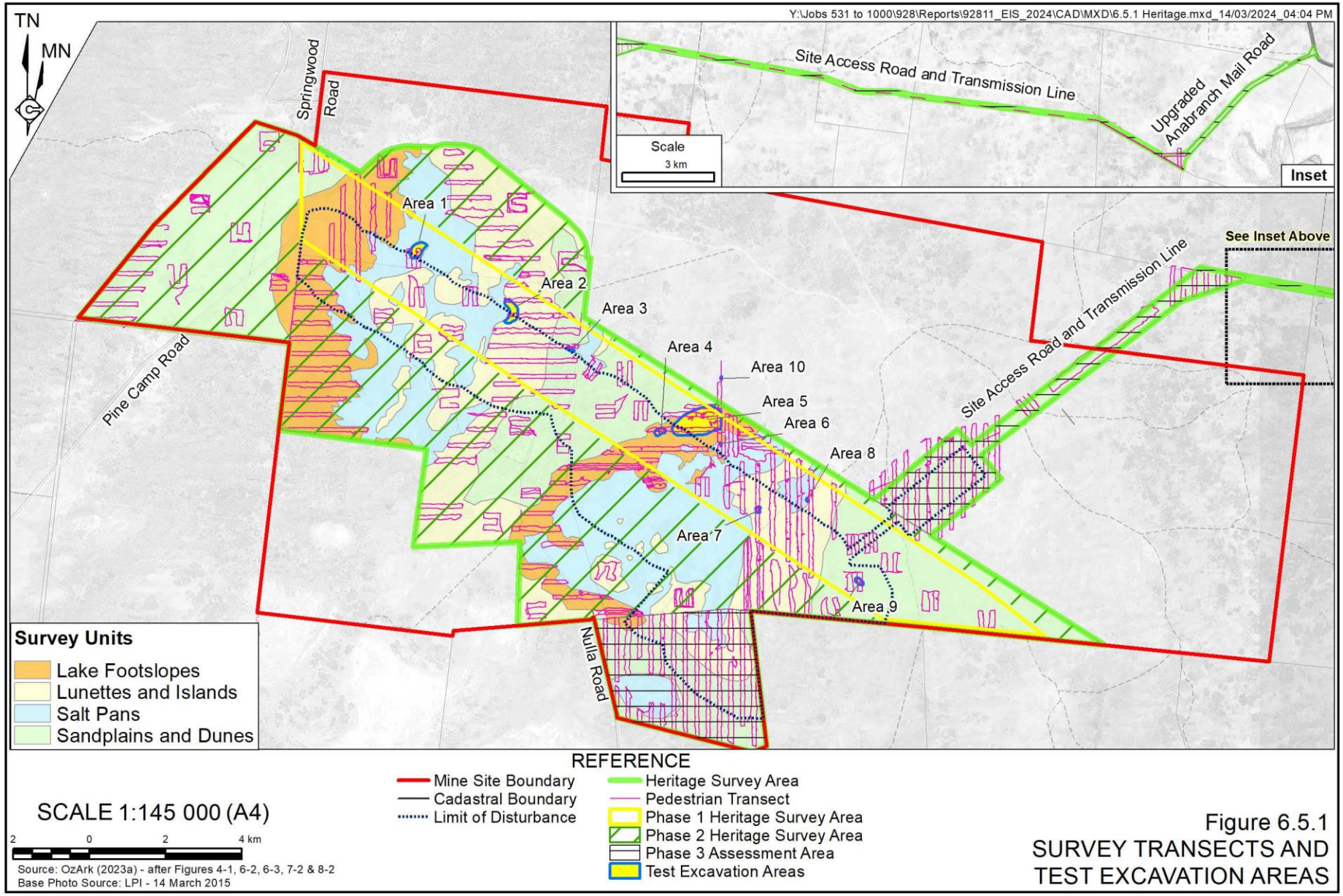
Additionally, Heritage NSW was consulted and have no additional recommendations.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

OzArk Environment and Heritage Pty Ltd (OzArk) prepared the *Aboriginal Cultural Heritage Assessment Report* (ACHAR) for the Project. The ACHAR, hereafter referred to as OzArk (2024a), is presented as **Appendix 8**. This subsection provides a summary of OzArk (2024a) and describes the management and management measures to be implemented by the Applicant.

For the sake of clarity, the following terminology has been used in this subsection.

- Heritage Survey Area – includes all areas surveyed by OzArk (2024a), including the following (**Figure 6.5.1**).
  - Phase 1 Heritage Survey Area. The field assessment for Phase 1 of the Aboriginal heritage survey was undertaken between February 2020 and May 2020.
  - Phase 2 Heritage Survey Area. The field assessment for Phase 2 of the Aboriginal Heritage Survey was undertaken between February 2022 and March 2022.
  - Phase 3 Heritage Survey Area. The field assessment for Phase 3 Aboriginal Heritage Survey was undertaken between November 2023 and February 2024.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TN
MN
Springwood Road
Site Access Road and Transmission Line
Upgraded Anabranch Mail Road
Scale
3 km
Inset
See Inset Above
Area 1
Area 2
Area 3
Area 4
Area 10
Area 5
Area 6
Area 8
Area 7
Area 9
Pine Camp Road
Site Access Road and Transmission Line
Nulla Road
Survey Units
Lake Footslopes
Lunettes and Islands
Salt Pans
Sandplains and Dunes
REFERENCE
Mine Site Boundary
Cadastral Boundary
Limit of Disturbance
Heritage Survey Area
Pedestrian Transect
Phase 1 Heritage Survey Area
Phase 2 Heritage Survey Area
Phase 3 Assessment Area
Test Excavation Areas
SCALE 1:145 000 (A4)
2 0 2 4 km
Source: OzArk (2023a) - after Figures 4-1, 6-2, 6-3, 7-2 & 8-2
Base Photo Source: LPI - 14 March 2015
Figure 6.5.1
SURVEY TRANSECTS AND
TEST EXCAVATION AREAS

  - In addition, the former site access route to the north and east of the Mine Site was assessed during Phase 1 of the heritage assessment. This route is no longer proposed to be used. However, artefacts of Aboriginal heritage significance were identified along the route. As a result, the former site access route has been included for completeness.

    The Rail Facility and Transportation Route is not included within the Heritage Survey Area as all areas that would be disturbed as a result of the Project have been previously disturbed.

- RAP – Registered Aboriginal Party, representing an individual or group who indicated as part of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs) (DECCW, 2010b) process that they wish to be consulted regarding the Project.
- PAD – potential archaeological deposit, namely a particular location has potential to contain subsurface archaeological deposits, although no Aboriginal objects are visible.

6.5.2 Existing Environment

6.5.2.1 Landscape Context

Under the Interim Biogeographic Regionalisation of Australia, the Mine Site falls within the Murray Darling Depression bioregion and the South Olary Plain subregion (NPWS, 2003). The landscape of the South Olary Plain is characterised by dunefields, sandplains, dry lakes and groundwater basins. For the purposes of the Aboriginal cultural heritage surveys, OzArk (2024a) divided the Mine Site into the following four survey units based on topographic zones which are expected to inform the archaeological characterisation of landforms present within the landscape.

- Lake Footslopes: approximately 2,290ha (13.5%) of the Heritage Survey Area consisting of long, gentle slopes on the western sides of the Salt Pans.
- Sandplains and Dunes: approximately 7,583ha (46.0%) of the Heritage Survey Area consisting of undulating plains, dunes and swales.
- Lunettes and Islands: approximately 3,839ha (23%) of the Heritage Survey Area consisting of aeolian landforms, generally on the eastern sides of salt pans, including irregular lunettes, raised gypsum islands and gypsite flats.
- Salt Pans: approximately 2,861ha (17.5%) of the Heritage Survey Area, including both the Eastern and Western Salt Pans as well as gypsite flats which are part of groundwater discharge basins.

OzArk (2024a) notes that, with the exception of elevated landforms such as footslopes, lunettes and islands bordering the water sources (Salt Pans) (**Figure 6.5.1**), the Mine Site contains no particular topographic features which would likely have attracted Aboriginal occupation. Additionally, the underlying geology offers limited potential for raw materials required for stone tool manufacture and infertile soils, combined low rainfall and the absence of semi-permanent or permanent freshwater sources, would have supported only sporadic or short-term visitation by

Aboriginal people (OzArk, 2024a). Coupled with dominant historical land uses, including vegetation clearing and grazing, the erodibility of the soil and its vulnerability to both wind and water erosion is likely to have resulted in the loss of the A1 soil horizon. As a result of this, any archaeological deposits associated with the A1 horizon may have been dispersed and possibly lost.

6.5.2.2 Ethno-Historical Context

At the time of first contact with colonial settlers, the Lower Darling region was inhabited by Aboriginal people of the Baakindji (Paakantji) language group which was comprised of people who spoke the sub-dialects Barindji, Barkindji, Danggali, Maraura and Wiljakali. The name Baakantji is derived from "*Paaka*" meaning that the Baakantji people are those 'belonging' to the Darling River, with Baakantji language country extending along the Darling River from approximately Bourke in the north of NSW to Wentworth in the south (OzArk, 2024a).

Based on both archaeological evidence as well as early European accounts, it is understood that the Baakindji were primarily hunter-fisher-gatherers who maintained a semi-sedentary lifestyle (OzArk, 2024a). It is understood that groups would live primarily along the Lower Darling and Murray Rivers during the warmest months of the year, venturing out into the surrounding dune fields to collect food resources which were available following winter rains.

Within approximately 10 years following the development of pioneering colonial settlements, it is believed that the majority of the Barkindji were living in association with pastoral homesteads and working as shepherds or in other labouring activities. By the early 1900s, many Barkindji people resided in an Aboriginal mission which had been established on the Darling River near Pooncarie in 1911 (OzArk, 2024a).

6.5.2.3 Previously Recorded Aboriginal Cultural Heritage

There have been few systematic regional investigations of records of Aboriginal cultural heritage in the area surrounding the Mine Site. However, limited information has been gathered through several surveys and assessments associated with isolated projects in the vicinity of the Mine Site. **Table 6.5.1** presents a summary of isolated investigations into Aboriginal cultural heritage in the vicinity of the Mine Site.

Table 6.5.1
Regional Aboriginal Cultural Heritage Investigations

Page 1 of 3

Source	Summary of Investigation
Clarke (1983a)	• Archaeological investigation within a 350m radius of a proposed drill hole 40km north of Lake Victoria. • Identified one potential Aboriginal object (piece of baked clay). • Absence of archaeological sites attributed to a scarcity of water resources.
Clarke (1983b)	• Archaeological assessment along three proposed seismic lines in south-western NSW. • Identified several campfire and hearth remnants in addition to stone artefacts including scrapers, adzes, cores, hammerstones and fragments of grinding dishes. • Location and frequency of types recorded in the Lower Darling region suggested occupation predominately along rivers, lakes and creeks, with brief visits away from water sources associated with hunting and gathering.

Table 6.5.1 (Cont'd)
Regional Aboriginal Cultural Heritage Investigations

Source	Summary of Investigation
Martin (1985)	• Survey for a proposed seismic line which included a variety of landforms located to the west of Lake Popiltah approximately 70km northeast of the Mine Site. • A high number of sites, including stone tools, hearths and middens, were located in close proximity to formerly permanent water sources.
Martin (1986)	• Archaeological survey for the Wentworth Pump Station located 80km southeast of the Mine Site. • Two middens, an open campsite and a scarred tree were recorded.
Bonhomme (1990)	• Examination of burials on the Riverine plain and the Murray Mallee Sandplain. • Found that burials locations reflected geomorphology, with burials typically located within sand bodies (e.g. lunettes, source bordering dunes, modern riverbank levees, paleochannels and paleochannel levees, and sandplain and alluvial fan remnants).
Craib (1992)	• Study of 625ha of land across the darling River and Murray River margins upstream of Wentworth. • Artefact scatters and scarred trees were identified in dune fields, sandplains and elevated alluvial terraces, with burials and stone artefacts confined to source bordering dunes. • Middens, scarred trees and artefact scatters correlated with riparian areas of flowing rivers and creeks, however higher densities of middens, scarred trees and burials were associated with lake deposits, swamps and billabongs.
Johnston and Witter (1996)	• Developed a predictive model for Aboriginal archaeological site locations in western NSW. • Occupation is expected near water, with the abundance of archaeological evidence proportional to the quality (i.e. reliability, salinity and vegetation) of the water source. • Occupation is expected to focus on ecotonal boundaries, with preference for the presence of ephemeral water, food resource abundance and food resource diversity. • Artefact numbers are expected to increase in abundance within 20km of a stone source, with extreme increases expected within 2km.
Bonhomme (1999)	• Desktop review of a 900 000ha area extending 5km either side of the Murray River from Wentworth to the Murrumbidgee confluence. • General increase in the number of Aboriginal sites occurring from east to west. • Burial grounds were most commonly recorded on source bordering dunes, prior stream levees and point bar sediment of rivers and lake outlet channels.
Edmunds (1999)	• Archaeological assessment for the bridge replacement across the Great Darling Anabranch located 50km south of the Mine Site. • Three land systems, including Anabranch, Hatfield and Wentworth, were identified as having moderate archaeological sensitivity.
Holdaway *et al.* (2002)	• Study of the chronology of Aboriginal occupation in the arid margins of south-eastern Australia. • Dating of charcoal from hearths north of Broken Hill demonstrated a hiatus in occupation between 820- and 1170-years BP.
Witter (2004)	• Proposed archaeological regions including the Darling plains which include the Mine Site. • Within the Darling plains, camps are common along water sources, silcrete quarries are rare, burials are frequent along riverbanks, lake shores, source bordering dunes and lunettes, scarred trees are frequent along riverbanks, hearths are common, and middens are typically present along riverbeds, lakeshores and some lunettes.

Table 6.5.1 (Cont'd)
Regional Aboriginal Cultural Heritage Investigations

Source	Summary of Investigation
Shiner (2006)	• Dated 16 hearth deposits south of the foothills of the Barrier range. • Found that different artefact assemblages represented unique occupational histories which were punctuated by long periods with little evidence of Aboriginal activity.
Cupper (2007)	• Archaeological assessment completed by Landskape for the Snapper Mineral Sands project, located 45km east of the Mine Site. • Two Aboriginal sites were recorded within the Hatfield land system, five within the Trelega and 15 within the Overnewton system. These land systems generally correlate with Sandplains and Dunefields and are present within the Mine Site.
Fanning *et al.* (2007)	• Archaeological research program in the Peerey Lake area of Paroo Darling National Park, located 45km east of the Mine Site. • Identified remains of 1,054 hearths in the Rutherfords Creek catchment, with 256 hearths excavated between 2006 and 2007 for radiocarbon dating and 300 hearth stones analysed via optically stimulated luminescence. • All hearths were dated to be less than 2 500 years old, indicating repeated returns of Aboriginal people to the area.
OzArk (2009)	• Aboriginal cultural heritage assessment for proposed shoulder widening along the Silver City Highway, 97km northeast of the Mine Site. • Identified six Aboriginal sites including artefact scatters, hearths and an isolated find. • Concluded that at the dunes adjacent to the highway, there is a potential for human burials – albeit rare.
Niche (2017) and Niche (2019)	• Archaeological survey for a 270km pipeline from the Murray River at Wentworth to Broken Hill. • Identified 240 Aboriginal sites, including stone artefacts, hearths, artefact scatters, shell, animal bones, and scarred trees. • Most sites were located within 600m of water and where sites were located further away, these were typically associated with stone sources.
Biosis (2020)	• Archaeological investigations completed for the Pooncarie Menindee Road Upgrade project. • Identified 82 Aboriginal sites, including stone artefact sites, hearths, scarred trees and one burial. • Most recorded sites were found on the outskirts of sand dune landforms with moderate to high potential to contain subsurface deposits. • Subsurface testing was conducted within a floodplain landform and it was deemed as having low archaeological subsurface potential.
OzArk (2022)	• Test excavation program completed along Pooncarie Road realignment route near Karoola Station. • The excavation focused on the high potential archaeological areas that were previously assessed by Biosis (2020). • 26 Test Units at four separate locations were excavated – and no artefacts were recovered. • This confirmed that the dunes within the study area are unlikely to be associated with subsurface deposits due to heavy erosion influence.
Source: OzArk (2024a) – modified after Section 5.2	

Table 6.5.2 and **Figure 6.5.2** presents a summary of desktop database searches completed by OzArk (2024a) in order to identify any previously recorded Aboriginal sites within or in the vicinity of the Heritage Survey Area. In summary, no listed Aboriginal places or identified Aboriginal sites occur within the Heritage Survey Area, with the exception of those Aboriginal sites recorded during the Phase 1 and Phase 2 heritage survey (see Section 6.5.4.1). Three searches of the Heritage NSW administered Aboriginal Heritage Information Management system (AHIMS) database were completed across the three phases of the assessment for the Project. These searches returned 16, 110 and 151 previously recorded Aboriginal sites within approximately 20km of the Heritage Survey Area in the Phase 1, 2 and 3 searches, respectively. Of the sites identified, 45 were not previously recorded by OzArk as part of the Project. Of these, the most recorded site type were:

- stone artefacts (77.5%);
- midden and artefact scatters (7%);
- hearth and artefact scatters (7%);
- modified trees (4/5%);
- hearths, artefact scatter and midden (2%); and
- burials (2%).

Table 6.5.2
Recorded Aboriginal Sites – Database Search Results

Database	Date of Search	Search Type	Results
Commonwealth Heritage Listings	12/01/2020, 11/1/2022 and 24/10/2023	Wentworth Local Government Area	No listed places are located within the Mine Site.
National Native Title Claims Search	12/01/2020, 11/1/2022 and 24/10/2023	NSW	One determined Native Title Claim (NC1997/032: NSD6084/1998 Barkandji Traditional Owners #8) is present within the Wentworth Local Government Area.
Aboriginal Heritage Information Management System (AHIMS)	12/01/2020, 11/1/2022 and 26/3/2023	GDA Zone 54 Eastings: 499143–559143; Northings: 6251420–6311420 GDA Zone 54 Eastings: 99162-579162 Northings: 6273649.0 -6293649.0 GDA Zone 54 Eastings: 529162 - 579162, Northings: 6273649 – 6293649 and Eastings: 499162 - 529161, Northings: 6273649 - 6293649	12/01/2020: None of the 16 sites identified within the search area are located within the Heritage Survey Area. 11/01/2022: 110 AHIMS sites, those within the Heritage Survey Area are recorded as part of the Phase 1 assessment (Section 6.5.4.1). 26/03/2023: 151 AHIMS sites within the designated search area. Sites located on AHIMS within the Heritage Survey Area are those recorded as part of the Phase 1 and 2 assessments.
Wentworth Local Environmental Plan (LEP)	12/01/2020, 11/01/2022 and 24/10/2023	Wentworth LEP 2011	None of the listed Aboriginal places occur within or near the Mine Site.
Source: OzArk (2024a) – Table 5-2			

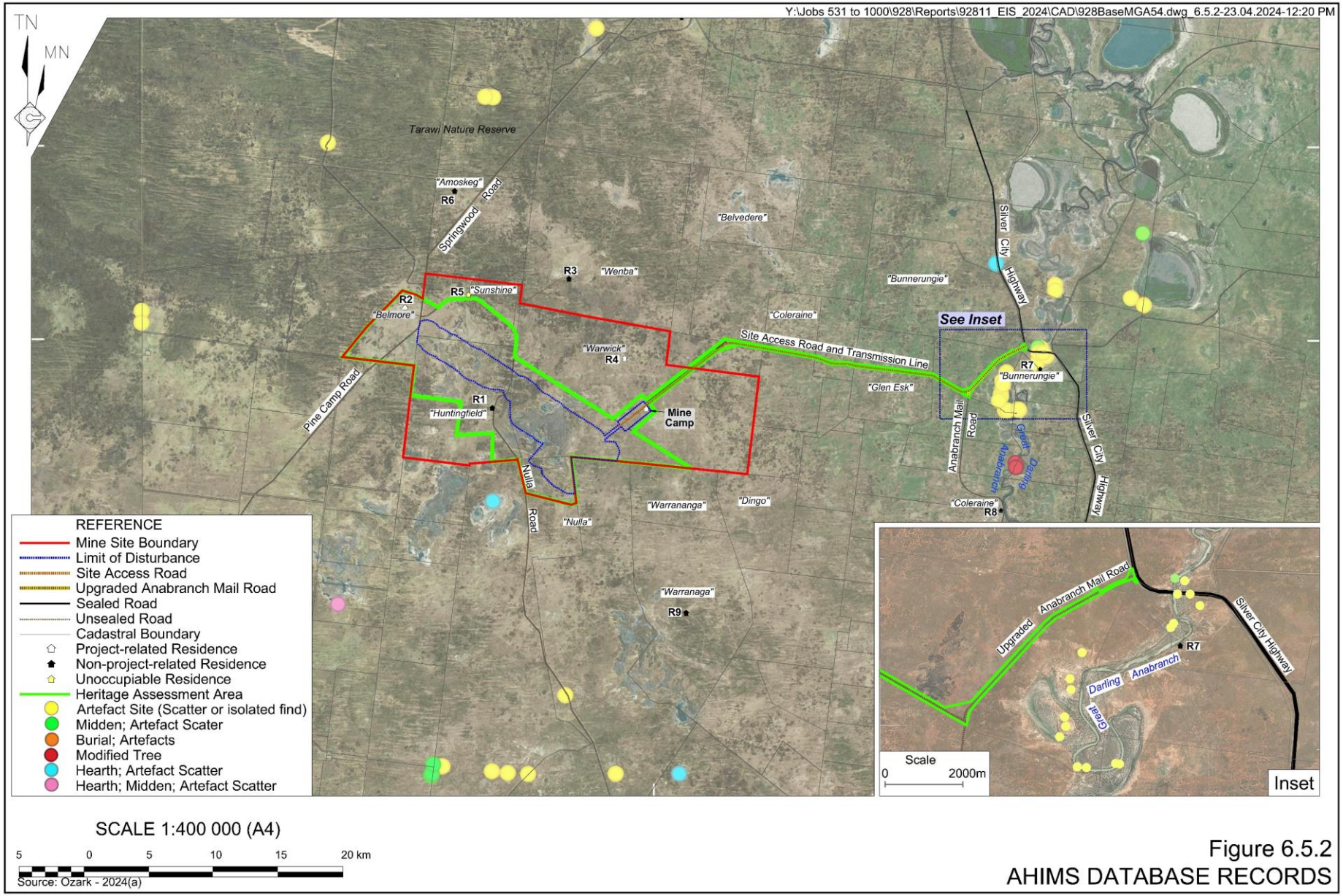


Figure 6.5.2
AHIMS DATABASE RECORDS

A due diligence assessment for eight proposed air-core drilling locations within the Mine Site was undertaken by Landskape Natural and Cultural Heritage Management (Landskape) in November 2015. Visual inspection of all impact areas was undertaken, and no Aboriginal sites were located despite high ground surface visibility (Landskape, 2015).

6.5.2.4 Water Jelly and the Mitchell Family

The Applicant during consultation with surrounding landholders during the April 2024 was advised of an "Aboriginal settlement" within Warwick Station known as "Water Jelly." No previous reference had been made to such a settlement and no evidence of a settlement had been identified during the field surveys undertaken by OzArk (2024).

The owners of Null Nulla Station were able to provide a copy of a book by a former local resident, Beryl Goodfellow, entitled *Wool Away on Nulla Nulla.* Ms Goodfellow was the daughter of a former owner of Nulla Nulla Station and grew up on the Station. She assembled a history of the Station from 1841 to the post WWII period from collated documents and oral history.

Ms Goodfellow stated that in 1920, Nulla Nulla Station included Warwick Station. At that time, there was a need for an outstation the northern boundary of the property. A house was purchased and relocated to "the Waltragille Tank". The Applicant understands that the house in question is the present Warwick Homestead and that the Waltragille Tank is the dam close to the homestead.

The Head Stockman, Mr Harry Mitchell, a local Barkindji man, resided in the residence with his wife Alice and 12 children. Ms Goodfellow states that the Mitchell family lived in "their own tribal ways" and that the areas was known colloquially as "Water Jelly."

Ms Goodfellow states that the family left the station prior to its sale, with the exact date of departure unclear. Mr Mitchell died in Ivanhoe in 1936 and the station was sold in 1946.

The Applicant has established that many descendants of Mr Mitchell still reside in Dareton and identified that at least one of the RAPs who participated in cultural heritage surveys of the Project area was a direct descendant of the Mitchell family.

In light of the above, the Applicant has satisfied itself that the "Water Jelly" settlement was in fact the Mitchell family residence at the present site of the Warwick Station homestead. The homestead is outside the heritage survey area and would not be disturbed by the Project.

6.5.3 Assessment Methodology

6.5.3.1 Introduction

OzArk (2024a) state that the Aboriginal cultural heritage assessment was undertaken in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) and the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010b).

The Aboriginal cultural heritage assessment was undertaken by OzArk (2024a) in order to achieve the following objectives.

- Undertake background research to formulate a predictive model for Aboriginal site locations within the Mine Site.
- Identify and record any Aboriginal objects and sites, in addition to landforms likely to contain further archaeological deposits, within the Mine Site.
- In consultation with Registered Aboriginal Parties (RAPs), undertake an Aboriginal cultural values assessment of both tangible and intangible heritage values that have the potential to experience Project-related impacts.
- In consultation with RAPs, assess the significance of any recorded Aboriginal sites, objects or places likely to be impacted by the Project.
- In consultation with RAPs, assess the likely impacts of the Project on any Aboriginal sites, objects, places, or intangible values and develop management recommendations.

6.5.3.2 Predictive Model

Based on the results of previous archaeological investigations into Aboriginal cultural heritage site types and their distribution conducted in the vicinity of the Mine Site, as well as a review of known Aboriginal sites recorded in online databases (see Section 6.5.2.3), OzArk (2024a) identified the following predictive model of Aboriginal cultural heritage site locations for the field survey component of the assessment.

- **Isolated finds** may occur anywhere in the landscape but are most likely to be associated with Sandplains and Dunes, Lake Footslopes and Lunettes landscapes. It is noted that isolated finds may also have washed into areas of depression within the salt pans due to erosion associated with natural processes and historic land uses (i.e. grazing and vegetation clearing).
- **Open artefact scatters** are considered one of the most likely site types to be encountered, with sparse, low-density scatters expected to occur in Sandplains and Dunes while higher density scatters and associated features (e.g. hearths, ovens and middens) are likely to be located on Lunettes and Islands and Lake Footslopes. Larger sites are anticipated near permanent water sources. Artefact scatters are also likely to be identified within scalds, as stone artefacts lag on scald surfaces and scalds provide high ground surface visibility.
- **Hearths and ground oven sites** are considered one of the most likely site types to be encountered and are predicted to occur along landforms adjacent to lake systems. Presence of hearths may be difficult to identify where significant ground surface disturbance such as grazing, or erosion has occurred.
- **Aboriginal scarred trees** may be present anywhere that older trees survive. Scarred trees are less likely to occur within the Mine Site due to the dominance of unsuitable tree species, although Black Box species of a suitable age may occur in depression bordering the salt pans and may host cultural modifications.

- **Quarry sites and stone procurement sites** are identified in areas that have suitable rock formations. They are unlikely to occur within the Mine Site and if present are most likely to consist of silcrete located on crests.
- **Middens** are most likely to be identified on Lunettes and Islands and Lake Footslopes due to their proximity to salt pans. Identification is often difficult as evidence of cultural discard is difficult to determine. Ultimately, the landforms surrounding the Mine Site do not represent a high potential for the presence of middens.
- **Burials** are most likely to occur in soft sediments at locally elevated topographies. Lunettes and Islands have a higher potential to contain burials due to softer soils and proximity to salt pans. The Mine Site does not contain true source-bordering dunes or lunettes which are generally associated with burial occurrence regionally.
- **Bora and Ceremonial Sites** consist of a cleared area with earthen rings and are rare site types with a low likelihood of being present and remaining extant. The occurrence of these site types cannot necessarily be predicted through correlation with landforms.

6.5.3.3 Aboriginal Stakeholder Consultation and Participation

Consultation with the Aboriginal community throughout the Aboriginal cultural heritage assessment process was undertaken by OzArk (2024a) in accordance with the ACHCRs.

The ACHCRs include four main stages which are detailed below. Consultation was split into three phases as described above. Following placement of the Project on hold in late 2020, the RAPs were updated on a 6-monthly basis, with the first update letter sent in March 2021 and the second update letter sent in September 2021.

Aboriginal participation in field survey and test pitting programs is detailed in Sections 6.5.3.3 and 6.5.3.4 respectively.

Phase 1

ACHCR Stage 1 – Identification of Registered Aboriginal Parties

An advertisement requesting expressions of interest in being consulted regarding the Project was placed in the *Sunraysia Daily* in August 2018. Additionally, OzArk (2024a) contacted the following agencies in order to identify potential Aboriginal stakeholders in the vicinity of the Mine Site:

- Office of Environment and Heritage (OEH) (now Heritage NSW);
- Dareton Local Aboriginal Land Council (Dareton LALC);
- *Office of the Registrar, Aboriginal Land Rights Act 1983* (ALRA);
- National Native Title Tribunal;
- NTSCORP;
- Wentworth Shire Council; and .
- Western Local Land Services

Groups and individuals identified by the agencies were contacted and expressions of interest in being consulted regarding the Project were sought.

The following groups or individuals registered to be consulted regarding the Project and therefore represent the Registered Aboriginal Parties (RAPs) for the Project.

- Dareton LALC
- Barkindji-Maraura Elders Council
- Barkandji #8 Native Title Determinants
- Maraura / Thangkaali (Pooncarie) First Nations Owners Association

Due to a delay associated with Project design finalisation which lasted over 12 months, an additional advertisement was placed in the *Sunraysia Daily* in December 2019 and Heritage NSW were contacted to request a list of stakeholders for new registrations. Consequently, the following individuals also registered an interest in the project and were included as RAPs.

- Arthur Kirby
- Clair Bates
- Amanda Whitton

ACHCRs Stages 2 and 3 – Project Details and Aboriginal Cultural Values

A copy of the proposed Aboriginal cultural heritage assessment field survey methodology, which also contained detailed Project information, was sent to the RAPs on 16 January 2020. No comments were received from the RAPs on the Project or proposed survey methodology by 13 February 2020 following the stipulated 28-day period.

Following completion of the field survey and the identification of locations within the Phase 1 Heritage Survey Area which warranted test excavation, a copy of the proposed test excavation methodology was distributed to all RAPs on 9 April 2020. No comments on the proposed test excavation methodology were received from the RAPs by 8 May 2020.

ACHCRs Stage 4 – Draft ACHAR

A draft copy of the Phase 1 ACHAR detailing the results of the assessment, outlining opportunities for the conservation of Aboriginal cultural values, and suggesting recommendations for the management of Aboriginal objects was provided to all RAPs on 27 July 2020. No comments on the draft ACHAR were received from RAPs by the end of the review period on 26 August 2020.

Phase 2

ACHCR Stage 1 – Identification of Registered Aboriginal Parties

After the Project recommenced in later 2021, OzArk requested new stakeholder lists from Heritage NSW. This was done to ensure any additional stakeholders were accounted for since the previous stakeholder list was produced in January 2020. Heritage NSW responded on 1 December 2021 and no additional stakeholders were identified. As a result, no further letters seeking registrations of interest were sent.

ACHCRs Stages 2 and 3 – Project Details and Aboriginal Cultural Values

A copy of the draft Aboriginal cultural heritage assessment field survey methodology, which also contained revised Project information, was sent to the RAPs on 21 December 2021. No comments on the Project or proposed survey methodology were received from the RAPs by 24 January 2022 following the stipulated 28-day period.

An update letter was sent to all RAPs on 22 July 2022 to advise them that following finalisation of Project components, a copy of the ACHAR would be supplied for their review.

ACHCRs Stage 4 – Draft ACHAR

A copy of the revised draft ACHAR was sent to all RAPs on 17 November 2022 with a 28-day review period closing 16 December 2022. No comments were received on the revised draft ACHAR from any of the RAPs.

Phase 3

ACHCR Stage 1 – Identification of Registered Aboriginal Parties

RAPs were notified that further assessment will be conducted by OzArk due to an increase in size of the Project. While consultation was ongoing from Phase 1 and 2 of the Project, a new stakeholder list for the Wentworth LGA was requested from Heritage NSW to ensure there were no additional stakeholders who had not been previous sent an expression of interest. Five additional Aboriginal stakeholders were identified by Heritage NSW (OzArk, 2024a), and OzArk wrote to these parties on 3 October 2023.

ACHCRs Stages 2 and 3 – Project Details and Aboriginal Cultural Values

A copy of the draft Aboriginal cultural heritage assessment field survey methodology, which also contained revised Project information, was sent to the RAPs on 19 October 2023. A response was received from Koori Digs Services on 22 October 2023 noting they agree with the methodology. No other comments on the Project or proposed survey methodology were received from the RAPs by 16 November 2023 following the stipulated 28-day period.

Following the completion of the survey, an area was identified in the Phase 3 Assessment Area that warranted test excavation. The test excavation methodology was distributed to all RAPs on 20 December 2023. A response was received from Koori Digs Services on 26 December 2023 noting they agree with the methodology. No other comments on the Project or proposed survey methodology were received from the RAPs by 23 January 2024 following the stipulated 28-day period.

ACHCRs Stage 4 – Draft ACHAR

A copy of the final draft ACHAR was sent to all RAPs on 18 March 2024 with a 28-day review period closing 19 April 2024. No comments were received on the final draft ACHAR from any of the RAPs.

6.5.3.4 Field Survey and Test Excavation Programs

The field survey component of the Aboriginal cultural heritage assessment was undertaken by OzArk (2024a) in accordance with the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (the Code of Practice; DECCW, 2010a) and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (The Guide; OEH, 2011).

The field surveys were undertaken by OzArk (2024a) using standard archaeological field survey and recording methods and was designed to provide sufficient survey effort in order to allow for the archaeological characterisation of all landforms within the Heritage Assessment Area. The survey methodology, involving pedestrian transects within the Mine Site (**Figure 6.5.1**), was developed to sample all landforms while concentrating on landforms with the greatest archaeological potential.

The test excavation components of the Aboriginal cultural heritage assessment was undertaken by OzArk (2024a) in accordance with the Code of Practice and The Guide.

RAPs participated in the field survey and test excavation programs by identifying Aboriginal objects, determining the cultural significance of Aboriginal objects and identifying cultural places or non-physical site types within the Heritage Assessment Area.

Phase 1 Field Survey

The Phase 1 field survey was undertaken over a period of eight days between 25 and 29 February 2020 and between 2 and 4 March 2020, with surveys of the former site access route completed during the test excavation program (i.e. between 12 and 18 May 2020).

The Phase 1 survey was undertaken by a team consisting of seven OzArk personnel and the following six site officers, consisting of representatives from two RAPs, with at least four site officers present for each of the eight field survey days.

- Dareton Local Aboriginal Land Council, including:
  - Ernest Mitchell;
  - Jason Smith;
  - Rexy Smith; and
  - Russel Taylor.
- Barkandji #8 Native Title Determinants, including:
  - Owen Whyman; and
  - Jamin Jones.

OzArk (2024a) divided the Mine Site into the following three zones which informed the survey methodology employed.

- Full Survey Areas
  - Included all landforms with greater archaeological potential (e.g. Lake Footslopes and portions of the Lunettes and Islands).
  - Pedestrian transects were completed in pairs spaced 100m apart, with 200m between transect pairs. Additional transects were completed between transect pairs where necessary.
- Sample Landform Surveys
  - Included landforms with lower archaeological potential (e.g. Sand Plains and Dunes located away from the salt pans).

  - Sample squares measuring 500m by 500m were covered by pedestrian transects, with the location of sample squares selected to include areas of greater vegetation coverage (i.e. potentially more stable soil profiles) or areas within depression basins that may contain elevated landforms.

- Site access route
  - Field surveys during Phase 1 covered the 39.5km length of the former site access route between the Heritage Survey Area and Anabranch Mail Road, and an approximately 38ha area at the junction of the Site Access Road and Springwood Road (**Figure 6.5.1**).
  - A sample of the site access route was completed on foot approximately every kilometre, with vehicle surveys used to cover areas between sample survey segments.

Phase 1 Test Excavation Program

Following the analysis of the Phase 1 field survey results, a test excavation program was completed within the Heritage Survey Area by a team of six OzArk personnel over a seven-day period between 12 and 18 May 2020. With the exception of Jason Smith from the Dareton Local Aboriginal Land Council, all site officers who were present during the original field surveys were also present during the test excavation program, with at least four site officers present for each of the seven days.

The field survey identified ten areas where test excavations could inform the understanding of subsurface archaeological potential within the Heritage Survey Area (**Figure 6.5.1**). **Table 6.5.3** identifies the ten areas of higher potential for subsurface deposits identified by OzArk (2024a) and which of those areas were subject to test excavation during Phase 1. In summary, eight of the ten identified areas were subject to the test excavation program, with two of these areas (Areas 1 and 2) subject to limited investigations only and two (Areas 3 and 9) excluded from the test excavation program as they were located outside the Limit of Disturbance as it was then understood.

Table 6.5.3
Phase 1 Test Excavation Areas

Test Area	Survey Unit	Reason for Inclusion / Exclusion	Status in Test Excavation Program
1	Lunettes and Islands	• Artefacts identified in this area in the western portion of the Mine Site. • Lunettes represent landforms with increased archaeological sensitivity and likelihood of subsurface deposits.	Limited Investigation[1]
2	Lunettes and Islands	• Lunettes represent landforms with increased archaeological sensitivity and likelihood of subsurface deposits.	Limited Investigation[1]
3	Dunes and Sandplains	• Area in the western portion of the Mine Site where the highest concentration of artefacts was identified.	Excluded[1]
4 & 5	Lake Footslopes	• Survey indicated high archaeological potential of the Lake Footslopes landform with the greatest density of artefacts within the Mine Site. • Test excavation would confirm whether artefacts are present on a deflated surface or associated with subsurface deposits.	Included
6	Lake Footslopes	• Discrete location of silcrete artefacts visible in the eroded edge of the landform. • Possibly a knapping floor.	Included

Table 6.5.3 (Cont'd)
Phase 1 Test Excavation Areas

Test Area	Survey Unit	Reason for Inclusion / Exclusion	Status in Test Excavation Program
7	Dunes and Sandplains	• Increased archaeological potential due adjacent depression which may have held water seasonally. • Intended to represent the nature of subsurface deposits in the Dunes and Sandplains survey units.	Included
8	Relict Lake and Dunes and Sandplains	• Represents a transition of two survey units. • Artefacts were identified at the surface in this location.	Included
9	Dunes and Sandplains	• Intended to represent archaeological potential of landforms more distant from the salt pans.	Excluded[1]
10	Dunes and Sandplains	• A concentration of artefacts was identified in this area along the proposed Site Access Road. • Intended to provide insight into the flat, undifferentiated plain landform which transitions into a long, gentle slope where the greatest concentration of artefacts was identified.	Included
Note 1: Limit of Disturbance at that time did not include these areas.			
Source: OzArk (2024a) – modified after Tables 7-1 and 7-2			

Table 6.5.4 describes the survey effort for each of the Phase 1 test excavation areas sampled by OzArk (2024a).

Table 6.5.4
Phase 1 – Test Excavation Program Effort

Area	Test Excavation Survey Effort
1	Two transects with excavation of 12 0.5m by 0.5m pits (5 and 7 pits per transect)
2	Two transects with excavation eight 0.5m by 0.5m pits (4 pits per transect)
4	Four transects with excavation of 20 0.5m by 0.5 pits (5 pits per transect)
5	Six transects with excavation of 36 0.5m by 0.5 pits (between 4 and 10 pits per transect)
6	Two transects with excavation of 10 0.5m by 0.5m pits (5 pits per transect)
7	Two transects with excavation of 10 0.5m by 0.5m pits (5 pits per transect)
8	Two transects with excavation of 10 0.5m by 0.5m pits (5 pits per transect)
10	One transect with excavation of six 0.5m by 0.5m pits
Source: OzArk (2024a) – modified after Table 7-3 and Section 7.3	

Phase 2 Field Survey

The Phase 2 field survey was undertaken over a period of seven days between 1 and 4 February 2022 and between 1 and 5 March 2022, with the test excavation program occurring on 1 March 2022.

The Phase 2 survey was undertaken by a team consisting of six OzArk personnel and the following nine site officers, consisting of representatives from two RAPs, with at least four site officers present for each of the nine field survey days.

- Dareton Local Aboriginal Land Council, including:
  - Ernest Mitchell;
  - James Toomey;

  - Jason Smith;
  - Brendan Harris; and
  - Russel Taylor.
- Barkandji #8 Native Title Determinants, including:
  - Hector Hudson;
  - Talan Brown;
  - Tarrant Lihou; and
  - Robert Kennedy.

OzArk (2024a) divided the Heritage Survey Area into the following two zones which informed the survey methodology employed.

- Full Survey Areas
  - Included all landforms with greater archaeological potential (e.g. Lake Footslopes and portions of the Lunettes and Islands).
  - Additionally, an area of Sandplains and Dunes in the southwest was surveyed due to the indication of potential linear sand dunes being present on desktop modelling.
  - The transects were completed in pairs spaced 100m apart, with 200m between transect pairs. Additional transects were completed between transect pairs where necessary.
- Sample Landform Surveys
  - Included landforms with lower archaeological potential (e.g. Sand Plains and Dunes located away from the salt pans).
  - Sample squares measuring 500m by 500m were covered by transects based on the results of the Phase 1 survey.

Phase 2 Test Excavation Program

Following the identification of ten areas where test excavations could inform the understanding of subsurface archaeological potential within the Mine Site during Phase 1, Areas 3 and 9 were excluded from the program as they were not to be disturbed at that time. The Limit of Disturbance was redesigned during Phase 2 of the Project, and as a result, Area 3 would now be impacted. Therefore, a test excavation program was completed within the Mine Site for Area 3 (**Figure 6.5.1**) by OzArk personnel on 1 March 2022. A total of four site officers were present during the test excavation. Sampling methodology for Area 3 included 2 x 50m transects comprising excavation of 12 test units measuring 0.5m x 0.5m each.

Phase 3 Field Survey

The Phase 3 field survey was undertaken over a period of four days between 20 and 23 November 2023, with the test excavation program also occurring over a period of four days between 30 January and 2 February 2024. The assessment methodology provided in OzArk (2024a)

provided a sampling strategy for the Phase 3 assessment area. Prior to the survey, the area was reduced, and a greater level of survey effort was able to be completed. A total of six site officers were present during the Phase 3 field survey.

The pedestrian survey completed across the Phase 3 assessment area included the 'full survey' approach across the south portion and the northern portions while sample survey was completed across the portion adjacent Anabranch Mail Road. A sample of approximately every kilometre was completed along Anabranch Mail Road.

Phase 3 Test Excavation Program

Results from the field survey identified an aeolian dune with PAD encompassing two surfaces (Copi OS-58 and Copi OS-59), which were considered likely to contain subsurface artefacts. Therefore, subsurface investigations were required investigate the nature of the landform and confirm whether the surface artefacts at Copi OS-58 and 59 are associated with intact subsurface deposits. A total of four site officers were present during the Phase 3 test excavation.

A total of 66 Test Units (0.5 x 0.5m) were excavated within the aeolian dune landform encompassing Copi OS-58 and Copi OS-59 PADs. Sampling methodology for the Phase 3 test excavation program is outlined in **Table 6.5.5** and the area represented is presented on **Figure 6.5.1**.

Table 6.5.5
Phase 3 – Test Excavation Program Effort

Transect	Sampling strategy
Transect 1	• Located between Copi OS-58 and OS-59 • 90m transect = 10 Test Units spaced 10m apart.
Transect 2	• Along the northwestern rim of Copi OS-58 exposure • 70m transect = 8 Test Units spaced 10m apart.
Transect 3	• Along the southwestern rim of Copi OS-58 exposure. • 70m transect = 8 Test Units spaced 10m apart.
Transect 4	• Along the southeastern rim of Copi OS-59 exposure • 70m transect = 8 Test Units spaced 10m apart.
Transects 5a and 5b	• Across the northwestern section of the dune. • Split into two 40m transects = 5 Test Units spaced 10m apart. Transect 5a testing the northern extent of the PAD, north of Copi-OS58 and Transect 5b completed to the north of Copi-OS59.
Transect 6	• Across the southeastern section of the dune which retains greater A Horizon soils. • 70m transect = 8 Test Units spaced 10m apart.
Transect 7	• Across the southeastern section of the dune which retains greater A Horizon soils. • 70m transect = 8 Test Units spaced 10m apart.
Transect 8	• Located within Copi OS-59 at the centre of the exposure • 20m transect = 3 Test Units spaced 10m apart.
Transect 9	• Located within Copi OS-58 at the centre of the exposure • 20m transect = 3 Test Units spaced 10m apart.
Source: OzArk (2024a) – After Table 11-1	

6.5.4 Assessment Results

6.5.4.1 Field Survey Results

Table 6.5.6 presents a summary of the effective coverage of landform survey units achieved during the field survey program as well as the number of Aboriginal sites, artefacts and features (hearths) identified within each landform survey unit. In summary, OzArk (2024a) notes that effective survey coverage over the Heritage Survey Area was relatively consistent during the Phase 1 field survey (42% to 59.5%), averaging approximately 50% across all four landform survey units. However, rainfall between the Phase 1 and Phase 2 field surveys resulted in reduced ground surface exposure and, as a result, reduced effective survey coverage (24% to 52%). Survey coverage during Phase 3 assessments were further reduced to between 15% to 42% across the landform survey units.

Table 6.5.6
Effective Survey Coverage and Survey Results

Survey Unit	Survey Unit Area (ha)	Visibility[1] (%)	Exposure[2] (%)	Effective Coverage Area[3] (ha)	Effective Coverage[4] (%)	Number of Sites	Number of Artefacts and Features
Phase 1 Field Survey							
Dunes and Sandplains	812.2	80	70	454.8	56.0	21	66
Lunettes and Islands	622.5	70	65	283.2	45.5	35	96
Lake Footslopes	342.1	85	70	203.5	59.5	12	221
Relict Lakes	123.4	70	60	51.8	42.0	13	42
Phase 2 Field Survey							
Dunes and Sandplains	304.3	70	50	106.5	35	7	220
Lunettes and Islands	240.0	65	40	62.4	26	18	88
Lake Footslopes	229.2	80	65	119.2	52	16	142
Salt Pans	223.0	60	40	53.5	24	0	0
Phase 3 Field Survey							
Dunes and Sandplains	1658.4	70	60	696.5	42	14	134
Lunettes and Islands	995.4	65	40	258.0	26	6	86
Lake Footslopes	25.9	50	30	3.9	15	0	0
Relict Lakes	216.2	60	40	51.9	24	1	1

Note 1: Ground Surface Visibility – the amount of bare ground on the exposures which may reveal artefacts of other archaeological material.

Note 2: Ground Surface Exposure – the percentage of land for which erosion and exposure was sufficient to reveal archaeological evidence on the surface of the ground. Estimates the area with a likelihood of revealing buried artefacts or deposits.

Note 3: Effective Coverage Area = Survey Unit Area x Visibility % x Exposure %. Represents the Area Effectively Surveyed.

Note 4: Equivalent to: Effective Coverage Area / Survey Unit Area x 100.

Source: OzArk (2024a) – modified after Tables 6-1, 6-2, 8-1, 8-2, 10-1 and 10-2

Figures 6.5.3 and **6.5.4** display the locations of all Aboriginal sites recorded within the Heritage Survey Area during the field survey program. In summary, the field survey component of the assessment identified the following. Sections 6, 8 and 10 of OzArk (2024a) provide a detailed description of each of the identified sites.

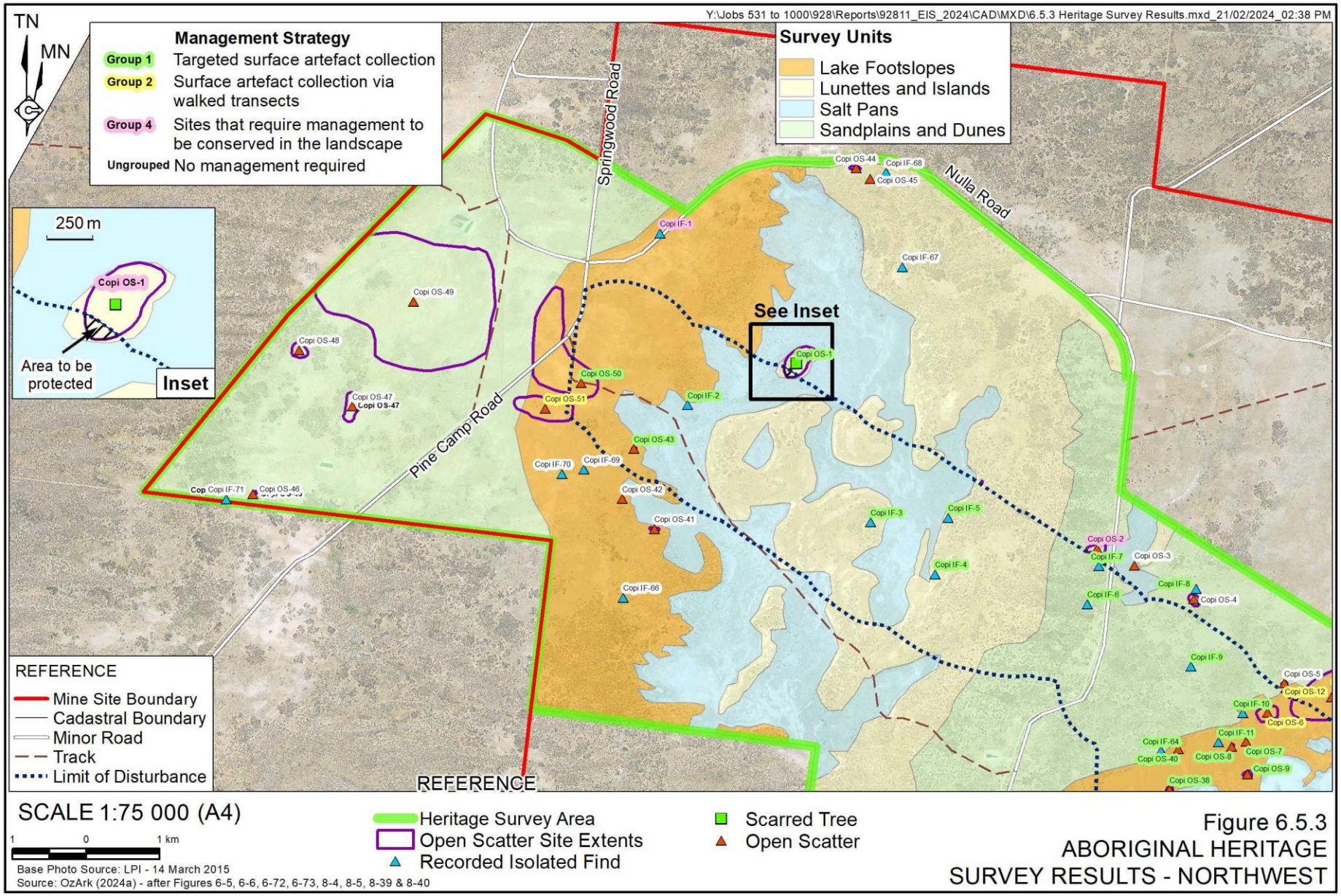
- 84 isolated finds
- 52 artefact scatters (including one PAD)
- Six artefact scatters with hearth/s
- One artefact scatter and a scarred tree.

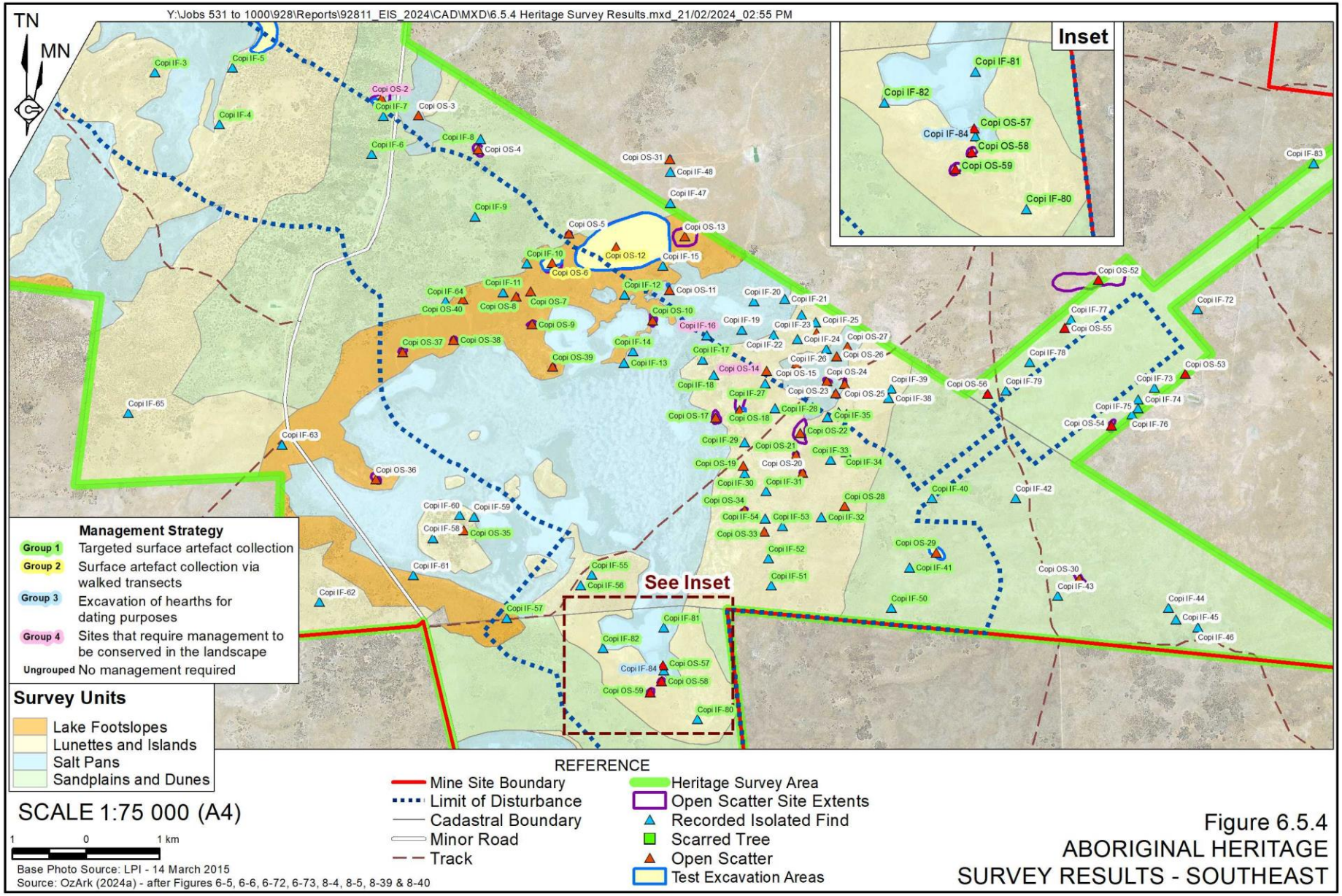
The results of the field survey are consistent with the predictive model developed for the Heritage Survey Area by OzArk (2024a). In summary:

- sites were most commonly recorded within the Lake Footslopes and Lunettes and Islands landform survey units;
- artefact sites, either low density artefacts scatters or isolated finds, were the most common site type identified within the Heritage Survey Area, with recorded artefacts primarily manufactured from silcrete, quartz, chert and quartzite;
- all recorded hearths were found to be associated with stone artefact sites;
- most sites were located within erosion scalds and are therefore considered likely to be within secondary contexts;
- one scarred tree was identified within the Heritage Survey Area;
- no middens or quarries were located within the Heritage Survey Area; and
- no particular landforms were identified as having a high likelihood of containing burials.

The results of the field survey show that the greatest density of artefacts and hearths was identified within the Lake Footslopes and Lunettes and Islands landforms associated with the Eastern Salt Pan, with very few artefacts identified in areas surrounding the Western Salt Pan. OzArk (2024a) notes that this clustering of artefacts potentially indicates that the eastern lake supported a feature (e.g. freshwater soaks) which attracted Aboriginal occupation.

The sites with the greatest density of artefacts are sites ‘Copi OS-58’ and ‘Copi OS-59’, located within the Phase 3 Heritage Survey Area. The sites, comprising a combined estimated 215 artefacts, are located on a hill crest adjacent to the southern boundary of the Eastern Salt Pan and were determined to include potential archaeological deposits (PADs) (**Figure 6.5.4**). Other sites determined to potentially include PADs included ‘Copi OS-06’ and ‘Copi OS-12’ located on the western side of the Eastern Salt Pan (**Figure 6.5.4**). Each of these sites were the subject of test excavation programs (see Section 6.5.4.2).


Y:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\MXD\6.5.3 Heritage Survey Results.mxd_21/02/2024_02:38 PM
TN
MN
Management Strategy
Group 1 Targeted surface artefact collection
Group 2 Surface artefact collection via walked transects
Group 4 Sites that require management to be conserved in the landscape
Ungrouped No management required
Survey Units
Lake Footslopes
Lunettes and Islands
Salt Pans
Sandplains and Dunes
250 m
Copi OS-1
Area to be protected
Inset
See Inset
Springwood Road
Nulla Road
Pine Camp Road
REFERENCE
Mine Site Boundary
Cadastral Boundary
Minor Road
Track
Limit of Disturbance
SCALE 1:75 000 (A4)
1 0 1 km
Base Photo Source: LPI - 14 March 2015
Source: OzArk (2024a) - after Figures 6-5, 6-6, 6-72, 6-73, 8-4, 8-5, 8-39 & 8-40
Heritage Survey Area
Open Scatter Site Extents
Recorded Isolated Find
Scarred Tree
Open Scatter
Figure 6.5.3
ABORIGINAL HERITAGE
SURVEY RESULTS - NORTHWEST


Y:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\MXD\6.5.4 Heritage Survey Results.mxd_21/02/2024_02:55 PM
TN
MN
Inset
See Inset
Management Strategy
Group 1 Targeted surface artefact collection
Group 2 Surface artefact collection via walked transects
Group 3 Excavation of hearths for dating purposes
Group 4 Sites that require management to be conserved in the landscape
Ungrouped No management required
Survey Units
Lake Footslopes
Lunettes and Islands
Salt Pans
Sandplains and Dunes
REFERENCE
Mine Site Boundary
Limit of Disturbance
Cadastral Boundary
Minor Road
Track
Heritage Survey Area
Open Scatter Site Extents
Recorded Isolated Find
Scarred Tree
Open Scatter
Test Excavation Areas
SCALE 1:75 000 (A4)
1 0 1 km
Base Photo Source: LPI - 14 March 2015
Source: OzArk (2024a) - after Figures 6-5, 6-6, 6-72, 6-73, 8-4, 8-5, 8-39 & 8-40
Figure 6.5.4
ABORIGINAL HERITAGE
SURVEY RESULTS - SOUTHEAST

A single scarred tree was identified in association with artefact scatter 'Copi OS-1' in the western portion of the Heritage Survey Area (see **Figure 6.5.3**), OzArk (2024a) notes that this site type did not conform to predictive modelling as culturally modified trees were not expected to in areas across landforms distant to permanent or semi-permanent water.

OzArk (2024a) notes that the vast majority of artefacts and hearths identified within the Heritage Survey Area were located within erosion scalds or areas considered likely to be lower soil strata. It was concluded that historical land uses within the Heritage Survey Area including vegetation clearing and grazing are likely to have affected the distribution of Aboriginal sites through soil degradation and erosion. Consequently, OzArk (2024a) considers the integrity of the Heritage Survey Area to be very low and the majority of the sites recorded were assessed as surface manifestations which have potentially been displaced and therefore have no associated archaeological deposits.

6.5.4.2 Test Excavation Program Results

Table 6.5.7 presents the results of the test excavation programs. In summary, 17 artefacts were recovered from a total of 188 x 0.5m by 0.5m test excavation pits (i.e. 47m^2) (OzArk, 2024a). This represents an average artefact density of approximately 0.36 artefacts per square metre, with a maximum of two artefacts being recorded in any individual test excavation pit. OzArk (2024a) state that this density of artefacts is extremely low.

As a result of the test excavation program, the allocation of 'PAD' is no longer applicable to Test Excavation Areas 1 and 6. The remaining test excavation areas (2, 3, 4, 5, 7, 8, 10) were found to be associated with subsurface deposits consisting of a low-density background scatter. The Phase 3 Test Excavation Area associated with 'Copi OS-59' is considered to be a medium-density background scatter (OzArk, 2024a).

Table 6.5.7
Test Excavation Program Results

Test Excavation Area	Number of Transects	Number of Test Pits	Test Pit Depth Range (cm)	Number of Artefacts	Artefact Description(s)
1	2	11	44 - 120	0	-
2	2	8	60 - 88	2	Two quartzite flakes
3	2	12	25 - 47	2	Two quartzite flakes
4	4	20	20 - 40	3	A chert core, a quartz flake and a broken quartzite flake
5	6	35	20 - 80	4	Two chert flakes (with retouch) and two quartz flakes
6	2	10	33 - 105	0	-
7	2	10	20 - 52	1	A quartzite flake
8	2	10	17 - 40	1	A broken quartzite flake
10	1	6	17 - 40	1	A broken quartz flake
Phase 3 Test Excavation Area	10	66	20 - 70	3	Two silcrete flakes and one quartzite flake
Total	**33**	**188**	**-**	**17**	

Source: OzArk (2024a) – modified after Tables 7-5, 9-2, 9-3, 11-2 and 11-3

These results indicate an extremely low incidence of subsurface artefacts across the test excavation areas, with low artefact numbers precluding meaningful analysis of artefact assemblages within all areas (OzArk, 2024a). Based on these results, OzArk (2024a) concludes that further archaeological excavations at these sites is not warranted. It is assessed that intact subsurface deposits within the Mine Site are extremely rare and visible artefacts recorded during the field surveys are likely the remnants of sites which have been exposed as a result of extensive erosion (OzArk, 2024a).

6.5.5 Assessment of Significance

Appropriate management of Aboriginal cultural heritage sites and items is typically determined based on their significance as well as the likely impacts of the proposed development. The significance of sites is assessed in terms of their importance to the Aboriginal community (i.e. social or cultural value), their importance archaeologists (i.e. archaeological or scientific value), their importance to the location (i.e. their aesthetic value) and their importance to a historically significant person, place, phase, event or activity in an Aboriginal community (i.e. historic value). A variety of factors including site integrity, structure, contents and rarity within the broader region are used to assess significance. It is also noted that the social or cultural value of a site can only be determined by the Aboriginal community.

Table 6.5.8 provides a summary of the significance assessment of the 143 sites recorded within the Heritage Survey Area. In summary, all sites have been identified by the RAPs as having high social or cultural value. The vast majority of identified sites are considered by OzArk (2024a) to be of low archaeological and scientific value, low aesthetic value and no historic value, excepting Copi OS-1, Copi OS-6, Copi OS-12, Copi OS-20, Copi OS-49, Copi OS-51 and Copi OS-52 which are considered to be of moderate archaeological or scientific value.

Table 6.5.8
Archaeological Significance Assessment Results for Identified Aboriginal Sites

Site ID	Social or Cultural Value	Archaeological or Scientific Value	Aesthetic Value	Historic Value	Degree of Harm	Management Strategy[1]
Copi IF-1	High	Low	Low	None	None	Group 4
Copi IF-2	High	Low	Low	None	Total	Group 1
Copi IF-3	High	Low	Low	None	Total	Group 1
Copi IF-4	High	Low	Low	None	Total	Group 1
Copi IF-5	High	Low	Low	None	Total	Group 1
Copi IF-6	High	Low	Low	None	Total	Group 1
Copi IF-7	High	Low	Low	None	Total	Group 1
Copi IF-8	High	Low	Low	None	None	Group 1
Copi IF-9	High	Low	Low	None	Total	Group 1
Copi IF-10	High	Low	Low	None	Total	Group 1
Copi IF-11	High	Low	Low	None	Total	Group 1
Copi IF-12	High	Low	Low	None	Total	Group 1
Copi IF-13	High	Low	Low	None	Total	Group 1
Copi IF-14	High	Low	Low	None	Total	Group 1

Table 6.5.8 (Cont'd)
Archaeological Significance Assessment Results for Identified Aboriginal Sites

Site ID	Social or Cultural Value	Archaeological or Scientific Value	Aesthetic Value	Historic Value	Degree of Harm	Management Strategy[1]
Copi IF-15	High	Low	Low	None	None	Nil
Copi IF-16	High	Low	Low	None	None	Group 4
Copi IF-17	High	Low	Low	None	Total	Group 1
Copi IF-18	High	Low	Low	None	Total	Group 1
Copi IF-19	High	Low	Low	None	None	Nil
Copi IF-20	High	Low	Low	None	None	Nil
Copi IF-21	High	Low	Low	None	None	Nil
Copi IF-22	High	Low	Low	None	None	Nil
Copi IF-23	High	Low	Low	None	None	Nil
Copi IF-24	High	Low	Low	None	None	Nil
Copi IF-25	High	Low	Low	None	None	Nil
Copi IF-26	High	Low	Low	None	None	Nil
Copi IF-27	High	Low	Low	None	Total	Group 1
Copi IF-28	High	Low	Low	None	Total	Group 1
Copi IF-29	High	Low	Low	None	Total	Group 1
Copi IF-30	High	Low	Low	None	Total	Group 1
Copi IF-31	High	Low	Low	None	Total	Group 1
Copi IF-32	High	Low	Low	None	Total	Group 1
Copi IF-33	High	Low	Low	None	Total	Group 1
Copi IF-34	High	Low	Low	None	Total	Group 1
Copi IF-35	High	Low	Low	None	Total	Group 1
Copi IF-36	High	Low	Low	None	None	Group 1
Copi IF-37	High	Low	Low	None	None	Group 1
Copi IF-38	High	Low	Low	None	None	Nil
Copi IF-39	High	Low	Low	None	None	Nil
Copi IF-40	High	Low	Low	None	Total	Group 1
Copi IF-41	High	Low	Low	None	Total	Group 1
Copi IF-42	High	Low	Low	None	None	Nil
Copi IF-43	High	Low	Low	None	None	Nil
Copi IF-44	High	Low	Low	None	None	Nil
Copi IF-45	High	Low	Low	None	None	Nil
Copi IF-46	High	Low	Low	None	None	Nil
Copi IF-47	High	Low	Low	None	None	Nil
Copi IF-48	High	Low	Low	None	None	Nil
Copi IF-49	High	Low	Low	None	None	Nil
Copi IF-50	High	Low	Low	None	Total	Group 1
Copi IF-51	High	Low	Low	None	Total	Group 1
Copi IF-52	High	Low	Low	None	Total	Group 1

Table 6.5.8 (Cont'd)
Archaeological Significance Assessment Results for Identified Aboriginal Sites

Site ID	Social or Cultural Value	Archaeological or Scientific Value	Aesthetic Value	Historic Value	Degree of Harm	Management Strategy[1]
Copi IF-53	High	Low	Low	None	Total	Group 1
Copi IF-54	High	Low	Low	None	Total	Group 1
Copi IF-55	High	Low	Low	None	Total	Group 1
Copi IF-56	High	Low	Low	None	Total	Group 1
Copi IF-57	High	Low	Low	None	Total	Group 1
Copi IF-58	High	Low	Low	None	None	Nil
Copi IF-59	High	Low	Low	None	None	Nil
Copi IF-60	High	Low	Low	None	None	Nil
Copi IF-61	High	Low	Low	None	None	Nil
Copi IF-62	High	Low	Low	None	None	Nil
Copi IF-63	High	Low	Low	None	None	Nil
Copi IF-64	High	Low	Low	None	Total	Group 1
Copi IF-65	High	Low	Low	None	None	Nil
Copi IF-66	High	Low	Low	None	None	Nil
Copi IF-67	High	Low	Low	None	None	Nil
Copi IF-68	High	Low	Low	None	None	Nil
Copi IF-69	High	Low	Low	None	None	Nil
Copi IF-70	High	Low	Low	None	None	Nil
Copi IF-71	High	Low	Low	None	None	Nil
Copi IF-72	High	Low	Low	None	None	Nil
Copi IF-73	High	Low	Low	None	None	Nil
Copi IF-74	High	Low	Low	None	None	Nil
Copi IF-75	High	Low	Low	None	None	Nil
Copi IF-76	High	Low	Low	None	None	Nil
Copi IF-77	High	Low	Low	None	None	Nil
Copi IF-78	High	Low	Low	None	None	Nil
Copi IF-79	High	Low	Low	None	None	Nil
Copi IF-80	High	Low	Low	None	Total	Group 1
Copi IF-81	High	Low	Low	None	Total	Group 1
Copi IF-82	High	Low	Low	None	Total	Group 1
Copi IF-83	High	Low	Low	None	None	Nil
Copi IF-84	High	Low	Low	None	Total	Group 3
Copi OS-1	High	Moderate	Low	None	None	Group 4
Copi OS-2	High	Low	Low	None	None	Group 4
Copi OS-3	High	Low	Low	None	None	Nil
Copi OS-4	High	Low	Low	None	None	Nil
Copi OS-5	High	Low	Low	None	None	Nil
Copi OS-6	High	Moderate	Low	None	Total	Group 2 & 3
Copi OS-7	High	Low	Low	None	Total	Group 1
Copi OS-8	High	Low	Low	None	Total	Group 1

Table 6.5.8 (Cont'd)
Archaeological Significance Assessment Results for Identified Aboriginal Sites

Site ID	Social or Cultural Value	Archaeological or Scientific Value	Aesthetic Value	Historic Value	Degree of Harm	Management Strategy[1]
Copi OS-9	High	Low	Low	None	Total	Group 1
Copi OS-10	High	Low	Low	None	Total	Group 1
Copi OS-11	High	Low	Low	None	None	Nil
Copi OS-12	High	Moderate	Low	None	Partial	Group 2, 3, & 4
Copi OS-13	High	Low	Low	None	None	Nil
Copi OS-14	High	Low	Low	None	None	Group 4
Copi OS-15	High	Low	Low	None	None	Nil
Copi OS-16	High	Low	Low	None	None	Nil
Copi OS-17	High	Low	Low	None	Total	Group 1
Copi OS-18	High	Low	Low	None	Total	Group 1
Copi OS-19	High	Low	Low	None	Total	Group 1
Copi OS-20	High	Moderate	Low	None	Total	Groups 1 & 3
Copi OS-21	High	Low	Low	None	Total	Group 1
Copi OS-22	High	Low	Low	None	Total	Group 1
Copi OS-23	High	Low	Low	None	None	Nil
Copi OS-24	High	Low	Low	None	None	Nil
Copi OS-25	High	Low	Low	None	None	Nil
Copi OS-26	High	Low	Low	None	None	Nil
Copi OS-27	High	Low	Low	None	None	Nil
Copi OS-28	High	Low	Low	None	Total	Group 1
Copi OS-29	High	Low	Low	None	Total	Group 1
Copi OS-30	High	Low	Low	None	None	Nil
Copi OS-31	High	Low	Low	None	None	Nil
Copi OS-32	High	Low	Low	None	None	Nil
Copi OS-33	High	Low	Low	None	Total	Group 1
Copi OS-34	High	Low	Low	None	Total	Group 1
Copi OS-35	High	Low	Low	None	Total	Group 1
Copi OS-36	High	Low	Low	None	None	Nil
Copi OS-37	High	Low	Low	None	Total	Group 1
Copi OS-38	High	Low	Low	None	Total	Group 1
Copi OS-39	High	Low	Low	None	Total	Group 1
Copi OS-40	High	Low	Low	None	Total	Group 1
Copi OS-41	High	Low	Low	None	None	Nil
Copi OS-42	High	Low	Low	None	None	Nil
Copi OS-43	High	Low	Low	None	Total	Group 1
Copi OS-44	High	Low	Low	None	None	Nil
Copi OS-45	High	Low	Low	None	None	Nil
Copi OS-46	High	Low	Low	None	None	Nil
Copi OS-47	High	Low	Low	None	None	Nil
Copi OS-48	High	Low	Low	None	None	Nil
Copi OS-49	High	Moderate	Low	None	None	Nil

Table 6.5.8 (Cont'd)
Archaeological Significance Assessment Results for Identified Aboriginal Sites

Site ID	Social or Cultural Value	Archaeological or Scientific Value	Aesthetic Value	Historic Value	Degree of Harm	Management Strategy[1]
Copi OS-50	High	Low	Low	None	Partial	Group 1 & 4
Copi OS-51	High	Moderate	Low	None	Partial	Group 2 & 4
Copi OS-52	High	Moderate	Low	None	None	Nil
Copi OS-53	High	Low	Low	None	None	Nil
Copi OS-54	High	Low	Low	None	None	Nil
Copi OS-55	High	Low	Low	None	None	Nil
Copi OS-56	High	Low	Low	None	None	Nil
Copi OS-57	High	Low	Low	None	Total	Group 1
Copi OS-58	High	Low	Low	None	Total	Group 1
Copi OS-59	High	Low	Low	None	Total	Group 1
Note 1: Management groups as detailed below.						
Source: OzArk (2024a) – modified after Table 13-1,14-1 and 15-1						

6.5.6 Management of Identified Sites

Figures 6.5.3 and **6.5.4** and **Table 6.5.8** identify the proposed management of identified sites of Aboriginal heritage significance. In summary, OzArk (2024a) propose five management "groups' as follows.

- Group 1 = These sites are located within the proposed area of disturbance and would be salvaged through targeted surface artefact collection.
- Group 2 = These sites are located within the proposed area of disturbance and would be salvaged through surface artefact collection via walked transect.
- Group 3 = These sites are located within the proposed area of disturbance and would be salvaged through limited archaeological excavation of hearths for dating purposes.
- Group 4 = These sites are not located within the proposed area of disturbance but require management to be conserved in the landscape (e.g. fencing).
- Ungrouped – These sites would not be disturbed and no particular management is warranted.

In summary, the Project would result in the disturbance of the following sites.

- Total disturbance of 62 sites.
- Partial disturbance of three sites.
- Avoidance of 78 sites.

6.5.7 Aboriginal Stakeholder Consultation Outcomes

6.5.7.1 Comments Arising from the Assessment

No specific resources, including quarry sites, food resources or freshwater sources, were noted by OzArk (2024a) within the Heritage Survey Area. However, the RAPs noted that gypsum present within the Heritage Survey Area may have been collected and used as a source of paint for Aboriginal ceremonies or art.

The following two requests were made by sites officers from both RAPs participating in the assessment fieldwork. The Applicant has agreed to both these requests.

- Hearths proposed to be impacted by the Project should be subject to radiocarbon dating to further inform understandings of the history of Aboriginal occupation in the area.
- An area within the Mine Site be set aside as a reburial location for Aboriginal objects salvaged from areas of proposed disturbance.

6.5.7.2 Comments Arising from Review of the Assessment Report

A copy of the draft ACHAR was provided to RAPs for review on 18 March 2024, with the 28 day review period closing on 19 April 2024. No comments were received on the draft ACHAR. Consequently, OzArk (2024a) have assigned all recorded sites an assessment of high cultural significance.

6.5.8 Avoidance, Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures in order to avoid, manage or mitigate any adverse impacts upon Aboriginal cultural heritage values associated with the Project. The proposed measures were developed in consultation with the RAPs and site officers who participated in the field surveys and represent the full range of reasonable and feasible mitigation measures taking into consideration the residual risk to biodiversity presented in **Appendix 2**. The proposed unanticipated finds protocols also represent appropriate contingency mitigation measures.

- Prepare and implement an *Aboriginal Cultural Heritage Management Plan* in consultation with RAPs and Heritage NSW, including the following measures.
  - Ensure that the entire extent of Copi OS-1, including the identified scarred tree, is fenced and preserved.
  - Salvage identified hearths to be impacted by the Project, and complete radiocarbon dating, prepare a report describing the results of the testing program and provide the report to the RAPs, Heritage NSW and the AHIMS database.
  - Identify, in consultation with the RAPs an area within the Mine Site be set aside as a reburial location for Aboriginal objects salvaged from areas of proposed disturbance.

  - Implement the following management strategies identified for each site as listed in **Table 6.5.8**.
    - Group 1 = targeted surface artefact collection
    - Group 2 = surface artefact collection via walked transect
    - Group 3 = limited archaeological excavation and radiocarbon dating of hearths
    - Group 4 = sites requiring management to be conserved in the landscape (e.g. fencing)
    - Ungrouped – These sites would not be disturbed and no particular management is warranted
  - Implement appropriate cultural heritage training for all site personnel, including in relation to identification and management of unanticipated finds.

- Implement the following procedures following the salvage of artefacts within areas of disturbance.
  - Prepare a brief salvage report to record the findings.
  - Complete an AHIMS Aboriginal Site Impact Recording Form and ensure that a copy is archived, and a digital copy is submitted to the AHIMS Registrar within four months following completion of salvage fieldwork.
  - Ensure that all salvaged artefacts are managed in consultation with RAPs, DPE and Heritage NSW. This may include the requirement for a Care and Control Agreement to be submitted to and endorsed by Heritage NSW for final artefact care arrangements or reburial within the Mine Site.
- Implement the following unanticipated finds protocol in the event that a previously unknown Aboriginal site is identified within the proposed areas of disturbance.
  - Cease all work in the vicinity of the site immediately.
  - Temporarily fence the site to prevent further disturbance.
  - Contact Heritage NSW, the RAPs and/or a qualified archaeologist to provide further advice or to assess the site.
  - Should the site be determined to be an Aboriginal object, ensure that the site location is registered with AHIMS and that a site card is submitted.
  - Avoid disturbing the site, if practicable. If not practicable ensure that all appropriate approvals are obtained prior to disturbance.
- Implement the following unanticipated finds protocol in the event that a previously unknown Aboriginal site is identified outside of the proposed disturbance areas.
  - The site will be assessed by a qualified archaeologist and a RAP
  - The site will be considered for fencing depending on its proximity to the Limit of Disturbance
  - The site location will be registered with AHIMS, and a site card submitted.

- Implement the following protocol in the event that suspected human skeletal material is discovered within areas to be disturbed.
  - Follow Requirement 25 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* which outlines the protocol for unexpected finds of physical remains are suspected to be Aboriginal ancestral remains, including to:
  - Cease all work in the vicinity of the site immediately.
  - Temporarily fence the site with a minimum buffer of 10m, ensuring that no further disturbance occurs to the skeletal remains or associated artefacts. If skeletal remains have been removed from the ground, these should be stored in a dry location on site.
  - Contact the NSW Police and Heritage NSW to assist with identification of the burial.
  - If the skeletal material is determined to be ancient Aboriginal remains, Heritage NSW would send a Compliance and Regulation Officer to the scene and then issue an Advisory Letter setting out the required process from this point.
  - Ensure that the Aboriginal community (i.e. RAPs) are notified of the discovery.
  - Ensure that the Aboriginal remains are recorded under the direct supervision of a specialist anthropologist or other suitably qualified person.
  - Ensure that the location of the burial is registered as an Aboriginal site on the AHIMS database.
  - Ensure that work within the cordoned off area is not recommenced until authorisation is received in writing from Heritage NSW.

6.5.9 Conclusion

Of the 143 Aboriginal sites recorded within the Heritage Survey Area during the field survey, 78 are located outside of the proposed Limit of Disturbance and would not be impacted by the Project. This includes Copi OS-1 which partially extends into Limit of Disturbance but would be protected to prevent harm to that site. All identified sites located within 50m of the Limit of Disturbance would be managed during the construction phase of the Project to ensure that they are not subject to inadvertent impacts.

Of the 65 remaining identified Aboriginal sites, 62 sites would be totally impacted, three would be partially impacted. Management and mitigation measures, as outlined in Section 6.5.8, would be implemented to mitigate harm to Aboriginal cultural heritage sites located within the Limit of Disturbance.

Six of the sites which would be impacted by the Project have been assessed as having moderate archaeological or scientific significance (Copi OS-6, Copi OS-12, Copi OS-20, Copi OS-49 and Copi OS-51 and Copi OS-52). It is proposed that hearths associated with three of the sites (Copi OS-6, Copi OS-12 and Copi OS-20) are excavated to obtain samples suitable for dating in order to further develop understandings of the regional chronology of Aboriginal occupation.

The preparation of an *Aboriginal Cultural Heritage Management Plan* in consultation with the RAPs and Heritage NSW would ensure that cultural heritage sites and values within the Mine Site would be protected in accordance with the expectations of the local Aboriginal and wider community as well as the requirements of the NSW Government.

6.6 Traffic and Transportation

6.6.1 Introduction

The SEARS identify "traffic and transport" as a key issue for assessment in the EIS. Matters to be addressed include:

- "an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the road and rail networks and any cumulative impacts of other developments in the locality…, including;
  - preliminary concept design drawings of proposed road upgrades, maps of the surrounding road network, details of the road geometry and alignment and capacity analysis;
  - details of road and traffic impacts including background traffic data, volume and distribution of trips during construction, operation and decommissioning and type and frequency of vehicles accessing the site, including the site access routes, site access point and road closures in accordance with the *Roads Act 1993*; and
  - a description of the measures that would be implemented to mitigate and / or manage potential traffic impacts including a schedule of all required road upgrades (including locations and durations of any road closures), road maintenance (operations, frequency and contributions), management of oversized and over mass traffic and other traffic control measures, road closures developed in consultation with the relevant road authority, and Driver Code of Conducts;"

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from Broken Hill City Council, Transport for NSW and Wentworth Shire Council. These requirements, where additional to those above, are summarised as follows.

- Preliminary concept drawings of the proposed upgrade for the Silver City Highway / Anabranch Mail Road intersection prepared in accordance with relevant Austroads Guides, Australian Standards and TfNSW supplements. Concept drawings should also include a swept path analysis for the largest design vehicle.
- Traffic impacts should consider each stage of the project including construction, operation, and decommissioning/rehabilitation.
- A map of the surrounding road network identifying the site access, nearby accesses, intersections and transport related facilities and the proposed transport route/s identifying all public roads proposed to obtain access from the classified (State) road/s to the development site.
- The total impact of existing and proposed development on the road network with consideration for a 10-year horizon. This should include:
  - Identify Annual Average Daily Traffic (AADT) volumes with percentage heavy vehicles along the transport route/s and diagrammatically demonstrate AM and PM peak hour movements at key intersections.

  - Background traffic data from published sources and/or recent survey data. The source of data and any assumptions are to be clearly explained and justified, including the growth rate applied to the future horizon. Including a review of crash data along the identified transport route/s for the most recent 5-year reporting period and an assessment of road safety along the proposed transport route/s considering the safe systems principles adopted under Future Transport 2056.
  - The volume and distribution of existing and proposed trips to be generated by the construction, operational and decommission phases of the development. This should identify the maximum daily and hourly demands generated by the development, particularly where they coincide with the network peak hour.
- A capacity analysis of any major/relevant intersections impacted, using SIDRA or a similar traffic model.
- The type and frequency of vehicles accessing the development site, and the origins, destinations and routes for commuter, heavy and oversize vehicles.
- The road geometry and alignment along the identified transport route/s should be detailed, including existing formations, crossings, intersection treatments and any identified hazards.
- A Traffic Management Plan should be prepared. The Applicant notes that this Plan would be prepared following determination of the application for development consent.

Appendix 1 presents a complete overview of the SEARs and Government agency requirements, and where each has been addressed.

Tonkin Consulting Pty Ltd (Tonkin) prepared the *Traffic Assessment* for the Project. The resulting report, referred to hereafter as Tonkin (2024), is presented as **Appendix 9**. The following subsection draws on information presented in that report and describes the existing road network and traffic environment, predicted changes to the traffic environment as a result of the Project, the proposed management and mitigation measures and an assessment of traffic-related impacts.

For the purposes of this section, it is recognised that the key origins/destinations of Project-related traffic are Broken Hill and Wentworth with the Silver City Highway as the key State road between both centres. As discussed in Section 3.6, the bulk or approximately 90% of Project personnel and vehicles delivering consumables and other products would travel from the south, to and from Wentworth, with the remainder travelling from the north, to and from Broken Hill. Heavy mineral concentrate would be transported to the Rail Facility in Broken Hill. From there, the material would be transported under separate approval by rail to the Applicant's processing facility in Pinkenba, Brisbane or direct to port. A small proportion of the heavy mineral concentrate would be transported by road direct to port, also under separate approval.

In light of the above, Tonkin (2024) assessed road transportation from the intersection with the Site Access Road to Wentworth and Broken Hill only.

Finally, Tonkin (2024) assessed the operation of vehicles up to and including Type 2 road trains, including BAB-quad road trains. These vehicles are classified as Level 4 vehicles by the National Heavy Vehicle Regulator.

6.6.2 Methodology

The traffic and transportation assessment was undertaken in accordance with the Transport for NSW *Guide to Traffic Generating Developments* (RTA 2013) and in consideration of the relevant parts of the Austroads Guide to Road Design and other relevant guidelines.

In May 2022, a site inspection was carried out at the proposed haul route through Broken Hill. A site inspection was also conducted at Anabranch Mail Road and the junction with the Silver City Highway on 13 August 2018, and a further inspection was undertaken on 8 January 2020. These inspections were conducted to establish the existing road arrangements, geometry, pavement conditions and sight distances to identify constraints and mitigation measures for the Project.

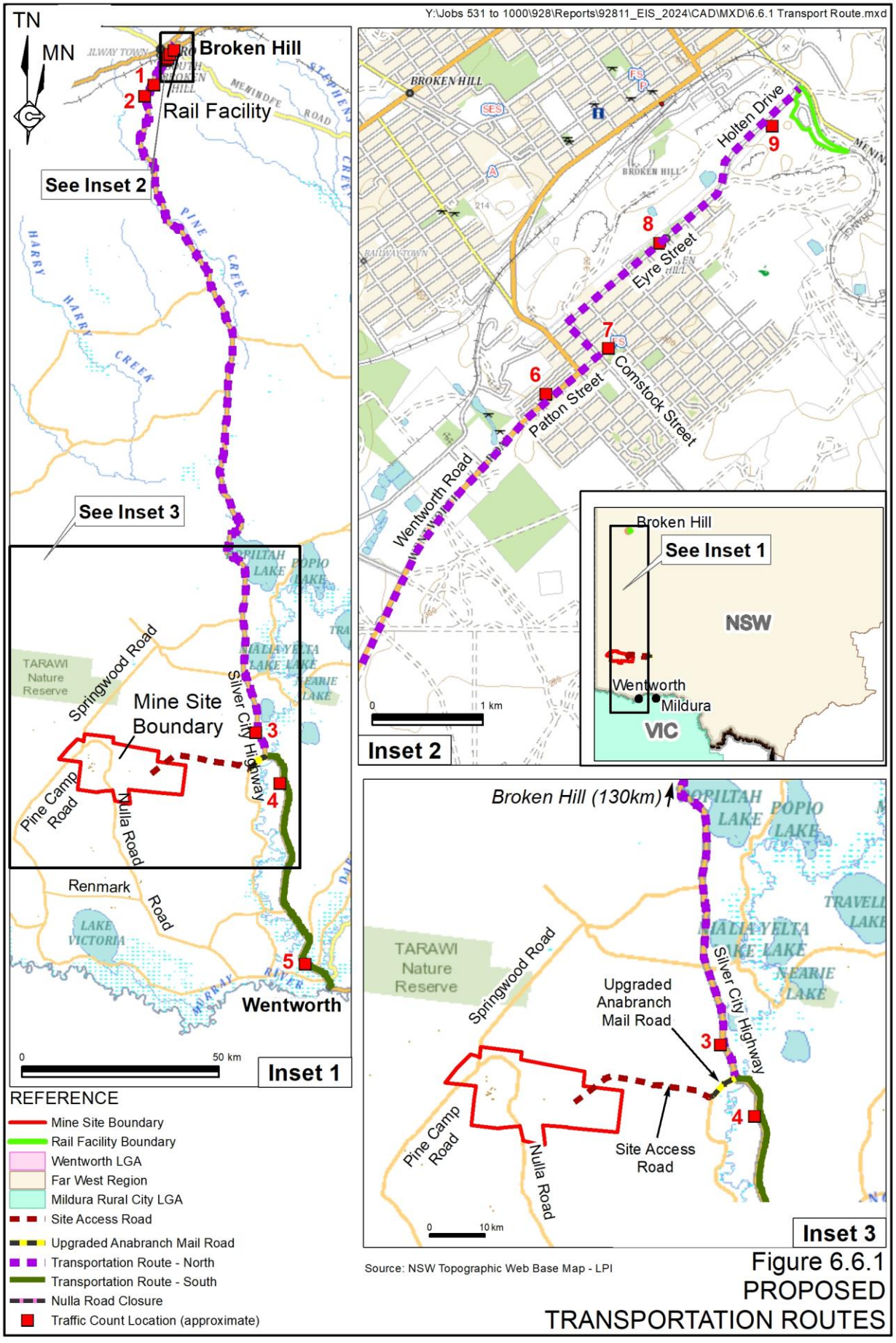
6.6.3 Existing Environment

6.6.3.1 Roads

Tonkin (2024) describes the public roads along the transportation routes to and from Broken Hill and Wentworth as follows (**Figure 6.6.1**).

Anabranch Mail Road

- Unsealed local road under the control of the Wentworth Shire Council.
- Length of approximately 68.9km from Silver City Highway to Nulla Road near Wentworth.
- Subject to the default speed limit under all other roads other than urban roads of 100km/h, however, Tonkin (2024) indicates that the road alignment between the Site Access Road and the Silver City Highway is unlikely to support speeds of 100km/h due to;
  - narrow travel width in sections;
  - an un-signposted crest located approximately 1.8km to 2.0km from the Highway resulting in restricted sightlines in both directions; and
  - a horizontal curve approximately 5.3km from the Highway which is not well delineated, with an approximate radius of 440m (minimum radius of curve of 800m required under ARRB Unsealed Roads Manual).
- The section between the Silver City Highway and the proposed Site Access Road varies in width between 6.5m and 7.5m for the main formation, which reduces to between 4m and 5m in some locations.
- Satisfactory road condition, with exposed subgrade and lacking sheeting material in the first 2km.



Source: NSW Topographic Web Base Map - LPI

Figure 6.6.1
PROPOSED
TRANSPORTATION ROUTES

Silver City Highway

- Sealed, two-lane, two-way State road under the care and control of Transport for NSW.
- Length of approximately 197km from Anabranch Mail Road to Broken Hill and 69km from Anabranch Mail Road to Wentworth.
- Sign-posted speed limit of 110km/h.
- A sealed width of between approximately 7.0m and 9.0m and marked lane widths of between approximately 3.0m and 4.0m.
- Minimal sealed shoulders and variable unsealed shoulder widths, measured at approximately 10m overall.
- Satisfactory condition with minimal rutting and surface defects.
- Approval for Type 1 road train (A-Double, Modular B-triple, B-triple and AB-triple) vehicle usage. Type 2 road trains (AB-quads) or Level 4 vehicles currently operate between the Snapper and Ginkgo Mines and Broken Hill under permit.

Wentworth Road

- Sealed, two-lane, two-way road that forms part of Silver City Highway under the care and control of Transport for NSW.
- Speed limit changes from 80km/h to 50km/hr approximately 90m southwest of the main site access for the Perilya Limited site.
- A sealed width varying between 9.1m and 9.4m with marked lane widths of approximately 3.5m and 3.6m.
- Shoulder widths vary between 1m and 2m.
- Satisfactory road condition with minimal rutting or surface defects, with some minor flushing.
- Approval for Type (1) A-Double, Modular B-triple, B-triple and AB-triple vehicle usage.

Patton Street

- Sealed, two-lane, two-way road under the care and control of Transport for NSW (southwest of the roundabout) and partly under the care and control of Broken Hill City Council (northeast of the roundabout).
- Sign-posted speed limit of 50km/h but transitions to 40km/h near the Patton Street/Comstock Street intersection.
- Sealed width varying between 13.4m and 15.2m and marked road widths ranging between 7.2m and 7.4m (3.6m - 3.7m lanes)
- Kerbing is located on each side of the street.

- Satisfactory road condition with minimal rutting or surface defects, with some defects observed at the roundabout.
- The section of Patton St forming part of the proposed transportation route has approval for Type (1) A-Double, Modular B-triple, B-triple and AB-triple vehicle usage.

Comstock Street

- Sealed, two-lane, two-way local road under the care and control of Broken Hill City Council.
- Sign-posted speed limit of 50km/h but transitions to 40km/hr near the Patton Street/Comstock Street intersection.
- Sealed width is measured at 15.2m with no edge lines present.
- Good road condition with new spray seal and intersection treatments.
- The section of Comstock Street forming part of the proposed transportation route has approval for Type (1) A-Double, Modular B-triple, B-triple and AB-triple vehicle usage.

Eyre Street

- Sealed, two-lane, two-way local road under the care and control of Broken Hill City Council.
- Sign-posted speed limit of 50km/h, transitioning to 60km/hr towards the northeastern end.
- Sealed width is measured at 13.5m at the southwestern end with no edge lines present. A sealed width of 9.8m and 6.4m lane width (3.2m lanes) is measured at the northeastern end of the street.
- A bike lane is present along the northwestern side of the street where no kerb is present.
- Reasonable road condition with minor rutting and cracking observed in older spray seal. The southwestern end has recently been resealed.
- The section forming part of the proposed transportation route has approval for Type (1) A-Double, Modular B-triple, B-triple and AB-triple vehicle usage.

Holten Drive

- Sealed, two-lane, two-way local road under the care and control of Broken Hill City Council.
- Sign-posted speed limit of 60km/h at southwestern end, transitioning to 50km/hr towards the northeastern end.
- Sealed width is measured at 11.2m with lane widths of 6.6m (3.3m lanes).

- Reasonable road condition with minor rutting observed. The underlying pavement is expected to be in an adequate condition.
- The section forming part of the proposed transportation route has approval for Type (1) A-Double, Modular B-triple, B-triple and AB-triple vehicle usage.

6.6.3.2 Intersections

Anabranch Mail Road / Site Access Road Junction

Anabranch Mail Road would be realigned and an intersection with the Site Access Road would be constructed. Based on the anticipated operating speed of 80km/h and a 3.5 second driver reaction time, the required SISD for the Silver City Highway / Anabranch Mail Road intersection is 204m based on, and allowing for a lower coefficient of deceleration of 0.2. Measurements completed by Tonkin (2024) indicate that the required SISD is achieved at the existing intersection as the available sight distance is sufficient in both directions.

Silver City Highway / Anabranch Mail Road Junction

The intersection of the Silver City Highway and Anabranch Mail Road is a 90-degree basic T-junction, with the Highway having priority marked with a Give Way sign at Anabranch Mail Road.

Based on an anticipated operating speed of 110km/h and a 2.5 second driver reaction time, the required Safe Intersection Sight Distance (SISD) for the Silver City Highway / Anabranch Mail Road intersection is 300m. Measurements completed by Tonkin (2024) indicate that the required SISD would be achieved.

Patton Street Roundabout

The roundabout located on Patton Street is currently located on an existing heavy vehicle route in Broken Hill. The roundabout is sealed with partial concrete / asphalt pavement material. The pavement present reflects extensive cracking, with crack sealing provided. Signage is in place approaching each direction.

Approach sight distance is satisfactory in each direction, with clear sight lines from the northeastern approach and narrow tree trunks and a pole momentarily obstructing the slight line from the southwestern approach.

The current roundabout configuration is suitable for use by Type 2 Road Trains/Level 4 vehicles for the required movements in its current configuration. Appendix B of Tonkin (2024) presents a turning path assessment that has been undertaken confirming the adequacy of the roundabout.

Patton Street / Comstock Street Junction

The Patton Street / Comstock Street Junction is currently located on an existing heavy vehicle route in Broken Hill. The junction consists of a concrete pavement and is located in an area with high pedestrian activity likely. A give way sign and hold line located 2m back from the kerb line is present on Comstock Street indicating priority for Patton Street.

Tonkin (2024) states that the sight distances at the current hold line on Comstock Street are not adequate but would likely be acceptable if the hold line were moved approximately 2m forwards.

Comstock Street / Eyre Street Junction

The Comstock Street / Eyre Street Junction is currently located on an existing heavy vehicle route in Broken Hill. The Junction consists of a concrete pavement. No give way or stop sign is present to indicate priority for Eyre Street.

Due to no hold line being present, sight distances were taken in line with the kerb. Tonkin (2024) notes that the required SISD is 124m. The observed sight distance to the southwest is 220m, while to the northeast it is 70m, with this distance affected by a parked car on the day of the inspection. Tonkin (2024) state that the required sight distance would have been achieved if the parked car were not present.

Holten Drive / Rail Facility Entrance Junction

The rail siding located off Holten Drive has two existing entrances, with the southwestern (closest to Eyre Street) entrance proposed to be used. No signage or painted lines are provided at the intersection. A bike lane is currently in place on Holten Drive.

SISD was assessed from the proposed intersection at approximately 7m back from the edge line, with sight distances of 350m to the southwest and 160m to the northeast exceeding the required distance of 124m.

6.6.3.3 Traffic Volumes

Table 6.6.1 presents measured traffic count results for the existing road network which encompasses the Silver City Highway and Project-related roads, as well as estimated 2024 traffic volumes determined assuming an average annual growth rate to 1%.

Table 6.6.1
Historic and Projected Traffic Volumes

	Daily Traffic Volume						Average Proportion of Heavy Vehicles (%)
	2006 Survey	2010 Survey	2016 Survey	2021 Survey	2022 Survey	2024 Projected[1]	
Location 1 - Silver City Highway (9.9km south of Wentworth Road, Broken Hill)	295					353	16.0
Location 2 - Silver City Highway (14.4km south of Kanandah Road, Broken Hill)					428	437	25.5
Location 3 - Silver City Highway (12.5km north of Anabranch Mail Road				110		113	45.3
Location 4 - Silver City Highway (17.4km south of Anabranch Mail Road, Anabranch South)	319	358				412	
Silver City Highway (80m north of Renmark Road)					1,071	1,093	19.0

Table 6.6.1 (Cont'd)
Historic and Projected Traffic Volumes

	Daily Traffic Volume						Average Proportion of Heavy Vehicles (%)
	2006 Survey	2010 Survey	2016 Survey	2021 Survey	2022 Survey	2024 Projected[1]	
Location 5 - Patton Street			2,117		2,441	2,490	16.4
Location 6 - Comstock Street			562			609	14.1
Location 7 - Eyre Street			2,274		2,150	2,194	13.3
Location 8 - Holten Drive					2,633	2,686	10.7

N/A = data not available.

Note 1: Projection for 2024 based on the application of a 1% annual traffic growth rate applied to the most recent traffic survey data.

Source: Tonkin (2024) – modified after Table 4.1 to Table 4.5

Whilst no traffic survey data is available for Wentworth Road, Tonkin (2024) estimates traffic volumes based on nearby traffic counts on Patton Street and the Silver City Highway south of Broken Hill. Traffic volumes on Anabranch Mail Road and Nulla Road are estimated to be substantially less than 50 movements per day.

6.6.3.4 Road Safety History

A review of published crash data from the five year period between 2018 to 2022 by the Centre for Road Safety identified the following traffic incidents (Tonkin, 2024).

- Silver City Highway, between Renmark Road and the Wentworth LGA boundary – seventeen crashes involving non-casualties, minor injuries, two serious injuries and two fatalities.
- Silver City Highway, between the northern border of the Wentworth LGA and the Broken Hill LGA – three crashes were reported, all involving run off road incidents, resulting in moderate injuries, a non-casualty and a serious injury.
- Patton Street roundabout – Two road incidents were reported. The crashes were a run off road incident which resulted in a non-casualty and a collision in the roundabout that resulted in a moderate injury.
- Eyre Street – Two crashes were reported, with one serious leaving parking incident and one run off road moderate injury.
- Holten Drive – Two non-casualty crashes were reported near the intersection of Menindee Road.
- Anabranch Mail Road, Wentworth Road, and Comstock Street – No crashes were reported.

6.6.3.5 Existing Constraints

Tonkin (2024) has identified the following key constraints associated with the existing public road network and the proposed use of these road sections by Project-related traffic. Unless noted to the contrary, each of these constraints would be addressed by the Applicant (see Section 3.6.2).

- Some sections of Anabranch Mail Road need localised widening to be suitable for Level 4 vehicles. There are several existing grids along Anabranch Mail Road, with all currently single lane width. These grids would require upgrading and widened to enable two-way traffic to pass. Anabranch Mail Road would be realigned and widened by the Applicant.
- The Silver City Highway meets the minimum seal width for a Type 2 road train or Level 4 vehicle, including AB-quad road trains, however the shoulder and lane widths are less than that defined by Austroads for such vehicles. As a State road, this is a matter for Transport for NSW.
- The Patton Street roundabout is suitable for Level 4 vehicles as per the relevant road standard guide, however, the desirable sight distance is not achieved. As a State road, this is a matter for Transport for NSW.
- The Patton Street / Comstock Street intersection would not accommodate turn movements for Level 4 vehicles and the required sight distance is not achieved in either direction. The intersection would be upgraded by the Applicant.
- The Comstock Street / Eyre Street intersection would not accommodate turn movements for Level 4 vehicles. The required sight distance to the northeast is limited by parked cars. The intersection would be upgraded by the Applicant.
- The Holten Drive / Rail Facility intersection would not accommodate turn movements for Level 4 vehicles. The intersection would be upgraded by the Applicant.
- Holten Drive and the northeastern section of Eyre Street do not meet lane width requirements for a Level 4 vehicle as a bike lane compromises lane markings. The Applicant has consulted with Broken Hill City Council and would reconstruct the bike path off-road to allow widening of the existing traffic lanes on Eyre Street and Holten Drive.

6.6.4 Assessment of Impacts

6.6.4.1 SIDRA Modelling

SIDRA modelling was undertaken at the Patton Street Roundabout to determine the function capability under increased traffic levels. SIDRA modelling was not undertaken at other intersections because Tonkin (2024) determined that these intersections are expected to be well within the capacity of the road network.

The following assumptions were relied upon for the SIDRA modelling of the Patton Street roundabout.

- Current AM and PM peak hour volumes have been taken from independent traffic counts conducted in September 2022.

- All heavy mineral concentrate road trains, and 10% of all other Project-related vehicles would utilise the roundabout.
- 5km approach distance from the southwest.
- 10-year horizon SIDRA model with 1.5% annual growth in traffic volumes.
- Cyclist and pedestrian traffic not assessed as volumes are expected to be negligible.
- Default gap acceptance inputs.
- Vehicle movement data including approach cruise speed and exit cruise speed is assumed to be as per signposted speed limits.

The results from the SIDRA modelling indicate that the roundabout at Patton Street would retain a Level of Service A, the highest operating condition. Queue lengths will see an increase due to the large trucks on the network, however Tonkin (2024) state that the increases are not expected to be significant.

6.6.4.2 Traffic Volumes

Expected traffic volumes generated by the Project during construction, operations and rehabilitation were provided by the Applicant.

Table 6.6.2 presents a summary of the anticipated vehicle movements during the construction, operational and rehabilitation phases of the Project. In summary, Project-related traffic volumes are expected to be highest during the operational phase, with up to 132 vehicle movements (i.e. 66 vehicle trips to and from the Mine Site) occurring each day and up to 34 vehicle movements (i.e. 17 vehicle trips to and from the Mine Site) per hour occurring during peak periods.

Table 6.6.2
Project-related Vehicle Movements

Vehicle	Phase								
	Construction				Operational				Rehabilitation
	Average Movements[1]		Peak Movements[1]		Average Movements[1]		Peak Movements[1]		Average Movements[1]
	Daily	Peak Hour	Daily	Peak Hour	Daily	Peak Hour	Daily	Peak Hour	Daily
Type 2 / Type 1 Road Train[2,3]	-	-	-	-	20/26	6/6	24/32	6/6	-
B-double / Semi Trailer Truck / Other heavy vehicle[4]	12[2]	4	22	6	8	2	14	4	10 to 22
Light Vehicle[4]	42	12	84	22	56	14	84	22	
Bus[5]	2	2	4	2	2	2	4	2	
Total Movements	56	18	110	30	86/92	24	126/132	34	

Note 1: One return trip = 2 movements
Note 2: 100% via the Transportation Route – North
Note 3: Type 1 road trains to be used until approval for Type 2 road trains provided
Note 4: 90% via the Transportation Route – South and 10% via the Transportation Route – North
Note 5: 100% via the Transportation Route - South

Source: RZ Resources Limited

Table 6.6.3 presents the baseline (2024) and projected daily traffic volumes for all Project-related roads, during construction, operational and rehabilitation phases of the Project. In summary, all predicted traffic volume increases associated with Project-related traffic during the construction, operational and rehabilitation phases are expected to remain below the relevant operating design standard for the identified roads.

Table 6.6.3
Baseline and Projected Traffic Volumes

Transport Route Section	Daily Traffic Volume (Vehicle Movements)				
	Design Standard[1]	Projected 2024 Baseline[2]	Daily Peak Project Contribution	Predicted Daily Total	Percent Increase (%)
Construction Traffic – Average					
Silver City Hwy - North	500 – 1,000	437	6	443	1.4
Silver City Hwy - South	500 – 1,000	412[4]	50	462	12.1
Anabranch Mail Road[3]	1 - 150	50	56	106	112
Wentworth Road	1,000 – 3,000	1,500[4]	6	1506	0.4
Patton Street	N/A	2,490	6	2496	0.2
Comstock Street	N/A	609[4]	0	609	0
Eyre Street	N/A	2,194	0	2194	0
Holten Drive	N/A	2,686	0	2686	0
Construction Traffic – Peak					
Silver City Hwy - North	500 – 1,000	437	11	448	2.5
Silver City Hwy - South	500 – 1,000	412[4]	99	511	24.0
Anabranch Mail Road[3]	1 - 150	50	110	160	220
Wentworth Road	1,000 – 3,000	1,500[4]	11	1511	0.7
Patton Street	N/A	2,490	11	2501	0.4
Comstock Street	N/A	609[4]	0	609	0
Eyre Street	N/A	2,194	0	2194	0
Holten Drive	N/A	2,686	0	2686	0
Operational Traffic – Average					
Silver City Hwy - North	500 – 1,000	437	33	470	7.6
Silver City Hwy - South	500 – 1,000	412[4]	59	471	14.3
Anabranch Mail Road[3]	1 - 150	50	92	142	184
Wentworth Road	1,000 – 3,000	1,500[4]	33	1533	2.2
Patton Street	N/A	2,490	33	2523	1.3
Comstock Street	N/A	609[4]	26	635	4.3
Eyre Street	N/A	2,194	26	2220	1.2
Holten Drive	N/A	2,686	26	2712	1.0
Operational Traffic – Peak					
Silver City Hwy - North	500 – 1,000	437	42	479	9.6
Silver City Hwy - South	500 – 1,000	412[4]	92	504	22.3
Anabranch Mail Road[3]	1 - 150	100	132	182	264
Wentworth Road	1,000 – 3,000	1,530[4]	42	1542	2.8

Table 6.6.3 (Cont'd)
Baseline and Projected Traffic Volumes

Transport Route Section	Daily Traffic Volume (Vehicle Movements)				
	Design Standard[1]	Projected 2024 Baseline[2]	Daily Peak Project Contribution	Predicted Daily Total	Percent Increase (%)
Operational Traffic – Peak (Cont'd)					
Patton Street	N/A	2,490	42	2532	1.7
Comstock Street	N/A	609[4]	32	641	5.3
Eyre Street	N/A	2,194	32	2226	1.5
Holten Drive	N/A	2,686	32	2718	1.2
Rehabilitation Traffic					
Silver City Hwy - North	500 – 1,000	437	2	439	0.5
Silver City Hwy - South	500 – 1,000	412[4]	20	432	4.9
Anabranch Mail Road[3]	0 - 150	100	22	72	44
Wentworth Road	1,000 – 3,000	1,530[4]	2	1502	0.1
Patton Street	N/A	2,490	2	2492	0.1
Comstock Street	N/A	609[4]	0	609	0
Eyre Street	N/A	2,194	0	2194	0
Holten Drive	N/A	2,686	0	2686	0

Note 1: Based on the Annual Average Daily Traffic (AADT) for single carriageway roads and the existing carriageway and lane widths of the subject roads.

Note 2: Projection for 2024 based on the application of a 1% annual traffic growth rate applied to the most recent traffic survey data.

Note 3: Section between Site Access Road and Silver City Highway.

Note 4: Assumed.

Source: Tonkin (2024) – modified after Tables 7.1 to 7.5

Significant increases in traffic volumes are predicted for the section of Anabranch Mail Road between the Site Access Road and the Silver City Highway as a result of the Project. Whilst this increase remains within the operational capacity of that road (<150 movements), Tonkin (2024) indicates that such an increase would warrant upgrading of the road during the construction phase for the Project, as well as assuming responsibility for maintenance of the road during the life of the Project. The Applicant has accepted this recommendation.

6.6.4.3 Cumulative Traffic Considerations

The Snapper and Ginkgo Mineral Sands Mines, operated by Tronox Mining Australia Limited, are located in Pooncarie, NSW, approximately 75km and 85km northeast of Wentworth and 80km and 90km east-northeast of the Mine Site respectively.

The Snapper Mineral Sands Mine northern extension modification, approved in March 2020, extends the mine's operational life until 10 July 2026. The Gingko Mine has a development consent that permits mining until 31 December 2025. Type 2 road trains associated with the Snapper and Ginkgo Mineral Sand Mines currently utilise the Silver City Highway to transport product to Broken Hill. Approximately 150km of the Silver City Highway between the Ginkgo/Snapper Haul Road and Kanandah Road intersections would be utilised by mining-related road trains. Assuming that the Project commenced construction in 2025,

transportation of heavy mineral concentrate would not commence until 2027, after the current closure date for the Snapper and Ginkgo Mineral Sand Mines. Notwithstanding, the following presents an assessment of concurrent transportation of heavy mineral concentrate from both operations in the event that the life of the Snapper and Ginkgo Mineral Sand Mines is extended.

Tonkin (2024) has assumed up to 27 trips between Broken Hill and the Snapper and Ginkgo mines (54 movements) per day on the Silver City Highway (The Transport Planning Partnership, 2019). As a result, the Project would result in an increase in maximum daily mining-related heavy vehicle traffic on the Silver City Highway from 54 movements to 90 movements, an increase of 59%.

Tonkin (2024) state that the additional trips on the road network are not expected to affect the operating capacity of the Silver City Highway. It is noted that the Highway has ample overtaking opportunities and the increase in mining-related road trains is not expected to significantly inconvenience other road users. In addition, the Applicant would ensure that road-train departures from the Rail Facility and Mine Site would be staggered and that Project-related road trains would be required to maintain suitable gaps to other heavy vehicles on the Silver City Highway to facilitate passing by other road users. The Applicant would also work with Tronox to ensure that each operation's haulage vehicles maintain a suitable distance apart to permit following vehicles to overtake one road train at a time.

6.6.4.4 Pavement Conditions

Estimates of existing and predicted pavement traffic loadings were calculated by Tonkin (2024) using the methodology outlined in the *Guide to Pavement Technology Part 2: Pavement Structural Design* (Austroads, 2018). **Table 6.6.4** presents the existing and predicted pavement loadings in Equivalent Standard Axles (ESAs) for the Silver City Highway.

Table 6.6.4
Estimated Existing and Project-related Pavement Loadings

Transport Route Section	Estimated Pavement Loading (ESAs[1] per lane)						Estimated Reduction in Pavement Life
	Existing			Project-related			
	Daily	Yearly	20 Year Loading[2]	Daily	Yearly	Total (Project life)	
Silver City Highway - North	175	63,875	1,406,464	59[3]	21,353	362,993	25.8% (5.15 years)
				54[4]	19,710	335,070	23.8% (4.5 years)
Silver City Highway - South	165	60,225	1,326,095	14 to 20	5,037 to 7,373	104,062	7.8% (1.5 years)

Note 1: ESAs = Equivalent Standard Axles.
Note 2: Based on assumed 1% annual traffic volume growth per year.
Note 3: Based on using Type 1 road trains
Note 4: Based on using Type 2 road trains

Source: Tonkin (2024) – modified after Tables 7.8 and 7.9

The assessment above indicates there will be a reduction in existing pavement life of up to 25.8% and 7.8% on the Silver City Highway to the north and south of Anabranch Mail Road respectively, assuming the existing pavement on Silver City Highway has a remaining life of 20

years. The reduction in pavement life may bring forward some pavement related rehabilitation of the Silver City Highway, however as the Highway is a State road, contributions to pavement rehabilitation/maintenance are not required by the Applicant.

Anabranch Mail Road will take the full pavement loading of the vehicles between the Mine Site and Silver City Highway (estimated at 467,055 ESAs) over the life of the Project. As unsealed roads, the Applicant will contribute to 100% of the cost of design, construction and maintenance of Anabranch Mail Road as part of the Project. It is expected that re-sheeting of the road would occur on an as needs basis and would be subject to the performance of locally available gravel material.

6.6.4.5 Nulla Road

Project related impacts on Nulla Road would include the following.

- Closure during the period when the Project would be mining through the road reserve and during subsequent backfilling and establishment of the post-mining landform, indicatively during Years 11, 12 and 13.
- Realignment of the road to the east of the current alignment.

These impacts are assessed separately below.

Closure of Nulla Road

Mining operations would remove a section of Nulla Road in approximately Year 11. As a result, the Applicant proposes to close the road for a period of approximately 3 years from Year 11 to Year 13. The section of road to be closed would be approximately 7km in length from the access road to the "Huntingfield" homestead to the access road to the "Wenba" property.

Potential impacts, and their significance, associated with the closure of Nulla Road would include the following. The following also includes an assessment of the significance of those impacts.

- Restricted access between the northern and southern sections of Huntingfield and Sunshine stations for the owner.

  As Nulla Road occurs within the Huntingfield and Sunshine stations, a commercial agreement will be required with the owner of those stations before mining of that land and removal of Nulla Road. That commercial agreement would include compensation for disruption of agricultural operations and amenity considerations. As a result, the closure of Nulla Road would have a negligible residual impact on the owner of Huntingfield and Sunshine stations.

- Restricted access and longer journey times for residents surrounding the Mine Site.

  The Applicant has consulted with all surrounding residents. Residents may use Pine Camp and Renmark Road instead of Nulla Road. Consulted residents indicate that taking into account the current condition of Nulla Road, additional travel time would be between 20 and 40 minutes, particularly for larger vehicles. The Applicant has agreed to include a contribution to maintenance of Pine Camp and Renmark

Roads in the Planning Agreement with Wentworth Shire Council. In addition, the Applicant would provide light vehicle access through the Mine Site if required, and would provide compensation for additional travel time and distance.

The owner of Nulla Station identified that they use Nulla Road within the Mine Site within the Mine Site to access a property to the east of the Mine Site. The Applicant has agreed to provide access to Anabranch Mail Road from Nulla Station via the Site Access Road.

- Inconvenience for members of the public.

  The Applicant would install advanced warning signage indicating the closure of the road and providing alternate directions. Given the limited volume of non-resident traffic, the closure of Nulla Road would have a negligible impact on members of the public.

Realignment of Nulla Road

That section of Nulla Road within the Limit of Disturbance would reestablish on a new alignment to the east of the current alignment during Year 13 to a standard that is better than the current standard (Section 3.6.2.5). The realigned section of road would be approximately 2.5km or 500m longer than the current alignment.

- Users of Nulla Road, including the owners of Huntingfield and Sunshine Station, surrounding landholder and the public.

  Journey distances would be increased by approximately 500m and travel times by approximately 23 seconds (assuming a travel speed of 80km/h). These increases are considered to be negligible and would be offset by the fact that the road would be substantially upgraded from its current condition.

- Wentworth Shire Council.

  As the road authority, Council would be required to maintain an additional 500m of road. However, the road would be reconstructed to a standard substantially better than the current road and, maintenance requirements would therefore be substantially less than the current requirements. The Applicant would also cover all costs associated with realigning the road, including creating a suitable road reserve. As a result, impacts associated with the realigned road on Council are considered negligible.

6.6.5 Management and Mitigation Measures

The Applicant would implement the following traffic management and mitigation measures to ensure that any traffic and transportation impacts associated with the Project are minimised. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual traffic and transportation-related risks presented in **Appendix 2**.

- Obtain all necessary approvals from Transport for NSW and Wentworth and Broken Hill Councils for all proposed road upgrade works prior to commencing those works.

- Prepare, in consultation with Wentworth and Broken Hill Councils and Transport for NSW, and implement a *Construction Traffic Management Plan* which includes worksite traffic control measures to be implemented throughout the road construction phase of the Project.
- Prepare, in consultation with Wentworth and Broken Hill Councils and Transport for NSW, and implement a *Transport Management Plan* detailing procedures for the construction and operational phases of the Project, including the following.
  - Procedures for oversize and/or over mass vehicles and/or loads accessing the Mine Site, including the need to obtain suitable permits from Transport for NSW.
  - A Driver Fatigue Management Plan which identifies measures to address driver fatigue during all phases of the Project, including identification of maximum travel periods and Mine Site accommodation usage requirements.
  - Procedures to stagger AB-Quad / AB-triple road train movements on the public road network in order to avoid the creation of peak haulage truck movement periods.
  - A Driver's Code of Conduct that outlines the Applicant's expectation in relation to driver behaviour, including driving in a courteous manner, adherence to all relevant road rules, minimising road traffic noise in built-up areas and ensuring that all Project-related vehicles remain on the approved transportation routes.
  - A requirement for all heavy vehicles regularly accessing the Project Site to have suitable vehicle monitoring systems installed to manage and record driving behaviour, fatigue and traffic incidents and for that data to be made available to the Applicant as required.
- Implement the infrastructure upgrades as described in Section 3.6.2.2 (Site Access Road concept plans and Broken Hill intersection upgrade concept designs are presented in Appendix A and B of Tonkin (2024)).
- Negotiate "Good neighbour agreements" with neighbours potentially impacted by the proposed closure of Nulla Road during years 11 to 13 to permit continued suitable access to the public road network.
- Facilitate suitable vehicular access to the Mine Site for surrounding landholders where appropriate and in accordance with strict safety protocols.
- Reinstate Nulla Road in accordance with the requirements of the Planning Agreement with Council.
- Undertake an independent road safety audit of the proposed transport route prior to the commencement of heavy mineral product transportation.

In addition to the above, the Applicant would implement the following contingency mitigation measures should the following triggers be exceeded.

- The condition of Council-maintained roads deteriorates substantially as a result of the Project.
  - Undertake, in consultation with Council, a review of the root cause of the deterioration of road conditions.

  - Advocate for additional maintenance of the roads/sections of roads under the relevant Planning Agreement.
  - Review and, if required, amend the quantum of the road maintenance contribution under the relevant Planning Agreement.
- Closure of Nulla Road results in unacceptable increase in travel time for local residents.
  - Negotiate a suitable agreement with the affected landholder(s), including potentially alternate access arrangements or compensation for additional travel time/costs.

6.6.6 Conclusion

Based on the results of the traffic impact assessment undertaken by Tonkin (2024) and the proposed management and mitigation measures outlined in Section 6.6.5, it is assessed that the Project would not result in significant adverse traffic-related or road safety impacts. It is noted that transportation of heavy mineral products to Broken Hill by any means other than road transportation would not be feasible due to the location of the Project. From Broken Hill, those products would be transported by rail under separate approval.

Traffic generated by the Project would not significantly affect the operating capacity of the existing public road network. Accounting for cumulative traffic increases associated with both the Project and the Snapper and Ginkgo Mineral Sand Mining operations which also utilise the Silver City Highway transport route, it is not anticipated that Project-related traffic (including heavy mineral product transportation activities) would result in adverse traffic-related impacts.

In order to gain access to the Project Site, a new Site Access Road and relocated and upgraded Anabranch Mail Road would be constructed, approximately 33km from the Silver City Highway/Anabranch Mail Road intersection. Pavement loadings associated with Project-related traffic would significantly contribute towards degradation and maintenance requirements for Anabranch Mail Road. The Applicant would upgrade that section of Anabranch Mail Road between the Mine Site entrance and the Silver City Highway during construction of the Project and would maintain that section of the road and the Site Access Road for the life of the Project.

Project-related heavy vehicles would require upgrades to a range of intersections along the Northern Transportation Route. The Applicant would complete these upgrades during the construction phase of the Project in consultation with Transport for NSW and Wentworth and Broken Hill City Councils.

Project-related traffic would result in estimated reductions in pavement life of up to 25.8% and 7.8% respectively on the northern and southern sections of the Silver City Highway which form part of the proposed transport routes.

6.7 Surface Water Resources

6.7.1 Introduction

The SEARS identify "water" as a key issue for assessment in the EIS. Matters to be addressed for surface water relevantly include:

- "a water management strategy;
- a description of all works/activities that may intercept, extract, use, divert or receive surface water;
- details of all water take for the life of the development and the relevant water source where water entitlements are required to account for the water take. If the water is to be taken from an alternative source, confirmation should be provided by the supplier that the appropriate volumes can be obtained;
- details of Water Access Licences (WALs) held to account for any take of water where required, or demonstration that WALs can be obtained prior to take of water occurring. This should include an assessment of the current market depth where water entitlement is required to be purchased and details of any exemptions or exclusions to requiring approvals or licenses under the Water Management Act 2000;
- an assessment of impacts on surface water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land;
- a detailed and consolidated site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply and transfer infrastructure and water storage structures, and measures to minimise water use;
- a description of the measures proposed, including monitoring activities and methodologies, to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;
- a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface water impacts;
- a description of construction erosion and sediment controls, how the impacts of the development on areas of erosion, salinity or acid-sulphate risk or erodible soils types would be managed and any contingency requirements to address residual impacts;
- identification and impact assessment of all works located on waterfront land including consideration of the *Guidelines for Controlled Activity Approvals*; and
- an assessment of any likely flooding impacts of the development including consideration of the hydrology of the site in the site design and the placement of infrastructure to minimise flood risks.

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from the DPE–Water, DPE – Biodiversity and Conservation Division, and the EPA.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

R.W. Corkery & Co. Pty. Limited (RWC) prepared the *Surface Water Assessment* to support the application for State Significant Development consent for the proposed construction and operation of the Copi Mineral Sands Project. The resulting report, hereafter referred to as RWC (2024), is presented as **Appendix 10**.

This subsection provides a summary of the *Surface Water Assessment* and describes the management and management measures to be implemented by the Applicant. The water balance for the Project is described in detail in Section 3.8.4.

6.7.2 Existing Environment

6.7.2.1 Local Climate and Drainage

The existing drainage and catchments within and surrounding the Mine Site are described in detail in Section 6.1.2. and are shown on **Figure 6.1.2**. In addition, rainfall and evaporation in the vicinity of the Mine Site are described in Section 6.1.3.3.

6.7.2.2 Mine Site Catchment Yield

Table 6.7.1 presents the annual yields for those catchments draining within the Mine Site across a range of annual exceedance probabilities (AEP).

Table 6.7.1
Estimated Annual Catchment Yields

Catchment	Area (km^2)	Annual Yield (ML)				
		99% AEP	50% AEP	20% AEP	10% AEP	1% AEP
Eastern Salt Pan	105.5	381	1,183	1,630	1,893	2,584
Western Salt Pan	91.5	330	1,025	1,412	1,641	2,239
Central	36.0	130	404	557	647	883
Eastern	41.9	151	470	647	752	1,026
Source: RWC (2024) – Table 6						

In summary, the relatively low estimated annual catchment yields reflect the permeable nature of the surficial sediments. Furthermore, the volumes collected at any point in the catchment are likely to be overstated. This is due to the nature of the topography which generally collects runoff in multiple minor depressions between sand dunes and lunettes from where it seeps into the ground or is evaporated. This is likely to prevent the cumulative concentration of overland flow.

6.7.2.3 Water Quality

Ambient water quality data is not available for the Mine Site, however, it is anticipated that surface water quality within the Mine Site would generally be similar to that monitored by WaterNSW in the Great Darling Anabranch and in the Darling River (**Figure 6.1.1**) and presented in **Table 6.7.2**.

Table 6.7.2
NSW DCCEEW Monitoring Data Summary

Parameter	Statistic	Station[1]		
		425007	425013	425011
EC (µS/cm)	Minimum	251.1	211.6	276.7
	Median	583.4	474.0	552.8
	95th Percentile	1,306.4	1,721.9	1,503.1
	Maximum	1,694.4	2,289.7	2,757.2
Dissolved Oxygen (% saturation)	Median (2021/2022)	95.9 / 71.4	Not available	Not available
Note 1: see **Figure 6.1.1**				
Source: RWC (2024) – Table 5				

6.7.2.4 Flooding

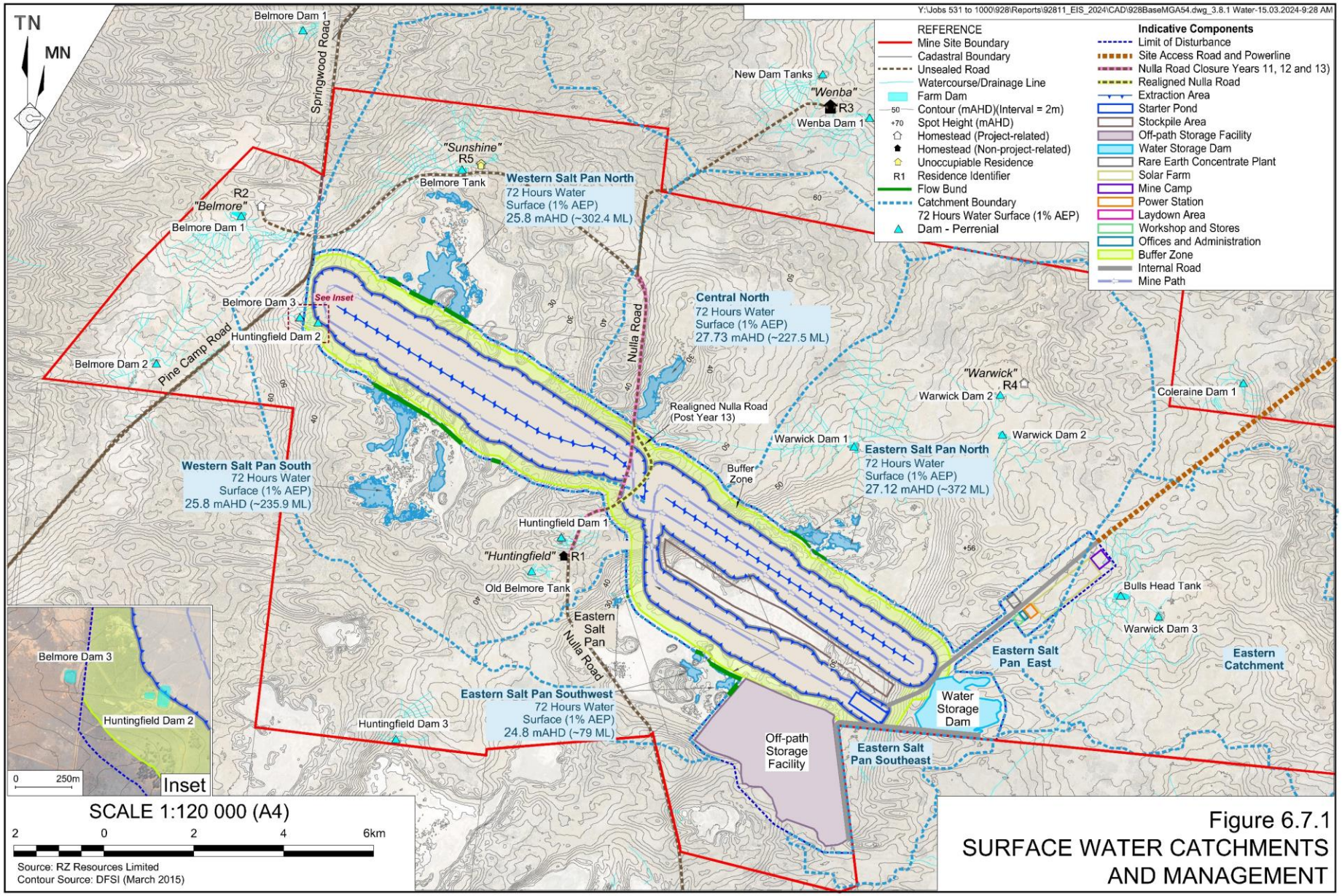
The Mine Site is not situated on land identified in the Wentworth LEP as being a "Flood Planning Area" (refer Section 3.3.1). Peak catchment discharge for the Mine Site sub-catchments that would be created by the Project's development are presented on **Figure 6.7.1** and Table 7 of RWC (2024). In summary, the Mine Site catchments are all internally draining and lack connections or outlets with adjacent catchments. Therefore, when rainfall events of sufficient magnitude to generate runoff occur, the discharge is directed by topography to the base of a localised depression where it ponds until the collected water evaporates. Given the size and depth of the Eastern and Western Salt Pan and the Central Catchments, it is extremely unlikely that surface water would overtop these depressions under a range of annual exceedance probability (AEP) rainfall events, and more likely result in evaporative features like the Western and Eastern Salt Pans.

6.7.3 Management and Mitigation Measures

6.7.3.1 Mine Site Sub-catchments

Mining operations would intercept the catchments as described in Section 6.1.2.2. The disturbance of the catchments would create the following separate sub-catchments.

- Southwestern Catchment: South and Disturbed sub-catchments.
- Eastern Salt Pan Catchment: North, East, Southeast, Southwest and Disturbed sub-catchments.
- Western Salt Pan Catchment: North, South, and Disturbed sub-catchments.
- Central Catchment: North and Disturbed sub-catchments.
- Eastern Catchment: Eastern and Disturbed sub-catchments.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REFERENCE
Mine Site Boundary
Cadastral Boundary
Unsealed Road
Watercourse/Drainage Line
Farm Dam
Contour (mAHD)(Interval = 2m)
Spot Height (mAHD)
Homestead (Project-related)
Homestead (Non-project-related)
Unoccupiable Residence
R1 Residence Identifier
Flow Bund
Catchment Boundary
72 Hours Water Surface (1% AEP)
Dam - Perrenial
Indicative Components
Limit of Disturbance
Site Access Road and Powerline
Nulla Road Closure Years 11, 12 and 13)
Realigned Nulla Road
Extraction Area
Starter Pond
Stockpile Area
Off-path Storage Facility
Water Storage Dam
Rare Earth Concentrate Plant
Solar Farm
Mine Camp
Power Station
Laydown Area
Workshop and Stores
Offices and Administration
Buffer Zone
Internal Road
Mine Path
Belmore Dam 1
Springwood Road
New Dam Tanks
"Wenba"
R3
Wenba Dam 1
"Sunshine"
R5
Belmore Tank
Western Salt Pan North
72 Hours Water
Surface (1% AEP)
25.8 mAHD (~302.4 ML)
R2
"Belmore"
Belmore Dam 1
Belmore Dam 3
See Inset
Huntingfield Dam 2
Belmore Dam 2
Pine Camp Road
Nulla Road
Central North
72 Hours Water
Surface (1% AEP)
27.73 mAHD (~227.5 ML)
"Warwick"
R4
Warwick Dam 2
Coleraine Dam 1
Realigned Nulla Road
(Post Year 13)
Warwick Dam 1
Warwick Dam 2
Eastern Salt Pan North
72 Hours Water
Surface (1% AEP)
27.12 mAHD (~372 ML)
Western Salt Pan South
72 Hours Water
Surface (1% AEP)
25.8 mAHD (~235.9 ML)
Buffer Zone
Huntingfield Dam 1
"Huntingfield"
R1
Old Belmore Tank
Eastern Salt Pan
Nulla Road
Bulls Head Tank
Warwick Dam 3
Eastern Salt Pan East
Eastern Catchment
Water Storage Dam
Eastern Salt Pan Southwest
72 Hours Water
Surface (1% AEP)
24.8 mAHD (~79 ML)
Huntingfield Dam 3
Off-path Storage Facility
Eastern Salt Pan Southeast
Belmore Dam 3
Huntingfield Dam 2
0 250m
Inset
SCALE 1:120 000 (A4)
2 0 2 4 6km
Source: RZ Resources Limited
Contour Source: DFSI (March 2015)
Figure 6.7.1
SURFACE WATER CATCHMENTS
AND MANAGEMENT

6.7.3.2 Mine Site Water Classification

During operations there would be three classes of water that would be managed on the Mine Site as follows.

- "Clean water" refers to runoff from those catchments unaffected by Project-related activities (regardless of water quality).
- "Sediment-laden water" refers to runoff from disturbed or active sections of the Mine Site with the potential to contain suspended sediment but not elevated concentrations of salt. This runoff would be captured and managed on site.
- "Mine Water" refers to the saline water of the dredge pond that results from groundwater inflows to the Extraction Area or other water with elevated salt concentrations such as brine from the reverse osmosis plants.

Table 6.7.3 describes where these classes of water would be managed within the Mine Site.

Table 6.7.3
Mine Site Catchment Management

Catchment	Sub-catchment	Class	Area (km^2)	Management
Northwestern	None	Clean	>82.5[1]	None required
Southwestern	South	Clean	>236.7[1]	None required
	Disturbed	Sediment-laden / Mine	0.5	Containment bund, drainage retained for infiltration
Western Salt Pan	North	Clean	41.8	Flow bund to prevent clean water entering disturbed sub-catchment
	South	Clean	32.6	Flow bund to prevent clean water entering disturbed sub-catchment
	Disturbed	Sediment-laden / Mine	17.1	Containment bund, drainage directed to dredge pond
Central	North	Clean	31.0	None required
	Disturbed	Sediment-laden / Mine	5.0	Containment bund, drainage directed to dredge pond
Eastern Salt Pan	North	Clean	51.4	Flow bund to prevent clean water entering disturbed sub-catchment
	East	Clean	2.5	Containment bund, drainage retained for infiltration
	Southeast	Clean	7.2	Containment bund, drainage retained for infiltration
	Southwest	Clean	10.9	Flow bund to prevent clean water entering disturbed sub-catchment
	Disturbed	Sediment-laden / Mine	33.4	Containment bund, drainage directed to dredge pond or Off Path Storage Facility.
Eastern	Eastern	Clean	41.9	None required
	Disturbed	Sediment-laden / Mine	0.6	Containment bund, drainage retained for infiltration

Note 1: Catchment extends beyond Mine Site.

Source: RWC (2024) – Table 8

6.7.3.3 Clean Runoff Management

Each of the Mine Site catchments would be intersected by Project-related disturbance. The topography of the Western and Eastern Salt Pans generally directs runoff to the central sections of their respective catchments whilst runoff in the Central catchment is collected in the central depression. Clean runoff from the Western and Eastern Salt Pans would be prevented from entering these disturbed sub-catchments via the construction of four flow bunds that would be located across the basal areas of each salt pan's depression at the boundaries of the disturbance area (**Figure 6.7.1**). The flow bunds would be constructed to meeting the design criteria to withstand a 1% AEP 72-hour (144mm). Flow bunds would only be constructed across key topographic low points (**Figure 6.7.1**). **Table 6.7.4** presents the impoundment volumes and water levels for the 1% Annual Exceedance Probability (AEP) 72-hour design rainfall event of each flow bund. Details of flow bund design is presented in **Table 6.7.5**.

Finally, the Applicant would, with the consent of the relevant landholders, monitor the quality of surface water within farm dams on properties adjoining the Mine Site prior to the commencement of construction.

Table 6.7.4
Clean Water Sub-catchment Flow Bunds: Nominal Design Water Levels, Depths and Impoundment Volumes

Sub-catchment	Area (km^2)	Water Level (mAHD)	Maximum Water Depth (m)	Impoundment Volume (ML)
Western Salt Pan North	41.8	25.8	0.7	302
Western Salt Pan South	32.6	25.8	0.2	236
Eastern Salt Pan North	51.4	27.1	0.05	372
Eastern Salt Pan Southwest	10.9	25.3	1.0	79
Source: RWC (2024) – Table 9				

Table 6.7.5
Nominal Clean Water Flow Bund Elevation, Height and Length

Bund	Crest Elevation (mAHD)	Maximum Height (m)	Total Length (m)	Comment
Western Salt Pan North	26.8	1.7	1,810	Three sections of 341m, 598m and 871m
Western Salt Pan South	26.8	1.2	2,284	Three sections of 1,418m, 651m and 215m
Eastern Salt Pan North	28.1	1.0	829	Two sections of 406m and 422m
Eastern Salt Pan Southwest	25.8	2.0	1,298	Four sections of 52m, 160m, 789m and 297m
Source: RWC (2024) – Table 10				

6.7.3.4 Acid Generation Potential

Sustainable Soils Management Pty Ltd (SSM) prepared the Land and Soil Capability Assessment for the Project (SSM, 2024). This assessment determined that that there is a low risk of acid sulphate soils within the Mine Site. Therefore, no specific measures are required to manage runoff from areas of acid sulphate soils.

In addition, RGS Environmental Consultants Pty Ltd (RGS, 2023) undertook an assessment of the acid generating potential of overburden, interburden and ore within the Mine Site (see Section 3.4.2.1). RGS (2023) determined that the interburden from immediately above the ore zone may be classified as potentially low-capacity acid forming. As a result, the material may have the potential to form an acidic leachate if exposed to oxygen, however the amount of acid that would be formed would be limited. The following measures would be implemented to minimise the risk of generation of an acidic leachate.

- Preferentially place interburden from immediately above the ore zone below the water level along the trailing edge of the dredge pond. Where this is not practicable, place such material into the Off Path Storage Facility.
- Line and cap the Off Path Storage Facility with clay from the Blanchetown Clay to prevent oxygen ingress into the facility.

In addition, the Applicant would implement the following management and mitigation measures to ensure that any other surface water-related impacts associated with the Project are minimised.

- Manage sewage and effluent disposal through an approved water treatment system situated within the Mine Camp and Workshop and Stores area. Discharge treated wastewater to the sub-surface or to land.
- Progressively construct bunds (at a minimum of 0.5m high) and/or roads at the perimeter of the disturbance areas to prevent sediment-laden runoff to the receiving surface water environment.
- Ensure that bunds constructed to prevent clean water entering disturbance areas meet the design criteria for a 1% AEP 72-hour (144mm) with maximum side slopes of 7:1 (H:V) and a minimum crest width of 1m.
- Store all hydrocarbon and chemical products in accordance with the manufacturers specification and the relevant Australian Standard.
- Ensure that saline water used for dust suppression is applied at a rate that ensures no runoff into roadside drainages.
- Undertake water quality monitoring of the dredge pond and ponded areas upstream of clean water bunds following a >25mm rainfall event over a 24 hour period.
- Ensure inspections of water management infrastructure will be undertaken monthly and following a rainfall event of >25mm over a 24 hour period.
- In any areas where active erosion of water management mitigation measures are observed, repairs shall be scheduled to re-instate full function and consideration given to installation of additional erosion mitigation as required.
- Reinstate all disturbance areas during the rehabilitation and closure stage of the Project, including the removal of all bunds.

6.7.3.5 Contingency Measures

In addition to the above, the Applicant would implement the following contingency mitigation measures should the following triggers be exceeded.

- Quality or quality or quantity of surface water available for neighbouring landholders is adversely impacted by the Project.
  - Provide immediate short-term makeup water or compensation to affected landholders.
  - Undertake further investigation(s) to determine if the observed impacts are Project-related.
  - Implement recommendations and remedial actions arising from the above investigation(s) in consultation with relevant landholders and agencies.

6.7.4 Assessment of Impacts

6.7.4.1 Water Availability and Licencing

All collected surface runoff would occur under the Western Division harvestable rights order area where it can be captured and used for any purpose. Where Project-related disturbance does disrupt the prevailing hydrological regime of an existing catchment, it does not reduce flow to a downstream catchment with external water users, as all Mine Site catchments are internally draining.

Figures 6.7.1 present the location of farm dams within and surrounding the Mine Site. The Project would not impact on the dams or their catchments, with the exception of Huntingfield Dam 2. The Huntingfield Dam 2 is located approximately 250m from the western boundary of Huntingfield Station, comprising of two nested dams, with a smaller, upstream dam and a larger downstream dam. The Dam is located within the proposed disturbance area and would be disturbed in Year 14 of the Project. To ensure continued access to water following rainfall events, the Applicant would implement the following.

- Negotiate a suitable agreement with the owner of Huntingfield Station in relation to the existing basic landholder rights, potentially including the following.
  - Reconstruct the Huntingfield 2 Dam, including surface water diversions, in an alternate location.
  - Provide an alternate supply of water.
  - Provide suitable compensation.
- Reconstruct the Huntingfield 2 Dam within the rehabilitated landform, including lining the dam with clay to limit seepage.

Therefore, the Applicant does not anticipate the loss of water availability to downstream users and the collection and use of runoff within the disturbance areas is permissible under the *Water Management Act (2000)*.

6.7.4.2 Flow and Watercourse Function

The Project would disturb the existing central sections of the Central, Western Salt Pan, Eastern Salt Pan, Eastern and Southwestern catchments. This disturbance represents the following proportions of each of the existing catchments.

- 19% of the Western Salt Pan Catchment.
- 32% of the Eastern Salt Pan Catchment.
- 14% of the Central Catchment.
- 1% of the Eastern Catchment.
- <1% of the Southwestern Catchment.

Apart from the disturbance area, flow and watercourse function would be thus maintained in the undisturbed sub-catchments of the Western Salt Pan and Central catchments.

The Eastern Salt Pan catchment contains a total of 105ha of mapped wetland situated within the proposed dredge pond. Most of this mapped wetland area is classified as "Lake – mainly dry" under the NSW 1:100,000 topographic mapping. This means that the bunds in these areas can be considered "excluded works" under Clause 8, Schedule 1 of the *Water Management (General) Regulation 2018*.

In light of the above, the Applicant contends that there would be negligible local or regional adverse impacts on watercourse function or flow, surrounding water users or wetland surrounding the Mine Site, and would be confined only to areas of disturbance.

6.7.4.3 Water Quality Impacts

Where surface water does accumulate in salt pans in the vicinity of the Mine Site, the quality is likely to be poor given the saline nature of the surface deposits in those areas. Additionally, the Applicant would endeavour to ensure the Project meets the water quality objectives or any others mandated by regulatory agencies.

As the proposed water management strategy for the Project includes the use of treated water for dust suppression and the capture, storage and re-use of sediment-laden runoff, the likelihood of sediment-laden discharge from the Mine Site is considered to be low.

Considering this, in addition to the management and mitigation measures, the Applicant contends that there would be negligible impacts on water quality within and surrounding the Mine Site,

6.7.4.4 Flooding Impacts

As described in Section 6.7.2, the Mine Site is not situated within a flood planning area or a zone where inundation from floodwater could be expected to occur. Subsequently, neither the development itself nor neighbouring properties would be adversely impacted by floodwater.

6.7.5 Conclusion

The Project would have minimal surface water impacts associated with the Mine Site for the following reasons.

- Flow accumulation in undisturbed sub-catchments, that represent the majority of existing catchments, would be unimpacted.
- There would be negligible water quality impacts as sediment-laden runoff and Mine water would be retained within catchments disturbed by the Project.
- The capture and use of runoff in disturbance areas is permissible under the *Water Management Act (2000)* and would not impact external water users.
- The construction of bunds in areas mapped as wetlands is permissible under *the Water Management (General) Regulation (2018)* as it is considered "excluded works".
- The Mine Site is not situated in an area that is mapped as a flood planning area and would not experience flooding impacts.

Overall, the Project will implement a water management strategy that excludes inflow from undisturbed catchments, captures, re-uses and recycles sediment-laden water, and provides for the efficient use of water resources whilst simultaneously maintaining to the greatest extent practicable, the existing surface water environment.

6.8 Noise

6.8.1 Introduction

The SEARs identify "noise" as a key issue for assessment in the EIS. Matters to be addressed include:

- "The likely construction, operational and off-site noise impacts of the development, and cumulative noise impacts (considering other mining developments in the locality), in accordance with the Interim Construction Noise Guideline (or as updated subject to transitional arrangements), NSW Noise Policy for Industry, NSW Road Noise Policy and Rail Infrastructure Noise Guideline (as applicable), and the Voluntary Land Acquisition and Mitigation Policy;
- An assessment of the likely noise impacts of the development in accordance with the *Noise Policy for Industry*, and the *Voluntary Land Acquisition and Mitigation Policy (2018)*;
- If a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities in accordance with the *Interim Construction Noise Guideline*; and
- An assessment of the likely road noise impacts of the development in accordance with the *NSW Road Noise Policy."*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from the EPA and Transport for NSW. These requirements where not consistent with those outlined above are outlined below.

- The goals of the project should include design, construction, operation and maintenance of plant and equipment in accordance with relevant EPA policy, guidelines and criteria, and in order to minimise potential impacts from noise on surrounding receptors.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

Muller Acoustic Consulting Pty Ltd (MAC) prepared the *Noise Impact Assessment* for the Project in accordance with the requirements of the *Interim Construction Noise Guideline*, *Noise Policy for Industry*, *Voluntary Land Acquisition and Mitigation Policy and NSW Road Noise Policy*. That report, hereafter referred to as MAC (2024), is presented as **Appendix 11**. This subsection provides a summary of MAC (2024) and describes the management and mitigation measures to be implemented by the Applicant.

6.8.2 Existing Environment

Descriptions of topography and climate in the vicinity of the Mine Site are provided in Section 6.1. MAC (2024) assessed prevailing winds at the onsite meteorological station between January 2018 and December 2019 and determined that prevailing winds are not applicable for the noise assessment. A Class G temperature inversion has been assumed during the night-time period in accordance with the *Noise Policy for Industry*.

The noise environment surrounding the Mine Site is typical of a remote rural setting. Noise which is currently audible at residences in the vicinity of the Mine Site includes:

- traffic on Pine Camp, Nulla, Springwood and Anabranch Mail Roads and the Silver City Highway;
- domestic and rural noise from agricultural equipment, pumps, dogs, etc.;
- rural fauna noises such as stock, birds and insects; and
- wind generated noises such as wind in trees.

Table 6.8.1 lists the sensitive receivers identified in the vicinity of the Mine Site.

Table 6.8.1
Sensitive Receivers in the Vicinity of the Mine Site

Sensitive Receiver ID[1]	Receiver Name	Approximate Distance to Limit of Disturbance (km)	Approximate Distance to Transport Route (km)	Status
R1	Huntingfield	1.3	>10	Permanently occupied
R2	Belmore	1.2	>10	Project Related
R3	Wenba	7.8	>10	Intermittently Occupied
R4	Warwick	5.1	5.2	Project Related
R5	Sunshine	2.4	>10	Unoccupiable
R6	Amoskeg	8.7	>10	Intermittently Occupied
R7	Bunnerungee	>10	2.1	Permanently occupied
R8	Coleraine	>10	9.4	Permanently occupied
R9	Warranaga	>10	>10	Permanently occupied
R10	Toora	>10	>10	Permanently occupied
MC	Mine Camp	Within boundary	0.5	Project Related
Note 1: See **Figure 5.1**				
Source: MAC (2024) – modified after Table 2.				

6.8.3 Assessment Criteria

6.8.3.1 Rating Background Noise Levels

Given that the Mine Site is situated in a rural environment, the following Rating Background Levels (RBLs) were adopted by MAC (2024) for the purposes of establishing relevant noise criteria for the Project.

- Minimum Daytime RBL ..... 35dB(A)
- Minimum Evening RBL ..... 30dB(A)
- Minimum Night RBL ..... 30dB(A)

6.8.3.2 Construction Noise Criteria

Noise generated during the construction and establishment phase of the Project would be subject to quantitative construction noise management levels as specified in the *Interim Construction Noise Guideline* (DECC, 2009). Construction and site establishment activities, including

construction of roads and road intersection upgrades along the Site Access Road, Anabranch Mail Road, Silver City Highway and in Broken Hill, establishment of the Mine Camp, Solar Farm, and Power Station, and preliminary vegetation clearing, soil stripping and earthworks would occur during the first two years of the Project. **Table 6.8.2** presents the relevant construction noise management levels (NMLs) for the Project.

Table 6.8.2
Construction Noise Management Criteria

Location	Assessment Period	RBL (dB(A))	NML (dB $LA_{eq(15min)}$)
All Residential Receivers	Standard Hours[1]	35	45 (RBL+10dB(A))
	Out of hours (Day)[2]	35	40 (RBL+5dB(A))
	Out of Hours (Night)[3]	30	35 (RBL+5dB(A))
Note 1: Standard Construction Hours – period between 7:00am and 6:00pm, Monday to Friday, and 8:00am to 1:00pm on Saturdays (only if required). No construction on Sundays or Public Holidays.			
Note 2: Out of Hours (OOH) Day – period between 7:00am and 8:00am and 1:00pm and 6:00pm on Saturdays.			
Note 3: OOH Evening/Night – all other times.			
Source: MAC (2024) – Table 8			

Land preparation activities are anticipated to occur between 7:00am and 6:00pm daily, on a campaign basis. Road construction would be undertaken between 7:00am and 10:00pm daily. All other construction would be undertaken 24-hours per day.

The out of hours construction activities are justified for the Project due to the remote location of the Mine Site and the requirement to transport equipment and personnel long distances. No objections to the proposed hours of operation have been raised by the surrounding residents to date. Mitigation measures outlined in Section 6.8.5 would be implemented to minimise noise impacts during construction.

6.8.3.3 Operational Noise Criteria

Project Intrusiveness Noise Levels (PINLs) are defined by the *Noise Policy for Industry* as RBL +5dB and are intended to limit the degree of change associated with the introduction of a new noise source. **Table 6.8.3** presents the relevant PINLs for residential receivers in the vicinity of the Mine Site.

Table 6.8.3
Project Intrusiveness Noise Levels

Receiver	Period	Minimum adopted RBL (dB LA_{90})	PINL (dB $LA_{eq(15min)}$)
All Residential Receivers	Day[1]	35	40
	Evening[2]	30	35
	Night[3]	30	35
Note 1: Day = period between 7:00am and 6:00pm, Monday to Saturday, and 8:00am to 6:00pm on Sundays and Public Holidays.			
Note 2: Evening = period between 6:00pm and 10:00pm, all days.			
Note 3: Night = the remaining periods.			
Source: MAC (2024) – Table 9			

Project Amenity Noise Levels (PANLs) are determined with consideration of all existing and future industrial noise in the vicinity of a receiver and are based on recommended amenity noise levels specified in the *Noise Policy for Industry*. **Table 6.8.4** presents the relevant PANLs for residential receivers in the vicinity of the Mine Site.

Table 6.8.4
Project Amenity Noise Levels

Receiver Type	Noise Amenity Area	Assessment Period	NPI Recommended ANL (dB $LA_{eq(period)}$)	PANL (dB $LA_{eq(15min)}$)[4]
Residential	Rural	Day[1]	50	53
		Evening[2]	45	48
		Night[3]	40	43
Project Mine Camp		Day[1]	55	58
		Evening[2]	50	53
		Night[3]	45	48

Note 1: Day = period between 7:00am and 6:00pm, Monday to Saturday, and 8:00am to 6:00pm on Sundays and Public Holidays.

Note 2: Evening = period between 6:00pm and 10:00pm, all days.

Note 3: Night = the remaining periods.

Note 4: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period.

Source: MAC (2024) – Table 10

Project Noise Trigger Levels (PNTLs) represent the lower of either the PINLs or the PANLs. **Table 6.8.5** presents the PNTLs for residential receivers in the vicinity of the Mine Site.

Table 6.8.5
Project Noise Trigger Levels

Receiver	Assessment Period	RBL dB(A) LA_{90}	PINL dB $LA_{eq(15\ min)}$	PANL dB $LA_{eq(15\ min)}$	PNTL dB $LA_{eq(15\ min)}$
All Residential	Day[1]	35	40	53	**40**
	Evening[2]	30	35	48	**35**
	Night[3]	30	35	43	**35**
Mine Camp	Day[1]	35	n/a	58	**58**
	Evening[2]	30	n/a	53	**53**
	Night[3]	30	n/a	48	**48**

Note 1: Day = period between 7:00am and 6:00pm, Monday to Saturday, and 8:00am to 6:00pm on Sundays and Public Holidays

Note 2: Evening = period between 6:00pm and 10:00pm, all days

Note 3: Night = the remaining periods

Source: MAC (2024) – Table 11

6.8.3.4 Voluntary Land Acquisition and Mitigation Policy Assessment Criteria

The *Noise Policy for Industry* states that the recommended noise amenity levels are based on protecting the majority of the community (90%) from being highly annoyed by industrial noise. Therefore, provided the Project Noise Trigger Levels are achieved, the *Noise Policy for Industry*

implies that most people would consider the resultant noise levels acceptable. In those cases where the Project Noise Trigger Levels are not achieved, it does not automatically follow that all people exposed to the noise would find the noise "unacceptable". In subjective terms, the Voluntary Land Acquisition and Mitigation Policy characterises noise impacts resulting from residual noise exceedances of the Project Noise Trigger Levels generally as follows.

- If the residual noise exceedance, namely after implementation of all reasonable and feasible noise mitigation measures, is >5dB(A) above the Project Noise Trigger Levels, then noise impacts are considered to be moderate to significant.
- If the residual noise exceedance is 3dB(A) to 5dB(A) above the Project Noise Trigger Levels, then noise impacts are considered to be marginal to moderate.
- If the residual noise exceedance is 1 to 2dB(A) above the Project Noise Trigger Levels, then noise impacts are considered to be negligible.

In the event the noise generated by a development exceeds the Project Noise Trigger Levels at any residence on privately-owned land by more than 5dB(A), a consent authority is able to apply voluntary acquisition rights in a development consent for the owner(s) of the subject properties. This also applies when the >5dB(A) exceedance occurs over more than 25% of any privately-owned land where there is an existing residence or where a residence could be built under current planning controls.

The *Voluntary Land Acquisition and Mitigation Policy* also provides for the consent authority to apply mitigation rights to the owner(s) of residences at which noise levels are predicted to be moderate (i.e. 3dB(A) to 5dB(A) above the Project Noise Trigger Levels).

The Voluntary Land Acquisition and Mitigation Policy records that when noise exceedances of 1 to 2dB(A) occur, the exceedances would not be discernible by the average listener and therefore would not warrant residence-based treatments or controls.

Table 6.8.6 presents the relevant VLAMP for residential receivers in the vicinity of the Mine Site.

Table 6.8.6
VLAMP Significant Impact Thresholds

Receiver	Assessment Period	PNTL dB $LA_{eq(15\ min)}$	Voluntary Acquisition[1]		Vacant Lands Acquisition[2]
			Recommended ANL dB $LA_{eq(period)}$	PNTL + 5dB dB $LA_{eq(15\ min)}$	Recommended ANL + 5dB dB $LA_{eq(period)}$
All	Day	40	50	45	55
	Evening	35	45	40	50
	Night	35	40	40	45
Note 1: Voluntary acquisition rights where the Project Noise Level (PNL) exceeds the PNTL by more than 5dB. Note 2: PNL exceed the relevant criteria on more than 25% for any privately-owned land.					
Source: MAC (2024) – modified after Table 12					

6.8.3.5 Road Traffic Noise Criteria

Table 6.8.7 presents the relevant road traffic noise criteria for residential receivers in the vicinity of the proposed transport routes as well as the relative increase criteria which takes into account any significant increases in total traffic noise at receivers. As the proposed transport route on Anabranch Mail Road then Silver City Highway to Broken Hill or Wentworth represent the principal haulage routes for the Project, MAC (2024) has adopted the category 'freeway/arterial/sub-arterial road' in accordance with the *Road Noise Policy*.

Table 6.8.7
Road Traffic Noise Criteria

Road Category	Development Type	Assessment Criteria	
		Day[1]	Night[2]
Freeway / arterial / sub-arterial road	Existing residences affected by additional traffic on existing freeway / sub-arterial roads generated by land use developments.	60dB(A) $LA_{eq(15\ hr)}$	55dB(A) $LA_{eq(9\ hr)}$
		Relative Increase Criteria	
		Existing $LA_{eq(15hour)}$ plus 12dB(external)	Existing $LA_{eq(9hour)}$ plus 12dB(external)
Note 1: Day = period between 7:00am and 10:00pm (no evening assessment) Note 2: Night = period between 10:00pm and 7:00am			
Source: MAC (2024) – modified after Table 13 and Table 15			

6.8.3.6 Maximum Noise Level Assessment Criteria

The maximum noise level assessment criteria are intended to assess potential impacts on sleep disturbance associated with maximum noise level events which occur during night periods.

Where the relevant maximum noise level trigger levels are exceeded at a residential location, a detailed maximum noise level event assessment is required to be undertaken. **Table 6.8.8** presents the maximum noise level assessment trigger levels for residential receivers in the vicinity of the Mine Site.

Table 6.8.8
Maximum Noise Level Assessment Trigger Levels

Receiver	$LA_{eq(15\ min)}$		LA_{max}	
All Residential	**40dB $LA_{eq(15\ min)}$ or RBL+ 5dB**		**52dB LA_{max} or RBL + 15dB**	
	Trigger	40	Trigger	52
	RBL+ 5dB	35	RBL + 15dB	45
	Highest	**40**	**Highest**	**52**
Source: MAC (2024) – Table 14				

6.8.4 Assessment Methodology

6.8.4.1 Guidelines and Software

The noise impact assessment was prepared by MAC (2024) in accordance with the following policies and guidelines.

- *Noise Policy for Industry* (NSW EPA, 2017)
- *Interim Construction Noise Guideline* (DECC, 2009)

- *Road Noise Policy* (DECCW, 2011)
- *Voluntary Land Acquisition and Mitigation Policy* (DECCW, 2018)

MAC (2024) used DGMR (iNoise, Version 2022) noise modelling software to model predicted noise emissions associated with construction and operational activities. The model incorporated a three-dimensional digital terrain map and used relevant noise source, ground type, attenuation and atmospheric data to predict noise levels at the nearest potentially affected receivers (MAC, 2024).

The model calculation method employed by MAC (2024) was in accordance with ISO 9613-1 'Acoustics – attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation' – with the use of CONCAWE to allow for corrections to meteorological conditions.

6.8.4.2 Meteorological Analysis

As previously indicated, MAC (2024) determined that prevailing winds are not applicable for the noise impact assessment. As a result, **Table 6.8.9** presents the relevant meteorological conditions adopted by MAC (2024) for the NIA.

Table 6.8.9
Site-specific Meteorological Parameters

Assessment Condition[1]	Temperature (°C)	Wind Speed / Direction	Relative Humidity (%)	Stability Class
Daytime[1] – Calm	20	N/A	60	N/A
Evening[2] – Calm	10	N/A	60	N/A
Night[3] – Inversion	10	N/A	90	G

N/A = not applicable.

Note 1: Day = period between 7:00am and 6:00pm, Monday to Saturday, and 8:00am to 6:00pm on Sundays and Public Holidays

Note 2: Evening = period between 6:00pm and 10:00pm, all days

Note 3: Night = the remaining periods

Source: MAC (2024) – Table 19

6.8.4.3 Construction Noise Modelling

As outlined in Section 3.3, the construction phase of the Project would involve several types of construction activities (e.g. bulk earthworks, road construction, erection of buildings, etc.). Construction activities would typically occur progressively and would occur at several locations simultaneously. Consequently, MAC (2024) modelled noise emissions associated with the Project under the following worst-case scenario.

- Construction Scenario – Construction of the Site Access Road and bulk earthworks, which includes the formation of laydown areas, and tailings and overburden emplacement areas.

Table 6.8.10 presents the assumed sound power levels (SWL) relied upon by MAC (2024). It is noted that, as the construction phase noise model has assumed all plant operating at peak capacity for 100% of the assessment period, the predicted construction noise levels represent worst-case noise emission scenario (MAC, 2024).

Table 6.8.10
Single Octave Construction Equipment Sound Power Levels

Noise Source/Item	Number of items	Sound Power Level (dB(A))
Construction Works Scenario		
Bulldozer (CAT D10T)	2	115
Scraper (Case Steiger AFS 550 dual scraper)	3	113
Grader (CAT 18M)	1	109
Excavator (CAT 6020)	2	116
Front-end Loader (CAT992)	1	113
Haul Truck (CAT 785)	9	116
Water Cart (CAT 789)	1	114
Diesel Generators (30MW)[1]	-	117
Note 1: Diesel generators to 30MW total capacity, for example, 15 x 2,500kva silenced BS Power generators at 102dBA Lw each.		
Source: MAC (2024) – modified after Table 16		

6.8.4.4 Road Construction and Intersection Upgrade Works

Additionally, the Project would involve the construction of the Site Access Road (approximately 27.0km), the realigning and upgrade of approximately 6.1km of Anabranch Mail Road, and installation of intersection treatments at the junction of:

- Anabranch Mail Road and Silver City Highway;
- Comstock Street and Patton Street;
- Comstock Street and Eyre Street; and
- Holton Drive and the Rail Facility Southern Access Road.

It is noted that there are no sensitive receivers within 3km of the Site Access Road. As such, it is considered that the construction of the Site Access Road would not result in noise levels above the NMLs at any sensitive receiver locations.

Table 6.8.11 presents the noise emission data for the Anabranch Mail Road works and the intersection treatments within Broken Hill, including the Rail Facility Access intersection. Due to the confined nature of the intersection works in Broken Hill, only the noisiest plant have been considered as not all equipment would run simultaneously.

Table 6.8.11
Single Octave Road Upgrade Equipment Sound Power Levels

Location	Noise Source/Item	Sound Power Level (dB(A))
Anabranch Mail Road	Construction Fleet	117
Intersection Upgrade Works	Concrete Saw	118
Rail Facility Access	Grader (CAT 18M)	109
Source: MAC (2024) – modified after Table 17		

6.8.4.5 Operational Noise Modelling

Proposed activities which would occur during the operational phase of the Project include vegetation and soil removal, conventional dredge mining, stockpiling, processing and transportation operations. Noise associated with the worst-case operational phases of the Project has been modelled by MAC (2024) under the following four operational scenarios (**Figures 6.8.1** to **6.8.4**).

- Noise Scenario 1 – Year 5 – includes mining activities at the central section of the Extraction Area, closest to Residence R1.
- Noise Scenario 2 – Year 11 – includes mining activities at the central section of the Extraction Area, closest to Residence R1.
- Noise Scenario 3 – Year 15 – includes mining activities at the northwest section of the Extraction, closest to Residence R2.
- Noise Scenario 4 – Year 17 – includes mining activities at the central section of the Extraction Area, at the end of the mine path, closest to Residence R1.

These scenarios represent the worst-case operating conditions, with the maximum number of plant and equipment operating simultaneously (24 hours per day), at the locations with the highest potential impact on neighbouring receivers. Detail of operational activities occurring during these scenarios is described in Section 3.4. **Table 6.8.12** presents the assumed sound power levels associated with equipment operating under each of these scenarios.

An assessment of annoying noise characteristics such as low frequency, tonality, intermittent noise, or noise short of duration has been undertaken for the Project and is provided in Appendix C of MAC (2024). Intermittent noise is not considered to be a feature of the site and therefore, has not been assessed. Analysis of low frequency noise and tonality was undertaken. Results demonstrate that the operations are not anticipated to result in noise that exceed relevant thresholds. Hence, no correction for low-frequency noise or tonality is applied.

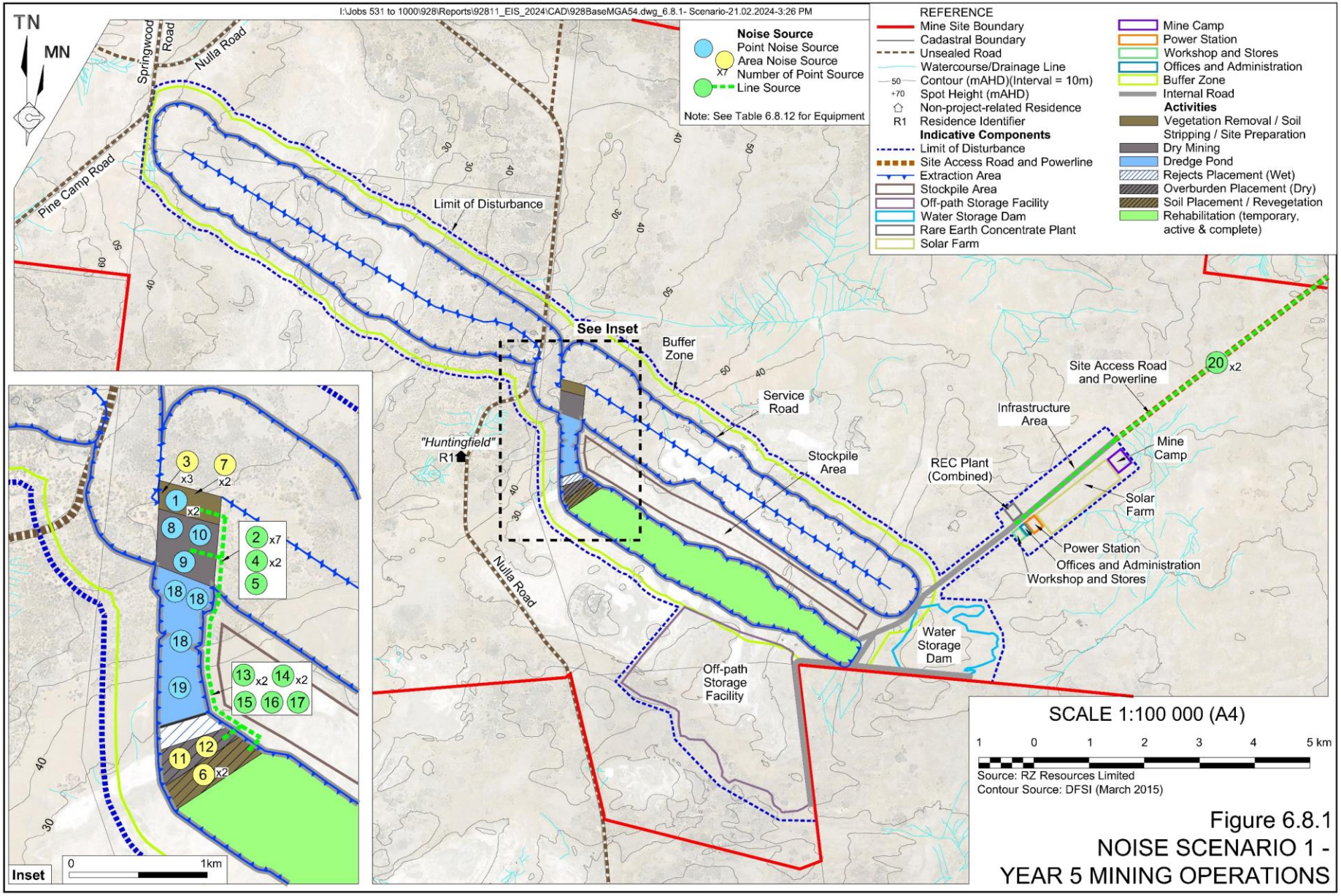
6.8.4.6 Sleep Disturbance

A maximum noise level assessment was undertaken to assess the potential for sleep disturbance effects from high impact noise sources. In assessing sleep disturbance, a typical LAmax noise source of 118dB was used to represent transient events such as an excavator shaking the bucket.

6.8.4.7 Road Noise

MAC (2024) used the iNoise modelling software based on ISO 9613-1 and ISO 9613-2 to represent traffic noise associated with Project-related trucks as moving sources along the proposed transport route.

Table 6.8.13 presents the offset distances between the closest receivers and the proposed transportation routes. As the nearest receiver to Anabranch Mail Road (Residence R7) is setback more than 2km, it is unlikely to be affected by road traffic noise, and has been excluded from the assessment.


I:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\928BaseMGA54.dwg_6.8.1- Scenario-21.02.2024-3:26 PM
TN
MN
Springwood Road
Nulla Road
Pine Camp Road
Limit of Disturbance
See Inset
Buffer Zone
Service Road
"Huntingfield" R1
Stockpile Area
Nulla Road
Off-path Storage Facility
Water Storage Dam
REC Plant (Combined)
Infrastructure Area
Site Access Road and Powerline
Mine Camp
Solar Farm
Power Station
Offices and Administration
Workshop and Stores
Inset
0
1km
Noise Source
Point Noise Source
Area Noise Source
Number of Point Source
Line Source
Note: See Table 6.8.12 for Equipment
REFERENCE
Mine Site Boundary
Cadastral Boundary
Unsealed Road
Watercourse/Drainage Line
Contour (mAHD)(Interval = 10m)
Spot Height (mAHD)
Non-project-related Residence
Residence Identifier
Indicative Components
Limit of Disturbance
Site Access Road and Powerline
Extraction Area
Stockpile Area
Off-path Storage Facility
Water Storage Dam
Rare Earth Concentrate Plant
Solar Farm
Mine Camp
Power Station
Workshop and Stores
Offices and Administration
Buffer Zone
Internal Road
Activities
Vegetation Removal / Soil Stripping / Site Preparation
Dry Mining
Dredge Pond
Rejects Placement (Wet)
Overburden Placement (Dry)
Soil Placement / Revegetation
Rehabilitation (temporary, active & complete)
SCALE 1:100 000 (A4)
1 0 1 2 3 4 5 km
Source: RZ Resources Limited
Contour Source: DFSI (March 2015)
Figure 6.8.1
NOISE SCENARIO 1 -
YEAR 5 MINING OPERATIONS

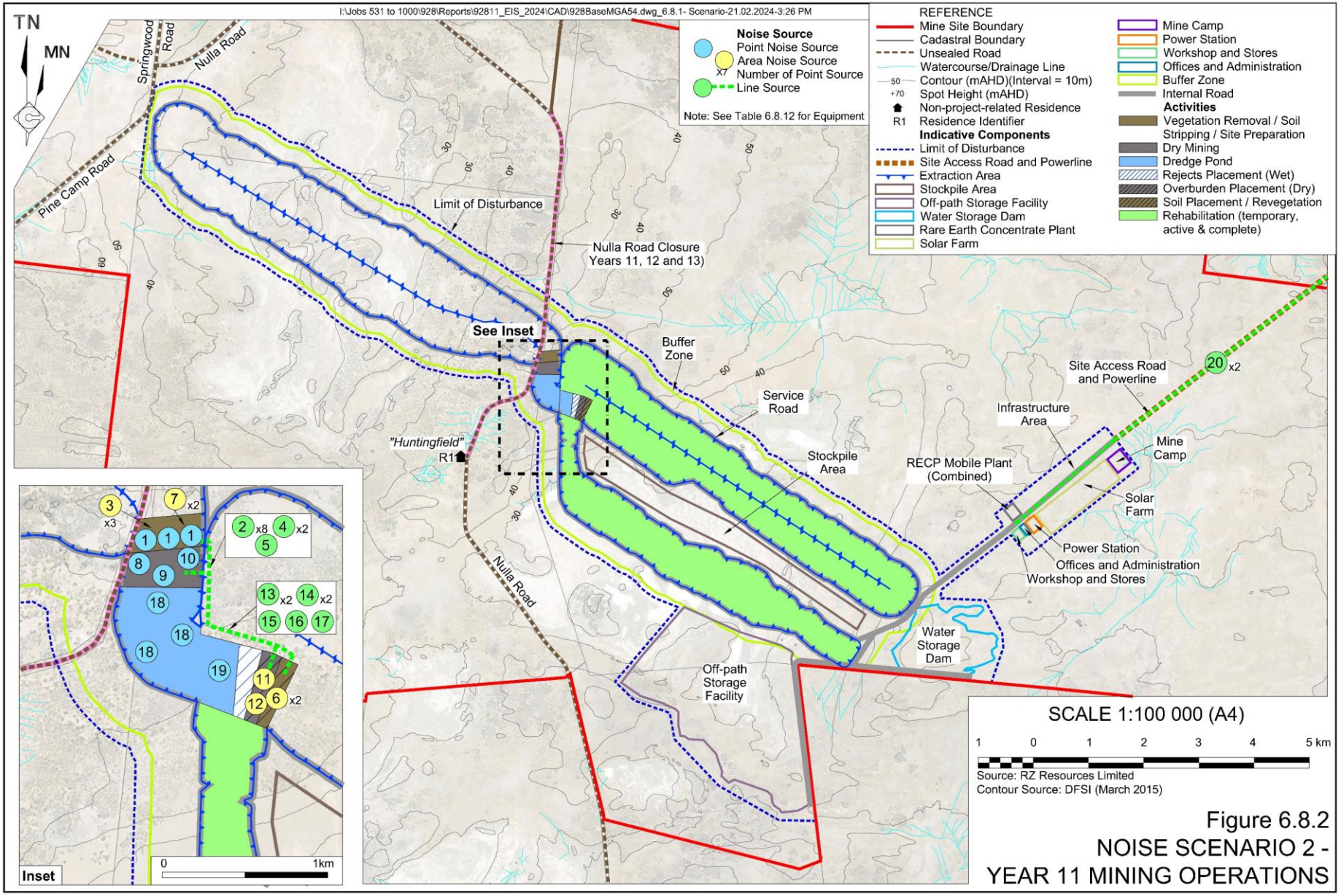
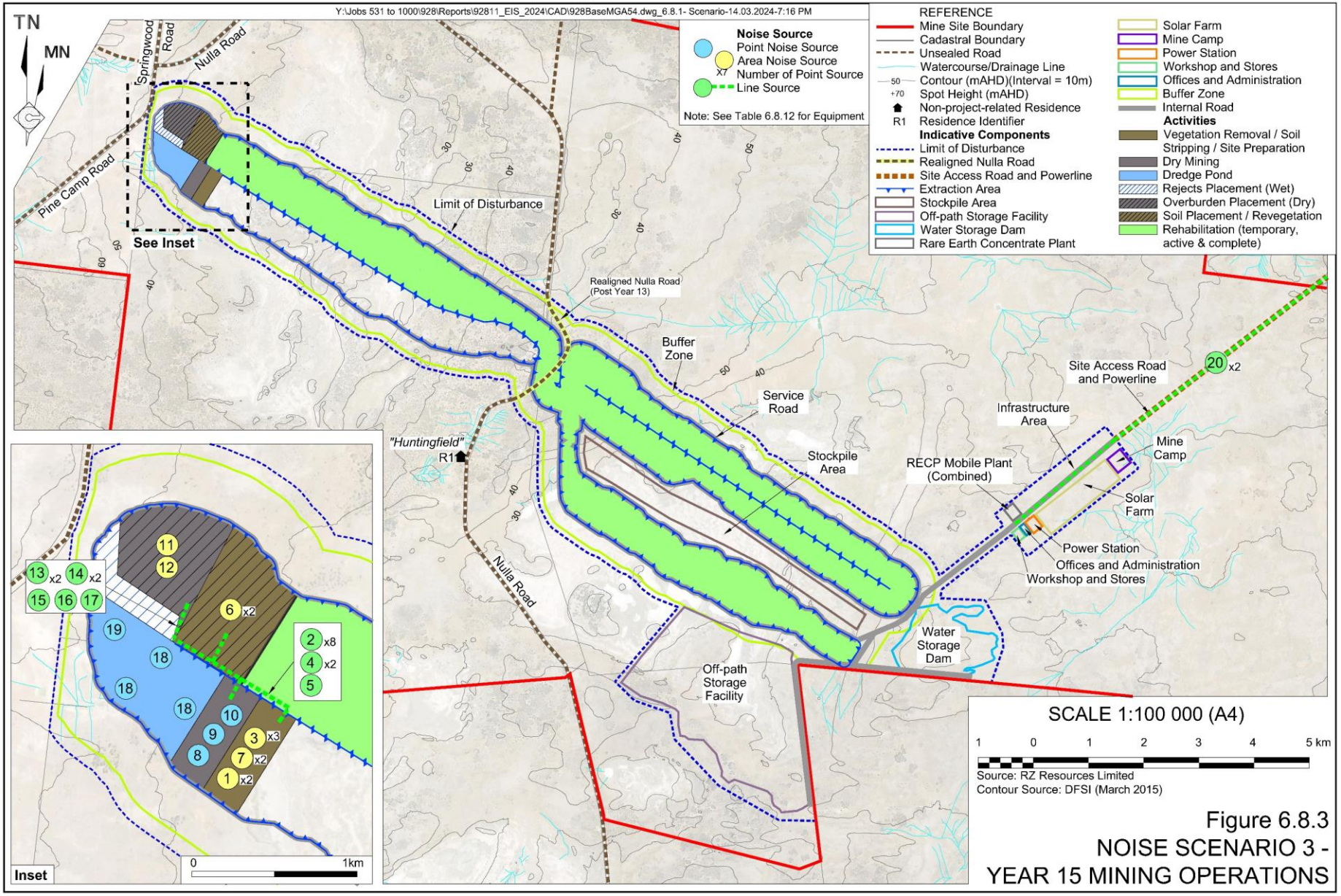


Figure 6.8.2
NOISE SCENARIO 2 - YEAR 11 MINING OPERATIONS


Y:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\928BaseMGA54.dwg_6.8.1- Scenario-14.03.2024-7:16 PM
TN
MN
Springwood Road
Nulla Road
Pine Camp Road
See Inset
Limit of Disturbance
Realigned Nulla Road (Post Year 13)
Buffer Zone
Service Road
"Huntingfield" R1
Stockpile Area
RECP Mobile Plant (Combined)
Infrastructure Area
Site Access Road and Powerline
Mine Camp
Solar Farm
Power Station
Offices and Administration
Workshop and Stores
Water Storage Dam
Off-path Storage Facility
Noise Source
Point Noise Source
Area Noise Source
Number of Point Source
Line Source
Note: See Table 6.8.12 for Equipment
REFERENCE
Mine Site Boundary
Cadastral Boundary
Unsealed Road
Watercourse/Drainage Line
Contour (mAHD)(Interval = 10m)
Spot Height (mAHD)
Non-project-related Residence
Residence Identifier
Indicative Components
Limit of Disturbance
Realigned Nulla Road
Site Access Road and Powerline
Extraction Area
Stockpile Area
Off-path Storage Facility
Water Storage Dam
Rare Earth Concentrate Plant
Solar Farm
Mine Camp
Power Station
Workshop and Stores
Offices and Administration
Buffer Zone
Internal Road
Activities
Vegetation Removal / Soil Stripping / Site Preparation
Dry Mining
Dredge Pond
Rejects Placement (Wet)
Overburden Placement (Dry)
Soil Placement / Revegetation
Rehabilitation (temporary, active & complete)
Inset
0
1km
SCALE 1:100 000 (A4)
1 0 1 2 3 4 5 km
Source: RZ Resources Limited
Contour Source: DFSI (March 2015)
Figure 6.8.3
NOISE SCENARIO 3 -
YEAR 15 MINING OPERATIONS

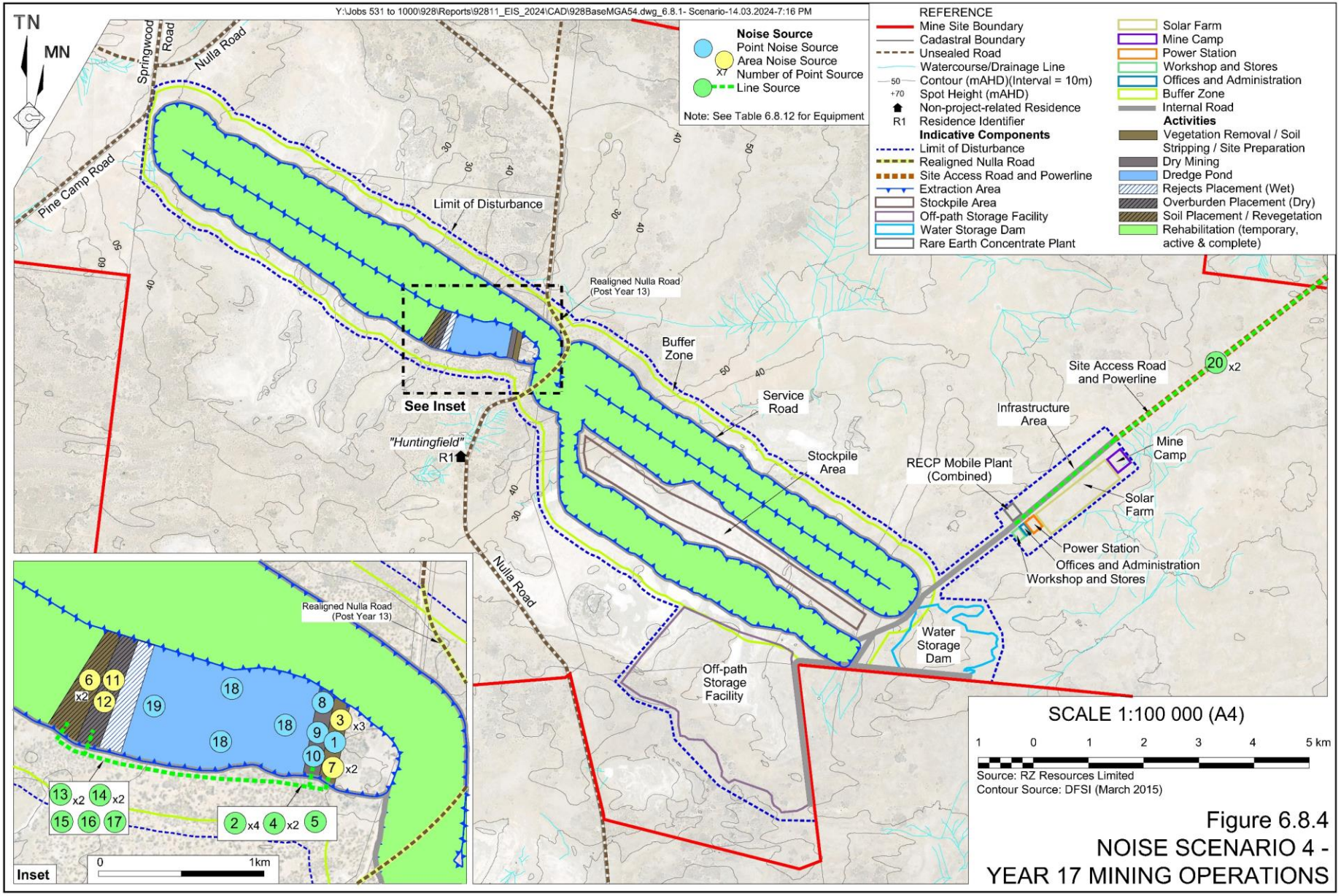

Y:\Jobs 531 to 1000\928\Reports\92811_EIS_2024\CAD\928BaseMGA54.dwg_6.8.1- Scenario-14.03.2024-7:16 PM
TN
MN
Springwood Road
Nulla Road
Pine Camp Road
Noise Source
Point Noise Source
Area Noise Source
Number of Point Source
Line Source
Note: See Table 6.8.12 for Equipment
REFERENCE
Mine Site Boundary
Cadastral Boundary
Unsealed Road
Watercourse/Drainage Line
Contour (mAHD)(Interval = 10m)
Spot Height (mAHD)
Non-project-related Residence
Residence Identifier
Indicative Components
Limit of Disturbance
Realigned Nulla Road
Site Access Road and Powerline
Extraction Area
Stockpile Area
Off-path Storage Facility
Water Storage Dam
Rare Earth Concentrate Plant
Solar Farm
Mine Camp
Power Station
Workshop and Stores
Offices and Administration
Buffer Zone
Internal Road
Activities
Vegetation Removal / Soil Stripping / Site Preparation
Dry Mining
Dredge Pond
Rejects Placement (Wet)
Overburden Placement (Dry)
Soil Placement / Revegetation
Rehabilitation (temporary, active & complete)
Limit of Disturbance
Realigned Nulla Road (Post Year 13)
Buffer Zone
See Inset
"Huntingfield" R1
Service Road
Stockpile Area
Site Access Road and Powerline
Infrastructure Area
RECP Mobile Plant (Combined)
Mine Camp
Solar Farm
Power Station
Offices and Administration
Workshop and Stores
Water Storage Dam
Off-path Storage Facility
Nulla Road
Inset
0
1km
SCALE 1:100 000 (A4)
1 0 1 2 3 4 5 km
Source: RZ Resources Limited
Contour Source: DFSI (March 2015)
Figure 6.8.4
NOISE SCENARIO 4 - YEAR 17 MINING OPERATIONS

Table 6.8.12
Operational Phase Equipment Sound Power Levels

ID	Noise Source / Item	Indicative Make / Model	Period of Operation	Number of Equipment				Total Sound Power Level (dB(A))
				Year 5	Year 11	Year 15	Year 17	
REC Plant	Excavator	Komatsu PC300	All	2	2	2	2	103
	Bulldozer	CAT D9		1	1	1	1	113
	Haul Truck	CAT 745		3	3	3	3	107
	Loader	CAT 966		1	1	1	1	109
1	Excavator	CAT 6020	Day	2	3	2	1	116
2	Haul Truck	CAT 785	All	7	8	8	4	116
3	Bulldozer	CAT D10T	Day	3	3	3	3	115
4	Grader	CAT 16K	All	2	2	2	2	109
5	Water Cart	CAT 777	All	1	1	1	1	115
6	Bulldozer	CAT D9	Day	2	2	2	2	113
7	Scraper	CAT 657	Day	2	2	2	2	113
8	Excavator	CAT 390	All	1	1	1	1	108
9	Excavator	CAT 349	All	1	1	1	1	108
10	Excavator	CAT 336	All	1	1	1	1	105
11	Wheeled Loader	CAT 992G	All	1	1	1	1	113
12	Wheeled Loader	CAT 980K	All	1	1	1	1	109
13	Articulated Truck	Volvo A60H	All	2	2	2	2	113
14	Articulated Truck	Bell Moxy B50D	All	2	2	2	2	110
15	Grader	CAT14M	All	1	1	1	1	107
16	Water Cart	CAT 773	All	1	1	1	1	114
17	Water Cart	Moxy	All	1	1	1	1	104
18	Dredge	Jet Suction Dredge	All	3	3	3	3	110
19	Wet Concentrator Plant	Floating Plant	All	1	1	1	1	95
20	Road Truck	Road Train	All	2	2	2	2	108
21	BESS	Modular	All	1	1	1	1	95

Source: MAC (2024) – modified after Table 20 and Table 21

Table 6.8.13
Closest Receivers to Transportation Route

Street Name	Receiver	Distance to Road (m)
Silver City Highway	14098 Silver City Highway	250
Wentworth Road	101 Wentworth Road	40
Patton Street	4 Patton Street	20
Comstock Street	43 Comstock Street	15
Eyre Street	155 Eyre Street	20
	St Annes Aged Care Facility	
Holten Drive[1]	N/A	N/A
Adams Street (Wentworth)	181 Adams Street	25

Note 1: No sensitive receivers located adjacent to the transportation route adjacent to Holten Drive.

Source: MAC (2024) – modified after Table 22

6.8.5 Avoidance, Management and Mitigation Measures

The Applicant would implement the following noise management and mitigation measures throughout the life of the Project. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual noise-related risks presented in **Appendix 2**.

- Strictly comply with the proposed hours of operation identified in **Table 3.10.1**.
- Regularly service all on-site equipment to ensure sound power levels of each item remains at or below the default/or factory-set values.
- Install frequency modulated reversing alarms to all mobile equipment.
- Ensure that all truck drivers comply with the Applicant's Driver's Code of Conduct outlining procedures for reducing noise impacts during transportation in the vicinity of residences along the transportation route.
- Only permit transportation of heavy mineral concentrate within the Broken Hill LGA between the hours of 7:00am and 10:00pm.
- Contact residents surrounding the Patton Street/ Comstock Street and Comstock Street / Eyre Street intersections prior to intersection upgrade works commencing to advise them of the works and likely duration of impacts.
- Maintain an open dialogue with the surrounding community and neighbours to ensure any concerns over noise are addressed.

6.8.6 Assessment of Impacts

6.8.6.1 Construction Noise Modelling

Table 6.8.14 presents the results of the combined construction noise modelling for the Project. In summary, predicted noise emissions for construction activities would satisfy the relevant construction noise management levels at all sensitive receiver locations (MAC, 2024).

Table 6.8.14
Construction Noise Modelling Results – Site Establishment and Construction

Receiver[1]	Predicted Noise Level dB $LA_{eq(15min)}$	NML dB $LA_{eq(15min)}$		Compliant
		Day	OOH	
R1	<30	45	35	✓
R2[2]	<30	45	35	n/a
R3	<30	45	35	✓
R4[2]	<30	45	35	n/a
R5[2]	<30	45	35	n/a
R6	<30	45	35	✓
R7	<30	45	35	✓
R8	<30	45	35	✓
R9	<30	45	35	✓
R10	<30	45	35	✓

Note 1: See **Figure 5.1**.
Note 2: Project related receivers.

Source: MAC (2024) – modified after Table 24

6.8.6.2 Road and Intersection Upgrade Works

Table 6.8.15 presents the results of the analysis of the predicted noise levels for road and intersection upgrade works as described in Section 6.8.4.4. In summary, the proposed works would be compliant at residences adjacent to the Rail Facility entrance during standard construction hours. However, noise levels at the Patton Street/ Comstock Street and Comstock Street / Eyre Street intersections would be non-compliant. The Applicant notes that these works would be undertaken over a short period and would rectify existing road alignment issues where approved vehicles are currently required to cross the centre line to get around the corner. As a result, the proposed works would provide a substantial benefit to residents living in close proximity to the intersections. Notwithstanding this, the Applicant would contact surrounding residents prior to undertaking the proposed intersection upgrade works to inform them of the nature of the works and duration of the activities.

Table 6.8.15
Combined Noise Predictions for Road and Intersection Upgrades

Location	Predicted Noise Level dB $LA_{eq(15min)}$	NML dB $LA_{eq(15min)}$		Compliant
		Day	HNA	
37 Comstock Street	80	45	75	No
137 Eyre Street	87	45	75	No
Lot 7313 DP1185108 (Junction Circle)	42	45	75	Yes
Source: MAC (2024) – modified after Table 25				

6.8.6.3 Operational Noise Modelling

Table 6.8.16 presents the results of the operational noise modelling for Scenarios 1 to 4. In summary, the results indicated that predicted noise emissions under both Scenarios would satisfy the relevant noise criteria, as well as the VLAMP requirements, during all assessment periods at each of the sensitive receiver locations.

6.8.6.4 Sleep Disturbance Assessment

Table 6.8.17 presents the predicted noise levels from LA_{max} events (i.e. 118dB) for sensitive receivers in the vicinity of the Mine Site. In summary, the maximum noise level trigger levels would be satisfied at all sensitive receivers (MAC, 2024). As predicted noise levels are below the screening criteria, no further assessment or detailed analysis is required (MAC, 2024).

6.8.6.5 Road Traffic Noise Results

Table 6.8.18 presents the results for the road traffic noise assessment. In summary, predicted road traffic noise would not exceed the relevant criteria at any receiver locations (MAC, 2024).

Table 6.8.16
Operational Noise Modelling Results – Operational Worst-Case Scenarios 1 to 4

Receiver	Predicted Noise Level, dB LAeq(15min)[1]																			Compliant
	Scenario 1 (Year 5)				Scenario 2 (Year 11)				Scenario 3 (Year 15)				Scenario 4 (Year 17)				PNTL, dB LAeq(15min)			
	Day	Evening	Night	Night Inversion	Day	Evening	Night	Night Inversion	Day	Evening	Night	Night Inversion	Day	Evening	Night	Night Inversion	Day	Evening	Night	
R1	35	30	31	33	34	<30	<30	32	<30	<30	<30	<30	34	<30	30	32	40	35	35	✓
R2[2]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a	n/a
R3	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	40	35	35	✓
R4[2]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a	n/a
R5[3]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a	n/a
R6	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	40	35	35	✓
R7	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	40	35	35	✓
R8	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	40	35	35	✓
R9	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	40	35	35	✓
R10	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	40	35	35	✓
Mine Camp[2]	37	34	<30	<30	37	34	<30	<30	37	34	<30	<30	37	34	<30	<30	58	53	48	n/a

Note 1: Day – the period from 7:00am to 6:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays; Evening – the period from 6:00pm to 10:00pm; Night – the remaining periods.

Note 2: Project-related receiver. Mine camp assessed against amenity criteria for short term accommodation.

Note 3: Unoccupiable residence.

Source: MAC (2024) – modified after Table 26

Table 6.8.17
Maximum Noise Level Assessment Results

Receiver	Predicted Maximum Night-time[1] Noise										
	Scenario 1 (Year 5)		Scenario 2 (Year 11)		Scenario 3 (Year 15)		Scenario 4 (Year 17)		Trigger Levels		
	dB $LA_{eq(15min)}$	dB LA_{max}	dB $LA_{eq(15min)}$	dB LA_{max}	dB $LA_{eq(15min)}$	dB LA_{max}	dB $LA_{eq(15min)}$	dB LA_{max}	dB $LA_{eq(15min)}$	dB LAmax	Compliant
R1	33	<30	32	<30	<30	<30	32	<30	40	52	✓
R2[2]	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a
R3	<30	<30	<30	<30	<30	<30	<30	<30	40	52	✓
R4[2]	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a
R5[3]	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a
R6	<30	<30	<30	<30	<30	<30	<30	<30	40	52	✓
R7	<30	<30	<30	<30	<30	<30	<30	<30	40	52	✓
R8	<30	<30	<30	<30	<30	<30	<30	<30	40	52	✓
R9	<30	<30	<30	<30	<30	<30	<30	<30	40	52	✓
R10	<30	<30	<30	<30	<30	<30	<30	<30	40	52	✓
Mine Camp[2]	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a	n/a

Note 1: Day – the period from 7:00am to 6:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays; Evening – the period from 6:00pm to 10:00pm; Night – the remaining periods.

Note 2: Project-related receiver. Mine camp assessed against amenity criteria for short term accommodation.

Note 3: Unoccupiable residence.

Source: MAC (2024) – Table 27

Table 6.8.18
Combined Noise Predictions for Road and Intersection Upgrades

Location	Receiver	Offset from Road	Assessment Criteria dB $LA_{eq(period)}$		Traffic Noise dB $LA_{eq(period)}$	Compliant
Broken Hill (North)	14098 Silver City Highway	255m	Day	60 $LA_{eq(15hr)}$	42.7	Yes
			Night	55 $LA_{eq(9hr)}$	21.5	Yes
	43 Comstock Street	15m	Day	60 $LA_{eq(15hr)}$	48.9	Yes
			Night	55 $LA_{eq(9hr)}$	31.3	Yes
	St Annes (Eyre Street)	20m	Day	60 $LA_{eq(15hr)}$	47.0	Yes
			Night	55 $LA_{eq(9hr)}$	29.2	Yes
Wentworth (South)	181 Adams Street	25m	Day	60 $LA_{eq(15hr)}$	39.9	Yes
			Night	55 $LA_{eq(9hr)}$	36.0	Yes
Source: MAC (2024) – modified after Table 28						

6.8.7 Monitoring

The Applicant would prepare a *Noise Management Plan* for the Project. The Plan would include the following noise monitoring aspects.

- Operation of an onsite Weather Station.
- Noise monitoring in response to noise complaints or reasonable enquiries.

Monitoring results would be maintained in a suitable database and would be reported in the Annual Review to be prepared for the Project. In addition, all monitoring results would continue to be made available on request to relevant government agencies and surrounding residents.

6.8.8 Conclusion

Management of potential noise impacts during the site establishment and operation of the Project would involve the adoption of a range of mitigation measures. The Applicant would implement a range of measures to ensure that noise criteria are not exceeded at the privately-owned residences surrounding the Mine Site.

MAC (2024) concludes that construction and operational noise levels would comply with the relevant criteria at all privately-owned residences, with the exception of residences in the vicinity of the proposed works at the Patton Street/ Comstock Street and Comstock Street / Eyre Street intersections. These works would be short-term in nature and would provide a substantial benefit to the affected residents. The Applicant would also contact potentially affected residents prior to undertaking the works. As a result, the anticipated noise levels are not considered significant.

Where the noise levels are anticipated to exceed standard noise management levels at the nearest receiver during intersection upgrade works within Broken Hill, communication with potentially affected residential receivers would be undertaken. It is noted that construction activities are anticipated to occur for a few days only.

6.9 Air Quality and Greenhouse Gas

6.9.1 Introduction

The SEARs identify "air quality" as a key issue for assessment in the EIS. Matters to be addressed include:

- "an assessment of the likely air quality impacts of the development, including cumulative impacts from nearby developments, in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (2016) (or its latest version), and having regard to the NSW Government's Voluntary Land Acquisition and Mitigation Policy;
- ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the Protection of the *Environment Operations (Clean Air) Regulation 2010;*
- an assessment of the likely greenhouse gas emissions of the development including measures to minimise emissions having regards to the *Climate Change (Net Zero Future) Act 2023* and the EPA's *Climate Change Policy and Climate Action Plan*, and Commonwealth Safeguard Mechanism reforms; and
- a description of the air pollution control techniques from any air emission sources of the development that would be implemented to manage and monitor efficiency and performance (including fugitive dust, particulates, emissions from vehicle movements and greenhouse gases)."

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the SEARs from the DPE-Crown Lands and the EPA. These requirements, where additional to the above, are summarised as follows.

- Much of the development will take place on low capability soil which is highly susceptible to wind erosion, particularly following disturbance. Further dust suppression measures should be considered on site and for the unsealed access road.
- Measures to prevent or control the emission of dust from vehicle movements and particulates from mining activities must be detailed based on the outcome of an assessment for undertaken in accordance with our guidelines the *'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'* (EPA, 2016). The assessment must identify all sensitive receptors in proximity to the proposed development and present the potential impacts on those receptors including worst case scenarios.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

Northstar Air Quality Pty Ltd (Northstar) prepared the *Air Quality Impact Assessment* (AQIA) for the Project. The AQIA, hereafter referred to as Northstar (2024), is presented as **Appendix 12**.

This subsection provides a summary of the AQIA and describes the management and management measures to be implemented by the Applicant.

Terminology used within this section includes the following.

- Deposited dust – that fraction of suspended particulates that settles out of the air and is deposited on surfaces.
- Total Suspended Particulates (TSP) – that fraction of dust suspended in the air. TSP typically refers to particulates smaller than 30 to 50 micrometres (µm) in diameter.
- PM_{10} – suspended particulates with a diameter of 10µm or less. PM_{10} is a subset of TSP.
- $PM_{2.5}$ – suspended particulates with a diameter of 2.5µm or less. $PM_{2.5}$ is a subset of PM_{10} and TSP and is typically a combustion-related pollutant.

6.9.2 Existing Environment

6.9.2.1 Surrounding Receivers

Figure 5.1 presents Project-related, non-Project related and unoccupiable residences surrounding the Mine Site. No sensitive receivers such as schools, places of worship or major residential areas are present in the vicinity.

6.9.2.2 Topography and Meteorology

The local topography and meteorology are discussed in Section 6.1 and are used as key inputs in the meteorological and dispersion modelling undertaken by Northstar (2024).

6.9.2.3 Potential for Cumulative Impacts

The area surrounding the Mine Site is primarily rural in nature, with no significant anthropogenic sources of particulate matter that may impact cumulatively with the Project on sensitive receivers (**Figure 2.1**). Northstar (2024) therefore concludes that the incorporation of background air quality data outlined in the following section would appropriately account for any potential cumulative impacts associated with surrounding land uses.

6.9.2.4 Background Air Quality

Following an examination of meteorological and air quality data from the Mildura Airport Automated Weather Station between 2017 and 2021, Northstar (2024) selected 2019 as the most representative year for assessment.

Northstar (2024) note that the Mine Site is located a significant distance from suitable air quality monitoring stations (AQMS) with publicly available data. Three potentially suitable monitoring stations were identified as follows.

- Wagga Wagga North AQMS, located in the Riverina Region of NSW approximately 581km east-southeast of the Mine Site.

- Albury AQMS, located in the Riverina Region of NSW approximately 589km southeast of the Mine Site.
- Elizabeth Downs AQMS (in South Australia), located on the outskirts of Adelaide approximately 259km southwest of the Mine Site.

The Wagga Wagga North AQMS was selected as this station represents the closest suitable AQMS with data available for the assessment year of 2019.

As TSP data was not available from any AQMS in the vicinity of the Mine Site, Northstar (2024) relied upon a TSP:PM_{10} ratio of 2.3404:1 (i.e. PM_{10} is equivalent to approximately 43% of TSP) derived from an analysis of co-located TSP and PM_{10} measurements recorded in the Lower Hunter, Illawarra and Sydney Metropolitan regions of NSW between 1999 and 2011.

Similarly, as no dust deposition data is available for the area surrounding the Mine Site, a criterion of 2g/m^2/month has been adopted by Northstar (2024) as per the Approved Methods.

No data is available on the background silica concentrations experienced in areas surrounding the Mine Site. In the absence of any information, and the absence of other sources in close proximity to the Mine Site, the background concentration has been assumed to be negligible.

Table 6.9.1 presents a summary of the background air quality data adopted by Northstar (2024). It is noted that the maximum 24-hour PM_{10} and $PM_{2.5}$ concentrations measured at the Wagga Wagga North AQMS exceed the relevant criteria. Exceedances of the 24-hour PM_{10} criterion are discussed in the NSW *Annual Compliance Report for the National Environment Protection (Ambient Air Quality) Measure for 2019* (NSW DPE, 2021). In particular, extensive drought conditions, dust storms and bushfires during 2019 were identified as the primary sources for these exceedances (Northstar, 2024).

Table 6.9.1
AQIA Background Air Quality Data

Pollutant	Averaging Period	Units	Measured Value	Comment
TSP	Annual	µg/m^3	82.7	Estimated based on TSP:PM_{10} ratio of 2.3404:1
PM_{10}	24-hour	µg/m^3	Daily Varying	24-hour maximum PM_{10} at Wagga Wagga North AQMS in 2019 measured as 251.7µg/m^3
	Annual	µg/m^3	35.3	Annual average at Wagga Wagga North AQMS in 2019
$PM_{2.5}$	24-hour	µg/m^3	Daily Varying	24-hour maximum $PM_{2.5}$ at Wagga Wagga North AQMS measured as 239.6µg/m^3
	Annual	µg/m^3	11.3	Annual average at Wagga Wagga North AQMS in 2019
Deposited Dust	Annual	g/m^2/month	2	Difference in NSW EPA maximum allowable and incremental impact criterion
Silica	Annual	µg/m^3	N/A	Assumed to be negligible
Source: Northstar (2024) – modified after Table 10				

Exceedances of the 24-hour $PM_{2.5}$ criterion, with increased concentrations typically occurring during cooler months, are more likely to be associated with the use of wood-fired heaters in the vicinity of the Wagga Wagga North AQMS. As wood-fired heater use is not expected to contribute significantly to $PM_{2.5}$ concentrations in the vicinity of the Mine Site, concentrations of $PM_{2.5}$ may be lower in areas surrounding the Mine Site.

6.9.2.5 Greenhouse Gases

Greenhouse gas emissions are tracked by the Commonwealth of Australia via the Australian National greenhouse accounts program and are reported in the State and Territory Greenhouse Gas Inventories report each year. Data from the 2020 report for Australia (DISER, 2020) representing the most recent available report at the time of the assessment, were used by Northstar (2024) for the purposes of the greenhouse gas assessment for the Project.

Greenhouse gas emissions for Australia in 2020 across all economic sectors were 496.68Mt carbon dioxide equivalent (CO_2-e). In NSW, greenhouse gas emissions were 132.41Mt CO2-e, representing 24.5% of total national emissions (DISER, 2020).

6.9.3 Potential Emission Sources

The following activities are likely to generate emissions of pollutants during the life of the Project.

- Soil and subsoil stripping and placement
- Vegetation removal
- Overburden stripping and placement
- Loading, transportation and unloading of haul trucks with topsoil, subsoil and overburden
- Loading of heavy mineral products into trucks and transportation off site
- Wind erosion of disturbed areas
- Emissions from vehicles and equipment exhaust

It is noted that, as the removal of interburden and ore by wet dredging and the processing of ore in the Wet Concentration Plant, as well as the pumping of tailings and slimes, would be wet processes, these activities are unlikely to generate emissions.

Furthermore, Northstar (2024) notes that emissions of the following pollutants would be associated with diesel and gas-powered equipment used in plant and machinery to meet the Project's material movements and power requirements.

- Oxides of Nitrogen (NO_X) – formed in the combustion zone due to high operating temperatures and principally emitted as nitric oxide (NO), nitrogen dioxide (NO_2) and a small component of nitrous oxide (N_2O).
- Carbon Monoxide (CO) – colourless and odourless gas formed as a result of incomplete fuel combustion.
- Sulphur Dioxide (SO_2) – generated from the oxidation of sulphur in fuel during combustion. The sulphur content of diesel is limited to a maximum of 10ppm under the *Fuel Quality Standards Act (2000)*.
- Particulate Matter – includes TSP, PM_{10} and $PM_{2.5}$, although the US Environmental Protection Agency notes that virtually 100% of particles emitted from the combustion of diesel fuel are <1µm and are therefore classified as $PM_{2.5}$.

Given the distances between the diesel-powered generators and nearest non-Project related receptors, the concentration of pollutants associated with those emissions are likely to disperse rapidly and not be likely to approach the relevant criteria at any receptor location (Northstar, 2024).

6.9.4 Assessment Criteria

6.9.4.1 Particulate Matter and Deposited Dust

The AQIA was prepared by Northstar (2024) with consideration of the following guidelines and legislation.

- *Protection of the Environment Operations Act 1997.*
- *Protection of the Environment Operations (Clean Air) Regulation 2022.*
- *Approved Methods for the Modelling and Assessment of Air Quality in NSW* (NSW EPA, 2022a).
- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (NSW EPA, 2022b).
- *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (NSW Government 2018).
- National Greenhouse and Energy Reporting (NGER) scheme under the *National Greenhouse and Energy Reporting Act (2007)* (NGER Act).

Table 6.9.2 presents the air quality criteria specified in the *Approved Methods for the Modelling and Assessment of Air Quality in NSW* (NSW EPA, 2022a) which were adopted for the Project.

Table 6.9.2
Impact Assessment Criteria – Particulate Matter and Dust Deposition

Pollutant	Averaging Period	Units	Criterion
TSP	Annual	µg/m^3	90
PM_{10}	24-hour	µg/m^3	50
	Annual	µg/m^3	25
$PM_{2.5}$	24-hour	µg/m^3	25
	Annual	µg/m^3	8
Deposited Dust[3]	Annual	g/m^2/month	2[1]
		g/m^2/month	4[2]
Respirable Crystalline Silica	Annual	µg/m^3	3
Note 1: Maximum increase in deposited dust level Note 2: Maximum total deposited dust level Note 3: Assessed as insoluble solids			
Source: Northstar (2024) – modified after Table 6			

6.9.4.2 Respirable Crystalline Silica

Silica (SiO_2) is a naturally occurring mineral which can exist in crystalline or amorphous (non-crystalline) forms. Only crystalline forms of silica are known to have adverse impacts on humans by increasing scar tissue in lungs and only respirable particles (i.e. respirable crystalline silica) are considered in assessing health effects.

Although an air quality criterion for respirable crystalline silica is not provided by the NSW EPA, Victoria EPA provide an annual average criterion for respirable silica (as $PM_{2.5}$) of 3µg/m^3 in their *State Environmental Planning Policy Protocol for Environmental Management: Mining and Extractive Industries* (VIC EPA, 2007). Although respirable crystalline silica is generally considered to be an occupational health and safety issue for onsite personnel rather than an environmental issue for offsite sensitive receivers, Northstar (2024) has considered respirable crystalline silica in the AQIA by adjusting annual average $PM_{2.5}$ modelling results on a pro rata basis to account for the determined maximum free silica content of the extracted material which is very conservatively assumed to be 100%.

6.9.4.3 Voluntary Land Acquisition and Mitigation Policy

The *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (NSW Government, 2018) (VLAMP) describes the NSW Government's approach to voluntary mitigation and the acquisition of land to address dust and noise impacts and outlines particulate matter mitigation and acquisition criteria. Voluntary acquisition rights also apply where an exceedance occurs or is predicted to occur over more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Table 6.9.3 presents the relevant voluntary mitigation and acquisition criteria for the Project. Acquisition criteria apply if more than five exceedances of the 24-hour PM_{10} criterion would occur over the Project life at a residence or receiver.

Table 6.9.3
Voluntary Mitigation and Acquisition Criteria

Pollutant	Averaging Period	Units	Criterion
TSP	Annual	µg/m^3	90[1]
PM_{10}	24-hour	µg/m^3	50[2]
	Annual	µg/m^3	25[1]
$PM_{2.5}$	24-hour	µg/m^3	25[2]
	Annual	µg/m^3	8[1]
Deposited Dust	Annual	g/m^2/month	2[2]
		g/m^2/month	4[1]
Note 1: Cumulative impact (i.e. increase in concentrations due to the Project plus background concentrations due to all other sources)			
Note 2: Incremental impact (i.e. increase in concentrations due to the Project alone), with zero allowable exceedances of the criteria over the life of the Project			
Source: Northstar (2024) – modified after Table 6			

6.9.5 Assessment Methodology

6.9.5.1 Modelling Software and Scenarios

A dispersion modelling assessment was completed by Northstar (2024) using the EPA approved CALPUFF atmospheric dispersion model. Modelling was performed in CALPUFF 2-dimensional (2-D) mode as a 3-D modelling assessment was not warranted based on the terrain in the vicinity of the Mine Site and the distance between sensitive receivers and the proposed activities.

The assessment included an assessment of particulate matter emissions associated with approximate average operational characteristics as well as likely peak activities at the Mine Site in order to permit comparison of potential impacts against the relevant long-term (annual) and short-term (24-hour) criteria. For the purposes of the assessment, detailed dispersion modelling was undertaken for the following four scenarios (see **Figures 6.8.1** to **6.8.4** in Section 6.8).

- Scenario 1 (Year 5)
- Scenario 2 (Year 11)
- Scenario 3 (Year 15)
- Scenario 4 (Year 17)

These scenarios would include mining activities (including all material stripping, extraction and replacement activities) representing the stripping of topsoil and removal of vegetation and overburden, extraction and processing of ore, as well as the transport of heavy mineral concentrate from the Mine Site and along Anabranch Mail Road.

In addition, in order to assess the impact of off-site transportation on residential receivers in the vicinity of Anabranch Mail Road, an assessment of the potential for discrete impacts at distances away from the road has been performed. A nominal 5km stretch of Anabranch Mail Road has been subject to dispersion modelling, and the inputs to that assessment are presented in Appendix C of Northstar (2024).

Table 6.9.4 provides a summary of the material and vehicle movements assessed by Northstar (2024) for each of the scenarios.

Table 6.9.4
Project Operational Characteristics –Scenarios 1 to 4

Component	Scenario 1 Annual Average	Scenario 2 Annual Average	Scenario 3 Annual Average	Scenario 4 Annual Average
Material Movements				
Topsoil Stripping Rate[1]	0.43 Mtpa	1.33 Mtpa	1.03 Mtpa	0.74 Mtpa
Overburden Extraction Rate	27.1 Mtpa	25.2 Mtpa	16.1 Mtpa	11.0 Mtpa
Interburden Removed	36.3 Mtpa	34.2 Mtpa	32.1 Mtpa	27.7 Mtpa
Ore Extraction Rate	23.4 Mtpa	23.4 Mtpa	27.6 Mtpa	20.9 Mtpa
Slimes Produced	1.0 Mtpa	1.0 Mtpa	1.34 Mtpa	1.2 Mtpa
Tailings Placement Rate	1.4 Mtpa	1.0 Mtpa	1.7 Mtpa	1.0 Mtpa
HMC transported	450,000 tpa	465,000 tpa	385,000 tpa	340,000 tpa

Table 6.9.4 (Cont'd)
Project Operational Characteristics –Scenarios 1 to 4

Component	Scenario 1 Annual Average		Scenario 2 Annual Average		Scenario 3 Annual Average		Scenario 4 Annual Average	
Daily Heavy Vehicle Movements								
	Average	Peak	Average	Peak	Average	Peak	Average	Peak
Type 2 Road Train[2]	20	24	20	24	20	24	20	24
B-Double / Semi Trailer Truck / other heavy vehicle	8	14	8	14	8	14	8	14
22 seater bus	2	4	2	4	2	4	2	4

Note 1: Discrepancies between topsoil stripping rates assumed by Northstar (2024) and those presented in **Table 6.4.9** relate to the fact that Northstar (2024) relied upon an early draft of the annual soil balance. The discrepancies are not considered material for the purposes of the air quality assessment.

Note 2: Northstar (2024) assessed particulate emissions associated with the use of Type 1 (up to 32 movements per day) and Type 2 (up to 24 movements per day) road trains and determined that there would be no material difference in predicted impacts at sensitive receptors between the vehicle types. As a result, Type 2 road trains have been assessed.

Source: Northstar (2024) – modified after Table 11

6.9.5.2 Particulate Emission Factors and Controls

Northstar (2024) has adopted emission factors for material handling processes, truck movements on unsealed roads, material screening and wind erosion from the US EPA AP-42 emission factor compendium (US EPA, 1995 – including updates) and NPI EETM (NPI, 2012). **Table 6.9.5** presents the emission reduction measures which were adopted for the assessment and which would be implemented throughout the life of the Project.

Table 6.9.5
Particulate Emission Controls

Emission Control Method	Control Efficiency (%)
Application of water and/or chemical suppressants on unpaved haulage routes	90
Limiting of on-site vehicle speeds to less than or equal to 50 km/hr^{-1}	75
Ore extraction, dredge mining, wet concentrator plant – wet processes	100
Retention of particulate matter in sub-ground level areas (pit retention)	95 (TSP) 5 (PM_{10} and $PM_{2.5}$)
Storage of heavy mineral concentrate in 3-sided bins prior to load-out	75
Movement of heavy mineral concentrate in sealed containers	Not quantified

Source: Northstar (2024) – Table 12

6.9.5.3 Greenhouse Gas Assessment

The following three scopes of greenhouse gas emissions were considered by Northstar (2024).

- Scope 1 – direct or point source emissions released to the atmosphere as a result of an activity or series of activities at a facility level.
- Scope 2 – emissions released to the atmosphere as a result of the direct consumption of electricity purchased and consumed from another facility.

- Scope 3 – indirect emissions other than Scope 2 emissions which are generated in the broader economy as a consequence of activities at a facility but from sources which are not owned or controlled by the organisation.

Table 6.9.6 presents a summary of Project-related activities which have the potential to generate greenhouse gas emissions as well as the anticipated annual fuel requirements for the Project.

Table 6.9.6
Greenhouse Gas Emission Sources and Annual Fuel Usage

Component	Scope	Consumption	Units
Construction			
Consumption of diesel fuel in fixed plant and equipment	1	12,700	kL/y
Consumption of purchased electricity	2	172,296[1]	kWh/y
Consumption of diesel fuel for power generation	3	68.92[2]	kL/y
Operation			
Consumption of liquified petroleum gas (LPG) for dryers	1	200,000	GJ/y
Consumption of purchased electricity	2	120,607[3]	kWh/y
Consumption of diesel fuel in fixed plant and equipment	1	10,500	kL/y
Consumption of diesel fuel in transport vehicles	3	2,481[4]	kL/y

Note 1: Electricity usage during construction is estimated based on the maximum annual usage from approximately Year 2 of construction works once the grid has been connected.

Note 2: The Applicant has determined that 172,296kWh of electricity will be required during the construction phase, which will be generated by diesel powered generators. Review of a number of resources indicates that to produce 1kWh of electricity from diesel power generation requires 0.4L of diesel, which equates to 68.92 kL of diesel required for power generation during construction.

Note 3: Electricity usage during operations is estimated based on the maximum annual usage assuming full production, noting that initially a minimum 30% of this usage will be sourced from either the on-site solar farm or from externally contracted and certified renewable sources. As noted in Section 3.3.3.2, the target percentage of renewable power would increase over the life of the Project.

Note 4: Diesel fuel for transport use has been calculated based on haulage of maximum total tonnes of concentrate provided by Applicant of 510,000tpa, and distance travelled of 458km return trip. Based on assumption of articulated B-Double capacity of 50 tonnes per trip and fuel usage of 53.1L/km, this equates to total diesel consumption of 2,481kL/y

Source: Northstar (2024) – modified after Table 16

Table 6.9.7 identifies the relevant greenhouse gas emission factors assumed by Northstar (2024) and adopted from the National Greenhouse Accounts Factors Workbook (Department of Climate Change, 2023) for the greenhouse gas assessment.

Table 6.9.7
Greenhouse Gas Emission Factors

Emission Scope	Emission Source	Emission Factor	Energy Content Factor
Scope 1	Consumption of diesel fuel in fixed plant and equipment – construction and operations	70.2 kg CO_2-e/GJ	38.6 GJ/kL
	Consumption of diesel fuel in transport vehicles - operations	70.4 kg CO_2-e/GJ	38.6 GJ/kL
	Consumption of liquified petroleum gas (LPG) for dryers – operations	60.6 kg CO_2-e/GJ	-

Table 6.9.7 (Cont'd)
Greenhouse Gas Emission Factors

Emission Scope	Emission Source	Emission Factor	Energy Content Factor
Scope 2	Consumption of purchased electricity – construction and operations (NSW)	0.68 kg CO_2-e/kWh[1]	-
Scope 3	Consumption of diesel fuel in fixed plant and equipment – construction and operations	17.3 kg CO_2-e/GJ	38.6 GJ/kL
	Consumption of diesel fuel in transport vehicles - operations	17.3 kg CO_2-e/GJ	38.6 GJ/kL
	Consumption of liquified petroleum gas (LPG) for dryers – operations	20.2 kg CO_2-e/GJ	-
	Consumption of purchased electricity – construction and operations (NSW)	0.05 kg CO_2-e/kWh	-
Note 1: Scope 3 emissions for consumption of liquified natural gas has not been undertaken as there is no data available to calculate Scope 3 for gaseous fuels.			
Source: Northstar (2024) – modified after Table 17			

6.9.6 Assessment of Impacts

6.9.6.1 Introduction

In order to permit the examination of Project-related impacts both in isolation and in the context of contribution to existing air quality, the results of modelling completed by Northstar (2024) are separated into the following two impact types.

- Incremental Impact – pollutant concentrations associated with the operation of the project in isolation.
- Cumulative Impact – the incremental pollutant concentrations associated with the Project plus the background air quality pollutant concentrations.

6.9.6.2 Annual Average Dust Deposition Rates

Table 6.9.8 presents the predicted annual average dust deposition rates at residential receivers in the vicinity of the Mine Site under Scenario 1, 2, 3 and 4. In summary, the results indicate minor incremental impacts at all surrounding receptor locations, and compliance with the relevant criterion.

Table 6.9.8
Predicted Annual Dust Deposition Rates

Receptor[1]	Annual Average Dust Deposition (g/m²/month)								
	Incremental Impact				Background Concentration	Cumulative Impact			
Criterion	2.0					4.0			
	Scenario					Scenario			
	1	2	3	4		1	2	3	4
R1	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R3	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R6	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R7	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R8	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R9	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R10	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R2[2]	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R4[2]	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
R5[2]	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1
Mine Camp[2]	<0.1	<0.1	<0.1	<0.1	2.0	2.1	2.1	2.1	2.1

Exceedances of the criterion values are shown as **bold red** text.

Note 1: See **Figure 5.1**

Note 2: Residence is Project-related

Source: Northstar (2024) – modified after Tables 19, 24, 29 and 34

6.9.6.3 Annual Average Particulate Matter Concentrations

Table 6.9.9 presents the predicted annual incremental and cumulative particulate matter emissions at residential receivers in the vicinity of the Mine Site under Scenarios 1, 2, 3 and 4. In summary, annual average incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ are expected to be all below relevant criteria.

By contrast, cumulative exceedances of the annual PM_{10} and $PM_{2.5}$ criteria are predicted to occur under each scenario assessed. These exceedances are driven by elevated background concentrations that already exceed the relevant criteria (see discussion in Appendix B of Northstar (2024)). In each case, the Project's incremental contribution is a very small contribution to the total modelled cumulative concentration.

Additionally, based on the modelling results presented in **Table 6.9.9** and conservatively assuming that up to 100% of $PM_{2.5}$ generated by the Project (i.e. the incremental impact) is in the form of respirable crystalline silica, incremental concentrations of respirable crystalline silica under all three scenarios would be less than 0.1µg/m^3, significantly below the relevant criterion value of 3µg/m^3.

Table 6.9.9
Predicted Annual Particulate Matter Concentrations

Receptor ID[1]	Annual Average Concentration (µg/m^3)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background Concentration	Cumulative Impact	Incremental Impact	Background Concentration	Cumulative Impact	Incremental Impact	Background Concentration	Cumulative Impact
Criterion	**90**			**25**			**8**		
Scenario 1									
R1	1.0	82.7	83.7	0.7	**35.3**	**36.0**	0.1	**11.3**	**11.4**
R3	0.2	82.7	82.9	0.2	**35.3**	**35.5**	<0.1	**11.3**	**11.4**
R6	0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R7	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R8	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R9	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R10	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R2[2]	0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R4[2]	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
R5[2]	0.3	82.7	83.0	0.2	35.3	35.5	<0.1	11.3	11.4
Mine Camp[2]	0.4	82.7	83.1	0.2	35.3	35.5	<0.1	11.3	11.4
Scenario 2									
R1	0.8	82.7	83.5	0.5	**35.3**	**35.8**	<0.1	**11.3**	**11.4**
R3	0.2	82.7	82.9	0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R6	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R7	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R8	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R9	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R10	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R2[2]	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R4[2]	0.1	82.7	82.8	0.1	35.3	35.4	<0.1	11.3	11.4
R5[2]	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
Mine Camp[2]	0.4	82.7	83.1	0.2	35.3	35.5	<0.1	11.3	11.4
Scenario 3									
R1	0.1	82.7	82.8	0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R3	0.1	82.7	82.8	0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R6	0.2	82.7	82.9	0.2	**35.3**	**35.5**	<0.1	**11.3**	**11.4**
R7	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R8	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R9	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R10	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R2[2]	1.1	82.7	83.8	0.9	35.3	36.2	0.1	11.3	11.4
R4[2]	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R5[2]	0.5	82.7	83.2	0.5	35.3	35.8	<0.1	11.3	11.4
Mine Camp[2]	0.4	82.7	83.1	0.1	35.3	35.4	<0.1	11.3	11.4

Table 6.9.9 (Cont'd)
Predicted Annual Particulate Matter Concentrations

Receptor ID[1]	Annual Average Concentration (µg/m³)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background Concentration	Cumulative Impact	Incremental Impact	Background Concentration	Cumulative Impact	Incremental Impact	Background Concentration	Cumulative Impact
Criterion	**90**			**25**			**8**		
Scenario 4									
R1	0.4	82.7	83.1	0.3	**35.3**	**35.6**	<0.1	**11.3**	**11.4**
R3	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R6	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R7	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R8	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R9	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R10	<0.1	82.7	82.8	<0.1	**35.3**	**35.4**	<0.1	**11.3**	**11.4**
R2[2]	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R4[2]	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R5[2]	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
Mine Camp[2]	0.3	82.7	83.0	0.1	35.3	35.4	<0.1	11.3	11.4

Exceedances of the criterion values are shown as **bold red** text

Note 1: See **Figure 5.1**

Note 2: Residence is Project-related

Source: Northstar (2024) – modified after Tables 18, 23, 28 and 33

6.9.6.4 Maximum 24-hour Particulate Matter Concentrations

Table 6.9.10 presents the predicted maximum incremental 24-hour average PM_{10} and $PM_{2.5}$ concentrations for residential receivers in the vicinity of the Mine Site under Scenarios 1, 2, 3 and 4. The predicted maximum incremental 24-hour average PM_{10} and $PM_{2.5}$ concentrations alone do not exceed the relevant criteria at any of the Project-related residential receivers under all scenarios.

Table 6.9.10
Predicted Maximum Incremental 24-hour Average PM_{10} and $PM_{2.5}$ Concentrations

Receptor[1]	Maximum Incremental 24-hour Average Concentration (µg/m³)							
	PM_{10}				$PM_{2.5}$			
Criterion	50				25			
	Scenario							
	1	2	3	4	1	2	3	4
R1	8.0	8.3	2.0	3.5	1.2	1.4	0.4	0.6
R3	1.5	1.3	1.0	0.6	0.2	0.2	0.2	0.1
R6	0.6	0.6	1.8	0.4	0.1	0.1	0.3	<0.1
R7	0.2	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
R8	0.2	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
R9	0.4	0.2	0.3	0.2	<0.1	<0.1	<0.1	<0.1
R10	0.2	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
R2[2]	1.5	1.1	12.6	1.0	0.2	0.2	2.1	0.2
R4[2]	1.3	0.9	1.0	0.6	0.2	0.2	0.2	<0.1
R5[2]	1.8	1.7	3.9	1.5	0.3	0.3	0.7	0.2
Mine Camp[2]	1.7	1.2	1.0	0.8	0.2	0.2	0.2	0.1

Exceedances of the criterion values are shown as **bold red** text

Note 1: See **Figure 5.1**

Note 2: Residence is Project-related

Source: Northstar (2024) – modified after Tables 20, 25, 30 and 35

In order to quantify the Project's contribution to the daily varying PM_{10} and $PM_{2.5}$ concentrations, including background, Northstar (2024) have presented highest the incremental and highest cumulative concentrations for the modelled year.

Table 6.9.11 presents the 12 days with the highest predicted cumulative and incremental 24-hour average PM_{10} concentrations. In summary, Residence R1 is expected to receive the highest incremental concentrations in Scenarios 1 and 3, and R3 in Scenario 2 and 4. Residence R6 is expected to receive the highest cumulative concentrations in Scenario 1 and 4, and R1 is expected to have the highest cumulative concentrations in Scenario 2 and 3.

As shown in **Table 6.9.11**, concentrations of PM_{10} that exceed criteria are largely driven by background conditions for all scenarios. Predicted exceedances of the PM_{10} 24-criterion on the highest days of incremental impact was found during Scenario 1 at R1 on 26/02/2019, 19/04/2019, and 2/04/2019, and during Scenario 4 at R3 on 28/03/2019. These exceedances are expected to occur on days when the existing PM_{10} background made up a significant percentage of the cumulative PM_{10} impact.

Table 6.9.11
Days with the Highest Predicted Cumulative and Incremental 24-hour Average PM_{10} Concentration

Date	12 days with the highest predicted cumulative 24-hour average PM_{10} concentration ($\mu g/m^3$)			Date	12 days with the highest predicted incremental 24-hour average PM_{10} concentration ($\mu g/m^3$)		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	**50**			**Criterion**	**50**		
Scenario 1							
Receptor	**R6**			**R1**			
20-12-2019	<0.1	**251.7**	**251.8**	25-06-2019	8.0	21.1	29.1
12-02-2019	<0.1	**221.9**	**222.0**	22-05-2019	7.3	30.7	38.0
18-02-2019	<0.1	**209.7**	**209.8**	26-06-2019	7.1	19.4	26.5
22-12-2019	0.1	**205.5**	**205.6**	24-06-2019	7.0	23.3	30.3
21-09-2019	<0.1	**196.8**	**196.9**	18-05-2019	5.5	34.2	39.7
24-12-2019	0.4	**148.3**	**148.7**	07-06-2019	5.3	23.0	28.3
23-12-2019	0.4	**145.8**	**146.2**	26-02-2019	5.1	**55.6**	**60.7**
26-11-2019	<0.1	**133.0**	**133.1**	19-04-2019	4.9	**61.0**	**65.9**
17-12-2019	<0.1	**131.5**	**131.6**	17-05-2019	4.8	40.5	45.3
21-11-2019	<0.1	**130.5**	**130.6**	12-05-2019	4.7	12.3	17.0
21-02-2019	0.2	49.9	**50.1**	02-04-2019	4.3	**52.3**	**56.6**
17-02-2019	0.5	48.0	48.5	13-05-2019	4.3	23.0	27.3
Scenario 2							
Receptor	**R1**			**R3**			
20/12/2019	0.6	**251.7**	**252.3**	25/07/2019	3.5	14.3	17.8
12/02/2019	<0.1	**221.9**	**222.0**	16/06/2019	2.7	15.4	18.1
18/02/2019	0.7	**209.7**	**210.4**	01/07/2019	2.7	17.9	20.6
22/12/2019	<0.1	**205.5**	**205.6**	17/06/2019	2.7	12.3	15.0
21/09/2019	<0.1	**196.8**	**196.9**	05/08/2019	2.4	10.7	13.1
24/12/2019	<0.1	**148.3**	**148.4**	02/05/2019	2.2	25.6	27.8
23/12/2019	<0.1	**145.8**	**145.9**	08/06/2019	1.9	18.3	20.2
26/11/2019	<0.1	**133.0**	**133.1**	01/05/2019	1.9	29.3	31.2
17/12/2019	<0.1	**131.5**	**131.6**	28/03/2019	1.8	52.3	54.1
21/11/2019	<0.1	**130.5**	**130.6**	19/07/2019	1.7	17.3	19.0
09/04/2019	<0.1	**50.2**	**50.3**	09/05/2019	1.7	18.8	20.5
21/02/2019	<0.1	49.9	50.0	07/08/2019	1.7	18.8	20.5

Table 6.9.11 (Cont'd)
Days with the Highest Predicted Cumulative and Incremental 24-hour Average PM_{10} Concentration

Date	12 days with the highest predicted cumulative 24-hour average PM_{10} concentration ($\mu g/m^3$)			Date	12 days with the highest predicted incremental 24-hour average PM_{10} concentration ($\mu g/m^3$)		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	**50**			**Criterion**	**50**		
Scenario 3							
Receptor	**R1**			**R1**			
20/12/2019	<0.1	**251.7**	**251.8**	19/07/2019	2.0	17.3	19.3
12/02/2019	0.4	**221.9**	**222.3**	23/07/2019	1.8	16.8	18.6
18/02/2019	<0.1	**209.7**	**209.8**	26/07/2019	1.3	17.0	18.3
22/12/2019	<0.1	**205.5**	**205.6**	30/06/2019	1.1	13.4	14.5
21/09/2019	<0.1	**196.8**	**196.9**	02/07/2019	1.1	18.0	19.1
24/12/2019	<0.1	**148.3**	**148.4**	14/06/2019	1.0	18.5	19.5
23/12/2019	<0.1	**145.8**	**145.9**	12/06/2019	0.9	12.3	13.2
26/11/2019	<0.1	**133.0**	**133.1**	18/07/2019	0.8	10.0	10.8
17/12/2019	<0.1	**131.5**	**131.6**	17/06/2019	0.8	12.3	13.1
21/11/2019	<0.1	**130.5**	**130.6**	06/11/2019	0.8	40.6	41.4
09/04/2019	<0.1	**50.2**	**50.3**	09/05/2019	1.7	18.8	20.5
21/02/2019	<0.1	49.9	50.0	07/08/2019	1.7	18.8	20.5
Scenario 4							
Receptor	**R6**			**R3**			
20/12/2019	<0.1	**251.7**	**251.8**	25/07/2019	3.5	14.3	17.8
12/02/2019	<0.1	**221.9**	**222.0**	16/06/2019	2.7	15.4	18.1
18/02/2019	<0.1	**209.7**	**209.8**	01/07/2019	2.7	17.9	20.6
22/12/2019	<0.1	**205.5**	**205.6**	17/06/2019	2.7	12.3	15.0
21/09/2019	<0.1	**196.8**	**196.9**	05/08/2019	2.4	10.7	13.1
24/12/2019	0.2	**148.3**	**148.5**	02/05/2019	2.2	25.6	27.8
23/12/2019	0.2	**145.8**	**146.0**	08/06/2019	1.9	18.3	20.2
26/11/2019	<0.1	**133.0**	**133.1**	01/05/2019	1.9	29.3	31.2
17/12/2019	<0.1	**131.5**	**131.6**	28/03/2019	1.8	**52.3**	**54.1**
21/11/2019	<0.1	**130.5**	**130.6**	19/07/2019	1.7	17.3	19.0
09/04/2019	<0.1	**50.2**	**50.3**	09/05/2019	1.7	18.8	20.5
21/02/2019	0.2	49.9	**50.1**	07/08/2019	1.7	18.8	20.5
Exceedances of the criterion values are shown as bold red text							
Source: Northstar (2024) – modified after Table 21, 26, 31, 36							

Table 6.9.12 presents the 12 days with the highest predicted cumulative and incremental 24-hour average $PM_{2.5}$ concentrations. In summary, Residence R1 is expected to receive the highest incremental and cumulative concentrations in all scenarios. As shown in **Table 6.9.12**, concentrations of $PM_{2.5}$ that exceed criteria are largely driven by background conditions for all scenarios. Predicted exceedances are only expected to occur on days when the existing $PM_{2.5}$ background made up a significant percentage of the cumulative $PM_{2.5}$ impact.

Table 6.9.12
Days with the Highest Predicted Cumulative and Incremental 24-hour Average $PM_{2.5}$ Concentration

Date	12 days with the highest predicted cumulative 24-hour average $PM_{2.5}$ concentration ($\mu g/m^3$)			Date	12 days with the highest predicted incremental 24-hour average $PM_{2.5}$ concentration ($\mu g/m^3$)		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	**25**			**Criterion**	**25**		
Scenario 1							
Receptor	**R1**			**R1**			
20/12/2019	0.3	**239.6**	**239.9**	25/06/2019	1.2	15.0	16.2
22/12/2019	<0.1	**129.4**	**129.5**	22/05/2019	1.1	11.4	12.5
23/12/2019	<0.1	**103.6**	**103.7**	24/06/2019	1.0	16.3	17.3
24/12/2019	<0.1	**87.5**	**87.6**	26/06/2019	0.9	13.5	14.4
17/12/2019	0.5	**83.2**	**83.7**	07/06/2019	0.9	19.3	20.2
18/12/2019	0.5	**71.6**	**72.1**	18/05/2019	0.8	22.3	23.1
09/12/2019	<0.1	**58.8**	**58.9**	12/05/2019	0.7	7.4	8.1
28/12/2019	0.3	**53.2**	**53.5**	26/02/2019	0.7	11.5	12.2
21/12/2019	<0.1	**50.5**	**50.6**	02/04/2019	0.7	5.2	5.9
21/11/2019	<0.1	**45.5**	**45.6**	17/05/2019	0.7	**26.6**	**27.3**
10/12/2019	<0.1	25.0	**25.1**	16/05/2019	0.7	**30.8**	**31.5**
18/05/2019	0.8	22.3	23.1	19/04/2019	0.7	14.1	14.8
Scenario 2							
Receptor	**R1**			**R1**			
20/12/2019	<0.1	**239.6**	**239.7**	16/06/2019	1.4	17.2	18.6
22/12/2019	<0.1	**129.4**	**129.5**	13/05/2019	0.9	14.9	15.8
23/12/2019	<0.1	**103.6**	**103.7**	08/06/2019	0.9	15.0	15.9
24/12/2019	<0.1	**87.5**	**87.6**	27/06/2019	0.6	10.8	11.4
17/12/2019	<0.1	**83.2**	**83.3**	11/06/2019	0.6	4.6	5.2
18/12/2019	0.5	**71.6**	**72.1**	02/03/2019	0.6	7.7	8.3
09/12/2019	0.2	**58.8**	**59.0**	28/07/2019	0.6	13.1	13.7
28/12/2019	<0.1	**53.2**	**53.3**	26/06/2019	0.6	13.5	14.1
21/12/2019	<0.1	**50.5**	**50.6**	24/06/2019	0.5	16.3	16.8
21/11/2019	<0.1	**45.5**	**45.6**	15/06/2019	0.5	17.0	17.5
10/12/2019	<0.1	25.0	**25.1**	07/03/2019	0.5	13.4	13.9
19/05/2019	0.3	22.6	22.9	15/04/2019	0.5	9.9	10.4

Table 6.9.12 (Cont'd)
Days with the Highest Predicted Cumulative and Incremental 24-hour Average $PM_{2.5}$ Concentration

Date	12 days with the highest predicted cumulative 24-hour average $PM_{2.5}$ concentration ($\mu g/m^3$)			Date	12 days with the highest predicted incremental 24-hour average $PM_{2.5}$ concentration ($\mu g/m^3$)		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	**25**			**Criterion**	**25**		
Scenario 3							
Receptor	**R1**			**R1**			
20/12/2019	<0.1	**239.6**	**239.7**	19/07/2019	0.4	9.4	9.8
22/12/2019	<0.1	**129.4**	**129.5**	23/07/2019	0.3	9.8	10.1
23/12/2019	<0.1	**103.6**	**103.7**	26/07/2019	0.2	9.0	9.2
24/12/2019	<0.1	**87.5**	**87.6**	30/06/2019	0.2	9.5	9.7
17/12/2019	<0.1	**83.2**	**83.3**	02/07/2019	0.2	12.7	12.9
18/12/2019	<0.1	**71.6**	**71.7**	14/06/2019	0.2	12.0	12.2
09/12/2019	<0.1	**58.8**	**58.9**	18/07/2019	0.2	4.1	4.3
28/12/2019	<0.1	**53.2**	**53.3**	20/06/2019	0.1	8.6	8.7
21/12/2019	<0.1	**50.5**	**50.6**	12/06/2019	0.1	6.6	6.7
21/11/2019	<0.1	**45.5**	**45.6**	13/06/2019	0.1	5.3	5.4
10/12/2019	<0.1	25.0	**25.1**	17/06/2019	0.1	11.1	11.2
18/02/2019	<0.1	22.8	22.9	06/11/2019	0.1	5.4	5.5
Scenario 4							
Receptor	**R3**			**R3**			
20/12/2019	<0.1	**239.6**	**239.7**	25/07/2019	0.6	8.2	8.8
22/12/2019	<0.1	**129.4**	**129.5**	01/07/2019	0.5	12.6	13.1
23/12/2019	<0.1	**103.6**	**103.7**	17/06/2019	0.5	11.1	11.6
24/12/2019	<0.1	**87.5**	**87.6**	16/06/2019	0.5	17.2	17.7
17/12/2019	<0.1	**83.2**	**83.3**	02/05/2019	0.4	8.2	8.6
18/12/2019	<0.1	**71.6**	**71.7**	05/08/2019	0.3	8.4	8.7
09/12/2019	<0.1	**58.8**	**58.9**	01/05/2019	0.3	7.9	8.2
28/12/2019	0.2	**53.2**	**53.4**	07/08/2019	0.3	9.8	10.1
21/12/2019	<0.1	**50.5**	**50.6**	09/05/2019	0.3	5.9	6.2
21/11/2019	<0.1	**45.5**	**45.6**	26/07/2019	0.3	9.0	9.3
10/12/2019	<0.1	25.0	**25.1**	08/06/2019	0.3	15.0	15.3
18/02/2019	<0.1	22.8	22.9	22/07/2019	0.3	10.9	11.2

Exceedances of the criterion values are shown as bold red text

Source: Northstar (2024) – modified after Table 22, 27, 32, 37

6.9.6.5 Silica

Annual average $PM_{2.5}$ concentrations at all non-Project related receptors are predicted to be $\leq 0.1 \mu g/m^3$ during all scenarios assessed. In relation to silica, even assuming that 100% of annual average $PM_{2.5}$ incremental impacts are respirable crystalline silica , impacts at non-Project related receptors during all Scenarios assessed are predicted to be significantly below the relevant annual average criterion of $3 \mu g/m^3$, which has been adopted from the California EPA Office for Environmental Health Hazard Assessment Reference Exposure Levels.

6.9.6.6 Off-site Transportation Assessment

The Applicant proposes to use Anabranch Mail Road between the Mine Site and the Silver City Highway as the principal transportation route for the Project. As described in Section 6.9.5.1, Northstar (2024) assessed a nominal 5km section of Anabranch Mail Road and established receivers at offset distances consistent with the distance from to road to nearby residences.

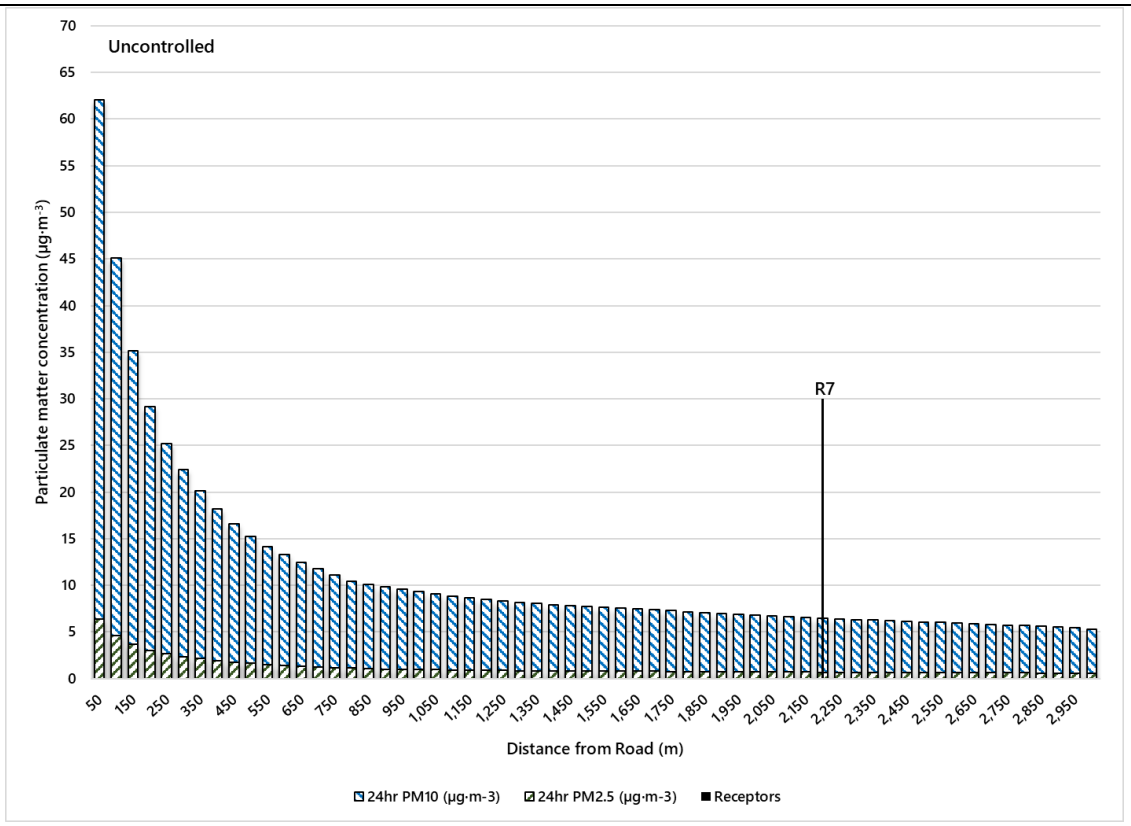
Figure 6.9.1 presents the results of that assessment for uncontrolled and controlled emissions. The results may be summarised as follows.

- Residence R7 is the closest residence to Anabranch Mail Road, located at a distance of approximately 2.25km from the road.
- 24-hour concentrations for PM_{10} and $PM_{2.5}$ decrease rapidly with increasing distance from the road.
- Uncontrolled incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations at Residence R7 are predicted to be $6.5 \mu g/m^3$ and $0.7 \mu g/m^3$ respectively. This compares with the assessment criteria of $50 \mu g/m^3$ and $25 \mu g/m^3$ respectively.
- Taking into consideration the proposed control measures (see Section 6.9.5.2), the predicted 24-hour PM_{10} and $PM_{2.5}$ concentrations at Residence R7 are predicted to be $0.4 \mu g/m^3$ and $<0.1 \mu g/m^3$ respectively.

6.9.6.7 Voluntary Land Acquisition and Mitigation Assessment

The results of Northstar (2024) indicate that predicted incremental concentrations associated with the operation of the Project at non-Project related receptors are minor, and exceedances of the annual average PM_{10} and $PM_{2.5}$ criteria are dominated by the already exceeding background conditions, representing 99.8 % of the PM_{10} criterion and 100 % of the $PM_{2.5}$ criterion. The contribution of the Project to those exceedances is minimal.

The *Voluntary Land Acquisition and Mitigation Policy* also applies to private land where a development is predicted to result in exceedances of the relevant criteria over >25% of that land. The voluntary mitigation and land acquisition criteria are not exceeded for >25% of any property in the vicinity of the Mine Site.



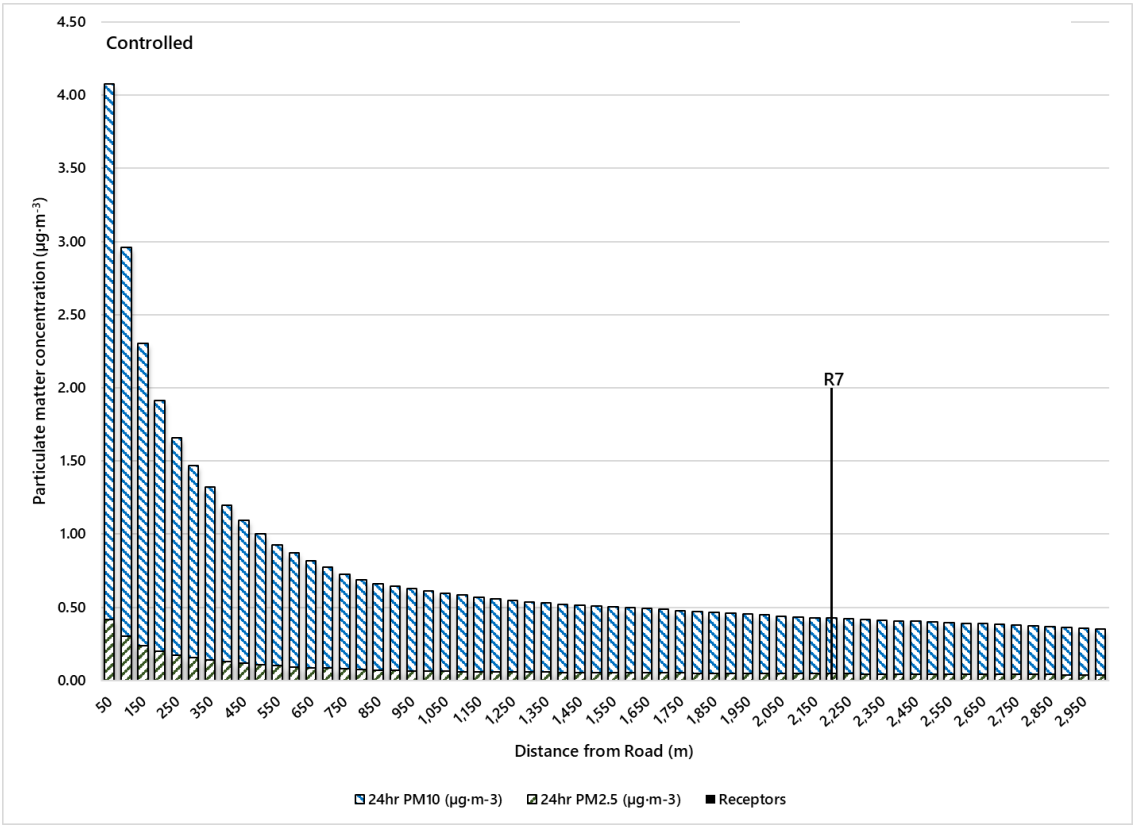


Figure 6.9.1
Off-site 24-hour Incremental Particulate Matter Concentrations

Source: Northstar (2024) – after Figures 17 and 18

6.9.6.8 Greenhouse Gas Assessment Results

Tables 6.9.13 to **6.9.16** present the Scope 1, 2 and 3 greenhouse gas emissions predicted as a result of the Project. In summary, total annual emissions during construction are expected to be 43,020t CO_2-e and a maximum of 60,109t CO_2-e during operations.

Table 6.9.13
Calculated Project-related Annual Greenhouse Gas Emissions for Construction

Emission Scope	Emission Source	Emission Factor	Energy Content Factor	Activity Rate	Emissions (t CO_2-e/y) Construction
Scope 1	Consumption of diesel fuel in fixed plant and mobile equipment	70.2 kg CO_2-e GJ^{-1}	38.6 GJ/kL	12,700 kL/y	34,413.4
	Consumption of diesel fuel for power generation	70.2 kg CO_2-e GJ^{-1}	38.6 GJ/kL	68.92 kL/y	186.8
				Total Scope 1	**34,600.2**
Scope 2	Consumption of purchased electricity	0.68 kg CO_2-e kWh^{-1}	-	172,296 kWh/y	117.2
				Total Scope 2	**117.2**
Scope 3	Consumption of diesel fuel in fixed plant and mobile equipment	17.3 kg CO_2-e GJ^{-1}	38.6 GJ/kL	12,700 kL/y	8,480.8
	Consumption of diesel fuel for power generation	17.3 kg CO_2-e GJ^{-1}	38.6 GJ/kL	68.92 kL/y	46.0
	Consumption of purchased electricity	0.05 kg CO_2-e kWh^{-1}	-	172,296 kWh/y	8.6
				Total Scope 3	**8,535.4**
Source: Northstar (2024) – Table 38					

Table 6.9.14
Calculated Project-related Annual Greenhouse Gas Emissions for Operation

Emission Scope	Emission Source	Emission Factor	Energy Content Factor	Activity Rate	Emissions (t CO_2-e.yr^{-1}) Operations
Scope 1	Consumption of diesel fuel in fixed plant and mobile equipment	70.2 kg CO_2-e GJ^{-1}	38.6 GJ/kL	10,500 kL/y	28,452.1
	Consumption of diesel fuel in transport vehicles	70.4 kg CO_2-e GJ^{-1}	38.6 GJ/kL	2,481 kL/y	6,740.9
	LPG consumption for operation of dryers	60.6 kg CO_2-e GJ^{-1}	-	200,000 GJ/y	12,120.0
				Total Scope 1	**47,313.0**
Scope 2	Consumption of purchased electricity	0.68 kg CO_2-e kWh^{-1}	-	120 607 kWh/y	82.0
				Total Scope 2	**82.0**
Scope 3	Consumption of diesel fuel in fixed plant and mobile equipment	17.3 kg CO_2-e GJ^{-1}	38.6 GJ/kL	10,500 kL/y	7,011.7
	Consumption of diesel fuel in transport vehicles	17.3 kg CO_2-e GJ^{-1}	38.6 GJ/kL	2,481 kL/y	1,656.5
	Consumption of purchased electricity	0.05 kg CO_2-e kWh^{-1}	-	120,607 kWh^{-1}	6.0
	LPG consumption for operation of dryers	20.2 kg CO_2-e GJ^{-1}	-	200,000 GJ/y	4,040.0
				Total Scope 3	**12,714.2**
Source: Northstar (2024) – Table 39					

Table 6.9.15
Summary of GHG Emissions

Emission Scope	Annual GHG Emissions (t CO_2-e/y) Construction	Annual GHG Emissions (t CO_2-e/y) Operations
Scope 1	34,600.2	47,313.0
Scope 2	117.2	82.0
Scope 3	8,535.4	12,714.2
Total	43,252.8	**60,109.2**
Source: Northstar (2024) – Table 40		

Compared to available greenhouse gas data for NSW (2019) and Australia (2023), the maximum Project-related Scope 1 emissions represent approximately 0.036% of total greenhouse gas emissions generated in NSW and 0.01% of total greenhouse gas emissions generated in Australia (Northstar, 2024).

In recognition of community and regulatory requirements to gradually reduce NSW and Australia's net greenhouse gas emissions over the life of the Project, the Applicant would progressively review and implement lower emissions intensive technologies and would seek to increase the proportion of electricity used for the Project that is sourced from renewable sources. Furthermore, the Applicant would seek to progressively review and, where practicable and viable, implement carbon offset processes to compensate for emissions that cannot be avoided.

6.9.7 Avoidance, Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures in order to manage and minimise to the extent practicable any adverse air quality impacts at surrounding non-Project related residences. Air quality mitigation measures are summarised in **Table 6.9.5**. Additionally measures to control and minimise particulate generation during the Project recommended by Northstar (2024) and adopted by the Applicant are detailed below. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual air quality-related risks presented in **Appendix 2**.

- Preparation and implementation of an *Air Quality and Greenhouse Gas Management Plan* which outlines air quality and greenhouse gas management measures and responsibilities for the Project.
- Implement the following emission reduction and dust controls throughout the life of the Project.
  - Sheet unsealed roads, where practicable, with low silt, durable materials to limit generation of silt-sized particles.
  - Limit on-site vehicle speeds to 50km/h (excluding the Site Access Road).
  - Ensure that bulk heavy mineral product is stored in 3-sided bins prior to load-out.
  - Ensure movement of heavy mineral concentrate is contained within sealed containers.

  - Apply water (non-saline) or appropriate binding agents to unsealed roads within the Mine Site, as well as on Anabranch Mail Road in the vicinity of adjacent residential receivers to achieve a 90% control level.
  - Apply water (non-saline) or appropriate binding agents to unvegetated soil stockpiles and areas undergoing rehabilitation until such time as a suitable vegetative cover can be established.
- Include details regarding vehicle speed limits and other dust controls in employee site inductions and toolbox meeting, as required.
- Maintain records of water cart use and water application to disturbed areas which include the timing and rate of water application as well as a justification for cases where water is not applied (e.g. wet conditions or binding agents applied).
- Ensure that all vehicles, plant and equipment used both at the Mine Site and to transport materials to and from the Mine Site are regularly maintained in accordance with manufacturer's requirements.
- Implement the following measures, where practicable, to minimise greenhouse gas emissions to the greatest extent possible.
  - Turn off all vehicles, plant and equipment when not in use.
  - The use of the most efficient vehicles and routes to minimise the number of trips required and minimise greenhouse gas (and particulate) emissions per tonne of material transported. This may include the use of the largest class of vehicle possible to transport overburden within the Mine Site, the use of Type 2 road trains for transportation of heavy mineral concentrate from the Mine Site to the Rail Facility and transporting project personnel at the Mine Camp to and from site by bus.
  - Ensure that all vehicles, plant and equipment are regularly serviced (including optimisation of tyre pressures) to ensure efficient operation.
  - Disturb only the minimum area necessary for mining operations.
  - Undertake progressive rehabilitation of areas no longer required for mining operations as soon as practicable once the area is no longer required for operational purposes.
  - Clearly mark all haul roads and other roads and tracks and ensure that signposted speed limits are complied with.
  - Ensure that internal haul roads and the Site Access Road are maintained in good condition to facilitate efficient travel and transportation of materials.
  - Minimise drop heights during loading and unloading of material and avoid tipping material down a tip face.
  - Monitor meteorological conditions (including via automated alerts) to identify periods of adverse weather (little or no rainfall and wind speeds above 30km/h) and implement appropriate additional mitigation measures as required.

- Undertake visual monitoring and mandatory reporting of visible dust emissions to site supervisors and implement measures to minimise or reduce observed dust emissions.
- Reduce gradients around the site where feasible.
- Utilise B5 fuel in plant and equipment (where practicable).
- Undertake power-consuming activities during the day where solar generation capacity is highest (where practicable).

6.9.8 Monitoring

In the event the Project is approved, the Applicant would prepare an *Air Quality and Greenhouse Gas Management Plan*. That document would identify air quality and greenhouse-related monitoring locations. However, it is not anticipated that any air quality monitoring would be required to be performed, as the distances between the Project and the receptor locations are large, and the incremental impacts associated with the Project operation are predicted to be relatively small in comparison to background concentrations. Notwithstanding, the Applicant would implement a monthly dust deposition monitoring program to ensure there is a baseline of information, should a complaint or incident occur. It is also recommended that regular audits are performed to ensure that the Project is implementing the air quality control measures appropriately, as outlined in Northstar (2024).

6.9.9 Conclusion

Management of potential air quality impacts during the site establishment and operation of the Project would involve the adoption of a range of mitigation measures. The Applicant would utilise predictive meteorological systems and site management procedures to ensure that air quality criteria are not exceeded at privately-owned residences surrounding the Mine Site.

The total greenhouse gas emissions for the Project, not accounting for existing and proposed offsetting through biodiversity offset plantings and the reduction in long-term emissions from agricultural activity, would account for 0.26% and 0.07% of the total greenhouse gas emissions of the State of NSW and Australia, respectively.

Based on the above, the potential impact of the Project on air quality are considered to be minor (Northstar, 2024).

6.10 Agriculture

6.10.1 Introduction

The SEARS identify "agriculture" as a key issue for assessment in the EIS. Matters to be addressed include:

- "an assessment of the likely impacts of the development on agriculture, including measures to manage biosecurity matters including spread of weeds."

Additionally, Department of Primary Industries – Agriculture was consulted recommended that additional matters to be included are:

- "Assessment of agricultural impacts from the development on current and future agriculture."

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

The *Land and Soil Capability Assessment* for the Project, including an assessment of the agricultural impacts, was undertaken by Sustainable Soils Management Pty Ltd (SSM). The resulting report, hereafter referred to as SSM (2024), is presented as **Appendix 7**. This subsection provides a summary of the agriculture-related aspects of SSM (2024) and describes the management and management measures to be implemented by the Applicant.

6.10.2 Existing Environment

The soil and land capability within the Soil Survey Area is described in Section 6.4.2. In summary, SSM (2024) identified six soil associations including the following.

- Dunefield and Sand Plains, comprising two separate phases, as follows.
  - Swales - well drained, high carbonate soil.
  - Dunes – well drained, high carbonate soil, higher in the landscape and had sandier surface soil than the Swales Phase.
- Blanchetown Clay
- Lunettes
- Lunettes with Copi
- Lake Floor East
- Lake Floor West

The Lake Floor East and West were determined to have Land and Soil Capability Classifications of Class 8 (extremely low capability land) and Class 7 (very low capability land) respectively. All other Soil Associations were determined to have Land and Soil Capability Classifications of Class 6 (low capability land).

The land within the Mine Site is used for very low intensity grazing, predominantly with sheep. Grazing of managed and harvesting of feral goats is also commonly undertaken.

6.10.3 Potential Impacts

The chief Project-related impact on agricultural productivity would be the temporary exclusion of agricultural land uses from operational areas for both the life of the Project and any subsequent rehabilitation period required to restore the rehabilitated landform to an acceptable level of agricultural productivity.

The following discussion regarding potential impacts to agricultural productivity centres on the proposed Project-related disturbance and does not account for any potential biodiversity offsetting arrangements (e.g. stewardship sites) which may result in the permanent removal of areas from agricultural land use.

6.10.4 Avoidance, Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures in order to avoid, manage or mitigate any adverse impacts upon agriculture within and surrounding the Mine Site. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual agriculture-related risks presented in **Appendix 2**.

- Strip, stockpile, replace and manage soils as described in Section 6.4.6.
- Undertake rehabilitation and revegetation of disturbed lands as described in Sections 3.12.
- Ensure that all earthmoving equipment bought to site is free from weeds and pathogens.
- Undertake monitoring of rehabilitation success and agricultural productivity on rehabilitated lands, including ensuring that rehabilitated lands are not subjected to premature or excessive grazing pressures by domestic, feral, or native fauna.
- Undertake monitoring of agricultural productivity of surrounding undisturbed lands to provide a benchmark for agricultural productivity of the rehabilitated final landform.
- Undertake regular weed and pest monitoring programs on disturbed and undisturbed sections of the Mine Site.
- Conduct targeted mechanical and/or chemical weed and pest control in consultation with neighbouring landholders, as required.
- Monitor for the effectiveness of any control measures and undertake remedial action, if required.
- Maintain records and results of weed and pest management programs.

6.10.5 Assessment of Impacts

Table 6.10.1 presents a summary of land uses within the Australian Bureau of Statistics (ABS) Wentworth-Balranald Region.[5] In summary, approximately 83% of the area of agricultural holdings within the Wentworth-Balranald Region are used for grazing, with the remainder used for cropping (4%) or other purposes (SSM, 2024). Cropping is primarily undertaken in close proximity to the major water sources, with no land within the Mine Site is used for cropping.

In preparing the agricultural assessment, SSM (2024) relied upon information presented in the document *Australian Collaborative Land Use and Management Program (ACLUMP)* (ABARES, 2022).

Table 6.10.1
Land Uses in the Wentworth Shire LGA

Land Use		Area	
Category	**Subcategory**	**(ha)**	**(%)**
Agricultural Holdings		2,311,149	87.6
	Grazing	2,188,079	83
	Cropping	108,732	4
	Irrigation	14,338	0.6
Nature Conservation and Forests		187,605	7
Rivers, lakes and wetlands		114,695	4
Other		8,911	0.3
	Total	**2,622,360**	**100**
Source: SSM (2024) – Table 11.2			

Table 6.10.2 presents the annual value of agricultural production for the 2020/2021 financial year sourced from ABS (2021). In summary, grazing-related activities generated approximately $43 million, or $19 per grazed hectare. By contrast, cropping and horticultural operations generated $257 million or $117 per cropped hectare.

Table 6.10.2
Annual Value of Agricultural Production 2011/2012

Product Type	Value ($ million)
Sheep and lambs	34
Meat cattle	9
Grain and hay	28
Tree crops	202
Vegetables	20
Nurseries and Turf	7
Total	**300**
Source: SSM (2024) – Table 11.3	

[5] The ABS Wentworth-Balranald Region (Statistical Area Level 2 – Area Code 109021179) comprises the Wentworth and Balranald Local Government Areas (see **Figure 1.1**) excluding the more densely populated areas in the towns of Wentworth, Dareton and Buronga, adjacent to the Murray River.

Table 6.10.3 presents stocking rates determined ABS (2021) for the Wentworth Shire LGA. These stocking rates have been converted to Dry Sheep Equivalent (DSE) by SSM (2024) using the conversion rates of Millear *et al* (2003). In summary, SSM (2024) determined that the Wentworth Shire LGA had an estimated stocking rate of 686,698 DSE or 0.31 DSE/grazed ha.

Table 6.10.3
Estimated Stocking Rate for the Wentworth Shire LGA

Stock Class	Total number	Estimated Stocking Rate (DSE)
Sheep	377,121	490,257
Cattle	14,326	186,238
Other livestock (Goats)	10,203	10,203
Total		686,698
Source: SSM (2024) – Table 11.4		

SSM (2024) state that a typical sheep enterprise in the vicinity of the Mine Site would involve a self-replacing flock of Dorper bred sheep, with ewes bred on farm, rams purchased from studs, lambs, and ewes older than breeding age sold. Based on an estimated gross margin of $118.49/ewe and a DSE rating of 2.8 DSE per ewe (DPI, 2022), a gross margin of $43/DSE was estimated. By combining the gross margin of $43/DSE with the average stocking rate of 0.31 DSE/ha, SSM (2024) concludes that an annual gross margin of approximately $13/ha reflects the value of agricultural production for land classed as Land and Soil Capability Class 6 in the vicinity of the Mine Site.

By contrast, SSM (2024) land classed as Land and Soil Capability Class 7 or Class 8 would have a stocking rate of zero and therefore a nil gross margin.

Based on the above, and the area 3,782 ha of Class 6 land to be disturbed, within the 5,622ha in the Disturbance Footprint is estimated to be 440 Dorper ewes. Thus, SSM (2024) determined that the pre-mining annual gross margin of that land would be approximately $50,414.

SSM (2024) state that provided that the soil, rehabilitation and revegetation measures described in Sections 3.12 and 6.4.6 are implemented, that Class 6 land should retain a carrying capacity of 0.31DSE/ha. This is aided by the planned 413ha increase in the area of LSC class 6 land and 455ha reduction in LSC class 8 land. As a result, the post-mining annual gross margin of that land would increase to approximately $62.421 as a result of rehabilitation.

6.10.6 Conclusion

In light of the above, there would be positive impact on agriculture as a result of the Project.

6.11 Radiation, Hazards and Public Safety

6.11.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Project on "public safety and hazards" including:

- "a detailed description of the management of concentrate and waste material (solid and liquid, including details of transportation, assessment and handling of waste arriving or generated on site), spontaneous ignition, electromagnetic fields and an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks, during storage, handling, transport and use of any dangerous goods; and
- a Preliminary Hazard Analysis (PHA) prepared in accordance with the *Hazardous Industry Planning Advisory Paper No. 6, 'Hazard Analysis' and Multi-Level Risk Assessment* (DoP, 2011)"

Additional public safety and hazards-related requirements for inclusion in the EIS were provided by the EPA as follows.

- "The EA must identify the potential hazardous chemical emissions from all processes and the proposed type, quantity and location of chemicals to be stored on site."

Appendix 1 presents an overview of the SEARs and Government agency requirements, and where each has been addressed.

The specific hazard-related impacts that may result as a consequence of the Project (without the implementation of the management and mitigation measures presented in this assessment section) and therefore requiring an assessment relate primarily to:

- radiation risks associated with the Monazite Product;
- unauthorised access to the Mine Site or Rail Facility;
- the handling, storage and disposal of hazardous materials; and
- potential for bushfire.

Flooding-related risks are addressed in Section 6.7.4.4. In summary, the Mine Site is not flood prone and risks associated with flooding are negligible.

The hazards and public safety assessment has been prepared by RWC, with technical input in relation to radiation risks from Mr Arno Kruger and Mr Paul Smith of the Applicant.

6.11.2 Radiation

6.11.2.1 Introduction

RZ Resources has prepared a *Preliminary Radiation Management Plan* for the Project (RZ Resources, 2024). That document was prepared by technical experts employed by the Applicant and has been peer reviewed by Dr Ross Kleinschmidt, Principal Consultant / Environmental Health Physicist with qRAD Consulting, a consultancy that specialises in radiation safety

solutions. The Plan has been drafted based on information available at the design phase of the Project and would be updated during commissioning of the Rare Earth Concentrate Plant when the performance of the Plant and the nature of the materials produced is more fully understood.

The objectives of the *Preliminary Radiation Management Plan* are as follows.

- Manage and control expose to all radiation sources associated with the Project.
- Manage and control the risk from radiation sources to human health and the environment associated with:
  - all potential radiation emitting minerals;
  - radiation gauges and equipment emitting radiation, and
  - handling, loading, transport, unloading and storage of radioactive minerals.

This summary of radiation-related hazards is limited to environmental or public safety-related hazards within and surrounding the Mine Site, the Transportation Route – North and the Rail Facility. Radiation-related hazards related to the Applicant's workers and site visitors are beyond the scope this document. Notwithstanding, the Applicant would obtain and maintain a range of radiation-related occupational health and safety permits and approvals and would implement stringent controls and monitoring to manage the health and safety of workers and visitors. Finally, the Applicant would appoint a suitably experienced and qualified Radiation Control Officer for the Project who would be responsible for management of both occupational health-related and environmental radiation risks.

6.11.2.2 Potential Radiation Sources

Potential radiation sources associated with the Project include the following.

- Radiation gauges and equipment emitting radiation.
- Heavy mineral ore.
- Heavy mineral concentrate produced by the Wet Concentration Plant.
- Mine Products produced by the Rare Earth Concentrate Plant.

Radiation gauges and equipment emitting radiation would be installed within the processing facilities and would be managed in accordance with the appropriate regulations, guidelines and manufacturers' instructions. The scope for environmental or public health-related impacts from these devices is limited. As a result, risks associated with radiation gauges and equipment emitting radiation are not considered further.

Heavy Mineral Ore

As identified in Section 1.5.3, the Copi deposit includes approximately 0.01% Monazite. Monazite is a phosphate mineral that contains rare earth elements, as well as very small amounts of uranium and thorium.

The Applicant determined the uranium and thorium content of the ore using XRF methods as follows.

- Uranium .....2ppm or 0.0002%
- Thorium .....8ppm or 0.0008%

Clause 4 of the *Protection from Harmful Radiation Regulation 2013* identifies radioactive ore as a material with:

> "in the case of material that contains both uranium and thorium, a percentage by weight of uranium and thorium such that the following expression is true.

$$\frac{U\% \text{ by weight}}{0.02} + \frac{Th\% \text{ by weight}}{0.05} > 1$$

The following applies these values to the above equation.

$$\frac{0.0002}{0.02} + \frac{0.0008}{0.05} = 0.01 + 0.016 = 0.026$$

As the equation generates a value substantially less than one, the Copi ore is not classified as radioactive ore and no particular measures are required to manage radiation-related risks.

Heavy Mineral Concentrate and Mine Products

The Monazite contained in the ore forms a component of the heavy mineral assemblage and would report to the heavy mineral concentrate produced by the Wet Concentration Plant. That material would be further separated to produce a Primary and Secondary Ilmenite Product, a Monazite Product and a Non-magnetic Concentrate.

Clause 4 of the *Protection from Harmful Radiation Regulation 2013* identifies a radioactive substance as a material with a prescribed activity of 100 becquerels per gram (Bg/g). **Table 6.11.1** presents the activity levels for the heavy mineral concentrate and each of the mine products. In summary, the heavy mineral concentrate, Primary and Secondary Ilmenite Product, and the Non-magnetic Concentrate are not classified as radioactive substances and no further assessment is required.

Table 6.11.1
Activity of Heavy Mineral Concentrate and Mine Products

Material	U XRF ppm	TH XRF ppm	Monazite %	Activity Bq/g
Heavy Mineral Concentrate	148	662	1.1	4.6
Primary Ilmenite Product	24	28	0.01	0.4
Secondary Ilmenite Product	42	96	0.05	0.9
Monazite Product	3094	51,388	100	254.3
Non-Magnetic Concentrate	187	311	0.35	3.6
Source: RZ Resources Limited				

The Monazite Product, with an activity of 254.3Bg/g, is classified as a radioactive substance. The Safety Data Sheet for the Monazite Product identifies that the material is further classified as follows.

- Hazardous under *Global Harmonised System of classification and labelling of chemicals.*
- Class 7 (Radioactive Material) under the *Australian Code for the Transport of Dangerous Goods by road and rail, International Air Transport Association Dangerous Goods Regulations* and the *International Maritime Dangerous Goods Code.*

Extracted monazite would be removed from the Mine Site with the heavy mineral concentrate. The heavy mineral concentrate would have a combined specific activity (a measure of the amount of radioactivity – or the decay rate – of a particular radionuclide per unit mass) of approximately 5.0 becquerel per gram (Bq/g) to 6.0Bq/g. Clause 5 of the *Radiation Control Regulation 2013* identifies a radioactive substance as a substance with a specific activity of 10Bq/g or more. As a result, the heavy mineral concentrate would not be classified as a radioactive substance and no particular measures are required to manage radiation associated with handling or transportation of the heavy mineral concentrate.

6.11.2.3 Management and Mitigation of Radiation Risks

Potential risks associated with the Monazite Product would be associated with the following activities.

- Production, handling and storage of the Monazite Product within the Rare Earth Concentrate Plant and associated storage areas.
- Transportation of the Monazite Product from the Mine Site to the Rail Facility.
- Storage of the Monazite Product at the Rail Facility.

Transportation of the Monazite Product from the Rail Facility to port of the Pinkenba Mineral Separation Plant would be undertaken under separate approval and assessment of radiation-related risks associated with those operations is beyond the scope of this assessment.

The following management and mitigation measures would be implemented to manage radiation-related risks associated with the Monazite Product. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the fact that the Rare Earth Concentrate Plant has yet to be constructed or commissioned.

General

- Undertake baseline monitoring within the Mine Site, along the Site Access Road, realigned Anabranch Mail Road and Transport Route – North and within the Rail Facility prior to the commencement of mining operations.
- Review and update the *Preliminary Radiation Management Plan* during commissioning of the Rare Earth Concentrate Plant.

- Implement training and monitoring for all workers and visitors appropriate to their individual roles and level of exposure.
- Undertake monitoring of the above areas throughout the life of the Project and following the completion of mining, processing and transportation operations to demonstrate background radiation levels are no higher than pre-mining radiation levels.
- Implement an audit process to ensure compliance with the conditional requirements of all radiation-related licences, approvals and procedures.
- Provide public information in relation to management of Class 7 (radioactive Material) prior to the commencement of transportation of Monazite Product from the Mine Site.

Production, handling and storage of the Monazite Product

- Restrict access to the Rare Earth Concentrate Plant and storage areas to appropriately trained and certified individuals only.
- Ensure that Monazite Product is placed into appropriate sealed containers (205L drums or bulka bags) and is stored in sealed shipping containers labelled in accordance with the *Australian Code for the Transport of Dangerous Goods by road and rail*.
- Ensure that shipping containers containing Monazite Product are appropriately stored on site pending transportation from the Mine Site.
- Ensure that mobile plant exiting the Rare Earth Concentrate Plant is thoroughly decontaminated and tested prior to exiting the plant area.

Transportation from the Mine Site to the Rail Facility

- Ensure that all licences and permits for transportation of Class 7 (Radioactive Material) under the *Australian Code for the Transport of Dangerous Goods by road and rail* are obtained prior to transporting Monazite Product from the Mine Site.
- Update the *Preliminary Radiation Management Plan* to address transportation of Monazite product from the Mine Site and train personnel in the procedures identified in that document, including:
  - managing radiation hazards during transportation;
  - emergency management and response, including in remote areas; and
  - managing exposure for drivers and the public.
- Ensure that all shipping containers containing Monazite Product are suitably labelled.

Storage at the Rail Facility

- Ensure that all shipping containers containing Monazite are transported to the Rail Facility for immediate loading. All Monazite containing containers will be held at the Rare Earth Concentrate Plant on Copi mine until the day before transportation to end user is confirmed to minimise storage times at the Rail Facility.

- Ensure that shipping containers containing Monazite Product are stored in a suitable, secure, well-marked location with access limited to appropriately trained and certified individuals only.
- Transport shipping containers containing Monazite Product from the Rail Facility to their final destination as soon as practicable following receipt.

6.11.2.4 Impact Assessment

In assessing potential public-health and environmental impacts associated with production, handling, transportation and storage of Monazite Product the following is relevant.

- The Monazite Product is classified as a Class 7 (Radioactive Material) under the *Australian Code for the Transport of Dangerous Goods by road and rail.*
- Clear guidelines in relation to managing such materials exist and such materials are regularly and safely transported on public roads throughout NSW and elsewhere.
- The Applicant would obtain all permits and approvals required prior to transporting the Monazite Product from the Mine Site.
- The Applicant would update the *Preliminary Radiation Management Plan* to address all radiation-related risks associated with the production, handling, transportation and storage of Monazite Product.
- A program of monitoring and auditing of radiation-related conditional requirements and management practices would be implemented prior to, throughout and following the life of the Project.

In light of the above, the Applicant contends that radiation-related risks associated with the Project would be acceptable.

6.11.3 Unauthorised Access

6.11.3.1 Mine Site

The Mine Site is located approximately 75km northwest of Wentworth in the Far West Region of NSW. The Mine Site would be accessed via Anabranch Mail Road and the Site Access Road. Access via other routes would be controlled through the use of lockable gates and fences.

Public access to the Mine Site would be controlled by a security gate within the Infrastructure Area. All visitors and non-authorised personnel would be required to report to the Mine Office and would be subject to relevant controls to ensure safety of visitors and workers. In addition, the boundaries of the Mine Site are currently fenced. These fences would be maintained and where required, upgraded, to prevent inadvertent access to the Mine Site. Finally, the Mine Site would be occupied 24-hours per day and all personnel would have access to the Mine's radio network. Remotely monitored cameras would also be installed. As a result, any unauthorised access to the Mine Site would be likely to be detected and appropriate actions, including ceasing all or some activities within the Mine Site would be implemented as required.

6.11.3.2 Rail Facility

Only the northern boundary of the Rail Facility is currently fenced. The Applicant does not propose to fence the remainder of the Facility as the eastern boundary adjoins the main Orange – Broken Hill Railway which is under the control of the rail operator and is not fenced. As a result, any attempt to fence the remainder of the Facility would be largely ineffective as the eastern boundary would remain open. The Applicant would, however, fence the Monazite Product storage area within the Rail Facility. The Applicant contends that the Project would not result in increased public safety risks for the following reasons.

- The Rail Facility would be equipped with adequate lighting to allow good visibility at all times of the day.
- "No access" signs would be erected to warn members of the public not to enter the Facility.
- Security services, including remotely monitored security cameras, would be provided for the Rail Facility to limit and control unauthorised access to the Rail Facility.
- Visitors accessing the Rail Facility via the Rail Facility Site Access Road would be directed to the site office and would be subject to relevant controls to ensure safety of visitors and workers.
- Mobile plant operators, including truck drivers and forklift operators, would immediately cease all operations in the event of unauthorised access to the Rail Facility.

6.11.4 Hazardous Materials

Potentially hazardous materials identified under the *Australian Code for the Transport of Dangerous Goods by Road & Rail* Edition 7.8 (National Transport Commission, 2022) that would be transported to and stored within the Mine Site would be limited to the following.

- Monazite Product - a Class 7 (Radioactive Material).
- Diesel fuel
- Liquified Natural Gas (LNG)

Table 6.11.2 presents a screening analysis for the above substances prepared in accordance with *Hazardous and Offensive Development Application Guidelines – Applying SEPP 33* (SEPP 33 Guideline). In summary,

- Class 7 materials are not required to be assessed in accordance with Appendix 4 of the SEPP 33 Guideline because those materials are adequately covered by national regulations and guidelines; and
- neither the diesel fuel nor the Liquified Natural Gas to be stored within the Mine Site would exceed the threshold that would require further analysis or preparation of a Preliminary Hazard Analysis.

Table 6.11.2
Potentially Hazardous Materials Screening Analysis

Material	UN Code	Class	Description	Actual / Proposed Storage Quantity	Storage Location	Distance to Site Boundary[1]	Threshold Limit	Threshold Triggered
Diesel Fuel	1202	3	Combustible liquids: flashpoint above 61°C but not exceeding 150°C	85,000L	Self-bunded storage tanks located: Workshop (75,000L) Dredge pond (5,000L) Power station (5,000L)	>500m >500m >250m	10m	No[2]
Liquified Natural Gas (LNG)	1972	2.1	Flammable gas stored at -160ºC and just above 1 bar (1 atmosphere) pressure	110m^3	Adjacent to the Power Station	>250m	No threshold[3]	No

Note 1: Site Boundary = boundary of closest publicly accessible location, including public roads or surrounding private land.

Note 2: If combustible liquids of class C1 are present on site and are stored in a separate bund or within a storage area where there are no flammable materials stored, they are not considered to be potentially hazardous.

Note 3: Tables 1 and 3 of the Hazards Guideline identify screening thresholds for pressurised, liquefied (pressure) and LPG. LNG to be stored within the Mine Site would be stored at -160ºC and just above 1 bar (1 atmosphere) pressure. As a result, the identified thresholds are not applicable.

Finally, small quantities of other materials would be transported to the Mine Site, including:

- petrol, oils and other hydrocarbons;
- materials for suppressing dust and stabilising rehabilitated surfaces; and
- chemicals for use in the reverse osmosis and water treatment.

These materials be stored in small quantities in accordance with the Safety Data Sheet for each chemical or hydrocarbon.

Small quantities of diesel would be transported to the Rail Facility on an as required basis for immediate use. No chemicals or other materials would be stored within the Rail Facility.

6.11.5 Bushfire

Section 6.3.5.1 presents an overview of the vegetation communities within the Mine Site. In summary, in accordance with the document *Planning for Bush Fire Protection - A guide for councils, planners, fire authorities and developers* published by the NSW Rural Fire Service in November 2022 (RFS, 2022), the vegetation within the Mine Site may be best classified as "grassland" albeit with substantial areas of bare earth between vegetated areas. Sections 7.9 and A1.3 of RFS (2022) identifies that where an asset protection zone, or a cleared area surrounding buildings and infrastructure that are required to be protected from bushfire, of 50m or more can be provided in a grassland setting, then no further assessment of bushfire risk to structures is required.

All proposed activities, with the exception of initial land clearing operations, would be undertaken within cleared areas with a minimum 50m buffer to vegetation. As a result, no further assessment of bushfire risks are required.

6.11.6 Management and Mitigation Measures

Radiation-related management and mitigation measures are described in Section 6.11.2.3.

The Applicant would implement the following management and mitigation measures throughout the life of the Project to minimise the potential for unacceptable public safety and hazard-related impacts. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual hazards-related risks presented in **Appendix 2**.

- Facilitate improved public communication infrastructure and services where practicable.
- Ensure that Project-related emergency response and medical personnel and equipment are available to respond to non-Project related emergencies.
- Facilitate establishment of a RFDS-certified airstrip.
- Ensure that access to the Mine Site is controlled and that adequate measures are in place to detect and manage unauthorised access.
- Store hydrocarbons and hazardous materials in bunded, impervious areas undercover in accordance with the relevant Australian Standard, including *AS1940 – The Storage and Handling of Flammable and Combustible Liquids*.
- Manage all hazardous materials in accordance with the requirements of the *Work Health and Safety Regulations 2017*.
- Store and transport mine products in sealed containers to prevent loss of the material in transit.
- Update the existing mine product Safety Data Sheet as required.
- Ensure that all transport operators are trained in the management of the material detailed within the Safety Data Sheet, including in the event of an unplanned spill.
- Remove waste oils from the Mine Site on a regular basis for disposal at an appropriately licenced location.
- Prepare and implement *Emergency Management and Evacuation Management Plan*, to safely manage bushfire and other emergency impacts.
- Ensure training is provided to selected site personnel in relation to specific firefighting tasks and procedures.
- Undertake all hot works within cleared areas or under a Hot Works Permit system.
- Ensure that all mobile plant and equipment is fitted with appropriate fire suppression equipment.

- Ensure that a water cart is available, thereby providing firefighting capabilities, if required.
- Fully comply with the requirements of Rural Fire Service and other emergency services in the event of a fire emergency.

6.11.7 Assessment of Impacts

The proposed management and mitigation measures related to hazards and public safety are expected to adequately address risks from unauthorised access, radiation and bushfire. In addition, the results of the screening analysis for diesel and LNG identify that a Preliminary Hazard Analyses is not required for those materials. No other potentially hazardous material would be transported to the Mine Site. Therefore, it is assessed that the Project would not result in adverse impacts associated with hazards and public safety.

6.12 Historic Heritage

6.12.1 Introduction

The SEARs identify "heritage" as a key issue for assessment in the EIS. The matter to be addressed include:

- "an assessment of the potential impacts on environmental heritage in accordance with the *NSW Heritage Manual*, including any heritage conservation areas and State and local historic heritage items within and near the site."

Heritage NSW reviewed the draft SEARs and provided no additional comments or recommendations in addition to the above.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

OzArk Environment and Heritage Pty Ltd (OzArk) prepared the Historic Heritage Assessment Report (HHAR) for the Project. The HHAR, hereafter referred to as OzArk (2024b), is presented as **Appendix 13**. This subsection provides a summary of OzArk (2024b) and describes the management and management measures to be implemented by the Applicant.

6.12.2 Existing Environment

6.12.2.1 Historic Heritage Context

The Murray-Darling Basin Depression bioregion was inhabited by Aboriginal people for approximately 50,000 years prior to the arrival of Europeans in the 1830s (OzArk, 2024b). Following Charles Sturt's arrival at the confluence of the Murry and Darling Rivers in 1830, further exploration of the region was completed by Major Thomas Mitchell and an overlanding expedition leading cattle from Howlong to Adelaide was undertaken by Joseph Hawdon and Charles Bonney in 1838.

The first unlicensed pastoral runs in the region, primarily occupying land fronting rivers, the Great Darling Anabranch and Lake Victoria, were claimed before 1847 (OzArk, 2024b). A large holding known as Lake Victoria Station was granted to John McInlay in 1854, with the Mine Site and surrounding lots known as the 'Scrub Run' blocks prior to the station's subdivision under the Land Act of 1884. Three properties which form part of the Mine Site, "Warwick," "Huntingfield/Sunshine," "Belmore," and "Nulla Station", were likely part of Lake Victoria Station (OzArk, 2024b).

Factors including limited water security, droughts, feral pests (e.g. rabbits) and uncertain leasehold legislation resulted in the frequent surrender of lots in the region (OzArk, 2024b). Despite issues surrounding the viability of smaller properties and the introduction of irrigated pastures in the early 1900's, grazing has remained a key industry in the region. The introduction of cost-effective water infrastructure (e.g. bores and pipes) and Dorper sheep which are adapted to more arid climates, combined with alternative income sources including the management and harvesting of feral goats, has enabled graziers to maintain grazing operations in the region (OzArk, 2024b).

6.12.2.2 Previously Recorded Historical Heritage

Table 6.12.1 outlines the desktop database searches completed by OzArk (2024b) in order to identify previously recorded historic heritage items in the vicinity of the Mine Site.

Table 6.12.1
Historic Heritage Database Search Results

Database	Date of Search	Type of Search	Comment
National and Commonwealth Heritage Listing	12/01/2020 14/12/2022 14/11/2023	Wentworth LGA	No listed items/places within the Heritage Survey Area.
State Heritage Register	12/01/2020 14/12/2022 14/11/2023	Wentworth LGA	No listed items/places within or near the Heritage Survey Area.
Section 170 Register	12/01/2020 14/12/2022 14/11/2023	Wentworth LGA	No listed items/places within or near the Heritage Survey Area of the Mine Site.
Local Environmental Plan	12/01/2020 14/12/2022 14/11/2023	Wentworth LEP (2011)	The Heritage Survey Area overlaps the curtilage for LEP listed items (see **Figure 3.2.2**) • I2 'Bunnerungie Homestead' • I3 'Bunnerungie Bridge' and; • I81 'Nulla Nulla Woolshed'. It is also adjacent to the curtilage for • I82 'Nulla Nulla Homestead and Associated Dwellings' and; • I4 'Bunnerungie Cemetery'.
Source: OzArk (2024b) – modified after Table 4-1			

Table 6.12.2 present the locations of the items listed under the Wentworth LEP (**Figure 3.2.2** for curtilage location).

Table 6.12.2
Wentworth Shire LEP 2011 – Historic Heritage Items in the Vicinity of the Mine Site

Item No.	Item Name	Lot and DP	Distance to Item
I2	Bunnerungie Homestead	Lot 3248 DP765453	2.2km southeast of Anabranch Mail Road
I3	Bunnerungie Bridge	Lot 3248 DP765453	940m east of Anabranch Mail Road
I4	Bunnerungie Cemetery	Lots 1913 and 1914 DP763770	The curtilage for the item is approximately 395 m to the east of the Heritage Assessment Area (Anabranch Mail Road) although the exact location of the cemetery cannot be determined at a desktop level
I81	Nulla Nulla Woolshed	Lot 4069 DP766544	20km south of the Mine Site
I82	Nulla Nulla Homestead and Associated Dwellings	Lot 4070 DP766545	18.5km south of the Mine Site
Source: OzArk (2024b) – modified after Section 4.2.1			

6.12.3 Assessment Methodology

The historic heritage field survey was completed concurrently with the Aboriginal heritage survey by OzArk personnel on the following dates:

- Phase 1: 25 February to 29 February 2020, 2 March to 4 March 2020
- Phase 2: 1 to 4 February 2022, 1 to 5 March 2022
- Phase 3: 20 to 23 November 2023

The historic heritage survey methodology is therefore the same as that employed for the Aboriginal heritage survey and is described in Section 6.5.3.4. Pedestrian coverage during the historic heritage survey of the Mine Site is shown in **Figure 6.5.1**.

6.12.4 Survey Results

Three historic heritage items were recorded by OzArk (2024b) during the field survey as follows (**Figure 6.12.1**).

- Huntingfield–HS01 - a habitation structure (hut).
- Huntingfield–HS02 - a memorial site.
- Warwick – HS01- stock yards.

OzArk (2024b) notes that Huntingfield–HS-01 and Huntingfield–HS-02 share a clear association with each other and that local knowledge regarding the provenance of these items was obtained from the current landowner of "Huntingfield". The Huntingfield-HS01 and Huntingfield-HS02 items are located within Aboriginal heritage site Copi OS-1 (Section 6.5.4.1) and would be preserved together with that site. **Table 6.12.3** provides a summary of the historical heritage items identified within the Mine Site.

Table 6.12.3
Historic Heritage Items within the Mine Site

Item Name	Location (GDA 2020 Zone 54)		Lot and DP	Description
	Easting	Northing		
Huntingfield – HS01	524809	6285430	Lot 1940 DP763792	• Located on "Huntingfield" Station on the crest of a gypsum rise elevated above the surrounding salt pan. • Consists of a habitation structure (hut) constructed within the last 50 years from locally procured timber posts, wire and twigs. • Built by the previous landholder of "Huntingfield" Station following the internment of his wife's cremated remains nearby.
Huntingfield – HS02	524829	6285412	Lot 1940 DP763792	• Located on "Huntingfield" Station on the crest of a gypsum rise elevated above the surrounding salt pan. • Consists of an ironstone marker commemorating the location at which the previous landholder of "Huntingfield" Station interred the cremated remains of his wife. • Associated with site Huntingfield-HS01 where the previous landholder stayed for a few days following the internment of his wife's cremated remains.
Warwick – HS01	548424	6284379	Lot 3422 DP765711	• Located approximately 20km west of the intersection of the Silver City Highway and Anabranch Mail Road. • Consists of the ruins of an agricultural shed and small stock yard constructed from local pine materials.
Source: OzArk (2024b) – modified after Section 5.3				

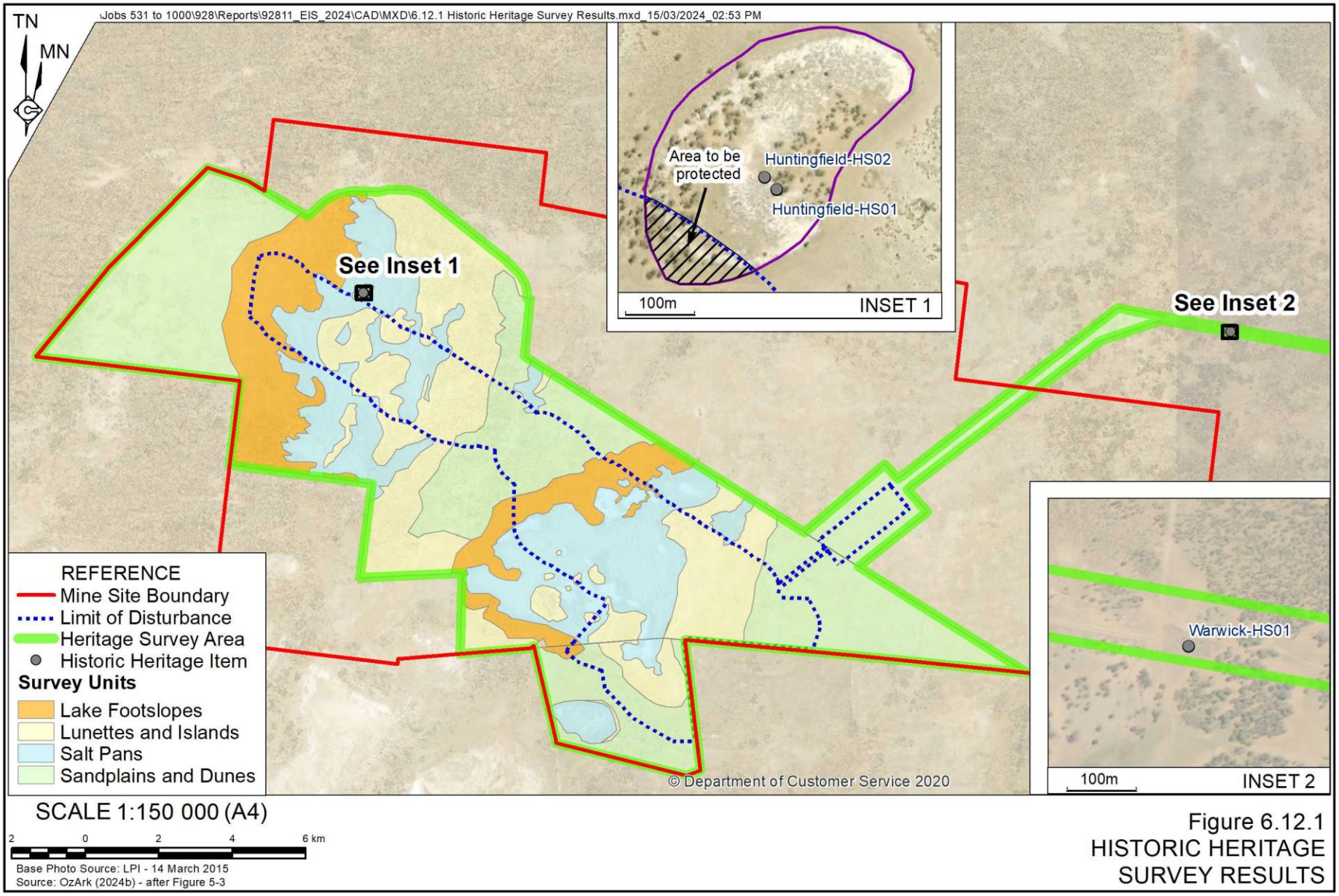


Figure 6.12.1
HISTORIC HERITAGE SURVEY RESULTS

6.12.5 Assessment of Significance

Table 6.12.4 details the assessment of significance completed in accordance with NSW Heritage Office's publication *Assessing Heritage Significance* (Heritage Office, 2001) and the *Australian ICOMOS Burra Charter* (2013) for the three historic heritage items recorded within the Mine Site. In summary, OzArk (2024b) has determined that the three historic heritage items identified within the Mine Site have no historic heritage significance with regard to the relevant significance criteria. The two 'Huntingfield' items are both located outside the Limit of Disturbance and therefore will not be impacted by the Project. Additionally, OzArk (2024b) notes that Huntingfield-HS01 and Huntingfield-HS02 have high personal significance to the individual who created them and to the family whose ancestor's ashes are interred at the location, and therefore the historic heritage items are part of the history of 'Huntingfield' Station.

Table 6.12.4
Historic Heritage Site – Assessment of Significance

Historic Significance Criterion	Item Huntingfield - HS01	Item Huntingfield - HS02	Item Warwick - HS01
An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)	No Historical Significance	No Historical Significance	No Historical Significance
An item has a strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)	No Historical Significance	No Historical Significance	No Historical Significance
An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)	No Historical Significance	No Historical Significance	No Historical Significance
An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons	No Historical Significance	No Historical Significance	No Historical Significance
An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)	No Historical Significance	No Historical Significance	No Historical Significance
An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area)	No Historical Significance	No Historical Significance	No Historical Significance
An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments (or a class of the local area's cultural or natural places; or cultural or natural environments).	No Historical Significance	No Historical Significance	No Historical Significance
Source: OzArk (2024b) – modified after Table 5-3,Table 5-4, Table 5-5			

Warwick-HS01 is located along the proposed Site Access Road and powerline route. This item would also be protected and would not be disturbed.

Finally, as the LEP-listed heritage items lay outside the Project's Limit of Disturbance, there will be no direct or indirect impacts to:

- I2 'Bunnerungie Homestead';
- I3 'Bunnerungie Bridge';
- I4 'Bunnerungie Cemetery';
- I81 'Nulla Nulla Woolshed'; and
- I82 'Nulla Nulla Homestead and Associated Dwellings'.

6.12.6 Avoidance, Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures in order to avoid any adverse impacts on items and sites of historic heritage value. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual heritage-related risks presented in **Appendix 2**.

- Ensure that approved disturbance areas are clearly delineated prior to disturbance.
- Ensure that each of the identified historic heritage sites are not disturbed by the Project.
- Facilitate on request visitation by persons with a personal connection to sites Huntingfield-HS01 and Huntingfield-HS02.
- Prepare and implement an *Historic Heritage Management Plan* (HHMP) which includes procedures to be implemented in the event that unexpected historical sites or objects or human remains are discovered during construction or operation of the Project.

6.12.7 Conclusion

Three historic heritage items, Huntingfield-HS01, Huntingfield-HS02 and Warwick-HS01were identified by OzArk (2024b) within the Mine Site.

Huntingfield-HS01 and Huntingfield-HS02 were assessed as having no historic heritage significance and therefore not protected by the Heritage Act, although OzArk (2024b) notes that both items are of personal significance to the individual who created them and to the family of the ancestor whose remains are reportedly interred at Huntingfield-HS02. Therefore, they would be conserved in the landscape and not harmed by the Project.

Warwick-HS01 was assessed as having no heritage significance and therefore it is not protected by the Heritage Act. As such, no management measures are required. However, as it is located on proposed Site Access Road and powerline route, it is proposed that the site can be avoided from construction activities and preserved by securing the area with a fence to ensure authorised access only.

Furthermore, the Project would not directly or indirectly disturb or impact upon the Wentworth LEP-listed historic heritage items.

6.13 Visual Amenity

6.13.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Project on visual amenity including:

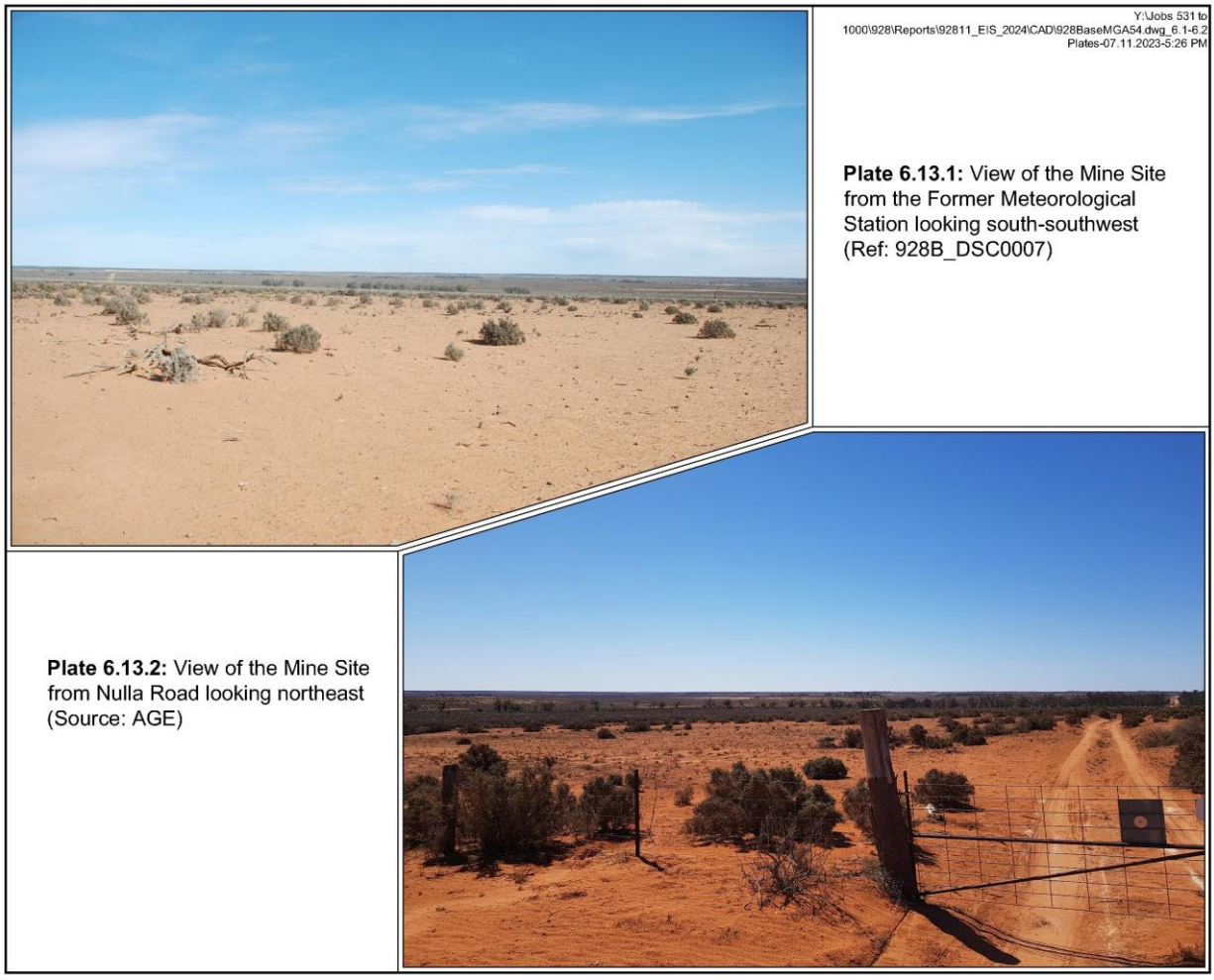
> "an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any temporary and permanent modification of the landscape (overburden dumps, bunds, etc.), and minimising the lighting impacts of the development;."

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

The visual amenity assessment has been completed by RWC.

6.13.2 Existing Environment

The visual environment within and surrounding the Mine Site is dominated by flat to very low hills dominated by widely spaced shrubs and scattered trees. **Plates 6.13.1** and **6.13.2** present views of the Mine Site from the northeast and southwest.



Rural residences surrounding the Mine Site are widely spaced with the closest non-Project-related residence being Residence R1, located approximately 1,300m from the limit of disturbance. (**Figures 3.4.4**, **3.4.5**, **3.4.7**). The next closest residences are Residences R3, R6 and R9, located approximately 8.2km, 10.0km and 12.6km from the limit of disturbance. Residence R7 is located approximately 2.2km from Anabranch Mail Road.

Only small sections of the Mine Site are visible from surrounding public vantage points, principally along Nulla, Springwood and Pine Camp Roads where they traverse the Mine Site.

The visual environment surrounding the Rail Facility is dominated by mining and quarrying related activities, including waste rock emplacements and mine and quarry-related infrastructure. Areas between mining and quarry-related disturbance are characterised by low, sparsely vegetated rocky hills.

Views of the Rail Facility are available from Menindee Road located to the east of the Facility, with views from other directions generally not available from publicly accessible locations.

6.13.3 Potential Visual Amenity Impacts

Potential Project-related changes to the existing visual setting surrounding the Mine Site include the following.

- Movement of mobile plant operating at the natural land surface may be visible at times, particularly as mining operations approach Residence R1, Nulla Road and Pine Camp/Springwood Roads. In elevated sections of the Mine Site, mobile plant operating below the natural surface, including the dredges and Wet Concentration Plant, would be unlikely to be visible as they would generally be below the crest of the Extraction Area. In less elevated sections of the Mine Site, including when mining operations are being undertaken within the Eastern and Western Salt Pans, the dredges and Wet Concentration Plant may be visible from surrounding areas.
- Fixed plant, in particular the Rare Earth Concentrate Plant which would be up to 47m high, may be visible, from Nulla Road, albeit at a distance of approximately 10km.
- Changed landforms, including the dredge pond, Off Path Storage Facility and the rehabilitated final landform may be visible from sections of Nulla Road and Residence R1.
- Raised dust from the movement of mobile plant within the Mine Site or along the Site Access Road or wind generated dust may be visible during the day from sections of Nulla Road and Residence R1.
- Condensed steam emissions from the Rare Earth Concentrate Plant driers may be visible during periods of cool or humid weather, likely limited to the early morning during winter.
- Direct views of lights from mobile or fixed plant, including the dredges and Wet Concentration Plant, the Infrastructure Area or mobile lighting towers in work areas may be visible at night sections of Nulla Road and Residence R1.

- Sky glow from lights may be visible during the night from a range of vantage points surrounding the Mine Site.

Potential Project-related changes to the existing visual setting surrounding the Mine Site include the following.

- Additional and larger vehicles travelling on the transportation route through Broken Hill, noting that the transportation route is already an approved heavy vehicle route for Type 1 road trains.
- Stockpiling of shipping containers and loading of those containers onto rail within the Rail Facility, noting that the Facility is an operating Rail Facility.

6.13.4 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures in order to limit any adverse impacts on visual amenity within and surrounding the Mine Site, along the Transportation Route and surrounding the Rail Facility. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual visual amenity-related risks presented in **Appendix 2**.

- Construct on-site infrastructure from non-reflective, neutral-coloured material.
- Progressively rehabilitate disturbed sections of the Mine Site no longer required for the Project and re-vegetate disturbed areas.
- Undertake active dust management measures to reduce the potential for the creation of a 'dust cloud', especially during site establishment and transportation activities.
- Minimise the use to night-time lighting to the extent practicable.
- Ensure that night-time lighting is directed towards the active areas of operation only and away from Residence R1 to minimise lights shining directly towards the residence.
- Ensure that fixed night-time lighting is directed below the horizontal to minimise the light spill from the Mine Site.
- Ensure that lighting within the Rail Facility during rail loading operations is directed away from Menindee Road so as not to distract or startle motorists driving at night. At other times, ensure that the only sufficient lighting is operated to ensure site safety and security and that such lighting is also directed away from Menindee Road.

6.13.5 Assessment of Impacts

At the outset, it is noted that visual amenity impacts are a subjective matter that is different for different individuals. Visual impacts that may affect one person may not be noticed by another person. As a result, particular individuals may be affected by changes in the visual landscape to a greater or lesser extent than described below.

The Mine Site is relatively isolated, with the only non-Project related residence with potential views being Residence R1. Views of the Mine Site would also be available from operational areas of Huntingfield and Sunshine stations after Year 11. As mining operations to the west of Nulla Road would only be undertaken in accordance with a compensation agreement with the owner of that property and visual amenity impacts would be accounted for under that agreement, visual amenity impacts would be negligible.

Views of the Mine Site may also be available from sections of Nulla Road and Pine Camp/Springwood Road as mining operations approach those locations. Given the limited traffic on those roads, the limited visibility available and the short time period over which operations would be visible, visual amenity impacts for users of those roads would be negligible. Furthermore, Nulla Road would be closed between Years 11 and 13 while mining operations crossed the road.

More distant view of the Mine Site may be available in the form of dust clouds. Given the proposed dust management measures proposed (see Section 6.9.7) and fact that raised dust is a feature of the natural environment within the Mine Site, dust-related visual amenity impacts would be negligible.

Similarly, more distant night-time views of the Mine Site may be available in the form of a light glow associated with sections of the Mine Site. Given the limited number of observers present and mitigation measures proposed, night-glow visual amenity impacts would be negligible.

Transportation operations along the transportation route would be consistent with existing uses of that route, noting that there would be a substantial increase in the number of vehicles using Anabranch Mail Road as a result of the Project. The closest non-Project related residence to Anabranch Mail Road is located approximately 2.2km from the road, behind substantial vegetation adjacent to the Great Darling Anabranch. The residence is also substantially closer (approximately 1.3km) to the Silver City Highway. As a result, transport-related visual amenity impacts associated Anabranch Mail Road would negligible.

Transportation operations with in Broken Hill would be visible to those using and living along the transportation route. Given that the route is an approved heavy vehicle route for Type 1 road trains, transport-related visual amenity impacts would negligible.

Finally, operations within the Rail Facility would be visible for motorists using Menindee Road. These activities are largely consistent with the existing use of the Facility and similar land uses visible to motorists elsewhere in Broken Hill. As a result, Rail Facility-related visual amenity impacts would negligible.

6.14 Social Impacts

6.14.1 Introduction

The SEARs identify "social impacts" as a key area for assessment. Matters to be addressed include:

- "an assessment of the social impacts of the project, prepared in accordance with the Department's Social Impact Assessment Guideline for State Significant Projects (2023), including the likely impacts of the development on the local community, cumulative impacts (considering other mining developments in the locality), and consideration of workforce accommodation;
- the biophysical, economic and social costs and benefits of the development;"

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

The Social Impact Assessment (SIA) was undertaken by Element Environment (Element, 2024) and is presented as **Appendix 14**. This subsection provides an overview of the SIA and describes the management and management measures that would be implemented by the Applicant.

6.14.2 Social Locality

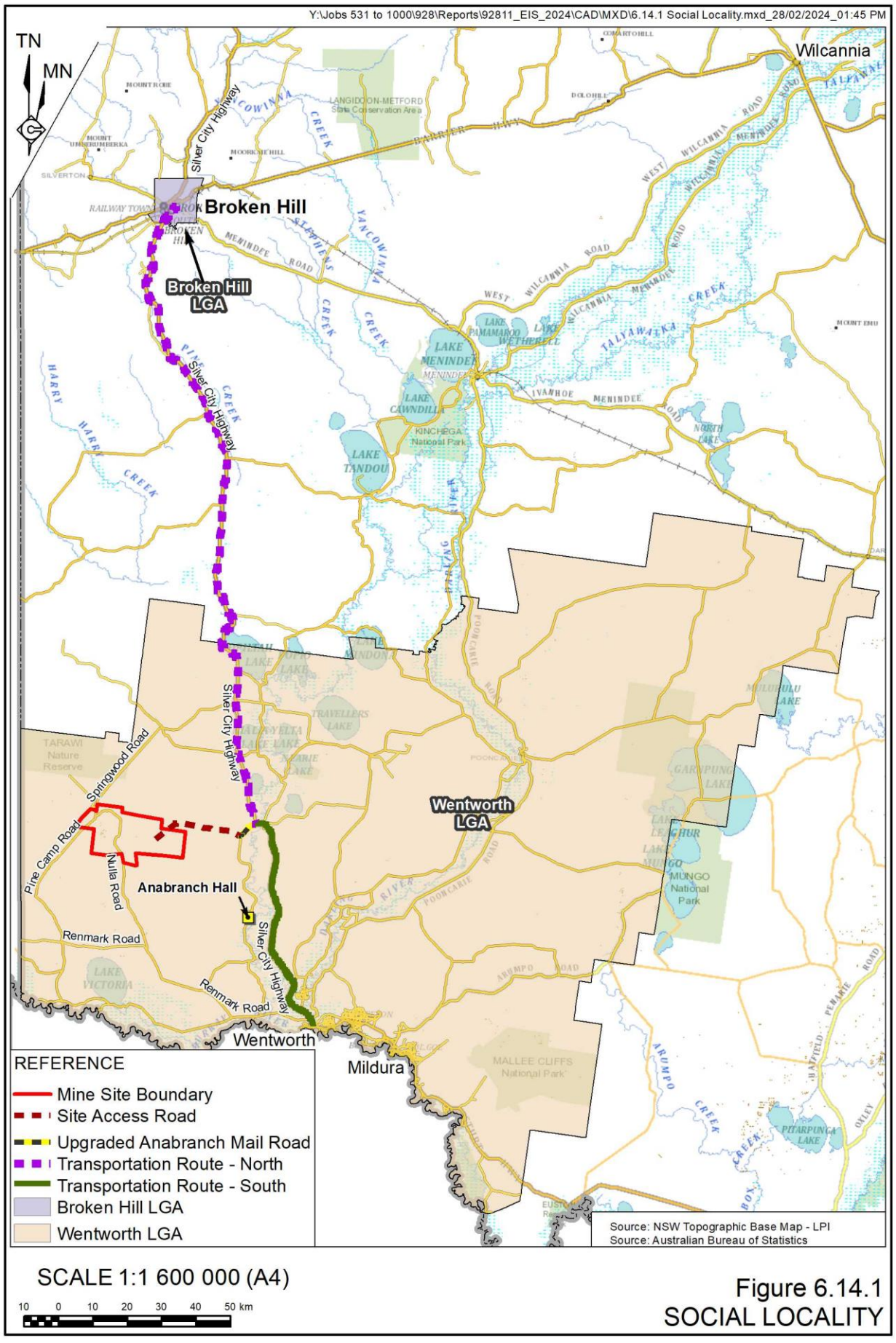
For the purposes of assessing the Project's social impacts, Element (2024) defined the Project's nominated social locality as two distinct areas, namely the:

- Wentworth Local Government Area (LGA); and
- Broken Hill LGA (**Figure 6.14.1**)

6.14.3 Methodology and Stakeholder Identification

Section 3 of Element (2024) describes the methods employed during preparation of the Social Impact Assessment, including the following.

- A scoping meeting with the Project team.
- Literature review.
- A review of cumulative impacts.
- Doorknocking in Broken Hill.
- Completion of the Scoping Worksheet prepared by Department of Planning and Environment.
- Landholder consultation, including:
  - invitations to meet with the landholders of 13 rural properties within and surrounding the Mine Site; and
  - review of the Applicant's community engagement log from October 2018 to July 2023.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TN
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Broken Hill LGA
Silver City Highway
Wentworth LGA
Springwood Road
Pine Camp Road
Nulla Road
Anabranch Hall
Renmark Road
Wentworth
Mildura
REFERENCE
Mine Site Boundary
Site Access Road
Upgraded Anabranch Mail Road
Transportation Route - North
Transportation Route - South
Broken Hill LGA
Wentworth LGA
Source: NSW Topographic Base Map - LPI
Source: Australian Bureau of Statistics
SCALE 1:1 600 000 (A4)
10 0 10 20 30 40 50 km
Figure 6.14.1
SOCIAL LOCALITY

Element (2024) state that these methods are compliant with the requirements of the *Social Impact Assessment Guideline for State Significant Projects* (2023).

Based on the above, Element (2024) identified the following stakeholders relevant to the Project.

- Road users.
- Government authorities.
- Property owners and residents.
- Local businesses.
- Aboriginal organisations and stakeholders

6.14.4 Community Baseline Data and Trends

The social baseline for the Project has been assembled through an interpretation/analysis of demographic data and research together with consultation with the surrounding community, a review of surrounding land uses, natural and built landscape feature, existing social infrastructure and the relationship between the Applicant and the surrounding community.

Section 5 of Element (2024) presents the community baseline for the Project including the Wentworth LGA and Broken Hill LGA. The key outcomes from that analysis includes the following.

- The Wentworth LGA had a population at the 2021 Census of 7,453 people, primarily living in the towns of Wentworth, Dareton, Buronga, Gol Gol and other settlements close to the Murray River. At the 2016 and 2011 census, the Wentworth LGA had a population of 6,794 and 6,609 people respectively, representing an annual population growth of 1.13%. The population of the Wentworth LGA is forecast to decline by 0.17% per annum to 2041.
- The Broken Hill LGA had a population at the 2021 Census of 17,588 people. At the 2016 and 2011 census, the Broken Hill LGA had a population of 17,814 and 18,777 people respectively, representing an annual population reduction of 0.6%per year. The population of the Broken Hill LGA is forecast to decline by 1.87% per year to 2041.
- Agriculture is the dominant employment sector within the Wentworth LGA. Mining employs 2.5% of workers within the LGA, with most positions being machinery operators and technical and trade roles.
- Health Care and Social Assistance is the dominant employment sector within the Broken Hill LGA, with Mining ranked second with 789 people employed in the industry, with most positions being machinery operators and technical and trade roles.
- Median weekly household income in the Wentworth LGA at the 2021 census was $1,392 or $437 lower than the rest of NSW. In the Broken Hill LGA, the median weekly household income was $1,173 or $656 lower than the rest of NSW.

- At the 2021 Census there was 484 unoccupied private dwellings (16.0% of total dwellings) within the Wentworth LGA, and 1,547 unoccupied private dwellings (17.1% of total dwellings) in the Broken Hill LGA. In addition, there were 2,125 unoccupied residences in the Mildura Rural City LGA across the border in Victoria. This would provide capacity for new residents to reside in each LGA without placing stress on the housing and accommodation market.
- The Wentworth LGA lies within the Western NSW Primary Health Network with services provided by the Far West Local Health District. The Wentworth Hospital is a small rural facility consisting of 20 inpatient beds, 12 sub/post-acute beds, and 8 transitional care beds. The nearest large regional hospital is the Mildura Base Public Hospital, a 172-bed facility which is the major referral public health service for far western NSW.
- At the 2021 Census, 53.7% of Wentworth LGA residents and 46.4% of Broken Hill LGA residents reported having one or more long-term health conditions in comparison to the NSW average of 61.0%.
- Wentworth LGA has a range of recreational, cultural and sporting facilities including:
  - the Old Wentworth Gaol;
  - Perry Sandhills;
  - the Murray-Darling Junction;
  - Lock 10 and weir;
  - Wentworth trail;
  - Wentworth Pioneer Museum;
  - Paddle Steamer Ruby;
  - Ferguson Tractor Monument;
  - Mungo National Park;
  - Trentham Estate Winery;
  - Orange World;
  - a sporting complex, consisting of an 18-hole championship golf course, 14 tennis courts, and one bowling green;
  - swimming pool;
  - bowling club; and
  - numerous sporting clubs.
- The Broken Hill similarly has a range of recreational, cultural and sporting facilities including:
  - the Albert Kersten Mining and Minerals Museum and White's Mineral Art and Living Mining Museum;
  - the Broken Hill Heritage Trail and historical buildings throughout the City;

- the Living Desert Reserve and Mutawinji National Park;
- various art galleries and studios;
- Stephen's Creek Reservoir.
- various sporting (rugby league, rugby union, soccer netball, AFL and cricket);
- two golf courses;
- lawn bowling clubs;
- squash and tennis courts;
- motocross and dirt bike riding events;
- clay target, pistol and gun clubs;
- water ski and fishing venues; and
- the Broken Hill Regional Aquatic Centre.

6.14.5 Community Values

Element (2024) identified the following as important for the community within the Wentworth LGA.

- All weather road safety and accessibility are of high importance to residents surrounding the Mine Site. The contribution of the project to road upgrades and maintenance, including for Anabranch Mail Road, in partnership with the local council is perceived to be of great benefit to the local community.
- Improved telecommunications is of high importance to residents surrounding the Mine Site, particularly in the event of an emergency given the remoteness of the residences in the area. RZ Resources has and will continue to advocate to government and Telstra to improve telecommunication service and increase mobile towers in the area.
- Employment opportunities are positively viewed as a direct benefit to residents of the Wentworth LGA and surrounding area. Employment and training opportunities at various levels and across and a broad range of occupational groups are expected to be a perceived community benefit associated with the Project. This may also have flow-on effects in the local community including:
  - direct and indirect economic benefits to local business in Wentworth through increased local spend;
  - attraction of families to the area with the prospect of employment opportunities; and
  - population growth enabled by local employment and housing affordability.
- The Anabranch Hall, located on the Great Darling Anabranch (**Figure 6.13.1**) is a highly valued community facility.

Element (2024) identified the following as important for the community within the Broken Hill LGA.

- Sustaining continued mining opportunities in and around Broken Hill to maintain population and ensure the prosperity of the local economy.
- Improved access to health and education services.

6.14.6 Assessment of Unmitigated Impacts

6.14.6.1 Introduction

Element (2024) assessed the social impacts of the Project in accordance with the *DPHI Social Assessment Guide for State Significant Projects* (DPHI, 2023) and in consultation with affected landholders and other stakeholders. The following subsection presents brief overview of the anticipated non-enhanced positive and unmitigated negative impacts. Section 6 of Element (2024) presents a detailed evaluation and discussion of that assessment.

As part of the SIA, a scoping assessment was undertaken to identify and discuss key social issues relating to the Project. The following social impacts were identified as requiring further investigation as part of the SIA.

- Community
- Accessibility
- Culture
- Livelihoods
- Health and Wellbeing
- Surroundings

6.14.6.2 Non-enhanced Positive Impacts

Community

Element (2024) identified that information gathered through stakeholder and community engagement determined that there is a strong sense of community cohesion which is demonstrated through community values, community connections and community events. The Applicant has made investments in the community to date, including donations to the Wentworth Show and providing research grants for the conservation of the threatened *Austrostipa nullanulla* that occurs within the Mine Site. Additionally, the Applicant has committed to providing additional community investments in the future if the Project proceeds, including supplying gravel sourced from the Project for use on local road development and maintenance and installation of a Rural Flying Doctor Service (RFDS)-registered airstrip by the Wentworth Pastoral Company for Project and community use.

Element (2024) determined that the Project, without additional measures, would create a positive impact of high significance and moderate magnitude.

Accessibility

Element (2024) identified that access to an RFDS-registered airstrip is of social value a concern for the community. The installation of a RFDS-registered air strip would create a potential positive impact of medium significance with minimal magnitude.

Culture (Aboriginal Employment)

Element (2024) state that potential positive impact associated with the employment of local Aboriginal peoples was identified by consulted Aboriginal persons and organisations. The Applicant has committed to consulting and facilitating with Aboriginal groups and businesses to provide employment training and skill development opportunities and to implementing an Aboriginal Heritage Management Plan in consultation with the RAPs to mitigate cultural impacts.

The Project's potential impact on Aboriginal employment is predicted to be positive and of medium significance and minor magnitude.

Livelihoods

Element (2024) identified hat the Project would provide employment or income generating opportunities that would improve the livelihood of the local community. This include:

- Management of land acquired by the Project;
- Supply agreements with local landholders for the use of landholder owned machinery; and
- Other contracting employment opportunities such as hospitality services for the mine camp.

Additionally, the 'Good Neighbour Agreements' would ensure that the livelihoods of local residents would not be adversely impacted.

A dominant theme resulting from consultation was focused on the prospect of employment, business opportunities, and economic growth. These impacts would be substantially positive, with 480 jobs during construction, 240 jobs during alteration and 40 rehabilitation jobs being created as a result of the Project, along with the training and upskilling of workers. The Applicant would aim to fill as many positions as possible from the local pool of applicants. In addition, local businesses in the Wentworth area would be likely to benefit substantially from increased Project employees purchasing local goods and services.

In light of the above, the Project is predicted to have positive impact of high significance with moderate magnitude.

6.14.6.3 Unmitigated Negative Impacts

Health and Wellbeing

Health and wellbeing-related impacts discussed in the SIA include biosecurity risks, radioactive materials, road safety, and anxiety and personal safety.

Biosecurity

Element (2024) state that two landholders identified biosecurity risks is related to the importation of pathogens and disease onto agricultural properties as a result of mining activities and a lack of adequate biosecurity controls. Without mitigation, the Project is forecast to have an unmitigated impact of medium significance on biosecurity related health and well-being risks.

Radioactive Material

Element (2024) state that two landholders identified extraction and processing radioactive minerals as a matter of concern. The risks associated with radioactive material have been addressed in the Section 6.11, noting that the quantity of radioactive material is minimal (<7,500tpa) and would be managed in accordance with best practice and relevant legislation and licencing requirements. Thus, the Project is predicted to have an unmitigated impact of medium significance.

Road Safety

Element (2024) state that road safety was a concern for Wentworth local community members related to increased heavy vehicle traffic derived from the Project. The Traffic Impact Assessment (Section 6.6 and Tonkin, 2024) assessed relevant safety considerations, ongoing consultation with TfNSW, and requirements for the *Traffic Management Plan* that will be implemented to address road safety. Additionally, vehicle tracking would be implemented to allow the enforcement of the speed and time restrictions. As a result, the Project is forecast to have an unmitigated impact of medium significance.

Anxiety and Personal Safety

Element (2024) state that one landholder (and their family) has concerns related anxiety and personal safety. Consultation revealed that this issue is related to disagreements between the Applicant and that landholder specifically and that those concerns are not shared by other landholders. As a result, the Project is predicted to have an unmitigated impact of medium significance.

Surroundings

Visual Amenity

Element (2024) state that potential visual impacts from the Project were raised by residents living near the Mine Site. The visual impact assessment (Section 6.13) concluded minimal visual impacts would be experienced on the surrounding areas, primarily due to the remoteness of the Project's location. Thus, the project is expected to have an unmitigated impact of minimal significance.

Air Quality

Element (2024) state that impacts associated with dust emissions was a common issue raised local landholders and residents of Broken Hill. The Air Quality Impact Assessment (Section 6.9) (Northstar, 2024) concluded that the Project's impact on local air-quality would be minimal, with most dust exceedances due to existing background conditions. Thus, it is predicted that the Project would have an unmitigated impact of medium significance.

Noise Disturbance

Element (2024) state that three landholders raised concerns about noise as a result of the Project. The Noise Impact Assessment (Section 6.8) (MAC, 2024) confirms compliance with relevant noise criteria during both construction and operational phases, including operational traffic movements. Construction activities, including onsite construction and intersection upgrade works, are predicted to exceed noise criteria for short periods at certain sensitive receiver locations within Broken Hill. Therefore, the Project is expected to have an unmitigated impact of low significance.

Accessibility

Element (2024) state that Potential negative impacts on access to essential services, such as emergency and medical services in Wentworth were identified by the community. Medical services and facilities are available in Dareton and Wentworth, with Wentworth District Hospital offering a 24-hour emergency service, with a larger base hospital in Mildura. Element (2024) determined the Project is forecast to have an unmitigated impact of low significance.

Livelihoods

Element (2024) state that one landholder identified the following potential negative impacts associated with the Project.

- Disrupted connectivity of on-farm water storages
- Reduced groundwater levels and resulting reduced salt bush growth.
- Mining equipment operating along the property boundary would disturb and prevent livestock from grazing.
- Property devaluation
- Estimated 50% reduction in farm revenue.

Element (2024) considered each of the matters raised in light of the specialist studies completed and determined the Project is forecast to have an unmitigated impact of medium significance.

Community

Community Cohesion and Trust

Element (2024) state that one landholder identified that their relationship with the Applicant had eroded over the previous years as a result of a range of matters, including but not limited to the following.

- Exploration-related disturbance that had not be rehabilitated.
- Disclosure of the status of property purchase negotiations by the Applicant, thereby damaging the landholder's reputation with their acquaintances.
- Enforceable undertakings entered into by the Applicant in relation to reporting-related matters for exploration on Warwick Station.
- The Applicant's staff have entered the landholder's property on some occasions without notice or permission.

In relation to each of the above, the Applicant notes the following.

- The Resources Regulator undertook an investigation in relation to 50 alleged contraventions of the *Mining Act 1992*, including:
  - failing to consult with the relevant landholder;
  - failing to rehabilitate exploration-related disturbance;
  - failing to abide with the relevant access agreement; and
  - accessing the relevant landholder's property in absence of valid access agreement.

  The Resources Regulator determined after a 10 month investigation that none of the alleged breaches were sustained.
- Only senior staff of the Applicant are privy to property purchase negotiations and those staff are bound by confidentiality agreements and are well aware of confidentiality of those negotiations. As a result, the Applicant denies discussing property purchase negotiations with any party other than the landholder.

Notwithstanding the above, Element (2024) states that the landholder predicts they will have difficulty trusting the Applicant should the Project be approved.

Element (2024) also note that consultation with other Project stakeholders (including other directly affected landholders) revealed healthy relationships that demonstrate the potential for positive community cohesion and trustworthy relationships should the Project proceed. As a result, and without dismissing the concerns of one landholder, the Project is predicted to have an unmitigated impact of medium significance.

Community Function (Housing)

Element (2024) state that one landholder identified increased housing demand in Wentworth as a concern, particularly for individuals in disadvantaged socio-economic circumstances. Mitigating this concern is following.

- The Snapper and Ginko Mines are expected to close in 2025 and 2026, with sections of the workforce potentially transitioning to the Project.
- The Applicant would be able to draw workers from a wide area and accommodate them in the Mine Camp.

As a result, Element (2024) determined that the Project would have an unmitigated impact of medium significance.

6.14.7 Assessment of Mitigated Impacts

6.14.7.1 Introduction

The following subsection presents brief overview of the proposed measures to enhance positive impacts and mitigate negative impacts and an assessment of the anticipated enhanced/mitigated impacts. Section 7 of Element (2024) presents a detailed evaluation and discussion of that assessment.

6.14.7.2 Enhancement of Positive Impacts

Culture (Aboriginal Employment)

The Applicant would implement the following to enhance Project benefits associated with Aboriginal employment.

- Continue to consult with First Nations groups, individuals and businesses, including in relation to assisting the community to implement community-led initiatives, build skills and resilience, build broad community understanding and knowledge and manage heritage objects within the Mine Site.
- Develop an Aboriginal employment policy at the corporate level and applying it to any project's pursued by the company.

Element (2024) determined that if the above enhancements were implemented, the positive impact is predicted to have a high significance.

Livelihood

The Applicant would implement the above and following to enhance Project benefits associated with capacity building and business support within the Wentworth LGA.

- Develop a local business strategy or a formal procurement policy aimed at prioritising businesses within the Wentworth and Broken Hill LGAs.
- Preferentially engage local residents within the Wentworth and Broken Hill LGAs, with a particular focus on First Nations persons.
- Facilitate capacity building within the Wentworth and Broken Hill LGAs, including providing training and skill development opportunities for local residences and businesses, with a particular focus on First Nations persons and businesses.

Element (2024) determined that if the above enhancements were implemented, the positive impact is predicted to have a very high significance.

6.14.7.3 Mitigation of Negative Impacts

Health and Wellbeing

Biosecurity

The Applicant would implement the following to manage and mitigate biosecurity-related risks associated with the Project:

- Control movements of personnel and mining equipment and limit such movements to approved areas only.
- Dedicated perimeter fencing would be constructed to improve the physical separation of the mine from nearby farming operations.
- Implement more stringent induction and access procedures that would apply to all personnel.

- Implement recommendations by EnviroKey (2024) regarding weed spread controls including ensuring soil and seed material is not transferred into the site, and any weed infestation found to occur within the construction footprint is to be identified and mapped for appropriate management as part of a Biodiversity Management Plan.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of low significance.

Road Safety

The Applicant would implement the following to manage and mitigate road safety-related risks associated with the Project.

- Prepare, in consultation with Council and Transport for NSW, and implement a *Transport Management Plan*, including a Driver's Code of Conduct, detailing procedures for the construction and operational phases of the Project.
- Undertake an independent road safety audit of the proposed transport route prior to the commencement of heavy mineral product transportation.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of medium significance.

Anxiety and Personal Safety

Element (2024) state that anxiety and personal safety are a concern to one landholder and that arbitration with the Applicant is ongoing. The Applicant would implement the following to manage and mitigate anxiety and personal safety-related risks associated with the Project

- Ensure that the movement of personnel and equipment within the Mine Site is highly controlled and that go/no go areas are clearly marked on plans and on the ground with fencing, posts or other markers.
- Ensure that all contact with surrounding landholders is managed by a Senior Manager whose role is to address Project related enquiries, concerns, and any landholder grievances.
- Ensure that Project-related activities do not adversely impact on livestock fodder on non-Project related properties adjacent to the Mine Site.
- Obtain negotiated or arbitrated commercial agreements with all affected landholders within and surrounding the Mine Site.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of low significance.

Surroundings

Air Quality

Element (2024) state that concerns in relation to dust emissions impacting on livestock fodder and contaminating water tanks was a concern for one landholder. The Applicant would implement the following to manage and mitigate air quality-related social risks associated with the Project.

- Prepare and implement an *Air Quality and Greenhouse Gas Management Plan* which outlines air quality and greenhouse gas management measures and responsibilities for the Project.
- Ensure that the results of all specialist assessments and ongoing monitoring are made publicly available and are explained to interested landholders on request.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of low significance.

Livelihoods

Element (2024) state that concerns in relation to farm workability, livestock conditions, property values, and business revenue were the matters of concern to one landholder. The Applicant would implement the following to manage and mitigate livelihood-related social risks associated with the Project.

- Ensure that surrounding landholders are provided with regular updates in relation to current and forecast mining operations.
- Negotiate a suitable agreement with the owner of Huntingfield Station in relation to the existing basic landholder rights, potentially including the following.
  - Reconstruct the Huntingfield 2 Dam, including surface water diversions, in an alternate location.
  - Provide an alternate supply of water.
  - Provide suitable compensation.
- Reconstruct the Huntingfield 2 Dam within the rehabilitated landform, including lining the dam with clay to limit seepage.
- Obtain negotiated or arbitrated commercial agreements with all affected landholders within and surrounding the Mine Site.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of low significance.

Community

Community Cohesion and Trust

The Applicant would implement the following to manage and mitigate community cohesion and trust-related social risks associated with the Project.

- Prepare a *Landholder Relations Plan*, including a landholder communications and engagement strategy and program for the ongoing analysis of social risks and opportunities arising from the Project.

- Ensure that surrounding landholders are provided with regular updates in relation to current and forecast mining operations.
- Ensure that the movement of personnel and equipment within the Mine Site is highly controlled and that go/no go areas are clearly marked on plans and on the ground with fencing, posts or other markers.
- Ensure that all contact with surrounding landholders is managed by a Senior Manager whose role is to address Project related enquiries, concerns, and any landholder grievances.
- Ensure that the results of all specialist assessments and ongoing monitoring are made publicly available and are explained to interested landholders on request.
- Obtain negotiated or arbitrated commercial agreements with all affected landholders within and surrounding the Mine Site.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of medium significance.

Community Function (Housing)

The Applicant would implement a Project strategy to prioritise the employment of local residents, thereby reducing the demand on housing stock required by an otherwise in-migrating workforce. Some strategies that the Project has committed to in this regard include the following.

- Develop a local business strategy or a formal procurement policy aimed at prioritising businesses within the Wentworth and Broken Hill LGA's.
- Preferentially engage local residents within the Wentworth and Broken Hill LGAs, with a particular focus on First Nations persons.
- Facilitate capacity building within the Wentworth and Broken Hill LGAs, including providing training and skill development opportunities for local residences and businesses, with a particular focus on First Nations persons and businesses.

Element (2024) determined that if the above management and mitigation measures were implemented, the negative impact is predicted to be of low significance.

Additional Management and Mitigation Measures

The Applicant would implement the following additional management and mitigation measures to minimise social risks associated with the Project.

- Negotiate good neighbour agreements with all Mine Site neighbours and residents along Anabranch Mail Road, and ensure that landholder concerns are adequately addressed.
- Maintain regular communication with the operators of surrounding mining operations to address potential cumulative impacts resulting from each company's operations.

- Regularly publish newsletters and distribute information in relation to the Project and provide other opportunities for the community to obtain information on the Project, including town hall meetings, open days, presentations to schools and other community groups, etc.
- Enter into Planning Agreements with Wentworth Shire Council and Broken Hill Council.
- Identify capacity constraints within the Wentworth LGA and work with Council to address them to maximise social and economic benefits for the local community.

Monitoring

Monitoring and management of the Project's potential social impacts can be integrated into the environmental management plans. The management plans would provide a mechanism to manage social issues identified by the SIA relating to:

- Biosecurity and health and wellbeing;
- Radioactive material and health and wellbeing;
- Project related traffic;
- Dust generated by the Project;
- Noise and vibration generated by the Project; and
- Community cohesion and trust.

Additionally, the Landholder Relations Plan recommended for the Project would provide a program for the ongoing monitoring of social issues related to the project. This includes a regular analysis of complaints, formal and informal feedback from the community, a consultation log of key consultation activities recorded by RZ Resources, and any technical monitoring outcomes.

6.14.8 Conclusion

Element (2024) has assessed both the negative and social positive impacts of the Project. Due to the location and setting of the Project, there would be mostly positive impacts for the community as a whole. The predicted adverse impacts are primarily expected to be direct and localised relating to health and wellbeing, surrounding amenity, accessibility, livelihoods and community.

The Applicant would seek to minimise these impacts through open, honest and proactive consultation with the local community and, where appropriate, adaptation of its operation or mitigation measures to address reasonable community concerns.

The Project would, however, result in substantial positive impacts in the wider community in terms of continuation of employment, workforce and supplier expenditure, and community investment and cohesion, with many of these benefits also expected to be experienced by the local community.

6.15 Economic Impacts

6.15.1 Introduction

The SEARs for the Project require the EIS to include a detailed assessment of the likely economic impacts of the development, paying particular attention to:

- "the significance of the resource;
- the costs and benefits of the development, identifying whether the development as a whole would result in a net benefit to NSW and region, including consideration of fluctuation in commodity markets and exchange rates;
- estimates of employment generation broken down into direct/indirect, ongoing and construction, operator/ contract workers as full-time equivalent (FTE) roles,
- demand for the provision of local infrastructure and services; and
- the need for a Voluntary Planning Agreement in relation to the demand for the provision of local infrastructure and services."

In addition, the Mining, Exploration and Geoscience Group within the Department of Regional NSW requested that the EIS provide an assessment of the Project's economics that includes:

- price forecasts by product type used by the proponent; and
- total royalty generated annually and over the Project-life.

Appendix 1 presents an overview of the SEARs and any additional government agency requirements, as well as where each of these has been addressed.

Synergies Economic Consulting prepared the *Economic Impact Assessment* (EIA) for the Project. That report, hereafter referred to as Synergies (2024) is presented as **Appendix 15**. This subsection provides a summary of the EIA.

6.15.2 Approach to the Economic Impact Assessment

In assessing the economic impacts of the Project, Synergies (2024) considered:

- the economic feasibility of the Project by undertaking a cost-benefit analysis (CBA);
- the net benefits of the Project to the NSW community;
- the employment, non-labour project expenditure, and environmental and social effects of the Project on the local community;
- the flow-on economic impacts attributable to the Project; and
- the impacts of the Project on the regional labour market.

Synergies (2024) relied upon information provided by the Applicant and third-party market forecasts to assess the Project-related economic benefits to NSW in accordance with the *Guideline for the Economic Assessment of Mining and Coal Seam Gas Proposals* (DPIE, 2015).

In addition to assessing the net economic benefit to be derived from the project using the standard cost-benefit analysis approach, Synergies (2024) also assessed the net benefit of the project to the NSW community, and a local effects analysis to the Wentworth Shire LGA, in accordance with the NSW Government-recommended evaluation approach.

Furthermore, whilst the EIA quantified the economic benefits of the Project based on the export value of the mineral product, Synergies (2024) also considered the strategic benefits of the Project that included:

- the implied growth in Australian critical minerals production;
- downstream mineral separation and processing for final manufacture of high value products; and
- enhancing Australia's self-sufficiency in the supply of critical minerals, thus reducing strategic risk associated with a reliance on imports.

This strategic value has been recognised by both the NSW and Australian Government's through their respective critical minerals strategies[6].

6.15.3 Cost Benefit Analysis

6.15.3.1 Cost Benefit Analysis Methodology

Overview

The following key steps formed part of the CBA undertaken for the Project. Further details of the CBA approach are provided in Section 3 of Synergies (2024). It is noted that the CBA not only assesses the costs and benefits of the Project's mining, road and rail transport activities to the State of NSW, but also considers mineral processing at the Applicant's Mineral Separation Plant located in Pinkenba, Queensland and the subsequent export of mineral product either shipped directly from the Mine Site or following further processing in Pinkenba. Where the EIA assesses the net costs and benefits of the Project's mining, road and rail transport activities, they apply to the State of NSW as a whole and not to the Applicant or the community immediately surrounding the Mine Site.

- Identification of the 'base case' (without) and 'Project case' (with) scenarios. Synergies (2024) states that the assessment of the incremental changes of the Project-case against the base case as being the relevant means to quantifying the Project's CBA.
- Identification of the incremental benefits and costs.
- Consolidation of value estimates using discounting to account for temporal differences over the 20-year evaluation period.
- Sensitivity testing.

[6] NSW Government (2021b) *Critical Minerals and High-Tech Metals Strategy*
Australian Department of Industry, Science and Resources (2022) *Critical Minerals Strategy 2022*.

'Base Case' and Project Case Scenarios

The Based Case or 'without' Project scenario forms the base case for the CBA against which the potential economic, environmental, social and cultural impacts of the Project are assessed. This scenario assumes the following.

- Agricultural production on the lands within the Mine Site would continue under current management regimes, with no increase in carrying capacity.
- The groundwater resources within the Mine Site carry no material economic value because they are hypersaline.
- The land use and remaining vegetation and species carry no material economic value due to the land being heavily degraded in the past.
- The resources within the Mine Site would remain in the ground, increasing the strategic risk associated with Australia's continued reliance on the importation of critical minerals.

The 'with' Project scenario assumes that the Project is approved and developed as described in Section 3.

Identification of Incremental Benefits and Costs

Synergies (2024) identified the Project-related benefits and costs that are presented in **Table 6.15.1** and which included the following.

- Value of the Project's minerals production.
- A loss of agricultural production on land to be disturbed by the Project.
- Initial and sustaining capital costs.
- Operational and maintenance costs such as:
  - soil and overburden removal;
  - o-site processing and off-site mineral separation (Pinkenba, Queensland);
  - rail transportation (Rail Facility to Brisbane railhead);
  - road transportation (Mine Site to Rail Facility or port and Brisbane railhead to Pinkenba); and
  - port storage and handling.
- Rehabilitation costs (Mine Site).
- Greenhouse gas emissions abatement costs (Mine Site and Mineral Separation Plant).
- Road transportation costs (e.g. noise, air quality and greenhouse gas emissions).
- Groundwater licensing costs.

Table 6.15.1
Overview of Cost Benefit Analysis Results

Metric	Estimate ($m, Present Value)[1]
Economic benefits	
Value of minerals and rare earths production	$4,416
Total economic benefits	**$4,416**
Operating and maintenance costs	
Foregone value of alternative land uses (grazing)	($0.7)
Capital and sustaining costs	($889)
Operating and maintenance costs	
General	*($3)*
Geology	*($7)*
Mining	*($870)*
Processing	*($479)*
Mine Site Infrastructure	*($103)*
Off-Site Infrastructure	*($5)*
Logistics	*($571)*
ESG (Land rehabilitation costs)	*($71)*
Project delivery	*($20)*
Overheads	*($193)*
Subtotal	($2,322)
Greenhouse gas emissions and other externalities	
Road and rail externalities	*($50)*
The Mine and MSP operations	*($99)*
Subtotal	($149)
Groundwater licensing costs	($3)
Total economic costs	**($3,364)**
Net Present Value	**$1,052**
Benefit Cost Ratio	**1.31**
Note 1: Real social discount rate of 5%	
Source: Synergies (2024) – Table 6	

Synergies (2024) also identified that costs associated with impacts on air quality, visual amenity, surface water, soil and costs of additional travel time on road networks would be negligible whilst impacts on Aboriginal and historic heritage or biodiversity could not be quantified.

In quantifying the Project's costs and benefits, Synergies (2024) has allowed for a 5% real social discount rate to convert future benefits and costs into a present value, in accordance with the NSW Treasury framework.

6.15.3.2 Cost Benefit Analysis Results

Table 6.15.1 presents an overview of the results of the CBA analysis over the 20-year evaluation period. Detailed results of the CBA are presented in Section 7 of Synergies (2024). The estimated Net Present Value (NPV) of the Project is **$1,052 million**. The Project can thus be considered as representing a worthwhile and economically efficient use of the resources employed.

6.15.3.3 Cost Benefit Analysis Sensitivity Analysis

Synergies (2024) undertook a sensitivity analysis for the following variables.

- The discount rate; the sensitivity analysis assumed rates of 3% and 7%.
- In addition to assessing the CBA's sensitivity to changes in the discount rate, Synergies (2024) also conducted a sensitivity analysis of the CBA using the following parameters:
  - Capital costs ± 20%
  - Operating costs ± 20%
  - Price projections ± 20%
  - Greenhouse gas abatement costs ± 50%
  - Exchange rates (USD to AUD - ±5 basis points)

Sensitivity analysis of the discount rate identified the Project NPV would vary from $708 million (7% discount rate) to $1,519 million (3% discount rate). Synergies (2024) also determined that the CBA was not particularly sensitive to assumptions made regarding the discount rate, largely due to the relatively short construction period and quick production ramp-up. Under all sensitivity scenarios examined, Synergies (2024) assessed the Project as having a cost-benefit ratio greater than one. The analysis identified that the CBA was most sensitive to price projections, followed by operating costs. **Table 6.15.2** presents the full results of sensitivity analyses undertaken.

Table 6.15.2
Results of Sensitivity Analysis

Parameter	Net Present Value[1]	Benefit Cost Ratio
Base results	$1,052	1.31
Capital costs		
Low (-20%)	$1,230	1.39
High (+20%)	$875	1.25
Operating costs		
Low (-20%)	$1,517	1.52
High (+20%)	$588	1.15
Price projections		
Low (-20%)	$169	1.05
High (+20%)	$1,936	1.58
Emissions allowance unit price		
Low (-50%)	$1,102	1.33
High (+50%)	$1,003	1.29
USD:AUD exchange rate		
Low ($0.65 AUD)	$1,392	1.41
High ($0.75 AUD)	$758	1.23
Note 1: Real social discount rate of 5%		
Source: Synergies (2024), Table 8		

6.15.4 Net Benefits to NSW

6.15.4.1 Net Benefits Analysis Methodology

Using the CBA, Synergies (2024) evaluated the Project's net benefits to the State of NSW in accordance with the *Guideline for the Economic Assessment of Mining and Coal Seam Gas Proposals* (DPIE, 2015). A brief overview of the key components of the net benefits analysis and their assumptions is provided below.

- The net producer surplus

  This component is derived based on the following formula: *Revenue - (Costs + Taxes + Royalties)*. In accordance with DPIE (2015), Synergies (2024) assumed that:

  – a 32% share of total net producer surplus would be retained in the State of NSW.

  – a 32% share of Commonwealth taxes would be returned to the State of NSW.

  – NSW would retain 100% of royalties payable by the Project.

- Benefits to existing landholders

  The value of the land within the limit of disturbance, based on current (grazing) land uses is approximately $670,817 in PV terms (5 per cent real). Synergies (2024) conservatively assumed no additional surplus is expected for existing landholders based on land acquisitions at market value.

- Benefits to workers

  This component assumes all Project employees receive wages that are consistent with market rates.

- Benefits to suppliers

  This component assumes all suppliers to the Project earn similar margins to those received from other sources.

- Net environmental, social and transport costs

  This component accounts for the various costs for the abatement of greenhouse gas emissions as well as road and rail transportation within NSW. As noted in Section 6.15.3.1, costs associated with a range of amenity impacts would be negligible whilst impacts on Aboriginal and historic heritage or biodiversity could not be quantified.

- Net public infrastructure costs

  This component accounts for any public infrastructure upgrade costs. However, these would all be met by the Applicant and are therefore included in the Project's capital cost estimate.

6.15.4.2 Net Benefits Analysis Results

Table 6.15.3 presents the results of the analysis of the Project's net benefits to NSW based on the CBA. Detailed results of this analysis are presented in Section 8 of Synergies (2024).

Table 6.15.3
Analysis Results for Project Net Benefits to NSW

Item	Incremental NPV ($M)	State of NSW Share (%)	Net Benefit / (Cost) to NSW (NPV, $M)
Net producer surplus	$434	32	$138
Commonwealth Taxes	$626	32	$200
Royalties	$143	100	$143
Benefits to existing landholders	-	-	-
Benefits to workers	-	-	-
Benefits to suppliers	-	-	-
Net Benefit to NSW			**$481**
Net environmental, social and transport costs			
Road and Rail	($50)	100	($50)
Greenhouse Gas	($99)	100	($99)
Net public infrastructure costs	-	-	-
Net Cost to NSW	-		**($149)**
Source: Synergies (2024) – Table 10			

As shown in **Table 6.15.3**, the Project would result in a **$481 million** net benefit to the State of NSW and an associated **$149 million** net cost.

6.15.4.3 Net Benefit Sensitivity Analysis

Synergies (2024) undertook a sensitivity analysis of the net benefit analysis for the following variables.

- The discount rate; the sensitivity analysis assumed rates of 3% and 7%
- Price projections ± 20%
- Taxes ± 50%
- Royalties ± 25%

This sensitivity analysis of the net benefits to the State of NSW identified results that were generally consistent with that undertaken for the CBA, namely that the Project's net benefits were most sensitive to price projections, particularly for rare earths and minerals. This notwithstanding and based on the sensitivity analysis undertaken, the Project would deliver a net benefit to NSW under all scenarios assessed.

6.15.5 Local Effects Analysis

6.15.5.1 Local Area Affected

The local area considered by Synergies (2024) for the Project's local effects analysis (LEA) was the Wentworth Local Government Area (LGA). Synergies (2024) noted that whilst DPIE (2015) recommends that an LEA consider an Australian Bureau of Statistics Level 3 Statistical Area[7], it was not considered appropriate for this analysis as the relevant Statistical Area (Lower Murray) fully or partially encompasses multiple economies (i.e. the Balranald, Polygon, Hay and Murray River LGAs) that would potentially lie outside the Project's direct influence.

6.15.5.2 Project-related Economic Components Relevant to the Local Area

Synergies (2024) identified the following components of the Project as being relevant to the LEA.

- Local employment effects based on the net benefits of the Project's direct employment of local residents in the Wentworth LGA and the relevant increase in incomes for the Project-related employees when compared to the average income for employees within the Wentworth LGA.
- Non-labour expenditure effects based on the Project's direct expenditure within the Wentworth LGA. This expenditure share was derived from Synergies' development of a non-linear input-output model (NLIO) that is described in Section 11 of Synergies (2024).
- Environmental and social effects based on the assumptions adopted for the NSW net benefit analysis described in Section 6.15.4 namely:
  - abatement of greenhouse gas emissions.
  - road and rail transportation within the Wentworth LGA.

6.15.5.3 Local Effects Analysis Results

The following presents an overview of the results of the local effect analysis (LEA) for the Project. Detailed results of the LEA are presented in Section 10 of Synergies (2024). It is however noted that the individual component values are not additive when considering the results of an LEA.

- Employment

  The Project would locally provide an additional 480 fulltime equivalent (FTE) positions during construction and 240 FTE during operations. This assumes that the Applicant would source 50% of employees from within the Wentworth LGA.

[7] The Australian Bureau of Statistics identifies that Level 3 Statistical Areas are designed to provide a regional breakdown of Australia. They generally have a population of between 30,000 and 130,000 people. In regional areas, they represent the area serviced by regional cities that have a population over 20,000 people.

- Average net Project-related employee income[8]

  Based on the employment assumptions above, Synergies (2024) identified that local employees residing in the Wentworth LGA would receive an average net income of $89,686/year for construction employees and $61,486/year for operational employees. These average net incomes are considerably higher than the $58,046 average net income for other employees in the Wentworth LGA. This would generate an additional approximately $7.92 million in wages during the construction phase of the Project and $0.41 million per year during the operational phase. This would generate additional economic activity as a substantial proportion of the wages paid would be spent within the Wentworth LGA.

- Non-labour Project expenditure

  The costs associated with the Project's construction are estimated to result in approximately $207.0 million being directly spent within the Wentworth LGA. During operations, the Project is expected to annually contribute between $29.64 million and $97.63 million to the local economy. This would be a significant boost to activity levels in all industrial sectors of the Wentworth LGA providing the Project's required goods and services.

- Environmental and social effects

  Synergies (2024) estimated the local costs for the abatement of greenhouse gas emissions would be $84 million whilst the amenity costs for road and rail transportation would be $3 million.

Whilst not directly accounted for in the LEA, the Project would also result in payments to both the Wentworth Shire and Broken Hill City Councils. This would include rates payable to the Wentworth Shire Council as well as payments to both Councils under the respective Planning Agreements that would be negotiated with the Applicant.

6.15.6 Economic Impact Assessment

6.15.6.1 Introduction

Sections 11 and 12 of Synergies (2024) presents the results of the economic impact assessment undertaken. Synergies (2024) state that while cost benefit analysis and local effects analysis focus on primary impacts (i.e. first round impacts) economic impact assessment modelling encompasses flow-on impacts (second and third-round impacts). The economic impacts for the Project have been estimated using a non-linear input-output (NLIO) model described in Section 11.1 of Synergies (2024).

[8] In accordance with DPIE (2015), average net income is the disposable income remaining from gross income after superannuation and tax payments.

6.15.6.2 NSW Economic Impact Analysis

Table 6.15.4 details the results of the economic impact modelling for the NSW and presents the overall contributions of the Project to the NSW economy.

Table 6.15.4
Economic Impacts on NSW

Metric	Unit	Construction Phase Benefits (3 years)	Operational Phase Benefits (17 years)	Total Benefits (20 years)
Additional Output	$million	$1,860	$12,160	$14,020
Gross State Product (GSP)	$million	$718	$4,600	$5,318
Labour Income	$million	$351	$1,700	$2,051
Employment supported	FTEs (peak)	1,465	1,133	
Source: Synergies (2024) – Section 12.1.1 and 12.1.2				

6.15.6.3 Wentworth LGA Economic Impact Analysis

Table 6.15.5 details the results of the economic impact modelling for the Wentworth LGA presents the overall contributions of the Project to the Wentworth LGA.

Table 6.15.5
Economic Impacts on Wentworth LGA

Metric	Unit	Construction Phase Benefits (3 years)	Operational Phase Benefits (17 years)	Total Benefits (20 years)
Additional Output	$million	$1,280	$10,690	$11,970
Gross State Product (GSP)	$million	$339	$1,560	$1,899
Labour Income	$million	$308	$848	$1,156
Employment supported	FTEs (peak)	754	580	
Source: Synergies (2024) – Section 12.2.1 and 12.2.2				

6.15.7 Regional Labour Market Impacts

Synergies (2024) assessed the impact of the Project on the regional labour market. This includes the extent to which the labour requirements would be sourced by the regional market for both the construction and operation phase of the Project.

The following steps were undertaken assess the extent to which the regional labour market would be capable of meeting the labour requirements for the Project:

- Assessment of the potential sources of labour supply in the regional economy, where at least some of the required skills and qualifications are available.
- Assessment of the extent to which the potential labour supply sources are feasible sources of labour supply for RZ Resources, having regard to labour force data and the occupational and industrial structure of the regional economy.

- Analysis of the extent to which the feasible labour supply potential of the regional economy could be used to meet the labour requirements of the Project.

Table 6.15.6 presents Synergies assessment of the occupational and industrial structure of Wentworth and Mildura labour forces and the subsequent implications on the Project.

Table 6.15.6
Implications on the Regional Labour Market and Labour Requirements for the Project

Occupation	Construction FTEs required	Operation FTEs required	Availability in Regional Labour Market
Managers	19	10	• Managers are the most common occupation in the Wentworth-Mildura labour forces • There is likely to be substantial potential for sourcing managers from the regional economy, with it being the fourth largest industry in the region • However, there is likely to be strong competition for construction managers (Synergies, 2024)
Technicians and Trade Workers	154	38	• The Wentworth and Mildura regions have a high proportion of Technicians and Trade Workers relative to the NSW economy • There is significant potential for these workers to be adequately sourced from within the regional economy • However, due to the proportion of people lacking trade and technical qualifications, the ability to source these workers would depend on the extent to which the skills and qualifications of the region's existing labour force in this occupation are aligned with the project's requirements • Synergies (2024) highlights that this is likely to represent a significant gap and require RZ Resources to source labour from outside of the regional labour force
Professionals	38	52	• There is relatively low proportion of Professionals in the Wentworth and Mildura regions • the only source of Professionals in the regional labour market are likely to be employed in the Health and Social Assistance industry and, to a lesser extent, the Agriculture, Forestry and Fishing industry. • Synergies (2024) recommends RZ Resources' labour sourcing strategy involve attracting workers from these industries within the regional labour market, or would be required to source these workers from outside of the regional labour force
Clerical and Administrative Workers	26	10	• Synergies (2024) indicates that RZ Resources would be able to source these workers from within the regional labour market, either from currently employed or unemployed persons.

Table 6.15.6 (Cont'd)
Implications on the Regional Labour Market and labour requirements for the Project

Occupation	Construction FTEs required	Operation FTEs required	Availability in Regional Labour Market
Machinery Operators and Drivers	73	76	• It is likely that workers in larger industries in the region such as Agriculture, Forestry and Fishing would be able to adapt to the requirements of these positions on the Project. • Synergies (2024) recommends wage premiums be offered to attract these workers from other industries
Labourers	170	54	• Labourers account for a significant proportion of employed persons in both Wentworth and Mildura. • RZ is expected to source these workers from within the regional labour market, either from currently employed or unemployed persons.
Source: Synergies (2024) – Tables 27 and 28			

As demonstrated in **Table 6.15.6**, the Project would generate significant employment in the Wentworth LGA, with total employment supported of 754 FTEs during the construction phase and 300 FTEs during operations at peak production. Total employment in the Wentworth region is currently estimated at 2,960, indicating that an increase in employment attributable to the Project is 25 per cent during construction and 10 per cent at full scale operation. Synergies (2024) indicates that the regional labour market is currently experiencing a period of low unemployment and constrained labour supply, with an unemployment rate of 3.2 per cent and only 142 unemployed persons in the region.

The impacts of the planned closure of the Snapper and Gingko mineral sands mines in the region would significantly impact that labour availability for the Project. Under the scenario in which these two mines close as scheduled and workers are not reallocated to other projects, it is likely that all labour requirements for the Projects would be met from within the broader region.

Alternatively, in the absence of labour to be made available as a result of these projects, there would likely be a need for either an increase in the population, and hence labour force of the region, or labour sourced from outside of the region. As described above, the key constraints on local labour supply for the Project are expected to be for Professionals and Technicians and Trades Workers, having regard for the skills and qualifications within the regional labour force.

6.15.8 Management and Mitigation Measures

In addition to the environmental management and mitigation measures identified throughout Section 6, the Applicant would implement the following management and mitigation measures to ensure that economic benefits arising from the Project are maximised and adverse impacts are minimised. The proposed measures represent the full range of reasonable and feasible mitigation measures taking into consideration the residual economic-related risks presented in **Appendix 2**.

- Enter into Planning Agreements that would be negotiated with the Wentworth Shire and Broken Hill City Councils for the life of the Project.

- Implement a local employment and procurement process that would:
  - give preference when engaging new employees to candidates who live within the Wentworth LGA;
  - give preference to suppliers of equipment, services or consumables located within the Wentworth LGA;
  - encourage and support participation of potential locally-based employees and contractors in appropriate training or education programs to build capacity within the surrounding areas; and
  - encourage and support participation of the Aboriginal community and organisations in Project-related employment and supply services.

6.15.9 Conclusion

The CBA undertaken by Synergies (2024) indicates that the Project would generate a NPV of $1,052 million with a benefit to cost ratio of 1.31. In addition, the Project would result in a $331 million net benefit to the State of NSW. Sensitivity analyses conducted for both the CBA and the net benefits to the State of NSW identified these were most susceptible to variation in the price received for the minerals produced by the Project. However, even with the alteration of this variable and a range of others, the Project's benefits, especially with regard to NSW, would be overwhelmingly positive and is therefore desirable and justified from an economic efficiency perspective.

The direct employment of an additional 240 fulltime equivalent (FTE) positions during construction and 120 FTE during operations would generate additional benefits to the local area economy and stimulate indirect economic activity within the local area via both wage and non-wage expenditure.

The main local environmental impacts are internalised into the initial and sustaining capital costs of the Applicant through improvements to public infrastructure, mitigation, offset and compensation costs. Residual financial costs associated with local environmental impacts are therefore likely to be immaterial.