

appendix e

# Environmental Impact Assessment

## TENINDEWA PROCESSING FACILITY

Environmental Impact Assessment  
AP-0000-ENV-REP-00001

**FINAL**

December 2023



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Environmental Impact Assessment  
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### FINAL

Prepared by  
Umwelt (Australia) Pty Limited  
on behalf of  
Australian Vanadium Limited

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Report No. 6183/R25/V3  
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This report was prepared using  
Umwelt's ISO 9001 certified  
Quality Management System.

### **Acknowledgement of Country**

*Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.*

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# 1.0 Introduction

Australian Vanadium Limited (AVL) is an emerging vanadium producer focused on the Australian Vanadium Project (the Project) in Western Australia. Vanadium is mainly used to strengthen steel, with growing demand from the battery market. An Australian invention, the Vanadium Flow Battery (VFB) is set to play a vital role in the battery revolution. Vanadium's use in master alloys for defence and aerospace applications makes it a critical mineral.

AVL's strategy is underpinned by the steel market which has increasing demand for vanadium, whilst securing the long-term viability of the Project by delivering products to both the steel and battery markets. AVL's vision is to supply its high-grade product to battery makers worldwide, a market expected to grow significantly on the back of increased renewable energy generation. Through its 100% owned subsidiary, VSUN Energy, AVL is developing the VFB market in Australia.

AVL has completed a bankable feasibility study (BFS) for the Project. The BFS highlights AVL's potential to become a new, low-cost producer, with an initial mine life of 25 years. The location of the vanadium processing plant in Tenindewa would also facilitate processing of vanadium concentrate from other mines in the Mid-West region.

AVL and VSUN Energy are both members of the Future Battery Industries Cooperative Research Centre and are engaged with the WA Government Future Battery Industry Strategy and the Federal Government's Critical Minerals Facilitation Office.

The project was awarded Major Project Status by the Federal Government in September 2019 and Lead Agency Status by the State Government in April 2020. AVL intends to develop the following facilities:

- Mining Facility – mining and primary processing of the ore to produce vanadium concentrate. Mining operations will occur mainly within tenement M51/878 (granted on 28/08/2020) located within the Shire of Meekatharra. Additional tenements are currently under application to support the project.
- Processing Facility – processing of the vanadium concentrate from the mining operations to produce an iron-titanium co-product and a high purity vanadium pentoxide product. The proposed processing facility will be located on Lots 40 and 41 on Plan 28736 (7224 Geraldton - Mount Magnet Road) within the City of Greater Geraldton.
- Vanadium Electrolyte Manufacturing Facility – to undertake further downstream processing of high purity vanadium pentoxide to produce electrolyte for use in vanadium batteries. The manufacturing facility is under construction in Wangara, in the northern suburbs of Perth.

The vanadium concentrate will be transported to the Processing Facility via Local Government Roads and Main Roads.

The Mining Facility is currently under assessment by the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (EP Act). Secondary environmental approvals for the Mining Facility will be sought in due course.

To allow for construction and operation of the Processing Facility, approval under the *Planning and Development Act 2005* (Planning Act) is required. Lots 40 and 41 are currently zoned as 'Rural' under the

City of Greater Geraldton Local Planning Scheme No. 1 (the scheme). Under the scheme, an area zoned as 'Rural' does not permit the use of the land for industrial purposes. Therefore, AVL has submitted a Development Application to the State Development and Assessment Unit (SDAU) concurrent with a scheme amendment application to City of Greater Geraldton (CoGG).

The Tenindewa Vanadium Processing Facility was referred to the WA EPA under section 38 of the EP Act in April 2022. The Chair of the EPA determined on 27 July 2022 not to assess the proposal, as the EPA considered that the likely environmental effects of the proposal were not so significant as to warrant formal assessment. The EPA concluded that the potential impacts of the proposed Processing Facility could be managed through the proposed management and mitigation measures and assessment by other statutory decision-making authorities under Part V of the *Environmental Protection Act 1986* and the *Rights in Water and Irrigation Act 1914*.

To support the Development Application, this environmental impact assessment has been undertaken to identify key environmental risks, mitigation strategies and expected environmental approvals pathways. The following sections have been presented in this report:

- **Section 2.0** provides an overview of the processing facility and type of infrastructure that will be constructed. Information in **Section 2.0** will assist in determining the key potential sources of pollution.
- **Section 3.0** describes the purpose and approach used to assess the risk of the project to the environment.
- **Section 4.0** presents the outcomes of the assessment and proposed controls.
- **Section 5.0** provides an overview of the environmental approvals pathway for the project.

The Processing Facility is expected to bring a positive impact to the local community via creation of job opportunities and by supporting local business in the area.

## 2.0 Processing Facility Overview

### 2.1 Location

The processing facility is near Tenindewa, a small rural locality of agricultural properties. The Tenindewa locality is approximately 80 km east of Geraldton and 27 km west of Mullewa on the Geraldton-Mount Magnet Road and lies within the City of Greater Geraldton (**Figure 1**).

The City of Greater Geraldton is also the regional service centre for the Mid-West region of Western Australia. It contains varied environments including fertile farmland, forests, rivers and coastal areas and is rich in indigenous and pioneering history. The region's economy is based on tourism, mining and agriculture as well as the Port of Geraldton, a major west coast port.

The processing location is on private land currently used for agricultural purposes. It is directly adjacent to Geraldton-Mount Magnet Road and is identified as Lot 40 and Lot 41 on Plan 28736. The Tenindewa railway siding is located at 1.5 km from the site's northern boundary and the nearest residence to the processing location is Smith's homestead (1.5 km west of Lot 40 boundary). No natural, historic, visual or recreational amenity values have been identified within the surrounding area.

AVL has an Option Agreement with the landowners which includes conditions relating to future purchase of the land for use by AVL. Access to the premises is via the Geraldton-Mount Magnet Road and Erangy Springs Road.

### 2.2 Proposal Description

The Processing Facility will include the following components:

- Two new access roads and internal roads.
- Materials storage and laydown areas.
- Processing plant.
- Power station, including solar component.
- Bores to source groundwater from the deep aquifer.
- Lined evaporation ponds.
- Temporary workers accommodation.
- Office and other support facilities.

The vanadium concentrate arriving at the processing site will either be directly tipped into the concentrate feed bins or into the concentrate stockpile which will be a designed facility for temporary storage until it is fed into the feed bins via a front-end loader. Handling of the concentrate will occur in the concentrate handling area and subsequent processing will involve the following activities:

- Mixing & pelletising.

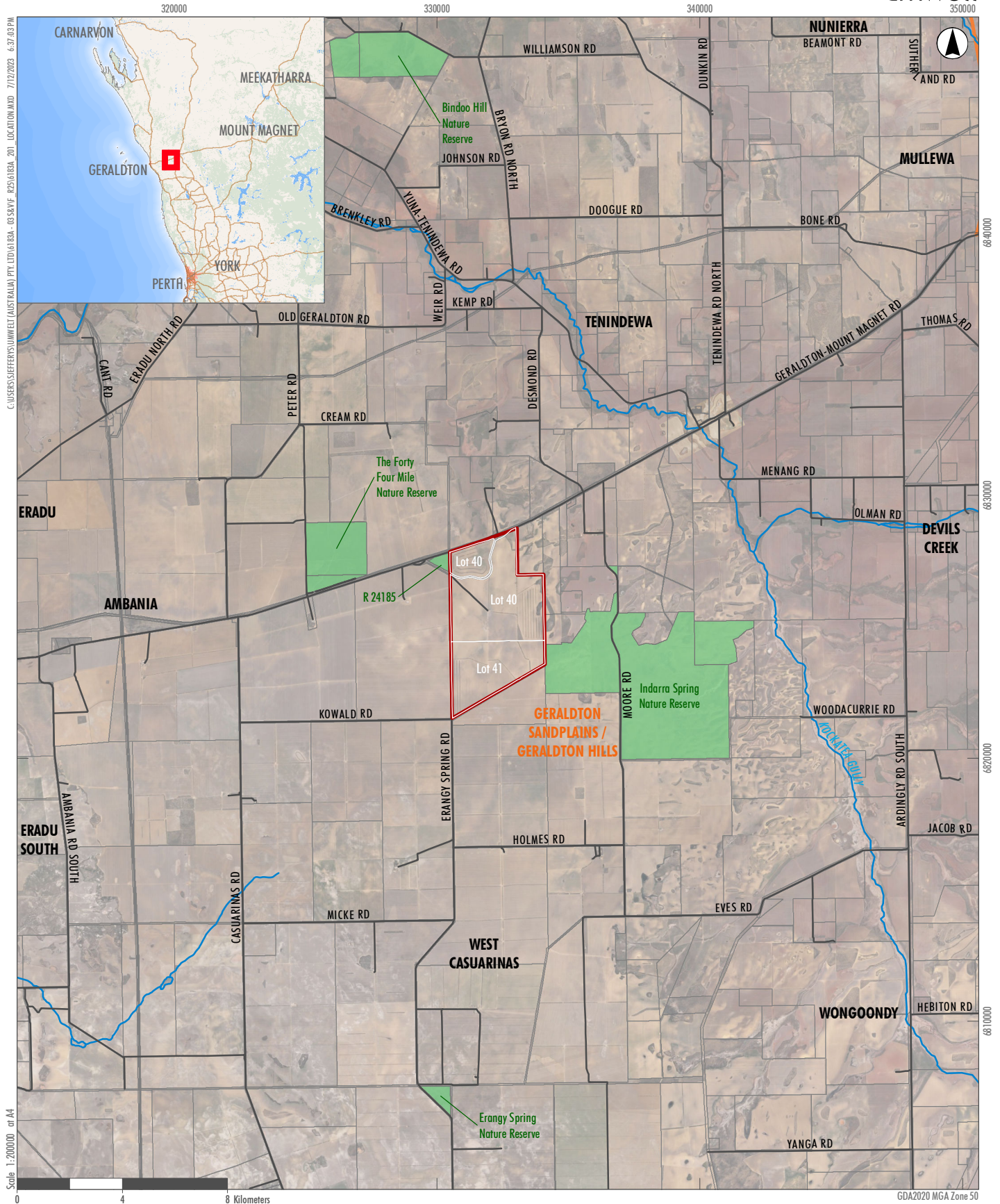
- Roasting.
- Leaching (generation of the iron-titanium co-product).
- Desilication.
- Precipitation.
- Barren solution treatment.
- Vanadium pentoxide production (generation of product – vanadium pentoxide solid flakes).

**Figure 2** is a process flow diagram demonstrating the steps involved in processing of vanadium concentrate at the Processing Facility. The Processing Facility has a maximum steady state design capacity of 13,000 tonnes of  $V_2O_5$  flake (98.5% w/w) per annum and approximately 1,050,000 tonnes of iron-titanium co-product. The vanadium pentoxide will be packaged for transport to Fremantle Port for export, and the iron-titanium co-product will be bulk transported and exported via Geraldton Port.

Raw inputs during processing are expected to include sodium carbonate, organic binder, flocculant, sulphuric acid, aluminium sulphate, ammonium sulphate, sodium metabisulphite and sodium hydroxide. All reagents will be stored in designated and suitably designed chemical storage areas. The process will also use raw water, and natural gas for direct combustion in the kiln and power generation. Renewable and hydrogen energy sources are expected to be included and increased as they become available and viable.

There will be air emissions from the processing plant, which will be mitigated via filters and scrubbers and other typical industrial processes to meet emissions limits and ensure there is no adverse impact to sensitive receptors and landowners. The only other waste from the process is barren solution, which will be treated to neutralise the pH and stored in lined ponds for evaporation. The residue will comprise salts, which may be a future product if a suitable market can be found.





- Legend**
- Project Area
  - Property Boundaries
  - IBRA Regions / Sub-regions
  - Nature Reserves
  - Roads
  - Watercourses

FIGURE 1

Processing Site Location

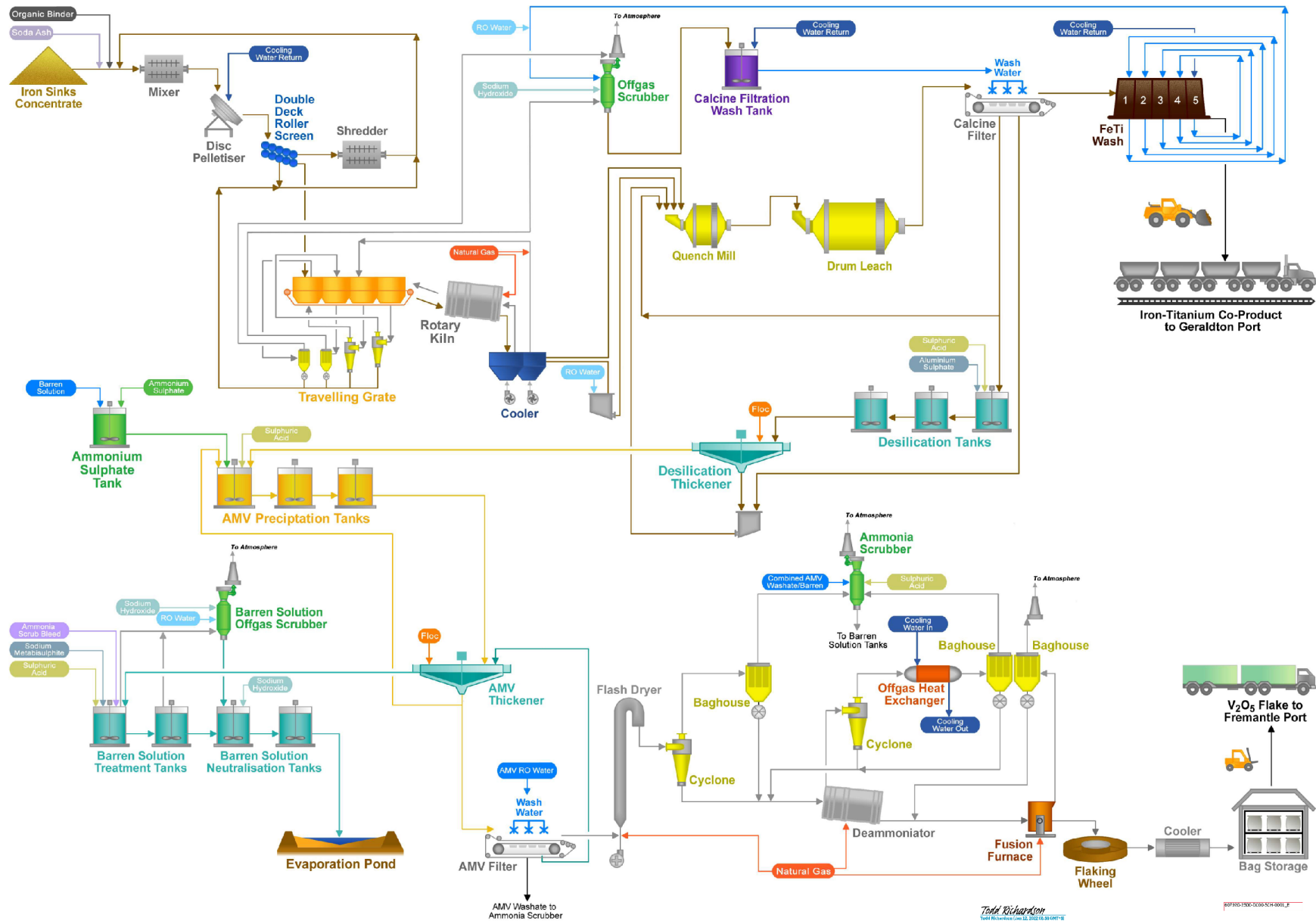


FIGURE 2  
Processing Plant - Process Flow  
Diagram



## 3.0 Preliminary EIA Approach

The preliminary environmental impact assessment (EIA) reviewed the proposed activities to determine potential environmental impacts, and identified environmental and social receptors that might be impacted. The purpose of the assessment was to understand potential environmental impacts, determine areas of focus for mitigation of the impacts and verify the environmental approvals pathway.

Sensitive receptors were determined by using the following guidance:

- EPA key environmental factors as defined under the *Statement of environmental principles, factors, objectives and aims of EIA* (EPA, 2023).
- *Matters of National Environmental Significance - Significant impact guidelines 1.1* (DAWE, 2013).
- *DWER Guideline: Environmental Siting* (DWER, Guideline: Environmental siting, 2020).

Based on the preliminary environmental impact assessment, the Proposal is not expected to have a significant impact on the environment or any Matters of National Environmental Significance (MNES).

## 4.0 Environmental Impact Assessment

### 4.1 Flora and Vegetation

*EPA Environmental Factor Guideline: Flora and Vegetation* (EPA, 2016a) has been used to address this section.

#### Receiving Environment

A field survey was undertaken in September 2022 to survey flora and vegetation in a Study Area encompassing native vegetation at the Processing Facility and nearby road reserves.

The results of the *Tenindewa Baseline Reconnaissance and Targeted Survey Report* (Umwelt, 2023) are summarised below and presented in **Figure 3**.

A total of 165 discrete vascular flora taxa were recorded in the Survey Area during this survey, representing 40 families and 99 genera. A total of seven introduced taxa and four planted taxa (native taxa but not indigenous to the area) were recorded within the Survey Area. No Declared Pests (as listed under the *Biosecurity and Agriculture Management Act 2007* (Department of Primary Industries and Regional Development 2022) or Weeds of National Significance (Weeds Australia 2022) were recorded.

One Threatened flora taxon (Federally and State listed) was recorded in the Survey Area, being *Caladenia wanosa* (T). This taxon was found in the central portion of Erangy Springs Road (**Sheet 2 of Figure 3**).

Eight State-listed Priority flora taxa were recorded in the Survey Area comprising *Tricoryne* sp. Geraldton (G.J. Keighery 10461) (P1), *Caladenia pluviialis* (P2), *Petrophile pilostyla* subsp. *syntoma* (P2), *Acacia leptospermoides* subsp. *psammophila* (P3), *Baeckea* sp. Walkaway (A.S. George 11249) (P3), *Thryptomene hubbardii* (P3), *Verticordia chrysostachys* var. *pallida* (P3) and *Verticordia capillaris* (P4). Most of the priority listed taxa were found within Erangy Springs Road reserve, Geraldton-Mt Magnet Road reserve, and remnant vegetation in the northeastern corner of Lot 40.

Two vegetation types were described and mapped within the Survey Area via structural vegetation classification. In addition, five highly modified areas were mapped in the Survey Area, which are vegetated to some extent but do not closely resemble intact remnant vegetation. These areas include non-indigenous and planted trees, potentially self-introduced trees from nearby plantings, some remnant native taxa and native disturbance specialists that have likely colonised the area post-disturbance. None of the vegetation described and mapped within the Survey Area is considered to be representative of any Threatened or Priority listed ecological community, nor considered to be significant for any other reason (as per the Environmental Protection Authority Technical Guidance and Factor Guideline).

The majority of the Survey Area (1,369.4 ha / 95.6 %) was cleared land consisting predominantly of paddocks with crops, pasture or agricultural weeds. A total of 63.5 ha (4.4 % of the Survey Area) was vegetated (including vegetation types and highly modified areas), with the condition ranging from Excellent to Completely Degraded. The vegetation condition of the vegetation types ranged from Excellent to Degraded, with vegetation impacted by edge effects, weeds and disturbance associated with farming, quarrying, and road or rail construction.

### Potential Impacts

The Processing Facility will be sited on agricultural land that has been cleared of native vegetation, which minimises the amount of native vegetation clearing required.

Priority flora were found within Erangy Springs Road reserve, Geraldton-Mt Magnet Road reserve, and remnant vegetation in the northeastern corner of Lot 40. Establishment of site entry and exit points may require small amounts of native vegetation clearing, which might include clearing of Priority flora if they can't be avoided.

There is a risk of accidental clearing of protected flora if land disturbance occurs outside of planned areas. This risk is highest during construction activities.

There may be minor indirect impacts to native vegetation in the adjacent reserves, such as dust emissions.

### Mitigation Measures

Disturbance of the one recorded location of Threatened Flora *Caladenia wanosa* will be avoided.

The final design of the site access roads will be adjusted where possible to avoid locations of Priority flora.

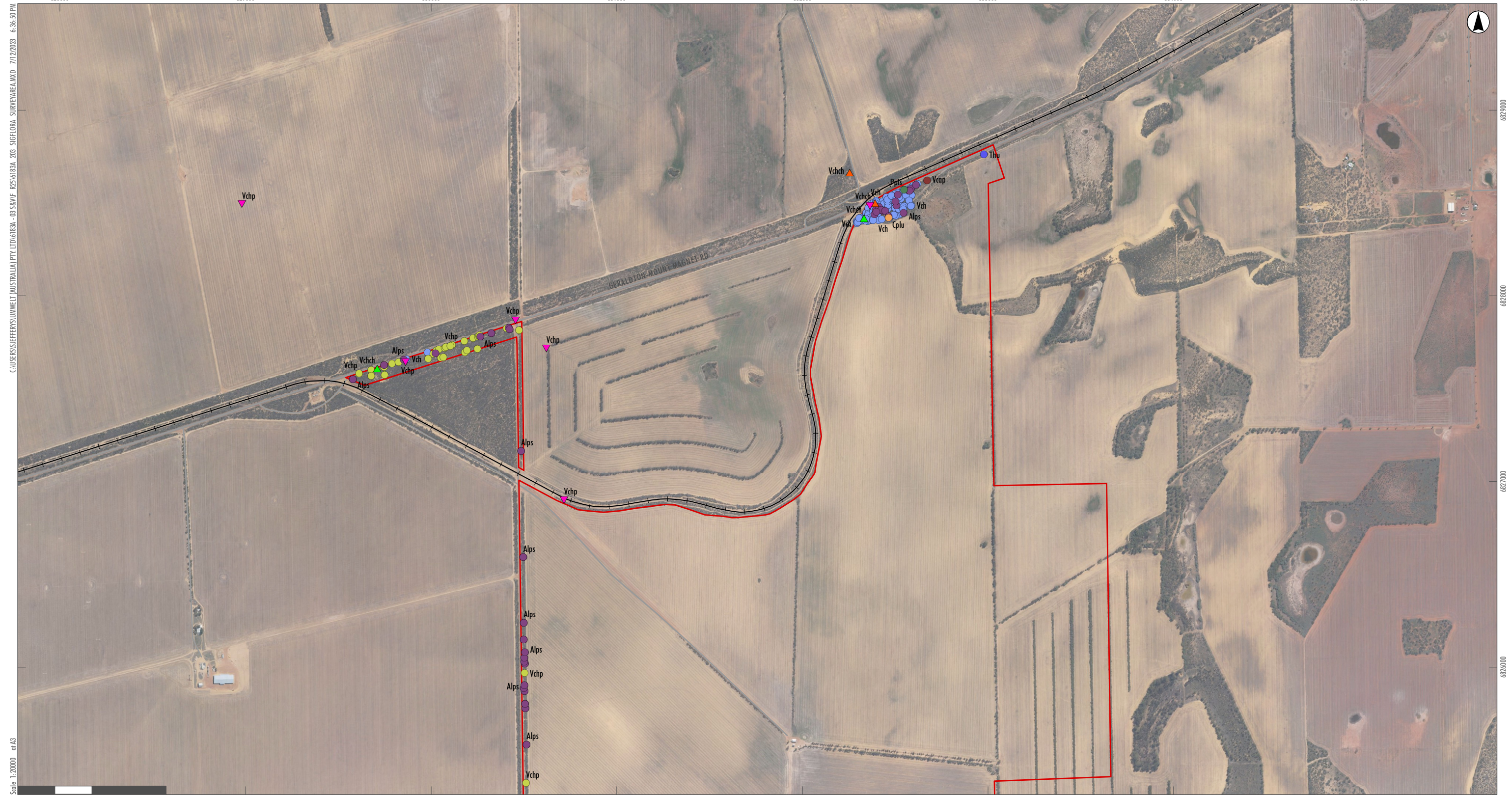
A native vegetation clearing permit will be obtained prior to clearing any native vegetation.

Management measures will be in place to prevent indirect impacts to the species such as dust suppression activities and clear demarcation of approved disturbance areas to prevent unauthorised clearing and disturbance. Controls to prevent indirect impacts are expected to be managed under the DWER Part V approvals and will include the following:

- an internal clearing permitting process
- an online GIS database with location of key species
- dust suppression as required during construction and operations to prevent excessive dust emission and deposition on nearby vegetation.



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Legend

- Survey Area
- Railways
- Roads
- Drainage Lines

Significant Flora

Umwelt

- Alps *Acacia leptospermoides* subsp. *psammophila* (P3)
- BspW *Baeckea* sp. Walkaway (A.S. George 11249) (P3)
- Cplu *Caladenia pluvialis* (P2)
- Cwa *Caladenia wanosa* (T)

DBCA Records

- Ppis *Petrophile pilostyla* subsp. *syntoma* (P2)
- Thu *Thryptomene hubbardii* (P3)
- TspG *Tricoryne* sp. Geraldton (G.J. Keighery 10461) (P1)
- Vcap *Verticordia capillaris* (P4)
- Vch *Verticordia chrysostachys* (variety uncertain)
- Vchp *Verticordia chrysostachys* var. *pallida* (P3)
- Vchp *Verticordia chrysostachys* var. *pallida* (P3)

Other Flora

- Vchch *Verticordia chrysostachys* var. *chrysostachys* - Umwelt
- Vchch *Verticordia chrysostachys* var. *chrysostachys* - DBCA

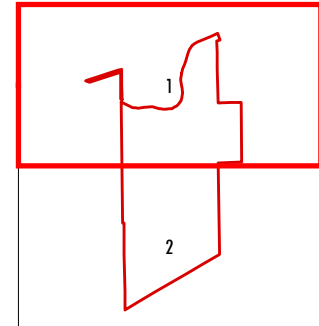


FIGURE 3

Significant Flora of the Survey Area



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GDA2020 MGA Zone 50

Legend

- Survey Area
- Railways
- Roads
- Drainage Lines

Significant Flora

Umwelt

- Alps *Acacia leptospermoides* subsp. *psammophila* (P3)
- BspW *Baeckea* sp. Walkaway (A.S. George 11249) (P3)
- Cplu *Caladenia pluvialis* (P2)
- Cwa *Caladenia wanosa* (T)

- Ppis *Petrophile pilostyla* subsp. *syntoma* (P2)
- Thu *Thryptomene hubbardii* (P3)
- TspG *Tricoryne* sp. Geraldton (G.J. Keighery 10461) (P1)
- Vcap *Verticordia capillaris* (P4)
- Vch *Verticordia chrysostachys* (variety uncertain)
- Vchp *Verticordia chrysostachys* var. *pallida* (P3)

DBCAs Records

- Vchp *Verticordia chrysostachys* var. *pallida* (P3)

Other Flora

- Vchch *Verticordia chrysostachys* var. *chrysostachys* - Umwelt
- Vchch *Verticordia chrysostachys* var. *chrysostachys* - DBCA

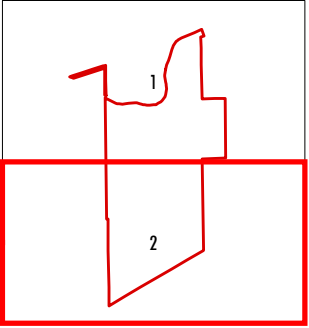


FIGURE 3  
Significant Flora of the Survey Area  
SHEET 2



## 4.2 Terrestrial Fauna

*EPA Environmental Factor Guideline: Terrestrial Fauna* (EPA, 2016f) has been used to address this section. Terrestrial fauna can be defined as all vertebrates and invertebrates that live on land.

### Receiving Environment

To identify presence of conservation significant fauna under the *Biodiversity Conservation Act 2016* (BC Act), a DBCA fauna search was requested. The Protected Matters Search Tool (PMST) was also used to identify presence of any Commonwealth-protected fauna species as listed under the EPBC Act. Summary of findings have been presented in **Table 4.1**.

The DBCA search identified 28 birds, 3 invertebrates and 4 reptile conservation significant fauna species that have previously been recorded within 60 km of the Processing Facility. The closest significant species recorded, Yuna broad-blazed slider (*Lerista yuna*), listed as Priority 3 under the BC Act, has been recorded 8 km east of the Processing Facility.

The PMST search tool identified 6 birds, 1 invertebrate and 1 mammal conservation-significant species that may potentially occur within the project boundary. However, none of these species have been previously recorded within the project boundary.

**Table 4.1 Conservation Significant Terrestrial Fauna from Database Searches**

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of presence	Nearest Record
<b>Birds</b>					
<i>Actitis hypoleucos</i>	Common sandpiper	MI	MI		50 km (DBCA)
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI		50 km (DBCA)
<i>Arenaria interpres</i>	Ruddy turnstone	MI	MI		60 km (DBCA)
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI		55 km (DBCA)
<i>Calidris alba</i>	Sanderling	MI	MI		60 km (DBCA)
<i>Calidris ferruginea</i>	Curlew sandpiper	CR	CR	May occur	35 km (DBCA)
<i>Calidris melanotos</i>	Pectoral sandpiper	MI	MI		20 km (DBCA)
<i>Calidris ruficollis</i>	Red-necked stint	MI	MI		60 km (DBCA)
<i>Calyptorhynchus banksii</i>	Forest red-tailed black cockatoo	VU	VU		30 km (DBCA)
<i>Charadrius leschenaultii</i>	Greater sand plover	VU	MI		50 km (DBCA)
<i>Elanus scriptus</i>	Letter-winged kite	P4			30 km (DBCA)
<i>Falco hypoleucos</i>	Gray falcon	VU	VU	May occur	
<i>Falco peregrinus</i>	Peregrine falcon	OS			30 km (DBCA)
<i>Hydroprogne caspia</i>	Caspian tern	MI	MI		60 km (DBCA)
<i>Leipoa ocellata</i>	Malleefowl	VU	VU	Likely to occur	25 km (DBCA)
<i>Limosa lapponica</i>	Bar-tailed godwit	MI	MI		55 km (DBCA)

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of presence	Nearest Record
<i>Macronectes giganteus</i>	Southern giant petrel	MI	EN		60 km (DBCA)
<i>Oxyura australis</i>	Blue-billed duck	P4			25 km (DBCA)
<i>Pandion cristatus</i>	Osprey	MI	MI		30 km (DBCA)
<i>Pezoporus occidentalis</i>	Night parrot	EN	CR	May occur	
<i>Plegadis falcinellus</i>	Glossy ibis	MI	MI		20 km (DBCA)
<i>Pluvialis squatarola</i>	Grey plover	MI	MI		60 km (DBCA)
<i>Rostratula australis</i>	Australian painted-snipe	EN	EN	May occur	
<i>Sternula nereis nereis</i>	Fairy tern	VU	VU		30 km (DBCA)
<i>Thalasseus bergii</i>	Crested tern	MI	MI		30 km (DBCA)
<i>Thinornis rubricollis</i>	Hooded plover	P4			60 km (DBCA)
<i>Tringa brevipes</i>	Grey-tailed tattler	P4	MI		50 km (DBCA)
<i>Tringa glareola</i>	Wood sandpiper	MI	MI		50 km (DBCA)
<i>Tringa nebularia</i>	Common greenshank	MI	MI		50 km (DBCA)
<i>Zanda latirostris</i>	Carnaby's cockatoo	EN	EN	Likely to occur	10 km (DBCA)
<i>Zanda sp. 'white-tailed black cockatoo'</i>	White-tailed black cockatoo	EN	EN		10 km (DBCA)
<b>Invertebrates</b>					
<i>Idiosoma arenaceum</i>	Geraldton Sandplain shield-backed trapdoor spider	P3			35 km (DBCA)
<i>Idiosoma clypeatum</i>	Northern shield-backed trapdoor spider	P3			35 km (DBCA)
<i>Idiosoma nigrum</i>	Shield-backed trapdoor spider	EN	VU	May occur	
<i>Idiosoma sp.</i>	An Idiosoma trapdoor spider	EN			15 km (DBCA)
<b>Reptiles</b>					
<i>Lerista yuna</i>	Yuna broad-blazed slider	P3			8 km (DBCA)
<i>Aspidites ramsayi</i> (southwest subpop.)	Woma (southwest subpop.)	P1			20 km (DBCA)
<i>Cyclodomorphus branchialis</i>	Gilled slender blue-tongue	VU			25 km (DBCA)
<i>Egernia stokesii badia</i>	western spiny-tailed skink	VU			25 km (DBCA)
<b>Mammals</b>					
<i>Dasyurus geoffroii</i>	Chuditch	VU	VU	May occur	

\*Conservation status P1=Priority 1; P3=Priority 3; P4=Priority 4; T=Threatened; EN=Endangered; VU=Vulnerable; CR=Critically Endangered; MI=Migratory; OS=Otherwise Specially Protected

### Potential Impacts

No direct impacts to conservation significant fauna are expected. The proposed development footprint falls in a largely cleared area and limited vegetation clearing would be required to support the project. However, fauna may be subject to indirect impacts including:

- Vehicle strikes on main roads and access roads from traffic movement.
- Noise and vibration leading to fauna migration away from the project area into non suitable habitats and predation zones.
- Fauna death by drowning in hazardous waste containment ponds.
- Light emissions from operations impacting nocturnal fauna.

### Mitigation Measures

Indirect impacts to fauna will be mitigated and assessed under Part V of the EP Act.

## **4.3 Subterranean Fauna**

*EPA Environmental Factor Guideline: Subterranean Fauna* (EPA, 2016d) has been used to address this section. Subterranean fauna can be classified as two groups, stygofauna which is capable of living in aquatic environments and predominantly found in groundwater and troglodfauna which is an air-breathing species predominantly found in caves and voids.

### Receiving Environment

There is a superficial low salinity aquifer hosted in the Wagina Sandstone occurring at approximately 20 m below ground level. This is expected to be used by local farmers. There may be potential habitat for stygofauna in this aquifer.

The superficial aquifer is isolated from the deep High Cliff aquifer by a clay aquitard. The deep aquifer occurs at a depth of over 200 m below ground level. There is a low likelihood of stygofauna being present at such a depth.

### Potential Impacts

There will be no direct impacts to subterranean fauna. No major excavational works or mining activities will occur within the project area.

Although groundwater abstraction will occur, the water source for this project is the deep aquifer, at a depth of over 200 m below ground level. The proposed groundwater abstraction from the deep aquifer is not expected to impact on the superficial aquifer. Therefore, any groundwater drawdown will be below a depth that could provide suitable habitat for stygofauna.

## **4.4 Inland Waters – Surface Water**

*EPA Environmental Factor Guideline: Inland Waters* (EPA, 2018b) has been used to address this section. Surface water includes wetlands, waterways, estuaries, lakes, rivers.



## Receiving Environment

A desktop assessment was undertaken to understand the surface water context of the area. Findings have been summarised below:

- Ramsar sites – Ramsar site are wetlands that are internationally recognised through the Ramsar Convention and protected by the Australian government. The DBCA dataset-010 (Ramsar Sites) (DataWA, 2021) was used to determine the presence of any sites near the project area. No Ramsar Sites were identified.
- Important wetlands – Important wetlands are classified as nationally significant wetlands and are listed under the “Directory of Important Wetlands in Australia”. The DBCA-0415 (Directory of Important Wetlands in Australia – Western Australia) dataset (DataWA, 2021) was used to determine the presence of any important wetlands and no important wetlands were identified.
- As per the DWER Hydrography Linear (Hierarchy) DWER-031 dataset, the following water bodies are located near the project area (DataWA, 2021):
  - Kockatoa Gully which is a minor river is located at 7.8 km directly east of the project boundary.
  - Greenough river which is a mainstream is located at 16.7 km north-west of project boundary.
  - There is an unnamed minor tributary located at 8.9 km south-west of the project boundary.
- The project area is located within the Greenough River basin catchment area (DWER-027 dataset) and Greenough River, Tributaries and Catchment sub catchment area (DWER-030 dataset) within the Indian ocean division (DWER-029 dataset) (DataWA, 2021).

The main receiving environment comprise the rivers/tributaries and nature reserves surrounding the project area. **Figure 1** provides the location of the nearby water bodies.

## Potential Impacts

Impacts to the Greenough River and Tributaries Catchment Area can possibly occur if waste containment infrastructure fails or bunds are over-topped. This could occur during large rainfall and flooding events or due to poorly designed, constructed or maintained infrastructure. This potential impact is assessed in **Section 4.6 Terrestrial Environmental Quality**.

## Mitigation Measures

AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant and hazardous material storage facilities. The design, construction, commissioning and operations of the processing plant and associated facilities that may discharge or emit materials to the environment will be regulated by DWER under Part V of the EP Act.

Further mitigation measures are described in **Section 4.6 Terrestrial Environmental Quality**.

## **4.5 Inland Waters – Groundwater**

*EPA Environmental Factor Guideline: Inland Waters* (EPA, 2018b) has been used to address this section. Groundwater which includes confined and unconfined aquifers.

## Receiving Environment

A desktop assessment was undertaken to understand the groundwater context of the area. Findings are summarised below:

- As per the DWER-083 WRIMS Groundwater Subareas dataset (DataWA, 2021), the project area is located within the Gascoyne groundwater area and Casuarina and Yuna/Eradu subareas.
- As per the DWER-033 Public Drinking Water Source Areas dataset (DataWA, 2021), the project is not located within any public drinking water source areas.
- Private bores are present within and surrounding the project area. Limited information is available as no sampling has been undertaken thus far but DWER's Water Reporting Portal shows private bores have been installed to a maximum depth of 21.3 m below ground level (mbgl) (DWER, 2021a).
- A hydrogeological investigation was undertaken by Rockwater in 2021, which informed preparation of the *Bore Completion Report and H2 Level Hydrogeological Assessment* (Rockwater, 2022). Based on investigations carried out by Rockwater, there is a shallow low salinity aquifer hosted in the Wagina Sandstone occurring at approximately 20 m below ground level. There is also a deep aquifer hosted in the High Cliff Formation occurring at a depth of over 200 m below ground level. The groundwater quality of the deep aquifer was sampled in September 2021, and was brackish (6,850 mg/L total dissolved solids). The shallow aquifer is isolated from the deep aquifer by a clay aquitard that is over 30 m thick.
- The shallow aquifer is expected to be used by local farmers. The deep aquifer is the proposed water source for AVL.

## Potential Impacts

Potential impacts to groundwater include:

- Change in groundwater quality could occur if waste containment infrastructure fails or bunds are overtopped. This could occur during large rainfall and flooding events or due to poorly designed, constructed or maintained infrastructure. This potential impact is assessed in **Section 4.6 Terrestrial Environmental Quality**.
- Decrease/drawdown of groundwater levels could occur from groundwater abstraction. The proposed groundwater abstraction could draw down groundwater levels in the deep aquifer.

## Mitigation Measures

AVL was issued a Licence to Take Groundwater (GWL 208955(1)) in July 2023, for abstraction of up to 1.2 GL of groundwater from the deep aquifer. Abstraction of groundwater will be managed in accordance with the approved *Water Resource Operating Strategy GWL208955(1)* (Australian Vanadium Limited, 2023), which includes monitoring and reporting of groundwater use, water levels and water quality.

AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant and hazardous material storage facilities. The design, construction, commissioning and operations of the processing plant and associated facilities that may discharge or emit materials to the environment will be regulated by DWER under Part V of the EP Act.

Further mitigation measures are described in **Section 4.6 Terrestrial Environmental Quality**.

## 4.6 Terrestrial Environmental Quality

*EPA Environmental Factor Guideline: Terrestrial Environmental Quality* (EPA, 2016e) has been used to address this section. Terrestrial environmental quality can be defined as the chemical, physical, biological and aesthetic characteristics of soils.

### Receiving Environment

The proposed site has a long history of agricultural use (crops such as wheat and canola) and the soil in the area is suitable for agriculture. No soil sampling has been undertaken to date to investigate soil characteristics in the area. To further understand the soil characteristics in the area, the following searches were undertaken:

- DWER-059 (Contaminated Sites Database) dataset was checked for the presence of any contaminated sites within 3 km of the proposal area (DataWA, 2021). No contaminated sites were identified.
- DWER-048 (Acid Sulphate Soil Risk Map 100K) dataset was assessed to determine the presence of any Acid Sulphate soil risks in the area (DataWA, 2021). No risk for Acid Sulphate Soils was identified.
- The Natural Resource Information (WA) online database provided the following context (DPIRD, 2021):
  - The area comprises the Binnu East Subsystem 4 (soil landscape map unit 227Be\_4) and the Eradu 1 subsystem (soil landscape map unit 220Er\_1).
  - The soil landscape mapping shows that the area is characterised by:
    - level to gently sandplains and relict hardpan wash plains on Permian and Carboniferous sedimentary rocks of the Perth Basin
    - yellow deep sands, red-brown hardpan shallow loams, yellow sandy earths, red sandy earths, deep, yellow siliceous clayey sands and pale sands over ferruginous gravel.
  - Both soil units have a high to extreme hazard potential for wind erosion.
  - Both soil units show no potential for water erosion hazards.
  - The soils show low salinity and alkalinity at surface. Soil unit 227Be\_4 shows potential for acidity at surface but no potential for acidity at subsurface. Both soil units show no potential for alkalinity at subsurface.

### Potential Impacts

Construction and operational activities may potentially impact the soil quality within the proposal area. At the end of the operations, the use of the soil within the proposal area for agricultural purposes may not be viable without mitigation measures. Social and economic impacts from changes of the current land use and impacts to agricultural productivity are discussed in the Social Surroundings environmental factor.

The feasible impacts to terrestrial environmental quality are grouped into impacts to topsoil revegetation quality, and potential discharge of contaminants.

### Potential impacts to topsoil quality and revegetation include:

- Poor topsoil stripping and handling practices during construction phase leading to insufficient material for rehabilitating the area.
- Poor weed management hygiene on the site leading to introduction of invasive species.
- Loss of soil during windy days due to soil characteristics demonstrating high to extreme potential for wind erosion.

### Potential impacts from discharge of contaminants:

Proposal activities will use, handle and store materials which, if discharged into the environment, have the potential to adversely impact terrestrial environmental quality, as well as other environmental values.

**Table 4.2** lists the potential contamination sources, and the pathways by which these contaminants might impact soils. **Table 4.2** also lists the soil receptor locations and the other environmental values that might be reasonably impacted.

**Table 4.2 Potential Contaminants, Contamination Pathways and Soil-Related Receptors**

Contamination Source	Potential Contamination Pathway	Potential Receptor
Hydrocarbons stored in appropriately designed facilities and used in plant and vehicles	Leak, spill or failure leading to hydrocarbon discharge from storage facility, vehicle, plant or workshop	<ul style="list-style-type: none"> <li>• Plant area or other cleared disturbed area – no topsoil</li> <li>• If not cleaned up, may impact on shallow groundwater or surface water</li> </ul>
Reagents stored in appropriately designed facilities and used in the processing plant	Leak, spill, overtopping or failure leading to reagent discharge from storage facility, pipeline or plant facility	<ul style="list-style-type: none"> <li>• Plant area or other cleared disturbed area – no topsoil</li> <li>• If not cleaned up, may impact on shallow groundwater or surface water</li> </ul>
Concentrate stored in stockpiles	Leaching from stockpile Water erosion/runoff from stockpile Wind erosion from stockpile	<ul style="list-style-type: none"> <li>• Leaching into shallow groundwater</li> <li>• Transport by surface water to undisturbed areas including topsoil</li> <li>• Transport by wind to undisturbed areas including topsoil and adjacent land</li> </ul>
Intermediate liquids formed as part of processing stored in appropriately designed facilities and used in the plant	Leak, spill, overtopping or failure leading to intermediate liquid discharge from storage facility, pipeline or plant facility	<ul style="list-style-type: none"> <li>• Plant area or other cleared disturbed area – no topsoil</li> <li>• If not cleaned up, may impact on shallow groundwater or surface water</li> </ul>

Contamination Source	Potential Contamination Pathway	Potential Receptor
<b>Calcine solids stored in appropriately designed facility, washed to leach out further vanadium-rich solution</b>	Leak, spill, overtopping or failure leading to discharge of wash water or leachate from storage facility Water erosion/runoff from stockpile Wind erosion from stockpile	<ul style="list-style-type: none"> <li>Leaching into shallow groundwater</li> <li>Transport by surface water to undisturbed areas including topsoil</li> <li>Transport by wind to undisturbed areas including topsoil and adjacent land</li> </ul>
<b>Emissions to air from processing plant</b>	Particulate emissions from flash dryer, de-ammoniator or fusion furnace (gaseous emissions are considered in Air Emissions section)	<ul style="list-style-type: none"> <li>Transport by wind to undisturbed areas including topsoil and adjacent land</li> </ul>
<b>Vanadium pentoxide product</b>	No pathways identified, solid metallic material packaged for transport.	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>
<b>Iron-titanium product</b>	Leak, spill or failure leading to discharge from storage facility Water erosion/runoff from stockpile Wind erosion from stockpile	<ul style="list-style-type: none"> <li>Leaching into shallow groundwater</li> <li>Transport by surface water to undisturbed areas including topsoil</li> <li>Transport by wind to undisturbed areas including topsoil and adjacent land</li> </ul>
<b>Final waste liquids treated to reduce toxicity (neutralised barren solution), evaporated in appropriately designed facilities</b>	Leak, spill or failure leading to discharge from plant facility, pipeline or storage facility	<ul style="list-style-type: none"> <li>Plant area or other cleared disturbed area – no topsoil</li> <li>In the event of a large discharge or failure, may impact on adjacent land</li> <li>If not cleaned up, may impact on shallow groundwater or surface water</li> </ul>
<b>Residual salts remaining from evaporation of neutralised barren solution, stored in appropriately designed facilities</b>	Residual salts may be permanently retained in a lined encapsulated storage facility on site after closure of the processing plant.	<p>Future land uses would be restricted in the area immediately above and surrounding the storage facility to prevent damage to the encapsulation. This may reduce economic value of the land and ability to use it for agriculture.</p> <p>Alternatively, the residual salts may be removed and the entire processing area remediated.</p>

The environmental values that may feasibly be impacted by discharge of contaminants are topsoil quality, groundwater quality and surface water quality, and associated water-dependent environmental values.

## Mitigation Measures

Risks to terrestrial environmental quality and associated management controls will be assessed and managed as part of the Works Approval and Operating Licence application through DWER Industry Regulation, under Part V of the EP Act (see **Section 5.0**).

The following measures will be implemented during detailed design, construction and operations to minimise potential impacts to terrestrial environmental quality:

### **Mitigation of impacts to topsoil quality and revegetation:**

- Topsoil from areas proposed for disturbance will be stripped and stored for use in rehabilitation.
- Appropriate measures will be taken to maintain the viability and quantity of topsoil, these may include:
  - Stripping topsoil as soon as possible following vegetation clearing.
  - Avoiding stripping and handling of soil during windy or wet conditions.
  - Covering soil stockpiles with stripped vegetation.
  - Limiting the height of stockpiles to 2 m.
  - Using only water of acceptable salinity for dust suppression on topsoil stockpiles.
  - Considering the use of dust suppression surfactants for long-term soil stockpiles.
  - Locating stockpiles in flood-free areas which are also sheltered from wind exposure and have sufficient separation distance from unsealed roads to minimise the risk of saline water spray accumulating on stored topsoil.
- Processes for management of weeds will be determined in consultation with adjacent landowners, and may include:
  - Weed and seed checks of vehicles prior to entering site during topsoil stripping.
  - Regular weed surveys and control measures as required.

### **Mitigation of impacts from discharge of contaminants:**

- Storage, handling, reporting, monitoring and clean-up of reagents, hydrocarbons and other pollutants will be undertaken in accordance with standard safety management practices and regulatory requirements including the *Work Health and Safety Act 2020*, *Dangerous Goods Safety Act 2004* and EP Act Part V (Industry Regulation).
- Spills will be recorded and cleaned up as soon as practicable to mitigate ongoing pollution.
- Concentrate, intermediate products and final products will be further characterised including assessment of physical properties and risk of metalliferous drainage.
- All environmentally hazardous materials will be stored and transported through the process site in facilities designed in accordance with relevant guidelines such as *Water quality protection note no. 61 – tanks for ground level chemical storage* (Department of Water, 2008), *Water quality protection note no.*

26 - *Liners for containing pollutants, using synthetic membranes* (Department of Water, 2013), *Water quality protection note no. 65 – Toxic and hazardous substances storage and use* (Department of Water, 2006) or other appropriate guideline. These requirements include use of chemically-resistance containers, suitable bunding and secondary containment, and separation of clean stormwater.

- Waste containment infrastructure will be designed, constructed and operated to manage the risk of flooding or overtopping. Regular visual inspections of waste containment infrastructure will be undertaken to ensure freeboard level and structural integrity are maintained.
- Groundwater monitoring bores will be installed and regular monitoring undertaken of ambient groundwater quality in the shallow aquifer, to detect any adverse impacts on groundwater quality from unknown leaks or other sources.
- Options for final disposal of residual salts will be explored prior to closure of the Processing Facility, and include:
  - AVL will seek opportunities for recovery and sale of salts that may become technically or financially viable over time.
  - Excavation and removal of salts from the lined facilities and disposal to an approved off-site location.
  - Encapsulation of residual salts in an enclosed permanent storage facility on site, which would restrict possible future land uses over the area where the salts are stored to prevent damage to the encapsulation.
- The method of final disposal of residual salts will be agreed with relevant stakeholders (including local landowners, local government authority and relevant regulators) prior to closure of the processing plant.
- At the time of closure, the processing plant will be decommissioning, deconstructed and removed from site for appropriate disposal or resale if possible. Any residual contamination will be remediated for a final land use agreed with relevant stakeholders prior to closure.
- Concentrate storage and processing area to be equipped with engineering controls to prevent dust emissions.
- Concentrate transport to be undertaken in tarped trucks to prevent emission of concentrate to the environment and prevent soil contamination due to deposition of the concentrate on the soil.

AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant and hazardous material storage facilities. The design, construction, commissioning and operations of the processing plant and associated facilities that may discharge or emit materials to the environment will be regulated by DWER under Part V of the EP Act.

## 4.7 Air Quality

The *EPA Environmental Factor Guideline: Air Quality* (EPA, 2020) defines air quality as the chemical, biological and aesthetic characteristics of air. Human health impacts are generally associated with emissions of particulates and pollutants.

### Receiving Environment

The homesteads closest to the boundary of Lot 40, which will host the Processing Facility, are located:

- 1.5 km west of Lot 40
- 1.7 km north of Lot 40
- 2.0 km northeast of Lot 40.

Climate records for Mullewa indicate the regional prevailing wind direction in the morning is from the east-southeast with afternoon winds coming from the southwest (Bureau of Meteorology, 2020).

All the nearest neighbouring homesteads might be in the direction of the prevailing winds at times.

### Potential Impacts

An air quality assessment was undertaken to model the predicted air emissions and dispersion from the Processing Facility. The *Tenindewa Project Air Quality Assessment Report* (Environmental Technologies & Analytics, 2023) used predicted emission rates and operating parameters to model emissions from the Processing Facility including material handling. The air pollutants relevant to the Processing Facility are particulate matter (dust), nitrogen dioxide, ammonia, sulphuric acid, and vanadium.

The modelling and analysis were undertaken in accordance with:

- *Air Quality Monitoring Guidance Notes* (DoE, 2006)
- *Guideline – Air Emissions, draft* (DWER, 2019)
- *Guideline – Dust Emissions, draft* (DWER, 2021)
- National Environmental Protection (Ambient Air Quality) Measure.

The predicted ground-level concentrations of pollutants and background air quality were compared to the ambient air quality assessment criteria, in accordance with the above guidelines.

The air quality assessment determined that the predicted air emissions associated with the Processing Facility would remain below the relevant ambient air quality assessment criteria at all homesteads, and at the boundary of Lots 40 and 41 (**Table 4.3**).

Predicted annual average PM<sub>2.5</sub> (fine particulate matter) is above the air quality assessment criteria as the background concentration exceeds the assessment criteria. The Processing Facility contributes a very small component of PM<sub>2.5</sub> emissions.



**Table 4.3 Predicted Air Emissions at the Processing Facility**

Pollutant	Ambient Air Quality Assessment Criteria			Maximum Off-site Emissions at Lots 40 & 41 Boundary	
	$\mu\text{g}/\text{m}^3$	Averaging period	Reference	Processing Facility only	Including Background
Nitrogen dioxide ( $\text{NO}_2$ )	151	1-hour	(DWER, 2019)	1.8	15.0
	28	Annual	(DWER, 2019)	<0.1	13.3
Dust ( $\text{PM}_{10}$ )	46	24-hour	(DWER, 2019)	6.2	30.5
	23	Annual	(DWER, 2019)	0.3	21.2
Dust ( $\text{PM}_{2.5}$ )	23	24-hour	(DWER, 2019)	1.07	10.3
	7	Annual	(DWER, 2019)	0.04	8.0
Dust (TSP, total suspended particulates)	82	24-hour	(DWER, 2019)	9.3	57.9
Dust deposition	4 g/m <sup>2</sup> /month	Maximum	(DWER, 2021)	0.03	Not available
	2 g/m <sup>2</sup> /month	Above background	(DWER, 2021)	0.03	Not available
Sulfuric acid ( $\text{H}_2\text{SO}_4$ )	18	1-hour	(DWER, 2019)	7.1	Not available
Ammonia ( $\text{NH}_3$ )	330	1-hour	(DWER, 2019)	6.4	Not available
Vanadium (V)	0.92	24-hour	(DWER, 2019)	0.03	Not available

### Mitigation Measures

The stack heights and gas and dust scrubbing and filtration systems at the processing plant facility have been designed to meet relevant air quality guidelines. Continuous Emission Monitoring Systems (CEMS) will be installed on relevant stacks for real time sampling and measurement of gas and particulate emissions.

AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant. The design, construction, commissioning and operations of air emissions from the processing plant will be regulated by DWER under Part V of the EP Act.

## 4.8 Greenhouse Gas Emissions

### Receiving Environment

The emission of greenhouse gases in one location contributes to the cumulative quantity of greenhouse gases in the global atmosphere. The receiving environment of greenhouse gas emissions is therefore the global atmosphere, although the scope of the EPA's obligations is the State of Western Australia.

The receiving environmental context is the emissions and policies relating to greenhouse gas management at the federal and state level.

The Western Australian *Greenhouse Gas Emissions Policy for Major Projects* (Government of Western Australia, 2019) adopted an aspirational target of net zero greenhouse gas emissions by 2050 and committed to working with the Commonwealth to achieve the targeted reductions under the Paris Agreement. The *Western Australia Climate Policy* (Government of Western Australia, 2020) commits to actions to achieve the target of net zero emissions by 2050. The policy also recognises that reduction of greenhouse gas emissions must occur to mitigate potential impacts from climate change including extreme weather events, rising sea levels, changes to climate and loss of habitats.

The State *Greenhouse Gas Emissions Policy for Major Projects* is intended to apply to new significant proposals that meet the criteria of a designated large facility under the Australian Government's Safeguard Mechanism. As the mine site and process site are different industry sectors and are located more than 400 km apart, they are two separate facilities for the purpose of GHG reporting under the Safeguard Mechanism.

The EPA *Environmental Factor Guideline for Greenhouse Gas Emissions* states that proposals which expect to emit more than 100,000 tpa CO<sub>2</sub>-e of Scope 1 emissions as a direct result of activities at a facility level would be assessed for this environmental factor.

Potential investors are focused on the longevity of the project which comprises financial sustainability (minimising operating costs) as well as maintaining social and environmental licenses to operate. There are global expectations of the need to reduce greenhouse gas emissions. Social licence to operate requires the project to demonstrate practices that recognise and mitigate climate change risks.

### Potential Impacts

Peak average annual GHG emissions for the processing facility were calculated as 95,575 t CO<sub>2</sub>-e pa, which is below the threshold that would require EPA assessment.

The Processing Facility includes innovations to enhance energy efficiency during processing. Vanadium production from this facility would have 50% lower carbon emissions intensity than three quarters of the vanadium that is produced globally.

Scope 3 GHG emissions associated with mining and beneficiation of vanadium concentrate and transport of large inputs and products were calculated as 114,584 t CO<sub>2</sub>-e pa. The calculated transport emissions could be reduced by mitigation throughout operations, as technologies become available. GHG emissions associated with the mining and beneficiation operations at the Australian Vanadium Project will be assessed by EPA.

Vanadium is primarily used for strengthening steel, which reduces the volume of steel that is required to be used for applications such as rebar. If the entire volume of vanadium pentoxide planned to be produced by the Processing Facility each year was used in high strength low alloy steel, the **net reduction** in carbon emissions from downstream use is estimated as 14,500,000 t CO<sub>2</sub>-e pa.

A growing use of vanadium is in vanadium flow batteries, which support the transition to a lower-carbon economy. This application is expected to drive increasing demand for vanadium and demonstrates the value of vanadium as a critical mineral and a battery metal.

### Mitigation Measures

The calculated GHG emissions for the processing facility incorporate:

- design improvements developed during Proposal feasibility studies to reduce GHG emissions by over 20,000 t CO<sub>2</sub>-e pa
- mitigation of GHG emissions feasible to incorporate straightaway upon proposal commencement, which will further reduce emissions by 11,000 t CO<sub>2</sub>-e pa.

The mitigation opportunities that are expected to be feasible upon commencement of the proposal include:

- incorporation of 35% renewable power generation and battery storage into the power plant
- use of 100% electric or hydrogen powered light vehicles at the processing facility
- incorporation of 2% of green hydrogen into the natural gas feed.

These mitigations are estimated to reduce the peak Scope 1 GHG emissions to 95,575 t CO<sub>2</sub>-e pa at Proposal commencement.

Additional mitigation strategies (such as inclusion of green hydrogen as an increasing proportion of the natural gas feed) are expected to be implemented during operations as technologies become available. It is also believed that further opportunities to improve efficiencies and reduce emissions will be achieved during detailed design and planned early vendor involvement, including site visits to similar operations both locally and abroad.

The Processing Facility was referred to EPA in April 2022, who determined not to assess the proposal (CMS Number 18189, EPA Notice of Decision dated 27 July 2022).

Greenhouse gas emissions at the Processing Facility will be managed and mitigated in accordance with the *Greenhouse Gas Management Plan – Tenindewa Vanadium Processing Facility* (Umwelt, 2022), which includes annual reporting of GHG emissions in a publicly available report.

## **4.9 Social Surroundings**

The *EPA Environmental Factor Guideline: Social Surroundings* (EPA, 2016f) states that social surroundings may include Aboriginal heritage, historical heritage, amenity (impacts associated with visual amenity, noise and fugitive dust emissions) and economic surroundings that may be impacted by the physical activities of the proposal.

**Table 4.4** lists the social values identified near the proposal, the possible impacts, mitigation measures, and assessment of residual impacts. These are shown in **Figure 4**.

**Table 4.4 Impact Assessment for Social Surroundings**

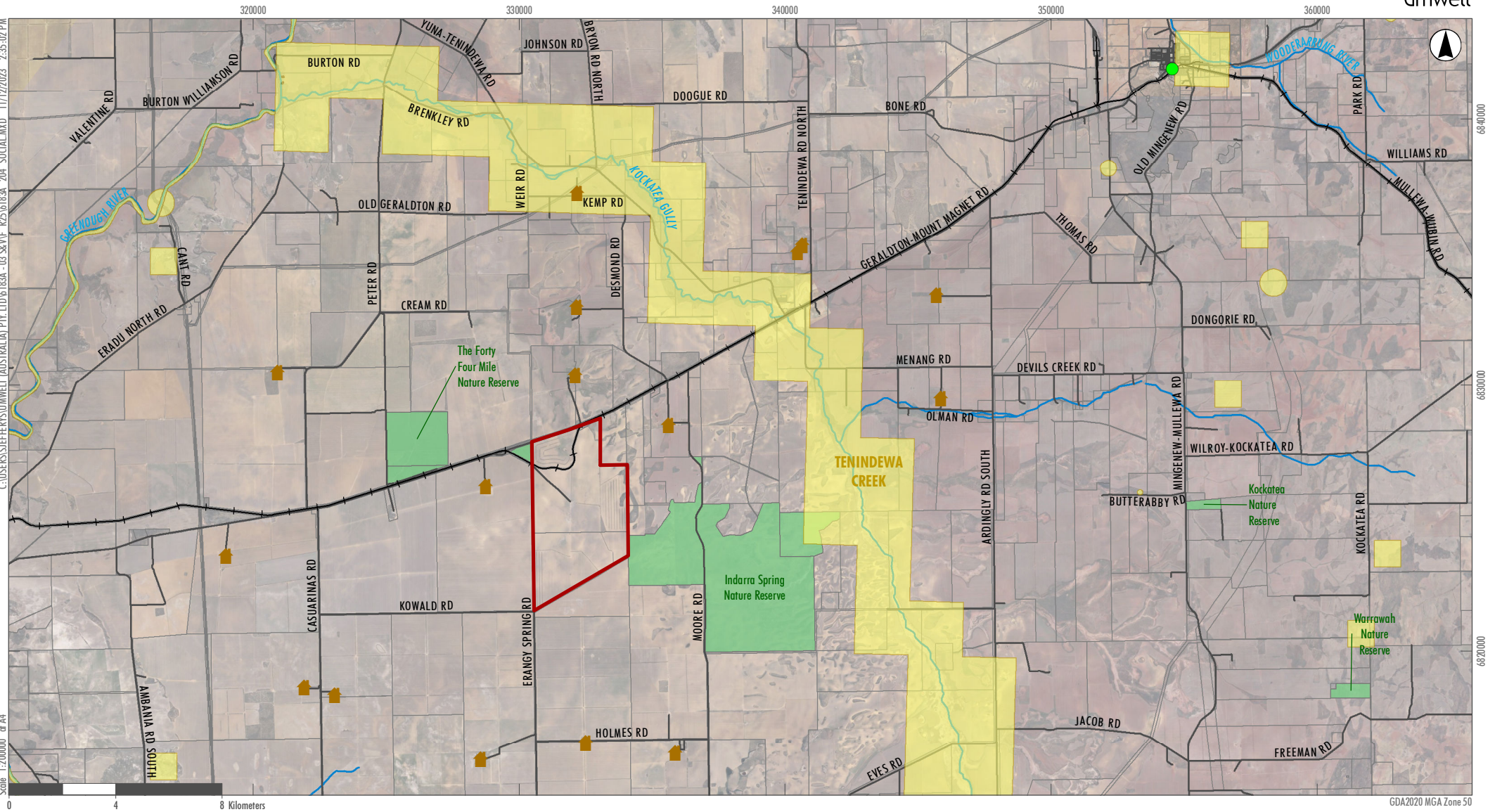
Type	Social Values	Potential Impacts	Mitigation	Assessment of Residual Impacts
Road Use	Mullewa Town is approximately 25 km northeast of the proposal area.	<p>Increase in road traffic within Mullewa townsite, forecast to comprise an additional:</p> <ul style="list-style-type: none"> <li>• 20 full and 20 empty heavy vehicle movements per day through Mullewa.</li> <li>• 27 light vehicle movements per day associated with employees based in Mullewa.</li> </ul>	<p>A Traffic Impact Statement has been prepared and submitted with the Development Application to the State Development Assessment Unit.</p> <p>The road network through Mullewa is a major highway and proposed haul trucks are compliant with the existing highway classification.</p> <p>Main Roads WA will review the traffic impact statement and agree road use conditions with AVL.</p>	<p>Traffic data for Geraldton-Mount Magnet Rd east of Mullewa Wubin Rd indicates annual average daily traffic volume for 2022-23 was 432 movements per day (223 heavy vehicles and 209 light vehicles).</p> <p>The forecast traffic movements associated with the proposal would be an 18% increase in heavy vehicle movements per day through Mullewa townsite, compared to 2022-23 data.</p>
	Public road users	<p>Increase in traffic volume along proposed transport routes, forecast to comprise an additional:</p> <ul style="list-style-type: none"> <li>• 20 full and 20 empty heavy vehicle movements per day between Tenindewa and Gabanintha</li> <li>• 27 full and 27 empty heavy vehicle movements per day between Tenindewa and Geraldton</li> <li>• 2 small buses transporting workers from Geraldton each day.</li> </ul>		<p>Traffic data for Geraldton Mount Magnet Rd east of Glengarry Road near Geraldton indicates annual average daily traffic volume for 2022-23 was 1,086 movements per day (402 heavy vehicles and 684 light vehicles).</p> <p>The forecast traffic movements associated with the proposal would be a 7% increase in heavy vehicle movements and 0.6% increase in light vehicle movements per day towards Geraldton, compared to 2022-23 data.</p>

Type	Social Values	Potential Impacts	Mitigation	Assessment of Residual Impacts
Homesteads	<p>Nearest homesteads are located:</p> <ul style="list-style-type: none"> <li>• 1.5 km west of Lot 40</li> <li>• 1.7 km north of Lot 40</li> <li>• 2.0 km northeast of Lot 40</li> </ul>	<p>Fugitive dust emissions from:</p> <ul style="list-style-type: none"> <li>Wind erosion of cleared areas and stockpiles</li> <li>Material handling including loading and tipping</li> <li>Driving on unsealed roads</li> <li>Land clearing for establishment of infrastructure</li> </ul>	<p>Fugitive dust emissions will be managed through typical controls such as water trucks on any unsealed road and sprays as needed for stockpiles and material handling.</p> <p>The concentrate and Fe-Ti Co-product will be transported with moisture levels suitable to facilitate handling and minimize dust emissions (typically 7-8%).</p> <p>AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant.</p>	<p>Dust deposition associated with the Processing Facility is predicted to be a maximum of 0.03 g/m<sup>2</sup>/month at the boundary of Lots 40 &amp; 41, which is well below the relevant assessment criteria of 2 g/m<sup>2</sup>/month above background (see <b>Section 4.7 Air Quality</b>).</p> <p>The potential noise impacts associated with construction and operations of the processing plant will be assessed and regulated by DWER under Part V of the EP Act.</p>
		<p>Noise emissions from construction and operation of processing facility.</p>	<p>A screening assessment will be undertaken as part of the DWER Works Approval application using the DWER Guideline: Assessment of environmental noise emissions.</p> <p>The processing facility will be designed to meet noise limits.</p> <p>AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant.</p>	<p>The potential noise impacts associated with construction and operations of the processing plant will be assessed and regulated by DWER under Part V of the EP Act.</p>
Other nearby land uses	<p>Railway line immediately north of the proposal boundary</p>	<p>Haul vehicle and light vehicle interactions with two level crossings on Geraldton-Mt Magnet Road and one level crossing on Erangy Springs Road.</p>	<p>A Traffic Impact Statement has been prepared and submitted with the Development Application to the State Development Assessment Unit.</p> <p>The road network along Geraldton-Mt Magnet Road is a major highway and proposed haul trucks are compliant with the existing highway classification.</p> <p>Main Roads WA will review the traffic impact statement and agree road use conditions with AVL.</p>	<p>Road usage is not expected to impact on the railway line.</p>

Type	Social Values	Potential Impacts	Mitigation	Assessment of Residual Impacts
	Public road users	Visual amenity impacts.	<p>An analysis of the views of the Processing Facility from Geraldton-Mt Magnet Road was undertaken using a 3D model and submitted as part of the Development Application to the State Development Assessment Unit.</p> <p>The processing plant will have at least 1 km setback from the Geraldton-Mt Magnet Road. There is existing vegetation along the road and the railway. Vegetation along the road corridor will be retained where possible (with the exception of the haul road) to preserve the visual screen.</p>	The 3D model demonstrated that the Processing Facility would not have a meaningful impact on visual amenity from the Geraldton-Mt Magnet Road.
Agricultural use of land	Agricultural production within Lots 40 and 41	Loss of productive agricultural land within Lots 40 and 41 when AVL take ownership and develop the processing plant.	<p>The proposal lies in the Mullewa Agricultural Land Area. Agricultural importance is limited by availability of fresh groundwater and low rainfall, which leads to lower yields than experienced on similar soils to the south and west (Department of Agriculture and Food, 2013).</p> <p>AVL has signed an options agreement with the landowner for the purchase of Lots 40 and 41, which will provide financial compensation for loss of the land.</p> <p>Parts of the options agreement makes provision for the landowner to optionally use that portion of Lots 40 and 41 that are outside of the Processing Facility development envelope for agricultural purposes.</p>	The residual impact from loss of productive agricultural land is expected to be low.
	Agricultural production within adjoining and nearby land	<p>The proposal could impact on agricultural productivity of adjacent and nearby land if:</p> <p>Dust emissions result in accumulation of environmentally deleterious materials on</p>	<p>Mitigation of impacts from discharge of contaminants is described in <b>Section 4.6 Terrestrial Environmental Quality</b>.</p> <p>AVL will apply for a Works Approval and Operating Licence under the EP Act Part V prior to commencement of construction of the processing plant.</p>	Dust deposition associated with the Processing Facility is predicted to be 0.03 g/m <sup>2</sup> /month at the boundary of Lots 40 & 41, which is well below the relevant assessment criteria of 2 g/m <sup>2</sup> /month above background (see <b>Section 4.7 Air Quality</b> ).

Type	Social Values	Potential Impacts	Mitigation	Assessment of Residual Impacts
		<p>nearby agricultural land outside of Lots 40 and 41.</p> <p>Discharges of environmentally hazardous materials result in contamination of surface or groundwater.</p>		<p>The potential dust emissions and discharges of hazardous materials associated with construction and operations of the processing plant will be assessed and regulated by DWER under Part V of the EP Act.</p>
Aboriginal heritage	Tenindewa Creek (Site ID 18905) located 8 km east of the proposal location	<p>Due to the distance from the proposal, no impacts to Tenindewa Creek are expected.</p> <p>It is possible that excavation associated with construction could unearth Aboriginal artefacts or remains.</p>	<p>The design, construction, commissioning and operations of the processing plant and associated facilities that may discharge or emit materials to the environment will be regulated by DWER under Part V of the EP Act.</p> <p>The proposed area is largely cleared, and no evidence of Aboriginal sites has been found during a desktop search of the Aboriginal Heritage Inquiry System.</p> <p>Should any Aboriginal artefacts or human remains be encountered during construction or other excavations, all nearby excavation work will cease and appropriate authorities will be notified.</p>	<p>No residual impacts to Aboriginal heritage sites are expected.</p>





### Legend

- Project Area
- Property Boundaries
- Nature Reserves
- Aboriginal Heritage
- Railways
- Roads
- Watercourses
- Homesteads within 12km
- Mullewa

FIGURE 4  
Social Surroundings

## 4.10 Human Health

The *EPA Environmental Factor Guideline: Human Health* (EPA, 2016b) considers impacts to human health from emission of radiation.

### Receiving Environment

Material and waste characterisation undertaken to support the project approvals have confirmed there is no risk from radioactive metals in the mine orebody and hence in the vanadium concentrate arriving at the Processing Facility.

### Potential Impacts

The processing plant will not use any installed radiation emitting equipment or devices. Therefore, no impacts to human health are anticipated.

## 4.11 Landforms

*EPA Environmental Factor Guideline: Landforms* (EPA, 2018a) has been used to address this section. Landform refers to the geology and morphology of an area and is characterised by the distinctive and recognisable physical features of the earth's surface.

### Receiving Environment

The landforms at the processing site are not considered significant as the landform is typical in the region and unremarkable.

### Potential Impacts

No major excavational works or mining activities will occur and therefore no permanent change to the physical landform is anticipated. No impacts to landforms are expected.

## 4.12 Matters of National Environmental Significance

### Receiving Environment

The Commonwealth Protected Matters Search Tool (PMST) was used to identify any MNES that could trigger a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A summary of the search is presented in **Table 4.5**.

**Table 4.5 Commonwealth Factors Impact Summary**

Factor	Present	Description	Comments
World Heritage Properties	No	Not applicable	
National Heritage Places	No	Not applicable	
Wetlands of International Importance	No	Not applicable	
Great Barrier Reef Marine Park	Not applicable	Not applicable	
Commonwealth Marine Area	Not applicable	Not applicable	
Listed Threatened Ecological Communities	No	Not applicable	No Listed Threatened Ecological Communities present.

Factor	Present	Description	Comments
Listed Threatened Species (flora)	Yes	Potential presence of 5 listed flora species.	Database searches identified five Commonwealth-listed flora species as having some potential to occur (ranging from 'may' to 'likely'). <i>Styphelia marginata</i> was also identified as being recorded in a nearby road reserve in 1986. A targeted flora survey undertaken in September 2022 recorded the presence of one Commonwealth-listed flora species, <i>Caladenia wanosa</i> (Threatened). Refer to <b>Section 4.1</b> for more information.
Listed Threatened Species (fauna)	Yes	Potential presence of 8 listed fauna species.	Database searches identified eight Commonwealth-listed fauna species as having some potential to occur (ranging from 'may' to 'likely'). However, it is not expected that fauna will be directly impacted by the Proposal due to the low density of fauna habitat in the area. Any indirect impacts will be managed through DWER approvals and licences. Refer to <b>Section 4.2</b> for further detail.
Listed Migratory Species	Yes	Potential presence of 7 species comprising avifauna.	The Protected Matters Search Tool identified one migratory marine bird, five migratory wetland birds, and one migratory terrestrial species that may occur. Due to the migratory nature of these species and the likely low habitat value of the Proposal area, there is not expected to be any significant impacts to migratory species.

### Potential Impacts

No direct impacts to any MNES will occur as part of this proposal and therefore referral under the EPBC Act is not required.

## 4.13 Reserves

### Receiving Environment

A search for any surrounding reserves within 3 km of the project area was undertaken using the DBCA-011 (DBCA – Legislated Lands and Waters) dataset (DataWA, 2021). Three natural reserves were identified as shown in **Figure 1** namely:

- Indarra Spring Nature Reserve (R 41885) is located immediately east of Lot 41. The reserve has been classified as a Class A reserve under Section 5(1)(d) of *Calm Act 1984*. The nature reserve is protected for the purpose of conservation of flora and fauna.
- Reserve R 24185 is located immediately west of Lot 40. R 24185 is a Class A reserve under Section 5(1)(d) of *Calm Act 1984* and is protected for the purpose of conservation of flora and fauna.

- The Forty-Four Mile nature reserve (R 1017) is located 3.2 km west of the project. The reserve is ranked as a Class A reserve under Section 5(1)(d) of *Calm Act 1984* and is protected for the purpose of conservation of flora and fauna.

#### Potential Impacts

The nature reserves are protected for the purpose of conservation of flora and fauna. No direct impacts are anticipated. However, given their proximity to the project area, indirect impacts may potentially affect the reserve including:

- Excessive dust emissions generated from traffic movement, poor dust suppression practices and wind erosion of mineral concentrate stockpiles impacting vegetation.
- Excessive noise emissions from processing facility and traffic movement disturbing fauna.
- Light emissions leading to impacts on nocturnal fauna.
- Fire risks leading to bushfire.

#### Mitigation Measures

The following controls will be implemented to mitigate impacts to nearby reserves:

- Dust mitigation as described in **Section 4.7**.
- Engineering controls will be used to mitigate noise emissions from the processing facility.
- Light emissions will be directed away from the nature reserve to minimise impacts to nocturnal fauna.
- Bushfire Management Plan is included as part of the Development Application.

Controls to mitigate impacts arising from dust, noise, water abstraction, bushfire and air emissions will be managed as part of the DWER Part V approvals (see **Section 5.0**).



## 5.0 Environmental Approvals Context

### 5.1 Environmental Approvals Completed

The Tenindewa Vanadium Processing Facility was referred to the WA EPA under section 38 of the EP Act in April 2022.

The Chair of the EPA determined on 27 July 2022 not to assess the proposal, with the following explanation of decision provided (CMS Number 18189, EPA Notice of Decision dated 27 July 2022):

“The EPA considers that the likely environmental effects of the proposal are not so significant as to warrant formal assessment. The EPA is of the view that the potential impacts of the proposal can be adequately managed through the implementation of the proposal in accordance with the referral documentation, and the proponent's management and mitigation measures. The EPA considers the potential impacts of the proposal can be dealt with under other statutory decision-making processes:

- Department of Water and Environmental Regulation – Part V Division 3 of the Environmental Protection Act 1986 (Works Approval and licence).
- Department of Water and Environmental Regulation – Part V Division 2 of the Environmental Protection Act 1986 (Clearing of Native Vegetation).
- Department of Water and Environmental Regulation – Rights in Water and Irrigation Act 1914 (5C groundwater Licence to take water)”.

AVL has subsequently obtained a 5C Licence to Take Water ((GWL 208955(1)) issued in July 2023. The licence is for abstraction of up to 1.2 GL of groundwater from the deep aquifer for industrial processing on Lots 40 and 41. Abstraction of groundwater will be managed in accordance with the approved *Water Resource Operating Strategy GWL208955(1)* (Australian Vanadium Limited, 2023), which includes monitoring and reporting of groundwater use, water levels and water quality.

The further environmental approvals expected to be required are described in the next section.

### 5.2 Environmental Approvals Required

Based on the preliminary environmental impact assessment presented above, the proposal is not expected to have a significant impact on the environment or any MNES. It is possible that there would be an impact on significant flora listed if they cannot be avoided in locating the site entry and exit roads.

It is expected that risks for each of the abovementioned environmental aspects can be managed under DWER and Planning approvals.

The identified environmental decision-making authorities and approvals processes, and their ability to mitigate environmental impacts, are described in **Table 5.1** below.

**Table 5.1 Environmental Approvals Pathway**

Decision-making authority	Legislation and guidelines regulating the activity	Approval required	Environmental Factor and Proposal Activity	Can the statutory decision-making process mitigate impacts on the environment? If yes, summary of reasons.
<b>DWER - Environment</b>	Environmental Protection Act 1986 Part V Environmental Protection Regulations 1987 Industry Regulation Guide to Licensing (DWER, 2019a) Guidance Statement – Environmental Siting (DWER, 2016) Guideline – Risk Assessments (DWER, 2017) Guidance Statement – Regulatory Principles (DWER, 2015)	Works Approval	Terrestrial environmental quality, air quality Construction of processing facility, evaporation ponds, power plant and wastewater treatment.	Yes, this process upholds EPA’s objective to maintain the quality and land and soils to protect their environmental values. Works Approval application and DWER assessment will consider risks from emissions and discharges to the environment and management of wastes. This will include risk assessment and controls relating to point and non-point sources of emissions and handling and storage of environmentally hazardous materials. The risk assessment will consider DWER listed Environmental Sensitive receptors including nearby human receptors, the groundwater management area, surface water catchment area, noise impacts, dust impacts and nearby reserves. Applications for Works Approvals are publicly advertised, and DWER seeks direct comment from relevant public authorities and direct landowners. Granted Works Approvals are also published and open to public appeal.
		Critical Containment Infrastructure Report assessment	Terrestrial environmental quality Commissioning of waste storage facilities (evaporation ponds)	Yes, this process upholds EPA’s objective to maintain the quality and land and soils to protect their environmental values. DWER will assess the Critical Containment Infrastructure Report to ensure that waste containment infrastructure is properly constructed with no material defects and all requirements have been met before being approved for use.
<b>DWER – Environment</b>	Environmental Protection Act 1986 Part V Environmental Protection Regulations 1987 Industry Regulation Guide to Licensing (DWER, 2019a) Guidance Statement – Environmental Siting (DWER, 2016)	Environmental Commissioning Report and Licence Application	Terrestrial environmental quality, air quality Operation of processing facility and wastewater treatment.	Yes, this process upholds EPA’s objective to maintain the quality and land and soils to protect their environmental values. The Environmental Commissioning Report is required to demonstrate that environmental commissioning activities have been completed, the premises can operate to the specification detailed in the Works Approval application, and emissions and discharges from the premises meet the required standard. The operational licence will include conditions for monitoring and annual reporting of environmental emissions and discharges and quality of the surrounding environment during operations, to verify compliance with required standards. Environmental factors that are expected to be subject

Decision-making authority	Legislation and guidelines regulating the activity	Approval required	Environmental Factor and Proposal Activity	Can the statutory decision-making process mitigate impacts on the environment? If yes, summary of reasons.
	Guideline – Risk Assessments (DWER, 2017) Guidance Statement – Regulatory Principles (DWER, 2015)			to monitoring and reporting include air emissions and surrounding groundwater quality. The annual reporting process also includes an audit for compliance with licence conditions. Applications for Licences are publicly advertised, and DWER seeks direct comment from relevant public authorities and direct landowners. Granted Licences are also published and open to public appeal.
<b>DWER – Environment</b>	Environmental Protection Act 1986 Part V Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Native vegetation clearing permit	Flora and vegetation Clearing of native vegetation	Yes, this process upholds EPA’s objective to protect flora and vegetation to maintain biological diversity and ecological integrity. The DWER assessment considers the likely environmental impacts of an application in accordance with the requirements of the EP Act and bilateral agreement (where relevant). The DWER guidelines and information sources are used by assessors in gathering the information required for objective assessment under each clearing principle. Applications and determinations for clearing permits are published on the DWER website. Decisions can be appealed in writing within 21 days of the applicant being notified of the decision. A vegetation clearing permit will include conditions to manage and monitor any potential impacts to flora.
<b>SDAU</b>	Planning and Development Act 2005	Development Application	Social surroundings Construction of processing facility including supporting infrastructure	Yes. Traffic and bushfire impact and mitigation measures are expected to be assessed as part of the Development Application.

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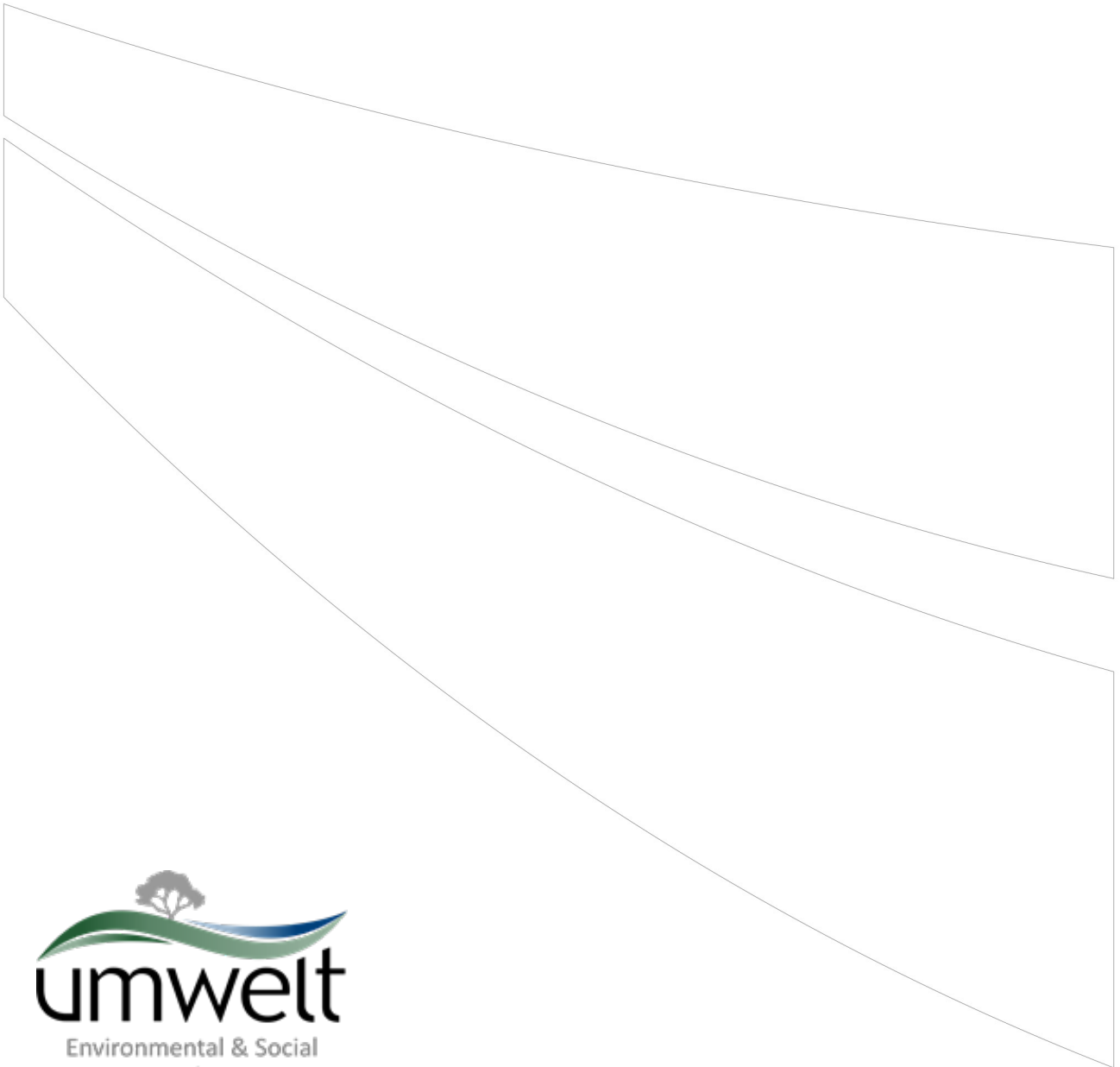
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