ILUKA

Tutunup Mineral Sands Project

Section 38 Referral Supporting Document

3 December 2021

Iluka Resources Limited

Authorisation

Version	Reason for Issue	Prepared	Checked	Authorised	Date
0.1	Internal Review	Shannon Jones	Angela Bishop	Angela Bishop	16 September 2021
0.2	Final Draft Report	Ben Kraft	Greg MacDonald	Phil Lazzari	22 November 2021
1	Final	Ben Kraft	Greg MacDonald	Phil Lazzari	3 December 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS

Acronym	Meaning
ALARA	As Low As Reasonably Achievable
ASS	Acid Sulfate Soils
BAM Act	Biosecurity and Agriculture Act 2007
BC Act	*Biodiversity Conservation Act 2016* (WA)
Cth	Commonwealth
DEWHA	Department of the Environment, Water, Heritage and the Arts
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height
DE	Development Envelope
DF	Disturbance Footprint
DMA	Decision Making Authorities
DMIRS	Department of Mines, Industry Regulation and Safety
DoEE	Department of Environment and Energy
DotE	Department of the Environment
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environment Regulation
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Environmental Protection Authority
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
GDE	Groundwater Dependent Ecosystem
GL	Gigalitre
GOS	Groundwater Operating Strategy
HMC	Heavy Mineral Concentrate
IBRA	Interim Biogeographical Regionalisation for Australia
ILUA	Indigenous Land Use Agreement
Iluka	Iluka Resources Limited
LGA	Local Government Area
MCP	Mine Closure Plan
Mining Act	*Mining Act 1978*

Acronym	Meaning
MNES	Matters of National Environmental Significance
MRWA	Main Roads Western Australia
MSIR	*Mines Safety and Inspection Regulations 1995*
MUP	Mining Unit Plant
MW	Megawatt
NEPM	National Environment Protection (Ambient Air Quality) Measure Standards
NORM	Naturally Occurring Radioactive Material
NSHA	Noongar Standard Heritage Agreement
PASS	Potential Acid Sulfate Soils
PEC	Priority Ecological Community
PER	Public Environmental Review
RCWA	Radiological Council of Western Australia
RIWA	*Rights in Water and Irrigation Act 1914*
RMP	Radiation Management Plan
RS Act	*Radiation Safety Act 1975* (WA)
SRE	Short Range Endemic
SWALSC	South West Aboriginal Land and Sea Council
SWC	Soil Water Consultants
SWCC	South West Catchments Council
SWORMP	Southwest Operations Radiation Management Plan
SWREL	South West Regional Ecological Linkages Project
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
UCL	Unallocated Crown land
VSA	Vegetation / Substrate Association
VT	Vegetation Type
WCP	Wet Concentrator Plant
WoNS	Weeds of National Significance

1 INTRODUCTION

1.1 Purpose and Scope

Iluka Resources Limited (Iluka) proposes to establish a mineral sands mine targeting the Tutunup deposit, located approximately 195km south of Perth and 17km east of Busselton, in the southwest of Western Australia (Figure 1). The Tutunup Mineral Sands Project (the Proposal) is part of Iluka's ongoing South West Operations, being a continuation of mining and production of heavy mineral concentrate (HMC) in the region.

This document has been prepared to support a Section 38 referral to the Environmental Protection Authority (EPA) under the Western Australian *Environmental Protection Act 1986* (EP Act), as the Proposal has the potential to have significant impacts to some aspects of the environment. This document also provides information on the Proposal's potential impacts on Matters of National Environmental Significance (MNES) that may require assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Should this Proposal be assessed under both the EP Act (WA) and EPBC Act (Cth), Iluka requests that the assessment be undertaken by the Western Australian EPA through an accredited process on behalf of the Commonwealth Department of Agriculture, Water and the Environment (DAWE).

1.2 Proponent

The Proponent for the Tutunup Mineral Sands Project is:

Iluka Resources Limited (ACN: 008 675 018)

Level 17, 240 St Georges Terrace

Perth, WA, 6000

GPO Box U1988

Perth Western Australia 6845

Phone +61 8 9360 4700

Fax +61 8 9360 4777

Internet: www.iluka.com

The key contact for the Proposal is:

Luke McManus

Senior Environmental Advisor

Phone: +61 8 9360 4399

Email: luke.mcmanus@iluka.com

1.3 Previous Assessments and Proposals

Iluka first referred the Tutunup Mineral Sands Project under the EP Act in April 2008 (EPA assessment number 1737) and under the EPBC Act in August 2008 (EPBC assessment number 2008/4409). That project involved traditional dry mining of the deposit. In May 2008, the EPA determined that the likely environmental impacts resulting from drawdown of the water table warranted a formal assessment at the level of a Public Environmental Review (PER) with an 8-week public review period. In March 2009, the then Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA), now DAWE, determined that the project was a Controlled Action and, as such, required assessment and approval under the EPBC Act, to be assessed through the WA assessment under a Bilateral Agreement. Iluka completed significant baseline environmental work to inform its understanding of the environmental setting and potential environmental impacts associated with the proposal to support the development of a PER.

In 2015, Iluka requested to withdraw the Tutunup Mineral Sands Project from the EP Act and EPBC Act environmental impact assessment process. In recognition of the high conservation value of the project area and surrounds, Iluka decided to investigate alternative mining methods. In response to Iluka's request and pursuant to Section 40A(1)(a) of the EP Act, the EPA terminated the environmental impact assessment of the proposal on 16 October 2015. The then Department of the Environment (DotE), now DAWE, published a Notification of Proposal Withdrawal on 4 December 2015.

Iluka has and continues to evaluate alternative mining methods to support develop of the Proposal and is now referring a new Proposal for assessment under the EP Act and EPBC Act.

1.4 Other Approvals and Regulation

Apart from the EP Act and EPBC Act, the Proposal may be subject to assessment and approval under other State environmental and heritage legislation, including:

- *Mining Act 1978;*
- Part V of the EP Act;
- *Rights in Water and Irrigation Act 1914*;
- *Aboriginal Heritage Act 1972*;
- *Radiation Safety Act 1975;*
- *Biodiversity and Conservation Act 2016;*
- *Mines Safety and Inspection Act 1994;* and
- *Dangerous Goods Safety Act 2004.*

2 PROPOSAL

2.1 Proposal Content

Iluka proposes to develop the Tutunup Mineral Sands deposit, located approximately 195 km south of Perth, 17 km east of Busselton in the locality of Tutunup in the City of Busselton (Figure 1). The mineral reserve within the Proposal area includes approximately 12 million tonnes of ore with an average grade of 11% heavy mineral. Mining and processing of ore from open pits up to 20 m deep are proposed. The Proposal is currently at an early planning phase.

The Proposal involves activities and infrastructure typically associated with mineral sands mining, including the development of mine pit(s), processing plant, dams for water and clay fines management, material stockpiles and associated supporting infrastructure such as power, drainage, haul roads, offices and workshops.

Pre-production earthworks will be required ahead of operations. These works include vegetation clearing, removal and stockpiling of topsoil, subsoil and overburden, installation of surface dams and drainage, preparation of haul roads and construction of the plant and other associated infrastructure.

Above the water table, the proposed earthmoving method is likely to incorporate typical dry-mining methods using equipment such as scrapers, excavators, trucks and dozers. Below the water table, wet mining methods will be employed, minimising the need for dewatering and the potential for changes in groundwater levels outside the mine pit. Iluka continues to investigate wet mining methods appropriate for deployment in the Proposal area (see Section 2.3).

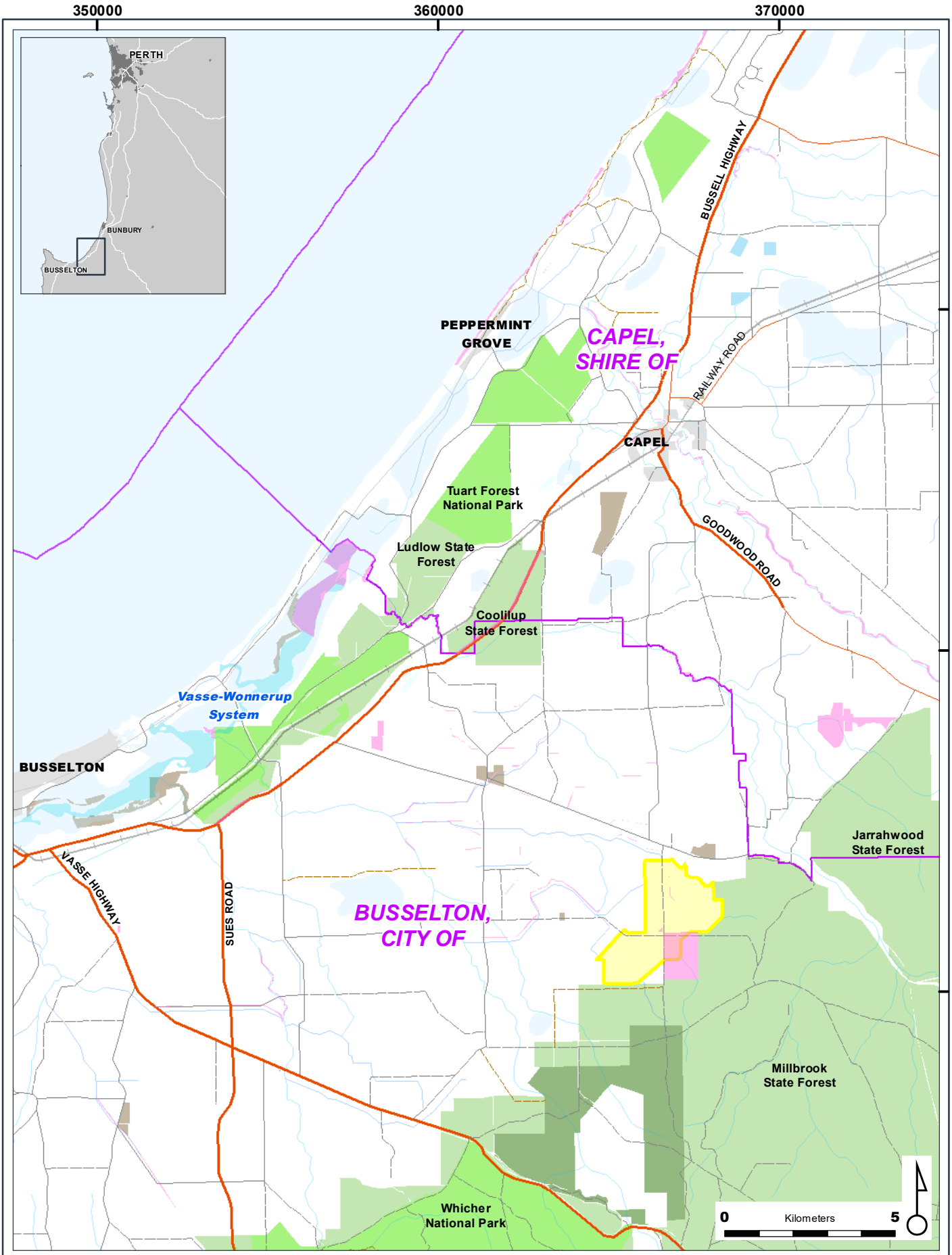
Once removed from the pit, ore will be transported to a mining unit plant (MUP) where oversize material (rocks, plant root material) will be removed. The ore will then be pumped to a wet concentrator plant (WCP) for physical separation into clay fines, sand tails and Heavy Mineral Concentrate (HMC). As Potential Acid Sulfate Soils (PASS) have been identified at Tutunup (see Section 5.4.3.5), the option of including a flotation plant onsite to remove pyrite from the HMC is being investigated.

Once sufficient space is available, sand tails will be deposited directly into the mine pit. Until then, sand tails will be stockpiled on surface for later relocation to the mine pit. Clay fines slurries are proposed to be pumped into temporary dams for drying and settlement prior to being returned to the mine pit. Overburden will also be returned to the mine pit, which allows the mine pit to be backfilled. Following backfill of the mine pit, the disturbance footprint will be rehabilitated to an agreed landform and land use (likely a mixture of agriculture and native vegetation).

The HMC will be transported offsite to Iluka's North Capel operations for further processing. As North Capel is an existing facility, the processing of HMC at North Capel is not part of this Proposal or discussed further in this document. No changes are proposed to the North Capel operations and no by-products of downstream processing are planned to be returned to Tutunup.

It is anticipated that plant power requirements will be supplied by the South West Interconnected System (SWIS), with power demand estimated to be in the order of 6 megawatts (MW). Diesel fuel may be used for some equipment, for example pumps for water management, and for the majority of the mining fleet. Processing water demand will be met by primarily re-circulated process water with make-up water from the flooded mining pit, with total water demand estimated to be in the order of 4.02 gigalitres (GL) per annum.

Access to the site will be via Tompsett Road. A preliminary transport route from Tutunup to the secondary processing facility at North Capel has been identified and is being reviewed by Iluka for conformance to Main Roads Western Australia (MRWA) standards and Austroads guidelines. The route utilises a combination of MRWA, City of Busselton and Shire of Capel controlled roads (Shawmac, 2014). Studies conducted to date indicate that no clearing (additional to general road safety maintenance) will be required along the transport route to facilitate transport from Tutunup.



PROPOSAL LOCATION

TUTUNUP

- Roads
- Development Envelope
- National Park
- Nature Reserve
- State Forest
- Timber Reserve
- Unallocated Crown Land

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:150,000 **DATE:** 23/09/2021 **DWG No:** 244793v01 **FIGURE: 1**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244793v01_Tutunup_Project_Location.mxd

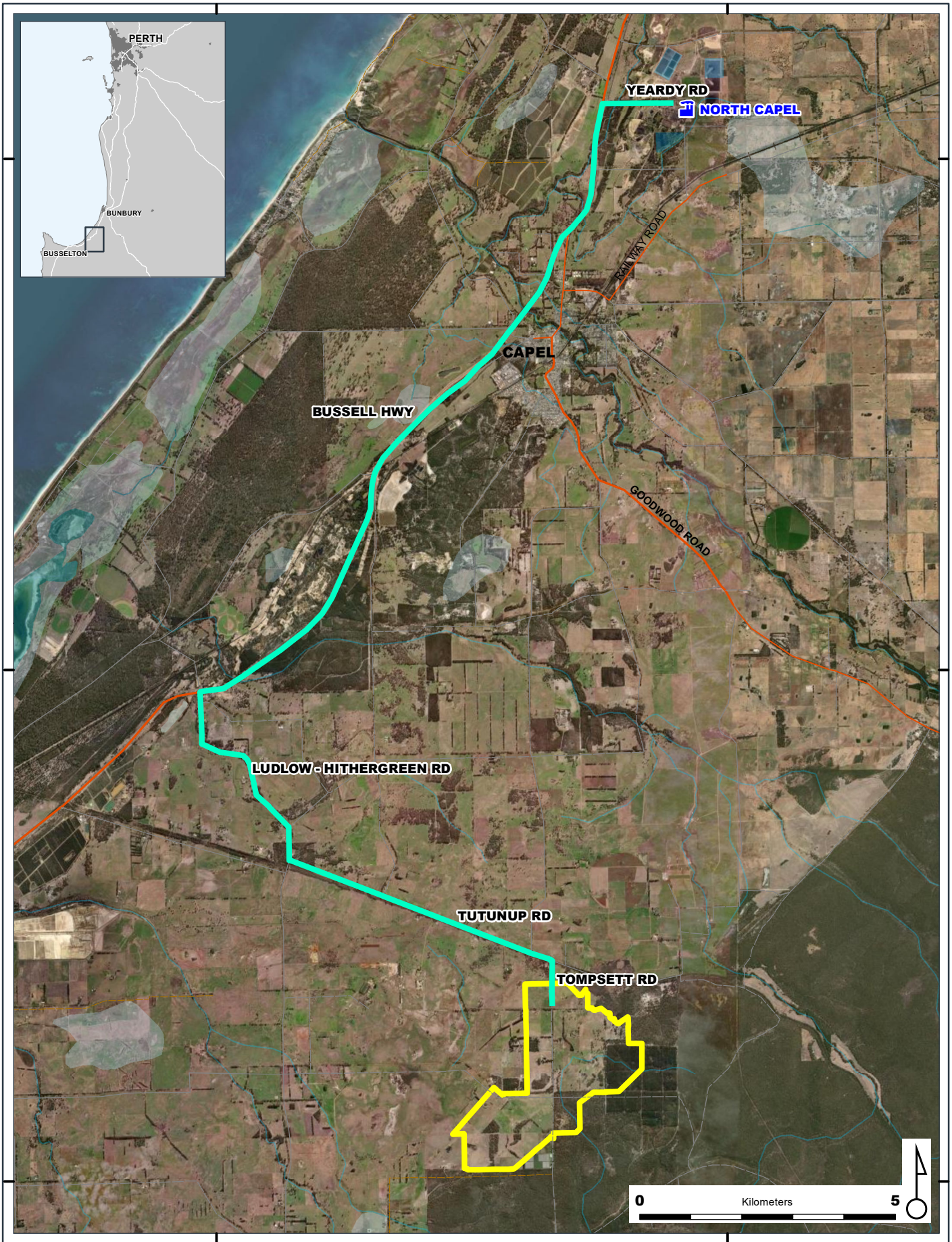
The proposed transport route is subject to refinement as additional studies are completed, however the current proposed route is included in Figure 2. Up to approximately 20 truck movements per day are anticipated during normal operation.

It is anticipated that the site will operate on a continuous 24 hour per day, seven days a week basis. However, activities such as construction and overburden stripping may operate on restricted timeframes for the purpose of managing potential noise and any other amenity impacts at local residences. The duration of mining will be dependent on the rate of mining. It is currently anticipated that the mine life would be up to approximately eight years for construction and operations followed by approximately seven years to complete rehabilitation works. Monitoring and maintenance activities will continue until closure obligations have been met.

The proposed timing for implementation of the Proposal is subject to commercial requirements. HMC from Tutunup is currently anticipated to be required from Quarter 1 2026. Based on this timing, construction is currently anticipated to commence in Quarter 3 2024, pending the outcome of regulatory processes.

A Development Envelope (DE) of 653 ha has been defined as shown in Figure 3. The DE has been constrained by *Mining Act 1978* tenure and by the presence of the Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (SCP 10b) Threatened Ecological Community (TEC) which Iluka has sought to avoid. The deposit also extends outside of the DE, to the northeast and southwest, however those areas have been deliberately excluded from the Proposal, as a key avoidance measure as part of the mitigation hierarchy. The Disturbance Footprint (DF) within the DE continues to be refined and therefore the Proposal DF assumes disturbance of the entire DE, made up of approximately 450 ha (69%) of cleared land, approximately 61 ha (9%) of plantation or other planted vegetation and approximately 142 ha (22%) of native vegetation.

An indicative maximum pit boundary is shown in Figure 3. However, for the purposes of the environmental impact assessment it is assumed the mine pit(s) could be located anywhere within the DE.



PROPOSED TRANSPORT ROUTE

TUTUNUP

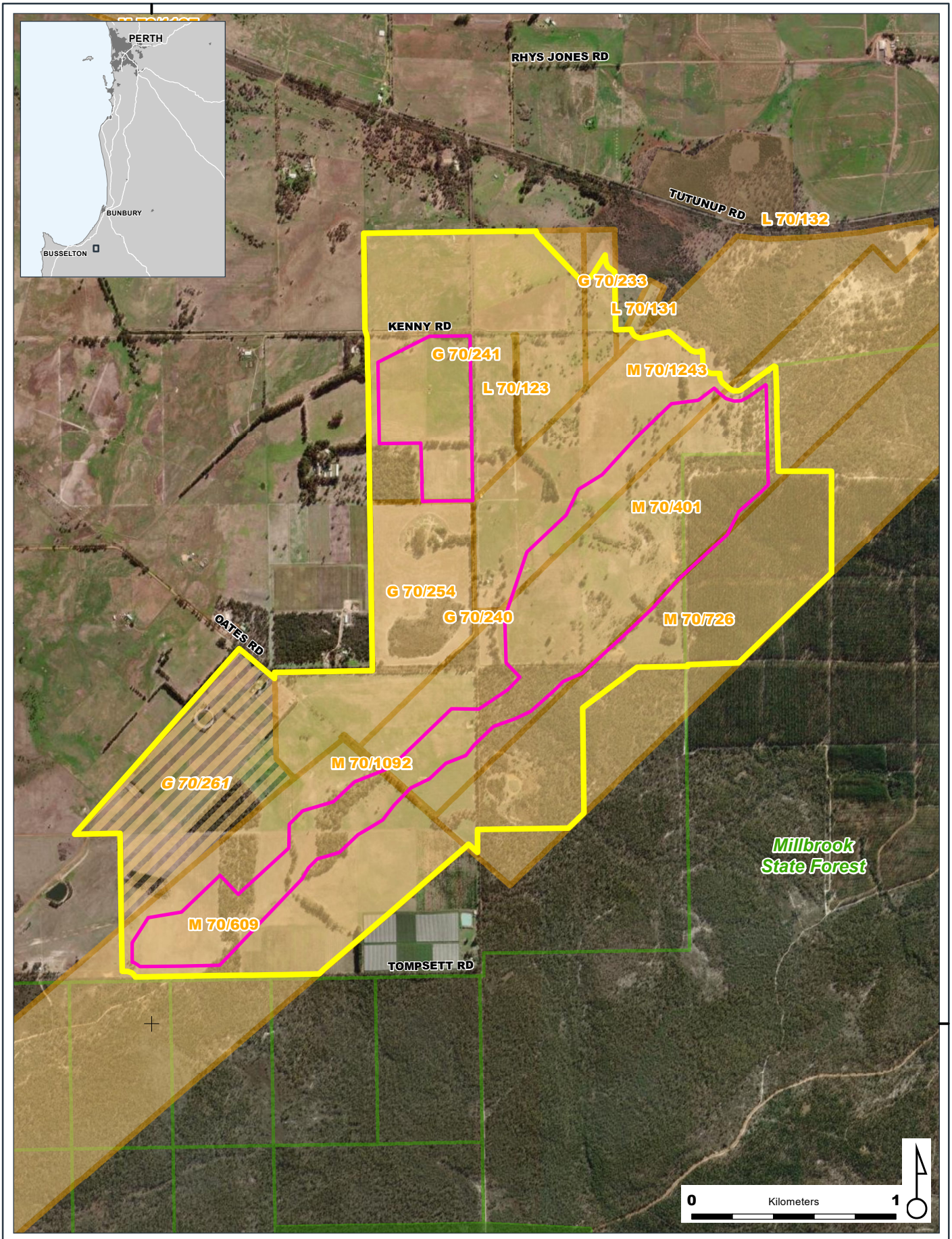
Processing Plant
Proposed Transport Route
Development Envelope

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:100,000 **DATE:** 2/12/2021 **DWG No:** 244796v01 **FIGURE: 2**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244796v01_Tutunup_Transport_Route.mxd



DEVELOPMENT ENVELOPE

TUTUNUP

- Maximum pit boundary
- Development Envelope
- Iluka Pending Tenements
- Iluka Tenements
- Nature Reserve
- State Forest
- Timber Reserve

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:25,000 **DATE:** 29/11/2021 **DWG No:** 244794v01 **FIGURE: 3**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244794v01_Tutunup_Development_Envelope.mxd

2.2 Justification

Mineral sands are used for a variety of applications including pigmentation for paints, paper and plastics, production of ceramic tiles, metal alloys, welding materials, as well as air and water purification systems. Mineral sands from Western Australia are exported to 35 countries and in 2016/17, generated around $550 million in sales revenue (DMIRS, 2017). Iluka is one of Australia's largest producers of mineral sands.

Tutunup is part of a greater program in the southwest that is focused on identifying and developing ongoing feed sources for Iluka's North Capel operations. Iluka's South West operations, including North Capel, employs approximately 200 personnel. In addition to supporting ongoing operations at North Capel, the development of the Tutunup deposit will support additional positions for the life of the mine. It is expected that operation of the Tutunup deposit will require a similar number of personnel as Iluka's previous South West mining operations. Iluka's recently-completed Tutunup South mine employed 26 Iluka employees and 25 specialist contractor roles while operating, up to 100 personnel during construction and 30 personnel during the rehabilitation phase, as well as corporate roles based out of Capel which support the operation.

2.3 Proposal Alternatives

The Tutunup deposit comprises a linear formation running in a northeast – southwest orientation. To the north, the deposit extends into State Forest and vegetated freehold land upslope of the Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (SCP 10b) TEC. The northernmost extent of the deposit was considered in initial mine planning and has subsequently been excluded from the DE and scope of the Proposal as an avoidance measure. In addition, a proposed buffer has been applied around the TEC of 100 m for the mine pit and 50 m for infrastructure to avoid direct impact to this TEC.

Iluka's south west mine sites typically use traditional open cut dry mining methods. Once the water table is reached, dry mining requires dewatering of groundwater inflows into the mine pit to allow machinery to operate within the mine pit. To minimise potential impacts of dewatering, particularly on the Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (SCP 10b) TEC, alternative mining methods have been identified and investigated by Iluka.

Two options have been investigated for mining below the water table:

- Excavator Dredge: The dredge mining method only requires dewatering of the mine pit for a short time, in a small area, at the commencement and completion of mining. Rather than operating mining equipment on the pit floor, dredge mining is conducted using an excavator mounted on a floating pontoon to excavate submerged material. Groundwater studies based on a dredge mining scenario are being progressed by Iluka, with early results indicating that mining can be designed to result in minimal modification to groundwater levels.
- Dragline: The dragline mining method requires no dewatering. Similarly to the dredge mining method, the dragline method allows excavation of submerged material, with the mobile unit operating off the advancing pit face. The proposed dragline method has sufficient reach to access material from a position above groundwater levels on land, rather than requiring a pontoon.

Iluka is continuing to investigate both dredge and dragline wet mining methods to identify the most appropriate method for mining at Tutunup, based on complexities from the hardness of the Tutunup orebody.

Within agricultural areas, remnant vegetation and trees within paddocks with environmental value occur, as outlined in Sections 5.2 and 5.3. Infrastructure placement that is sympathetic to environmental values within the DE have been identified, but will continue to be reviewed and revised by Iluka throughout the planning phase for the Proposal. Iluka will consider opportunities to minimise impact where possible within the constraints of the area available.

2.4 Local and regional context

2.4.1 Location

The Proposal is located approximately 17km east of Busselton in the City of Busselton Local Government Area (LGA). The Proposal is located near the following mineral sand mines (Figure 4):

- Iluka's rehabilitated Yoganup / Yoganup West / Cloverdale Mineral Sands Mine, located approximately 4km northeast;
- Iluka's rehabilitated Tutunup South Mineral Sands Mine, located approximately 4km southwest (currently in rehabilitation maintenance and monitoring phase);
- Doral's proposed Yalyalup Mineral Sands Mine, located approximately 10km southwest;
- Tronox's Wonnerup Mineral Sands Mine, located approximately 10km west; and
- Doral's Yoongarillup Mineral Sands Mine, located approximately 14km southwest;

2.4.2 Land Tenure

The DE is covered by *Mining Act 1978* tenements held by Iluka, as shown in Table 1. In addition to *Mining Act* tenure, there are six private landowners (including Iluka) which occupy land within the DE (Table 2) as well as State Forest 33 (Millbrook State Forest), unallocated crown land and Crown Reserves R24197, R32562 and R34283 for the purpose of drainage (Figure 5).

Table 1 Tenement Summary

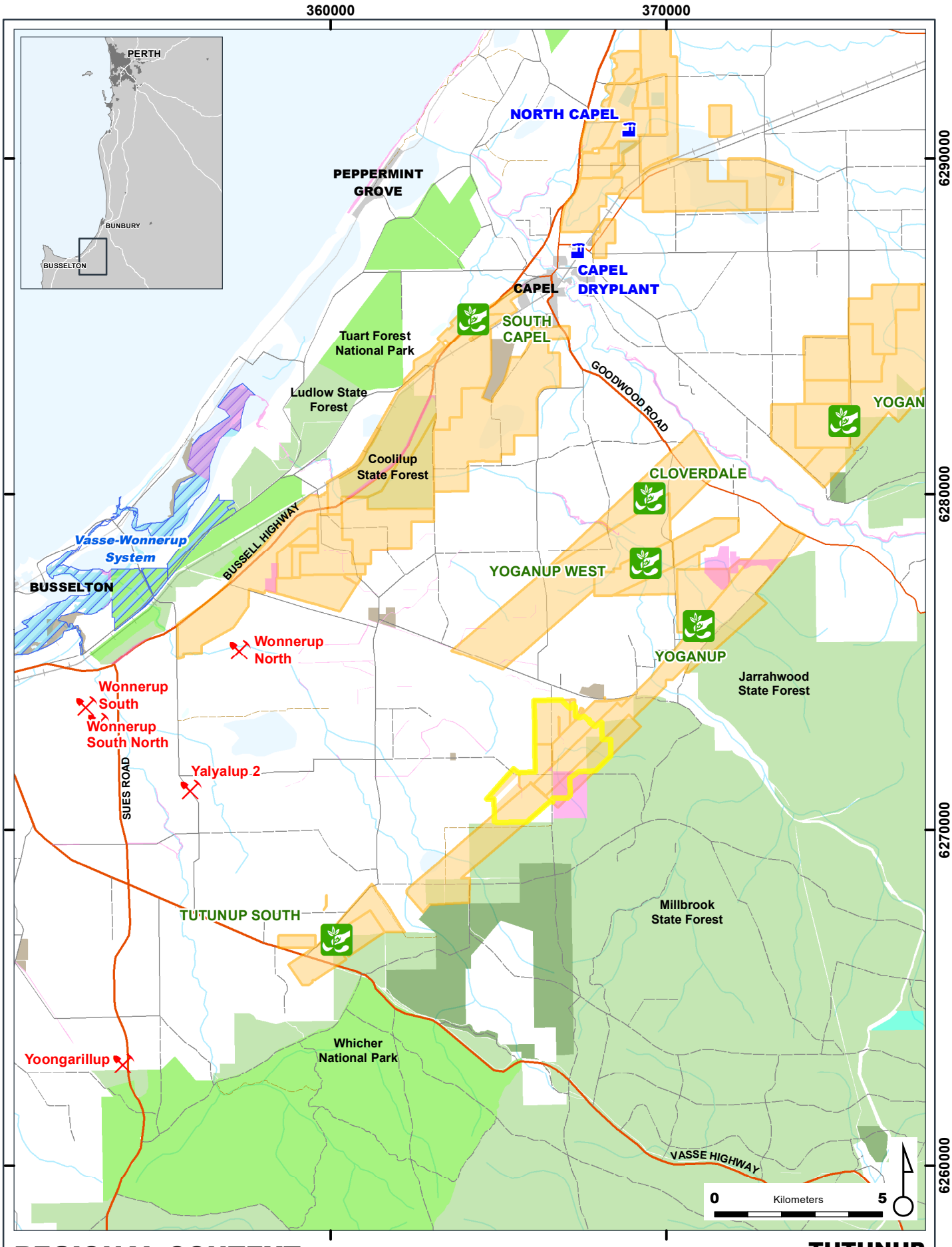
Tenement	Holder[1]	Granted	Expiry
G70/233	Iluka Resources Limited	26/11/2008	25/11/2029
G70/240	Iluka Resources Limited	19/08/2009	18/08/2030
G70/241	Iluka Resources Limited	19/08/2009	18/08/2030
G70/254	Iluka Resources Limited	26/11/2015	25/11/2036
G70/261	Iluka Resources Limited	Pending	N/A
L70/123	Iluka Resources Limited	22/07/2014	21/07/2035
L70/131	Iluka Resources Limited	22/06/2010	21/06/2031
M70/401	Iluka Resources Limited	28/05/1992	27/05/2034
M70/609	Ilmenite Pty Ltd	05/10/1992	07/10/2034
M70/726	Iluka Resources Limited	05/02/1993	04/02/2035
M70/1092	Iluka Resources Limited	25/09/2001	24/09/2022
M70/1243	Iluka Resources Limited	30/03/2007	29/03/2028

1 Ilmenite Pty Ltd is a wholly-owned subsidiary of Iluka Resources Limited

Table 2 Land Parcels and Ownership

Lot Number	Land Manager / Landowner[1]
44 on Plan 201686 (Unallocated Crown Land)	State of Western Australia
45 on Plan 201686 (Unallocated Crown Land)	State of Western Australia
1772 on Plan 201686	Non-Iluka landowner
1773 on Plan 201682	Iluka Resources Ltd
1774 on Plan 201686	Westralian Sands Ltd
1775 on Plan 201686	Westralian Sands Ltd
1776 on Plan 201686	Non-Iluka landowner
1780 on Plan 201686	Non-Iluka landowner
1781 on Plan 201686	Westralian Sands Ltd
1782 on Plan 201686	Westralian Sands Ltd
1783 on Plan 201686 (Unallocated Crown Land)	State of Western Australia
1784 on Plan 201686 (Unallocated Crown Land)	State of Western Australia
1785 on Plan 201686	Iluka Resources Ltd
1786 on Plan 201686	Westralian Sands Ltd
1787 on Plan 201686	Non-Iluka landowner
1790 on Plan 201686	Non-Iluka landowner
1791 on Plan 201686	Non-Iluka landowner
1792 on Plan 201686	Non-Iluka landowner
3194 on Plan 140968	Westralian Sands Ltd
4101 on Plan 140968 (Crown Reserve 24197)	State of Western Australia
4373 on Plan 169733 (Unallocated Crown Land)	State of Western Australia
4639 on Plan 004752 (Crown Reserve 34283 for the purpose of drainage)	State of Western Australia
4679 on Diagram 044079 (Crown Reserve 32562)	State of Western Australia
Road Reserve (Oates Road)	City of Busselton
Road Reserve (Tompsett Road)	City of Busselton
Road Reserve (Kenny Road)	City of Busselton
State Forest 33	State of Western Australia

1 Westralian Sands Ltd is a wholly-owned subsidiary of Iluka Resources Ltd



REGIONAL CONTEXT

TUTUNUP

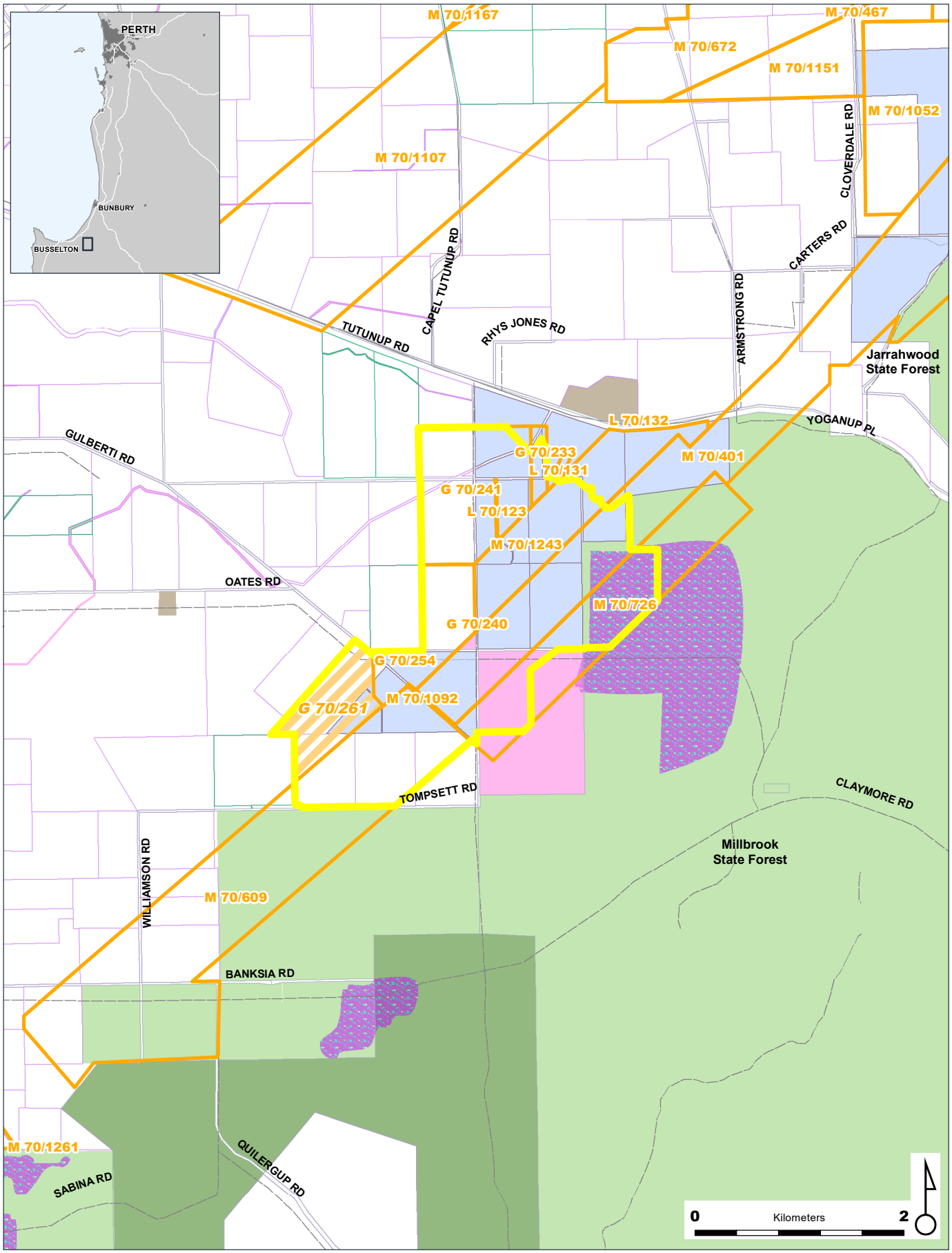
- Iluka Processing Plant
- Other Sites
- Iluka Pending Tenements
- Iluka Tenements
- Development Envelope
- RAMSAR Wetlands
- Ex Dir Freehold
- National Park
- Nature Reserve
- State Forest
- Timber Reserve
- Iluka Rehabilitation sites
- Unallocated Crown Land

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:150,000 **DATE:** 29/11/2021 **DWG No:** 245287v00 **FIGURE: 4**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245287v00_Tutunup_Regional_Context.mxd



LAND TENURE

- Private
- Company
- Iluka
- Unknown
- Iluka Pending Tenements
- Iluka Tenements
- Tutunup Development Area
- Nature Reserve
- State Forest
- Timber Reserve
- Plantation
- Vacant Crown Land

TUTUNUP

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:50,000 **DATE:** 14/09/2021 **DWG No:** 244798v02 **FIGURE: 5**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244798v02_Tutunup_Land_Tenure.mxd

3 STAKEHOLDER ENGAGEMENT

3.1 Stakeholder identification

3.1.1 Key and other stakeholders

Iluka has identified stakeholders who have an interest in the Proposal (Table 3). 'Key Stakeholders' are defined as those who own or manage land within the DE, the Wadandi Noongar people as Traditional Owners, and relevant decision-making authorities (DMAs). 'Other Stakeholders' include community and interest groups that have an interest in the Proposal but do not own or manage land within the DE. This includes neighbouring landowners, other Government agencies (state and local) and non-government organisations.

Table 3 Tutunup Proposal Stakeholders

Stakeholder Category	Stakeholder Name
Key Stakeholders	
Decision Making Authorities	Department of Agriculture, Water and the Environment (Federal)
	Department of Water and Environmental Regulation (DWER) – EPA Services Unit
	Department of Planning, Lands and Heritage (DPLH) (in respect of heritage approvals)
	Department of Mines, Industry Regulation and Safety (DMIRS) – Environment Division
	DWER - Regulatory Services (Environment)
	DWER –Regulatory Services (Water)
	DMIRS Resources Safety Division
	Radiation Council of Western Australia
Landowners and land managers	Private Landowners
	Iluka – as landowner
	Department of Biodiversity, Conservation and Attractions (DBCA)
	DPLH (in respect of Unallocated Crown land)
	Forest Products Commission
	Water Corporation
	City of Busselton
Traditional Owners	Wadandi Noongar people (refer to Section 5.6)
Other Stakeholders	
Government Agencies	Main Roads WA (inc South West region)
	South West Development Commission
Local Government	City of Busselton
	Shire of Capel
Community Members	Communities of Tutunup, Ruabon and Ludlow localities

Stakeholder Category	Stakeholder Name
Non-Government Organisations	South West Aboriginal Land and Sea Council (refer to Section 5.7)
	South West Boojarah #2 Agreement Regional Corporation
	Undalup Association Incorporated
	GeoCatch
	Vasse-Wonnerup Land Conservation District Committee
	South West Catchments Council
	Busselton Dunsborough Environment Centre
	Wildflower Society
	Conservation Council of Western Australia
	Western Ringtail Action Group
	Environmental Defenders Office of WA
	FAWNA

3.1.2 Engagement with Traditional Owners

The Tutunup Proposal is located on Wadandi Noongar country. Iluka has engaged with the South West Aboriginal Land and Sea Council (SWALSC), who provided native title services to Noongar People during the South West Native Title settlement period, and the South West Boojarah Working Group, whose members include Wadandi representatives. Iluka's discussions with SWALSC relate to the Proposal's potential to intersect with Aboriginal cultural heritage issues as well as broader matter around engagement expectations and the development of a mutually beneficial relationship between Iluka and the Wadandi people over time. Please refer to Social Surrounds Chapter Sections 5.6.3.2 and 5.6.3.3 for further information about Iluka's engagement framework and activities with Traditional Owners.

3.2 Stakeholder Engagement Process

Iluka's HSEC Standard: Social Performance prescribes a risk-based approach to stakeholder engagement; including assessment of social risks against the risk matrix in the Group Risk Procedure and managed proportionately. The engagement process adopted for this project provides the opportunity to test and validate both risk assumptions and community concerns.

Iluka have taken a targeted approach with 'key stakeholders'. Engagement has included providing updates on the Proposal status and seeking stakeholder input. Other communications and engagement has included briefings, face to face meetings and site tours. In cases where Covid-19 restrictions prevented face-to-face meetings, alternative methods of communication were utilised, including virtual meetings, phone calls and letters. An engagement website has also been established for the Proposal that provides information, updates and opportunities for stakeholders to comment.

More recently in the lead up to referral submission, Iluka has completed a round of stakeholder engagement activities with both landowners within the DE and neighbouring landowners, government agencies and Aboriginal groups, including:

- Door-knock/face-to-face contact with landowners in the Proposal's DE and surrounds.
- Proposal updates provided in person to landowners, and attached to emails/letters to other identified stakeholders.
- Face-to-face and online meetings with other identified stakeholders, including the Wadandi Noongar people which included a site tour.

- Proposal engagement website including access to Proposal information and the development of feedback mechanisms.
- Engagement activities aligned with Iluka's draft South West Social Strategy, including broader Iluka news and context via Iluka's South West Newsletter.

Discussions with stakeholders to date have focused on providing an update on Proposal activities, including:

- Scope and purpose of baseline environmental studies such as flora /vegetation, fauna and water (groundwater monitoring).
- Summary explanation of the interests granted with mining tenure within the DE.
- Access arrangements with landowners associated with Proposal activities.
- Approximate Proposal commencement timeframe, pending the outcome of regulatory processes.
- How the Proposal's DE was determined.
- Mine planning process, including potential infrastructure requirements.
- Provided information about the EPA referral process and the information Iluka is required to provide.
- Identifying stakeholder concerns for integration into mine planning as appropriate.

As the Proposal progresses through the regulatory processes and project lifecycle, Iluka will continue to engage with key stakeholders on a regular basis. Stakeholder engagement will be recorded and maintained in Iluka's internal stakeholder database, Isometrix. Isometrix is used to:

- Capture contact information for each stakeholder, categorise them by issue, track commitments made, and record the history of each stakeholder's interaction with the project. The database also enables the project team to capture and understand how stakeholder engagement has influenced project outcomes.
- Ensure that all stakeholders receive relevant and timely information as the Proposal evolves, in a format that best suits their needs and expectations. It also provides statistical data to aid the identification and analysis of communication risks and satisfaction levels.
- Regularly monitor the sentiment of stakeholders regarding the Proposal, which may change over time.

The Proposal's stakeholder engagement program forms part of Iluka's draft South West Social Strategy, which seeks to support a consistent approach to managing stakeholder and community relations across its operations and projects in the South West of Western Australia. Iluka is also commissioning a Social Impact Assessment (SIA) which will help to further understand the potential social impacts associated with Iluka activities at Tutunup and the range of options to address. The SIA will additionally be used to continue monitoring community sentiment towards Iluka operations in the South West.

3.3 Stakeholder Consultation Outcomes

Key stakeholder engagement to date is summarised in Table 4. It is Iluka's intention to consult with DWER, DMIRS, DAWE and DBCA in early 2022 on the Proposal.

Table 4 Stakeholder consultation

Stakeholder	Date	Matters Discussed	Response / Outcome
Key Stakeholders			
DWER – EPA Services	3 December 2021	Pre-referral Meeting	Iluka to refer the Proposal.
	August 2019	Discussed the Proposal and the requirements for further consultation with DWER's Mining Industrial Assessments (South).	Consultation to occur as required.
DMIRS	3 December 2021	Overview of project and environmental studies undertaken to date.	Consultation to occur as required.
	December 2019 to January 2020 December 2020 to February 2021 August 2021	Several Programme of Work (PoW) applications.	PoWs have been approved
Private landowners within and surrounding Development Envelope	August 2019 November 2020 (largely by phone) May 2021 September 2021	Sought permission from landowners and leasees of the Tutunup area to undertake flora and fauna surveys on private land.	Permission granted from private local landowners and lessees with specific access instructions from each landowner for each property.
	November 2020 Face to face and via Phone followed up by a Project Update August – November 2021 interviews with landowners face to face and by phone	Update on the Proposal status including environmental studies to inform referral process October 2021 Project Information sheet emailed or mailed to DE landonwers Interviews with 5 of 12 DE landowners completed – 11 – 12 November	Largely landowners within the development envelope were unconcerned by mining or the prospect of infrastructure being located on their land. Many landowners were also happy to grant land access for environmental studies. Consultation fatigue was evident due to cyniscm about project realisation. Issues raised included: • Future management of vegetation (burns offs and weed control); • Impacts on local flora and fauna including the ironstone TEC and how Iluka will proactively manage impacts; • Amenity including dust, noise and visual impacts (particularly at night from lights); • Local issues, including Iluka's progress of rehabilitation on other sites, and local security and fire danger; and • Impact to future property sales These issues have been taken into account in the framing of this referral, and will represent key considerations to be

			addressed in the forward approvals and related technical studies.
	August – Sept 2021	Negotiations with landowners within the DE regarding potential purchase or lease of properties	Very positive support received from landowners regarding the options for purchase or lease proposed.
	Sept 2021	Permissions sought from landowners and lessees for exploration program and CPT testing across the DE. Program from Sept – November.	Landowners support for exploration programme positive.
Department of Biodiversity, Conservation and Attractions (DBCA)	August to September 2019	Sought permission to enter land for the purpose of flora and fauna surveys.	Written permission was granted for flora access to some areas, other areas not accessed at this time due to sensitivity. Verbal advice received for fauna access.
Department of Planning, Lands and Heritage (DPLH)	August to September 2019	Sought permission from the Department of Planning, Lands and Heritage to access UCL areas for the purpose of flora and fauna surveys.	Written permission granted from DPLH via a licence on 31/10/19
Water Corporation	September 2019	Sought permission from the Water Corporation to undertake flora and fauna surveys around the area of Water Corporation Reserves R34283 and R32562.	Permission granted from the Water Corporation in the form of a 'Clearance to Work Permit' dated 12/09/2019.
City of Busselton	September 2019	Sought permission to access a subject portion of Rail Reserve R13136, which the City of Busselton lease from the Public Transport Authority, for the purpose of flora and fauna surveys.	Permission granted from the City of Busselton via email on 12/09/2019.
	3 December 2020	Provided an overview of all of Iluka's South West activities (exploration, projects, operations, rehabilitation and closure).	Iluka to consider how best to provide more consistent and regular updates and link with ongoing engagement.
	19 May 2021	Provided an update of all of Iluka's South West activities including a summary of the Tutunup Pre-feasibility works.	
Public Transport Authority	September 2019	Sought permission from the Public Transport Authority to access Rail Reserve R13136 for the purpose of flora and fauna surveys.	Permission granted from the Public Transport Authority via a licence and indemnity form on 09/09/2019.

Other stakeholders			
South West Boojarah Working Group (SWBWG) – Wadandi Representatives	25 November 2020 - Iluka presentation to the full SWBWG 9 June 2021 – project site tour and workshop at Iluka Capel offices with key Iluka staff and SWBWG nomindated representatives	Information provided about the Tutunup Proposal including the options to managepotential impacts to heritage and culture. Broader opportunities for collaboration were discussed regarding Iluka South West region operations and projects including remediation activites. Wadandi People outlined their engagement expectations The process to develop a broader mutually beneficial relationship between Iluka and the Wadandi people over time The SWBWG has directed Iluka to work withSWALSC as the Noongar Peoples native title service provider on all heritage issues.	Both these engagements were introductory and positive in nature. Discussion themes included: **Heritage** • Identification and protection of heritage and culture in and around the Development Envelope • Engagement of Wadandi people in heritage matters and the broader project is key, including design of the heritage surveys including management options • Taking a cultural landscape approach to heritage and culture rather than the current heritage and ethnographic survey approach • Directed Iluka to agree a NSHA with SWALSC **Economic Development / Social Initiatives** • Employment and procurement opportunities for Wadandi and Noongar People in the South West. Including exploring potential for entering into some form of voluntary agreement with Iluka to enable economic and social initiatives e.g. MOU etc • Support for Ranger programmes – e.g. contracts for rehab projects • Potential education collaborations between Iluka, Wadandi People, schools and higher education providers such as TAFE and Universities **Environmental** • Better understanding the environmental impacts resulting from Iluka proposed activities and their management. **Other** • Development of a Reconciliation Action Plan • Management of health and safety aspects of project activities
South West Aboriginal Land and Sea Council	17 August 2021 – Iluka/SWALSC meeting at SWALSC offices August – September 2021 ongoing correspondence exchanges regarding NSHA terms 2 September 2021	Information about the Tutunup Proposal and other SW projects Potential project heritage issues and mitigation/remedy actions The Noongar Standard Heritage Agreement (NSHA) process and requirements Engagement expectations, resourcing and timeframes Offer to appointment	**Heritage** • Iluka is finalising with SWALSC a Tutunup Project NSHA. • In lieu of an NSHA, Iluka wrote to SWALSC on 2 September 2021 advising it of its explorative sonic drill programme to be carried out in September 2021 and inviting SWALSC to appoint monitors for the duration of the programme and/or to undertake heritage clearances of the 3 drill sites. • On 10 November 2021 Iluka met with SWALSC to outline its exploration programme for early 2022 and

	correspondence advising commencement of an explorative low impact sonic drill programme 23 September 2021 correspondence advising Cone Penetration Testing programme commencement 1 October 2021 correspondence 10 November 2021 Iluka and SWALSC meeting	monitors or complete heritage clearances to cover September – December 2021 explorative drilling and testing programme. Correspondence between Iluka and SWALSC regarding the options to enter into a Regional NSHA that would include all of Ilua's operations in the South West region Meeting where agreement was reached for an initial Tutunup Project specific NSHA which over time will be expanded into a regional NSHA covering all Iluka mining tenements within South West Boojarah Country	agreement was reached for works information to be provided in the form of a NSHA Activity Notice format. Agreement was also reached for an initial NSHA covering the Tutunup project
Undalup Association Inc Iluka is engaged with the Undalup Association Inc (UA) through the South Capel Wetland remediation project where they partner with the FAWNA Possum Finishing School.	9 June 2021 Site vist at South Capel rehabilitation Project	Information about the Tutunup Proposal and other SW projects Engagement expectations Opportunities for collaboration	• Ranger Programme opportunities • On Country economic development projects • Tutunup Proposal heritage issues including protection of sites and species of cultural significance • Support for social programmes they run with school aged children • UA expressed an interest to continue engagement with Iluka to identify projects for collaboration
Conservation Council WA (CCWA)	21 September 2021 email requesting a meeting to discuss Iluka South West projects and operations including the Tutunup Proposal	Iluka contacted CCWA to organise an opportunity to discuss its current WA Proposals including the Tutunup.	• CCWA expressed an interest about GHG emissions from the developments with a preference for net zero over the life of the project, protection of biodiversity values , waste disposal methods being safe and away from people and water sources

4 OBJECT AND PRINCIPALS OF THE EP ACT

There are five principles which guide the overall application of the EP Act as established under Section 4A of the EP Act. Iluka has considered these principles during planning and commissioning of feasibility studies for development of the Proposal. These considerations are summarised in Table 5.

Table 5 Object and Principles of the EP Act

Principle	Consideration
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by:* *A. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *B. an assessment of the risk-weighted consequences of various options.*	Iluka continues to undertake a range of studies on environmental factors, to ensure a thorough understanding of the environmental setting at Tutunup. As the development of the Proposal progresses, the outcome of studies will inform mine planning and the development of additional mitigation measures to prevent unacceptable harm to the environment. Iluka will take a precautionary approach where threats or impacts to the environment are uncertain.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	As the development of the Proposal progresses, the outcome of studies will inform mine planning and the development of mitigation measures. Iluka will manage environmental factors within its control to minimise future adverse impacts and, where possible, maintain or enhance the health, diversity and productivity of the environment for the benefit of future generations. As evidenced by Iluka's recent minesites in the South West, the proposed mine will represent a temporary change in the landscape, rehabilitated to post-mining landform and land use in accordance with a Mine Closure Plan (MCP) required under the *Mining Act 1978*.
3. Principles relating to improved valuation, pricing and incentive mechanisms *(1) Environmental factors should be included in the valuation of assets and services.* *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.*	The following valuation, pricing and incentive mechanisms have been considered as relevant to the Proposal: • Factor costs of environmental management and offsets into annual budgets for the Proposal; • Factor estimated rehabilitation and closure costs of into the financial assessments of the Proposal; • Minimise vegetation clearing which presents a cost saving associated with earthworks as well as a reduced environmental footprint; • Minimise the use of consumables where possible and identify opportunities for recycling of materials; and • Improve efficiencies with water consumption and water recycling.

Principle	Consideration
4. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	Iluka recognises the value of vegetation, fauna habitat and ecological linkages for maintaining diversity and ecosystem integrity. These values are incorproated into Iluka's rehabilitation practises.The Proposal is currently in an early planning phase. Iluka's continuing evaluation of mining methods incorporates environmental considerations such as minimising impacts to groundwater levels and, as a result, to groundwater dependent ecosystems. The outcome of studies will inform mine planning and the development of additional mitigation measures to minimise impact where possible.
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	Iluka commits to minimising waste as far as practicable during construction, operation and closure by adopting the hierarchy of waste controls: avoid, reduce, reuse, recycle and safe disposal as far as reasonably practicable.

5 ENVIRONMENTAL FACTORS AND OBJECTIVES

5.1 Identification of Environmental Factors

The EPA's Environmental Impact Assessment Administrative Procedures (WA Government 2021) defines a number of environmental factors that the EPA utilises as their organising principles for conducting an EIA. There are 14 factors organised into five themes: Sea, Land, Water, Air and People.

Iluka has taken into consideration all available information at the time of preparing this document including historic baseline surveys, preliminary mine planning and regional environmental and social context. The Proponent considers that the preliminary key environmental factors for the Proposal will be:

- Flora and Vegetation;
- Terrestrial Fauna;
- Terrestrial Environmental Quality;
- Inland Waters; and
- Social Surroundings (with respect to Aboriginal heritage).

Information relating to these environmental factors including regional context, baseline environmental data (where available), potential impacts and mitigation measures are provided in Sections 5.2 to 5.6.

Environmental factors considered relevant to the Proposal but not determined to be key environmental factors are discussed, albeit in less detail, in Sections 5.7 to 5.9, including:

- Air Quality;
- Human Health; and
- Greenhouse Gas Emissions.

Environmental factors not considered relevant to the Proposal include:

- Subterranean Fauna – within the DE, the geology predominantly consists of sand and clay. The absence of voids within the geology indicates that the habitat present is not conducive to hosting subterranean fauna with restricted distributions; and
- Landforms – the Proposal is located predominantly on previously cleared, agricultural land and represents a temporary change in land use.

These environmental factors are not discussed further in this document.

5.2 Environmental Factor – Flora and Vegetation

5.2.1 EPA Objective

The EPA objective for Flora and Vegetation is *to protect flora and vegetation so that biological diversity and ecological integrity are maintained.*

5.2.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline – Flora and Vegetation (EPA, 2016a);
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b); and

- EPA Statement of Environmental Principles, Factors and Objectives (EPA, 2020a).

5.2.3 Receiving Environment

5.2.3.1 Completed and Proposed Studies

The following flora and vegetation studies have been completed over whole or part of the DE:

- Flora and Vegetation of Iluka's Proposed Tutunup Mineral Sands Project (Bennett Environmental, 2008);
- Flora and Vegetation of Iluka's Proposed Tutunup Mineral Sands Project (Bennett Environmental, 2009);
- Botanical Assessment of Selected Areas at Tutunup (Bennett Environmental, 2013);
- Tutunup Weed Survey (Ecoedge, 2011a);
- Tutunup Weed Survey (Ecoedge, 2012);
- *Phytophthora cinnamomi* survey Tutunup Area (Raudino, 2007);
- *Phytophthora cinnamomi* re-check survey Tutunup Area (Raudino, 2008);
- Tutunup Mineral Sands Mine Stage 1 – Desktop Flora and Vegetation Review (WEC, 2015);
- Update and Review of Tutunup Mineral Sands Mine Stage 1 – Desktop Flora and Vegetation Review (WEC, 2019); and
- Tutunup Mineral Sands Project Flora and Vegetation Survey (WEC, 2021) (presented in Appendix 1).

Iluka proposes to undertake further studies to inform the EIA:

- additional targeted searches for conservation significant species to ensure appropriate coverage of the DE;
- a groundwater dependent ecosystem (GDE) assessment to confirm the presence of GDEs and the nature of their dependence on groundwater; and
- a *Phytophthora* dieback assessment to ensure understanding of the current extent of the dieback infestation in and around the DE.

This will be synthesised into a contemporary summary of flora and vegetation knowledge, consistent with current EPA Guidance.

5.2.3.2 Regional Vegetation

The Proposal is situated in the Perth Subregion (SWA02) of the Swan Coastal Plain Biogeographic Region, near the junction with the Jarrah Forest Bioregion (specifically the Southern Jarrah Forest Subregion), as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia, 2012). The Perth Subregion is broadly characterised by heath or tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on quaternary marine dunes and Marri on colluvial and alluvials (Mitchell, et al., 2002). The Perth Subregion also includes a complex series of seasonal wetlands (Mitchell, et al., 2002).

The Proposal is located within the South West Botanical Province which is regarded as having a very high degree of species diversity (Mitchell, et al., 2002). Broad scale vegetation mapping completed by Beard in 1981 and later revised by Shepherd describe two vegetation system associations within the DE; Pinjarra woodlands (vegetation association 1136) and Chapman woodlands (vegetation association 1181) (Beard, et al., 2013; Shepherd, et al., 2002). More than 93% of the Pinjarra_1136 vegetation association has been cleared since European arrival. The vegetation associations within the DE are presented in Table 6 and Figure 6.

The Proposal occurs partly on the Whicher Scarp, which has been noted as having diverse and varied natural values in relation to landforms, flora, vegetation and fauna and remaining native vegetation meets the six criteria for regionally significant natural areas (EPA, 2013).

Table 6 Vegetation associations within the DE (WEC, 2021; Government of Western Australia, 2019)

Vegetation Association	Description	Current Extent (ha)	Percentage Remaining (%)
Pinjarra_1136	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	2,959	7
Chapman_1181	1 Medium woodland, jarrah and *Corymbia haematoxylon* (Whicher Range)	6,754	43

5.2.3.3 Local Vegetation

With the exception of one agricultural lot, the DE and surrounds were surveyed in 2019 by Woodman Environmental Consulting (WEC, 2021) as shown in Figure 7. A total of 1,410 ha was surveyed, including 612 ha of the 653 ha DE. Within the flora and vegetation study area, WEC (2021) defined and mapped 27 vegetation types (six of which occurred within the DE), and areas of highly modified vegetation, including:

- stands of native trees over pasture weeds;
- scattered remnant trees and shrubs over pasture weeds along roads and drains
- regrowth in gravel pits;
- planted vegetation, including pine plantation; and
- cleared land.

Of the 612 ha survey area of the DE within the flora and vegetation study area, 409 ha was mapped by WEC (2021) as cleared land. The 41 ha unsurveyed lot within the DE is also cleared, with little vegetation present. Therefore approximately 450 ha (69%) of the DE is cleared.

The lower-lying western section of the DE has been historically cleared for farming and agriculture. Patches of vegetation, both native and planted, occur within paddocks. Native vegetation in this area generally comprised stands of *Corymbia calophylla*, mixed *Corymbia calophylla*/*Eucalyptus marginata*, *Agonis flexuosa* or mixed *Eucalyptus rudis*/*Melaleuca* sp. over pasture weeds (WEC, 2021). Elsewhere, relatively intact patches of native vegetation on agricultural land comprised woodlands of *Corymbia haematoxylon*/*Eucalyptus marginata*, *Banksia attenuata*/*Melaleuca thymoides* or *Melaleuca preissiana*.

The eastern part of the DE includes a portion of State Forest 33 comprising areas of native vegetation and a pine plantation and unallocated Crown land, which is mostly vegetated with areas of historic disturbance including gravel pits. In the eastern part of the DE, stands of native vegetation comprised woodlands of *Corymbia haematoxylon*/*Eucalyptus marginata* or *Eucalyptus marginata*/*Corymbia haematoxylon*/*Corymbia calophylla* forest with affinities to Whicher Scarp Floristic Community Types (WEC, 2021).

Vegetation condition across the DE was mapped as ranging from Excellent to Degraded (WEC, 2021). Vegetation within the DE is summarised in Table 7 and shown in Figure 7.

Table 7 Vegetation mapped within the DE (WEC, 2021)

Vegetation type	Area (Ha) (to 1dp)
Native	
Native vegetation communities	102.5
Excellent Condition	*45.2*
Very Good Condition	*10.2*
Good Condition	*21.5*
Degraded Condition	*25.5*
Scattered remnant native trees and shrubs over pasture along roads and drains (degraded)	3.6
Regrowth of native species in gravel pits (degraded)	3.1
Stands of native trees over pasture weeds (completely degraded)	32.8
Total native	**142.0**
Planted	
Stands of planted non-native Eucalypt species over pasture weeds; and planted native and non-native mixed species	6.3
Pine plantation	54.9
Total planted	**61.2**
Total vegetation within the DE	***203.2***

5.2.3.4 Conservation Significant Vegetation

Three TECs and two Priority Ecological Communities (PECs) have been identified as occurring within the Flora and Vegetation Study Area (WEC, 2021). Of these, two TECs occur within the DE. TECs and PECs are outlined in Table 8 and Figure 8, and are discussed further, below.

Table 8 TECs and PECs within the Flora and Vegetation Study Area (WEC, 2021)

Community	Conservation Status		Area mapped within the DE (Ha) (to 1dp)
	BC Act 2016 (WA)	EPBC Act 1999 (Cth)	
Occurring both within and outside the DE			
Banksia Woodlands of the Swan Coastal Plain TEC	Priority 3	Endangered	*Excellent* - *6.3* *Very good* - *4.2* *Good* - *6.8* *Degraded* - *6.8* Total - 24.0
Corymbia calophylla woodlands on heavy soils of the southern Swan Coastal Plain (SCP 1b) TEC	Vulnerable	N/A	Degraded - 3.4
Occurring only outside the DE			
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (SCP 10b) TEC	Critically Endangered	Endangered	Nil
Central Whicher Scarp Mountain Marri woodland (Whicher Scarp woodlands of grey/white sands floristic community A1) PEC	Priority 1	Endangered (forms part of the Banksia Woodlands of the Swan Coastal Plain TEC)	Nil

Community	Conservation Status		Area mapped within the DE (Ha) (to 1dp)
	BC Act 2016 (WA)	EPBC Act 1999 (Cth)	
Whicher Scarp Jarrah woodland of deep coloured sands (Whicher Scarp woodlands of coloured sands and laterites floristic community C2) PEC	Priority 1	N/A*	Nil

* This community can be a component of the Commonwealth Banksia Woodlands of the Swan Coastal Plain TEC, however the vegetation within the Study Area does not represent the TEC (WEC, 2021, pp. 137-138)

The following were mapped by WEC (2021) both within and outside of the DE:

- Banksia Woodlands of the Swan Coastal Plain TEC (Commonwealth)

  This TEC was listed as a TEC under the EPBC Act in 2016. WEC (2021) recorded three patches occurring within the DE that met the Threatened Species Scientific Committee (TSSC) (2016) patch size and condition criteria to be classified as representative of the TEC. The condition of these patches ranged from Excellent to Degraded. A further six patches meeting the TSSC criteria occurred to the south, southeast and northeast outside of the DE, ranging in condition from Excellent to Good.

- *Corymbia calophylla* woodlands on heavy soils of the southern Swan Coastal Plain (SCP 1b) TEC (State)

  This TEC was recorded in small, degraded patches within the DE, along and adjacent to Tompsett Road and Kenny Road (WEC, 2021). These patches appear to represent new occurrences with respect to Department of Biodiversity, Conservation and Attractions (DBCA) TEC and PEC database. This TEC was also recorded in small patches north of the DE on Iluka-owned land and in the Tutunup Road reserve. The patches outside of the DE ranged from Degraded to Excellent.

The following were mapped by WEC (2021) as occurring outside the DE:

- The Shrublands on Southern Swan Coastal Plain Ironstones (SCP 10b) (Busselton area) TEC (State and Commonwealth)

  This TEC occurs to the north and the south of the DE. While the orebody extends beneath part of this TEC, a buffer has been imposed around occurrences of this TEC to exclude it from the DE, as a key avoidance measure as part of the mitigation hierarchy. This community was surveyed by WEC (2021) where it occurs on Iluka-owned land within the Flora and Vegetation Study Area. Occurrences north of Tutunup Rd (Negus Block) and south of the DE (Abba Block) were not sampled by WEC, though DBCA have identified the occurrence of the TEC in these locations (WEC, 2021). Iluka has utilised DBCA mapping to identify the boundaries of this TEC and define the exclusion area.

- The Whicher Scarp Jarrah woodland of deep coloured sands (Whicher Scarp woodlands of coloured sands and laterites floristic community C2) PEC (State)

  This PEC has been identified and mapped by WEC (2021) in State Forest 33, immediately to the south of the DE. The vegetation condition was rated as Excellent. The DBCA TEC and PEC Database also includes a buffer polygon for this community intersecting the Study Area, though that polygon occurs in a location where this community is not considered to occur (WEC, 2021).

  This PEC itself is not listed by the Commonwealth but can be a component of the EPBC Act-listed Banksia Woodlands of the Swan Coastal Plain TEC. However, due to the absence of *Banksia attenuata*, the occurrence of this PEC within the Study Area is not Banksia Woodlands of the Swan Coastal Plain TEC (WEC, 2021).

- The Central Whicher Scarp Mountain Marri woodland (Whicher Scarp woodlands of grey/white sands floristic community A1) PEC (State and Commonwealth)

  This PEC occurs 800m south of the DE, on the Whicher Scarp (WEC, 2021). This PEC forms part of the EPBC Act-listed Banksia Woodlands of the Swan Coastal Plain TEC. The vegetation condition was rated as Excellent.

The DBCA TEC and PEC Database includes buffer polygons of several additional State and Commonwealth TECs and PECs overlying the DE (Figure 9) though representatives of these communities were not detected by WEC (2021). These comprised:

- Swan Coastal Plain Paluslope Wetlands (Priority 1);
- '*Eucalyptus haematoxylon -Eucalyptus marginata* woodlands on Whicher foothills ('floristic community type 1a')' (Priority 3); and
- Southern *Banksia attenuata* woodlands ('community type 21b') (Priority 3). Note this also forms part of the Banksia Woodlands of the Swan Coastal Plain TEC.

WEC (2021) also recorded vegetation types (VT) that were unaligned with either Swan Coastal Plain or Whicher Scarp floristic community types. As a result, it is considered that these VTs are potentially restricted in their distribution and therefore potentially significant. Within the DE, these comprised VT1, VT2, VT3 and VT12 as shown on Figure 8.

Some patches of VT3 and all of VT12 within the DE meet the criteria for Banksia Woodlands of the Swan Coastal Plain TEC and are captured in consideration of that TEC.

5.2.3.5 Conservation Significant Flora

Threatened and Priority flora taxa recorded in or adjacent to the DE during flora surveys conducted to date are identified in Table 9 and shown in Figure 8. Threatened and Priority flora taxa not recorded but potentially occurring in or adjacent to the DE are shown in Table 10. In total, five Threatened and four Priority flora species have been recorded within the DE to date. Additional targeted searches for conservation significant flora are planned to ensure appropriate coverage of the DE, in accordance with EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b).

Table 9 Significant flora recorded within and outside of the DE (WEC, 2021)

Taxon	Conservation Status	
	BC Act	EPBC Act
Recorded within the DE		
Banksia nivea subsp. *uliginosa*	T	En
Banksia squarrosa subsp. *argillacea*	T	Vu
Chamelaucium roycei	T	Vu
Grevillea elongata	T	Vu
Lambertia echinata subsp. *occidentalis*	T	En
Calytrix retrorsifolia	P1	-
Hakea oldfieldii	P3	-
Acacia semitrullata	P4	-
Calothamnus quadrifidus subsp. *teretifolius*	P4	-
Recorded outside the DE		
Brachyscias verecundus	T	Cr En
Darwinia whicherensis	T	En

Taxon	Conservation Status	
	BC Act	EPBC Act
Daviesia elongata	T	Vu
Gastrolobium papilio	T	En
Grevillea maccutcheonii	T	En
Morelotia australiensis (formerly *Tetraria australiensis)*	T	Vu
Petrophile latericola	T	En
Andersonia ferricola	P1	-
Dillwynia sp. Capel (P.A. Jurjevich 1771)	P1	-
Loxocarya striata subsp. *implexa*	P1	-
Stylidium ferricola	P1	-
Amperea micrantha	P2	-
Poranthera moorokatta	P2	-
Blennospora doliiformis	P3	-
Boronia capitata subsp. *gracilis*	P3	-
Isopogon formosus subsp. *dasylepis*	P3	-
Loxocarya magna	P3	-
Meionectes tenuifolia	P3	-
Myriophyllum echinatum	P3	-
Olearia strigosa	P3	-
Schoenus pennisetis	P3	-
Stylidium paludicola	P3	-
Acacia flagelliformis	P4	-
Banksia meisneri subsp. *ascendens*	P4	-
Drosera fimbrata	P4	-
Franklandia triaristata	P4	-
Pultenaea skinneri	P4	-

BC Act Conservation Codes: T – Threatened, P1 – Priority 1, P2 – Priority 2, P3 – Priority 3, P4 – Priority 4

EPBC Act Conservation Codes: Cr En – Critically Endangered, En – Endangered, Vu - Vulnerable

Table 10 Significant flora potentially occurring within the DE (WEC, 2021)

Taxon	Conservation Status		Potential occurrence
	BC Act	EPBC Act	
Species not recorded but potentially occurring in the DE			
Andersonia gracilis	T	En	Unlikely
Caladenia busselliana	T	En	Unlikely
Caladenia hoffmanii	T	En	Unlikely
Caladenia huegelii	T	En	Unlikely
Diuris micrantha	T	Vu	Unlikely

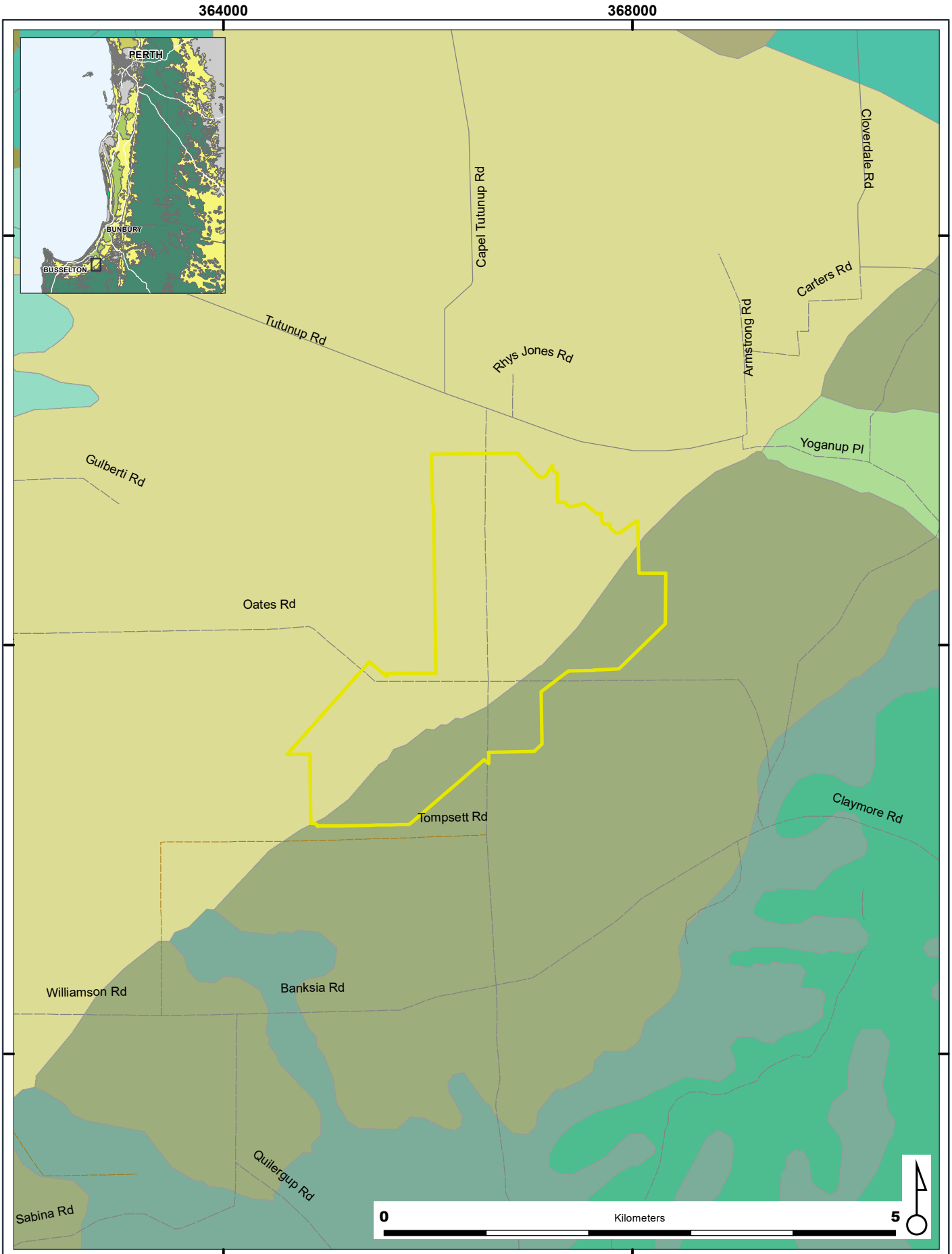
Drakaea elastica	T	En	Possible
Drakaea micrantha	T	Vu	Possible
Sphenotoma drummondii	T	En	Unlikely
Synaphea stenoloba	T	En	Unlikely
Synaphea sp. Fairbridge farm	T	Cr En	Unlikely
Verticordia densiflora var. *pedunculata*	T	En	Unlikely
Verticordia plumosa var. *vassensis*	T	En	Unlikely
Boronia humifusa	P1		Possible
Actinotus whicheranus	P2		Possible
Stylidium squamellosum	P2		Possible
Thysanotus sp. Badgingarra (E.A. Griffin 2511)	P2		Possible
Cyathochaeta teretifolia	P3		Possible
Verticordia attenuata	P3		Unlikely
Verticordia lehmannii	P4		Possible

BC Act Conservation Codes: T – Threatened, P1 – Priority 1, P2 – Priority 2, P3 – Priority 3, P4 – Priority 4

EPBC Act Conservation Codes: Cr En – Critically Endangered, En – Endangered, Vu - Vulnerable

5.2.3.6 Introduced Flora

WEC (2021) recorded 40 introduced flora taxa (not including pasture) within and around the DE. Of these, two species, *Asparagus asparagoides* and *Zantedeschia aethiopica*, are Declared Pests under the *Biosecurity and Agriculture Act 2007* (BAM Act). *Asparagus asparagoides* is also a Weed of National Significance (WoNS). Part of a pine plantation (*Pinus radiata*) located in State Forest 33 occurs within the north-eastern boundary of the DE.



REGIONAL VEGETATION ASSOCIATIONS

TUTUNUP

- Development Envelope
- Minor Road
- Minor Road unsealed
- Track unsealed

Vegetation Associations

- Pinjarra woodlands (1136)
- Chapman woodlands (1181)
- Chapman forest (3)
- Chapman woodland (1185)
- Chapman woodland (1182)
- Bassendean woodland (1136)
- Bassendean woodland (1000)
- Bassendean low forest (973)
- Bassendean low forest (990)
- BASSENDEAN_1182
- BASSENDEAN_4
- BASSENDEAN_6
- BASSENDEAN_949
- PINJARRA_968
- SPEARWOOD_1000
- SPEARWOOD_125
- SPEARWOOD_2
- SPEARWOOD_37
- SPEARWOOD_6
- SPEARWOOD_676
- SPEARWOOD_990

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:50,000 **DATE:** 30/11/2021 **DWG No:** 244799v02 **FIGURE: 6**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244799v02_Tutunup_Veg_Associations.mxd

366000

368000

6272000

6270000

PERTH

BUNBURY

BUSSELTON

Development Envelope

Study Area

Vegetation in Study Area (Woodman Environmental)

- Native vegetation - Excellent condition
- Native vegetation - Very good condition
- Native vegetation- Good condition
- Native vegetation - Degraded condition
- Scattered remnant (degraded)
- Regrowth (degraded)
- Trees over pasture (completely degraded)
- Planted
- Native vegitation not surveyed

TUTUNUP
SURVEYED VEGETATION

0 Kilometers 2

ILUKA

ORIG: SJ | DRAWN: DRB | SCALE (A3): 1:15,000 | DATE: 2/12/2021 | DWG No: 245293v00

FIGURE: 7

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245293v00_Tutunup_Surveyed_Vegatation.mxd

364000

366000

368000

6274000

6272000

6270000

6268000

PERTH

BUNBURY

BUSSELTON

Development Envelope

Study

Significant Flora (WEC 2021)

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

Previous surveys

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

Significant Vegetation

Threatened Ecological Communities

- SCP 1b – Corymbia calophylla woodlands on heavy soils of the southern Swan Coastal Plain
- SCP10b – Shrublands on southern Swan Coastal Plain Ironstones
- Banksia Woodland TEC

Priority Ecological Communities

- Central Whicher Scarp Mountain Marri woodland (Whicher Scarp woodlands of grey/white sands floristic community A1)
- Whicher Scarp Jarrah woodland of deep coloured sands (Whicher Scarp woodlands of coloured sands and laterites floristic community C2)

Unaligned vegetation

- VT 1, VT 2, VT 3, VT 6, VT 7 & VT 12
- SCP10b - Shrublands on Southern SCP Ironstones (DBCA mapping)

SIGNIFICANT FLORA AND VEGETATION

0 Kilometers 2

TUTUNUP

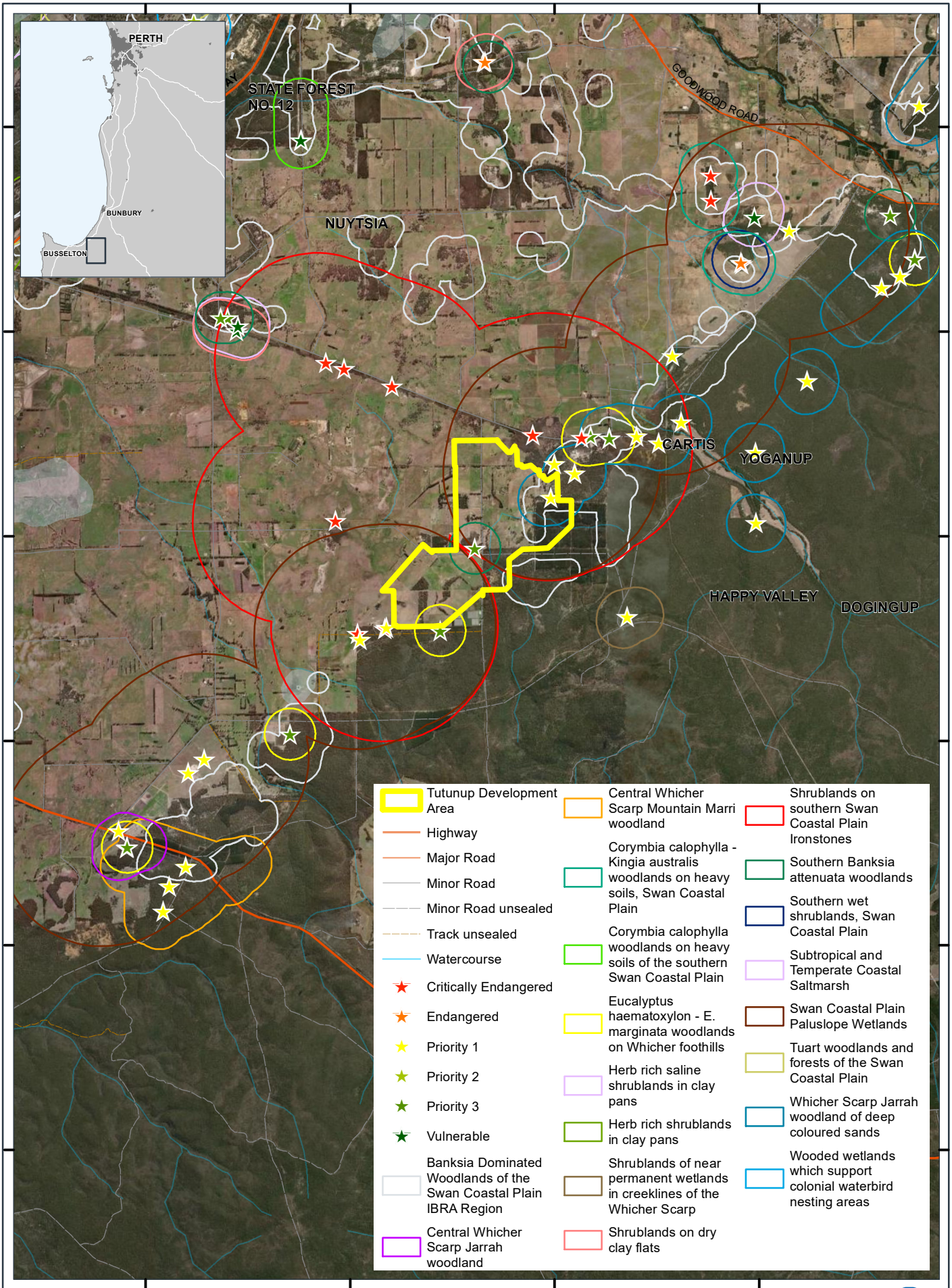
ILUKA

ORIG: SJ | DRAWN: drb | SCALE (A3): 1:20,000 | DATE: 2/12/2021 | DWG No: 245294v00

FIGURE:8

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245294v00_Tutunup_Significant_Flora_Veg.mxd



TUTUNUP

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

0 Kilometers 3

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:100,000 **DATE:** 30/11/2021 **DWG No:** 244801v01

FIGURE: 9

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244801v01_Tutunup_Regional_TECPEC.mxd

5.2.3.7 Phytophthora Dieback

Phytophthora cinnamomi is a pathogen introduced to Western Australia. *Phytophthora* Dieback is the common name for the observable disease caused as a result of interaction between the pathogen *P. cinnamomi* (and others) and susceptible plant species. Areas vulnerable to *Phytophthora* Dieback are defined as native vegetation occurring west of the 400 mm rainfall isohyet (Project Dieback, 2014). The Proposal is located within a Dieback Risk Zone.

Phytophthora Dieback is known to occur within the vicinity of the Proposal. DBCA data indicates *Phytophthora* Dieback infestation in the native vegetation located to the south and east of the DE (DIDMS, 2014). Records of *Phytophthora* Dieback have also been lodged in parts of State Forest 33 to the northeast of the DE (DIDMS, 2014).

5.2.4 Potential Impacts

While Iluka has substantial baseline studies that characterise the receiving environment and inform its understanding of potential impacts to flora and vegetation associated with the Proposal, further studies in this regard are ongoing. Iluka has commissioned additional vegetation and flora assessments and plans to commission a GDE assessment. This work will continue as planning progresses and will assist to enhance the assessment of the potential impacts associated with the vegetation and flora impacts.

The Proposal could potentially result in the following impacts to Flora and Vegetation:

- Direct loss of vegetation resulting from clearing, potentially including areas of:
  - *Banksia Woodlands of the Swan Coastal Plain* TEC;
  - *Corymbia calophylla* woodlands on heavy soils of the southern Swan Coastal Plain TEC; and / or
  - occurrences of Threatened and Priority Flora.
- Indirect impacts on native vegetation resulting from:
  - alterations to surface water or groundwater hydrology, including indirect impacts on the Shrublands on Southern Swan Coastal Plain Ironstones (Busselton area) TEC;
  - introduction or spread of weeds or soil pathogens through vehicular movement and earthmoving operations.
  - Loss or degradation of vegetation condition due to dust emissions; and
  - Loss or degradation of vegetation condition due to hazardous materials spillage.

Iluka recognises the significance of the TECs, PECs and Threatened and Priority Flora that occur within the DE and its surrounding environs. Detailed environmental surveys and impact and risk assessments to inform the Proposal design, layout and mining method are ongoing. Iluka has experience in mining in similar environments located on the Swan Coastal Plain / Whicher Scarp interface. That experience, coupled with baseline studies to date, gives Iluka confidence that, with appropriate management measures in place, the potential environmental impacts can be managed in a manner consistent with the EPA's objectives for Flora and Vegetation.

5.2.5 Mitigation

The mitigation hierarchy of avoidance, minimisation and rehabilitation is an inherent feature of Iluka's environmental management practices.

In recognition of the particularly high conservation value of the Shrublands on Southern Swan Coastal Plain Ironstones (Busselton area) TEC, two key avoidance measures have already been committed to in relation to the protection of this TEC:

- TEC buffer: the DE and mine pit boundaries are set back 50 m and 100 m, respectively, from the TEC.
- Using wet mining methods: while dry mining is the traditional method of mining in Iluka's south west mine sites, it requires dewatering of the active mine pit, potentially creating a cone of groundwater depression around the pit. Wet mining methods are proposed to be employed at Tutunup, minimising the need for significant dewatering and the potential for changes in groundwater levels outside the mine pit.

The outcome of ongoing studies will inform mine planning and the development of further mitigation measures. Iluka has extensive experience mining similar environments and will incorporate the experience into its management of the Proposal.

Examples of mitigation measures for the protection of flora and vegetation previously employed and which may be relevant to the Proposal include:

Avoid

- Identify and map the distribution of conservation significant flora and vegetation communities within and around the DE.
- Design the site to locate infrastructure, such as stockpiles, dams and support infrastructure, to avoid clearing or disturbance of conservation significant flora and vegetation, wherever possible.
- Identify and map the distribution of declared weeds and *Phytophthora* infestations within and around the DE, to inform hygiene management and soil management measures.

Minimise

- Undertake clearing incrementally as required for operational purposes and manage clearing through Iluka's established ground disturbance permitting procedures.
- Implement Iluka's established vehicle and equipment hygiene procedures to minimise the entry or spread of weeds and soil borne pathogens.
- Implement dust management procedures to minimise the potential for dust or airborne HMC emissions to occur.

Rehabilitate

In consultation with key stakeholders and in accordance with the *Mining Act 1978*, Iluka will develop a mine closure plan (MCP) detailing its closure objectives, post-mine land use(s), potential risks to achieving closure objectives, management controls to address those risks, completion criteria and the monitoring to be undertaken to demonstrate that completion criteria have been met. The MCP will also detail how closure of the site will be implemented. Once approved, the MCP will be implemented to achieve the required completion criteria.

Iluka has a range of established practices to facilitate successful mine site rehabilitation, which will be incorporated into mine closure planning for Tutunup as appropriate. Examples of the types of controls that may be included in the MCP in relation to flora and vegetation include:

- Removing and stockpiling topsoils, subsoils or soils with potential adverse properties separately;
- Restricting stockpile heights for valuable resources such as topsoil, to preserve seed banks;
- Replacing stockpiled soil materials to an appropriate position in the rehabilitated profile to achieve the agreed post-mining land use(s) and maintain groundwater throughflows;
- Developing rehabilitation species lists which include species that are appropriate to the area and the soil/landform habitat being constructed after mining, cover all functional types and whose establishment is considered achievable;

- Use of a variety of revegetation methods as appropriate, including natural establishment from the topsoil seed store, direct seeding, planting seedlings propagated from seed, cuttings or tissue culture and/or transplanting; and,
- Maintaining rehabilitated areas until completion criteria are met, by managing weeds and pests.

5.2.6 Assessment and significance of residual impacts

Based on current information available to Iluka, the Proposal has potential for significant impact to this environmental factor. The outcome of further studies and assessment will inform mine planning, consideration of the mitigation measures available and therefore determine the potential presence and significance of any residual impacts. However, Iluka considers that residual impacts will be demonstrated to be at an acceptable level.

5.2.7 Environmental Outcomes

Whilst a significant amount of information has already been developed for the Proposal and a DE has been defined, further studies to be completed as part of the EIA process will allow better determination of the likely environmental outcomes and, where appropriate, may result in amendments to the Proposal. Iluka will demonstrate through assessment of the Proposal that the EPA's objectives for flora and vegetation can be achieved.

5.3 Environmental Factor – Terrestrial Fauna

5.3.1 EPA Objective

The EPA objective for Terrestrial Fauna is to *protect terrestrial fauna so that biological diversity and ecological integrity are maintained.*

5.3.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline – Terrestrial Fauna (EPA, 2016c).
- Technical Guidance – Sampling methods for terrestrial vertebrate fauna (EPA, 2016d).
- Technical Guidance – Sampling of Short-Range Endemic Invertebrate Fauna (EPA, 2016e).
- Technical Guidance – Terrestrial Fauna Surveys for Environmental Impact Assessment (EPA, 2020b).
- EPA Statement of Environmental Principles, Factors and Objectives (EPA, 2020a).

5.3.3 Receiving Environment

5.3.3.1 Completed and Proposed Studies

The following fauna studies have been completed over the whole or part of the DE:

Terrestrial Fauna

- Tutunup Fauna Assemblage and Fauna Habitat Seasonal Survey (Biota, 2009).
- Iluka Tutunup Project Detailed Fauna Assessment (BCE, 2021) (presented in Appendix 2).

Black Cockatoos

- Assessment of Significant Habitat for Black Cockatoos in the Proposed Tutunup Study Area (Johnstone, et al., 2008).

- Surveys and Monitoring of Black Cockatoos in the Tutunup Region (Johnstone, et al., 2009).
- Tutunup Potential Nesting Tree Survey (Ecoedge, 2011b).
- Tutunup Potential Black Cockatoo Nesting Tree Survey (Ecoedge, 2013a).

Western Ringtail Possum

- Western Ringtail Possum Baseline Assessment Tutunup (Harewood, 2009).

Aquatic Fauna

- Tutunup Wetland Baseline Aquatic Biology Study (WRM, 2009).
- Tutunup Mineral Sands Project Aquatic Biology Desktop Review and Aquatic Fauna Field Survey 2020 (WRM, 2021) (presented in Appendix 3).

Ecological Linkages

- Assessment of Potential Impacts on Ecological Linkages at Iluka's Proposed Tutunup Mineral Sands Project (Ecoedge, 2013b).

5.3.3.2 Fauna Habitats

Based on vegetation mapping (WEC, 2021), approximately 69% of the DE has been cleared for agricultural activities. BCE (2021) recognised ten fauna habitat types (classified on the basis of vegetation / substrate associations (VSAs)) as a means of describing faunal assemblages, patterns of distribution and ecological linkages. These VSAs were:

1. Open Jarrah forest over *Banksia* spp., *Mountain Marri (Corymbia haematoxylon)* and *Xanthorrhoea preissii* on laterite ridge on the upper slope and sandy, loamy gravels on the lower slope.
2. Jarrah Forest with some Marri (*Corymbia calophylla*) over mixed *Banksia* spp. and *Allocasuarina fraseriana* over a shrubby understorey on gravelly sand.
3. Woodland of *Banksia* spp. and Mountain Marri *(Corymbia haematoxylon)* over tall/low open shrubland of mixed species. Small patches of Peppermint (*Agonis flexuosa*) and *Nuytsia floribunda* present.
4. Jarrah and Marri forest over Mountain Marri and *Banksia grandis* over a shrubby understorey on heavy loam-clay to sandy-clay.
5. A complex of wetland associated vegetation with patches of Flooded Gum (*Eucalytus rudis*) while other areas consisted of tall shrubland of *Melaleuca* sp. and *Kunzea* sp. as well as mixed scrub in seasonally damp wetland on sandy and peaty soils over ironstone.
6. *Banksia attenuata* woodland over open low mixed scrub and grass layer on pale grey sand.
7. Pine plantation on mostly gravelly sands and loamy gravels.
8. Remnant woodland and forest with little or no understorey. Occurs in small and isolated patches in agricultural areas and includes some areas of degraded wetland.
9. Introduced Eucalypt stands of planted non-native and occasional native trees over pasture weeds on agricultural areas on sandy soils.
10. Cleared agricultural land. Pastures and some perennial crops, including orchards and vineyards, on sands, peaty-sands and gravels where the Coastal Plain meets the Whicher Range.

5.3.3.3 Vertebrate Fauna assemblage

A desktop study identified 208 vertebrate fauna species as potentially occurring in the survey area, comprising 1 fish, 9 frogs, 30 reptiles, 138 birds and 23 native (plus 7 introduced) mammals (BCE, 2021). Field investigations confirmed the presence of 128 vertebrate fauna species, including 7 frogs, 22 reptiles, 77 birds (74 native and 2 introduced), and 22 mammals (17 native and 5 introduced) (BCE, 2021).

The fauna assemblage includes elements of the Swan Coastal Plain and forests of the Whicher Range due to its position across the transition between these two landscapes. Particularly important biodiversity areas were represented by:

- High bird species richness and abundance in areas of diverse floristics in and around wetland margins (VSA 5 & 3) and in the Jarrah forest VSAs (particularly VSA 4 which has a rich and diverse understorey);
- High frog species richness and abundance in and around the margins of wetland areas (VSA 5); and
- Important refuge and breeding habitat for several taxa in Jarrah forest, including all three Black Cockatoo species.

VSAs represented by highly modified environments e.g. cleared farmland, may support fewer species however remnant vegetation and introduced eucalypts are likely to provide important functions for refuge and movement across an otherwise barren landscape. Similarly, pine forest (not directly sampled) although likely to support low species richness is recognised as an important foraging resource for Carnaby's Black Cockatoo (BCE, 2021).

5.3.3.4 Conservation Significant Fauna

Conservation significant fauna taxa recorded or likely to occur within the DE and surrounding environs (BCE, 2021; Biota 2009) are presented in Table 11. Threatened fauna recorded in the survey area comprised Black Cockatoos and the Western Ringtail Possum, which are discussed further in Section 5.3.3.5 and 5.3.3.6, respectively.

Table 11 Conservation significant fauna taxa

Common Name	Scientific Name	Conservation Status		Recorded	Status in survey area
		BC Act 2016	EPBC Act 1999		
Reptiles					
Coastal Plains Ctenotus	*Ctenotus ora*	Priority 3		Y	Resident
Birds					
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii naso*	Vulnerable	Vulnerable	Y	Resident
Baudin's Black-Cockatoo	*Calyptorhynchus baudinii*	Endangered	Endangered	Y	Resident
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	Endangered	Endangered	Y	Regular visitor
Australian Painted Snipe	*Rostratula australis*	Endangered	Endangered	N	Vagrant*
Australasian Bittern	*Botaurus poiciloptilus*	Threatened	Endangered	N	Vagrant*
Common Sandpiper	*Actitis hypoleucos*		Migratory	N	Irregular visitor#
Sharp-tailed Sandpiper	*Calidris acuminata*		Migratory	N	Irregular visitor#

Common Name	Scientific Name	Conservation Status		Recorded	Status in survey area
		BC Act 2016	EPBC Act 1999		
Wood Sandpiper	*Tringa glareola*		Migratory	N	Irregular visitor#
Common Greenshank	*Tringa nebularia*		Migratory	N	Irregular visitor#
Marsh Sandpiper	*Tringa stagnatilis*		Migratory	N	Irregular visitor#
Glossy Ibis	*Plegadis falcinellus*		Migratory	N	Irregular visitor#
Fork-tailed Swift	*Apus pacificus*		Migratory	N	Irregular visitor#
Barking Owl	*Ninox connivens*	Priority 3		N	Irregular visitor#
Masked Owl	*Tyto novaehollandiae*	Priority 3		N	Resident (not recorded but likley to occur)
Australian Little Bittern	*Ixobrychus dubius*	Priority 4		N	Vagrant*
Peregrine Falcon	*Falco peregrinus*	Other Specially Protected Fauna		N	Resident (not recorded but likley to occur)
Mammals					
Western Ringtail Possum	*Pseudocheirus occidentalis*	Critically Endangered	Critically Endangered	Y	Resident
Chuditch	*Dasyurus geoffroii*	Vulnerable	Vulnerable	N	Resident (not recorded but likley to occur)
Quenda	*Isoodon fusciventer*	Priority 4		Y	Resident
South-western Brush-tailed Phascogale	*Phascogale tapoatafa* subsp. *wambenger*	Conservation Dependent		Y	Resident
Brush Wallaby	*Notamacropus irma*	Priority 4		Y	Resident
Western False Pipistrelle	*Falsistrellu mackenziei*	Priority 4		Y	Regular visitor
Rakali or Water-Rat	*Hydromys chrysogaster*	Priority 4		Y	Irregular visitor

*Vagrant - May occur unpredictably, in small numbers or for brief periods

#Irregular visitor – may occur at some time

5.3.3.5 Black Cockatoos

BCE (2021) recorded 1,577 potential nesting trees (i.e. with a diameter at breast height (DBH) of >500mm) in forested areas (primarily comprising Jarrah) and 1,190 trees in remnant vegetation on farmland (primarily comprising Marri). Of these, seven exhibited chew marks around hollows as evidence of recent nesting activity and a further 422 trees had suitable hollows but no evidence of nesting. The majority of trees had no suitable hollows presently but were considered likely to at some point in the future.

An assessment of the foraging quality of each VSA indicated that the Jarrah and Marri forests, *Banksia* woodlands and remnant vegetation on farmland rated highly as food resources for all three species of Black Cockatoo (BCE, 2021). The pine plantation also provided a high quality food

resource for Carnaby's Black Cockatoos. Tall shrublands on seasonal wetlands, introduced eucalypts on farmland, and cleared farmland provided few food resources for Black Cockatoos.

Several Black Cockatoo roosting sites are known to occur within a 12 km radius of the DE (BCE, 2021). Site investigations indicated roosting activity by Carnaby's Black Cockatoos and Baudin's Black Cockatoos in forested areas near the DE (BCE, 2021). Roosting activity by Forest Red-tailed Black Cockatoos was not detected. Black Cockatoos were observed moving between water points on farmland and nearby forested areas, leading BCE (2021) to hypothesise that access to water on agricultural land may be important for Black Cockatoos roosting in the adjacent forest.

5.3.3.6 Western Ringtail Possum

In 2009, a targeted survey for Western Ringtail Possum (WRP) was completed for the Tutunup area (Harewood, 2009). The survey work focused on identifying WRP use of remnant native vegetation within agricultural land and State Forest occurring to the east. During the 2009 survey, 44 WRP were observed as well as dreys and scat evidence (Harewood, 2009). WRP were observed utilising remnant native vegetation within agricultural land as well as native vegetation in State Forest to the east (Harewood, 2009). Surveys conducted in 2019 and 2020 recorded nine WRP and two dreys in areas of remnant vegetation on farmland (VSA 8) and in woodland immediately west of the Whicher Scarp (VSA2) (BCE, 2021).

5.3.3.7 Short Range Endemic Fauna

Short Range Endemic (SRE) fauna are defined as terrestrial and freshwater invertebrates that occur in naturally small distributions, often less than 10,000km^2 (Harvey, 2002). Within this distribution the actual habitat areas can be small, discontinuous or fragmented (Harvey, 2002). Taxa which exhibit short range endemism are characterised by poor dispersal capabilities, confinement to disjunct habitats and low fecundity such as millipedes, mygalomorph spiders and molluscs (Harvey, 2002).

In 2009, Biota completed a fauna survey of the Tutunup area that included the DE. The fauna survey also targeted SRE fauna through pitfall traps and searching of microhabitats (Biota, 2009). While a small number of invertebrates were collected including four scorpions of *Urodacus sp.* and two mygalomorph spiders, none of the specimens were identified to species level (Biota, 2009). The habitats these species were identified in were considered, at the time, to be characteristic of the adjacent forest and Whicher Scarp suggesting it is unlikely that the specimens were true SRE taxa (Biota, 2009).

BCE (2021) noted that distribution patterns of invertebrates are poorly documented and SRE species are often associated with isolated and distinctive environments (Harvey 2012). Much of the area east of the DE is fairly uniform forest, but wetlands and vegetation associated with ironstone are fragmented in distribution and therefore have the potential to support SRE invertebrates (BCE, 2021).

5.3.3.8 Ecological Linkages

The south-west of Western Australia is internationally recognised as a 'biodiversity hotspot' because of the high concentration of endemic species coupled with the level of threat facing these species and communities (Myers, et al., 2000). Since European settlement, the condition and extent of native vegetation in the south-west has declined leading to a fragmented landscape where native vegetation is reduced to small patches of varying quality (Molloy, et al., 2009). This can considerably influence long-term persistence of native species and the ecological function of vegetation patches (Molloy, et al., 2009). Connectivity of patches across the landscape is recognised as being an important factor for biodiversity conservation and the long-term persistence of species and communities (Molloy, et al., 2009).

Ecological linkages are recognised as one measure of biodiversity conservation that aim to improve connectivity between vegetation patches in fragmented landscapes (Molloy, et al., 2009). Increased connectivity can improve ecological function and provide 'stepping stones' for flora and fauna

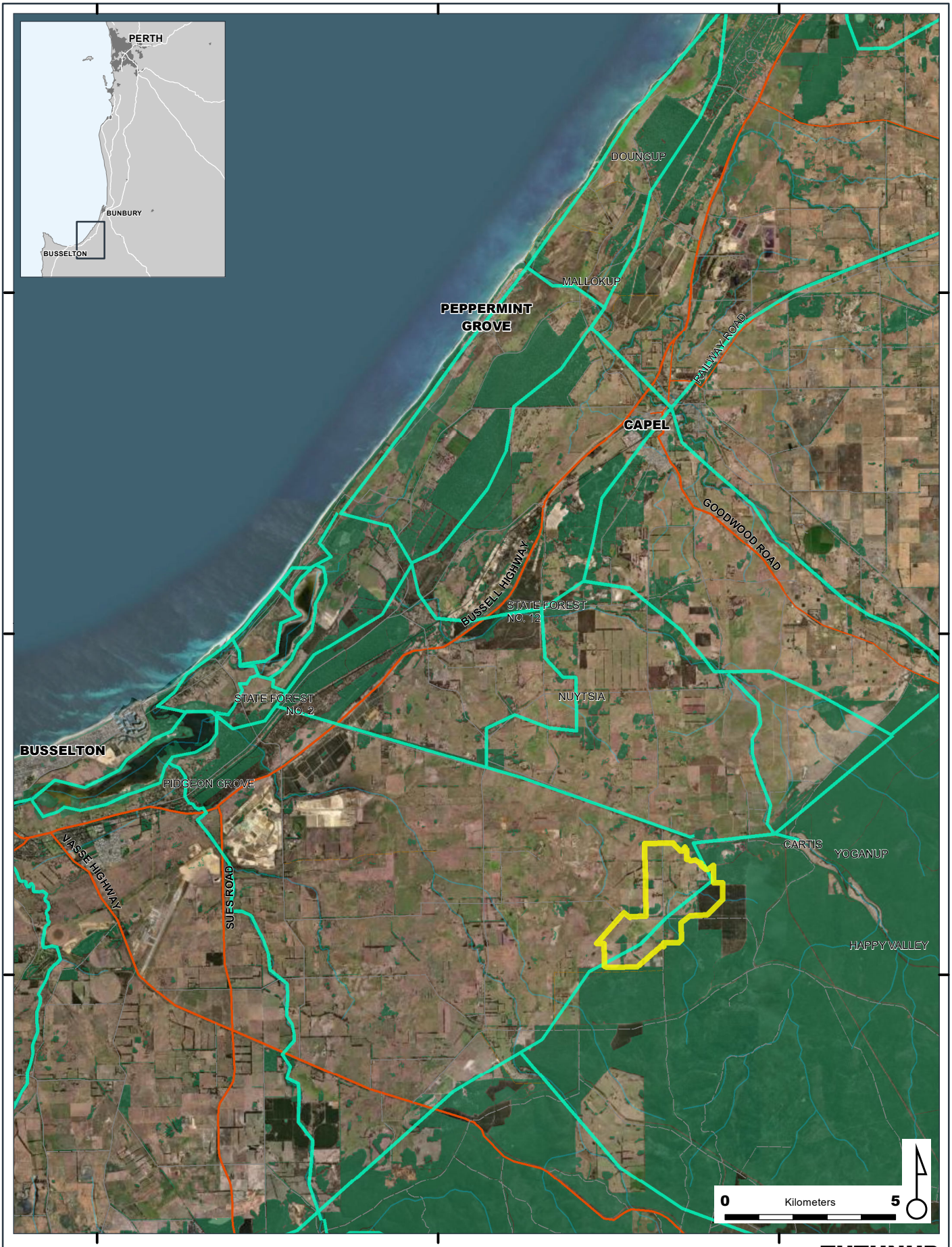
between regionally significant areas such as national parks and nature reserves (Molloy, et al., 2009).

The South West Regional Ecological Linkages Project (SWREL) undertaken by the South West Catchments Council (SWCC) has identified target areas for ecological linkages at a regional level based on native vegetation extent and proximity between patches and regionally significant conservation areas (Molloy & Deeley, 2013; Molloy, et al., 2009). These Regional Ecological Linkage axes represent patches which are of a certain size and distance from one another to act as 'stepping stones', and also identify regional priorities for improving landscape-scale connectivity (Molloy & Deeley, 2013; Molloy, et al., 2009). One such Regional Ecological Linkage runs north-east to south-west with the aim of connecting patches within paddocks to State Forest and the Busselton Ironstone TEC vegetation to the north of the DE (Molloy & Deeley, 2013; Molloy, et al., 2009; Ecoedge, 2013b) (Figure 10). A second axis occur to the north of the DE, running east to west along the vegetated road reserve of Tutunup Road, joining State Forest with the Ruabon Nature Reserve (Molloy & Deeley, 2013; Molloy, et al., 2009; Ecoedge, 2013b).

5.3.3.9 Aquatic Fauna

Wetland Research and Management (WRM) conducted aquatic biology studies of the Tutunup Wetland (WRM 2008, WRM 2021), which included sampling of micro- and macro-invertebrates, tadpoles, fish, freshwater crayfish, water quality, and aquatic habitat characterisation. Most aquatic species recorded were common and widespread (WRM, 2021). One listed species, the freshwater snail *Glacidorbis occidentalis* (DBCA-classified as Priority 3), and three potential SRE species; the epigean diving beetles *Paroster* sp. nov. and *P. ellenbrookensis*, and the stygobiotic amphipod *Westiphargus nichollsi* were recorded. Further distributional data are required to confirm the status of these latter three species as SREs.

Two species of microinvertebrate, the protists *Arcella* cf. *crenullata* and *Difflugia* cf. *distenda,* represented new records for Australia. These microinvertebrates are highly likely to be widely distributed throughout Australia. Overall, WRM (2021) concluded that the Tutunup Wetland supports a high diversity of aquatic invertebrates and, given the highly modified surrounding landscape, the ecological value of the remnant aquatic habitat is high.



ECOLOGICAL LINKAGES

TUTUNUP

Ecological Linkages Axis Lines (South West Catchment Council (SWCC), 2013)
Development Envelope
Native Vegetation Extent

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:150,000 **DATE:** 30/11/2021 **DWG No:** 245289v00 **FIGURE: 10**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245289v00_Tutunup_Ecological_Linkages.mxd

5.3.4 Potential Impacts

While Iluka has substantial baseline studies to characterise the receiving environment and identify and assess the potential impacts to terrestrial fauna associated with the Proposal, further studies in this regard are ongoing. This work will continue as project planning progresses and will assist to enhance the assessment of potential impacts to fauna

The Proposal could potentially result in the following impacts to Terrestrial Fauna:

- Reduction in local fauna habitat due to clearing of native vegetation, including:
    - Potential Black Cockatoo nesting trees;
    - Black Cockatoo foraging habitat;
    - Western Ringtail Possum habitat trees, and
    - Fragmentation of ecological linkages
- Injury or mortality of fauna through entrapment or vehicle strikes;
- Indirect effects on fauna distribution and foraging or breeding activity though disturbance from light, noise or vibration; and
- Indirect impacts on aquatic fauna and habitat through:
    - changes in hydrology;
    - Spread of pests, weeds or diseases (such as *Phytophthora* Dieback)

The majority of the DE occurs on previously cleared agricultural land that has minimal habitat value to native fauna, with the exception of patches of remnant native vegetation and planted eucalypts. Iluka recognises the significance of the habitat values for threatened species such as Black Cockatoos and the Western Ringtail Possum. Iluka also recognises the significance of remnant native vegetation on cleared farmland in providing a refuge for fauna and supporting ecological linkages in a highly modified landscape.

Additional detailed environmental surveys and impact and risk assessments to inform the Proposal design, layout and mining method are ongoing. Iluka has experience in mining in similar environments located on the Swan Coastal Plain / Whicher Scarp interface and considers that, with appropriate management measures in place, the potential environmental impacts can be managed in a manner consistent with the EPA's objectives for Terrestrial Fauna.

5.3.5 Mitigation

The mitigation hierarchy of avoidance, minimisation and rehabilitation is an inherent feature of Iluka's environmental management practices.

The outcome of studies will inform mine planning and the development of further mitigation measures. Iluka has extensive experience in mining in similar environments in the southwest of Western Australia and elsewhere and will incorporate the experience gained from these mining projects into the management of the Proposal.

Examples of mitigation measures for the protection of terrestrial fauna previously employed and which may be relevant to the Proposal include:

Avoid

- Design the site to locate infrastructure, such as stockpiles, dams and support infrastructure, to avoid clearing of significant fauna habitats or linkages, where possible.

Minimise

- Identify and map significant terrestrial fauna habitats within and around the DE.

- Ensure awareness of the fauna values of the site through inductions.
- Undertake any required pre-clearing surveys, impose site speed limits and demarcate any exclusion zones to prevent unplanned injury to significant fauna.
- Undertake clearing incrementally as required for operational purposes and manage clearing through Iluka's established ground disturbance permitting procedures.

Rehabilitate

As described in Section 5.2.5, Iluka will develop a MCP in accordance with the *Mining Act 1978* which, once approved, will be implemented to achieve the agreed completion criteria.

Iluka has a range of established practices to facilitate successful mine site rehabilitation which will be incorporated into mine closure planning for Tutunup, as appropriate. Examples of the types of controls that may be included in the MCP in relation to terrestrial fauna include:

- In defining post-mining land use(s), consider the improvement or development of wildlife corridors.
- Where rehabilitation aims to establish suitable habitat for specific fauna species, include plant species known to provide feed or breeding habitat for target species, where those species are appropriate to the area and the soil/landform habitat being constructed after mining and whose establishment is considered achievable.
- Consider, with appropriate advice, inclusion of salvaged or artificial hollows designed to target relevant conservation significant species in native vegetation rehabilitation areas, to support reintroduction of species.
- Monitoring to ensure that completion criteria are met.

5.3.6 Assessment and significance of residual impacts

Based on current information available to Iluka, the Proposal has potential for significant impact to this environmental factor. The outcome of further studies and assessment will inform mine planning, consideration of the mitigation measures available and therefore determine the presence and significance of any residual impacts. However, Iluka considers that residual impacts will be demonstrated to be at an acceptable level.

5.3.7 Environmental Outcomes

Whilst a significant amount of information has already been developed for the Proposal and a DE has been defined, further studies to be completed as part of the EIA process will allow better determination of the likely environmental outcomes and, where appropriate, may result in amendments to the Proposal. Iluka will demonstrate through assessment of the Proposal that the EPA's objectives for terrestrial fauna can be achieved.

5.4 Environmental Factor – Terrestrial Environmental Quality

5.4.1 EPA Objective

The EPA objective for Terrestrial Environmental Quality is to *maintain the quality of land and soils so that environmental values are protected.*

5.4.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline: Terrestrial Environmental Quality (EPA, 2016f)
- EPA Statement of Environmental Principles, Factors and Objectives (EPA, 2020a)

5.4.3 Receiving Environment

5.4.3.1 Completed and Proposed Studies

The following studies have been completed over whole or part of the DE relating to soils:

- Acid Sulfate Soils and Heavy Mineral Deposits: General Theory (Iluka, 2008); and
- Pre-Mine Soil Survey for the Proposed Tutunup Mine Site (SWC, 2009).

Acid sulfate soil (ASS) investigations have also been commenced, with an extensive drilling program and lab analysis conducted. The current DE covers a larger area than the previous studies and therefore further investigation is required and remains ongoing.

In addition, metallurgical testing to characterise the properties of the Tutunup ores have been conducted. Results of this test work will inform the management requirements for various process streams, in particular clay fines.

5.4.3.2 Geology

The Proposal area covers parts of the Yoganup Formation and younger littoral and marginal marine units deposited on the Western Australian continental shelf during the Pliocene and Pleistocene periods. The Proposal area is located along the foot of the Whicher Scarp, a prominent topographic feature orientated parallel to, and about 14 km inland from, the present day coastline. The scarp has formed the limit of numerous Tertiary marine transgressions. Palaeo-shorelines along this part of the scarp are collectively referred to as the Yoganup Shorelines.

The Yoganup Formation crops out as a yellow-orange, heavy mineral rich, clay-sand on its eastern margin against the Leederville Formation sea-cliff. This location is also generally coincident with a fragmented laterite duricrust. The western flank of the Yoganup Formation is buried by thin, white (at surface), aeolian quartz sands of the Bassendean dune system.

There have been numerous phases of heavy mineral accumulation in the Tutunup Deposit. Subsequent to deposition, the deposit has undergone topographic deflation, erosion by drainage channels off the scarp, induration through lateritisation and ironstone development, and alteration of the mineral constituents. Laterite presents as extensive sheets at or near surface in the Tutunup Region, is about 1 – 5 m in thickness and variably developed in terms of its hardness.

5.4.3.3 Topography and Landforms

The Swan Coastal Plain slopes gently from the base of the Whicher and Darling Scarps at about 40m above sea level down to the coast (DoW, 2007). The coastal belt contains low dune systems (Bassendean, Spearwood and Quindalup dunes) parallel to the coast (DoW, 2007). The inner part of the plain is an extension of the flat Pinjarra Plain (DoW, 2007).

The Proposal is located at the boundary of the Whicher Scarp and the Abba Plain. The Abba Plain has a gently undulating land surface consisting of small localised rises separated by broad low-lying flats (SWC, 2009). Small rises represent remnants of the once extensive Bassendean dune system, there is very little height difference between the rises and flats (SWC, 2009). Slope gradients are mostly less than 1% but occasionally range up to 3% (Schoknecht, et al., 2004; DPIRD, 2019). Low lying flats experience prolonged waterlogging in some areas during the winter months (SWC, 2009). In contrast, the Whicher Scarp has a considerable relief and is dissected by river systems (SWC, 2009). The raised shelf of the Whicher Scarp is 10-40 m above the Swan Coastal Plain with a level to undulating surface while valley floors can have relief of 5 to 20 m (Schoknecht, et al., 2004; DPIRD, 2019). Slope gradients are mostly 3% but can range from 10 to 20% (Schoknecht, et al., 2004; DPIRD, 2019). At the base of the Whicher Scarp there are small concave depressions that experience prolonged saturation and correspond to sumplands and floodplains which delineate the boundary of the Abba Plain and Whicher Scarp (SWC, 2009). In the vicinity of the Proposal this relates to the Tutunup Wetland and location of the Busselton Ironstone TEC.

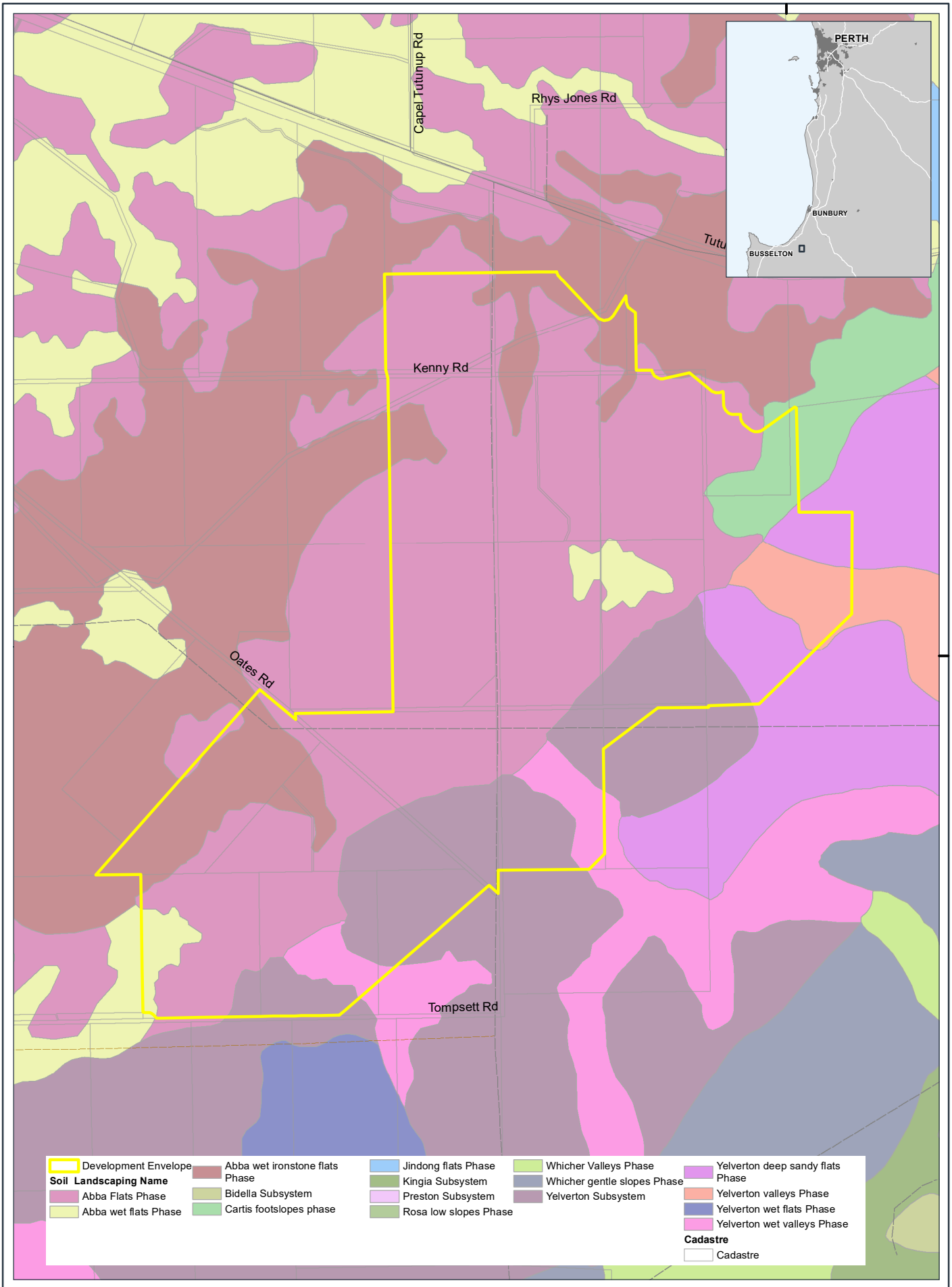
5.4.3.4 Soil types

The DE is located across two broad soil landscape mapping zones: the Pinjarra Zone (213) and the Donnybrook Sunkland Zone (214) (Schoknecht, et al., 2004). The Pinjarra Zone is characterised by alluvial and colluvial deposits with clayey to sandy alluvial soil in wet areas (Schoknecht, et al., 2004). The Donnybrook Sunkland Zone is characterised by a moderately dissected lateritic plateau on Perth Basin sedimentary rocks with soils formed in lateritic colluvium, sedimentary rocks weathered *in-situ* and alluvium (Schoknecht, et al., 2004).

Soil landscape zones are classified further into land mapping systems. Within and around the DE, three soil systems have been mapped (Schoknecht, et al., 2004):

- Abba System – poorly drained flats with grey deep sandy duplex wet soil;
- Forrestfield System – undulating footslopes of the Whicher Scarp with duplex sandy gravels, pale deep sands and grey deep sandy duplexes; and
- Whicher Scarp System – a low scarp and raised platform with sandy gravel and pale deep sands, loamy gravel and non-saline wet soils.

Soil investigations by Soil Water Consultants (SWC, 2009) have been conducted over the majority of the DE, characterising soils and identifying adverse soil properties. Five soil types were identified occurring within and around the DE (SWC, 2009). The indicative distribution of these soil types in relation to the DE is shown in Figure 11.



TUTUNUP
REGIONAL SOILS

0 Kilometers 1.5

ILUKA

Regional Soils – Source: DPIRD-027

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:25,000 **DATE:** 2/12/2021 **DWG No:** 245290v00 **FIGURE: 11**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245290v00_Tutunup_Regional_Soils.mxd

5.4.3.5 Acid Sulfate Soils

DWER Acid Sulfate Soil (ASS) risk maps identify a small part of the northern end of the DE as a Class 1 ASS risk (moderate to high risk of ASS occurring within 3 m of the soil surface). The north-western corner of the DE and a small area in the south-west is mapped by DWER as a Class 2 ASS risk (moderate to low risk of ASS occurring within 3 m of the natural soil surface but high to moderate risk of ASS beyond 3 m of the natural soil surface). However, the majority of the DE occurs in an area which has not been mapped as an ASS risk area by DWER.

A review of the Australian Soil Resources Information System (ASRIS) indicates that part of the DE has a high probability of occurrence of ASS (ASRIS, 2011). Analysis of ASS drilling samples indicates the presence of ASS at Tutunup. Further investigation is required to determine the extent of ASS presence within the DE so that the most appropriate management strategy for this material can be scheduled as part of the mining process, so as to minimise risk of disturbance and potential impacts.

5.4.3.6 Contaminated Sites

A search of the DWER contaminated sites database (DWER, 2020) indicates that there are no known contaminated sites within the DE. Iluka considers it is unlikely that a contaminated site of significance occurs within the DE.

5.4.4 Potential Impacts

The Proposal could potentially result in the following impacts to Terrestrial Environmental Quality:

- Direct disturbance of soil structure and quality through the excavation, stockpiling and backfilling of topsoil and subsoil.
- Alteration of soil hydrology through the backfilling of mined areas with sand tailings and clay fines.
- Exposure and oxidation of PASS, resulting in the generation of acidic and metalliferous leachate.
- Potential contamination of soil and land from spills and leaks of hydrocarbons.

While Iluka has substantial baseline surveys, additional environmental impact and risk assessments to inform soil management measures are ongoing. This includes studies to quantify volumes of available rehabilitation resources as well as to determine the extent and distribution of problematic materials. Iluka has experience in mining in similar environments in the south west, including sites with PASS and other adverse soil properties, and in reinstating soil profiles that support productive agricultural land uses and native vegetation cover post-mining. Iluka considers that the potential environmental impacts can be managed in a manner consistent with the EPA's objectives for terrestrial environmental quality.

5.4.5 Mitigation

The mitigation hierarchy of avoidance, minimisation and rehabilitation is an inherent feature of Iluka's environmental management practices. The outcome of ongoing studies will inform the development of mitigation measures. Iluka has extensive experience in mining in similar environments in the southwest of Western Australia and elsewhere and will incorporate the experience gained from these mining projects into the management of the Proposal.

Examples of mitigation measures for the protection of terrestrial environmental quality previously employed and which may be relevant to the Proposal include:

Avoid:

- Pre-mining soil surveys to inform the scheduling of topsoil and subsoil stripping and stockpiling, which will facilitate sequential backfilling during rehabilitation and avoid unnecessary clearing;
- Pre-mining soil surveys to determine the presence of ASS/PASS to facilitate the scheduled excavation, handling and sequential backfilling placement of these materials;
- Metallurgical studies that characterise the properties of process by-products (i.e. sand tailings and clay fines) so that problematic materials can be identified and managed to avoid detrimental effects on soil quality and/or hydrology.

Minimise:

- Stockpiling and inventory management of topsoil and subsoil to facilitate sequential backfilling and avoid loss of rehabilitation resources;
- Managing ASS to avoid the generation of acidic and metalliferous drainage e.g. through neutralisation or backfilling below the saturated zone of the unconfined aquifer;
- Managing the backfilling of mined areas with sand tailings and clay fines to minimise the potential development of soil profiles that inhibit plant growth.
- Storage and handling of hazardous materials within bunded facilities to minimise the potential for leaks and spills to cause soil contamination.

Rehabilitate:

As described in Section 5.2.5, Iluka will develop a MCP in accordance with the *Mining Act 1978* which, once approved, will be implemented to achieve the agreed completion criteria.

Iluka has a range of established practices to facilitate successful mine site rehabilitation which will be incorporated into mine closure planning for Tutunup, as appropriate. Examples of the types of controls that may be included in the MCP in relation to terrestrial environmental quality include:

- Removing and stockpiling topsoils, subsoils or soils with potential adverse properties separately;
- Preventing or neutralising acidification of PASS materials prior to replacement in the mine void;
- Replacing stockpiled soil materials to an appropriate position in the rehabilitated profile to achieve the agreed post-mining land use(s); and
- Monitoring to ensure that completion criteria are met.

5.4.6 Assessment and significance of residual impacts

Based on current information available to Iluka, the Proposal has potential for significant impact to this environmental factor. As Proposal development progresses, the outcome of further studies and assessment will inform mine planning, consideration of the mitigation measures available and therefore determine the presence and significance of any residual impacts. However, Iluka considers that residual impacts will be demonstrated to be at an acceptable level .

5.4.7 Environmental Outcomes

Whilst a significant amount of information has already been developed for the Proposal and a DE has been defined, further studies to be completed as part of the EIA process will allow better determination of the likely environmental outcomes and, where appropriate, may result in amendments to the Proposal. Iluka will demonstrate through assessment of the Proposal that the EPA's objectives for terrestrial environmental quality can be achieved.

5.5 Environmental Factor – Inland Waters

5.5.1 EPA Objective

The EPA objective for Inland Waters is to *maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.*

5.5.2 Policy and Guidance

The following guidance and policy is relevant to this objective:

- Environmental Factor Guideline: Inland Waters (EPA, 2018a); and
- EPA Statement of Environmental Principles, Factors and Objectives (EPA, 2020a)

5.5.3 Receiving Environment

5.5.3.1 Completed and Proposed Studies

A number of hydrology and hydrogeology studies have been completed over the whole or part of the DE. The most recent of these are listed below. These studies were not conducted for the current Proposal, however represent the current (pre-proposal) environment and are therefore referenced in the following sections.

- Tutunup Groundwater Model (SKM, 2013).
- Surface Water Assessment Tutunup Mine Stage 1 (Aecom, 2013).

Iluka has commissioned hydrology and hydrogeology assessments and intends to commission a GDE assessment over the DE for the current Proposal. This work will continue as Proposal planning progresses.

5.5.3.2 Regional Hydrology

The Proposal is located within the Wonnerup (Busselton Coast) Surface Water Management Subarea and is not within a Proclaimed Surface Water area (DoW, 2020) (Figure 12).

The Proposal is located within the Vasse Wonnerup Estuary Catchment and the Abba River sub-catchment. The Abba River sub-catchment covers an area of approximately 141.5 km^2 (Aecom, 2013). The Abba River is a major ephemeral system, which has its headwaters in the Whicher Scarp and flows into the Vasse-Wonnerup Estuary just south of Wonnerup (Aecom, 2013). Drainage within the catchment is predominantly in a north-westerly or westerly direction determined by the natural topography (Aecom, 2013). Extensive clearing of the Abba River catchment has occurred for agricultural activities, including the removal of fringing vegetation and the development of artificial drainage systems (Aecom, 2013; DoW, 2007). These activities have affected local drainage and the river system.

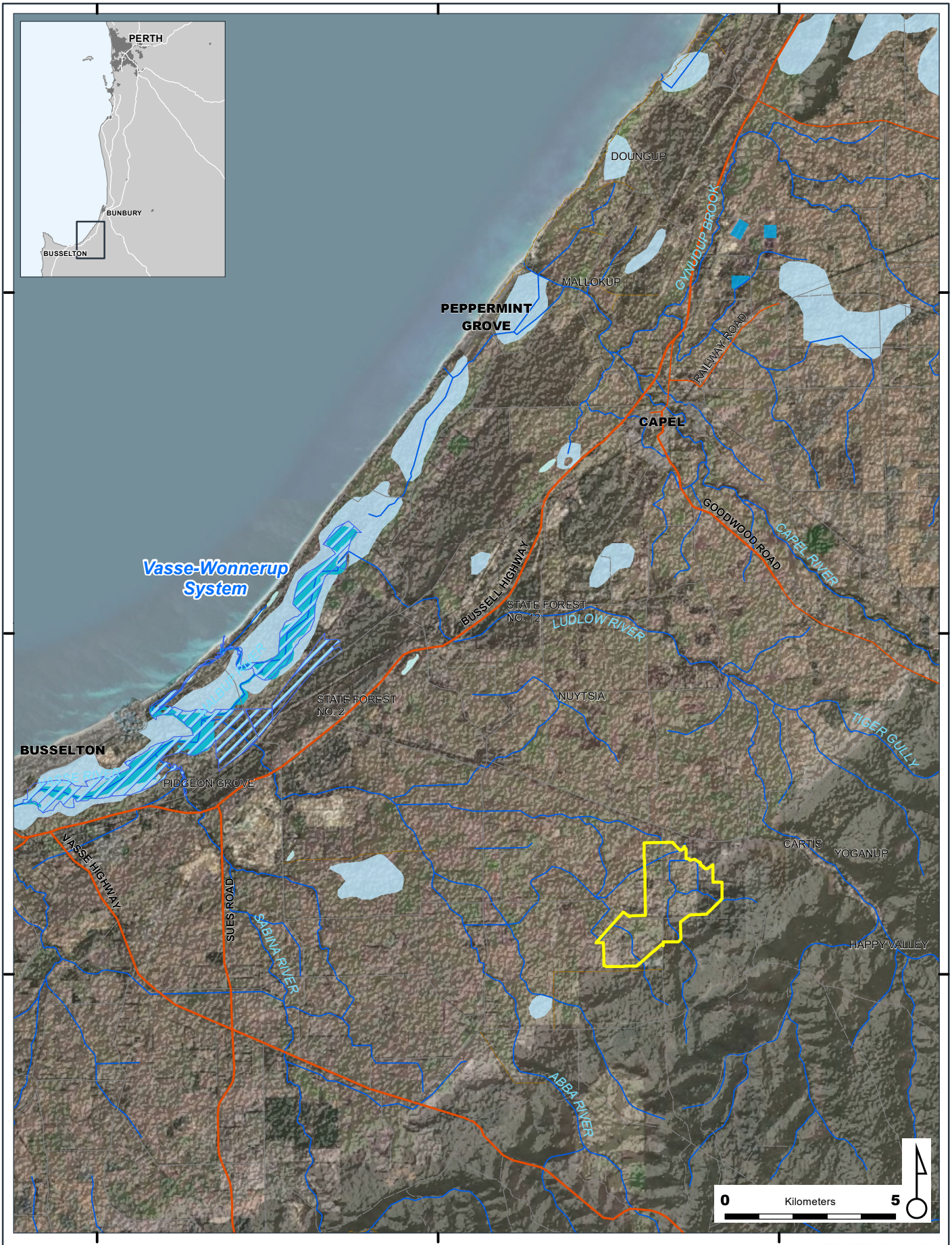
The Abba River is located approximately 3km to the southwest of the Proposal and the Ludlow River is located approximately 2km to the northeast. These rivers flow seasonally, with most flow occurring over autumn to spring and little or no flow over summer (DWER, 2019). Within the vicinity of the Proposal, smaller streams and tributaries are present, including several small drainage lines that flow from the Whicher Scarp within well-defined channels and agricultural sumps (Aecom, 2013).

Immediately to the north of the Proposal is a wetland classified as a 'sumpland' for conservation and resource enhancement (DBCA, 2018) (Figure 13). Parts of this wetland are included in the Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) TEC (SCP10b) and Banksia Woodlands of the Swan Coastal Plain TEC. Multiple use wetlands occur on the western side of the DE (DBCA, 2018) (Figure 13).

5.5.3.3 Vasse-Wonnerup RAMSAR Wetland System

The RAMSAR listed Vasse-Wonnerup wetland system is located approximately 12 km to the north-west of the Proposal (Figure 12). This system is recognised on a local, State, national and international level for its conservation, social and cultural values and has been listed under the RAMSAR Convention (GeoCatch, 2018). The wetlands associated within this system are recognised as an important waterbird habitat with more than 30,000 waterbirds of 90 species using the wetland habitat each year and is one of the most important waterbird habitats in Western Australia (GeoCatch, 2018). Areas surrounding the wetlands provide habitat for threatened and priority flora and fauna species including salt tolerant samphire communities (GeoCatch, 2018). The RAMSAR listed site comprises the Vasse and Wonnerup estuaries, their seasonally inundated floodplains, their connecting channels and shared sea inlet and the marshes on the deltas of their inflow rivers (Vasse, Sabina, Abba and Ludlow Rivers) (WRM, 2007).

Water flow into the wetland system has been highly modified since European settlement with drainage networks built and rivers which flow into the wetland system altered or diverted (DoW, 2010). Surface waters from the DE pass through a series of agricultural drains before entering the Vasse-Wonnerup system. As the Vasse-Wonnerup wetlands are located approximately 12 km from the Proposal and separated by a highly modified environment, impacts from the Proposal are considered unlikely, however potential downstream impacts will be considered in the context of its low risk of occurrence.



HYDROLOGY

TUTUNUP

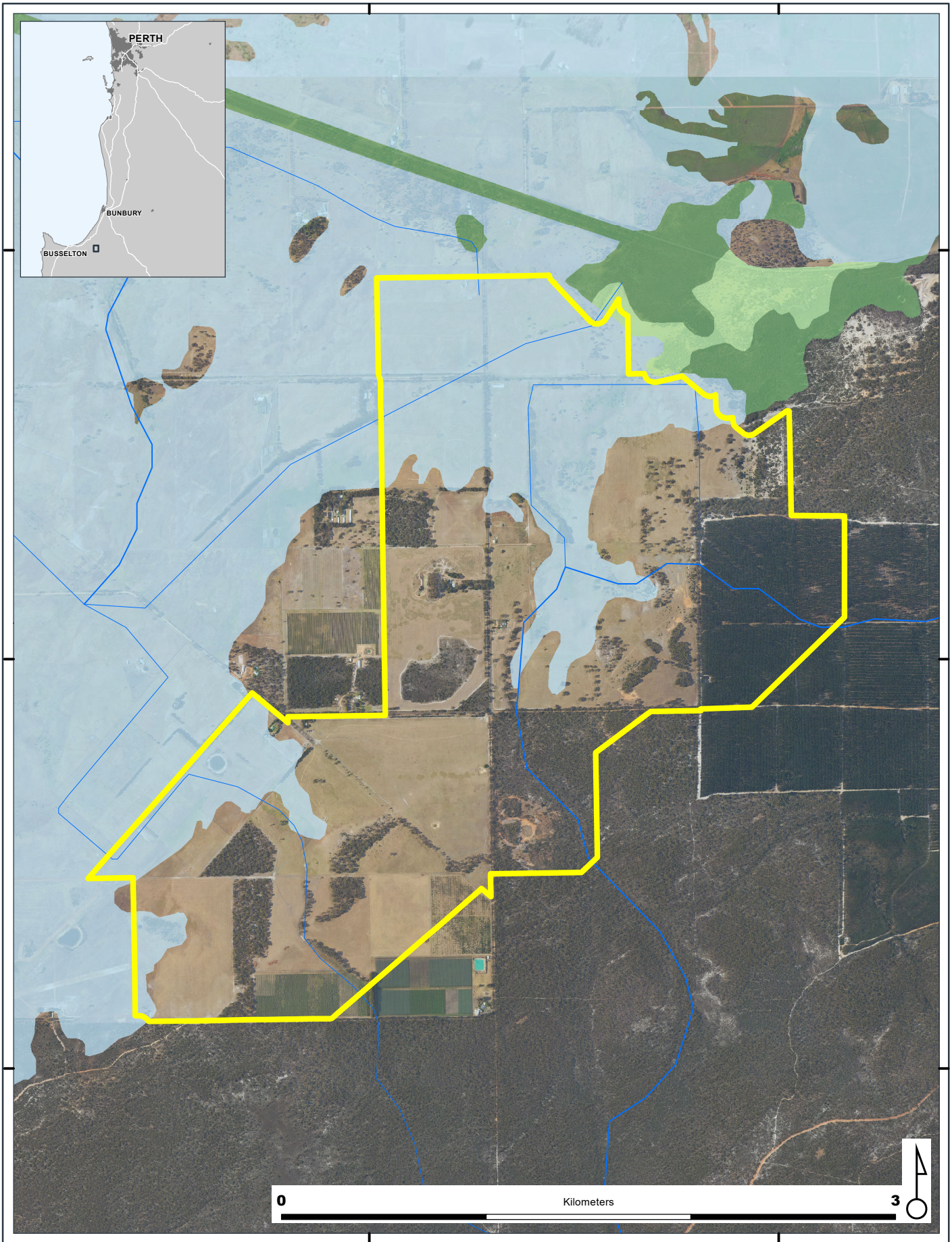
- Development Envelope
- RAMSAR Wetlands
- Drainage Lines
- Watercourse
- Watercourse perennial
- Reservoirs
- Lake - perennial
- Flats

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:150,000 **DATE:** 30/11/2021 **DWG No:** 245291v00 **FIGURE: 12**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245291v00_Tutunup_Hydrology.mxd



GEOMORPHIC WETLANDS

TUTUNUP

- Drainage Lines
- Watercourse
- Development Envelope

Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)

- Conservation category wetland
- Resource enhancement category wetland
- Multiple use category wetland

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:25,000 **DATE:** 30/11/2021 **DWG No:** 245292v00 **FIGURE: 13**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\245292V00_Geomorphic_Wetlands.mxd

5.5.3.4 Regional Hydrogeology

The Proposal is within the Busselton-Capel proclaimed groundwater resource area. Groundwater allocation areas are further divided into sub-areas based on the target aquifer. The Proposal is within the Busselton-Capel groundwater resource subarea for the Superficial and Leederville aquifers and the Busselton-Yarragadee groundwater resources sub-area for the Yarragadee aquifer (DoW, 2009).

Groundwater across the region is present within a multi-layered aquifer system. The major aquifers with depth are the Superficial, Leederville and Yarragadee.

The Superficial Formations are generally less than 10 m thick and include the Yoganup, Guildford, Bassendean Sand, Tamala Limestone and Safety Bay Sand formations (DoW, 2009). At Tutunup, the Superficial Formations comprise, with depth, Bassendean Sands (0.3 m – 0.6 m thick), Guildford Formation (7 m – 14 m thick) and Yoganup Formation (up to 15 m thick) (SKM, 2013). The Tutunup mineral resource is hosted in the Yoganup Formation. Limited supplies of groundwater are present in the Superficial Formations depending on sediments (DoW, 2009). The Superficial Formation is recharged primarily by rainfall, with some infiltration from shallow seepages from the base of the Whicher Scarp, and from the underlying Leederville Formation (SKM, 2013).

The Leederville Formation is a confined aquifer that underlies the Superficial Formation on the coastal plains (DoW, 2009). The Leederville Formation is typically 100m thick and the most widely used in the Swan Coastal Plain, as it is shallow and contains fresh water (DoW, 2009). Regionally, the Superficial Formations are separated in places from the Leederville Formation by the Mowen Aquitard, a layer of clay units (DoW, 2009), however the presence and extent of the Mowen Aquitard at Tutunup is yet to be determined (SKM, 2013).

The Yarragadee Formation is an extensive fluvial deposit of Jurassic age present beneath the Swan Coastal Plain and Blackwood Plateau and underlies the younger Leederville Formation (SKM, 2013). It predominantly comprises sand (making up 80 – 90% of the formation), interbedded with sandy clay and clay (DoW, 2009). The maximum thickness of the Yarragadee Formation is 1,250 m and it is divided into four units (DoW, 2009; SKM, 2013). Unit 3 is extensive, has the highest proportion of sand and is the major producing unit (SKM, 2013).

5.5.3.5 Local Hydrogeology

Iluka has been measuring groundwater levels at Tutunup since 2008. The water table geometry closely follows the topography of the plains, which gently fall at a slope of approximately 1:350. Groundwater levels of the surficial formation range between 1.5 and 4 m below ground level. Groundwater flow directions are generally from southeast to northwest. Groundwater levels at the site vary seasonally by up to 4.5 metres in some locations, exhibiting a strong recharge effect in response to rainfall. Significant vertical hydraulic gradients exist at some locations near the proposed mine due to the presence of sediments that exhibit low vertical conductivity in the stratigraphic profile (SKM, 2013).

Groundwater is acidic to slightly acidic with pH range of 3.05 to 6.54 and has fresh to brackish salinity with electrical conductivity (EC) ranging from 88 to 3,330µS/cm. The salinity is derived primarily from sodium and chloride ions. There is a general observation that shallow groundwater towards the Whicher Scarp associated with the Yoganup Formation is fresher. Conversely, higher total dissolives solids (TDS) concentrations are observed towards the north west, where the Guildford Formation is dominant. This supports the conceptual model that the Yoganup Formation is a zone of rainfall recharge while the Guildford Formation is more likely to be subject to discharge via evapotranspiration. This location coincides with low topography and low permeability driving shallow water table depths and discharge of groundwater (SKM, 2013).

5.5.3.6 Groundwater Dependent Ecosystems

The Bureau of Meteorology maintains a national GDE Atlas to assist with informing groundwater planning and management (BOM, 2019c). A search of the GDE Atlas over the DE indicates a high potential for both aquatic GDE occurrence, related to palusplain wetlands, and terrestrial GDE occurrence, related to medium woodland vegetation with Marri, Jarrah, Wandoo, River Gum and *Casuarina* (BOM, 2019c).

The aquatic GDE occurrence may be related to the presence of a sumpland area located to the north of the DE. Parts of this wetland are classified as Conservation category wetland and Resource Enhancement category wetland (DBCA, 2018). Part of this wetland is also included in the Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) TEC (SCP10b), which is a species rich community restricted to seasonal wetlands on ironstone and heavy clay soils (SKM, 2013). The groundwater dependence of the wetlands is yet to be determined and this will be a focus of a GDE assessment to be undertaken.

5.5.3.7 Groundwater Users

Within a three-kilometre radius of the Proposal, which includes the surrounding agricultural properties, there are 14 groundwater licences (DWER, 2021). Two licences occur within the DE including a licence held by Iluka Resources (DWER, 2021). The majority of the licences held in the area target the Leederville aquifer (DWER, 2021). The majority of groundwater use associated with these licences is for agriculture, livestock and domestic use.

5.5.4 Potential Impacts

Baseline studies to characterise the receiving environment and potential impacts to Inland Waters associated with the Proposal are ongoing. Iluka has commissioned hydrology and hydrogeology assessments and intends to commission a GDE assessment and further PASS assessment (see Section 5.4.3). This work will continue as Proposal planning progresses and will inform the identification and assessment of surface water and groundwater impacts.

The Proposal could potentially result in the following impacts to Inland Waters:

- Changes to surface water flows downstream of the site, potentially impacting downstream receivers including agricultural users, surface water dependent ecosystems and wetlands, arising from:
    - diversion of drainage lines within the DE;
    - removal of vegetation cover within the DE;
    - interaction of surface waters with the process water system; and
    - off-site discharge of site water.
- Changes in groundwater levels (drawdown or mounding), potentially impacting groundwater availability to GDEs and third-party users, arising from changes in water levels during mining; and
- Decline in surface water or groundwater quality arising from exposure of PASS, accidental spills or discharges of contaminated or turbid site water.

Wet mining methods are proposed to be employed at Tutunup, minimising the need for dewatering and the potential for changes in groundwater levels outside the mine pit. Studies to understand the relationships between surface water, groundwater, GDEs and the potential impacts of mining, will also be completed and a detailed environmental impact and risk assessment for the Inland Waters factor will be undertaken. Drawing on its successful undertaking of mining operations in similar localities in the South West, Iluka considers that the potential environmental impacts of the Proposal can be managed in a manner consistent with the EPA's objectives for Inland Waters.

5.5.5 Mitigation

The mitigation hierarchy of avoidance, minimisation and rehabilitation is an inherent feature of Iluka's environmental management practices. Studies to characterise the receiving environment and potential impacts to inland waters are ongoing.

In recognition of the particularly high conservation value of the Shrublands on Southern Swan Coastal Plain Ironstones (Busselton area) TEC, two key avoidance measures have already been committed to in relation to the protection of this TEC:

- TEC buffer: the DE and mine pit boundaries are set back 50m and 100m, respectively, from the TEC.
- Using wet mining methods: whilst dry mining is the traditional method of mining in Iluka's south west mine sites, it requires dewatering of the active mine pit, potentially creating a cone of groundwater depression around the pit. Wet mining methods will be employed at Tutunup, minimising the need for dewatering and the potential for changes in groundwater levels outside the mine pit. In addition, Iluka is planning to actively manage the water levels within the mine pit to mimic the natural seasonal variation of water levels, as far as practicable.

Preliminary modelling focussing on the Shrublands on Southern Swan Coastal Plain Ironstones (Busselton area) TEC immediately north of the DE indicates that, with the 100m set-back in place and use of wet mining methods with active management of pit water levels, negligible drawdown beneath the TEC can be achieved. The use of wet mining methods with active water level management will also result in avoidance or minimisation of potential drawdown impacts on other vegetation in the near vicinity of the mine pit.

The detailed groundwater and surface water assessments being undertaken will enable additional mitigation measures to be applied to Inland Waters will be defined. Iluka has extensive experience in mining in similar environments in the southwest of Western Australia and elsewhere and will incorporate the experience gained from these mining projects into the management of the Proposal.

Examples of mitigation measures for the protection of Inland Waters previously employed and which may be relevant to Tutunup include:

Avoid

- Design the site infrastructure to maintain pre-mining surface water flow regimes.

Minimise

- Minimise open area by conducting clearing activities only as required
- Manage groundwater abstraction in accordance with a 5C water licence under the RIWI Act, supported by a Groundwater Operating Strategy (GOS).
- Manage off-site discharges of surface water and groundwater to the environment in accordance with a licence under Part V of the EP Act.
- Maintain a Site Water Balance Model to inform the management of site water inventories and the on-site retention and use or planned release of water as required.
- Managing ASS to avoid the generation of acidic and metalliferous drainage and the impacts on surface and groundwater e.g. through neutralisation and/or backfilling below the saturated zone of the unconfined aquifer.
- Storage and handling of hazardous materials within bunded facilities to minimise the potential for leaks and spills to prevent potential contamination of water.
- Implement an environmental monitoring program that includes monitoring of surface water and groundwater quantity and quality to detect adverse changes that may impact receptors.

Rehabilitate

As described in Section 5.2.5, Iluka will develop a MCP in accordance with the *Mining Act 1978*. Once approved, the MCP will be implemented to achieve the required completion criteria.

Iluka has a range of established practices to facilitate successful mine site rehabilitation which will be incorporated into mine closure planning for Tutunup, as appropriate. Examples of the types of controls that may be included in the MCP in relation to inland waters include:

- Replacing stockpiled soil materials to an appropriate position in the rehabilitated profile to maintain groundwater throughflows.
- Final land surface and drainage design to reinstate pre-mining surface water drainage.
- Monitoring and maintenance to ensure that plans are implemented successfully and completion criteria are met.

5.5.6 Assessment and significance of residual impacts

Based on current information available to Iluka, the Proposal has potential for significant impact to this environmental factor. The outcome of further studies and assessment will inform mine planning, consideration of the mitigation measures available and therefore determine the presence and significance of any residual impacts. However, Iluka considers that residual impacts will be demonstrated to be at an acceptable level.

5.5.7 Environmental Outcomes

Whilst a significant amount of information has already been developed for the Proposal and a DE has been defined, further studies to be completed as part of the EIA process will allow better determination of the likely environmental outcomes and, where appropriate, may result in amendments to the Proposal. Iluka will demonstrate through assessment of the Proposal that the EPA's objectives for inland waters can be achieved.

5.6 Environmental Factor – Social Surroundings

5.6.1 EPA Objective

The EPA objective for Social Surroundings is to *protect social surroundings from significant harm.*

5.6.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline: Social Surroundings (EPA, 2016g);
- EPA Statement of Environmental Principles, Factors and Objectives (EPA, 2020a);
- *Aboriginal Heritage Act 1972*;
- DWER Draft Guideline - Assessment of environmental noise emissions (DWER 2021a).

5.6.3 Receiving Environment

5.6.3.1 Completed and Proposed Studies

The following studies relating to the Proposal's social surroundings have been completed over whole or part of the DE:

- Anthropos Australis, 2013, The Report of an Aboriginal Heritage Survey of the Proposed Tutunup Mineral Sands Mine South-West Region WA (Anthropos Australia, 2013).

- Ethnosciences, 2007, Preliminary Report of an Ethnographic Survey of the Proposed Tutunup Satellite Mineral Sands Mines near Capel, WA (Ethnosciences, 2007);
- SVT Engineering Consultants, 2009, Environmental Noise Impact Assessment for the Proposed Tutunup Stage 1 Mineral Sands Mine (SVT, 2009);
- SVT Engineering Consultants, 2013, Summary of Previous Tutunup Stage 1 Noise Impact Investigations (SVT, 2013); and
- Shawmac, 2014, Tutunup Transport Study (Shawmac, 2014).

Iluka intends to undertake an archaeological and ethnographic heritage survey, noise assessment, traffic and transport assessment as well as a pasture productivity assessment of agricultural land occurring within the DE. Dust may also be relevant to Social Surroundings, however is covered under Air Quality (Section 5.8).

5.6.3.2 Aboriginal Heritage

A search of the Aboriginal Heritage Inquiry System (AHIS) identified no registered aboriginal heritage sites within the DE (DPLH, 2019). The closest registered site is located 5km to the south-west and is Tutunup South Artefact Cluster 001 (ID 22884) (DPLH, 2019). The Abba River is also a registered Aboriginal site (ID 17354) and is located 5km to the west of the Proposal (DPLH, 2019). There are two Other Heritage Place sites outside of the DE. The first is Other Heritage Place Tutunup South Modified Tree 001 (ID 22883) with a stored data / not a site status and is 1.8km to the south west of the DE (DPLH, 2021). The second Other Heritage Places, Tutunup Mine Artefact Cluster 01 (ID 19362), is located 2km to the south west (DPLH, 2019).

To date there have been eight Aboriginal heritage surveys completed in the vicinity of the Proposal. Five of these of particular relevance intersect the DE being:

- An addendum to a desktop preliminary Aboriginal heritage survey for Water Corporation's proposed development of the Yarragadee Aquifer extending to the Blackwood Groundwater area by Brad Goode (ID 20283).
- Report of an Aboriginal heritage survey proposed Tutunup titanium mineral mine near Capel, Western Australia by McDonald Hales and Associates (ID 106386). (DPLH, 2019).
- Report of an ethnographic survey, proposed Tutunup South orebody, Tutunup mineral sands mine, near Capel, Western Australia. January 2006 by Edward McDonald (ID 22046)
- Report on phase I & II archaeological investigations Tutunup South Minerals Sands Project, Shire of Busselton, Western Australia. January 2006 by Tempus Archaeology (ID 22045)
- National Estates Grants Programme Aboriginal Sites in the Lower Southwest Heritage Study. July 1995 by McDonald, Hales and Associates (ID 101971)

In addition to these surveys, Iluka commissioned an archaeological and ethnographic survey in 2009 (later updated in 2013) which covers the majority of the DE (Figure 14). This survey was undertaken by Anthropos Australia and representatives from the South West Boojarah Native Title Claimant Group (SWB) and the South West Aboriginal Land and Sea Council (SWALSC) (Anthropos Australia, 2013). The survey recorded that the area has historical significance to the SWB due to the presence of creeks, springs and soaks which would have supported camp sites (Anthropos Australia, 2013). An area of ethnographic significance was noted on Lot 1782 relating to a copse of melaleuca scarred trees, a water source, camp site and possible burial related to the number of marker scars on trees (Anthropos Australia, 2013). The survey also recorded areas of archaeological significance including 38 scarred trees, many of which had multiple scars and three copses of scarred trees (Anthropos Australia, 2013). The presence of scarred trees provides significant evidence of previous Aboriginal occupation within a highly modified environment (Anthropos Australia, 2013). The high occurrence of scarred trees within the survey area suggests intense previous occupation in this area by

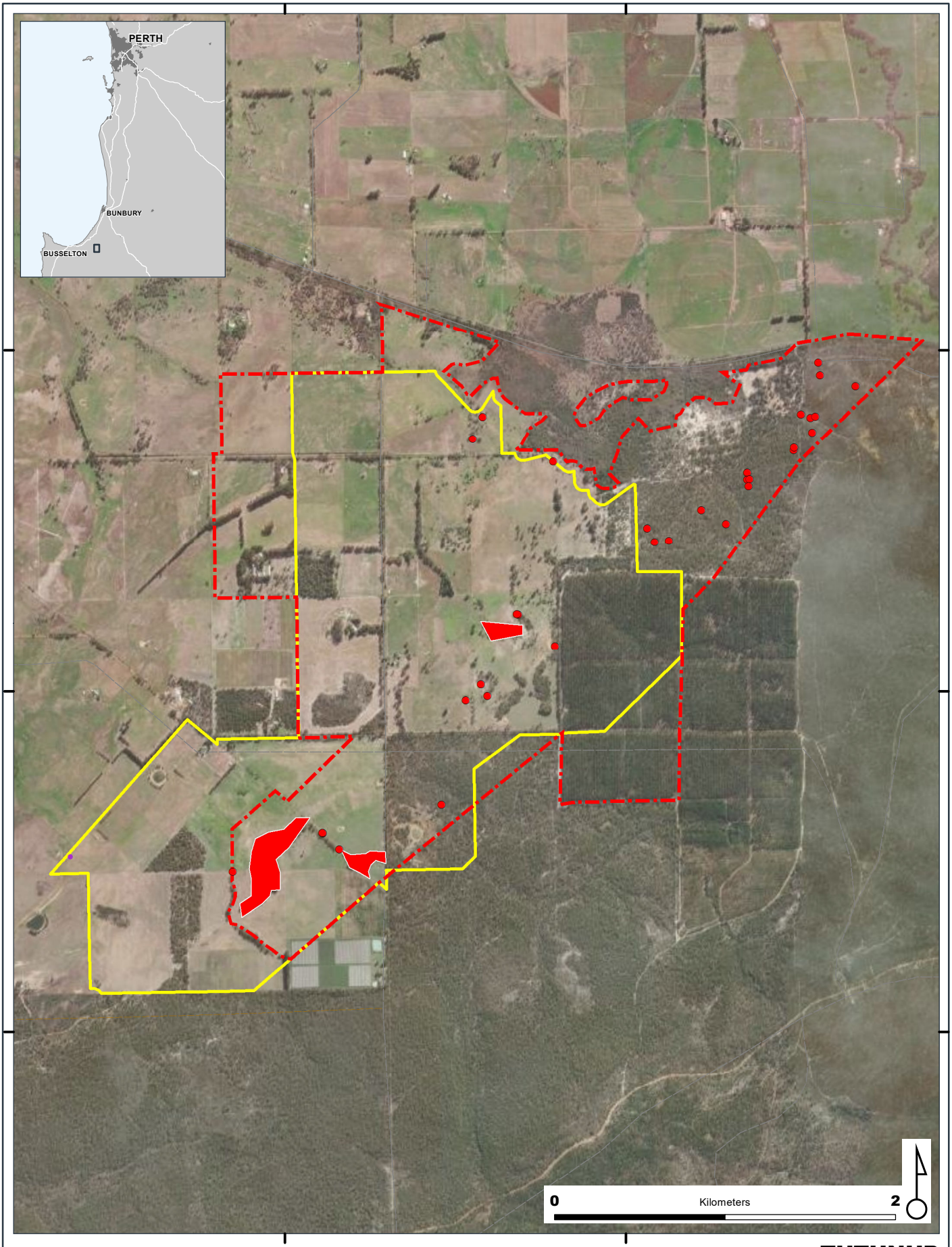
Aboriginal populations (Anthropos Australia, 2013). The location of heritage features identified from this survey are presented in Figure 14.

These identified heritage features do not appear to have been submitted to the Department of Planning, Lands and Heritage (DPLH) for assessment as registered sites under the *Aboriginal Heritage Act 1972*. The heritage features identified during the 2009 heritage survey intersect with the DE. Where the proposed activities result in impacts to identified potential Aboriginal cultural heritage, Iluka, in consultation with Traditional Owners, will apply for the appropriate Section 16 or 18 clearances (or alternative authorisations required under the *Aboriginal Cultural Heritage Act*). Iluka has been directed by the South West Boojarah #2 Agreement area Traditional Owners to work with the SWALSC to address heritage and culture matters.

Iluka is working with SWALSC to establish a regional Noongar Standard Heritage Agreement (NSHA) and to jointly design a heritage survey process that has benefits additional to Proposal requirements. More broadly Iluka is working with the South West Boojarah #2 Agreement Area Traditional Owners, the Wadandi People, to identify opportunities for collaboration that are mutually beneficial regarding social, environment, cultural and economic initiatives.

5.6.3.3 Native Title

The South West Native Title Settlement in the form of six Indigenous Land Use Agreements (ILUAs) was negotiated between the Noongar People and the Western Australian Government and commenced on 25 February 2021. The Proposal is located with the South West Boojarah #2 Agreement area. The recognised Traditional Owners for this area are the Wadandi and Pibelman/Bibbulman People. The Proposal DE is specifically located within the Wadandi Peoples Country. A requirement of the Settlement is for the establishment of six Regional Corporations to be the key conduits for engagement and as of November 2021 the South West Boojarah #2 Agreement Regional Corporation is yet to be established. In June 2021 Iluka was directed by the South West Boojarah Working Party to work with the South West Aboriginal Land and Sea Council on all heritage matters. This will be reviewed once the South West Boojarah #2 Agreement Regional Corporation is established which is expected to be in late 2022.



ABORIGINAL HERITAGE

TUTUNUP

- Scar Trees (Anthropos 2009)
- Other Heritage Sites
- Development Envelope
- Heritage Survey Area (Anthropos 2009)
- Scar Tree Copses (Anthropos 2009)

ILUKA

ORIG: SJ **DRAWN:** DRB **SCALE (A4):** 1:30,000 **DATE:** 30/11/2021 **DWG No:** 244800v00 **FIGURE: 14**

GDA 1994 MGA Zone 50

L:\Maps\2021\Registered\Perth Basin\Tutunup\244800v01_Tutunup_Indigenous.mxd

5.6.3.4 European Heritage

A database search has determined that there are no World Heritage Sites or National Heritage Sites within the DE (DoEE, 2019).

A search of inHerit, the Western Australia heritage database, has identified no European heritage listings within the DE (Heritage Council, 2017). A search of the City of Busselton Heritage inventory found the closest heritage listing is located 500m to the north of the DE boundary and relates to the 'Route of the Ballarat Railway Line' place number 5358 (Heritage Council, 2017).

5.6.3.5 Land Use

Land use in the City of Busselton is predominantly rural / agricultural with local industries including tourism, manufacturing, beef, dairy, viticulture and mineral sands mining (City of Busselton, n.d.). The DE is located in an area zoned 'rural'. The predominant land use within and adjacent to the DE is agriculture, including dairy and beef farming and viticulture. The DE also abuts other land uses including State Forest 33 (Millbrook State Forest), unallocated crown land and Crown Reserves R24197, R32562 and R34283 for the purpose of drainage. Within the DE there is existing infrastructure including local roads, fences and power lines.

5.6.3.6 Noise, vibration and Light

Environmental noise is regulated by the EP Act through the *Environmental Protection (Noise) Regulations 1997*. It is currently proposed that the mine will operate on a continuous 24/7 basis. As such, mining operations will result in emissions of noise, vibrations and light, which may impact the amenity of any surrounding sensitive premises. There are at least 12 potential sensitive premises within approximately 1km of the DE that relate to domestic premises associated with agricultural land. Potential sensitive premises also occur along the transport route from the DE to Iluka's existing processing facilities at North Capel. Potential noise and light generating sources during construction and mining activities include fixed plant equipment, such as the concentrator and pumps, and mobile plant, such as trucks, excavators, bulldozers, graders and loaders. The presence of rock within the mine pit may result in the generation of vibration from earthmoving activities.

In 2009, background noise levels were monitored for a period of two weeks (SVT, 2009). The noise logging from 2009 showed that the underlying background noise level was very low, particularly at night when the L_{90} of L_{A90} values range from 20 to 27 dB(A) (SVT, 2009). Iluka intends to commission an updated noise and vibration assessment for the Proposal.

5.6.4 Potential Impacts

Whilst Iluka has substantial baseline studies to characterise the receiving environment and potential impacts to Social Surroundings associated with the Proposal, further studies in this regard are ongoing. Iluka will commission an archaeological and ethnographic heritage survey, Social Impact Assessment, noise assessment, transport assessment and a pasture productivity assessment of agricultural land occurring within the DE. This work will assist Iluka to further identify and assess the potential impacts associated with the Proposal.

The Proposal could potentially result in the following impacts to Social Surroundings:

- Damage or removal of sites of Aboriginal heritage significance, including scarred trees, through clearing;
- Loss of access to sites of Aboriginal heritage significance, including Traditional hunting and gathering grounds for native flora and fauna as bush tucker or medicine;
- Noise, vibration and/or light impacts to sensitive receptors from the operation;
- Reduced visual amenity during mining when operations are visible to local residents and/or traffic or post-mining, should the final landform or land use be inconsistent with the surroundings;

- Increased traffic on local road networks; and
- Reduced agricultural productivity from replaced soil profile.

Iluka acknowledge that the Proposal occurs within an area of multiple land uses which include Aboriginal heritage values and sensitive receptors to noise, dust and visual amenity. Studies to enhance Iluka's understanding of these values and the potential impacts associated with the Proposal are ongoing. Iluka has experience in mining in similar environments and it is expected that the potential impacts can be managed in a manner consistent with the EPA's objectives for Social Surroundings. It is recognised that additional approval through Section 18 of the *Aboriginal Heritage Act 1972* (or alternative authorisations required under the *Aboriginal Cultural Heritage Act*) may be required to interact with any Aboriginal cultural heritage located within the DE.

Iluka is working with SWALSC to agree a Noongar Standard Heritage Agreement (NSHA) and to jointly design a heritage survey process that has benefits additional to project requirements, therefore providing high confidence of heritage considerations being addressed in close consultation with the agreed representatives.

It is expected that dust, noise and vibration would be managed under Part V of the EP Act.

5.6.5 Mitigation

The mitigation hierarchy of avoidance, minimisation and rehabilitation is an inherent feature of Iluka's environmental management practices. The outcome of studies will inform mine planning and the development of mitigation measures. Iluka has extensive experience in mining in similar environments in the southwest of Western Australia and elsewhere and will incorporate the experience gained from these mining projects into the management of the Proposal. Iluka has developed a Stakeholder Engagement Strategy to coordinate and guide input from stakeholders to ensure potential impacts are identified and addressed as appropriate.

Examples of mitigation measures previously employed in relation to Social Surroundings and which may be relevant to the Proposal include:

Avoid

- Avoid (where possible) the location of sites of Aboriginal heritage and cultural significance in the design of the site layout;

Minimise

- In collaboration with South West Boojarah #2 Agreement Traditional Owners, complete Aboriginal and ethnographic heritage surveys across the DE, and submit identified heritage features to the DPLH for assessment under the *Aboriginal Heritage Act 1972*; and
- Include checks for registered Aboriginal heritage sites, other Aboriginal heritage sites and Aboriginal heritage features identified during surveys as part of internal clearing procedures and ground clearances.
- As agreed undertake ground disturbance works with South West Boojarah #2 Agreement Traditional Owners Heritage Monitors present;
- Ensure employees are made aware of Aboriginal heritage features, any no-go areas within the Proposal area and are aware of the legal requirements in relation to Aboriginal heritage sites;
- Educate employees and contractors on the importance of noise and light management as part of the induction process;
- If noise modelling predicts periods of unacceptable noise emissions, investigate opportunities to reduce noise emissions such as shielding, modified operating hours of machinery and the fitting of noise attenuation equipment;

- Conduct noise monitoring in accordance with a licence under Part V of the EP Act;
- Position lighting to avoid light spill to surrounding residences;
- Adhere to traffic restrictions along the transport route from Tutunup to North Capel (such as restrictions during school hours);
- Maintain relationships with the South West Boojarah #2 Agreement Traditional Owners and other South West Traditional Owner Groups to ensure Aboriginal heritage and culture impacts are communicated to Iluka for collaborative examination and resolution;
- Maintain relationships with surrounding land owners to ensure noise, light and/or visual impacts are communicated to Iluka for examination and resolution; and
- Maintain a public comment and complaint register to ensure concerns are received, documented and actioned as appropriate.

Rehabilitate

As described in Section 5.2.5, Iluka will develop and implement a MCP. The MCP will include requirements for final landform restoration, surface drainage and land use, ensuring that the final rehabilitated site is visually compatible with the surroundings. Iluka is also working with South West Boojarah #2 Agreement Traditional Owners to identify opportunities for collaboration throughout the mine closure range of activities.

5.6.6 Assessment and significance of residual impacts

Based on current information available to Iluka, the Proposal has potential for significant impact to this environmental factor. The outcome of further studies and assessment will inform mine planning, consideration of the mitigation measures available and therefore determine the presence and significance of any residual impacts. However, Iluka considers that residual impacts will be demonstrated to be at an acceptable level.

5.6.7 Environmental Outcomes

Whilst a significant amount of information has already been developed for the Proposal and a DE has been defined, further studies to be completed as part of the EIA process will allow better determination of the likely environmental outcomes and, where appropriate, may result in amendments to the Proposal. Iluka will demonstrate through assessment of the Proposal that the EPA's objectives for social surroundings can be achieved.

5.7 Environmental Factor – Human Health

5.7.1 EPA Objective

The EPA objective for Human Health is to *protect human health from significant harm.*

5.7.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline: Human Health (EPA, 2016h);
- EPA Statement of Environmental Principles, Factors and Objectives (EPA, 2020a);
- *Mines Safety and Inspection Act 1994 (WA)* - Department of Mines, Industry Regulation and Safety (DMIRS);
- *Occupational Safety and Health Act 1984 (WA)*; and

- *Radiation Safety Act 1975 (WA)* - Radiological Council of WA (RCWA) - Health Department of WA.

5.7.3 Receiving Environment Potential Impacts, Mitigation and Assessment

Mineral Sands, as with other minerals such as clay, soils, rocks and many ores, contain levels of naturally occurring radioactive material (NORM). This is associated with low level naturally occurring uranium and thorium contained within the grains of the minerals monazite, xenotime, zircon and some ilmenites (Iluka, n.d.).

While the level of NORM in most natural substances is low, any operation in which material containing radiation is extracted from the earth and processed, can potentially concentrate NORM in the mineral sands products, by-products and waste materials (Iluka, n.d.).

Most of these minerals occur within the heavy mineral fraction of the ore, which reports as HMC. Consequently, HMC contains low levels of NORM.

The Proposal could potentially potential exposure to radiation affecting the health of members of the public and workers.

An assessment is currently underway to determine the particular radiation characteristics of the material streams arising from the Proposal and to confirm that the Proposal will not have the potential for a significant impact in regards to radiation. Iluka will also undertake a baseline gamma survey of the DE. Iluka will hold a radiation registration for the mine site under the RS Act and will manage radiation in accordance with the Southwest Operations Radiation Management Plan (SWORMP), which will be amended to include the Tutunup site, as required under the RS Act and *Mines Safety and Inspection Regulations 1995* (MSIR).

Iluka has mature radiation management practices that are aligned with international best practice according to the publications of the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency's (IAEA), as well as Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), and Western Australian legislation (Iluka, n.d.). These practices will be applied in implementing the Proposal.

Iluka identifies, assesses and controls risks associated with exposure to radiation from NORM (including radon gas) and man-made sources through all phases of its activities, from exploration, Proposal development, operations, rehabilitation and closure. Iluka's Group Radiation Management Standard and site-specific Radiation Management Plans (RMP) ensure exposure to radiation meets the prescribed statutory limits and is as low as reasonably achievable (ALARA) taking economic and social factors into account. Risks associated with exposure to ionising radiation from NORM and man-made sources are identified, assessed and controlled in all areas of an operation, from initial planning to closure (Iluka, n.d.).

In Western Australia, the Radiological Council is an independent statutory authority appointed under the RS Act in Western Australia to assist the Minister for Health to protect public health and to maintain safe practices in the use of radiation. Daily administration of the Act is handled by personnel of the Radiation Health Unit (Radiation Health) acting through the Secretary of the Council. The Unit has separate responsibilities to the Department of Health and is under the direction of the Managing Health Physicist. Under this Act, Iluka is required to hold a radiation registration, with conditions requiring a RMP to be developed and implemented in accordance with the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) *Code of Practice and Safety Guide for Radiation Protection and radioactive waste management in mining and mineral processing (2005)* (RPS9). The RMP applies to the management of radiation throughout all stages of mining and mineral processing from exploration to final site rehabilitation. The RMP is required to be submitted to and approved by the RCWA every two years. Additionally, radiation is regulated for the mining industry by DMIRS – Resources Safety under the *Mines Safety and Inspection Regulations (MSIR) 1995*. Part 16 of the regulations also requires an approved RMP.

Iluka's Southwest Operations, of which Tutunup will become a part, operate under SWORMP. The SWORMP will be updated to include the Tutunup Proposal, in accordance with RS Act and MSIR requirements. Iluka has been managing NORM from similar mine sites in the south west for many years and will apply the experience gained to manage radiation at Tutunup, in accordance with the approved SWORMP.

Current information available to Iluka from similar operations in the area, indicates that Human Health would not be considered a key environmental factor for the Proposal. Based on Iluka's experience in managing NORM at mines in the south west, radiation exposure to members of the public is considered highly unlikely. By managing radiation in accordance with the requirements of the RS Act and the MSIR, Iluka is confident that the direct, indirect and cumulative impacts associated with the proposal can be managed to meet the EPA's objectives for Human Health.

5.8 Environmental Factor – Air Quality

5.8.1 EPA Objective

The EPA objective for Air Quality is to *maintain air quality and minimise emissions so that environmental values are protected.*

5.8.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline: Air Quality (EPA, 2016j);
- DWER Draft Guideline – Dust Emissions (DWER, 2021b); and
- National Environment Protection (Ambient Air Quality) Measure Standards (NEPM).

5.8.3 Receiving environment, potential impacts, mitigation and assessment

Air quality is not expected to be a key environmental factor for the Proposal. The Proposal could potentially result in impacts to air quality due to dust generation from mining and transport activities and combustion emissions from vehicles, plant and equipment.

Mining operations typically have the potential to generate dust associated with mining, processing, transport and rehabilitation activities. Dust may originate from clearing of topsoil and overburden, through vehicle movement and lift-off from exposed surfaces during dry and windy conditions. Dust may also be generated during rehabilitation activities prior to the establishment of vegetation. Emissions related to dust are significantly influenced by soil moisture conditions and prevailing winds. Although the Proposal is located within a sparsely-populated agricultural setting, unmanaged dust has the potential impact surrounding landowners. Wet mining will result in materially less dust emissions than typical dry mining methods; however, other sources of dust emissions will still be present.

Iluka intends to complete an air quality assessment over the DE. Irrespective, Iluka expects that dust can be adequately managed under Part V of the EP Act by implementing standard dust monitoring and management measures, and that combustion emissions can be adequately managed through procurement and maintenance processes. This is typical of the approach taken to management of dust from mining operations in WA. It is therefore expected that the potential impacts associated with the Proposal can be managed in a manner consistent with the EPA's objectives for Air Quality.

5.9 Environmental Factor – Greenhouse Gas Emissions

5.9.1 EPA Objective

The EPA objective for Greenhouse Gas Emissions is to *reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.*

5.9.2 Policy and Guidance

The following guidance and policy are relevant to this objective:

- Environmental Factor Guideline: Greenhouse Gas Emissions (EPA, 2020c).

5.9.3 Receiving Environment, potential Impacts, mitigation and assessment

Greenhouse gas (GHG) emissions are not expected to be a key environmental factor for the Proposal as Scope 1 emissions are not expected to exceed the 100,000 t CO_2-e per annum threshold specified in the Environmental Factor Guideline: Greenhouse Gas Emissions (EPA, 2020c). Iluka tracks and reports greenhouse gas emissions under the National Greenhouse and Energy Reporting System (NGERS). Reporting from the last three years of operation at Iluka's most recent South West mine site (Tutunup South) was reviewed and used as the basis for estimating annual GHG emissions from Tutunup.

A worst-case approach was taken to develop a conservative estimate of annual GHG emissions from Tutunup, as follows:

- Assumed current technology used in respect of plant and equipment (i.e. no allowance for electrified fixed and mobile plant)
- No allowance for reduction in emission factor for Scope 2 electricity sourced from the Southwest Interconnected System
- Tutunup South data from the year with the highest reportable CO_2-e emissions per tonne of ore mined (2016) was multiplied by the planned annual tonnes of ore to be mined at Tutunup; and
- The mining and ore processing rate used to estimate annual CO_2-e emissions was based on the largest concentrator under consideration for Tutunup;

The total estimated Scope 1 and 2 emissions for Tutunup are shown in Table 12. Conservatively, the peak annual quantity of Scope 1 emissions is estimated to be in the order of 75,701 tCO_2-e, if the clearing of all native vegetation within the DE occurred within a single 12 month period. In practice, not all vegetation within the DE would be cleared; and clearing would not all occur within a single 12 month period. The value of 68,800 tCO_2-e emissions from clearing (Table 12) therefore represents the estimated maximum GHG emissions over the life of the mine. Excluding native vegetation clearing, the peak annual quantity of Scope 1 emissions is estimated to be in the order of 6,901 tCO_2-e.

Table 12 Estimated Scope 1 and 2 GHG emissions

Source	Activities	Estimated tCO_2-e
Scope 1		**Annual**
Diesel	Surface mobile equipment Light vehicles Mobile pumps, lighting towers	6,900
Oils and greases	Non-combustion consumption of hydrocarbons	1.0
	Total Annual Scope 1	6,901

Scope 1		**One-Off**
Vegetation	Total Vegetation Clearing	68,800
Scope 2		
Power	Electricity sourced from the Southwest Interconnected System	15,400
	Total Annual Scope 2	15,400

Iluka's mitigation measures for GHG emissions typically comprise minimising the clearing of native vegetation where possible, consideration of operating efficiency in the procurement of vehicles and machinery, and conducting regular inspections and maintenance of processing equipment to maintain operating efficiency.

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

6.1 Policy and Guidance

Under the EPBC Act, proposals that have the potential to significantly impact MNES trigger the requirement for referral to the Commonwealth to determine whether assessment as a 'controlled action' is required.

Table 13 summarises the potential for the Proposal to impact on MNES. The Proposal has the potential to impact on listed threatened species and ecological communities. Consequently, Iluka will refer the Proposal to the DAWE.

Table 13 MNES potentially impacted by the Proposal

MNES	Potential Impact
World heritage properties	Not applicable. There are no World heritage properties in the vicinity of the Proposal.
National heritage places	Not applicable. There are no National heritage properties in the vicinity of the Proposal.
Wetlands of International Importance (listed under the RAMSAR Convention)	Not applicable. The nearest Wetland of International Importance is the Vasse-Wonnerup Wetland system, located approximately 12km to the west of the Proposal. The Vasse-Wonnerup Wetlands and surrouding areas are highly modified, which have altered the hydrology, nutrient flux and ecology of the wetlands. Given its distance from the Wetlands, significant impacts arising from the Proposal are improbable.
Listed threatened species and ecological communities	The presence of threatened flora, fauna and ecological communties has been identified within the DE and its surrounds. The Proposal therefore has the potential to impact on threatened flora, fauna and ecological communties (refer to Section 6.2).
Migratory species protected under international agreements	Not applicable. Although migratory species may occassionally occur in the vicinity of the Proposal, significant impacts are improbable.
Commonwealth marine areas	Not applicable. The Proposal is not located in a Commonwealth marine area.
The Great Barrier Reef Marine Park	Not applicable. The Proposal is not located in the Great Barrier Reef Marine Park.
Nuclear actions (including uranium mines)	Not applicable. The Proposal is not likley to represent a significant impact to the environmental resulting from a Nuclear Action (refer to Section 5.7).
A water resource, in relation to coal seam gas development and large coal mining development	Not applicable. The Proposal is not a coal seam gas or coal mining development.

6.2 Summary of Values Relating to MNES

The following values relating to MNES have been identified as occurring, or having the potential to occur, within or near the DE.

Table 14 MNES Listed Species and Communities

Species or Community	EPBC Act listing	Status with the DE
Threatened Flora		
Banksia nivea subsp. *uliginosa*	Endangered	Recorded within the DE
Banksia squarrosa subsp. *argillacea*	Vulnerable	Recorded within the DE
Brachyscias verecundus	Critically Endangered	Recorded outside the DE

Species or Community	EPBC Act listing	Status with the DE
Chamelaucium roycei	Vulnerable	Recorded within the DE
Darwinia whicherensis	Endangered	Recorded outside the DE
Daviesia elongata	Vulnerable	Recorded outside the DE
Drakaea elastica	Endangered	Possible occurrence
Drakaea micrantha	Vulnerable	Possible occurrence
Gastrolobium papilio	Endangered	Recorded outside the DE
Grevillea elongata	Vulnerable	Recorded within the DE
Grevillea maccutcheonii	Endangered	Recorded outside the DE
Lambertia echinata subsp. *occidentalis*	Endangered	Recorded within the DE
Morelotia australiensis	Vulnerable	Recorded outside the DE
Petrophile latericola	Endangered	Recorded outside the DE
Threatened fauna		
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Recorded
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	Endangered	Recorded
Forest Red-Tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Vulnerable	Recorded
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Critically Endangered	Recorded
Chuditch (*Dasyurus geoffroii*)	Vulnerable	Likely to occur
Threatened Ecological Communities		
Banksia Woodlands of the Swan Coastal Plain	Endangered	Within and outside the DE
Shrublands on Southern Swan Coastal Plain Ironstones (Busselton area) (SCP10b)	Endangered	Outside the DE

6.3 Summary of Potential Impacts to MNES and Mitigation Measures

A detailed environmental impact and risk assessment relating to MNES has not been undertaken for this proposal. Knowledge gaps are being addressed by the proposed studies and detailed Proposal design is still ongoing. Potential impacts to MNES have been outlined under the relevant EPA Environmental Factor in Sections 5.2 and 5.3. The outcome of studies will inform mine planning and the development of further mitigation measures to address potential impacts on MNES.

7 HOLISTIC IMPACT ASSESSMENT

The Proposal is located predominantly on agricultural land on the Swan Coastal Plain, at the foot-slopes of the Whicher Scarp. The Swan Coastal Plain has been heavily cleared and, accordingly, it is recognised that further clearing has the potential to have a significant impact on vegetation communities, and associated flora and fauna at a local and regional scale. The adjacent Whicher Scarp is also recognised for its biodiversity values and the potential for significant impacts is acknowledged.

The Proposal is at an early stage in the planning process. Adopting a conservative approach, a maximum DF comprising the whole of the DE has been included in this Proposal. The proposed pit shells have been indicated in Figure 3. In recognition of the particularly high conservation value of the Shrublands on Southern Swan Coastal Plain Ironstones (Busselton area) (SCP 10b)TEC, the DE has been constructed to avoid areas of importance and buffers have also been incorporated into the DE to maintain setbacks for the protection of this TEC. Iluka will also implement a wet mining method with the aim of minimising indirect impacts on surface water and groundwater and groundwater dependent ecosystems.

At this early stage in the planning and impact assessment process, the preliminary key environmental factors likely to be relevant to the Proposal include Flora and Vegetation, Terrestrial Fauna, Terrestrial Environmental Quality and Inland Waters. In addition, Iluka has identified several MNES including listed Threatened Flora, Fauna and Ecological Communities. Additional environmental baseline studies are being implemented to enhance Iluka's understanding of the environmental values within and surrounding the DE and to support Proposal planning (including the delineation of a DF), the assessment of impacts and development of appropriate mitigation measures.

Iluka will also utilise its experience in implementing mineral sands mining projects in the southwest of Western Australia with similar environmental and social sensitivities in the context of this Proposal. Accordingly, Iluka's assessment of impacts from a holistic perspective incorporates the following mitigating factors:

- The Proposal will be planned and implemented so as to avoid (where possible) or minimise impacts to significant environmental assets;
- The mitigation hierarchy (avoid, minimise, rehabilitate) will be applied during the development of appropriate mitigation and management measures;
- The Proposal represents a temporary change in land use only; and
- Rehabilitation will be carried out to create a safe, stable and non-polluting landform that is suitable for the agreed post-mining land uses.

In this context, Iluka is confident that the Proposal can be implemented in a manner that is consistent with the EPA's environmental objectives.

8 CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

Cumulative environmental impacts are defined as 'the successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities' (EPA, 2021). The Proposal is located within a region containing a number of existing, and successfully rehabilitated mineral sands mines, vast areas of agriculture and remnant natural bushland/forests, of varying health and condition.

The Proposal is located within the South West Botanical Province which is regarded as having a very high degree of species diversity. The Proposal occurs partly on the Whicher Scarp, which has been noted as having diverse and varied natural values in relation to landforms, flora, vegetation and fauna, with remaining native vegetation meeting the six criteria for consideration as regionally significant natural areas.

Potential cumulative impacts to this region will be further assessed during the environmental impact assessment process.

9 CONCLUSION

The Tutunup Mineral Sands Project is located 17km east of Busselton, in the southwest of Western Australia. The Proposal involves the development of mine pit(s), a processing plant, dams for water and clay fines management, material stockpiles and associated supporting infrastructure such as power, drainage, haul roads, offices and workshops.

The DE has been constrained by *Mining Act 1978* tenure and by the presence of the Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (SCP 10b) TEC. The deposit also extends outside of the DE, to the northeast and southwest, however those areas have been deliberately excluded from the Proposal, as a key avoidance measure as part of the mitigation hierarchy. The DF within the DE is yet to be completely defined and therefore the Proposal DF comprises the entire DE, made up of approximately 450 ha (69%) of cleared land, approximately 61 ha (9%) of plantation or other planted vegetation and approximately 142 ha (22%) of native vegetation, of various condition and health.

Iluka recognises the significance of the TECs, PECs, Threatened and Priority Flora and the significance of the habitat values for threatened fauna species such as Black Cockatoos and the Western Ringtail Possum that occur within the DE and its surrounding environs. Iluka also recognises the significance of remnant native vegetation on cleared farmland in providing a refuge for fauna and supporting ecological linkages in a highly modified landscape. Potential impacts to these significant environmental factors within the DE through both direct (clearing) and indirect (potential groundwater drawdown) will be further assessed during the environmental impact assessment process. Detailed environmental surveys and impact assessments to inform the Proposal design, layout and mining method will identify further avoidance and mitigation measures to ensure the Proposal meets the EPA Objectives. . In the unlikely event that significant residual impacts are identified following these avoidance and mitigation measures, an appropriate offsets package will also be developed.

Iluka considers the Proposal has the potential for significant impacts to the environment. As such it expects that the Proposal will be assessed under Part IV of the EP Act. However, from currently available information and Iluka's long experience in similar environments, it is confident the Proposal can be implemented in a manner that is consistent with the EPA's objectives and does not result in unacceptable environmental impacts.

10 REFERENCES

AD Lasse Hydrologic Consulting, 2009. *Construction, Calibration and Predictions of the Tutunup Mine Groundwater Flow Model,* Perth, WA: Prepared for Iluka Resources Ltd.

Aecom, 2010. *Surface Water Assessment Tutunup Mine Stage 1,* Perth, WA: Prepared for Iluka Resources Ltd.

Aecom, 2013. *Surface Water Assessment - Tutunup Mine Stage 1,* Perth, WA: Prepared for Iluka Resources Ltd.

Anthropos Australia, 2013. *The Report of an Aboriginal Heritage Survey of the Proposed Tutunup Mineral Sands Mine, South-West Region WA,* Perth, WA: Prepared for Iluka Reosurces Ltd with input from South West Boojarah Native Title Claimant Group and the South West Aboriginal Land and Sea Council.

ASRIS, 2011. *ASRIS - Australian Soil Resource Information System.* [Online]
Available at: http://www.asris.csiro.au/
[Accessed 24 September 2019].

Barnesby, B., King, P. & Proulx-Nixon, M., 1995. *Land Resources from Harvey to Capel on the Swan Coastal Plain Western Australia (Scale 1:50,000, 2 map sheets),* Perth, WA: DAWA Land Resource Map Np 23/2 to accompan Land Resources Series No. 15. Department of Agriculture.

BCE, 2021. *Iluka Tutunup Project Detailsed Fauna Assessment Tutunup Mineral Sand Project,* s.l.: Unpublished report prepared for Iluka Resources Ltd.

Beard, J. S. et al., 2013. The Vegetation of Western Australia at the 1:3,000,000 Scale. Explanatory Memoir. Second Edition. *Conservation Science Western Australia,* Issue 9, pp. 1-152.

Bennett Environmental, 2008. *Flora and Vegetation of Iluka's Proposed Tutunup Mineral Sands Project,* Perth, WA: Prepared for Iluka Resources Ltd.

Bennett Environmental, 2009. *Flora and Vegetation of Ilukas Proposed Tutunup Mineral Sands Project,* Perth, WA: Prepared for Iluka Resources Ltd.

Bennett Environmental, 2013. *Botanical Assessment of Selected Areas at Tutunup,* Perth, WA: Prepared for Iluka Resources.

Biota, 2009. *Tutunup Fauna Assemblage and Fauna Habitat Seasonal Survey,* Perth, WA: Prepared for Iluka Resources.

BoM, 2019a. *Climate statistics for Australian locations - Busselton Aero Weather Station.* [Online]
Available at: http://www.bom.gov.au/climate/averages/tables/cw_009603.shtml
[Accessed 24 September 2019].

BoM, 2019b. *Climate statistics for Australian locations - Busselton Shire Weather Station.* [Online]
Available at:
http://www.bom.gov.au/jsp/ncc/cdio/cvg/av?p_stn_num=009515&p_prim_element_index=0&p_comp_element_index=0&redraw=null&p_display_type=statistics_summary&normals_years=1961-1990&tablesizebutt=normal
[Accessed 24 September 2019].

BOM, 2019c. *Groundwater Dependent Ecosystems Atlas.* [Online]
Available at: http://www.bom.gov.au/water/groundwater/gde/map.shtml
[Accessed 25 September 2019].

City of Busselton, n.d. *Future Busselton 2050,* Busselton, WA: Prepared by Land Insights for the Ciy of Busselton.

Commonwealth of Australia, 2012. *Interim Biogeographical Regionalisation for Australia (IBRA) version 7,* Canberra, ACT: Department of the Environment and Energy.

DBCA, 2018. *Geomorphic Wetlands, Swan Coastal Plain - Spatial Data,* Perth, WA: Department of Biodiversity, Conservation and Attractions.

DER, 2015. *What are acid sulfate soils?,* Perth, WA: Fact Sheet. Department of Environment Regulation.

DIDMS, 2014. *Dieback Information Delivery and Management System - Online Mapping Tool,* Perth, WA: Gaia Resources, South Coast NRM & Department of Biodiverity, Conservation and Attractions.

DMIRS, 2017. *Mineral sands fact sheet,* s.l.: s.n.

DoEE, 2019. *EPBC Act Protected Matters Report,* Canberra, ACT: Department of the Environment and Energy.

DoW, 2007. *Surface Hydrology of the Cape to Cape Region in Western Australia,* Perth, WA: Department of Water.

DoW, 2009. *South West Groundwater Areas Allocation Plan. Water resource allocation planning series, Report 21,* Perth, WA: Department of Water.

DoW, 2010. *Vasse Wonnerup Wetlands and Geographe Bay Water Quality Improvement Plan,* Perth, WA: Department of Water.

DoW, 2020. *RIWI Act Surface Water Proclamation Areas March 2020.* [Online]
Available at: http://www.water.wa.gov.au/__data/assets/pdf_file/0004/1669/86306.pdf
[Accessed 10 August 2021].

DPC, 2019. *South West Native Title Settlement.* [Online]
Available at: https://www.wa.gov.au/organisation/department-of-the-premier-and-cabinet/south-west-native-title-settlement#about-the-agreement
[Accessed 26 September 2019].

DPIRD, 2019. *NR Info (Natural Resource Information).* [Online]
Available at: https://www.agric.wa.gov.au/resource-assessment/nrinfo-western-australia
[Accessed 25 September 2019].

DPLH, 2019. *Aboriginal Heritage Inquiry System.* [Online]
Available at: https://www.dplh.wa.gov.au/information-and-services/online-services/aboriginal-heritage-inquiry-system
[Accessed 26 September 2019].

DWER, 2019. *South West Rivers. Vasse - Ludlow Rivers, Busselton Coast.* [Online]
Available at: https://rivers.dwer.wa.gov.au/catchment/vasse-ludlow-rivers/
[Accessed 24 September 2019].

DWER, 2020. *Contaminated Sites Database.* [Online]
Available at:
https://dow.maps.arcgis.com/apps/webappviewer/index.html?id=c2ecb74291ae4da2ac32c441819c6d47
[Accessed 17 November 2020].

DWER, 2021. *Water Register.* [Online]
Available at: https://maps.water.wa.gov.au/#/webmap/register
[Accessed 12 August 2021].

Ecoedge, 2011a. *Letter RE: Tutunup Weed Survey,* Perth, WA: Prepared for Iluka Resources Ltd.

Ecoedge, 2011b. *Tutunup Potential Nesting Tree Survey,* Perth, WA: Prepared for Iluka Resources Ltd.

Ecoedge, 2012. *Letter RE: Tutunup Weed Survey 2012,* Perth, WA: Prepared for Iluka Resources.

Ecoedge, 2013a. *Tutunup Potential Black Cockatoo Nesting Tree Survey,* Perth, WA: Prepared for Iluka Resources Ltd.

Ecoedge, 2013b. *Assessment of Potential Impacts on Ecological Linkages at Iluka's Proposed Tutunup Mineral Sands Project,* Perth, WA: Prepared for Iluka Resources Ltd.

EPA, 2013. *Environmental Protection Bulletin No.6. The Natural Values of the Whicher Scarp,* Perth, WA: Environmental Protection Authority.

EPA, 2016a. *Environmental Factor Guideline: Flora and Vegetation,* Perth, WA: Environmental Protection Authority.

EPA, 2016b. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment,* Perth, WA: Environmental Protection Authority.

EPA, 2016c. *Environmental Factor Guideline: Terrestrial Fauna,* Perth, WA: Environmental Protection Authority.

EPA, 2016d. *Technical Guidance: Sampling methods for terrestrial vertebrate fauna,* Perth, WA: Environmental Protection Authority.

EPA, 2016e. *Technical Guidance: Sampling of short range endemic invertebrate fauna,* Perth, WA: Environmental Protection Authority.

EPA, 2016f. *Environmental Factor Guideline: Terrestrial Environmental Quality,* Perth, WA: Environmental Protection Authority.

EPA, 2016g. *Environmental Factor Guideline: Social Surroundings,* Perth, WA: Environmental Protection Authority.

EPA, 2016h. *Environmental Factor Guideline: Human Health,* Perth, WA: Environmental Protection Authority.

EPA, 2016j. *Environmental Factor Guideline - Subterranean Fauna,* Perth, WA: Environmental Protection Authority.

EPA, 2016j. *Environmental Factor Guideline: Air Quality,* Perth, WA: Environmental Protection Authority.

EPA, 2018a. *Environmental Factor Guideline: Inland Waters,* Perth, WA: Environmental Protection Authority.

EPA, 2018b. *Environmental Factor Guideline: Landforms,* Perth, WA: Environmental Protection Authority.

EPA, 2018d. *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual,* Perth, WA: Environmental Protection Authority.

EPA, 2020a. *Statement of Environmental Principles, Factors and Objectives,* Perth, WA: Environmental Protection Authority.

EPA, 2020b. *Technical Guidance: Terrestrial Fauna Surveys for Environmental Impact Assessment,* Perth, WA: Environmental Protection Authority.

EPA, 2020c. *Environmental Factor Guideline: Greenhouse Gas Emissions,* Western Australia: EPA.

Ethnosciences, 2007. *Preliminary Report of an Ethnographic Survey of the Proposed Tutunup Satellite Mineral Sands Mine near Capel WA,* Perth, WA: Prepared for Bemax Resources.

GeoCatch, 2018. *Vasse Wonnerup Wetlands.* [Online]
Available at: https://rgw.dwer.wa.gov.au/vasse-wonnerup-wetland/
[Accessed 25 September 2019].

GHD, 2010. *Stygofauna Baseline Survey. Murray Drainage and Water Management Plan and Associated Studies,* Perth, WA: Unpublished report prepared for the Department of Water.

Government of Western Australia, 2019. *2018 Statewide Vegetation Statistics (formerly the CAR Reserve Analysis) (Full Report)..* [Online]
Available at: https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation statistics

Government of Western Australia, 2019. *2018 Statewide Vegetation Statistics Incorporating the CAR Reserve Analysis. Current as of March 2019.* Perth, WA: Department of Biodiversity, Conservation and Attractions.

Harewood, G., 2009. *Western Ringtail Possum Baseline Assessment Tutunup,* Perth, WA: Prepared for Iluka Resources Ltd.

Harvey, M., 2002. Short-range endemism in the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics,* Volume 16, pp. 555-570.

Hearn, R., Williams, K., Comer, S. & Beecham, B., 2002. *A Biodiveristy Audit of Western Australia's 53 Biogeographic Subregions in 2002 - Jarrah Forest 2 (JF2 - Southern Jarrah Forest Subregion),* Perth, WA: Department of Conservation and Land Management.

Heritage Council, 2017. *inHerit. Route of the Ballarat Railway Line.* [Online]
Available at: http://inherit.stateheritage.wa.gov.au/Public/Inventory/Details/68570c2b-059b-48e5-bb73-a93297fbfac9
[Accessed 26 Spetember 2019].

Humphreys, W., 2006. Aquifers: the ultimate groundwater-dependent ecosystems. *Australian Journal of Botany,* Volume 54, pp. 115-132.

Iluka, 2008. *Acid Sulfate Soils and Heavy Mineral Deposits: General Theory,* Perth, WA: Prepared by Iluka Resources Ltd. Doc: ILUKA-TR-T16762.

Iluka, n.d.. *Naturally Occurring Radiation and Mineral Sands.* [Online]
Available at: https://www.iluka.com/CMSPages/GetFile.aspx?guid=f84981c7-a010-4db7-a1ec-e7ab0f011db8
[Accessed 19 November 2020].

Invertebrate Solutions, 2018. *Desktop Review and Risk Assessment of Subterranean Fauna for the Yanchep Rail Extension, Western Australia,* Perth, WA: Unpublished report prepared for the Public Transport Authority.

Johnstone, R. E., Johnstone, C. & Kirkby, T., 2008. *Assessment of Significant Habitat for Black Cockatoos in the Proposed Tutunup Study Area,* Perth, WA: Prepared for Iluka Resources Ltd.

Johnstone, R. E., Johnstone, C. & Kirkby, T., 2009. *Surveys and Monitoring of Black Cockatoos in the Tutunup Region,* Perth, WA: Prepared for Iluka Resources Ltd.

Meissner, R. & English, V., 2005. *Shrubland Association on Southern Swan Coastal Plain Ironston (Busselton Area) (Southern Ironstone Association) Interim Recovery Plan 2005-2010,* Perth, WA: Conservation and Land Management, Interim Recovery Plan No 215.

Mitchell, D., Williams, K. & Desmond, A., 2002. *Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion),* Perth, WA: A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. Department of Conservation and Land Management .

Molloy, S. & Deeley, J., 2013. *Extending the South West Regional Ecological Linkages in the South West Catchments Council Region: Developing the Draft Linkages,* Bunbury, WA: South West Catchments Council.

Molloy, S. et al., 2009. *South West Regional Ecological Linkages Technical Report,* Perth, WA: Western Australian Local Government Association and Department of Environmental and Conservation.

Myers, N. et al., 2000. Biodiveristy Hotspots for Conservation Priorities. *Nature,* 403(6772), pp. 853-858.

Myers, N. et al., 2000. Biodiversity hotspots for conservation priorities. *Nature,* 403(6772), p. 853.

Outback Ecology, 2007. *Tutunup East Deposit. Soil Characteristics and Groundwater Dependence of Vegetation,* Perth, WA: Prepared for Bemax Resources Ltd.

Project Dieback, 2014. *State Phytophthora Dieback Management and Investment Framework,* Perth, WA: Western Australian Government.

Raudino, A., 2007. *Phytophthora cinnamomi survey Tutunup area,* Perth, WA: Letter from CALM prepared for Iluka Resources Ltd.

Raudino, A., 2008. *Phytophthora cinnamomi recheck survey Tutunup Area,* Perth, WA: Letter prepared by CALM for Iluka Resources Ltd.

RPS, 2013. *Memorandum: Tutunup Groundwater Model Review - Initial Draft for Discussion,* Perth, WA: Prepared for Iluka Resources Ltd.

Schoknecht, N. R., Tille, P. J. & Purdie, B. R., 2004. *Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs,* Perth, WA: Department of Agriculture and Food. Report 280.

Shawmac, 2014. *Tutunup Transport Study,* Perth, WA: Prepared for Iluka Resources Ltd.

Shedley, E. & Williams, K., 2014. *An assessment of habitat for western ringtail possum (Pseudocheirus occidentalis) on the southern Swan Coastal Plain,* Bunbury, WA: Unpublished report for the Department of Parks and Wildlife.

Shepherd, D. P., Beeston, G. R. & Hopkins, A. J. M., 2002. *Native Vegetation in Western Australia: Extent, type and status,* Perth, WA: Department of Agriculture and Food. Report 249.

Shulze, E. & Mooney, H. eds., 2012. *Biodiversity and Ecosystem Function.* s.l.:Springer Science & Business Media.

SKM, 2013. *Tutunup Groundwater Model,* Perth, WA: Prepared for Iluka Resources Ltd.

SVT, 2009. *Environmental Noise Impact Assessment for the Proposed Tutunup Stage 1 Mineral Sands Mine,* Perth, WA: Prepared for Iluka Resources Ltd.

SVT, 2013. *Letter RE: Summary of Previous Tutunup Stage 1 Noise Impact Investigations,* Perth, WA: Prepared for Iluka Resources Ltd.

SWC, 2009. *Pre-Mine Soil Survey for the Proposed Tutunup Mine Site,* Perth, WA: Prepared by Soil Water Consulting for Iluka Resources Ltd.

Threatened Species Scientific Committee, 2016. *Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community,* s.l.: s.n.

Tille, P. J. & Lantzke, N. C., 1990. *Busselton, Margaret River, Augusta: land capability study,* Perth, WA: Department of Agriculture and Food, Report 5.

URS, 2008. *Tutunup Phase 1 Hydrogeology,* Perth, WA: Prepared for Iluka Resources Ltd.

WEC, 2015. *Tutunup Mineral Sands Mine - Stage 1. Desktop Flora and Vegetation Review,* Perth, WA: Prepared for Iluka Resources Ltd.

WEC, 2019. *Update and Review of Tutunup Mineral Sand Mine Stage 1 - Desktop Flora and Vegetation Review,* Perth, WA: Prepared for Iluka Resources Ltd.

WEC, 2021. *Tutunup Mineral Sands Project Flora and Vegetation Survey,* s.l.: Unpublished report prepared for Iluka Resources Limited..

WRM, 2007. *Ecological Character Description for the Vasse-Wonnerup Wetlands Ramsar Site in South-west Western Australia,* Perth, WA: Report to the Department of Environment and Conservation and Geographe Catchment Council Inc. by Wetland Research & Management.

WRM, 2009. *Tutunup Wetland Baseline Aquatic Biology Study,* Perth, WA: Prepared for Iluka Resources Ltd.

WRM, 2021. *Tutunup Mineral Sands Project: Aquatic Biology Desktop Review and Aquatic Fauna Field Survey 2020,* s.l.: Unpublished report by Wetland Research & Management to Iluka Resources Ltd.

APPENDICES

Appendix 1 – Woodman Environmental Tutunup Mineral Sands Project Flora and Vegetation Survey

Appendix 2 – Bamford Consulting Ecologists Iluka Tutunup Project Detailed Fauna Assessment Tutunup Mineral Sand Project

Appendix 3 – WRM Tutunup Mineral Sands Project Aquatic Biology Desktop Review and Field Survey 2020

Appendix 4 – Spatial Data and IBSA Data Package

Provided electronically