Attachment 2

Glenaladale Mineral Sands Project
Baseline Report

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Kalbar Resources Ltd

Glenaladale Mineral Sands Project

Baseline Report

July 2015

When you
think with a
global mind
problems
get smaller

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Glenaladale Mineral Sands Project

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July 2015

Quality Information

Revision History

Revision	Description	Date	Author	Reviewer
v1 draft	Draft for client review	30/06/2015	Coffey	CB
V2	Final	28/07/2015	Coffey	CB

Distribution

Report Status	No. of copies	Format	Distributed to	Date
v1 draft	1	Word	Rob Bishop	30/6/15
V2 final	1	PDF	Rob Bishop	28/07/15

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Executive Summary

Kalbar Resources Ltd (Kalbar) is proposing to develop a world-class mineral sands mine in East Gippsland, Victoria. The Glenaladale Mineral Sands Project (the project) including the proposed Fingerboards Mine, is located on the foothills of the Great Dividing Range. The broader area encompasses the productive Mitchell River floodplain, river terraces, and gently undulating gullies that graduate into steeper foothills where soils become shallow, stony and poorly structured. These areas support a variety of land uses including agriculture, forestry and native forests.

Average annual rainfall varies across Gippsland. Bairnsdale, approximately 20 km from the project area, receives approximately 700 mm annually. Surface water drains from southern slopes of the Great Dividing Range and flows southward towards the Gippsland Lakes. The project area straddles the lower floodplains of the Mitchell River Basin in the east, and the Avon River Basin in the west. Small, tributary streams of the Mitchell and Avon rivers drain into the project area. The project is located at the northern margin of the Central Gippsland groundwater basin where the basement rock rises form the Great Dividing Range. A number of shallow groundwater bores in the project area are used for stock and domestic use.

Biogeographically, the region overlaps between southern cool temperate and eastern warm temperate zones. The project area comprises agricultural land (including grazing, irrigation and dairy) and forestry plantations, with remnant native vegetation largely restricted to state forest, riparian vegetation along gullies, creeks and roadside reserves. These areas contain a range of ecological communities and flora and fauna species, many of which are either rare or threatened.

The history of the region is diverse. From Aboriginal inhabitation for several thousand years to the settlement of early European graziers, the region has significant cultural and historical values. The local area attracts tourists visiting the Den of Nargun and Mitchell River National Park, among other attractions. The scenic landscape of the mountains and the rising terraces from the floodplain are valued by local residents and visitors alike.

The region contains a range of social infrastructure and services including primary schools, secondary schools, recreation facilities and health services. It is well serviced by roads, telecommunication towers and high-voltage electricity. The project area overlaps the East Gippsland Shire and Wellington Shire. The town of Glenaladale is located immediately north of the project area. Other towns such as Lindenow, Fernbank and Walpa are located nearby.

The project has the potential to generate an increased demand for goods and services and in turn contribute to the local economy of the surrounding region. Key potential socio-economic issues associated with project activities may include: changes in the local population due to the influx of personnel during construction of the project; alteration of the amenity of the local environment; and the temporary loss of agricultural land use. Project infrastructure will also create noise and emissions to air.

Locally there will be competing demands for resources and infrastructure including water and roads. Sourcing 3 to 4 GL/year of water for processing, rehabilitation and amenities is likely to require both groundwater and surface water. The area is dependent upon the multiple income streams derived from forestry, horticulture and agriculture. These enterprises also rely upon the same natural resources and infrastructure that a mineral sands mine will require. The challenge will be to balance the competing needs of the different industries with the temporary nature of mineral sands mining.

Ground disturbance during project construction will cause biological impacts (such as habitat loss from vegetation clearance) and could impact cultural heritage values. Mining operations also has the potential to cause groundwater and surface water impacts. The significance of such impacts will

depend on factors such as the location and size of project infrastructure requirements, monitoring and management regimes adopted, and future plans to rehabilitate disturbed areas.

The regulatory environment in Victoria is mature and the approval pathway clear. However, the project is located in a region of Victoria new to mineral sands mining. As such, the sensitive socio-political context is likely to result in concentration and interest in the project's assessment and (if successful) approval conditions. Likely issues include perceived conflicts between existing land uses, the use of natural resources (such as water) and potential impacts on sensitive values such as threatened flora and fauna and cultural heritage.

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1 Introduction

1.1 Overview

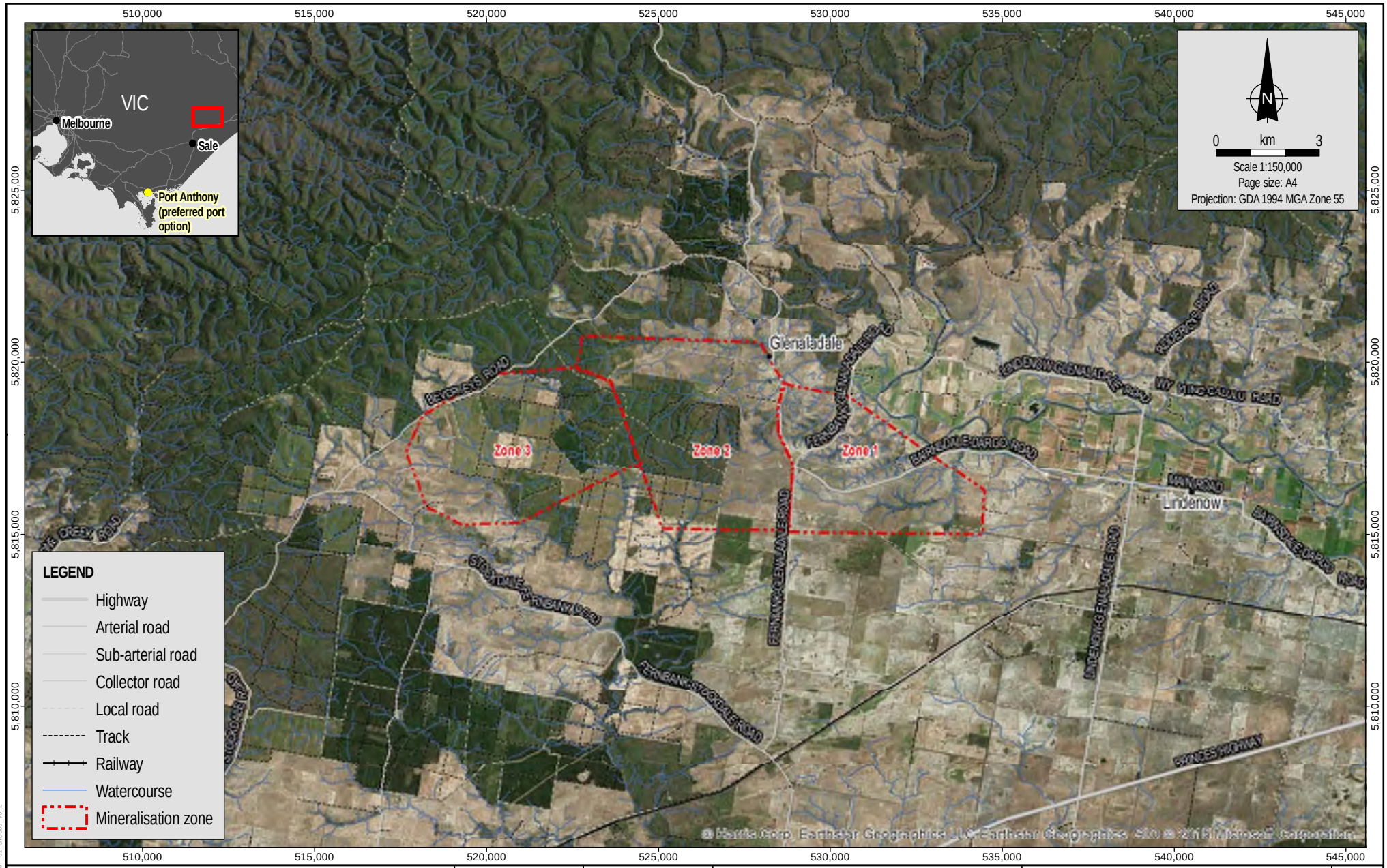
Kalbar Resources Ltd (Kalbar) is planning to develop the Glenaladale deposit, which contains heavy mineral sands, in south east Victoria (see Figure 1.1). The focus of this report is on the proposed Fingerboards Mine, an area in the eastern part of the Glenaladale deposit. The Glenaladale Mineral Sands Project (the project) will involve open cut mining to extract 1.6 Mt of heavy mineral concentrate (HMC) over 10 years from the Fingerboards Mine. The Glenaladale deposit is located south of the town of Glenaladale within the East Gippsland Shire and Wellington Shire and extends across approximately 12,000 ha. The HMC will be exported for further processing into commercial products such as zircon and rutile.

This report describes the physical context of the project location and key features of its existing environmental and social conditions. It outlines the key environmental and social issues likely to be encountered during the development and life of the project. The report draws on information obtained from a review of government databases, strategy and policy along with a site visit conducted by Coffey environmental professionals in June 2015.

1.2 Study and project areas

Each of the desktop reviews conducted as a part of this report have a designated study area which was used to frame the investigation and identify key issues. The study area varies according to the field of investigation and was defined by the context in which the proposal is to be developed. Each of these study areas are defined in chapter 4 of this report.

For the purposes of this report, the term project area is used to refer to the area potentially disturbed by proposed project activities. This includes the establishment of infrastructure, removal of topsoil and overburden, ore removal, processing of mined ore, management of mining by-products and progressive rehabilitation. The project area covers the three mineralisation zones shown in Figure 1.1.



Source:
Mineralisation zones from Kalbar.
Roads, railway and watercourses from Vicmap.
Imagery from Bing (capture date unknown).

coffey

Date: 29.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F01.01_GIS

KALBAR RESOURCES LTD

Baseline Technical Report

Glenaladale Mineral Sands
Project location and area

Figure No: **1.1**

MXD Reference: 11607_01_GIS009_v0_2

2 Project description

2.1 Project overview

The Glenaladale deposit is located in East Gippsland near the towns of Glenaladale and Lindenow. The deposit contains an estimated 36 Mt of heavy mineral (HM) including around 7 Mt of zircon. The focus of this report is on the Fingerboards Mine, which is an area in the eastern part of the Glenaladale deposit. Kalbar will use open cut mining methods to extract 50 Mt of ore to produce 1.6 Mt of heavy mineral concentrate (HMC) over 10 years from the Fingerboards Mine It is envisaged that, due to the size of the deposit, mining will continue in other areas of the deposit following the closure of the Fingerboards Mine.

The ore will be fed to a mining unit plant (MUP) for slurrying and pumping to the wet concentrator plant (WCP). There the slurried ore will undergo initial onsite processing to produce the HMC. The HMC will be exported for further processing into commercial products such as zircon and rutile. Mining will be conducted 24 hours/day and 365 days/year.

All overburden will be returned to the mined-out void, with the majority directly returned as mining progresses, without stockpiling. Mining by-products and non-economic minerals will be placed in the mined out void and in an off-path tailings storage facility. Rehabilitation will occur on the reinstated land surface behind the advancing open cut.

2.2 Project schedule

Kalbar intends to begin construction of the project in 2017, with mining operations to commence in 2018. Construction will take approximately six months with a further six months of commissioning and start-up.

The approvals process for the Fingerboards Mine will commence in late 2015 and is likely to require an environment effects statement (EES) under the Victorian *Environment Effects Act 1978*. Kalbar anticipate that the approval of an EES, planning scheme amendment, mining work plan, mining licence and cultural heritage management plan will take approximately 1.5 years.

2.3 Mining

The proposed mineral sands mining operation will involve:

- Establishment of infrastructure (site access and haul roads, site office and workshop, power and water, WCP) and the working mine area.
- Removal of topsoil and overburden using conventional earthmoving equipment (e.g., excavators, bulldozers, scrapers, front-end loaders and trucks).
- Ore removal by conventional earthmoving equipment.
- Initial wet gravity processing of mined ore in a WCP to produce heavy mineral concentrate.
- Management of mining by-products by either co-disposal to the mine void or off-path co-disposal to a tailings storage facility.
- Transportation of heavy mineral concentrate by truck via the state road system directly to the preferred port for export.
- Progressive rehabilitation of the mined areas and other disturbed areas.

2.3.1 Mining equipment

Indicative equipment to be used in the mining process includes scrapers, dozers, trucks, excavators, water carts and front end loaders. The exact size and numbers of mobile plant and equipment will be determined by the mining contractor and Kalbar as the project progresses.

2.3.2 Stockpiles

Temporary stockpiles of soils, overburden and ore will be established adjacent to the mine path during mining. Stockpiled soils and overburden will be returned to the mined-out void as part of the rehabilitation process. Where possible, direct return of the overburden to the void will be conducted, reducing the footprint of the disturbed area and the need for stockpiling.

Ore will be fed directly to the MUP. It is not anticipated that ore will need to be stockpiled outside of the mine void after start-up.

Topsoil and subsoil will be stockpiled separately adjacent to the mine void. Topsoil will be stockpiled to a maximum height of 2 m. Subsoil will be stockpiled to a maximum height of 5 m. Soils from agricultural areas will be stockpiled separately to those harvested from areas with native vegetation.

All overburden will be direct returned where possible. During start-up, overburden will be stockpiled to a maximum height of 15 m for safety reasons.

2.3.3 Soil, overburden and ore removal

Topsoil and subsoil will be stripped separately using conventional earthmoving machinery. Topsoil and subsoil removal rates will be determined by the requirement to remove soils and overburden in advance of the mine face, the presence and nature of the soils and the prevailing weather conditions.

Chemical and structural analysis of soils will be conducted prior to soil stripping operations so that targeted soil management and rehabilitation can be achieved. Dozers and scrapers will remove topsoil and subsoil due to their rocky nature in some areas. Other sandy soils will be removed using tractor scoops.

Conventional earthmoving machinery including dozers, scrapers and excavators will extract overburden.

Extracted ore will be transferred to the MUP, where it will be screened, slurried and pumped to the WCP.

2.4 Processing

Throughout the life of the project, the processing plant components (MUP and WCP) will operate continuously once sufficient ore has been excavated. The MUP will be located adjacent or in the mine void and will be moved regularly to keep pace with the advancing mine face. The WCP is likely to be located off the mine path near the mine offices and administration area and tailings storage facility.

2.4.1 Mining unit plant

Ore will be processed in the MUP at a nominal rate of 570 t/hour. The MUP will screen ore to remove oversize material, mix the screened material with water to form slurry and pump the slurry to the WCP.

The MUP will consist of an apron feeder with a vibrating dry grizzly, scrubber and trommel unit and will be track-mounted to enable relocation along the pit floor. The two waste streams from the MUP will be >300 mm oversize from the vibrating grizzly and a 2.5 mm oversize stream from the trommel. Oversize streams will generally be returned directly into the pit, although a proportion of the oversize material may be used for road construction or other purposes.

2.4.2 Wet concentrator plant

The WCP will process the upgraded ore at a nominal rate of 400 t/hr. Wet gravity processing methods will separate light minerals (such as quartz) from heavy minerals (such as rutile and zircon), and remove mining by-products such as clay and sand. The WCP will comprise thickeners, a spirals and/or classifiers building, flocculant units, a cyclone stacker, pump stations and a mining by-product handling plant, constant density tank and structure, screens and associated stockpiles and pipelines, pump stations and water storage dams. A stacker will place the HMC that is produced into a stockpile ready for transport to the preferred port for export.

2.4.3 Mining by-products

The sources and sizes of mining by-products include material from the MUP and WCP. The mining by-products from the WCP will consist of a combined mining by-product of fines and sand..

Mining by-products will be placed on the working platform in the mined-out footprint. Deposition will stop at least 2 m below the ground level.

Mining by-products will not be deposited in low-lying areas due to a lack of space within the mine void. Excess overburden will be stockpiled and used in other sections of the pit or, where necessary, used to supplement construction of the mining platform.

After approximately three months, the mining by-products will have dried sufficiently to allow earthmoving equipment to place overburden, subsoil and topsoil on top.

The off-path tailings storage facility will be used for the storage and co-disposal of clay fines and sand from the processing of ore in the WCP. As a contingency, if the tailings storage facility reaches capacity, the drying mining by-products will be moved to the mine void and the tailings storage facility will continue to be used.

The design, construction, monitoring and rehabilitation of the tailings storage facility will be in compliance with Department of Primary Industries management of tailings storage facilities guidelines (DPI, 2004).

Construction of the tailings storage facility will involve:

- Removal of topsoil and subsoil.
- Use of overburden to form walls 3 m high.
- Use of local clay for lining.
- Compaction of clay to seal the base and prevent seepage from fines.
- Installation of a decant system, including drains and sumps, to harvest water for use in the process water circuit.
- Construction of spoon drains along the perimeter to divert any surface runoff from outside the facility.

Rehabilitation of the tailings storage facility will involve:

- Allowing the mining by-products to settle and dry sufficiently to support a mobile plant.
- Ripping the dried mining by-products.
- Applying gypsum.
- Applying additional overburden and then replacing subsoil and topsoil stripped from the area prior to construction of the tailings storage facility.
- Shaping of the facility to blend in with the surrounding topography.
- Applying cover crop/pasture.

Where off-path tailings storage facilities are used, the remaining WCP by-products placed in the mine void will dewater quickly and it will be possible to directly place overburden, and possibly subsoil and topsoil, behind the active mine face. This will enable rehabilitation to commence soon after mining.

2.5 Wastes

The mine will create various non-hazardous recyclable and non-recyclable wastes, as well as waste hydrocarbons.

2.5.1 Solid waste

The mine site will be kept free of litter by bins positioned where food is consumed. All non-toxic waste (including putrescible and inert) will be securely stored in appropriate receptacles. All waste (including chemical toilet effluent) will be removed from site and disposed of by licensed contractors. Recyclable materials (such as aluminium cans, glass and recyclable plastics) will be sent to a licensed recycler by the licensed waste contractor.

2.5.2 Waste hydrocarbons

Operation of the mining fleet will generate waste hydrocarbons such as oils, greases and hydraulic fluids. These waste hydrocarbons will be placed in suitable containers and removed from the mine site for disposal at either an EPA-approved hydrocarbon waste site or a recycling depot. Runoff water from mobile equipment service areas will be directed to an interceptor trap to extract hydrocarbons, prior to it being discharged to the drain and sump network. The trap will be emptied of hydrocarbons routinely by a licensed contractor.

2.5.3 Energy efficiency

Electricity and fuel consumption is expected to generate greenhouse gas emissions. Electrical energy will be used on a continuous basis to power the processing plants and administration areas. Diesel will be consumed by mobile plant and equipment as well as the transport fleet from the mine to the port.

2.6 Water

During operations, the mine will require water for processing, dust suppression, rehabilitation and human consumption and ablutions. Water sources during operations will require high security and be able to supply the 3 to 4 GL required. Key sources of water during operations are discussed further in sections 2.6.1 and 2.6.2.

During construction, fresh high quality water may be required for the concrete batching plant and civil earthworks. There may be several sources of water during construction including supplies trucked in from neighbouring towns.

2.6.1 Process water

Process water will be used to transport ore through the various stages of the ore processing system from the MUP to the WCP in what is effectively a closed water circuit. Groundwater is to be the likely source of processing water for the mine. Process water does not have to be potable or of high quality. Recycled water or poor quality or even saline water can be used in the process circuit.

2.6.2 Potable and fresh water

It is anticipated that an average of up to 50 m^3/hr of fresh water will be used at the site, predominantly for dust suppression on materials such as the topsoil and subsoil stockpiles. Fresh water may be sourced from groundwater and surface water outside of the immediate project area. Freshwater will also be used within the ablutions and administration buildings. Bottled water will be supplied on site for drinking.

A number of onsite dams will be required for water storage. These dams will be lined with clay or plastic.

2.6.3 Runoff management

Stockpile slope angles will be as low as practicable and mulch materials and contour ripping will be strategically used to stabilise stockpiles and minimise erosion. All site drains will be designed and constructed using scour-resistant materials to prevent erosion.

Diversion drains will prevent clean stormwater runoff from entering the pit. This may require infilling of disused water supply channels directly adjacent to the mine site.

2.6.4 Sewage

Freshwater for sewage will be provided by a borefield and pipeline outside of the project area. All sewage will be collected in a septic tank for removal and offsite disposal by an approved contractor. The contractor will be required to comply with local government statutory requirements.

2.7 Infrastructure

Non-mining infrastructure such as site offices, main site access roads, the WCP and service corridors, will be located in the vicinity of the mine void. Mining infrastructure including a mining contractors' workshop, and compounds and haul roads, will be located adjacent to the mine paths.

Establishment of mine infrastructure for the project will involve the following steps:

- Construction of highway intersection and local road detours to maintain access between and within properties, as required.
- Construction of roads including site access and main haul roads.
- Transport and assemblage of the processing plant components (MUP, WCP and associated components).
- Construction and transportation of site office and workshops.

- Installation and reconnection of powerlines and water facilities.
- Diversion of electricity and telecommunication assets in the region.

Buildings including the administration area, mining contractor workshops and stores will be constructed in close proximity to the WCP and tailings storage facility. The ablutions block will include showers, toilets and change rooms. The crib rooms will include first aid facilities, and meeting and training rooms. The ablutions block and crib rooms are likely to be arranged in a cluster adjacent to the administration area and workshops.

2.7.1 Roads and transport route

Mine access roads and haul roads will be constructed adjacent to the pit to minimise interaction and the risk of accidents occurring between mining equipment and general site traffic. A risk assessment will provide the basis of a traffic management plan, which will form part of the mining work plan. Instruction and training will ensure that personnel are aware of the mining work plan and its requirements.

Haul roads will be constructed using overburden and local materials and will be of sufficient width to allow passage for haul trucks and light vehicles. The widths of haul roads will be determined after equipment fleets are finalised, but are estimated to need to be 20 to 30 m wide.

Chemical or physical dust suppressants will be the main form of dust control on access roads. Road construction will vary depending on the surface and substrate.

Access roads will link processing plant components on site and provide access from the Princes Highway and Bairnsdale. Access roads will be used by mine construction and operations staff, contractors and delivery personnel and drivers of trucks taking HMC to the preferred port.

Two proposed routes from the project site to the Port Anthony are being investigated; east along Bairnsdale-Dargo Road to Lindenow-Glenaladale Road, and south to the Princes Highway to Sale; or west along Bairnsdale-Dargo Road to Fernbank-Glenaladale Road and south to the Princes Highway to Sale. From Sale, the trucks transporting the heavy mineral concentrate will continue on to the South Gippsland Highway to Port Anthony on Barry Road, Agnes.

Car parks will be located adjacent to the administration area and WCP. Car parking areas will have topsoil and subsoil removed and stockpiled, and will be surfaced as required.

During construction, access to the site will be prevented or controlled via a security post located on the access road. During construction and operation, assets that require security will be fenced to prevent unauthorised access. The premises will be sign-posted and a security gate will prevent unauthorised vehicle access. Visitors will be accompanied at all times by an authorised company representative.

2.7.2 Port facilities

Kalbar are yet to select a preferred port in Victoria for exporting the HMC. Under assessment are Port Anthony, Port of Melbourne and Port of Portland. Port Anthony is currently the preferred option as it is the closest to the project area (approximately 160 km from the mine site), has adequate capacity, suitable shed facilities for stockpiling HMC and appropriate shipping fleets.

2.8 Workforce

The workforce for the project is likely to be made up of both Kalbar employees and contractors. Kalbar has indicated it will use local employees and contractors where possible. The workforce for the mine and associated processing and transport activities will comprise of local residents and others sourced outside of Gippsland for specialist roles if required.

2.8.1 Construction

Kalbar will appoint a contractor to perform the construction phase of the project, which will last approximately 12 months. The onsite and offsite construction workforce is estimated to be up to 200 people. This will, however, vary through the different stages of construction as some construction and fabrication will occur offsite. Kalbar will maintain a site workforce of 50 people during construction. It is anticipated that the contractor will operate 24 hrs/day, 7 days/wk. The construction contractor will be encouraged to employ locally, where possible.

2.8.2 Operations

The majority of the operations workforce will operate on a 12-hour shift and is likely to consist of approximately 70 people. Specialist skills and previous experience are required for positions such as mine manager, mining and metallurgical engineers, geologists and environment, health and safety personnel. These may need to be sourced from outside the local area, although there are individuals with mining skills in the area that currently work out of Victoria. Kalbar hopes to utilise this experience. Kalbar plans to source the majority of the workforce locally, with the opportunity to train personnel once the mine is operational.

Kalbar are likely to use a mining contractor for earthmoving and mining activities. They will make up the majority of the workforce with Kalbar employees in some management and specialist roles.

Technical and administration staff, cleaners, couriers and general maintenance staff will work 8 to 12 hrs/day on a roster system. It is likely that these workers will be sourced locally.

2.9 Accommodation

The construction workforce is unlikely to require a purpose built accommodation facility due to capacity within surrounding towns.

The operations workforce will be accommodated in a combination of the following ways:

- In current housing within the local area (for local residents).
- In current housing in Glenaladale, Lindenow, Fernbank and, to a lesser extent, surrounding towns (for a smaller number of non-local mining personnel).
- In current housing in the larger rural cities such as Bairnsdale, Stratford, Maffra and Sale, commuting to the mining site (for some non-local mining personnel).

2.10 Decommissioning and Rehabilitation

Restoration and rehabilitation of the mined areas will be carried out progressively as the mine face advances. The aim will be to restore the land to at least its existing land capability and to resemble the landscape prior to mining.

After discussion with relevant stakeholders, project infrastructure, such as buildings, fencing, pipelines and powerlines, haul roads and other pavements, will be removed. The area will then be cleared of any debris and rehabilitated. Some infrastructure may be retained at the request of landholders or local and Victorian government agencies.

3. Legislative context

This chapter details the statutory approvals, permits and consents and the associated environmental assessment process that is expected to apply to the project.

3.1 Key legislation, approvals and assessments

The project is expected to require approval under a range of Commonwealth and Victorian legislation. Key environmental and planning legislation and their associated approvals and assessment requirements that may apply to the project are summarised in Table 3.1. The associated approvals and assessments relevant to the project are also discussed.

Table 3.1 Summary of approvals and assessments

Legislation	Approvals/Assessment	Relevant Authority	Reason/Activity
Commonwealth			
Environment Protection and Biodiversity Conservation Act 1999	Environmental assessment and approval under Commonwealth guidelines or an accredited Victorian process.	Department of the Environment (DoE).	The project will likely be determined a 'controlled action' by DoE.
Native Title Act 1993	Indigenous Land Use Agreement or Negotiation for Consent.	National Native Title Tribunal.	Native Title had been determined to exist within the project area; therefore this legislation is applicable to this project.
Victoria			
Aboriginal Heritage Act 2006	Consent to disturb Aboriginal heritage sites. Approved cultural heritage management plan (CHMP).	Registered Aboriginal Party.	Impacts on Aboriginal cultural heritage values. A CHMP needs to be prepared if an EES is required for the project.
Catchment and Land Protection Act 1994	Pest plant and animal assessment.	East Gippsland and West Gippsland Catchment Management Authorities. Department of Environment, Land, Water and Planning (DELWP)	Required for mining. Potential for the project to introduce and/or spread the distribution of pest plants and pest animals.

Table 3.1 Summary of approvals and assessments (cont'd)

Legislation	Approvals/Assessment	Relevant Authority	Reason/Activity
Victoria			
Conservation, Forests and Land Act 1987	Landowner Agreement (being an Agreement made pursuant to Section 69 of the *Conservation, Forests and Land Act 1987.*	DELWP	Removal and/or destruction of native vegetation and protected flora/fauna. Provides an option for the contractual basis for long-term native vegetation offset arrangements and incorporates the financial and management obligations associated with the native vegetation offset management plan.
Country Fire Authority Act 1958	Hot Work Permit.	Country Fire Authority.	Operation of construction equipment in the open air during a Total Fire Ban.
Crown Land (Reserves) Act 1978	Ministerial consent.	DELWP	Mining on Crown land.
Dangerous Goods Act 1985	Dangerous Goods Licence	WorkSafe	Importing, exporting, manufacturing, storing, selling, supplying, using, handling, transferring, transporting or disposing of certain types of dangerous goods.
Environment Effects Act 1978	Environmental assessment of project by Victorian Minister for Planning.	DELWP (Victorian Minister for Environment, Climate Change and Water).	The project is likely to require an EES under this Act.
Environment Protection Act 1970	Licence to discharge. Air and noise emissions assessment. Works Approval, financial assurance and licence for onsite bulk storage of gas and diesel fuel.	Environment Protection Authority Victoria.	Offsite discharges, including atmospheric emissions. Onsite bulk storage of gas and diesel fuel.
Flora and Fauna Guarantee Act 1988	Permit to take protected flora. Approved native vegetation offset management plan.	DELWP (Victorian Minister for Environment, Climate Change and Water).	Removal and/or destruction of native vegetation and protected flora and fauna.

Table 3.1 Summary of approvals and assessments (cont'd)

Legislation	Approvals/Assessment	Relevant Authority	Reason/Activity
Victoria			
Heritage Act 1995	Permit to disturb known historic sites.	Heritage Victoria.	Disturbance of historic sites.
Land Act 1958	Ministerial consent.	DELWP (Victorian Minister for Environment, Climate Change and Water).	Mining on Crown land.
Mineral Resources (Sustainable Development) Act 1990	Mining licence. Approved mining work plan. Restricted Crown land consent. Work authority to commence mining. Rehabilitation bond in place. Public liability insurance.	DEDJTR (Energy and Earth Resources)	Required for mining. Impacts on bushland reserves. Gives effect under the mining work plan to the Native Vegetation Management: A Framework for Action 2002.
Occupational Health and Safety Act 2004	Licences or registration required under the Regulations to Operate a Major Hazardous Facility.	WorkSafe	Onsite bulk storage of gas and diesel fuel.
Planning and Environment Act 1987	Planning permit.	East Gippsland Shire. Wellington Shire.	Should the project require an EES, a planning permit will only be required for development of infrastructure or activities outside the project area (i.e. road diversions and/or upgrades).
Radiation Act 2005	Radiation management licence. Approved radiation management plan and radioactive waste management plan.	Department of Health and Human Services.	Required for development of a mineral sands mine under the Radiation Regulations 2007 and the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing.

Table 3.1 Summary of approvals and assessments (cont'd)

Legislation	Approvals/Assessment	Relevant Authority	Reason/Activity
Victoria			
Road Management Act 2004	Written consent. Road closure, diversion and/or opening permits.	VicRoads. East Gippsland Shire. Wellington Shire. South Gippsland Shire.	Mining through road reserves. Road closure, diversion and/or upgrade.
Water Act 1989	Bore construction licence. Groundwater extraction licence. Works on a waterway permit.	DELWP (Victorian Minister for Environment, Climate Change and Water). East Gippsland Water East Gippsland CMA	Groundwater extraction. Water pipeline construction and operation. Mining on or beneath a waterway.
Wildlife Act 1975	Permit to control wildlife.	DELWP (Victorian Minister for Environment, Climate Change and Water).	Fauna surveys, salvage and translocation activities.

3.2 Environmental approvals and assessment process

The *Environment Effects Act 1978* requires the preparation of an environment effects statement (EES) for activities considered to have a significant effect on the environment. Where the Victorian Minister for Planning decides that an EES is required, Kalbar will be responsible for preparing the EES and conducting the necessary investigations.

The assessment process under the Environment Effects Act is not an approval process itself; rather it enables statutory decision-makers (i.e. Ministers, local government and statutory authorities) to make decisions about whether a project with potentially significant environmental effects should proceed. The EES is also used to inform further approvals, permits and licences subsequent to the EES.

Where works are considered to have, or are capable of having, a significant effect on the environment, the Ministerial Guidelines for Environment Effects Statements (DSE, 2006) outline a number of triggers for an EES.

The EES process can be broken down into several steps as follows:

- Referral – The project is referred by Kalbar to the Minister for Planning in accordance with the referral criteria.
- Decision – The Minister will decide if an EES is necessary.
- Scoping requirements – The project specific matters that need to be investigated and documented as part of the EES are set out in the scoping requirements that are issued by the Minister. Kalbar and relevant government agencies will provide input into the draft scoping requirements, which will be released for public comment, before the final scoping requirements are released.
- Preparing the EES – An EES will be prepared and a technical reference group will be appointed to provide advice to Kalbar and the Department during the preparation of the EES.

- Public review - When the Minister is satisfied that the EES meets all of its requirements it is released for public comment. An inquiry report may be required to evaluate the effects of the project.
- Making an assessment - The Minister prepares an assessment which takes into account all relevant information including the EES documents, public submissions and Kalbar's responses to these submissions, and if produced, the inquiry report.
- Informing decisions – The Minister's assessment will be considered by the appropriate decision makers when deciding whether to approve the project under Victorian law.

In addition to the preparation of an EES and its associated documents (if required), Kalbar will require a range of licences, permits and government approved plans to construct and operate the project. The aforementioned environmental assessment process will inform the licences, permits and government approved plans required.

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4 Existing environment

4.1 Geology, landforms and soils

This section focuses on the geology, landforms and soils within the project area and immediate surrounds. Geology, landforms and soils along the transport route and at Port Anthony have not been characterised as it is not expected that there will be any land disturbance as a result of project activities in these areas. This section is based on publicly available information and a site visit conducted by Coffey in June 2015 noting landform and general soil characteristics and the evidence of any issues present (such as erosion).

The project area is located within the Gippsland Lakes drainage basin. Most soil variation in the Gippsland Lakes basin is caused by differences in factors such as drainage status, source rocks, climatic conditions which range from sub-alpine to maritime, and stream regimes (Aldrick et al., 1984). In depressions poor drainage has limited soil development through lack of leaching, bioturbation, oxidation and drying fractures (Aldrick et al., 1984).

Soils in the eastern lowlands region range from red texture contrast soils, kursols and chromosols to brown and red friable earths, dermosols, kandosols and ferrosols (DEPI, 2015c). Much of the soils in the modern floodplains of the eastern lowlands are high quality agricultural soils ideally suited to irrigated use (Aldrick et al., 1984). Within the project area soils are characterised by pale sands and duplex soils (brown kursols and sodosols) with low compaction and high leaching (DEPI, 2015c). Soil leaching can result in slightly acidic soils as bases are removed from the soil. During a site visit by Coffey in June 2015 soils in the western portion of the project area were observed to be shallow or absent of topsoil, nutrient poor, rocky and with dispersive subsoil.

There is clear evidence for past or current mass movement of soil within the project area. Soils in the eastern lowlands are prone to gully, wind, rill and tunnel erosion and are moderately well drained (DEPI, 2015c). Evidence of sheet, rill and tunnel erosion was noted during a site visit in June 2015 (Plate 4.1). An East Gippsland Soil Erosion Management Plan has been developed for the region to assess the risk of erosion and identify and set management actions for freehold land (DPI, 2009). The risk assessment shows that the project area is located within an area that has been identified as high risk for sheet and rill erosion.

North of the project area the landsystem changes to the eastern uplands region of the Gippsland Lakes basin. The lithology changes to colluvial in origin and soils become shallow stony loams (DELWP, 2015a). The most common soils in the eastern uplands of the Gippsland Lakes basin are poorly structured gradational soils (kandosols) on the steeper slopes and red to yellow acid texture contrast soils (kurosols) on the less steep slopes (VRO, 2015a).

The project area is low-hill landform with a relative relief of 30 to 90 m characterised by sharply rising river terraces, eroded gullies and waterways (Plate 4.2). This increases to hill landforms to the north of the project area where the relative relief increases from 90 to 300 m (DWLWP, 2015a). The majority of the project area is located within the dissected plains with dunes geomorphological unit (GMU). The southern portion of the project area extends into the plains without dunes GMU. To the north of the project area is moderately dissected landscapes at a range of elevations.

Geologically the Gippsland Lakes basin is highly complex in its structure and sedimentary deposition. The oldest exposed rocks are Cambrian submarine basic volcanics, associated sediments and intrusive rocks (Aldrick et al., 1984). The Gippsland Lakes basin is broadly divided into two regions; the hill and mountains on consolidated rocks and the relatively flat terrain at low elevations. These two regions are generally referred to as the uplands and lowlands.

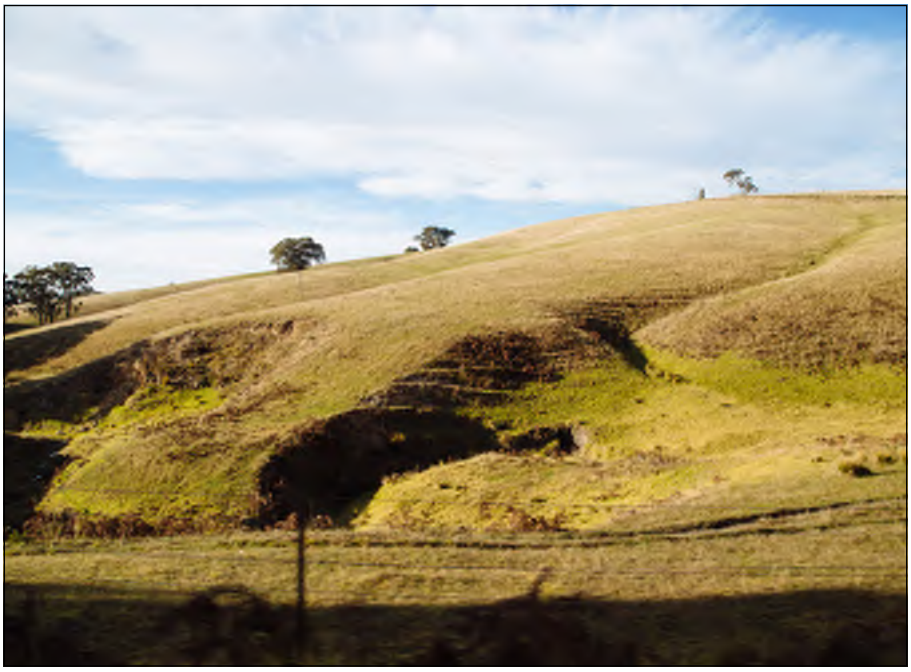


Photo credit: Coffey

Plate 4.1
Evidence of erosion in the project area

Photo credit: Coffey

Plate 4.2
General landform of the project area

Photo credit: Coffey

Plate 4.3
Haunted Hills gravels

The lowland areas were initiated by down-warping in the Paleocene that provided an extensive trough for highly complex sedimentary deposition. This sedimentary deposition ranged from terrestrial to open marine which were then overrun by alluvial fan and floodplain deposits during the Late Pliocene when the sea level retreated (Aldrick et al., 1984). The Late Pliocene was associated with the Kosciusko Uplift during which time the alluvial fan and floodplain deposits of the Haunted Hills Gravels were laid along the margins of the uplands. This activity warped the sediments resulting in the present physiography of rocky outcrops of varying hardness at different levels (i.e. varying elevations of the surface and subsurface) and bounded by faults or monoclines (Aldrick et al., 1984). Evidence of the Haunted Hills Gravels was noted at the surface and in road cuttings during a site visit in June 2015 (Plate 4.3) by Coffey.

The project area is located within the eastern lowlands subregion, which consists of fans, terraces and floodplains. The eastern lowlands is the largest lowlands subregion of the Gippsland Lakes basin (Aldrick et al., 1984) and consists of marine, aeolian, lacustrine and fluvial sediments as well as minor colluvial and palidal deposits (Aldrick et al., 1984). Compared to the older fans formed in the Pleistocene (approximately 1.6 million years old), floodplains are modern of Holocene age (approximately 12,000 years old). The shape of the modern floodplains has been influenced by the location of resistant rock barriers. The development of the lower parts of the Tambo, Nicholson and Mitchell rivers floodplains were influenced by limestone formations known as the Bairnsdale Limestone Formation. The easterly trend of the Mitchell River floodplain follows the junction of coarse unconsolidated Tertiary deposits and the more resistant limestone (Aldrick et al., 1984). There is an extensive outcrop of limestone east of Bairnsdale, where it is exposed as cliffs along the Tambo River (VRO, 2015b).

4.1.1 Key aspects and issues

The undulating landforms of the project area present unique challenges for managing mining and rehabilitation of the area. Some of these challenges include presence of waterways, eroding topography, steep gullies, rocky outcrops, little or no topsoil in areas, stony topsoil and dispersive subsoil. As a result project activities that have the potential to impact geology, landforms and soil include:

- Clearing of vegetation and topsoil.
- Overburden removal and stockpiling.
- Overburden removal and emplacement directly as backfill.
- Stockpiling of topsoil and subsoils.
- Deposition of co-disposed mining by-products.
- Rehabilitation of cleared areas.

These activities have the potential to result in the degradation of soil structure and fertility, changes in soil chemistry and changes to landform. The impact of which will depend on how the activities are conducted and managed. These may either reduce or improve the:

- Capability of land to support agriculture.
- Capability of land to support existing ecosystems.
- Potential for erosion.
- Ability to rehabilitate successfully.
- Ability to achieve closure criteria.

There are currently no public records of soil contamination within the mine area. Given the land uses within and surrounding the mine area (predominantly agricultural, conservation and forestry) there is potential for soil contamination within the project area as a result of old cattle dips and drenching. Inactive gravel borrow pits that were used for gravel extraction for road making were observed during

a site visit by Coffey in June 2015. There is the potential for these gravel borrow pits to be contaminated with hydrocarbons that were often used to stabilise borrow pits in the past. A search of the CSIRO Australian Soil Resource Information System (ASRIS) (2015) showed that there is a low to extremely low probability of acid sulfate soils occurring within the project area.

4.1.2 Conclusions

Given the soil type and proneness to erosion, management of surface water flows and erosion will need to be planned and implemented prior to construction activities. Some soils in the region are highly productive and support many intensive agricultural activities. This should be considered when planning land clearance and rehabilitation activities. While there is a low likelihood of soil contamination being present within the mine area, consideration to further investigations should be given during preliminary excavation activities.

4.2 Water

Mineral sands developments require significant volumes of water for processing, dust suppression and rehabilitation. During construction water may be required for dust suppression, concrete batching and road formation. Processing will be the major use of water during operations, followed by dust suppression, depending upon climatic conditions. Rehabilitation with the re-establishment of landforms and vegetation also requires large volumes of water initially, with a declining requirement once the site becomes self-sustaining.

4.2.1 Groundwater

This section provides an overview of the hydrogeological setting of the project area as well as a wider study area in the Gippsland region based on a desktop study and site inspection. The following summary aims to present an understanding of the baseline groundwater conditions of the area, the potential interactions that may occur with the proposed project, and further groundwater-related considerations that may be required in later stages of environmental assessment.

Regional hydrogeology

Groundwater in Victoria is managed under designated groundwater catchments or basins. The project is located within the Central Gippsland groundwater basin which is managed jointly by Southern Rural Water (SRW) and the Victorian Department of Environment, Land, Water and Planning (DELWP).

Aquifers

The aquifers and aquitards (collectively referred to as aquifers) that make up each groundwater basin are defined in the Victorian Aquifer Framework (VAF). The VAF provides a consistent approach to the definition of aquifers and aquitards and the management of groundwater across Victoria.

At a regional scale, aquifers in the Central Gippsland groundwater basin have been broadly divided into three layers; the upper, middle and lower. Table 4.1 provides an overview of the aquifers, corresponding hydrogeological units and associated geological formations (relevant to the Rosedale area) in the Central Gippsland groundwater basin. Further detail on the key aquifer systems of the area is provided in the following sections.

Table 4.1 Summary of regional aquifers, hydrogeological units and formation names

Regional aquifer classification		Hydrogeological unit		Formation name
Upper		QA	Quaternary Aquifer	Aeolian, fluvial, lacustrine deposits
		UTQA	Upper Tertiary/Quaternary Aquifer	Haunted Hill Formation
		UTQD	Upper Tertiary/Quaternary Aquitard	Boisdale Formation (Nuntin Clay)
		UTAF	Upper Tertiary Aquifer	Boisdale Formation (Warruk Sand)
		UTD	Upper Tertiary Aquitard	Hazelwood and Yallourn formations
Middle	Upper Middle	UMTA	Upper Mid Tertiary Aquifer	Balook Formation
		UMTD	Upper Mid Tertiary Aquitard	Lakes Entrance Formation and Gippsland Limestone
	Lower Middle	LMTA	Lower Mid Tertiary Aquifer	Latrobe Valley Group (M2C aquifer)
Lower		LTA	Lower Tertiary Aquifer	Latrobe Group
Basement		BSE	Mesozoic and Palaeozoic basement rocks	Strzelecki Group

Lower Aquifer

The Lower Aquifer comprises aquifers associated with the Latrobe Group, including the sandstone, claystone and coals of the Traralgon Formation. It is the most widespread aquifer system in the Central Gippsland groundwater basin comprised of sand and gravel aquifers, and clay, silt and coal aquitards. The formation occurs at or near the surface around the northern margin of the Central Gippsland groundwater basin but is deeply buried further south where it reaches depths of 1,000 m at the Victorian coast line. The formation extends offshore where it hosts oil and gas deposits.

The Lower Aquifer receives direct rainfall and stream recharge around the basin margins where the units outcrop, as well as vertical seepage from overlying formations. Groundwater within the Lower Aquifer has shown consistent declining groundwater levels in the order of 1 m to 1.5 m per year since the 1960s to 1970s, primarily due to the large scale groundwater extractions associated with coal mining in the Latrobe Valley, and offshore oil and gas extraction (GHD, 2010).

The hydraulic conductivity of the Traralgon Formation has been estimated at 1.1 m/day through basin scale modelling, and storativity 0.0004 and specific yield of 0.02 (GHD, 2010). The Lower Aquifer overlies Palaeozoic basement rock of the Strzelecki Group which represents a hydrogeological base confining layer with hydraulic conductivity values in the order of 0.0001 m/day based on regional modelling (GHD, 2010).

Middle Aquifer

At a regional scale, the Middle Aquifer is further divided into the Upper Middle and Lower Middle aquifers. In the vicinity of the study area the Upper Middle Aquifer is comprised of the Balook Formation which in part overlies a lower confining layer of the Lakes Entrance Formation and Gippsland Limestone. These formations are generally present across the same region as the overlying Boisdale Formation (Upper Aquifer) but extend further north and west towards the basin margins at the foothills of the Great Dividing Range. The onshore Balook Formation grades into the offshore Gippsland Limestone which is predominantly marl and limestone, however does contain lenses of shelly sands. The Lakes Entrance Formation is known to form a regional cap over the gas and oil reservoirs that effectively seal it from overlying surface processes (GHD, 2010). The Balook Formation aquifer represents a high value resource for agribusiness and industry throughout the Latrobe Valley and along the basin margin near Bairnsdale and Yarram.

Hydraulic conductivity values for the Balook Formation are relatively low, estimated as ranging from 2 to 7 m/day (Brumley et al., 1981). The hydraulic properties of the Gippsland Limestone and Lakes Entrance Formation are noted to vary. Where it is comprised of mainly marl or marly limestone it is a poor aquifer in terms of both yield and quality. Yields can increase where the formation grades into more limestone or shelly sands (GSA, 2003). Together the Lakes Entrance Formation and Gippsland Limestone can be between 100 m to 500 m thick onshore, and commonly act as a confining layer between the Balook Formation and the underlying Lower Middle Aquifer (GHD, 2010).

The Lower Middle Aquifer is comprised of the inter-bedded sedimentary sequences of the Latrobe Valley Group. The group consists of unconsolidated sands and gravels which form aquifers, and clays, silts and coal measures which form aquitards. Recharge occurs where the aquifers outcrop or subcrop along the flanks of the Strezelecki Ranges, and by vertical leakage through the overlying aquitard units. The aquifer generally contains low salinity groundwater (less than 900 mg/L total dissolved solids (TDS)) and is capable of yielding up to 150 L/sec (GSA, 2003). More than 27,000 ML of groundwater is extracted annually to dewater the formation at the open cut coal mines at Morwell and Loy Yang which has created a 35 km cone of depression around the area (GSA, 2003).

Yields from the Upper and Lower Middle aquifers are generally highest between Moe and Sale (>50 L/sec) and reduce where the aquifer becomes thin in the central and eastern parts of the basin. Groundwater salinity is low, ranging up to 1,000 mg/L. These formations are often confined by thick clay, coal or limestone aquitards.

Groundwater levels, particularly in the Lower Middle Aquifer, have shown long-term declining trends which have been associated with a long history of use by irrigators, mining activities in the Latrobe Valley, and offshore oil and gas industries. Groundwater is recharged around the basin margins (the foothills of the Great Dividing Range to the north of the project area) where the unit outcrops either by direct infiltration from rainfall or surface water interactions. These aquifers also receive recharge from the overlying formations via vertical seepage. Groundwater in both the Upper and Lower Middle aquifers migrate from the recharge areas at the basin margin towards the lower plains where vertical hydraulic gradients reverse and discharge occurs to the overlying shallower aquifers, streams, and the coastline.

Upper Aquifer

The Upper Aquifer is comprised of the Quaternary Alluvium, concentrated around the present day river valleys, the Haunted Hill Formation which extends across the floodplains, and the Boisdale Formation, which has a defined upper clay unit (Nuntin Clay) that acts as an aquitard and a lower sand unit (Wurruck Sand) that acts as an aquifer. The Hazlewood and Yallourn formations (aquitards) form the base of much of the Upper Aquifer to the south of the project area.

The lateral extent of the Quaternary Alluvium aquifers is generally limited by the less permeable Tertiary clay aquitards that surround them. Groundwater flow within the unconfined alluvial aquifers is typically associated with local groundwater flow systems that follow the structure of each aquifer from high to low elevation (SRW, 2012). Where they are present, these deposits often represent high value aquifers which occur at or near the ground surface and receive recharge directly from rainfall, and surface water during periods of high stream flow or flood. The aquifer properties of the Quaternary deposits in the Gippsland region are noted to be variable, but typically hydraulic conductivities range from 5 to 30 m/day, and specific yields range from 0.1 to 0.2 (GHD, 2010). Bore yields are variable however they are typically less than 5 L/sec (GHD, 2010).

The Pliocene/Pleistocene aged Haunted Hill Formation provides variable thickness of surface cover of between 5 m and 80 m across most of the Central Gippsland groundwater basin. The formation is comprised of well to poorly sorted cemented gravels, sands and clays (Hofmann, 2011). The gravels and sands of the Haunted Hill Formation are reported to have hydraulic conductivity values up to 100 m/day but, whilst sandy in parts, have a significant clay component and in many areas act as a semi-confining layer (Schaeffer, 2008).

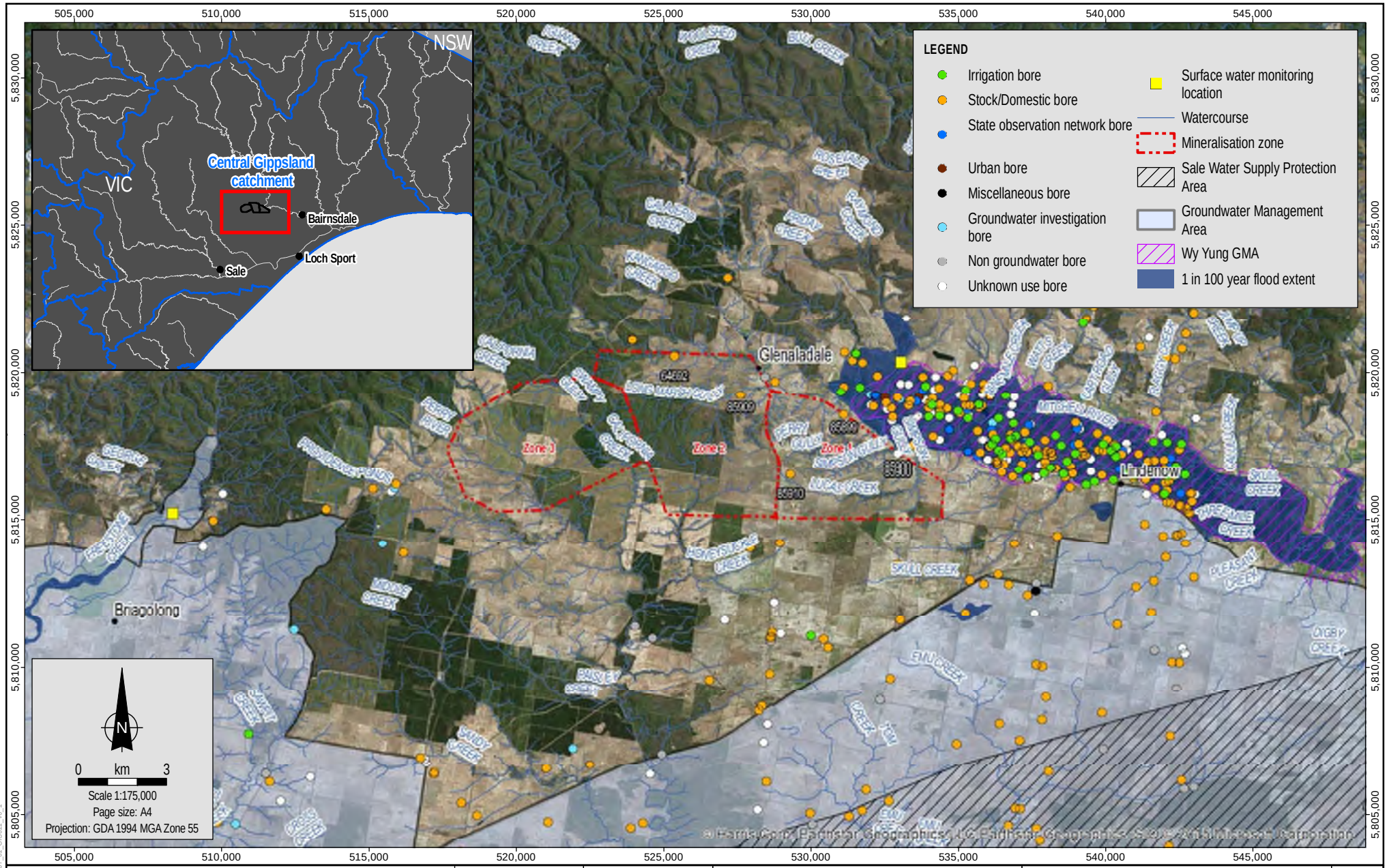
The Boisdale Formation occurs up to 200 m below ground and is generally up to 50 m thick. It is typically described as being comprised of two units; the upper Nuntin Clay, and the lower Wurruk Sand (Holdgate and Gallagher, 2003). This aquifer is limited to the southern, central area around Sale, Stratford and Loch Sport, and generally does not extend north to the foothills of the Great Dividing Range. Where it exists, the Boisdale Formation of the Upper Aquifer is an important supply of high yielding (typically 5 to 20 L/sec, up to 50 L/sec), low salinity (<500 mg/L TDS) groundwater for urban, stock and domestic, and irrigation supply. The Boisdale Formation aquifer is the primary water supply for the town of Sale. Reported hydraulic conductivity typically ranges from 24 to 30 m/day and specific storage of 10^{-4} to 10^{-2} (Schaeffer, 2008., Walker and Mollica, 1990., SKM, 2006).

Groundwater salinity in the Upper Aquifer is generally low (<1,000 mg/L) making these aquifers highly valued and beneficial for stock and domestic use, as well as irrigation.

Regional groundwater monitoring and management

Groundwater monitoring in Victoria is conducted using a network of groundwater observation bores known as the State Observation Bore Network (SOBN). DELWP manages the SOBN which monitors groundwater levels and quality at approximately 2,500 sites across Victoria. In addition to monitoring data gathered via the SOBN, groundwater information is held in relation to approximately 135,000 other boreholes throughout Victoria from a range of sources, including historical exploration activities for mineral and resource development, salinity management programs and general groundwater investigations.

Within the Central Gippsland groundwater basin there are a number of groundwater management units (GMUs) which are comprised of both groundwater management areas (GMAs) and water supply protection areas (WSPAs). These declared areas protect the groundwater resources and ensure that a moderate level of monitoring and management occurs to secure the long-term sustainability of groundwater. There are three GMAs and three WSPAs within the Central Gippsland groundwater basin (Figure 4.1). Their proximity to the project area is discussed further below.



Source:
Bores and surface water monitoring locations from WMIS (DEPI).
WSPA, GWA and 1 in 100 year flood extents from DELWP. Wy Yung GMA digitised by Coffey from Southern Rural Water map (indicative only).
Mineralisation zones from Kalbar.
Watercourses from Vicmap.
Imagery from Bing (capture date unknown).

coffey

Date: 29.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F04.01_GIS

KALBAR RESOURCES LTD

Baseline Technical Report

Central Gippsland groundwater catchment and declared GMA/WSPAs

Figure No: **4.1**

MXD Reference: 11607_01_GIS011_v0_1

Local hydrogeology

Assessment of local hydrogeology focuses primarily on the immediate project area identified by the mineral resource area as shown in Figure 4.1. However, the principles of groundwater flow and systems requires a wider study area to been considered which, in this case, has been nominated as an area 10 km south of the project area (in the direction of groundwater flow), and 5 km east and west (perpendicular to groundwater flow). The project area is located at the northern margin of the Central Gippsland groundwater basin which constrains the study area to the north.

Aquifers and aquitards

The project area is located at the northern margin of the Central Gippsland groundwater basin where basement rock rises to form the Great Dividing Range approximately 5 km to the north. A summary of the hydrogeological units considered likely to be present below the project area are summarised in Table 4.2.

Table 4.2 Local hydrogeological summary (after DEPI, 2015)

Aquifer group	Inferred formation name	Description	Depth
Upper aquifer	Quaternary alluvium	Sands, gravels, clays and silts	0 – 8 m
Upper aquifer	Haunted Hill Formation	Sands, gravels, clays and silts	0 to 50 m
Middle aquifer	Balook Formation	Limestone (fractured rock), sand, gravel, clay, minor coal	70 – 140 m
Lower aquifer	Latrobe Group	Sand, gravel, clay, silt and coal.	220 – 225 m
Basement	Mesozoic and Palaeozoic bedrock	Fractured bedrock	140 – 340 m

Source: Department of Environment and Primary Industries, Groundwater Resource Reports. (DEPI, 2015e)

Some geological units are absent along the northern margin of the Central Gippsland groundwater basin due to the effects of tectonic uplift and subsequent erosion of the deposited material. Within the project area the Lower Middle Aquifer (Latrobe Valley Group) is absent, and the Lower Aquifer (Latrobe Group) is present only at the southern project boundary, where it thins at its margin. These regionally significant aquifers are present further south of the project area.

The Balook Formation (Upper Middle Aquifer) is inferred as the deepest sedimentary unit directly overlying the fractured bedrock and is estimated to be present at a depth of approximately 70 m below ground surface (bGS). The aquifer is expected to extend to a depth of approximately 140 m bGS and represents a productive groundwater resource. While only limited information is available on local groundwater levels within the Balook Formation, groundwater flow is anticipated to be south to south-easterly away from the recharge zones along the northern basin margins towards the Gippsland Lakes and the Victorian coast where groundwater discharges (SRW, 2012). Groundwater levels within the Balook Formation beneath the project area are likely to display a long-term declining trend associated with groundwater abstraction for irrigation, offshore oil and gas extraction, and coal mining in the Latrobe Valley. Aquifer hydraulic properties and groundwater quality is expected to be in line with the regional discussion presented above. The mapped resource potential of the Upper Middle Aquifer within the project area was noted to be ‘medium’ given the position close to the basin margins where the aquifer thins and bore yields can decrease (SRW, 2012).

The Haunted Hill Formation is mapped to outcrop in some parts of the project area and was observed during Coffey's site visit in June 2015. The Haunted Hills Formation comprises sand, clay and gravel and extends up to 80 m below ground surface. It directly overlies basement rock in the northern project area, and to the south overlies the Balook Formation, where the clay content of the Haunted Hill Formation can act to confine the underlying aquifer.

Shallow groundwater is inferred to be generally limited to the alluvial aquifers which exist along most of the major surface water features. While these aquifers are not regionally extensive, they represent high value resources for many irrigators. Aquifers associated with the Wy Yung WSPA to the north east of the project area are an example of high value shallow groundwater resources in close proximity to the project area. Groundwater is present in shallow alluvial deposits associated with the Mitchell River valley and has provided relatively stable groundwater levels since records began in 1969.

Shallow groundwater bores in the area have historically displayed significant seasonal fluctuations in groundwater levels (from 2 to 4 m), with deeper bores being showing a more subdued response. The aquifer hydraulic properties and groundwater quality range for shallow alluvial deposits are expected to be consistent with the ranges presented in the regional hydrogeological discussion. Other, smaller alluvial aquifers are likely to exist around streams particularly to the north (in the vicinity of Moilun and Iguana creeks), and the west (in the vicinity of Freestone and Sawpit creeks) of the project area.

Groundwater beneficial uses

The quality of groundwater in Victoria is protected under the State Environment Protection Policy (Groundwaters of Victoria) (1997) (Groundwater SEPP), issued under the *Environment Protection Act 1970*. The Groundwater SEPP defines a range of protected beneficial uses for specific segments of the groundwater environment, which are based on groundwater salinity. EPA Victoria considers that groundwater is polluted where current and/or future protected beneficial uses for the relevant segment are precluded.

The beneficial uses of aquifers in the Gippsland region have been mapped according to the Groundwater Segment that may apply at a regional scale (SKM, 1994). Based on this regional mapping, groundwater in both the Upper (Quaternary alluvium and Haunted Hills Formation) and Middle (Balook Formation) aquifers were noted to generally fall within Segments A1 and A2 as classified by the Groundwater SEPP, requiring the highest level of protection. These segments have the following protected beneficial uses:

- Maintenance of ecosystems.
- Potable water supply.
- Potable mineral water supply.
- Agriculture, parks and gardens.
- Stock watering.
- Industrial water use.
- Primary contact recreation (e.g., bathing, swimming).
- Buildings and structures.

Beneficial uses of groundwater are considered to be precluded when relevant groundwater quality objectives for those beneficial uses have been exceeded. Further consideration of these beneficial uses, their likelihood of being realised and the applicable groundwater monitoring criteria would be given as a part of the approvals process for the project.

Local groundwater monitoring and management

The project area lies within the Central Gippsland groundwater basin and straddles the boundary between the East Gippsland Catchment Management Authority and West Gippsland Catchment Management Authority (CMA).

The project area is within close proximity to two GMU's; the Wy Yung WSPA and the Stratford GMA. The north eastern boundary of the project area borders (and potentially includes) Zones 1 and 2 of the Wy Yung WSPA (Figure 4.1). A permissible consumptive volume currently applies to the Wy Yung WSPA, capping the amount of groundwater allocated in this management unit for all aquifers from the ground surface to 25 m below surface. Zones 1 and 2 have permissible consumptive volumes of 691 ML/yr, and 5,342 ML/year, respectively. There are 60 groundwater licences in the WY Yung WSPA that authorise a total of 7,463 ML/year, for irrigation purposes. It is understood that the majority of these allocations are not realised each year. Licence transfers are permitted within zones, and between zones within the permissible consumptive volumes.

The Stratford GMA is located outside of the project area and extends from Stockdale south of the project area (see Figure 4.1). The total permissible consumptive volume of 27,645 ML/year is allocated across seven groundwater licences, for aquifers below 350 m (in Zone 2). Groundwater from the Stratford GMA is also used by power generators in the Latrobe Valley. A separate permissible consumptive volume of 21,238 ML/year across 109 groundwater licences has been applied to Sale WSPA which forms part of the wider Stratford GMA. This cap applies to the aquifers between depths of 100 to 200 m below surface. Approximately 82% of licensed groundwater use from the Sale WSPA is for irrigation purposes.

Groundwater receptors

The Groundwater SEPP outlines the beneficial uses of groundwater that must be considered when assessing the value of, and potential impacts that may occur to groundwater resources. This section provides a summary of the likely users (or receptors) of groundwater in the study area based on a desktop assessment and site walkover.

It is noted that a thorough assessment would be undertaken during the environmental approvals process to formally define which beneficial uses require protection, and which groundwater values may be at risk from project development.

Potential groundwater receptors that may reasonably exist within the study area include:

- Existing groundwater users.
- Groundwater dependent ecosystems.
- Cultural / spiritual sites potentially dependent on groundwater (i.e. springs or wells).

Existing groundwater users

A search of registered groundwater bores was conducted for the project area and the wider study area. Six groundwater bores were identified within the boundary of the project area (Figure 4.1). Five of the bores are registered for stock and domestic use and one is listed without a specified use (Table 4.3). Bores in close proximity to streams and rivers along the northern and eastern project boundary were generally shallow (10 to 15 m below ground) and are likely to source groundwater from shallow alluvial aquifers. Towards the centre of the project area existing groundwater bores are deeper, sourcing groundwater from depths of between 50 and 100 m, likely to screen the Balook Formation.

Table 4.3 Registered groundwater bores within the project footprint.

Bore ID	Registered use	Total depth (m below ground)
85900	Unknown	10.66
85895	Stock and domestic	Unknown
85910	Stock and domestic	107
85906	Stock and domestic	74.37
85909	Stock and domestic	54.8
64692	Stock and domestic	16.8

A total of 434 registered bores were found to be present within the wider study area as defined by Figure 4.1. A breakdown of the registered groundwater bore users within the search area is provided in Table 4.4.

The majority of bores (220) were registered for stock and domestic use and were distributed across the search area. A large number of stock and domestic bores, and the majority of registered irrigation bores were concentrated around Briagolong (10 km west of the project area), and within the Wy Yung WSPA (<500 m east of the project area). In these areas bores were generally shallow, accessing groundwater from the Haunted Hills Formation and recent Quaternary Alluvium associated with nearby surface water features. While the project area does not directly overlie the Wy Yung WSPA, the eastern extent of the project area passes within less than 1 km of the Mitchell River and the Wy Yung WSPA. The high-value aquifer protected under this WSPA has 60 licensed groundwater abstraction bores with a combined total licensed annual extraction volume of 7,462 ML, of which between 300 and 1000 ML is estimated to be consumed annually (SRW, 2013).

Elsewhere, registered bores to the south of the project area were deeper accessing groundwater from the Lower Middle Aquifer at depths in excess of 50 to 70 m below ground level.

Table 4.4 Summary of registered groundwater bores within the wider study area

Registered use	Total bores	Construction dates	Bore depths (m below ground)
Stock & domestic	220	1922-2010	3 to 164
Urban	5	2007	60.5 to 96
Irrigation	77	1958 to 2008	3.7 to 138
Investigation, miscellaneous and non-groundwater	31	1930 to 2008	7 to 1,197
State observation	30	1966 to 1992	5 to 116
Unknown	71	1958 to 1988	3 to 427
Total			434

Groundwater dependent ecosystems

Groundwater dependant ecosystems (GDEs) are defined as natural ecosystems that require access to groundwater to meet all or some of their water requirements to maintain their ecological processes. GDEs can be both terrestrial and water-based ecosystems (both saline and fresh). There are typically five categories of GDEs:

- Wetland GDEs (i.e. groundwater discharge to wetland environments).
- River baseflow GDEs (i.e. groundwater discharge to rivers and streams).
- Terrestrial vegetation GDEs (i.e. vegetation accessing shallow groundwater).
- Estuarine/marine GDEs (i.e. groundwater discharge to estuarine/marine environments).
- Stygofauna (i.e. biota living within aquifer systems).

The National Atlas of Groundwater Dependant Ecosystems (BOM, 2015) maps known and potential wetland, river baseflow and terrestrial GDEs, as well as areas potentially hosting stygofauna. It incorporates multiple lines of scientific evidence to support an assessment of an ecosystems potential to be reliant on groundwater, including previous fieldwork, literature and mapping, and combines nation-wide layers of satellite remote sensing data. The atlas maps previous studies according to the following classification:

- Identified in previous study (fieldwork).
- Identified in previous study (desktop).

GDEs derived by remote sensing analysis are mapped according to the following classifications:

- High potential for groundwater interaction.
- Moderate potential for groundwater interaction.
- Low potential for groundwater interaction.

Whilst the atlas maps the potential for a feature to interact with groundwater, it does not assess the level of potential dependency on groundwater.

Most streams and rivers within and immediately surrounding the project area were '*identified in previous studies*' as dependent on groundwater. This includes the Mitchell River and a number of tributary streams which extend west across the project area. The upper reaches of several tributary streams were designated as having a '*moderate potential for groundwater interaction'*, which is interpreted to represent some real potential for groundwater dependence.

Some areas of vegetation within the project area were identified as having '*moderate potential*' for being reliant on groundwater. Vegetation in riparian zones had a higher confidence of being likely to be reliant on groundwater (BOM, 2015), which in part is interpreted to be a function of stream leakage supporting riparian vegetation, rather than true groundwater support. However it is typical for depth to groundwater to be shallower in riparian environments and this may represent shallow groundwater support of deep rooted vegetation. The atlas does not map the potential for stygofauna to be present in the study area.

The Gippsland Lakes, located 25 km south of the project area, represent a regional groundwater discharge zone for the Upper and Lower Middle aquifers. They are known to support a number of internationally significant wetlands and estuaries.

Groundwater in the Middle aquifers beneath the project area flow towards the Gippsland Lakes and the coastal zone where some discharge to the lakes occurs (SRW, 2012). The role that groundwater from the Middle Aquifer plays in supporting the Gippsland Lakes is difficult to assess given the complex and variable vertical hydraulic gradients that exist. Over-abstraction of groundwater from the

Upper and Lower Middle aquifers increases the risk of inducing the flow of saline water from the Gippsland Lakes into the aquifers.

Spiritual and cultural sites of significance

Groundwater can have spiritual and cultural importance to local communities often where groundwater feeds surface water features such as water holes, springs or wetlands. A discussion on the spiritual and cultural importance of water features, which may be dependent on groundwater discharge, is provided in Section 4.5: Cultural Heritage.

4.2.2 Surface water

This section provides an overview of the hydrological setting of the project area as well as the wider study area in the Gippsland region based on a desktop study and site inspection. The following summary aims to present a baseline understanding of surface water resources that are present, the potential interactions that may occur with the proposed project, and further considerations that may be required in later stages of environmental assessment.

Regional surface water

The surface water catchments in the Gippsland region drain the southern slopes of the Great Dividing Range and flow south towards the Gippsland Lakes or the Victorian coast. Average annual rainfall varies across the Gippsland catchments but is relatively high compared with the rest of the Victoria (DSE, 2011). The average annual rainfall in some areas is less than 600 mm, while in other areas it is more than 1,100 mm per year (DSE, 2011).

The project area spans the lower floodplains of two surface water drainage basins; the Mitchell River Basin to the east, and the Avon River Basin to the west. This discussion summarises the surface water environment at the regional scale which is defined by these two river basins.

Regulatory setting

Surface water resources are managed and regulated by a number of different groups including State Government, rural water supply authorities, CMAs, and Local Government. The *Water Act 1989* is the legislation that governs the way water entitlements are issued and allocated in Victoria. It defines water entitlements and establishes the mechanisms for managing Victoria's water resources.

The controlling authority is the DELWP who delegate local responsibility to the relevant Water Corporations. Licensing of the take and use of water anywhere in a catchment has been delegated to the relevant Water Corporations, and CMAs are responsible for managing other proposed works on waterways.

The Environment Protection Authority (EPA) administers the *Environment Protection Act 1970*. This Act puts in place a wide range of environmental safeguards relevant to water management and the regulation of discharges into waters.

Mitchell and Avon rivers

The Mitchell River drains a catchment of 664 km^2 and has an estimated average annual stream flow of 884,500 ML/year (DSE, 2011). The upper catchment is predominantly undisturbed, forested, public land including sections of the Alpine National Park and Mitchell River National Park. In the lower reaches of the catchment, the river enters the floodplains where deposited sediments have created

fertile agricultural land. The floodplains have been extensively cleared for agriculture and are highly modified from their natural state.

The Mitchell River system is the largest remaining river system in Victoria that does not have a large on-stream dam, which has assisted to maintain the high environmental values that still exist in this river system. Flooding occurs across the low-lying plains with approximately 60 km^2 of land prone to flooding, with major floods persisting between 3 and 40 days (DEDJTR, 2015). The Mitchell River discharges into Jones Bay and Lake King which form part of the Gippsland Lakes.

The Mitchell River Basin falls under the management of the East Gippsland CMA and is listed as a Heritage River under the *Heritage Rivers Act 1992*. The Heritage Rivers Act protects public lands in specific parts of heritage river catchments and prohibits some activities, including constructing artificial barriers and structures which may impact on the passage of water fauna or significantly impair the area's recreation, nature conservation, scenic or cultural heritage attributes.

The Avon River catchment drains an area of approximately 2,000 km^2 and extends from the foothills of the Great Dividing Range to Lake Wellington, part of the wider Gippsland Lakes and discharges to Lake Wellington, part of the Gippsland Lakes. The Avon River catchment supports a wide range of agricultural and irrigation industries on the lower floodplains. Across the wider Thomson River Basin (of which the Avon is a sub-catchment), 282 irrigation licences are in place for a combined total surface water abstraction of 16,000 ML/annum.

The Avon River is estimated to have an average annual stream flow of 239,600 ML/year (DSE, 2011). There are no large on-stream storages in the major waterways of the Avon catchment, but water is diverted for irrigation from waterways and from the shallow groundwater aquifer, with which there is significant interaction with surface water (DSE, 2011). Flooding is a common occurrence in the Avon River catchment with major flood events occurring in 2007, 2011 and 2012. The Avon River is managed by the West Gippsland CMA who are currently conducting detailed flood mapping for the catchment, due for release in 2016.

Many consumptive users and environmental values across the Avon and Mitchell river catchments rely on surface water flows. Water is diverted from the Mitchell River to meet most of the urban and industrial water demands in the area and high value irrigated vegetable production along the lower section of the river near Lindenow. However the Avon and Mitchell river catchments have lower consumptive water use than other catchments further to the west where surface water is used extensively in urban areas, industry and agriculture, and to generate electricity in the Latrobe Valley (DSE, 2011). While these western catchments are considered to be fully allocated, the eastern catchments, particularly the Mitchell catchment, still have some water available for new water users under a range of licence conditions (DSE, 2011).

Gippsland Lakes

The Gippsland Lakes (the lakes) consists of a group of coastal lagoons along the Gippsland coast line, separated from the sea by a barrier system of sand dunes and fringed on the seaward side by the Ninety-Mile Beach. The lakes consist of a system of 13 lakes and wetlands including; Sale Common, Lake Reeve, Lake Wellington, Lake Victoria, Lake King, Lake Bunga, Lake Tyers and Macleod Morass. While positioned outside of the project area and the wider study area, the Gippsland Lakes depend on both the rivers and aquifers which flow through the study area and provide significant social and economic benefits to the region through tourism and recreation.

The lakes are predominately an estuarine environment, whereby the ecological functions are controlled by the mixing of seawater and freshwater which discharges from surface water and groundwater. The complexity of freshwater flows and salinity vary over time and across different parts of the lakes system which supports the diversity of habitats and ecological values (DSE, 2011). The

Gippsland Lakes are Ramsar listed wetlands and are important for waterbirds, including migratory shorebirds, fish such as black bream (*Acanthapagrus butchem)* and threatened species such as the nationally vulnerable growling grass frog (*Litoria raniformis*) (DEPI, 2015c).

Both the East Gippsland CMA and West Gippsland CMA are responsible for actively managing the freshwater needs of the high value fringing wetlands and river estuaries by limiting consumptive extractions from upstream catchments, and providing additional environmental flows in the Thomson, Macalister and Latrobe rivers to improve the condition of the river estuaries and fringing wetlands.

Local surface water

This section provides further detailed information on surface water features that exists within, or in proximity to the project area.

The Mitchell River passes to the north-east of the project area. A number of small, ephemeral tributary streams drain the eastern half of the project area. Stream discharge rates have been monitored on the Mitchell River at Glenaladale since 1937. Daily stream discharge rates were obtained for the past 10 years for the Glenaladale monitoring location (see Figure 4.1). Flow rates ranged from 20 ML/day during December 2006 to over 12,000 ML/day in June 2007 (DEPI, 2015g). During periods when the Mitchell River experiences lower flow, the East Gippsland CMA imposes restrictions on surface water abstraction for irrigation (SRW, 2013).

Flooding is a natural function of the river system and these over-bank flows are important processes which provide recharge to the shallow alluvial aquifers and sustain river flows during the dryer summer months. Flood inundation zones for a 1 in 100 year flood event are shown in Figure 4.1.

The western half of the project area lies within the Avon River catchment which forms the eastern arm of the larger Thomson River Basin. A number of small ephemeral tributaries to the Avon River flow from the western half of the project area. Freestone Creek is one of main tributaries in the study area where daily stream discharge rates have been monitored at Briagalong since 1967 (see Figure 4.1) (DEPI, 2015g). Over the past decade the monthly averaged, daily stream discharge rates for Freestone Creek (monitored at Briagalong) have fluctuated from periods of no recorded flow (primarily during summer months in 2006 and 2007) to peak monthly average flow rates in the order of 2,000 to 3,000 ML/day recorded in 2007 and 2012 (DEPI, 2015g).

There a number of minor dams across the project area that may have some ecological value. However for the purpose of this assessment they are unlikely to represent critical components of the hydrological cycle of the study area.

Peatlands and alpine bogs are important ecological communities predominantly found in small pockets of the high country in Tasmania, New South Wales, Victoria and the Australian Capital Territory. As well as being important because of their unique biodiversity and place within the Australian landscape, ecological communities provide a range of ecosystem services, including the natural management of water, the reduction or control of erosion and salinity, and carbon storage (DoEWHA, 2009). These communities are listed as endangered and are protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, and exist primarily in alpine regions above 1,200 m above sea level in Victoria (DoEWHA, 2009), and are not inferred to exist within the study area.

4.2.3 Key aspects and issues

This section outlines groundwater and surface water aspects and issues that may be associated with the project. For the purpose of this assessment an aspect is defined as an activity or component of

the proposed project, and an issue is defined as a potentially detrimental change to the natural surface water or groundwater system, or impact to existing users of these resources.

Project aspects that may result in potential groundwater or surface water issues include:

- *Water supply - groundwater.* An estimated 3 to 4 GL/year of make-up water may be required for ore processing. This water may be sought from the Middle aquifer (Balook Formation). This aspect has the following issues:
  - *Competing groundwater users*. Existing licensed groundwater users including irrigators, stock farmers, domestic households and town water supplies already use this water resource, which is finite.
  - *Groundwater dependant ecosystems*. The Middle aquifer is already under stress and has displayed long-term declining groundwater level trends. Additional groundwater abstraction may further impact groundwater levels and therefore GDEs, including the Gippsland Lakes and Ramsar listed wetlands.
  - *Altered groundwater quality.* Abstraction of large volumes of groundwater may alter groundwater quality due to altered groundwater flow direction (i.e. induced flow from saline Gippsland Lakes).

These issues will require further investigation as part of a hydrogeological assessment.

- *Water supply – surface water.* An estimated 3 to 4 GL/year of make-up water may be required for ore processing. This water may be sought from a number of surface water resources in the study area. This aspect has the following issues:
  - *Competing surface water users*. Granting of a license to abstract surface water may be limited by other existing licenced users, primarily irrigators who rely on this resource. The dryer summer months see limited flows in most rivers and streams and CMAs have imposed restrictions on existing licence holders during periods of drought.
  - *Regulatory approval*. CMAs have indicated that additional new allocations may be available in both the Avon and Mitchell river catchments since the end of drought conditions. Further discussions with the relevant CMA should be held in order to confirm the potential for new surface water allocations, opportunities to trade existing licenced allocations, and confirm volumes and timing of winter-fill allocations that may be available.
- *Water storage – valley fill*. Storage of process water and other water of varying quality in new dams off-river. This aspect has the following issues:
  - *Diversion of flow from catchments*. Construction of valley-fill dams may alter the water balance within catchments, ultimately leading to decreased flow to Avon or Mitchell rivers. In addition to planning approval, approval from the relevant CMA would be required.
  - *Infiltration.* Coffey's site inspection identified predominantly sand and gravels of the Haunted Hills Formation occurring at surface. The hydraulic conductivity of this material is expected to be highly conductive and may not be suitable to retain water. Construction of a water storage facility would require further engineering design.
- *Water storage – river dam*. Damming of Stony Creek or other waterways to provide a mine water supply. This aspect has the following issues:
  - *Community*. There is likely to be strong community resistance to plans to dam waterways in the study area.
  - *Regulatory restrictions*. A number of regulatory restrictions apply to works associated with or near waterways.
- *Earthworks and mining*. Removal of overburden and mining of the mineral resource. This aspect has the following issues:

  - *Sediment transport to rivers*. Rainfall runoff within the project area could mobilise silt and sediment towards waterways.
  - *Intersection of shallow alluvial aquifers*. Excavation activities have the potential to intersect the watertable, particularly in the north and east of the project area where groundwater may be shallow in proximity to surface water features. Should dewatering be required to allow mining to proceed in these areas, the likelihood for hydraulic connection between these systems and the shallow aquifers associated with the Wy Yung WSPA located immediately northwest of the project area should be determined to understand the potential to impact existing groundwater users.
  - *Altered groundwater regime.* Excavation and mining activities have the potential to alter rainfall recharge rates across the project area altering local groundwater flow direction and groundwater quality in shallow aquifers.

- *Mining Operations*. Storage, maintenance, fuel supply, cleaning and operation of a range of major plant, equipment and processing facilities will be located within the project area. This aspect has the following issues:
  - *Groundwater contamination*. Spills or leaks of chemicals may infiltrate into shallow aquifers (along the eastern project boundary) could occur. Deep aquifers beneath the site are less at risk to contamination from surface activities due to isolation from these processes.
  - *Surface water contamination*. Spills or leaks of chemicals may be transported into catchments impacting on aquatic ecosystems and surface water users.
- *Tailing disposal.* Tailings produced during the ore benefaction process will be disposed within the project area. The storage method is yet to be confirmed but may include a purpose built tailings storage facility and in-pit disposal. Tailings material will likely be disposed as a slurry with a high water content. This aspect has the following issues:
  - *Surface water and groundwater contamination*. Water will be released as the tailings settles. This water may have chemistry different from that of surface water and groundwater and has the potential to cause contamination to both resources if not adequately managed.
  - *Saturation of shallow soils.* Deposition of saturated tailings may cause local water-logging of land and development of shallow, perched groundwater systems that could migrate towards rivers and streams. Adequate monitoring and assessment would be required to prevent these impacts.
  - *Rehabilitation*. Deposited tailings will likely be a saturated, fine grained material that will require time to dry and settle before land rehabilitation can occur. This process, and the need to stockpile topsoil prior to mining, should be addressed by the mine closure management plan.

4.2.4 Conclusions

Groundwater and surface water in the Gippsland region are recognised by the community as high-value resources. A large number of landholders within close proximity to the project area use both surface water and groundwater for irrigated agriculture, industrial and stock and domestic uses.

Productive groundwater in the project area primarily occurs in the Balook Formation aquifer which is estimated to be present at depths of between 50 and 150 m bGS. Long term declining groundwater levels have been noted for this and other deep aquifers in Gippsland. The available baseline data for the Balook Formation aquifer within the project area is limited with no regular level or quality monitoring currently undertaken. Early baseline monitoring of groundwater level and quality should be considered in order to adequately establish baseline trends and separate potential project impacts from pre-existing, regional stresses on relevant aquifers.

Surface water resources are utilised across the study area for consumptive and environmental purposes and the Mitchell River represents the largest remaining un-regulated flow system in Victoria.

This has resulted in significant environmental value being placed on these water resources. There remains some potential for the development of surface water resources.

The potential for mining activities along the eastern project boundary to intersect the shallow alluvial aquifer of the Wy Yung WSPA should be further assessed so that the potential issues and impacts can be fully understood. In the case where the mineral resource is hydraulically connected to shallow aquifers a range of regulatory restrictions may apply to planned extraction activities.

4.3 Biodiversity

This section provides an overview of the existing biological environment within the study area. The study area for the biodiversity review comprises the main areas of mineralisation (i.e., the project area) with an additional 5 km buffer.

Since there has yet to be a detailed assessment of the vegetation communities, and the flora and fauna present in the study area, the presence and extent of these communities cannot be conclusively confirmed. The majority of data in this review has been sourced from publicly available information such as Victorian and Australian databases and search tools. In addition, a site visit was completed on 4 June 2015 by Coffey (including a qualified ecologist) to assess the ecological values of the region.

A comprehensive list of potential flora and fauna species that could occur in the study area has not been compiled for this scoping report. Rather, this desktop review focuses on the likely issues for any project such as rare or threatened communities or species that may occur in the study area.

4.3.1 Regional context

The region is important biogeographically (i.e., at the continental scale) as it overlaps between southern cool temperate and eastern warm temperate zones. As a result, it contains diverse flora and fauna communities, many of which are absent from, or rare in, the rest of Victoria.

The national bioregion classification system categorises regions that are geographically distinct based on characteristics such as geology, landform patterns, climate and ecological features. The project is located within a transitional zone between the East Gippsland Lowlands and Gippsland Plain bioregions, and a short distance from the Highlands Southern Fall and East Gippsland Uplands bioregions (DEPI, 2015b).

The second important feature of the regional landscape is the continuity of native vegetation over an extensive area covering subalpine environments to coastal environments making it a reservoir of biodiversity. The bioregions contain significant natural assets including declared ‘heritage rivers’, Ramsar listed wetlands, national parks and reserves.

The East Gippsland Lowlands bioregion is located south of the Highlands Southern Fall bioregion and stretches along the East Gippsland coast. This bioregion has gently undulating terraces flanked by coastal plains, dunefields and inlets. The vegetation is dominated by Lowland Forest with Damp Forest and Shrubby Dry Forest ecosystems interspersed throughout the foothills. This bioregion is moderately cleared with more than half of the native vegetation remaining in a fragmented landscape (Plate 4.4). Over half of this remnant vegetation is on public land, and only a small proportion (3.9%) is within conservation reserves (VEAC, 2011).

On the western side of the study area, the East Gippsland Lowlands bioregion transitions to the Gippsland Plain bioregion. This bioregion consists of flat low lying coastal and alluvial plains with a gently undulating terrain dominated by barrier dunes and floodplains and swampy flats generally below 200 m above sea level. This bioregion retains native vegetation in a highly fragmented pattern,

Photo credit: Coffey

Plate 4.4
Typical grazing land with scattered trees within the study area

Photo credit: Coffey

Plate 4.5
Providence Ponds Flora and Fauna Reserve

Photo credit: Coffey

Plate 4.6
Typical grazing land in the northwest of the study area

reflecting a variety of land-use histories in the region. Much of the bioregion has been heavily modified with a quarter of the original extent of native vegetation remaining. Of this remaining native vegetation about half is on public land and a substantial proportion within conservation reserves (VEAC, 2011).

A range of landscape features that contribute positively to the biodiversity values of the region are located within the study area. These include:

- Mitchell River National Park – located approximately 4 km northeast of the project area and covers a variety of habitats from open forests to river gorges (over 14,250 ha). The Mitchell River divides the park into two sections, east and west. The park has conservation values with a number of rare and threatened communities and flora and fauna species of state and national significance known to occur in the park. The southernmost occurrence of warm-temperate rainforest also occur in some of the gorges. The Mitchell River National Park is assigned the International Union for Conservation of Nature (IUCN) Category II (National Parks) of the United Nations' List of National Parks and Protected Areas. Category II areas are managed primarily for ecosystem conservation and appropriate recreation.
- Gippsland Lakes Ramsar wetland – located 25 km south of the project area, the Gippsland Lakes support a number of internationally significant wetlands and estuaries. The lakes consist of a system of thirteen lakes and swamplands including; Sale Common, Lake Reeve Lake Wellington, Lake Victoria, Lake King, Lake Bunga, Lake Tyers and Macleod Morass. The Gippsland Lakes were listed as a Ramsar site in 1982 and it is the largest estuarine lagoon system in Australia.
- Nationally important Deep Water Morass (also known as Saplings Morass Flora and Fauna Reserve) – this contains a deep freshwater marsh located more than 3 km southeast of the project area this wetland is highly valued for its flora and. Deep Water Morass supports large numbers of southern pygmy perch (*Nannoperca australis*) and freshwater yabby (*Cherax destructor*). The threatened dwarf kerrawang (*Rulingia prostrate*) grows on embankments fringing Deep Water Morass.
- Providence Ponds Flora and Fauna Reserve (Plate 4.5) – located at Fernbank approximately 5 km south of the project area. This reserve contains a concentration of populations of the dwarf kerrawang (*Commersonia prostrate*) listed as Endangered nationally.
- State forests. One patch of approximately 250 ha of forest is located in the centre of the study area and dissected by Limpyers Road primarily to the south of Long Marsh Gully and bounded by Boundary No. 34 Track. Two smaller patches of state forests (approximately 30 ha each) are located adjacent to Beverleys Road in the northwest of the study area. A large state forest is located to the north of the study area. This park forms a large, continuous area of native vegetation of the Great Dividing Range including various national parks.
- Forestry plantations for softwood (both blue gum and pine) are located to the south of Long Marsh Gully and to the east of California Creek.
- Riparian vegetation along streams and creeks including Long Marsh Gully, Perry Gully located in the centre and eastern portions of the project area and California Creek and Perry River to the west and south (Plate 4.6).

4.3.2 Vegetation communities

The study area comprises forestry plantations and agricultural land (including grazing, irrigation and dairy) with remnant native vegetation largely restricted to state forest, riparian vegetation along gullies, creeks and roadside reserves.

Due to the absence of specific vegetation surveys in the study area, the desktop review of vegetation communities that are likely to be present in the study area has relied on publicly available mapping and databases (e.g., DEPI, 2015b). More specifically this included:

- Victorian Bioregions - Mapped at 1:100,000.
- Modelled 2005 Ecological Vegetation Classes.
- Ecological Vegetation Classes.

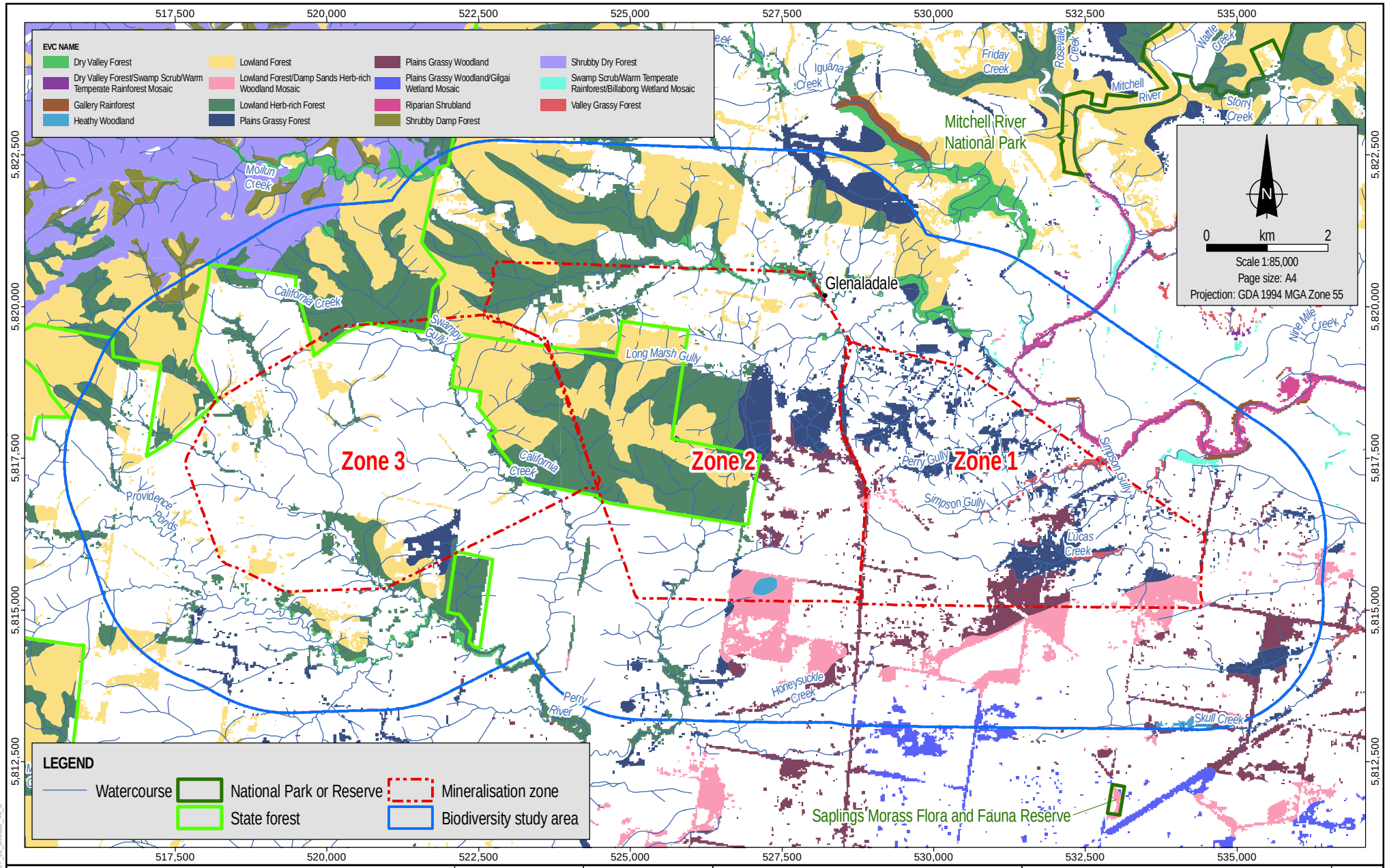
Ecological vegetation classes

Within each Victorian bioregion, the ecological vegetation class (EVC) is the basic mapping unit for ecosystem assessment, biodiversity planning and conservation management at regional scales. An EVC is described through a combination of its floristic, life form and ecological characteristics, and through an inferred fidelity to particular environmental attributes.

Assessment of the Bioregion EVC units was undertaken using the 'Modelled 2005 Ecological Vegetation Classes' data layer. This is a landscape scale dataset and site verification is required for detailed assessment, but does give a coarse indication of the likely EVCs present in the study area. Eight EVCs are likely to occur within the study area in the state forest, habitat fragments, along roadsides and in riparian areas. These EVCs are mapped on Figure 4.2 and described in Table 4.5.

Table 4.5 Ecological vegetation classes in the study area

Name	Description	Bioregional Conservation Status	Occurrence
Lowland Herb-rich Forest	Consists of open eucalypt forest to 20 m tall with a range of medium shrubs conspicuous in the mid-stratum. The ground layer is dominated by a dense cover of grasses and a high diversity of tussock-forming graminoids and herbs. Occurs primarily in gullies and along lower slopes close to minor drainage lines. Soils are reasonably fertile colluvial loams.	Depleted	Most widely occurring EVC in the study area occurring in the state forest dissected by Limpyers Rd.
Lowland Forest	A widespread dry forest type with an understorey that varies from shrubby to heathy to sedgy and may even be grassy. Occurs on soils of moderate fertility on the foothills of the Great Dividing Range through to the foothills of the Strzelecki ranges and Wilsons Promontory National Park to far East Gippsland.	Least Concern	Occurs in similar locations to the Lowland Herb-rich Forest particularly the state forest dissected by Limpyers Rd.
Plains Grassy Forest	Consists of a tall eucalypt forest with a shrub understorey over a rich grassy and herbaceous ground layer. Occurs on lowland plains and old river terraces in Gippsland where it grows on gravelly sandy clay loam.	Vulnerable	Occurs in smaller patches on the eastern side of the state forest dissected by Limpyers Rd.
Plains Grassy Woodland	Consists of an open, grassy eucalypt woodland with a sparse understorey consisting of a species-rich grassy and herbaceous ground layer. Occurs on fertile soils on flats and gently undulating plains at low elevations with low rainfall.	Endangered	Occurs in fragmented locations to the south of Glenaladale in areas adjacent to Bairnsdale – Dargo Rd in the east of the study area.



Source:
Biodiversity study area from Coffey.
EVCs from DELWP.
Mineralisation zones from Kalbar.
Watercourses, national parks and reserves from Vicmap.
State forests from GEODATA250K (optimum scale 1:250,000).

coffey

Date: 22.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F04.02_GIS

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Ecological Vegetation Classes in the study area

Figure No: 4.2

MXD Reference: 11607_01_GIS002_v0_3

Table 4.5 Ecological vegetation classes in the study area (cont'd)

Name	Description	Bioregional Conservation Status	Occurrence
Valley Grassy Forest	**Consists of a tall, open overstorey containing a variety of eucalypts with a sparse shrub cover and a rich ground laying dominated by herbs, lilies, grasses and sedges. Occurs on gently undulating lower slopes and valley floors with fertile, well-drained, colluvial or alluvial soils.**	**Depleted**	**Very small patch (3.4 ha) in the northwest of the study area.**
Dry Valley Forest	**Consists of eucalypt forest. The overstorey may contain a range of eucalypts typical of drier environments over an understorey of scattered shrubs and a notably mossy herb-rich groundcover. Occurs along minor gullies, ephemeral streams and river flats**	**Vulnerable**	**Occurs in very small areas to the south of the project area along Perry River and Providence Ponds.**
Damp Sands herb-Rich Woodland	Consists of woodland with a grassy, heathy or bracken-dominated understorey and a ground layer rich in herbs, grasses, and orchids. Occurs mainly on flat or undulating areas on moderately fertile, relatively well drained, deep sand or sandy loam.	Vulnerable	Occurs to the south of Limpyers Rd and west of Fernbank – Glenaladale Rd in the centre of the study area.
Riparian Shrubland	Consists of a range of vegetation types from closed heath to open shrubland and even grassland. Occurs in narrow strips along deep sub-alpine creeks in treeless areas that are prone to disturbance by periodic flooding and intensive grazing by native animals.	Endangered	Occurs in small areas along the Mitchell River to the east of the study area.

Conservation-significant vegetation and ecological communities

One nationally-listed vegetation community, the Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) grassy woodland and associated native grassland, has the potential to occur within the study area. A second community, the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains, may occur within the region, but is unlikely to occur in the study area. A further two vegetation communities listed under the *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act) have modelled distributions within the study area.

These communities are described in Table 4.6.

Table 4.6 Threatened vegetation communities likely to occur in the study area

Name	Description	Status	Likelihood of occurrence
Gippsland Red Gum (*Eucalyptus tereticornis subsp. mediana*) grassy woodland and associated native grassland	Typically occurs on undulating to flat plains less than 100 m above sea-level with some occurrences extending onto low hills. The ecological community occurs in two structural forms: grassland and grassy woodland. The woodland form has a tree canopy that is dominated by Gippsland red gum (*Eucalyptus tereticornis* subsp*. mediana*). Other tree species that may occur include: drooping sheoak (*Allocasuarina verticillata*), black sheoak (*A. littoralis*), apple-topped box (*Eucalyptus angophoroides*), coast grey box (*E. bosistoana*), but but (*E. bridgesiana*), white stringybark (*E. globoidea*) and yellow box (*E. melliodora*). The ground layer of the ecological community is dominated by a suite of native graminoids, including perennial tussock grasses, sedges, non-tufted grasses and other graminoids.	Critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Community likely to occur within the area
Seasonal Herbaceous Wetlands (freshwater) of the Temperate Lowland Plains	Typically occur on seasonally-filled drainage lines or depressions, sometimes poorly defined, that are variously categorised as isolated, closed systems. Generally treeless and dominated by a herbaceous ground layer, often with a considerable graminoid. They occur on fertile, but poorly draining clays of various geologies.	Critically endangered under the EPBC Act	Likely to occur outside the project area, but locally
Warm Temperate Rainforest (East Gippsland Alluvial Terraces)	Is the most diverse rainforest community in Victoria with a low to moderate density of canopy species. The community has a high diversity of vines with robust, wiry, cane-like and herbaceous climbers common. The understorey is dominated by tree ferns, with abundant, conspicuous and diverse ground fern flora, with several vascular epiphytes common.	Listed as threatened under the FFG Act	Has a modelled distribution of approximately 2 km north of the project area by along Iguana Creek.
Forest Red Gum Grassy Woodland	Found at a number of sites in Gippsland. The community is characteristically dominated by forest red gum (*Eucalyptus tereticornis*), often with co-dominant red box (*E. polyanthemos*). Beneath the eucalypts, there are often scattered small trees of lightwood (*Acacia implexa*), and groves of black she-oak (*Allocasuarina littoralis*) in some places. The herbaceous understorey is co-dominated by a variety of species.	Listed as threatened under the FFG Act	Has a modelled distribution at scattered locations to the west and south of Bairnsdale – Dargo Rd and The Fingerboards.

Four EVCs that have the potential to exist within the project area are classified as ‘endangered’ or ‘vulnerable’ within the bioregions present. These are:

- Plains Grassy Forest – Endangered.
- Plains Grassy Woodland – Endangered.
- Dry Valley Forest – Vulnerable.
- Damp Sands herb-Rich Woodland – Vulnerable.

4.3.3 Flora and fauna

Owing to its location in a transitional zone between three bioregions and biogeographically between southern cool temperate and eastern warm temperate zones, a variety of ecosystems support diverse flora and fauna communities.

Due to the absence of specific flora and fauna surveys in the study area, characterisation of the flora and fauna communities that are likely to be present has relied on publicly available databases and literature. More specifically this included:

- Biodiversity Interactive Map - 3.2, which includes a variety of spatial data including (Victorian Department of Environment and Primary Industries).
- The Protected Matters Search Tool (Commonwealth Department of Environment) (see Attachment 1.
- Publicly available reports and literature.

Flora

Typical overstory or canopy species that dominate the most common vegetation communities in the study area include red stringybark (*Eucalyptus macrorhyncha*), forest red gum (*Eucalyptus tereticornis*), white stringybark (*E. globoidea*), red stringybark (*E. macrorhyncha*), red box (*E. polyanthemos*), Gippsland stringybark (*E. mackintii*), apple-topped box (*E. angophoroides*) and blackwood (*Acacia melanoxylon*).

Understorey trees and shrubs vary in both density and diversity and include black wattle (*Acacia mearnsii*), tree violet (*Hymenanthera dentate*), shiny cassinia (*Cassinia longifolia*), large mock-olive (*Notelaea venosa*), prickly tea-tree (*Leptospermum continentale*), common heath (*Epacris impressa*), common rice-flower (*Pimelea humilis*), prickly bush-pea (*Pultenaea forsythiana*), eastern nightshade (*Solanum pungetium*), burgan (*Kunzea ericoides*), sandfly zieria (*Zieria smithii*) and grey guineaflower (*Hibbertia obtusifolia*).

The ground layer of these communities typically has a diversity of grasses, graminoids and forbs and consists of shrubby, heathy, sedgy and grassy communities. Graminoids present include wallaby grasses (*Austrodanthonia* spp.), spear-grasses (*Austrostipa* spp.), grey tussock-grass (*Poa sieberiana*), bordered panic (*Entolasia marginate*), short-stem sedge (*Carex breviculmis*), wattle mat-rush (*Lomandra filiformis*), and thatch saw-sedge (*Gahnia radula*). A high diversity of forbs may be present although each is low in cover and abundance. Species include tall sundew (*Drosera peltata*), button everlasting (*Helichrysum scorpioides*), small St John's wort (*Hypericum gramineum*), and a range of orchids including greenhoods (*Pterostylis* spp.), bird-orchids (*Chiloglottis* spp.) and spiderorchids (*Caladenia* spp).

Rare or threatened flora species listed under either the EPBC Act, FFG Act, or on the Advisory List of Rare or Threatened Plants in Victoria (DEPI, 2014) with the potential to occur in the study area based on suitable habitat, are presented in Table 4.7. Those that have point records within and surrounding the study area are shown on Figure 4.3.

Two nationally listed species, the dwarf kerrawang (*Commersonia prostrate*) and swamp everlasting (*Xerochrysum palustre*), have been recorded locally. Both of these species occur in swampy, sometimes ephemeral, wetlands and shallow freshwater marshes. Another four nationally-listed species or their habitat may occur within the study area.

Two state listed species, yellow-wood (*Acronychia oblongifolia*) and prostrate cone-bush (*Isopogon prostrates*) have been recorded locally. The former is a small to medium sized tree that grows at the margins or within rainforest. The latter is a rare heath shrub that occurs in dry open Eucalyptus woodlands.

A further 10 species are listed on the Advisory List of Rare or Threatened Plants in Victoria as either rare or poorly known (Table 4.7).

Table 4.7 Rare or threatened flora with the potential to occur in the study area

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Dwarf kerrawang	*Commersonia prostrate*	Endangered	Threatened	Endangered	In Victoria, the species grows on swampy, sometimes ephemeral, wetlands and lake margins, often dominated by *Lepidosperma* spp. It is part of the Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) Grassy Woodland and Associated Native Grassland ecological community, listed as critically endangered under the EPBC Act.	Recorded adjacent to Fernbank – Glenaladale Rd (south of Fingerboards) in 1969. There also is a concentration of populations in and around Providence Ponds Flora and Fauna Reserve.	1, 2,4
Swamp everlasting	*Xerochrysum palustre*	Vulnerable	Vulnerable	Vulnerable	Grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils.	Recorded adjacent to Fernbank – Glenaladale Rd (south of Fingerboards) in 1984.	1, 2,4
Aniseed boronia	*Boronia galbraithiae*	Vulnerable	Vulnerable	Rejected for listing as threatened; taxon invalid or ineligible	Occur in tall open sclerophyll forest, usually dominated by silvertop ash (*Eucalyptus sieberi)*. The largest population occurs on a dry ridgetop on skeletal soils, while the other two known populations occur in riparian and moist forest habitats.	Species or species habitat may occur within the study area.	1, 2
Clover glycine	*Glycine latrobeana*	Vulnerable	Threatened	Vulnerable	Grows in lowland grasslands, grassy woodlands and sometimes in grassy heath. The grasslands are dominated by kangaroo grass (*Themeda triandra)* as well as *Poa* species with the grassy woodland characterized by eucalyptus species (*Eucalyptus leucoxylon*, *E. viminalis*, and *E. camaldulensis)*.	Species or species habitat may occur within the study area.	1, 2

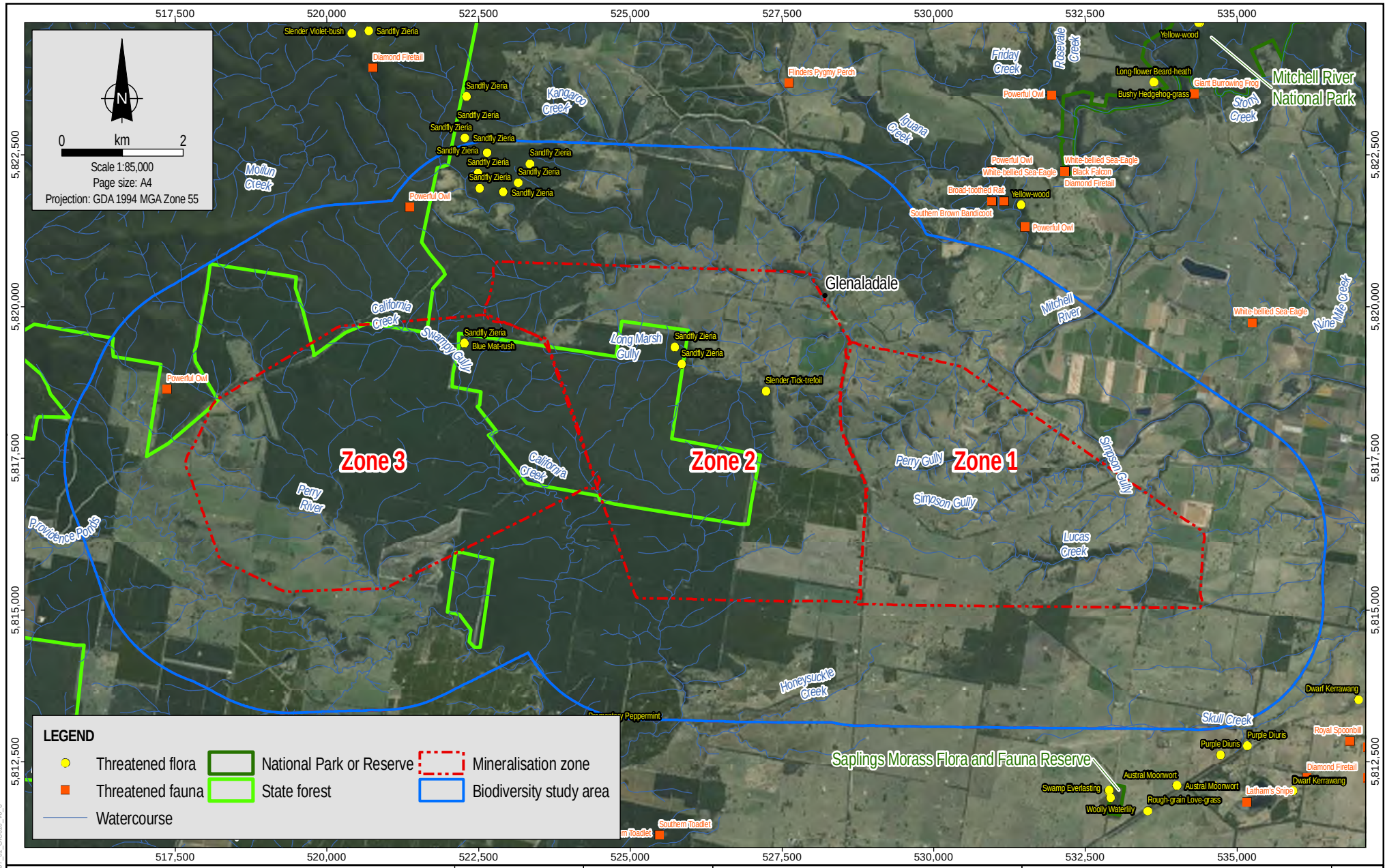
Table 4.7 Rare or threatened flora with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Gaping leek-orchid	*Prasophyllum correctum*	Endangered	Threatened	Endangered	The species grows in freely draining sandy loam soils derived from alluvium or brown clay loam, and at 20 to 50 m above sea level. It occurs in the Forest Red Gum (*Eucalyptus tereticornis*) Grassy Woodland EPBC-listed community.	Species or species habitat may occur within the study area.	1, 2
Austral toadflax	*Thesium australe*	Vulnerable	Threatened	Vulnerable	Semi-parasitic on roots of a range of grass species notably kangaroo grass (*Themeda triandra*). It occurs in subtropical, temperate and subalpine climates over a wide range of altitudes on a range of soils including black clay loams to yellow podzolics and peaty loams.	Species or species habitat may occur within the study area.	1, 2
Yellow-wood	*Acronychia oblongifolia*	-	Threatened	Rare	Grows in the rainforest and the rainforest margin.	Recorded at Long Marsh Gully, Moilun Creek, Iguana Creek in 1962, 1987.	1,3
Prostrate cone-bush	*Isopogon prostrates*	-	Threatened	Endangered	Mostly in heath and dry sclerophyll forest, often in exposed situations	Recorded adjacent to Fernbank – Glenaladale Rd (south of Fingerboards) in 1942.	1,5
Sandfly zieria	*Zieria smithii* subsp. *Smithii*	-	-	Rare	Grows as an understory plant in wet sclerophyll forest, occasionally on the edge of rain forest	Recorded in Swampy Gully and Long Marsh Gully, and adjacent to Private Rd (Cobbannah) in 2012.	1,6
Blue mat-rush	*Lomandra glauca*	-	-	Poorly known	Usually grows in heath to dry sclerophyll forest on deep coastal sandy soil or on sandstone	Recorded in Swampy Gully in 2012.	5
Promontory Peppermint	*Eucalyptus willisii s.s*	-	-	Rare	Endemic to Gippsland	Recorded at Perry River in 2011.	1

Table 4.7 Rare or threatened flora with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Yellow burr-daisy	*Calotis lappulacea*	-	-	Rare	Grows in grassy woodland habitat in full sun to light shade	Recorded at Moilun Creek in 1946.	1
Stalked adder's-tongue	*Ophioglossum reticulatum*	-	-	Rare	Grows in fully exposed sandy soil along the river and in laterite areas during the wet season	Recorded at Iguana Creek and the Mitchell River in 1987.	1,7
Wrinkle-nut lignum	*Muehlenbeckia rhyticarya*	-	-	Rare	Grows in moist situations in forests and on rocky slopes	Recorded adjacent to Fernbank – Glenaladale Rd (south of Fingerboards) in 1967.	1,5
Heath platysace	*Platysace ericoides*	-	-	Rare	Grows in coastal heath, scrubby heath and sclerophyll woodland on sandy soils over various substrates	Recorded less than 1 km south of Perry River in 1964.	1, 5
Tangled pseudanthus	*Pseudanthus orbicularis*	-	-	Rare	Grows in rocky sites on hillsides and ridges in shrubland, low woodland with heath understorey or open eucalypt forest with shrubby understorey. Shallow soils, mostly sandy or occasionally sandy oam or sandy clay, often overlying granite or rhyolite, occasionally sandstone.	Recorded off Private Rd (Cobbannah) in 1984.	1, 5
Slender violet-bush	*Hybanthus monopetalus*	-	-	Rare	Grows mostly on sandy soils or rocky granitic outcrops in dry sclerophyll forest or woodland	Recorded off Private Rd (Cobbannah) in 1998.	1, 5
Stalked brooklime	*Gratiola pedunculata*	-	-	Poorly known	Grows on river or lagoon banks, and other damp places	Recorded adjacent to Fernbank – Glenaladale Rd (south of Fingerboards) in 1984.	1, 5
Slender Tick-trefoil	*Desmodium varians*	-	-	Poorly known	An uncommon species that occurs mainly in woodland or eucalypt forest in eastern Australia.	Recorded in approximately 1.5 km southwest of The Fingerboards in 2011.	1,

[1]Victorian Biodiversity Atlas, [2]Department of the Environment (2015), Protected Matters Search, [3]Atlas of Living Australia, [4]Department of the Environment (2015), Species Profile and Threats Database, [5] PlantNET (2015), New South Wales Flora Online, [6]Australian Tropical Rainforest Plants Edition 6, [7] The IUCN Red List of Threatened Species. Version 2015.1



Source:
Biodiversity study area from Coffey. Threatened flora and fauna from DELWP.
Mineralisation zones from Kalbar.
Watercourses, national parks and reserves from Vicmap.
State forests from GEODATA250K (optimum scale 1:250,000).
Imagery from ArcGIS Online (capture date unknown).

coffey

Date: 26.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F04.03_GIS

KALBAR RESOURCES LTD

Baseline Technical Report

Rare and threatened flora and fauna records in the study area

Figure No: **4.3**

MXD Reference: 11607_01_GIS010_v0_3

Terrestrial fauna

Rare or threatened fauna species listed under either the EPBC Act, FFG Act, or on the Advisory List of Rare or Threatened Fauna in Victoria (DSE, 2013), with the potential to occur in the study area based on suitable habitat, are presented in Table 4.8.

In terms of invertebrate species, the golden sun moth (*Synemon planar*) is listed as potentially occurring or having habitat that may occur within the study area. However, the closest records of the species are more than 100 km away and it is considered unlikely that they occur in the study area.

Four amphibian and two reptile species either threatened or rare could occur in the study area. Two nationally-listed amphibian species, the giant burrowing frog (*Heleioporus australiacus)* and the growling grass frog (*Litoria raniformis)*, have been recorded locally. The giant burrowing frog was recorded east of the Mitchell River in 2003 and the growling grass frog at Lindenow South and Brigalong in 1977 and 1978, with other records of the species in the region. Other nationally-listed amphibian and reptile species listed as potentially occurring by the Protected Matters Search Tool (Attachment 1) are considered to be unlikely to occur in the study area based on their distribution and habitat requirements. The southern toadlet (*Pseudophryne semimarmorata)*, listed as vulnerable on the Advisory List of Rare or Threatened Fauna, has been recorded at various locations locally particularly around Stockdale, at Glenaladale and Moilun Creek, most recently in 2010.

A total of 26 rare or threatened bird species have either been recorded locally or have potential habitat present in the study area. Four species are listed both under the EPBC Act and FFG Act. The swift parrot was recorded at Moilun Creek and Nile Creek in 1977 as well as other more recent records being made in the broader region. The regent honeyeater (*Anthochaera phrygia*) and the Australian painted snipe (*Rostratula australis*) have also been recorded locally; the latter at Lindenow and the former at Lindenow and Stockdale. The Australasian bittern (*Botaurus poiciloptilus*) has not been recorded locally with the closest record of the species in Bairnsdale (but is as potentially occurring based on the EPBC Protected Matters search). Nine additional species listed as threatened on the FFG Act have been recorded locally including the little egret (*Egretta garzetta nigripes*), masked owl (*Tyto novaehollandiae novaehollandiae*), grey goshawk (*Accipiter novaehollandiae novaehollandiae*), hooded robin (*Melanodryas cucullata cucullata*), diamond firetail (*Stagonopleura guttata*), blue-billed duck (*Oxyura australis*), powerful owl (*Ninox strenua*), chestnut-rumped heathwren (*Calamanthus pyrrhopygius*) and speckled warbler (*Chthonicola sagittatus*). A further thirteen bird species have been recorded locally and are listed on the Advisory List of Rare or Threatened Fauna in Victoria.

In terms of mammals eight listed species have either been recorded locally or have potential habitat present. Of these, six are listed under the EPBC Act. The long-nosed potoroo, broad-toothed rat and southern brown bandicoot were each recorded at Iguana Creek adjacent to Friday Creek Rd in 2000. The spot-tailed quoll has been recorded in the Mitchell River National Park and in early 2012, a male was found dead on the road at the Providence Ponds Reserve between Bairnsdale and Stratford. The New Holland mouse has also been recorded in this reserve. The greater glider has been recorded at various locations around Stockdale including Beverleys Road between 1962 and 1998. The remaining species, including the brush-tailed rock-wallaby and grey-headed flying fox were listed as having the potential to occur within the study area, but no records have been made locally.

Table 4.8 Rare or threatened fauna with the potential to occur in the study area

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Invertebrate							
Golden sun moth	*Synemon plana*	Critically endangered	Threatened	Critically endangered	Native temperate grassland and open grassy woodlands dominated by wallaby grass.	Species or species habitat may occur within the study area	1,2,4
Fish							
Eastern dwarf galaxias	*Galaxiella pusilla*	Vulnerable	Threatened	Endangered	Slow flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often containing dense aquatic macrophytes and emergent plants.	Species or species habitat may occur within the study area	1,2,4
Australian grayling	*Prototroctes maraena*	Vulnerable	Threatened	Vulnerable	Diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones.	Recorded in the Moilun Creek at weir, 30 miles by road from river mouth in 1905	1,2,4
Amphibians							
Giant burrowing frog	*Heleioporus australiacus*	Vulnerable	Threatened	Critically endangered	Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Recorded in east of the Mitchell River south of Wattle Creek in 2003	1,2,5
Growling grass frog	*Litoria raniformis*	Vulnerable	Threatened	Endangered	Generally occurs among emergent vegetation including *Typha* sp., *Phragmites* sp. and *Eleocharis* sp., in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams.	Recorded at Lindenow South and Brigalong in 1977 and 1978	1,2,4

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Amphibians							
Green and golden bell frog	*Litoria aurea*	Vulnerable	Rejected for listing	Vulnerable	Range of still water and terrestrial habitats in the coastal plains and low foothills including lowland forest, Banksia woodland, wet heath land, riparian scrub complex, riparian forest, damp forest, shrubby dry forest, limestone box woodland and cleared pastoral areas.	Species or species habitat may occur within the area. The closest record at Bairnsdale.	1,2,4
Southern toadlet	*Pseudophryne semimarmorata*	-	-	Vulnerable	Dry forest, woodland, shrubland, grassland, and heaths.	Recorded at numerous locations around Stockdale, at Glenaladale and Moilun Creek between 1961 and 2010	1,3
Reptiles							
Striped legless lizard	*Delma impar*	Vulnerable		Endangered	Potential habitat includes all areas which have, or once had, native grasslands or grassy woodlands (including derived grasslands) across the historical range of the species, provided that area retains suitable tussock structure.	Species or species habitat may occur within the study area	1,2,4
Pink-tailed legless lizard	*Aprasia parapulchella*	Vulnerable		Endangered	Primary and secondary grassland, grassy woodland and woodland communities including mallee, and box-ironbark forest.	Species or species habitat may occur within the study area	1,2,4

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Birds							
Regent honeyeater	*Anthochaera phrygia*	Endangered	Threatened	Critically endangered	Occurs in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations in areas of low to moderate relief, wherein they prefer moister, more fertile sites available, for example along creek flats, or in broad river valleys and foothills. They nest in the canopy of forests or woodlands, and in the crowns of tall trees, mostly eucalypts.	Recorded at Lindenow and Stockdale	1,2,4
Australasian bittern	*Botaurus poiciloptilus*	Endangered	Threatened	Endangered	Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats. It favours wetlands with tall, dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water.	Species or species habitat may occur within the study area	1,2,4
Swift parrot	*Lathamus discolour*	Endangered	Threatened	Endangered	Occurs in all box-ironbark reserves in Victoria and New South Wales, when flowering eucalypts provide suitable foraging habitat.	Recorded at Moilun Creek and Nile Creek in 1977	1,2,4
Australian painted snipe	*Rostratula australis*	Endangered	Threatened	Critically endangered	Inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.	Species or species habitat may occur within the area	1,2,4
Little egret	*Egretta garzetta nigripes*	-	Threatened	Endangered	Inhabit mudflats, saltworks and shallow margins of tidal estuaries and inland rivers and lakes.	Recorded at Moilun Creek in 1977	1,3,6

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Birds							
Masked owl	*Tyto novaehollandiae novaehollandiae*	-	Threatened	Endangered	Inhabits a wide variety of lowland forests and woodlands that provide mature trees with hollows suitable for nesting and roosting nearby open areas for foraging.	Recorded at Moilun Creek in 1977	1,3,6
Grey goshawk	*Accipiter novaehollandiae novaehollandiae*	-	Threatened	Vulnerable	Found in most forest types, especially tall closed forests, including rainforests.	Recorded at Moilun Creek in 1977	1
Hooded robin	*Melanodryas cucullata cucullata*	-	Threatened	Near Threatened	Occurs in lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.	Recorded at Perry River and at Fernbank in 1977, 1980	1
Diamond firetail	*Stagonopleura guttata*	-	Threatened	Near threatened	Occurs in grassy eucalypt woodlands, including box-gum woodlands and snow gum (*Eucalyptus pauciflora)* Woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Recorded at Moilun Creek in 1977	1
Blue-billed duck	*Oxyura australis*	-	Threatened	Endangered	Prefer stable, deep, fresh well-vegetated wetlands for much of the year, particularly for breeding. These swamps often contain rushes or sedges.	Recorded at Nile Creek in 1977	1,6
Powerful owl	*Ninox strenua*	-	Threatened	Vulnerable	Occurs in a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	Recorded at Nile Creek north of Beverleys Rd in 1977 and 2007	1,3,5

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Birds							
Chestnut-rumped heathwren	*Calamanthus pyrrhopygius*	-	Threatened	Vulnerable	Occurs in temperate forests and subtropical or tropical moist lowland forests.	Recorded at Nile Creek in 1977	1
Speckled warbler	*Chthonicola sagittatus*	-	Threatened	Vulnerable	Occurs in a range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies.	Recorded at Nile Creek in 1977	1
Black falcon	*Falco subniger*	-	-	Vulnerable	Usually found near watercourses or patches of isolated trees. It hunts over open wooded grasslands, saltbush plains, bluebush plains and other low vegetation.	Recorded on the Bairnsdale – Dargo Rd in 2007	1
White-throated needletail	*Hirundapus caudacutus*	-	-	Vulnerable	Almost exclusively aerial; over a wide variety of habitats.	Recorded at various locations (Moilun Creek, Nile Creek, Long Marsh Gully) in 1977	1
Hardhead	*Aythya australis*	-	-	Vulnerable	Prefer larger lakes, swamps and rivers with deep, still water, but are often seen in smaller streams, flooded grasslands, and shallow pools.	Recorded at Nile Creek in 1977	1
Australasian shoveler	*Anas rhynchotis*	-	-	Vulnerable	Found in all kinds of wetlands, preferring large undisturbed heavily vegetated freshwater swamps.	Recorded at Nile Creek in 1977	1

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Birds							
Eastern great egret	*Ardea modesta*	-	-	Vulnerable	Common throughout Australia, with the exception of the most arid areas. Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Recorded at Nile Creek in 1977, 1978	1,6
Azure kingfisher	*Alcedo azurea*	-	-	Near threatened	Prefers areas adjacent to freshwater rivers and creeks as well as billabongs, lakes, swamps and dams, usually in shady overhanging vegetation.	Recorded at Moilun Creek and Nile Creek in 1980, 1981	1
Emu	*Dromaius novaehollandiae*	-	-	Near threatened	Most habitats across Australia, although they are most common in areas of sclerophyll forest and savanna woodland.	Recorded at various locations (Moilun Creek, Stockdale, Nile Creek) in 1977, 1978, 1980, 1981	1
Royal spoonbill	*Platalea regia*	-	-	Near threatened	Occurs in shallow freshwater and saltwater wetlands, intertidal mud flats and wet grasslands.	Recorded at Moilun Creek and Nile Creek in 1977	1
Nankeen night Heron	*Nycticorax caledonicus hillii*	-	-	Near Threatened	Occurs in well-vegetated wetlands, and is found along shallow river margins, mangroves, floodplains, swamps, and parks and gardens.	Recorded at Moilun Creek and Nile Creek in 1977	1
Brown treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*	-	-	Near Threatened	Inhabits dry eucalypt woodland and adjoining vegetation, though absent from degraded woodlands and steep rocky hills.	Recorded at Moilun Creek in 1977, 1978	1

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Birds							
Spotted quail-thrush	*Cinclosoma punctatum*	-	-	Near threatened	Occurs in subtropical or tropical dry forests. They forage entirely on the ground amongst the grass tussocks, logs and rocks.	Recorded on Limpyers Rd and Moilun Creek in 1977, 1980, 1998	1
Pied cormorant	*Phalacrocorax varius*	-	-	Near threatened	Found in marine habitats, including estuaries, harbours and bays.	Recorded at Nile Creek in 1980	1
Mammals							
Spot-tailed quoll	*Dasyurus maculatus maculates*	Endangered	Threatened	Endangered	Found in a range of forest environments, from rainforest to open woodland. They require forest with suitable den sites such as rock crevices, caves, hollow logs, burrows and tree hollows.	In early 2012, a male spot-tailed quoll was found dead on the road at the Providence Ponds Reserve between Bairnsdale and Stratford.	1,2,4
Southern brown bandicoot	Isoodon obesulus obesulus	Endangered	Listed	Near Threatened	Inhabit a variety of habitats including heathland, shrubland, sedgeland, heathy open forest and woodland and are usually associated with infertile, sandy and well drained soils, but can be found in a range of soil types.	Recorded at Iguana Creek adjacent to Friday Creek Rd in 2000	1,2,4
Brush-tailed rock-wallaby	*Petrogale penicillata*	Vulnerable	Critically endangered	Critically endangered	Occur on rocky escarpments, granite outcrops and cliffs, which have caves and ledges for shelter and face north for warmth. Graze on native grasses found in surrounding habitat at dawn and dusk.	Species or species habitat may occur within the area	1,2,4

Table 4.8 Rare or threatened fauna with the potential to occur in the study area (cont'd)

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Mammals							
Long-nosed potoroo	*Potorous tridactylus tridactylus*	Vulnerable	Threatened	Near threatened	In East Gippsland they are found in both open forest and woodland and the ecotone in-between. It is found in areas containing Eucalyptus (e.g., *Eucalyptus sieberi, E. globoidea*, *E. muellerana*, *E. baxteri* and *E. cypellocarpa)*.	Recorded at Iguana Creek adjacent to Friday Creek Rd in 2000	1,2,4
New Holland mouse	*Pseudomys novaehollandiae*	Vulnerable	Threatened	Vulnerable	Inhabit open heathland, open woodland with a heathland understorey and vegetated sand dunes.	Species or species habitat may occur within the area. Closest records from the Providence Ponds Reserve.	1,2,4
Grey-headed flying fox	*Pteropus poliocephalus*	Vulnerable	Threatened	Vulnerable	Canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. Roost sites are typically located near water, such as lakes, rivers or the coast.	Species or species habitat may occur within the area	1,2,4
Broad-toothed Rat	*Mastacomys fuscus mordicus*	-	Threatened	Endangered	Found in Alpine and subalpine heaths and eucalypt woodlands, wet sclerophyll forest, grasslands and wet sedgelands from sea level to 2,200m.	Recorded at Iguana Creek adjacent to Friday Creek Rd in 2000	1,2,3
Greater glider	*Petauroides volans*	-	-	Vulnerable	Found in Eucalypt forests and woodlands along the east coast of Australia from north-eastern Queensland to the Central Highlands of Victoria.	Recorded at various locations around Stockdale including Beverly's Rd in 1962, 1978, 1998	1,2,3

[1]Victorian Biodiversity Atlas (DEP, 2015f), [2]DoE Protected Matters Search (Attachment 1), [3]Atlas of Living Australia (NCRIS, 2015), [4]Department of the Environment (2015), Species Profile and Threats Database (DoE, 2015, [5]NSW Office of Environment and Heritage Threatened species profiles (OEH, 2015), [6]DEPI, Respective Action Statements under the Flora and Fauna Guarantee Act (DEPI, 2015a)

Eleven migratory species (excluding marine species) have the potential to occur within the study area based on their distribution and habitat. Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations.

Listed migratory species are those listed in the:

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).
- China-Australia Migratory Bird Agreement (CAMBA).
- Japan-Australia Migratory Bird Agreement (JAMBA).
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

In addition, native species can be listed in an international agreement approved by the Minister of Environment.

A review of the Protected Matters Search Tool indicates that six terrestrial migratory species or their habitat may occur within the study area. These include:

- White-bellied sea-eagle (*Haliaeetus leucogaster*).
- White-throated needletail (*Hirundapus caudacutus*) (recorded in the study area, Table 4.8).
- Rainbow bee-eater (*Merops ornatus*).
- Black-faced monarch (*Monarcha melanopsis*).
- Satin flycatcher (*Myiagra cyanoleuca*).
- Rufous fantail (*Rhipidura rufifrons*).

In addition, the Protected Matters Search Tool indicates that six migratory species dependent on wetland habitats may occur within the study area. These include:

- Great egret (*Ardea alba*).
- Cattle egret (*Ardea ibis*).
- Latham's snipe (*Gallinago hardwickii*).
- Eastern osprey (*Pandion cristatus*).
- Australian painted snipe (*Rostratula australis*) (also listed as Endangered under the EPBC Act and critically endangered under the FFG Act).

For the majority of these species, suitable habitat is lacking within the project area as many of these species have specific habitat requirements, such as large waterbodies or wetlands.

Aquatic and semi-aquatic fauna

The range of habitats and their geographical position suggest that the East Gippsland region is an important transition area between different climatic zones, and harbours several different groups of freshwater fish and macroinvertebrate species at the limit of their ranges (LCC, 1986).

Aquatic macroinvertebrates consist of a diverse assemblage of species, with many taxa endemic to the region and with restricted distributions. In the late 1990s EPA Victoria sampled aquatic macroinvertebrates in Iguana Creek at Dargo Road. This sampling yielded 40 macroinvertebrate taxa, the most for any edge sample in the Mitchell catchment. However, only five of these were members of the relatively sensitive Ephemeroptera, Plecoptera and Trichoptera orders of insects (EPA, 2002).

Rare or threatened aquatic fauna species listed under either the EPBC Act, FFG Act, or on the Advisory List of Rare or Threatened Fauna in Victoria (DSE, 2013), with the potential to occur in the study area based on suitable habitat, are presented in Table 4.9.

Two nationally-listed fish species, Australian grayling (*Prototroctes maraen*) and eastern dwarf galaxias (*Galaxiella pusilla*), may occur in the study area. Australian grayling has been recorded locally. The species was recorded in the Moilun Creek in 1905 and in the Avon River at Stratford most recently in 2010. The eastern dwarf galaxias has been recorded in the Perry River at the Providence Ponds Flora and Fauna Reserve, some 7 km from the study area, but has the potential to occur in the study area.

Table 4.9 Rare or threatened aquatic fauna with the potential to occur in the study area

Common Name	Species Name	Status			Habitat	Occurrence	Source
		EPBC Act	FFG Act	Advisory List			
Eastern dwarf galaxias	*Galaxiella pusilla*	Vulnerable	Threatened	Endangered	Slow flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often containing dense aquatic macrophytes and emergent plants	Species or species habitat may occur within the study area	1,2,4
Australian grayling	*Prototroctes maraena*	Vulnerable	Threatened	Vulnerable	Diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones.	Recorded in the Moilun Creek at weir, 30 miles by road from river mouth in 1905	1,2,4

4.3.4 Exotic and invasive species

Invasive plants and animals are a persistent and widespread threat to East Gippsland's natural environment and agricultural industries (RMCG, undated). An indication of the extent of the invasive plant species in the region are the records of over 120 exotic species in East Gippsland, which vary in their threat, distribution and degree of impact (RMCG, undated).

Eight weeds of national significance are present in East Gippsland (RMCG, undated). These are:

- Blackberry (*Rubus fruticosus*).
- Bitou bush (*Chrysanthemoides monilifera* subspecies *rotundata*).
- Boneseed (*Chrysanthemoides monilifera* subspecies *monilifera*).
- Bridal creeper (*Asparagus asparagoides*).
- Chilean needle grass (*Nassella neesiana*).
- Gorse / furze (*Ulex europaeus*).

- Serrated tussock (*Nassella trichotoma*).
- Willow (*Salix* spp.).

Four state prohibited weeds are also known to occur in East Gippsland including horsetail (*Equisetum* spp.), Japanese knotweed (*Fallopia japonica*), nodding thistle (*Carduus nutans*) and water hyacinth (*Eichhornia crassipes*) and a further ten regionally prohibited weeds are known to occur in the region (RMCG, undated). A further five invasive plant species were listed as potentially occurring in the study area by the Protected Matters Search Tool including: Wards weed (*Carrichtera annua*), broom (*Genista* sp. X *Genista monspessulana*), African boxthorn (*Lycium ferocissimum*), olive (*Olea europaea*), radiata pine (*Pinus radiata*)

Within the Mitchell River catchment, willow, poplar and blackberry remain significant problems in riparian areas (RMCG, undated). During the site visit by Coffey in June 2015, various pest plant species were observed within the project area including cape weed (*Arctotheca calendula*), blackberry (*Rubus fruticosus* spp. agg.), willow, spear thistle (*Cirsium vulgare*), and fennel (*Foeniculum vulgare*). Other exotic plants previously recorded in the study area include: African love-grass (*Eragrostis curvula*), flaxleaf fleabane (*Conyza bonariensis*), panic veldt-grass (*Ehrharta erecta* var. *erecta*), flatweed (*Hypochaeris radicata*), black nightshade (*Solanum nigrum*), ox-eye daisy (*Leucanthemum vulgare*), St John's wort (*Hypericum perforatum* subsp. *veronense*) and Paterson's curse (*Echium plantagineum*).

A range of pest animals occur in East Gippsland including: the red fox (*Vulpes vulpes*), European rabbit (*Oryctolagus cuniculus*), wild dogs (*Canis lupus familiaris*), brown hare (*Lepus capensis*), feral cat (*Felis catus*), feral pig (*Sus scrofa*), Sambar deer (*Cervus unicolor*), black rat (*Rattus rattus*) and house mouse (*Mus musculus*); and birds Indian myna (*Acridotheres tristis*), common starling (*Sturnus vulgaris*) common blackbird (*Turdus merula*), house sparrow (*Passer domesticus*) and rock pigeon (*Columba livia*).

The Southern Ark project controls across approximately one million hectares of public land in far East Gippsland, to protect native mammals, birds and reptiles from fox predation.

4.3.5 Ecological values present in the study area

The site visit focused on broadly identifying areas of remnant native vegetation, assessing fauna habitat values present and conducting a high level assessment of the ecological values (including their sensitivity) of the remnant native vegetation including:

- Habitat type, status and quality.
- Patch size and degree of fragmentation.
- Habitat value to significant species.
- Corridor value.

In addition, a range of mapping and database resources were accessed to describe the ecological values of the study area. These included:

- Modelled 2005 Ecological Vegetation Classes.
- Native Vegetation Regulation 2013 data.
- Public Land Management (PLM25) Generalised
- Logging history overlay of most recent harvesting activities.

State forest

The largest area of ecological value within the study area is the state forest located south of Long Marsh Gully, to the north of Boundary 34 Track and to the east and south of the softwood pine

plantation (Plate 4.7). As indicated by the state-wide vegetation mapping, this forest contains predominantly Lowland Forest vegetation in areas of higher relief such as on rises and hills and Lowland Herb-rich Forest in gullies and low lying gullies and depressions. The latter community has an understorey that is generally more heath-like in comparison to the former, which has a ground layer dominated by grasses. In the northeast corner of the state forest there is also a patch of approximately 60 ha of Plains Grassy Forest vegetation.

The Biodiversity Interactive Map indicates that the state forest has a high degree of tree cover. The canopy throughout the area is likely to be of medium height and include a range of species such as the red stringybark (*Eucalyptus macrorhyncha*), white stringybark (*E. globoidea*), red box (*E. polyanthemos*) and apple-topped box (*E. angophoroides*).

Native vegetation quality has been modelled over Victoria by assessing vegetation against a benchmark of vegetation quality and combining a site component associated with vegetation condition and a landscape component describing patch size and shape and landscape connectivity and proximity (DEPI, 2015b). The state forest within the study area is rated as having a quality score of 61 to 70 out of 100, with small patches of higher quality vegetation scattered throughout. The edges of the forest are modelled as having a slightly lower vegetation score between 51 and 60. Areas outside of the state forest are generally of lower quality.

The state forest also contains a reasonably large continuous tract of native vegetation that provides connectivity to the extensive, contiguous forests of the Great Dividing Range. This area includes a number of national parks including the Mitchell River National Park. Landscape connectivity was modelled over Victoria and rates the landscape according to its connection and proximity to surrounding native vegetation. The state forest within the study area is given the highest landscape connectivity rating (highly likely).

Inspection of satellite imagery indicates that the state forest has a relatively intact canopy cover, although further conclusions regarding its composition and intactness of understory components will require verification. In terms of disturbance, the state forest has a number of access tracks that dissect the area. There is also evidence of recent bushfires with blackened tree trunks and a sparse understory noted from the forest edge. This may, in part, be from a prescribed burn that was undertaken during 2010 (as mapped by the Biodiversity Interactive Map). During 2014 and 2015 summer, a bushfire also burnt areas of the study area. The state forest has also been harvested for single tree harvesting and is located within the Central Gippsland Forest Management Area. This area was selectively logged in 15 coupes ranging in size from approximately 1 ha to 70 ha between 1979 and 1985.

Within the state forest it is likely that a mosaic of microhabitats occur. These are likely to be influenced by a range of physical and geographical aspects including topography, soils and aspect. These habitats are likely to support a range of flora and fauna species. Although given the recent history of fire in the forest the diversity of species is likely to be lower due to the reduced diversity of the shrub and understory components.

A range of rare threatened flora species may occur in the state forest based on their habitat requirements including the prostrate cone-bush, sandfly zieria, blue mat-rush, yellow burr-daisy, wrinkle-nut lignum, heath platysace, tangled pseudanthus and slender violet-bush. Due to the recording of dwarf kerrawang adjacent to Fernbank – Glenaladale Road there is the potential for this critically endangered species to occur in any areas of ephemeral wetlands.

Photo credit: Coffey

Plate 4.7
State Forest within the west of the study area

Photo credit: Coffey

Plate 4.8
Mitchell River at the Wuk Wuk bridge with riparian vegetation consisting of willow

Photo credit: Coffey

Plate 4.9
Farm dam and example of a large mature tree within the study area

A number of rare and threatened fauna species may occur in the state forest including: the swift parrot, masked owl, grey goshawk, hooded robin, diamond firetail, white-throated needletail, azure kingfisher, brown treecreeper (south-eastern sub species.), spotted quail-thrush and the greater glider. Most of these species have been recorded historically with a high concentration of records at Moilun Creek, which contains similar habitat to the state forest. A number of additional threatened mammal species including the spot-tailed quoll, southern brown bandicoot, long-nosed potoroo, broad-toothed rat could occur in the area although their occurrence is unlikely due to the condition of the forest. These latter species were recorded at Iguana Creek to the northeast of the state forest.

Rivers and riparian vegetation

There are two main waterways within the study area: The Mitchell River and the Perry River.

Mitchell River

The Mitchell River is a Heritage River and is the only unregulated river of its size in Victoria. Much of the upper Mitchell River Catchment is state forest and national park. The Mitchell River passes through the Mitchell River National Park where it passes between high cliffs and several gorges. Tributaries of the Mitchell River have populations of Australian grayling. The gorge area and sections of the river on the Lindenow flats are of conservation significance because of the abundance and diversity of native species recorded during fish surveys (LCC, 1991).

Below the national park and within the study area, the river enters a floodplain, over three kilometres wide in places. Sediment deposited here has made the floodplain a fertile area for intensive irrigation and cattle grazing. In many areas, riparian zones have been cleared or replaced by exotic vegetation such as willows, and there is little evidence of regeneration of the natural riparian zone (see Plate 4.8; EPA, 2002).

In their 2002 investigation, EPA Victoria note that in this floodplain area of intensive agriculture, water quality, habitat condition and biological scores are markedly lower compared to sites in the upper catchment (EPA, 2002).

The Mitchell River has a long estuary reach which extends from the old barrier upstream from Bairnsdale township to where the river enters the Gippsland Lakes at Lake King. These wetlands are part of the Gippsland Lakes Ramsar site which is listed as internationally important under the Convention on Wetlands.

Perry River

Perry River, a permanent watercourse, runs along the southwestern edge of the study area before joining Providence Ponds. It passes through predominantly softwood plantations and farmland. Perry River is a permanent waterway.

Perry River provides freshwater habitat for macroinvertebrates, fish and frogs. These may include the eastern dwarf galaxias and Australian grayling, growling grass frog and southern toadlet. One of the few records of the promontory peppermint (a tree species) was made on Perry River. The riparian vegetation is likely to provide a habitat refuge and a corridor for a range of terrestrial species including the azure kingfisher and hooded robin.

Gullies and creeks

The undulating topography of the study area means that there are numerous gullies and creeklines. Outside the state forest and plantations these areas provide areas of native vegetation that will provide habitat for a range of flora and fauna.

Due to the aspect and topography of these gullies, moist and damp conditions are likely to persist in these habitats. During periods of drought, these remnants may provide refuge habitats for fauna from drier surrounding areas. The linear nature of gullies and creeks is also likely to provide some habitat connectivity for fauna across the landscape.

Native vegetation within these areas is likely to persist within grazing areas due to the difficult grazing conditions on steeper slopes, reduced availability of grazing grasses and preference for more open and flat areas. However the habitat quality of these patches is likely to be lower than large patches of remnant vegetation. These areas are subject to substantial erosion causing rills, slumping and loss of topsoil. The habitat is also degraded from the establishment of pest plants and animals and disturbance from grazing livestock (sheep and cattle). These smaller remnants are also likely to experience edge effects, such as dryer microclimates due to increased temperatures, wind throw and light penetration.

Artificial waterbodies in the form of farm dams also provide habitat for a range of fauna species (both terrestrial and aquatic) and may be important as refuge sites during periods of drought (Plate 4.9). There are several dams present within the study area. The nationally-listed growling grass frog commonly inhabits dams and wetlands within farming land.

A description of the gullies and creeks within the study area is provided in Table 4.10.

Table 4.10 Description of the gullies and creeks within the study area

Feature	Description	Ecological value
Moilun Creek	Situated in the north of the study area, the Moilun Creek is a permanent surface feature lined with Dry Valley Forest vegetation with small areas of scattered Plains Grassy Forest and Lowland Herb-rich Forest vegetation. This remnant vegetation occurs in a predominantly cleared landscape.	Due to the presence of permanent water, Moilun Creek provides ecological value intact remnant habitat, and acts as a refuge and a habitat corridor for fauna. Numerous historical records of rare and threatened fauna have been made along the creek (see Table 4.8). This creek is one of the few permanent surface water features in the study area and may provide habitat for the vulnerable Australian grayling and other aquatic fauna such as frogs. A range of other rare and threatened terrestrial flora and fauna have historically been recorded at sites on this creek (see tables 4.7, 4.8). Modelled native vegetation quality varies with patches of high quality scores and others with low quality scores.
Long Marsh Gully	Long Marsh Gully is situated in the north of the study area and runs from the state forest to Moilun Creek approximately 1.3 km east of Glenaladale. The gully contains a creek that has been dammed at various places within farmland and has other natural pools, which may be ephemeral. Within the state forest the gully contains Lowland Forest and Lowland Herb-rich Forest vegetation. Beyond the state forest native vegetation has been cleared except for a very small area of Dry Valley Forest.	This gully contains constructed farm dams and other standing pools. These provide some aquatic habitat for freshwater aquatic macroinvertbrates and frogs. Most of the gully is situated within grazing land and is likely to experience disturbance from grazing. Modelled native vegetation quality is generally very low.

Table 4.10 Description of the gullies and creeks within the study area (cont'd)

Feature	Description	Ecological value
California Creek	California Creek runs along the western boundary of the state forest in a southeasterly directly before turning due south for approximately 3 km and joining the Perry River. Like the Long Marsh Gully, it contains Lowland Forest, Lowland Herb-rich Forest vegetation and plantation forest. Based on aerial imagery, it appears that this creek is ephemeral.	Due to vegetation along this ephemeral creek, this habitat is likely to provide refuge to native fauna and provide habitat connectivity.
Perry Gully	Perry Gully runs west–east in the centre of the study area between The Fingerboards and the Mitchell River. The gully contains approximately 50 ha of Plains Grassy Forest vegetation. This gully was inspected during the site visit and had signs of a recent fire with sapling black wattle (*Acacia mearnsii*) dominating the understory. Large patches of blackberries were noted and the gully was experiencing extensive erosion (Plate 4.10).	This gully contains an ephemeral creek and provides habitat and is likely to provide refuge to native fauna and connectivity across the landscape. The deeper pools and swampy areas may provide habitat for aquatic flora and fauna. The habitat has been degraded by the presence of pest plants and fire. Modelled native vegetation quality is low with scores between 0 and 50 out of 100.
Simpson Gully	Simpson Gully runs west–east approximately 1 km south of Perry Gully. There is a small patch of Plains Grassy Forest and Valley Grassy Forest vegetation where it crosses Careys Road. Analysis of aerial imagery indicates that the gully contains an ephemeral creek with a pool on the western end.	The ephemeral creek within the gully provides habitat and is likely to provide refuge to native fauna and connectivity across the landscape. Modelled native vegetation quality is low with scores between 0 and 30 out of 100.
Lucas Creek	Lucas Creek runs west–east approximately 1 km south of Simpson Gully. The gully contains approximately 60 ha of Plains Grassy Forest and a smaller patch of Valley Grassy Forest. Like Simpson and Perry gullies, Lucas Creek is ephemeral.	Lucas Creek is ephemeral and is surrounded by remnant vegetation. It is likely to provide refuge to native fauna and some connectivity across the landscape. Modelled native vegetation quality is moderate with scores between 51 and 60 in the main remnant patch. This vegetation appears to be of higher quality than Perry or Simpson gullies.

Roadside vegetation, modified and cleared land

Disturbed environments are represented by native and non-native habitats with varying levels of disturbance, including small remnant native stands of trees, semi-cleared bushland, isolated mature trees, totally cleared grassland, regenerating areas and constructed habitat. While small remnants remain viable, this is diminished with decreasing size through edge effects and ongoing disturbance.

Much of the remaining remnant native vegetation within the study area (not covered by the other values defined for the study area) is along roadsides. Some of the most depleted and threatened vegetation types are found on roadsides (Plate 4.11). Roadsides provide corridors of connectivity. This may be habitat connectivity for individual species, spatial connectivity for physical connectedness of patches, or ecological connectivity for function of complex natural processes (EGSC, 2012). These strips of vegetation often contain large mature trees with hollows that support a variety of fauna. For example, there are records of the greater glider along roadways around Stockdale including Beverleys Road.

Photo credit: Coffey

Plate 4.10
Vegetation in Perry Gully including an understory dominated by blackberries

Photo credit: Coffey

Plate 4.11
Typical roadside vegetation along Fernbank-Glenaladale Road

Photo credit: Coffey

Plate 4.12
Blue gum forestry plantation within the study area

Remnant fragments of vegetation within areas that have been cleared for agricultural purposes are likely to contain elements of pre-existing vegetation communities. Modelled Ecological Vegetation Classes over Victoria prior to European settlement at 1750 (DEPI, 2015b) provide an indication as to what the historical vegetation of the study area consisted of. The modelled vegetation indicates a number of main trends of vegetation clearance, which are:

- Areas of Lowland Herb-rich Forest and Lowland Forest were more extensive and stretched further south and east within the west of the study area.
- Plains Grassy Forest was more widespread between The Fingerboards and Glenaladale (i.e., in the east of the study area).
- Plains Grassy Woodland was more widespread around The Fingerboards south of Bairnsdale-Dargo Road (to the south east of the study area).

Patches of Plains Grassy Forest and Plains Grassy Woodland are of elevated conservation significance due to their rarity and conservation status of Vulnerable and Endangered respectively. The latter vegetation class is associated with the critically endangered (EPBC-listed) Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) Grassy Woodland and Associated Native Grassland ecological community and the FFG listed Forest Red Gum Grassy Woodland.

The Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) Grassy Woodland has two forms (DEWHA, 2010):

- Grassy woodland: the most common form of the ecological community, which has a projective foliage cover of more than 5 % and is dominated by Gippsland red gum (*Eucalyptus tereticornis* subsp. *mediana*). The ground layer is covered by native perennial tussock grasses and grass-like plants with a variety of wildflowers such as daisies, lilies and orchids, occupying the spaces between tussocks.
- Grassland: natural temperate grasslands formerly occurred on the Gippsland plains, but they may have been entirely cleared since European settlement. In the grassland remnants of this ecological community, it is likely that a tree canopy was formerly present, but it has been largely cleared and only the native ground layer remains. Many of these remnant grassland sites have been managed as native grasslands for decades.

While trees may be cleared from areas formerly forested, they may still meet the classification of Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) Grassy Woodland and Associated Native Grassland are therefore of very high conservation significance. Areas with ground vegetation dominated by seven or more native grasses and grass-like plants (for example, sedges, lilies or *Lomandra*) may be considered part of this community. The grassy woodland form of this nationally threatened ecological community has been recorded in the region at the Fernbank Recreation Reserve and Providence Ponds Flora and Fauna Reserve. The native grassland form of the ecological community has been recorded at the Fernbank Recreation Reserve. Therefore this community may be present in roadside reserves and scattered remnants within the study area.

Planted vegetation includes windrows of exotic species, modified treeless vegetation, and planted native vegetation that provides limited habitat for fauna species. The disturbed, modified or artificial nature of this value means the structure and composition of vegetation is often poor, resulting in limited opportunities for local indigenous wildlife to use these resources.

Many mature scattered remnant trees that are not part of a remnant patch of vegetation occur within cleared areas of the study area (Plate 4.9). There are likely to be several thousand scattered trees, which contribute to the area's ecological value. These trees not only represent some of the oldest in the landscape, but also provide habitat and connectivity for a wide range of ground dwelling and arboreal fauna. They also provide an insight into the composition of vegetation in the landscape prior

to disturbance and provide opportunities for restoration around these assets. The modelled conservation significance for scattered trees, which was developed to aid in the assessment of planning permit applications to clear native vegetation that are classified as low impact, generally rates the area surrounding The Fingerboards as moderate to high. A 'low' rating for scattered trees is assigned from the eastern area of the state forest e.

Plantations

Plantation forests, both blue gum and pine, dominate the western areas of the study area (Plate 4.12). These areas provide some ecological value within the landscape. They adjoin state forest and provide habitat for a range of species (for example foraging habitat). When forested, these areas provide a degree of forest cover that can provide habitat connectivity to other remnant areas.

Habitat provided by plantations is of lower ecological value than intact remnant vegetation. This is because:

- Plantations are periodically subject to complete clearance when harvested.
- Stands are monocultures and their plant diversity is low.
- Structural diversity is low with absence of an understory.

4.3.6 Key aspects and issues

The project area currently consisting of the main areas of mineralisation covers a large area with a range of ecological values. Potential flora and fauna issues will depend on the refined project location.

Potential high level issues for terrestrial aquatic biodiversity values may relate to direct or indirect project activities or mechanisms. These issues can be grouped into three broad types:

- Habitat loss from vegetation clearance and earthworks and subsequent smothering of vegetation by eroded material, altered hydrology and altered land uses.
- Habitat degradation associated with the establishment of invasive species or the introduction of pathogens, edge effects, deposition of eroded sediments, or from contamination caused by accidental spills of hazardous materials.
- Reduced abundance and/or diversity of flora and fauna populations as a consequence of:
  - Injury, death or displacement of flora and fauna from vegetation clearing and earthworks, collision with vehicles, or predation by exotic species.
  - Changes to available habitat (including food sources, shelter and nesting or roosting sites) due to habitat loss and degradation (described above).
  - Increased disturbance (through project-related noise and lighting) disrupting the behaviour of fauna and potentially reducing reproductive success.
- Reduced water quality of downstream of aquatic habitats as a result of changes to hydrology, elevated turbidity, TSS and concentrations of contaminants potentially affecting aquatic ecosystems.

Within the project area, existing remnant vegetation (both patches and scattered trees) is likely to provide corridors or act as habitat stepping stones (or refuges) for wildlife moving across the mostly modified landscape. The removal of remnant vegetation within the project area has the potential to further fragment and isolate some ecological values within the heavily modified landscape. Biodiversity most vulnerable to isolation include fauna restricted to woodland habitats such as small ground-dwelling species, species which have the inability to disperse over large distances (low mobility), and species with small populations.

The loss of hollow-bearing trees from native forests in Victoria, including scattered remnant trees in paddocks such as in the project area, is considered to be a threatening process under the FFG Act. Hollow-bearing trees play a specific role in providing habitat for a range of fauna taxa. Given hollows generally form as trees age, hollow-bearing trees are also regarded as significant due to the long time required to replace this resource. Removal of mature hollow-bearing trees will reduce the presence of hollow-dependent fauna species including arboreal mammals, parrots, owls and bats in the project footprint. Several species recorded during the site visit are known to require hollows during their life cycle (e.g., yellow-tailed black cockatoo, *Calyptorhynchus funereus*). Removal of hollow-bearing and regeneration trees has the potential to limit the long-term maintenance of these species populations in the project area.

Potential permitting and project considerations that may result as a consequence of the issues above include:

- Removal of nationally (EPBC) or state-listed vegetation communities and Ecological Vegetation Class (EVC) some with a conservation status of vulnerable or endangered.
- The potential for removal of habitat and/or flora and fauna species listed under Victorian and Australian legislation with consequential approval conditions placed upon the project.
- Offset requirements resulting from the clearance of native vegetation and habitat. Depending on the placement of project infrastructure this may create significant cost imposts to the project. In terms a Native Vegetation Location Risk score, most of the study area is classified as ‘Location A’ the lowest risk rating.

4.3.7 Conclusion

The project is located within a transitional zone between three bioregions and at the boundary of southern cool temperate and eastern warm temperate zones. As a consequence, the region contacts biogeographically distinct and diverse flora and fauna communities, many of which are absent from, or rare in, the rest of Victoria. Within the study area native and non-native habitats occur with varying levels of disturbance, including relatively intact state forests, small remnant native stands of trees, isolated mature trees, and cleared grassland.

Potential ecological issues relating to the project include vegetation clearance and consequential habitat loss, further habitat degradation and reduced abundance and/or diversity of flora and fauna populations. Permitting considerations for the project include the potential removal of nationally (EPBC) and state-listed conservation significant vegetation communities, removal of habitat and/or flora and fauna species listed under Victorian and Australian legislation and offset requirements resulting from the clearance of native vegetation and habitat.

Further detailed ecological investigations will be required to define ecological impacts and their management for the project.

4.4 Land use and planning

This section outlines the land use and planning context for the project. It provides an overview of the existing land uses within the project area and wider region and planning policy framework that relates to the project. The study area incorporates south east Victoria with a focus on East Gippsland Shire and Wellington Shire.

4.4.1 Existing land uses

The majority of land in south east Victoria is public land occupied by state forests, national, coastal and marine parks (EGCMA, 2013 and WGCMA, 2012). The bulk of private land has been cleared for agriculture and is used for grazing, dairy, meat production, forestry and irrigated horticulture.

The key land uses within the project area and immediate surrounds include grazing (sheep and cattle), dairy, irrigated horticulture, hobby farms, plantations, state forest, and residential, leisure and commercial uses in small rural towns. The Fernbank-Glenaladale Road (local road) and Bairnsdale-Dargo Road (declared road) traverse the eastern part of the project area.

There are in the order of 15-20 residences within or directly adjacent to the project area. The town of Glenaladale is situated just north of the project area within the East Gippsland Shire. Glenaladale is a settlement with scattered residences, a community hall, recreational reserve, playground and Country Fire Authority facilities.

4.4.2 Planning context

The project area straddles three local government areas, the East Gippsland Shire, Wellington Shire and South Gippsland Shire. Given that no project works are expected to be required at the preferred port option of Port Anthony within the South Gippsland Shire, the focus of this review is on the planning context for the East Gippsland Shire and Wellington Shire.

The planning permit requirements for the project will depend on the environmental and planning approvals process that applies to the project. Should the project require an EES, a planning permit will not be required to use or develop land for mining within the Mining Licence. Planning permit(s) or planning scheme amendments may be required for project activities that are not related to mining or minerals processing.

State Planning Policy Framework

The State Planning Policy Framework consists of policies that apply to land across Victoria. Key clauses within the State Planning Policy Framework of relevance to the project and their key objectives are:

- Clause 11.08 Gippsland regional growth: aims to build economic resilience in the Gippsland region through economic diversification and new investment and ideas.
- Clause 14.01 Agriculture: aims to protect productive agricultural land of strategic significance within the local area and region. This involves protecting against the unplanned loss of productive agricultural land from permanent changes to land use.
- Clause 14.02 Water: aims to assist in protecting and restoring catchments, water supply sources and the marine environment.
- Clause 14.03 Resource exploration and extraction: aims to encourage natural resource exploration and extraction in accordance with environmental standards. It sets out factors to be considered when determining buffer areas between extractive activities and sensitive land uses.

Local Planning Policy Framework

The Local Planning Policy Framework sets out the local policies that apply to land within a municipality. They are specific to each local government area and consist of a Municipal Strategic Statement, local policies, schedules and incorporated documents.

East Gippsland Shire

Key clauses in the East Gippsland Municipal Strategic Statement of particular relevance to the project and their key objectives are:

- Clause 21.05 Environmental risk: aims to ensure that land use and development occurs in locations and is carried out in ways that reduce the potential for land degradation.
- Clause 21.06 Natural resource management: aims to encourage the exploration for and development of mineral resources in suitable areas. This is to be achieved through strategies such as identifying valuable areas as resources for potential extractive industries and ensuring that they are not sterilised by inappropriate development, including development on neighbouring properties.
- Clause 21.09 Economic development: aims to encourage development of a range of industries in appropriate locations in the Shire or adjacent to major towns (DELWP, 2015b).

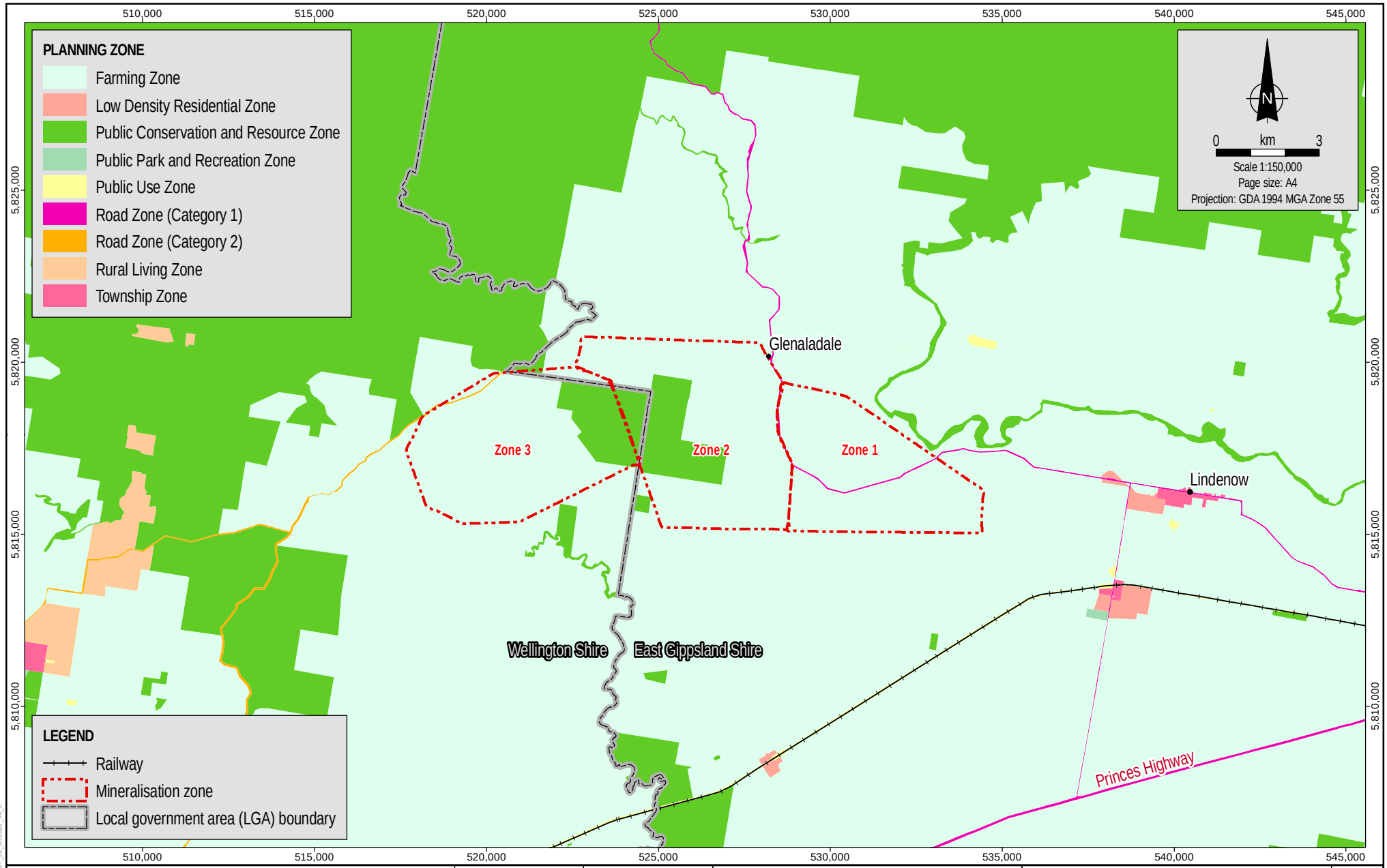
The majority of the project area situated within the East Gippsland Shire is zoned Farming Zone (FZ1 and FZ4) under the East Gippsland Planning Scheme (see Figure 4.4). The purpose of the Farming Zone is to protect land for agriculture and encourage the retention of productive agricultural land. Under the Farming Zone, a planning permit is required to carry out earthworks which change the rate of flow or the discharge point of water across a property boundary.

Small areas east of the project area are zoned Public Conservation and Resource Zone (PCRZ) under the East Gippsland Planning Scheme. The purpose of this zone is to protect and conserve the natural environment and natural processes and provide for appropriate resource based uses. A planning permit is required to construct a building or construct or carry out works within this zone.

The Bairnsdale-Dargo Road, which passes through the east of the project area, is zoned Road Zone Category 1 (RDZ1). A planning permit is required to create or alter access to a road in a Road Zone Category 1.

The following overlays apply to the project area situated within the East Gippsland Shire (see Figure 4.5):

- An Erosion Management Overlay (EMO) applies to much of the east and north east of the project area. The purpose of this overlay is to protect areas prone to erosion, landslip or other processes that will degrade the land by minimising land disturbance and inappropriate development. A planning permit is required for earthworks where excavations or fill exceed one metre (height or depth).
- A Bushfire Management Overlay (WMO) applies to small sections of the east of the project area. The purpose of this overlay is to implement bushfire protection measures in areas where there is a bushfire hazard and ensure that development of land minimises risk to life and property from bushfire to an acceptable level.
- A Vegetation Protection Overlay (VPO) applies to parts of some of the road reserves within the project area. The purpose of this overlay is to protect areas of significant vegetation and minimise the removal of vegetation.



Source:
Mineralisation zones from Kalbar.
Railway and planning zones from Vicmap.
LGA boundary from ABS.

coffey

Date: 30.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F04.04_GIS

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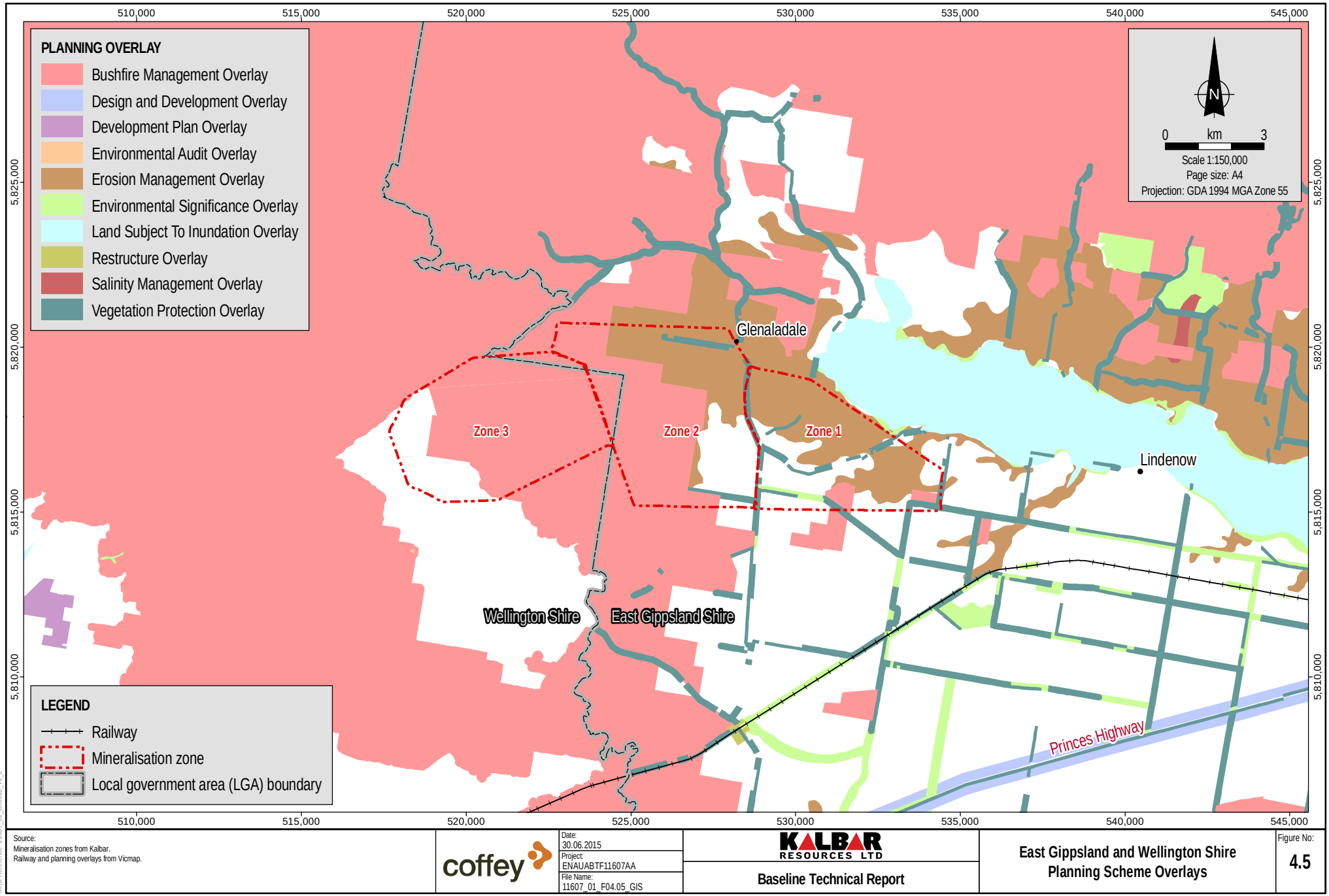
East Gippsland and Wellington Shire Planning Scheme Zones

Figure No: 4.4

MXD Reference: 11607_01_GIS001_v0_2



Source:
Mineralisation zones from Kalbar.
Railway and planning overlays from Vicmap.

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East Gippsland and Wellington Shire Planning Scheme Overlays

Figure No: 4.5

MXD Reference: 11607_01_GIS015_v0_2

- An Environment Significance Overlay (ESO38) applies to land surrounding the Mitchell River to the east of the project area and a selection of road reserves. The purpose of this overlay is to ensure that development of land is compatible with its identified environmental values. Under most circumstances a planning permit is required for buildings and works, subdivision and vegetation removal.

Wellington Shire

Key clauses in the Wellington Municipal Strategic Statement of particular relevance to the project and their key objectives are:

- Clause 21.5 Natural resource management: aims to:
  - Protect natural assets and areas of ecological, cultural heritage and scientific interest.
  - Preserve water quality and quantity within catchments and ensure its availability for domestic and agricultural users.
  - Achieve sustainable management of rural land, particularly agricultural, timber and other industries that depend on natural resources within the Shire (DELWP, 2015c).
- Clause 21.17 Economic development: aims to increase and diversify the region's economy and achieve job growth. This is to be met through strategies such as facilitating exploration and support for business enterprises which use the Shire's natural resources in a sustainable way.

The majority of the project area situated within the Wellington Shire is zoned Farming Zone (FZ) under the Wellington Planning Scheme (see Figure 4.4). A planning permit is required for certain building or works within this zone.

The centre of the project area is zoned Public Conservation and Resource Zone (PCRZ) as are small areas northwest and southwest of the project area. A planning permit is required to construct a building or construct or carry out works within this zone.

A Bushfire Management Overlay (WMO) applies to much of the western part of the project area that falls within the Wellington Shire Council.

Particular Provisions

Particular Provisions are controls generally associated with a specific use or activity, which is not geographically defined by a planning scheme map, such as a zone or overlay. Relevant Particular Provisions to this project include:

- Clause 52.08: Earth and Energy Resources Industry. This is the principal clause that deals with mineral exploration and mining. A permit is required to use and develop land for earth and energy resources industry unless a specific exemption applies.
- Clause 52.17: Native Vegetation. This clause sets out the general requirement for a permit to remove, destroy or lop native vegetation. The provision includes a three-tiered approach to manage native vegetation removal in Victoria including avoidance, minimisation and provision of offsets.
- Clause 52.29: Land Adjacent to a Road Zone Category 1. This clause requires a planning permit to create or alter access to a road in a Road Zone Category 1. Within the project area this applies to the Bairnsdale-Dargo Road. A planning permit will be required should upgrades to this road be required for the project.

4.4.3 Key aspects and issues

Key land use and planning aspects and issues associated with the project are expected to relate to the:

- Temporary use of agricultural land for the development of an extractive industry. This could influence the availability of agricultural land within the East Gippsland Shire and Wellington Shire in the short to medium term.
- Incompatible uses of land could lead to changes to the natural environment and natural processes and / or peoples' enjoyment of these areas along with changes in amenity. For instance, the use of land zoned for protection and conservation (or use of land adjoining these areas) for the development of an extractive industry and the development of an extractive industry in proximity to residential properties.
- Environmental and heritage values associated with land within the project area and surrounds could be influenced by the change in land use. This is discussed further in Sections 4.1 (Geology, Landforms and Soils), 4.2 (Surface Water and Groundwater), 4.3 (Biodiversity), 4.5 (Cultural Heritage) and 4.7 (Landscape and Visual Amenity).

4.4.4 Conclusions

The project area and immediate surrounds are dominated by agricultural activities including grazing (sheep and cattle), dairy and irrigated horticulture. This is reflected in the zoning in the project area which is largely Farming Zone (FZ). There are also a number of natural assets and areas of environmental sensitivity within the project area and surrounds which are reflected in the zoning and overlays that apply (such as the Public Conservation and Resource Zone (PCRZ) and Environment Significance Overlay (ESO38). It is expected that the key land use and planning issues associated with the project will relate to the change in land use, most notably the temporary loss in productive agricultural land, and the incompatible uses of land.

4.5 Cultural heritage

This section describes the Aboriginal and non-Indigenous cultural heritage values within the study area. It also includes a discussion of potential cultural heritage issues associated with the construction and operation of the project.

4.5.1 Aboriginal cultural heritage

The Indigenous inhabitants of the East Gippsland region are known as the Gunaikurnai people. Pre-European settlement, the Gunaikurnai comprised five tribal groups; the Krowathunkooloong, Brataualong, Tatungalong, Brabralong, Brayakaulung peoples (GTLMOB, 2015). For thousands of years, the East Gippsland region sustained the Gunaikurnai people, providing fertile soils, freshwater systems and coastal environments that offered food sources, hunting and gathering sites and shelter. Influenced by seasonal weather and food supplies, these groups moved between defined coastal areas and the foothills of the Great Dividing Range high country (GTLMOB, 2015). Traditionally Gunaikurnai territory occupied most of present-day Gippsland, between Wilson's Promontory and far East Gippsland, including the coastal and inland areas and much of the southern slopes of the Victorian Alps (GTLMOB, 2015). Aboriginal artefacts present in the region provide evidence of this occupation. The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) is the Registered Aboriginal Party for the Gippsland area (DJR, 2010)

A review of Victorian Department of Premier and Cabinet cultural heritage sensitivity mapping indicates that there are areas of cultural heritage sensitivity within and adjacent to the project area,

particularly near fresh watercourses including rivers and creeks (DPC, 2015). Approximately 80 registered places (predominately scarred trees and artefact scatters) were identified on the Victorian Aboriginal Heritage Register as being present in the wider East Gippsland region; however only 10 of these sites are located within or adjacent to the project area. Of these, one registered heritage place (a scarred tree) is located within the project area and two scarred trees are on the boundary of the project area. One artefact scatter is located just to the east of the project area, close to the banks of the Mitchell River (Figure 4.6).

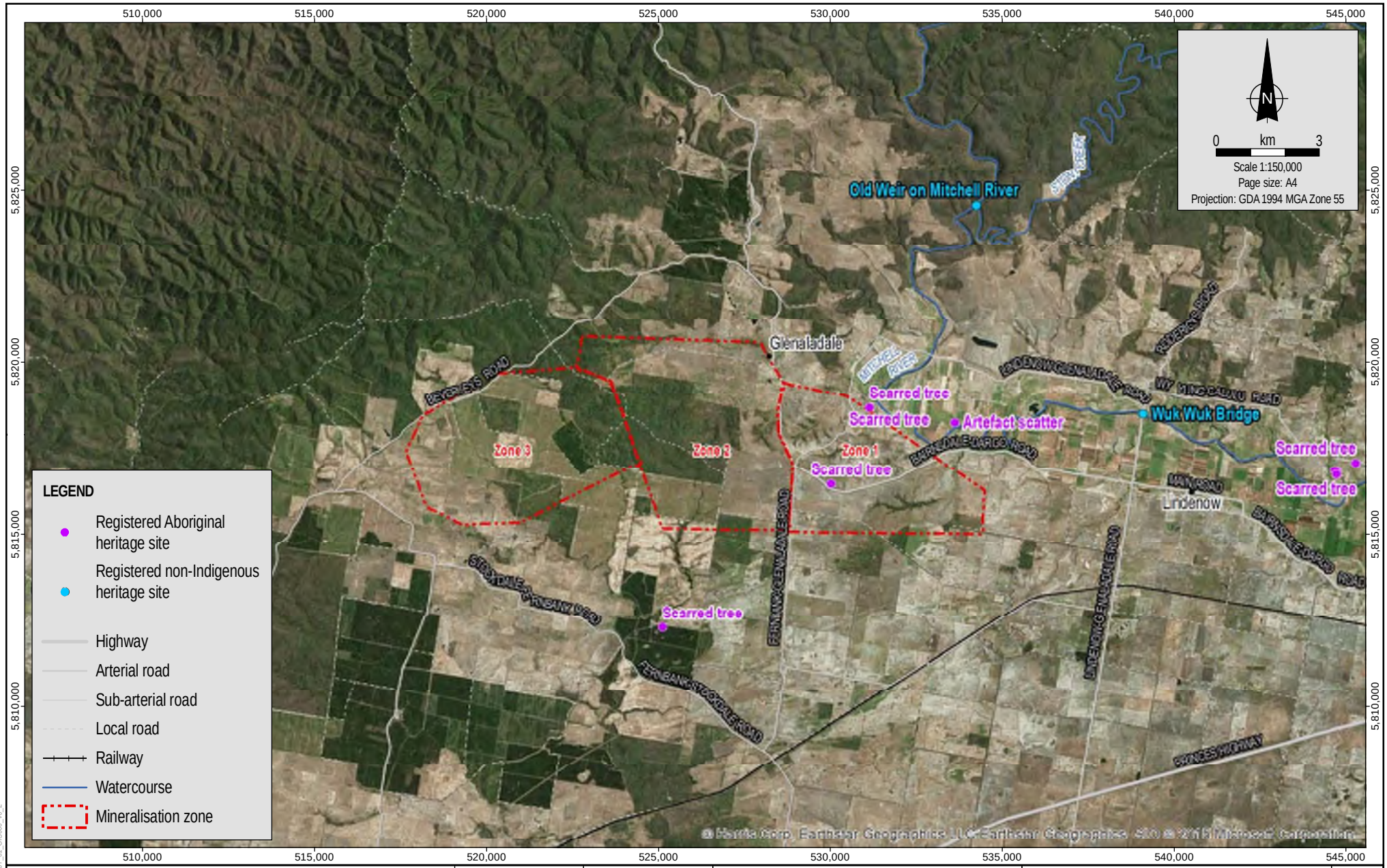
Initial desktop investigations undertaken by AECOM in 2012 as part of the preliminary constraints, opportunities and process assessment report (AECOM, 2012) established that an area to the south of the project area (as per the project footprint at the time of the desktop study) had been recorded as a sand dune feature which is believed to be Pleistocene in age. Pleistocene sand dunes are associated with significant sites and old burial areas and are therefore typically classified as highly sensitive landforms.

4.5.2 Non-Indigenous cultural heritage

East Gippsland was one of the first parts of the eastern Australian mainland to be sighted by Europeans. However, there was little European activity in the region until the late 1830s, when land in the Buchan, Tubbut and Gelantipy areas was taken up by graziers moving south into Victoria from southern New South Wales (EGSC, 2015). Although land was primarily used for sheep and cattle grazing, other land uses in the area included dairying and timber extraction. Growth of the region took place in the 1850s and 1860s and was associated with the region's gold rush. From the 1880s more substantial growth took place as settlement moved into the adjacent forests and hills. Development of the area continued during the early 1900s and throughout the post-war years (EGSC, 2015).

Many of the townships surrounding the project area still contain historical buildings and relics that provide a record of the European history of the area, including the unregistered former Fernbank School (established 1908). The Fingerboards is an area located at the intersection of the Bairnsdale-Dargo Rd and Glenaladale-Fernbank Road and is known to have local significance due to its association with past grazing.

A search of the Victorian Heritage Database indicates that there are a number of listed heritage places adjacent to but not within the project area. These include Wuk Wuk Bridge and the Glenaladale Weir (both are listed on the National Trust register). The Old Weir on Mitchell River (also known as Glenaladale Weir) is located near the junction of the Mitchell River and Stony Creek. Construction commenced in 1891 however the weir was damaged by floods in 1893 and was never repaired. Sections of the weir wall are still present today (EGCMA, 2015). The Wuk Wuk Bridge was constructed in 1937 and forms the overpass of the Mitchell River for the Lindenow-Glenaladale Road. The bridge is historically, scientifically and aesthetically of State significance. It is a representative example of novel Victorian bridge engineering of the mid to late 1930s (HCV, 2015). Although most of the timber foundations have been replaced, one of the original pylons is still present (Plate 4.13). Figure 4.6 shows the location of these two sites.



Source:
Indigenous heritage sites from Victorian Aboriginal Heritage Register (via Kalbar, currency April 2014).
Non-Indigenous heritage sites from Heritage Council Victoria.
Mineralisation zones from Kalbar.
Roads and railway from Vicmap.
Imagery from Bing (capture date unknown).

MXD Reference: 11607_01_GIS006_v0_2

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Date: 29.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F04.06_GIS

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Baseline Technical Report

Registered cultural heritage places

Figure No: **4.6**

Photo credit: Coffey

Plate 4.13
The original pylon at the Wuk Wuk Bridge

Photo credit: Coffey

Plate 4.14
Glass bottles on private property at a disused gravel borrow pit

Photo credit: Coffey

Plate 4.15
Old homestead and its associated buildings located near The Fingerboards

During a site visit by Coffey in June 2015 potential historical relics including glass bottles (Plate 4.14), and an old homestead and its associated buildings (Plate 4.15) were identified.

4.5.3 Key aspects and issues

This section provides a high level summary of the likely cultural heritage aspects and issues associated with the project.

The Aboriginal cultural heritage aspects and issues relate to:

- The presence of scar trees and artefact scatters in the greater area, the proximity of the project area to the Mitchell River and its associated creeks and tributaries, and regional patterning of known archaeological sites (as identified by cultural heritage mapping) makes it likely that further significant sites will be identified within the project area during cultural heritage surveys, which will require management.
- Discovery of previously unidentified Aboriginal cultural heritage sites, places or items during the construction phase of the project could cause project delays.
- The presence of significant cultural heritage areas or sites could require changes to the project layout and/or monitoring and salvage work.
- The preparation of a cultural heritage management plan (CHMP) is mandatory if an EES is required for the project. Depending on the level of assessment required (i.e., standard or complex assessment), the preparation of this document can take an extended period.

The non-Indigenous cultural heritage aspects and issues relate to:

- The presence of unidentified non-Indigenous cultural heritage sites could require salvage work during the life of the project.
- Any significant sites within the project area may need protecting if salvage work is not an option.

4.5.4 Conclusions

The Gunaikurnai people have a strong spiritual, physical, social and cultural connection to their land. There is also a rich European history in East Gippsland, which forms part of the region's character and historical value. The key cultural heritage issues relating to the project are expected to be associated with the presence of unidentified cultural heritage sites, places or items in the project area which could influence the layout and timing of the project and the requirements for monitoring and salvage work. The rich archaeological history of the area suggests that there will be significant unregistered sites present in the study area. Once the project description and footprint are established, further investigations will be required to understand the cultural heritage significance of the study area and the impacts to cultural heritage that could be associated with the project.

4.6 Socio-economic

This chapter provides an overview of the existing socio-economic environment within the study area. The study area for the socio-economic review comprises three local government areas (LGA's), Wellington, East Gippsland and South Gippsland LGAs. As the project activities occurring within the South Gippsland LGA are expected to be limited to the movement of trucks and shipment of the HMC to the preferred port option of Port Anthony, socio-economic information has been provided for the South Gippsland LGA under the transport and access aspect only.

The majority of data reported on in this review has been sourced from the 2011 Australian Bureau of Statistics (ABS) census.

4.6.1 Population and demography

The town of Glenaladale is located just north of the project area. The project area straddles the East Gippsland and Wellington Local Government Areas (LGA) (see Figure 4.4). The population of East Gippsland LGA and Wellington LGA was 42,196 and 41,440 in 2011 respectively (ABS, 2011bc) (Table 4.11). The East Gippsland LGA population comprised of 49.3% males and the Wellington LGA of 50.2% males which was similar to the Victorian average of 49.4% in 2011.

The study area was characterised by an ageing population with 23.8% of the East Gippsland LGA and 16.8% of the Wellington LGA aged 65 years or older in 2011, compared to the Victorian average of 14.2%. The median age of the East Gippsland LGA (47 years) was considerably higher than the Victorian average of 37 years (see Table 4.11). The majority of the population in both LGA's was born in Australia, with English the predominate language spoken (ABS, 2011bc).

The average household size in the study area in 2011 was below the Victorian average of 2.6 people, at 2.3 people per household in the East Gippsland LGA and 2.4 people in the Wellington LGA.

Table 4.11 Population and demography in the study area in 2011

Locality	Total population	Median age	Seniors % (65+)
East Gippsland LGA	42,196	47	23.3%
Wellington LGA	41,440	41	16.8%
Victoria	5,354,042	37	14.2%

Source: ABS, 2011bc

4.6.2 Housing and accommodation

The primary land use within the project area is agricultural which includes a mixture of grazing sheep and cattle, dairy and irrigated horticulture. The East Gippsland and Wellington LGAs had a similar percentage of occupied private dwellings (77.3% and 77.2% respectively) in 2011, lower than the Victorian average of 88.7%. Of the occupied private dwellings in the East Gippsland LGA, 45.3% were owned outright, 27.8% were owned with a mortgage and 23.3% were rented. Of the occupied private dwellings in Wellington LGA, 39.5% were owned outright, 33.8% were owned with a mortgage and 22.9% were rented (ABS, 2011bc).

Real estate data for the Bairnsdale region shows that the median selling house price was $239,500 and average rental income was $285 per week in May 2015. House prices in Bairnsdale have consistently increased between 2012 to 2014, moving on average from $230,000 (2012), to $235,000 (2013) and $243,000 in 2014 (REA Group, 2015). During the period 1 May 2014 to 18 May 2015 Bairnsdale had 124 house sales. During the same period there were 310 house listings for rent (REA Group, 2015). There was no real estate data available for the township of Glenaladale however a Lindenow land demand and supply assessment analysed the supply and demand for residential, commercial and industrial land in the town and made recommendations to respond to future land requirements over the next 20 years (Urban Enterprise, 2010). The report outlined that there is a strong demand for township lots and houses in Lindenow. Residential price growth in Lindenow has been steady however high sale prices are not being reached despite the strong demand.

Short term accommodation within 10 km of the project area is fairly limited and includes the Old School Bed and Breakfast in Fernbank (see Plate 4.16), Wuk Wuk Caravan Park and Coonawarra Farm Resort near Glenaladale which has two campsites, a lakeside lodge resort and self-contained cabins (Google Earth, 2015). The majority of short term accommodation is located in the wider study area near or within the towns of Bairnsdale, Stratford, Lakes Entrance, Sale, Briagalong and Dargo.

Photo credit: Coffey

Plate 4.16
The Old School Bed and Breakfast

Photo credit: Coffey

Plate 4.17
Glenaladale recreation reserve

Photo credit: Coffey

Plate 4.18
Glenaladale playground

Photo credit: Coffey

Plate 4.19
Lindenow football club

Photo credit: Coffey

Plate 4.20
Lindenow Hotel

Photo credit: Coffey

Plate 4.21
Lindenow General Store

These towns have a range of short term accommodation including hotels, motels, bed and breakfasts, holiday units and caravan parks.

A survey of tourist visitation (Tourism Victoria, 2013) found that the Gippsland region received an estimated 1.6 million domestic overnight visitors for the year ending December 2013. This was an increase of 10.4% from 2012 to 2013. Fourteen per cent of all domestic overnight visitors to regional Victoria visited the Gippsland region (Tourism Victoria, 2013). As Gippsland is a popular tourist destination, room occupancy rates in the region remain high, with Tourism Victoria estimating an increase of 2.6% to 47.0% occupancy in the year ending June 2014 (Tourism Victoria, 2014).

4.6.3 Employment, local business and economy

In 2011, the proportion of the labour force looking for work in the East Gippsland LGA (5.5%) was similar to the Victorian average (5.4%). The Wellington LGA unemployment rate was sitting at 5.2% (see Table 4.12). The percentage of Victorians on an income less than $400 per week (39.9%) was lower than for both the East Gippsland and Wellington LGA, sitting at 47.0% and 44.0% respectively (ABS, 2011bc).

The main sources of employment in the East Gippsland LGA in 2011 were school education (6.4%), residential care services (4.5%) and sheep, beef cattle and grain farming (3.9%) (ABS, 2011bc). The top industries of employment in the Wellington LGA were dairy cattle farming (6.1%), school education (5.9%), and hospitals (5.0%).

Managerial, technicians and trades workers and professional positions were the main types of occupation in the study area, in line with the Victorian trend (See Table 4.12).

Table 4.12 Education and employment in the study area (2011)

Locality	Proportion of labour force unemployed	Top employment industry	Top type of occupation
East Gippsland LGA	5.5%	School education (6.4%)	Managers (15.7%)
Wellington LGA	5.2%	Dairy cattle farming (6.1%)	Managers (17.3%)
Victorian average*	5.4%	School education 4.4% and dairy farming at 0.4%.	Manager 13.2%

Note: *Employment industries and occupation given for Victoria average are not necessarily the top industries for Victoria, they have been shown as a comparison against the top industries for the LGAs.
Source: ABS, 2011bc

East Gippsland Shire estimates the gross regional product of the area at $1.55 billion, representing 0.5% of the Victoria's gross product (EGSC, 2015). The East Gippsland Economic Development Strategy (EGSC, 2014) provides focus growth areas and aims to drive opportunities across industries. The focus growth areas include manufacturing, construction, agriculture, forestry, fishing, retail, health services and tourism. The strategy also outlines a focus on maximising the opportunities in the mining industry for local businesses and the community.

The Wellington Shire Council Economic Development and Tourism Strategy (2011-2015) (WSC, 2011) aims to identify and enhance the economic drivers for the area which have given the region a proven comparative advantage. The strategy provides actions according to industry sectors, including the mining, oil and gas industry with a particular focus on supporting alternative energy sectors (WSC, 2011).

4.6.4 Social and community infrastructure

The East Gippsland LGA and Wellington LGA contain a range of community infrastructure such as community centres, libraries, and sporting and recreational facilities that provide formal and informal opportunities for sporting and recreational involvement. Community infrastructure in close proximity to the project area includes conservation parks and recreational areas such as the Mitchell River National Park (approximately 16 km away) and the Bairnsdale racecourse and recreational reserve (approximately 30 km away). Sporting ovals and playgrounds were sighted during a site visit by Coffey (June 2015) in Lindenow, Lindenow South, Fernbank and Glenaladale (see Plate 4.17 and Plate 4.18). The town of Lindenow approximately 15 km from the project area has a primary school, football club, hotel and general store (see Plate 4.19, 4.20, 4.21). The East Gippsland LGA has 23 primary schools and 8 secondary schools, the Wellington LGA has 24 primary schools and 4 secondary schools (DET, 2014).

The Department of Health's local government area profiles (DoH, 2014ab) provide health services information for both the East Gippsland and Wellington LGAs (see Table 4.13). The number of general practitioners per 1,000 of the population was similar to the Victorian average of 1.2 for both LGAs and the number of pharmacies available in both the East Gippsland and Wellington LGAs is similar to the Victorian average of 0.2.

The main public hospital in the East Gippsland LGA was the Bairnsdale Regional Health Service and in the Wellington LGA, the Central Gippsland Health Service at Traralgon. The Bairnsdale Regional Health service includes dental services, home based nursing services, palliative care, residential aged care, pathology and an emergency department.

Table 4.13 Access to services and community infrastructure in the study area

Services	East Gippsland LGA	Wellington LGA	Victorian measure
Number of hospitals/health services	3	4	305
General practitioners per 1,000 population	1.1	1.1	1.2
General practice clinics per 1,000 population	0.7	0.5	0.5
Pharmacies per 1,000 population	0.2	0.3	0.2
Number of schools in the LGA	38	37	2,238
Percentage of population near to public transport	19.6%	26.6%	74.2%
Aged care places (low care) per 1,000 eligible Population	37.3	63	44.4

Source: DoH, 2014ab

4.6.5 Transport and access

The project area can be accessed by the Bairnsdale-Dargo Road, which leads to the Lindenow-Glenaladale Road through the township of Walpa. The Lindenow-Glenaladale Road leads to the Princes Highway which intersects the South Gippsland Highway at Sale. Port Anthony can be

accessed by the South Gippsland Highway via Barry Road. See Section 4.7 Built infrastructure for more information regarding road infrastructure in the project area.

In the East Gippsland LGA, 69.1% of work journeys were by car in 2011 with 0.6% of the population using public transport, compared to the Victorian average of 66.2% and 11.1% respectively (DoH, 2014a). The Wellington LGA had a greater percentage of work journeys by car at 68.2% in 2011 with 0.7% of the population using public transport (DoH, 2014b). There were 648.9 passenger vehicles per 1,000 people in the East Gippsland LGA in 2011 and less in the Wellington LGA (610.4 passenger vehicles per 1,000 people) (See Table 4.13).

4.6.6 Community health

The socio-economic indexes for areas (SEIFA) (ABS, 2011a) highlight the relative socio-economic advantage and disadvantage with a LGA and towns or areas' vulnerability to change. The index is calculated in terms of people's access to material and social resources, and their ability to participate in society. Both the East Gippsland LGA and Wellington LGA recorded a SEIFA score below the Australian average of 1000, with 942 and 961 indicating a slight disadvantage (ABS, 2011a).

The East Gippsland LGA reported higher rates of asthma, high blood pressure and heart disease than the Victorian average. The exception was type 2 diabetes which was below the Victorian average (see Table 4.14). Cancer incidence was well above the Victorian average, especially for males (957.9 incidences against a Victorian average of 577 incidences per 100,000), and avoidable deaths were higher than the Victorian average across all reported causes (DoH, 2014a).

Community health data for the Wellington LGA indicates that a higher percentage of the community suffer from health ailments such as asthma and type 2 diabetes than the Victorian average (see Table 4.14). The percentage of persons reporting high blood pressure and heart disease were all above the Victorian average in 2011. Smoking rates were high in the Wellington LGA, as was the percentage of people at risk of short-term harm from drinking, and cancer incidence was slightly above average (DoH, 2014b). In terms of psychological health, the percentage of the population in the Wellington LGA reporting high or very high levels of psychological distress was the fourth highest in Victoria. Emergency department presentation rates, including primary care type presentations, were well above the Victorian average and rates of intentional injuries (105.6 incidents per 1,000 of the population) and unintentional injuries (6.1 incidents per 1,000 of the population) were much higher than the Victorian average of 59.1 and 3.1 incidents per 1,000 of the population respectively (DoH, 2014b).

Table 4.14 Community health and services in the study area (2014)

Services	East Gippsland LGA	Wellington LGA	Victorian measure
Female life expectancy	78.4	78.0	80.3
Male life expectancy	83.3	83.1	84.4
Percentage of persons reporting asthma	13%	14.4%	10.9%
Percentage of persons reporting type 2 diabetes	3.8%	6.6%	5.0%
Percentage of persons reporting high blood pressure	28.3%	28.4%	24.5%

Table 4.14 Community health and services in the study area (2014) (cont'd)

Services	East Gippsland LGA	Wellington LGA	Victorian measure
Percentage of persons reporting heart disease	9.0%	7.0%	6.9%
Percentage of persons overweight	36.8%	37.4%	32.5%

Source: DoH, 2014ab.

Across both LGAs the life expectancy for males was higher than for females, and both were below the Victorian average. In the East Gippsland LGA males perform poorly on a variety of health behaviours, with the third highest percentage of smokers in Victoria as well as above average percentages of the population who do not meet fruit and vegetable intake and physical activity guidelines (DoH, 2014ab).

4.6.7 Native Title

In October 2010, the Federal Court, under the *Native Title Act 1993* (Cwlth), recognised that the Gunaikurnai people hold native title over much of Gippsland. At the same time, the Victorian Government entered into a recognition and settlement agreement with the Gunaikurnai people under the *Traditional Owner Settlement Act 2010* (Vic), the first agreement to be made under the Act (DJR, 2015).

The Native Title area extends across Crown land from West Gippsland close to Warragul, east to the Snowy River and north to the Great Dividing Range. The area also extends 200 m offshore. The same area is recognised under the agreement with the Victorian Government. The recognition of their land has resulted in the transfer of 10 parks and reserves to the Gunaikurnai as 'Aboriginal Title', to be jointly managed by the Gunaikurnai and the Victorian Government. It also allows the Gunaikurnai people to access and use Crown land for traditional purposes, including hunting, fishing and camping in accordance with current laws (DJR, 2010). The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) is the Registered Aboriginal Party for the Gippsland area (DJR, 2010).

4.6.8 Key aspects and issues

Key socio-economic aspects of any typical Australian community relate to population, housing, environmental health, infrastructure and economic characteristics all of which provide intrinsic values that are unique to a particular community. Residents consider such aspects and values important and these can range from physical spaces or places to less tangible attributes such as community cohesion, friendliness or character. Such values can usually only be identified through consultation and engagement with residents of the community.

This section outlines the key aspects and issues likely to be associated with the project. A summary of the study area's socio-economic aspects and associated issues are shown in Table 4.15.

Table 4.15 Socio-economic aspects and issues within the study area

Socio-economic aspect	Issue
Population and demographic	Change in the local population and community.
Property and land use	Temporary change in land available for agricultural production.
	Change in Aboriginal connection to country.
Environmental amenity	Change in amenity for surrounding communities.
Housing and accommodation	Change to the availability and affordability of housing.
	Change to the availability and affordability of short-term accommodation.
	Generation of training opportunities.
	Change to the local workforce availability.
	Generation of short-term employment opportunities.
Business and economy	Change in local business opportunities.
	Strong and sustainable local economy.
	Change in the supply and demand of goods and services.
	Change to the tourism trade associated with a decline in availability of short-term accommodation.
	Change to the tourism trade associated with the presence of the mine and associated changes to the amenity of the area.
Social and community infrastructure	Change to the availability and affordability of community infrastructure and services.
	Competition for resources such as water.
Transport and access	Accessible and safe roads.
Physical infrastructure	Change to the quality of local and regional physical infrastructure.
Community health and wellbeing	Change to the health and safety of the community.
Community values	Changes to sense of community and place.
	Integration and inclusiveness changes in the local community.

Key socio-economic issues associated with the project are expected to include:

- Changes in the local population due to an influx of workers associated with employment opportunities for the project. This in turn can affect the availability and affordability of housing, accommodation and social services and have other health and lifestyle implications. While Kalbar intend to primarily source the project workforce required for construction and operations from the local area, specialist expertise may be required from outside the area.

- Changes to amenity in communities surrounding the project area associated with the movement of construction vehicles and project traffic from the project area to Port Anthony. Refer to Section 4.10 (Noise), Section 4.9 (Air quality) and Section 4.8 (Built infrastructure) for a discussion on associated amenity issues.
- Change in land use for the construction of the proposed mine has the potential to temporarily change land available for agricultural production and generate competition for resources such as water.
- Project activities have the potential to increase income and demand for goods and services in the local community. For instance, the National Resources Sector Employment Taskforce estimates that each additional job in the mining industry generates up to three jobs in other industries (Minerals Council of Australia, 2015).

4.6.9 Conclusions

The East Gippsland and Wellington LGAs have an ageing population (ABS, 2011bc). The study area contains a range of social infrastructure and services including primary schools, secondary schools, recreation facilities and health services. Unemployment rates in the study area are similar to the Victorian average and school education and dairy farming were the top employment industries in 2011 for the study area.

Key potential socio-economic issues associated with project activities may include changes in the local population due to the influx of personnel during construction and operations of the project which in turn could affect the availability and affordability of housing, short-term accommodation and other social services in the area. Construction and operational activities may generate changes to the amenity for the local community and agricultural land use opportunities may be temporarily impacted by the land requirement for the project. The project also has the potential to generate an increased demand for goods and services and in turn contribute to the local economy of the surrounding region.

4.7 Landscape and visual amenity

This section provides an overview of the landscape and visual amenity within the study area. The study area for the landscape character and visual amenity review comprises the main areas of mineralisation (i.e., the project area) with an additional 5 km buffer.

4.7.1 Landscape character

The topography of the study area can be classified as flat to gently undulating with sharply rising river terraces, eroded gullies (Plate 4.22) and surface water forms scattered throughout the landscape. Gully, sheet and rill erosion are common features of the landscape. Fence lines, treed shelterbelts, thin bands of vegetation along property boundaries, road reserves, waterways and intermittent streams (such as the Mitchell River and its associated tributaries) provide a distinctive character to the area. Irrigated horticulture (Plate 4.23), grazing (both sheep and cattle) (see Plate 4.6) and dairy and hobby farming are the dominant land uses of the landscape.

The foothills of the Great Dividing Range rise gradually above the surrounding plains (Plate 4.24). This can be characterised as a rugged uninhabited upper landscape of mountains, hills, ridges and sheltered valleys covered by native forests. Key features in the landscape surrounding the project area include the Mitchell River National Park, significant wetlands and reserves, and state forest. The formation of these landscapes, coupled with remnant and riparian vegetation patches, and numerous waterways are the most significant natural features in the region.

Photo credit: Coffey

Plate 4.22
A gully within the project area

Photo credit: Coffey

Plate 4.23
Typical irrigation landscape showing the flat to gently undulating topography within the study area

Photo credit: Coffey

Plate 4.24
The foothills of the Great Dividing Range rising from the surrounding plains

There are several significant landscape overlays in proximity to the project area that relate to the Gippsland Lakes. East Gippsland is a valued scenic resource in Victoria, and is considered a major tourism destination due in part to its landscape significance.

The project area is located in the transitional zone of the Gippsland Plain and East Gippsland Lowlands bioregions, and a short distance from the Highlands Southern Fall bioregions and East Gippsland Lowlands bioregions, which is characterised by widespread, continuous tracts of native forest, with isolated 'islands' of settlement in the river valleys (DEPI, 2015c). Parts of these forests have supported a major timber industry for several decades. There is evidence of land clearing within the project area associated with irrigation, grazing and other agricultural activities.

The project area is sparsely populated. The undulating topography and roadside and paddock boundary vegetation present in the area act as natural screening, concealing or partially concealing residences and roadsides from certain viewpoints. Given the rural location of the project, the night landscape is primarily dark with scattered residences producing little external light. To the east of the project area, the towns of Walpa, Lindenow and Bairnsdale may emit a low light spill.

Potential viewpoints from the roadside to the mine site and associated infrastructure could be from Lindenow-Glenaladale Road, Rodericks Road, Bairnsdale-Dargo Road and other smaller roads running north of the project area towards the foothills.

4.7.2 Key aspects and issues

This section provides a high level summary of the likely landscape and visual aspects and issues associated with the project.

- A change to the landscape during the construction and operation of the project and its associated effects has the potential to affect the landscape values and visual amenity of the area enjoyed by local residences and passing motorists. This has the potential to adversely affect tourists coming to the region and could also attract visitors to the area curious to inspect the mine site. During construction key issues are expected to relate to the generation of dust, night lighting, transportation increases, vegetation removal, and visibility of built infrastructure, construction machinery and stockpiles. During operations, key issues are expected to relate to the visibility of mine infrastructure and stockpiles, land disturbance associated with mining activities, night lighting and transportation increases. With rehabilitation of the mined areas to occur progressively during mining, some of these changes to the landscape will be temporary, with the aim of rehabilitation and closure works to resemble the landscape prior to mining.
- While viewpoints to the project area are expected to be fairly limited given the topography of the landscape and the presence of some natural screening, it is likely that the project will be visible from adjacent roadsides such as the Bairnsdale-Dargo Road and Lindenow-Glenaladale Road.

4.7.3 Conclusion

The project is located in a region with high natural and rural landscape significance which is valued by local residences and tourists alike. These landscapes play an important role in shaping the region's character and identity, and modifications to these landscapes could influence the overall value of the region. The project area is located in a highly modified landscape that forms part of the region's rural setting.

Potential issues associated with landscape and visual amenity largely relates to the change in landscape during the construction and operation of the project. Potential zones of visual influence will need to be further investigated as a part of a landscape and visual assessment to better understand potential impacts.

4.8 Built infrastructure

This section describes the road network within the study area and the other pre-existing built infrastructure that could potentially support the project. It also includes a discussion of the issues associated with the project's transport and infrastructure needs.

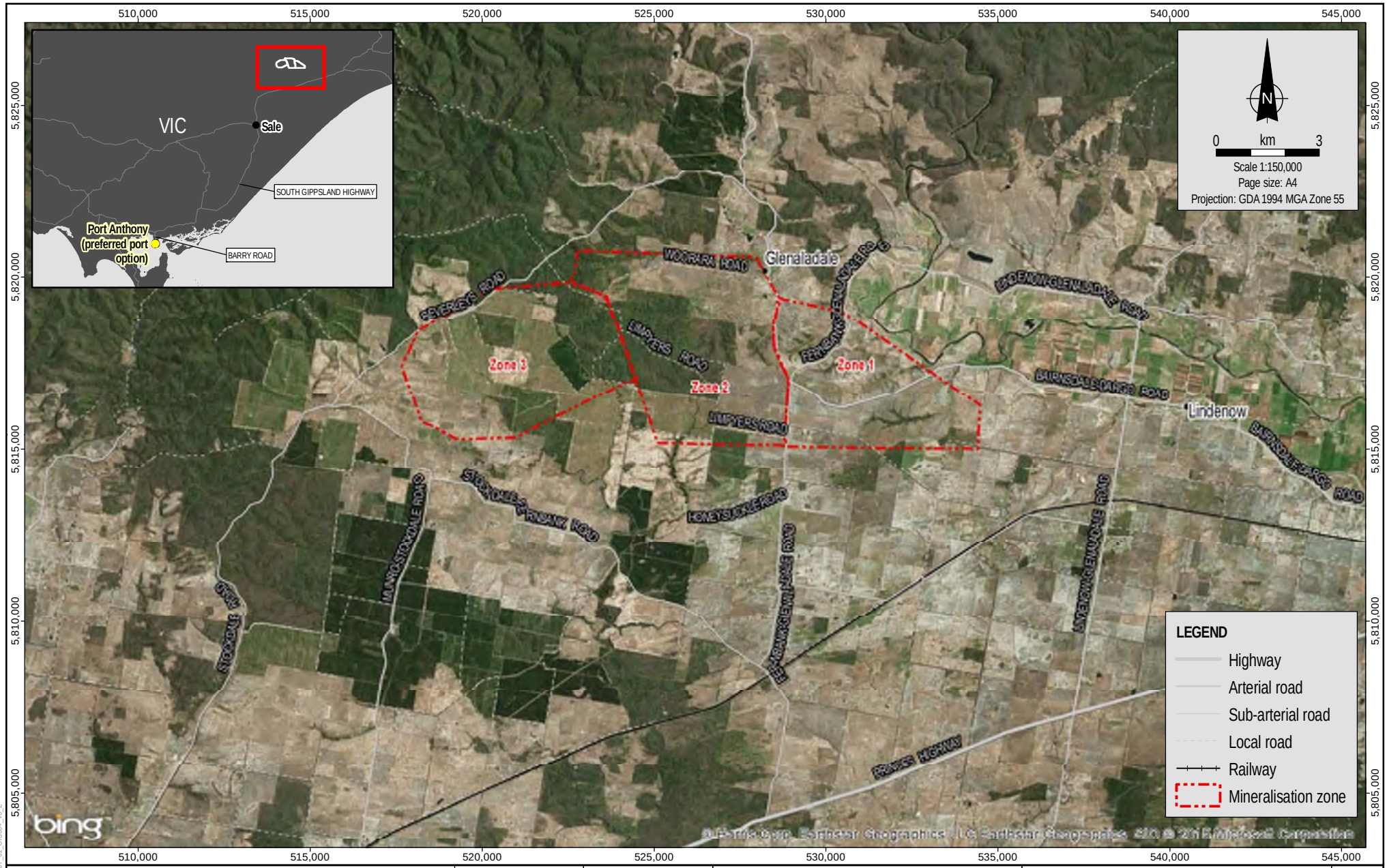
4.8.1 Road Network

A system of highways and regional and local roads make up the road network in the study area. This includes a combination of declared roads managed by VicRoads, and local roads managed by East Gippsland Shire and Wellington Shire. A number of regional arterial and sub-arterial roads and arterial highways are being considered as a part of the transport route for the construction and operation of the project (Figure 4.7). The local road network within and surrounding the project area is used to access private properties and arterial routes. Table 4.16 outlines the status of the existing roads that forms the study area.

Table 4.16 Status of existing road network in the vicinity of the project area

Name	Description	Pavement Type	Approved B-Double Road	Declared Road
Bairnsdale-Dargo Road	2 lane arterial road	Sealed	Yes	Yes
Lindenow-Glenaladale Road	2 lane arterial road	Sealed	Yes	Yes
Fernbank-Glenaladale Road	2 lane sub-arterial road	Sealed	No	No
Stockdale-Fernbank Road	2 lane sub-arterial road	Sealed	No	No
Beverleys Road	2 lane sub-arterial road	Sealed	No	No
Stockdale Road	2 lane sub-arterial road	Sealed	Yes	No
Munro-Stockdale Road	2 lane sub-arterial road	Sealed	No	No
Woorara Road	2 lane local road	Unsealed	No	No
Limpyers Road	2 lane local road	Unsealed	No	No
Honeysuckle Road	2 lane local road	Unsealed	No	No
Princes Highway	2 lane arterial highway	Sealed	Yes	Yes
South Gippsland Highway (route to Port Anthony via Princess Highway)	2 lane arterial highway	Sealed	No	Yes
Barry Road (road via South Gippsland Highway to Port Anthony)	2 lane arterial road	Sealed	No	Yes

During construction, materials and equipment will be transported to the project area from within Victoria, interstate and overseas. For international deliveries, shipments may arrive through Port of Melbourne, Port of Portland or Port Anthony, then via rail and/or road. All materials and equipment coming from within Victoria to the project area will most likely arrive via road, using the existing road network via the Princes Highway or via rail using the existing Melbourne-Bairnsdale rail line.



Source:
Mineralisation zones from Kalbar.
Roads, railway and watercourses from Vicmap.
Imagery from Bing (capture date unknown).

coffey

Date: 29.06.2015
Project: ENAUABTF11607AA
File Name: 11607_01_F04.07_GIS

KALBAR RESOURCES LTD

Baseline Technical Report

Existing road network in the study area

Figure No: **4.7**

MXD Reference: 11607_01_GIS004_v0_2

During operations, the project is anticipated to transport HMC directly to Port Anthony, which is located approximately 160 km southwest of the project area on Barry Road, Agnes. Six B-double trucks are proposed to make the return journey to the port each day, via the Princes Highway to Sale and then onto the South Gippsland Highway. The Princes Highway, South Gippsland Highway and Barry Road are all approved B-double roads. Two proposed local routes from the project site to Princes Highway are being investigated; east along Bairnsdale-Dargo Road to Lindenow-Glenaladale Road, and south to the Princes Highway; or west along Bairnsdale-Dargo Road to Fernbank-Glenaladale Road and south to Princes Highway.

Bairnsdale-Dargo Road (Plate 4.25) and Lindenow-Glenaladale Road (Plate 4.26) are single carriageway (one lane in each direction) arterial roads and approved B-double gazetted roads. Both roads are in good condition with minimal road shoulders in parts and have intermittent traffic volumes with a mix of passenger vehicles, farming machinery and freight vehicles (including B-doubles).

The township of Walpa is situated on the Bairnsdale-Dargo Road and the township of Lindenow South is located on the Lindenow-Glenaladale Road. The Lindenow-Glenaladale Road also intersects the Bairnsdale V/Line train line. There are no boom gates at this intersection, only warning lights. Townships north of the project area, such as Dargo, use the Bairnsdale-Dargo Road as the most direct southern route to access the Princes Highway.

Fernbank-Glenaladale Road (see Plate 4.11 in Section 4.3) is classified as a local sub-arterial road and is not an approved B-double gazetted road. Traffic volumes on this road could be characterised as intermittent with a mix of passenger vehicles, farming machinery, logging trucks (including a B-double logging truck seen during the site visit by Coffey on 4 June 2015) (Plate 4.27)) and freight vehicles. The road is a single carriageway in a moderate condition with minimal road shoulder in parts. It would need to be upgraded to an approved B-double gazetted road if selected as the preferred route to support the project. The township of Fernbank is situated close to the junction of Stockdale-Fernbank Road on Fernbank-Glenaladale Road. The road also intersects the Bairnsdale V/Line train line. There are only warning lights at this intersection (Plate 4.27).

The Fernbank-Glenaladale and Lindenow-Glenaladale roads (north of the project area) may be used to access the project site by project personnel. If this route is selected, the Mitchell River Bridge (Plate 4.28) located in Woodglen (one way) at the interchange of these two roads may need to be upgraded.

A number of local bus services and school bus services operate within the study area. This includes bus services from the Gippsland Lakes district and Bairnsdale and surrounding townships. The Lindenow South Primary School bus picks up passengers from the following townships: Dargo, Fernbank, Walpa, Glenaladale, Hillside/Bairnsdale, Flaggy Creek and Woodglen.

4.8.2 Other built infrastructure

A range of other infrastructure exists within the study area. The Melbourne to Bairnsdale V/Line train line runs parallel (east-west) with Fernbank-Lindenow South Road and has services from Melbourne return running six times daily (Monday to Saturday), and four times daily on Sunday.

Two communication towers were noted during the Coffey site visit; one within the project area (near The Fingerboards) on Fernbank-Glenaladale Road (Plate 4.29) and another smaller tower west of the township of Walpa. The Wy Yung water storage facility supplies drinking water to Bairnsdale and surrounding communities and was upgraded in 2008. There are existing transmission lines approximately 13 km north of the project area and 22 kV powerlines run east-west, crossing Fernbank-Glenaladale Road south of The Fingerboards (see Plate 4.29).

Photo credit: Coffey

Plate 4.25
Bairnsdale-Dargo Road (looking west)

Photo credit: Coffey

Plate 4.26
Lindenow-Glenaladale Road (looking north)

Photo credit: Coffey

Plate 4.27
Fernbank-Glenaladale Road railway crossing with B-Double truck

Photo credit: Coffey

Plate 4.28
Mitchell River Bridge in Woodglen

Photo credit: Coffey

Plate 4.29
Communication tower and 22kV powerline south of The Fingerboards

Photo credit: Coffey

Plate 4.30
Intersection of Lindenow-Glenaladale Road and Rodericks Road and Wuk Wuk Bridge

The Eastern Gas Pipeline transports natural gas from the Gippsland Basin (from Longford) to markets in Sydney and regional centres along its route including Bairnsdale. The pipeline is approximately 10 km from the project area. Numerous bridges are located in the study area including the Wuk Wuk Bridge on Lindenow-Glenaladale Road (Plate 4.30), the Mitchell River Bridge in Woodglen and various bridges on Princes Highway. One of note is the low rail bridge at Stratford with a 4.7 m clearance.

Port Anthony is a privately owned port with pre-existing infrastructure onsite. The facility contains a land-backed steel sheet piled 200 m wharf, crane pad and topped wharf apron. It operates one multi-purpose berth and has extensive laydown, receiving and handling areas, hardstand area storage and indoor storage facilities with overhead gantry cranes.

4.8.3 Key aspects and issues

This section provides a high level summary of the likely aspects and issues associated with built infrastructure within the study area. These include:

- The increased traffic volumes associated with the construction and operation phases of the project and safety on local and regional roads, intersections and level crossings.
- Changes to private property or townships access associated with road closures, temporary diversions or detours, during the life of the project.
- The construction of new roads or diversions of existing roads could require planning scheme amendments.
- Increased traffic volumes and transport loads could influence the condition of roads and necessitate increased maintenance of the road network as well as road or intersection upgrades including the Princes Highway.
- Project traffic interacting with existing school bus or local bus routes.
- Existing linear infrastructure such as powerlines, fibre optics or pipelines may need to be diverted if components of the project footprint are built within their path.
- Selection of transport methods (i.e., road and rail) to receive supplies and dispatch HM C during construction and operation.
- Upgrades to existing bridges or diversions around low height clearance bridges may need to occur to support the projects transportation needs.

4.8.4 Conclusion

The existing road network in the project area has the potential to support the project throughout its various phases. The project area is well serviced by other infrastructure such as communication towers and powerlines, the Melbourne/Bairnsdale V/Line train line and water storage facilities. Potential issues associated with built infrastructure are expected to largely relate to changes to the existing road networks due to an increase in traffic volumes and the types of vehicles needed to support the project. These issues will require further investigation as part of a socio-economic and traffic and transport impact assessment.

4.9 Air quality

The project area and surrounding landscape is sparsely populated with 15 to 20 residences within or directly adjacent to the project area. The nearest town to the project area is Glenaladale which is located on the northern boundary of the project area. Other towns within 10 km of the project area

include Stockdale, Iguana Creek, Fernbank, Walpa, Lindenow, Lindenow South, Woodglen and Wuk Wuk. Bairnsdale is the main service centre of East Gippsland and is located approximately 20 km east of the project area. Land use within and surrounding the project area predominantly consists of agriculture, forestry practices and conservation areas (DTPLI, 2007).

Key sources of ambient air emissions within the project area include:

- Controlled burning.
- Bushfires.
- Dust storms.
- Domestic wood heating.
- Motor vehicles.
- Heavy vehicle transportation associated with the timber and milling industry.
- Agricultural activities such as crop dusting and ploughing of paddocks.

These activities generate a range of air emissions including particulate matter, volatile organic compounds (VOCs), nitrogen oxides (NO_x) and sulfur oxides (SO_x).

The preferred port option of Port Anthony is an existing operational port located adjacent to the Barry Beach Marine Terminal. Key sources of air emissions from the port and terminal include transport, handling and storage of cargo (generating particulate matter), heavy machinery used to load and unload ships (generating VOCs, NO_x and SO_x).

Ambient air quality is monitored across Victoria by the Victorian Environment Protection Authority (EPA Victoria) using objectives and goals set in the State Environment Protection Policy (Ambient Air Quality) (SEPP AAQ). The SEPP AAQ adopts the requirements for gases and particulates of the National Environment Protection Council (Ambient Air Quality) Measure (Air NEPM) and also includes a separate objective for visibility reducing particles (EPA Victoria, 2014b). EPA Victoria measures a range of pollutants at 13 monitoring stations within the greater Melbourne area and at 1 regional location. The nearest monitoring station to the project area is the Traralgon monitoring station located 85 km southwest of the project area. Emissions monitored at this station include nitrogen dioxide, ozone, sulfur dioxide and particles as PM_{10}.

In 2013, the ozone (four-hour) and particulate matter (as PM_{10}) objectives were exceeded at Traralgon. Exceedances were still within the SEPP AAQ goal of no more than one exceedance for ozone and no more than five days per year for PM_{10}. The highest reading of PM_{10} was 104.8 µg/m^3 (the SEPP AAQ maximum ambient concentration is 50 µg/m^3) (EPA Victoria, 2014b). These exceedances were a result of planned burning, bushfires and local dust. Fine particles from industrial emissions from the Latrobe Valley can be expected to follow plume dispersion in the direction of the project area, but concentrations are expected to decrease with distance. No other air quality monitoring is available for the area.

Dispersion of air pollutants is climate dependent. Warmer temperatures lead to greater dispersion of pollutants released into the atmosphere and rainfall assists in removing particles and water soluble VOCs. According to data collected at the Bureau of Metrology's Mount Moornapa meteorological station (the nearest station to the project area), prevailing winds are predominantly in a westerly direction (BoM, 2012). The mean maximum temperature recorded at Mount Moornapa in 2014 ranged from 25.5°C (in January) to 12.1°C (in July) and mean annual rainfall was 838.6 mm (BoM, 2012). Rainfall is spread fairly evenly throughout the year.

4.9.1 Key aspects and issues

The project will be required to meet requirements set out in the *Environment Protection Act 1970* and the criteria set out in the SEPP (Air Quality Management) (SEPP AQM) for all activities within the

project area and along the transport route. Kalbar will be required to adhere to the existing requirements and management practices in place at the port.

The SEPP AQM provides a framework including objective and goals for managing emissions in Victoria from all sources of air pollutants (EPA Victoria, 2014a). Incorporated into the SEPP AQM are three protocols for environmental management (PEMs) that provide guidance on how to assess the potential impacts of emissions from industry, stationary sources and mining and extractive industries. The PEM criteria for mining and extractive industries are shown in Table 4.17.

Table 4.17 Assessment criteria for mining and extractive industries

Indicator	Criteria	Averaging period
PM_{10}	60 µg/m^3	24-hour average
$PM_{2.5}$	36 µg/m^3	24-hour average
Respirable crystalline silica (as $PM_{2.5}$)	3 µg/m^3	Annual average
Arsenic (total inorganic)	0.003 µg/m^3	Annual average
Hydrogen cyanide	340 µg/m^3	1-hour average
	9 µg/m^3	Annual average
Nitrogen dioxide	0.14 ppm	1-hour average
Carbon monoxide	29 ppm	1-hour average
Polycyclic aromatic hydrocarbons (as benzo-a-pyrene)	0.3 ng/m^3	Annual average
Asbestos	0.2 µg/m^3 or 0.05 phase contrast microscopy fibres/m^3	Annual average
Radionuclides*	As low as reasonably achievable	Annual average

* The term ‘radionuclide’ includes naturally occurring radioactive isotopes. ALARA is determined by the Department of Human Services, Public Health Branch under the *Radiation Act 2005* and Radiation Regulations 2007. This Act applies where radioactive material (as defined in the Act) is possessed, transported, mined or processed.
Source: EPA Victoria, 2007.

The suspended particle size of particulate matter (generally between 0.005 to 100 micrometres (µm) is important in determining dispersion rates in the atmosphere and impacts on human health. Smaller particulate matter is generally considered to be of greater health concern, due to its ability to penetrate deeper into the respiratory tract. The typical size ranges of particulate matter are:

- TSP – total suspended particulate matter refers to all suspended particulates with a general upper size range of 30 µm to 50 µm.
- PM_{10} – particulates with a size or equivalent aerodynamic diameter less than 10 µm.
- $PM_{2.5}$ – a subset of PM_{10}, refers to particulates with a size or an equivalent aerodynamic diameter of less than 2.5 µm. These particulates are also known as fine particles, and are generally produced through combustion.
- Silicon dioxide (SiO2), or silica, is of particular relevance to this project due to its presence in mineral sands. Respirable crystalline silica (RCS) is the fraction of airborne crystalline silica that has the capacity to enter into the gas exchange regions of the lungs and cause the medical condition silicosis. RCS is typically smaller than 2.5 µm ($PM_{2.5}$).

Given the main emission sources within the project area, it is expected that the main pollutants of concern would be: NO_x, VOCs and particulate matter (PM_{10}, $PM_{2.5}$ and RCS). PM_{10} and $PM_{2.5}$ is expected to be the primary emission of concern as a result of mining, processing and transportation activities. They key dust/particulate generating activities during construction and operations include:

- Clearing of vegetation and topsoil.
- Overburden removal and out-of-pit stockpiling at the initial stages.
- Overburden removal and emplacement directly as backfill.
- Construction of tailings storage facility walls.
- Loading and unloading of topsoil, ore and waste.
- Processing of ore.
- Transportation of the HMC for export.
- Wind erosion from exposed areas.
- Mobile plant and equipment exhaust emissions.

The key potential air quality issues associated with these project activities include:

- Change in PM concentrations.
- Reduced amenity.
- Decrease in respiratory health.
- Reduced crop quality and yield for irrigated horticulturalists downwind of the mine area (Lindenow Valley).

The prevailing westerly winds of the region may disperse dust from the project area across horticulture crops east of the project area, in Lindenow Valley. During the summer months (December to March) easterly winds along the coast have the potential to reduce particle dispersion from the metropolitan and Latrobe Valley region. However during these months the risk of bushfire is increased, which can result in increased ambient concentrations of particulate matter.

4.9.2 Conclusions

Given the existing land uses in the project area and surrounds, background air quality is expected to be generally good (i.e., within SEPP AAQ objectives). This is supported by the monitoring results at Traralgon where only exceedances of ozone and particulate matter were recorded as a result of bushfires and planned burning. Establishing an air quality monitoring program at and surrounding the project area will assist in recording baseline ambient air quality and provide a data set against which air quality impacts associated with the project can be compared. This can also be used as a baseline for any construction or operation monitoring programs.

4.10 Noise

The project area and surrounding landscape is sparsely populated. There are in the order of 15-20 residences scattered within or adjacent to the project area. Glenaladale is the nearest town to the project area located on the boundary of the project area. Other towns within 10 km of the project area include Stockdale, Iguana Creek, Fernbank, Walpa, Lindenow, Lindenow South, Woodglen and Wuk Wuk. Bairnsdale is the main service centre of East Gippsland and is located approximately 28 km east of the project area.

There is no available noise data for the project area and immediate surrounds. Land within and surrounding the project area is zoned predominantly for agriculture, forestry practices and conservation areas (DTPLI, 2007). The noise environment is reflective of this and background noise levels are generally low. As identified during a site visit by Coffey in June 2015, background noise levels are characterised by natural noise sources with occasional vehicle and agricultural machinery

noise (associated with activities such as crop dusting, ploughing). Roads located within and adjacent to the project area, including the Fernbank-Glenaladale Road and Bairnsdale-Dargo Road have low traffic volumes but carry heavy vehicles, including logging trucks associated with blue gum and softwood plantations (see Plate 4.27, Section 4.8: Built infrastructure).

There are a number of small towns and isolated residences located along the proposed transport routes from the project area to the preferred port option of Port Anthony. Sale is the largest town along the two proposed routes. The majority of the two proposed transport routes are along the Princes and South Gippsland highways, which are classified as arterial highways (VicRoads, 2015). These highways and all roads included in the proposed transport routes, with the exception of Fernbank-Glenaladale Road, are approved under the VicRoads B-Double Network and are already used as major transport routes (VicRoads, 2015). Port Anthony is located at Corner Inlet in South Gippsland, approximately 133 km southwest of the project area adjacent to the Barry Beach Marine Terminal. The Barry Beach Marine Terminal is the main supply depot for ExxonMobil's Bass Strait oil and gas operations (ExxonMobil, 2015). Port Anthony is an operational port and caters for handling dry-bulk cargo with a focus on bulk commodities such as brown coal, dairy products and timber (Port Anthony, 2014).

Barry Beach Marine Terminal is located adjacent to Port Anthony and operates 24 hours a day servicing 23 offshore oil and gas platforms and installations (ExxonMobil, 2015). Approximately 70,000 tonnes for cargo are shipped from the terminal each year (ExxonMobil, 2015). The main source of noise emissions from the Barry Beach Marine Terminal and Port Anthony are the loading, unloading and movement of cargo and the transport of goods and workforce to and from the site.

Weather conditions can have an effect on noise propagation. Climate in the lowlands of East Gippsland is temperate. Data collected at the Mount Moornapa meteorological station (the nearest station to the project area) showed that prevailing winds are predominantly in a westerly direction (BoM, 2012). The mean maximum temperature recorded at Mount Moornapa ranged from 25.5°C (in January) to 12.1°C (in July) and mean minimum ranged from 5.3°C (July) to 13.5°C (February). The mean temperature at 9:00 a.m. ranged from 7.0°C (July) to 16.8°C (January).

4.10.1 Key aspects and issues

The project will generate noise emissions during construction and operations. Excessive noise emissions can cause hearing damage, reduce amenity, disrupt sleep and disturb wildlife. The main noise generating activities associated with construction and operation of the project are expected to include:

- Establishment of infrastructure (site access and haul roads, site office and workshop, power and water).
- Removal of topsoil, subsoil, overburden and ore.
- Construction of tailings storage facility walls.
- Processing of ore.
- On-site vehicle/heavy equipment traffic.
- Transport of heavy mineral concentrate to the port.
- Additional traffic with light vehicles going to and from the mine.

It is anticipated that noise associated with the operation of the mine will occur 24 hours per day, 7 days per week. Construction noise will be short term compared with operations noise and is likely to be greater at times. The extent to which noise will be an issue at any location will depend on several factors including:

- Existing noise environment.
- Proximity of residences and habitat to noise generating activities.
- Variable factors such as weather and wind direction.
- Occurrence of adverse conditions that may cause enhanced noise propagation.
- Individual sensitivity to noise.
- Duration of project-derived noise.
- Timing of project-derived noise.
- Tonal qualities of repetitive project-derived noise.
- Effectiveness of noise mitigation and management procedures carried out by Kalbar.

Adverse weather conditions for noise propagation occur in inversion conditions, when a light wind blowing from the source to the receiver enhances noise propagation and noise levels are higher than they would be otherwise. Cool, still mornings often occur in the project area and are likely to be the biggest issue for noise propagation as a result of weather conditions.

EPA guidelines Noise from Industry in Regional Victoria (NIRV) (EPA Victoria, 2011) provide the methods to set noise criteria for industry in regional Victoria and include specific reference to noise from earth resources industries such as mining and quarrying. Noise levels from project activities will need to be met for day, evening and night periods. Construction activities are to be limited to the day periods and noise should not be above background levels inside any adjacent residence between 2200 and 0700. Day, evening and night periods are defined in Table 4.18.

Table 4.18 Defined noise periods

Period	Time
Day	0700 to 1800 Monday to Friday
	0700 to 1300 Saturdays
Evening	1800 to 2200 all days
	1300 to 1800 Saturdays
	0700 to 1800 Sundays and public holidays
Night	2200 to 0700

Source: EPA Victoria, 2011.

Recommended base noise levels as outlined in the EPA guidelines NIRV that are likely to be applied to the project area are shown in Table 4.19.

Table 4.19 Noise assessment criteria expected to be applied to the project area

Period	Day	Evening	Night
Project area (farming zone/rural conservation zone)	46 dB	41 dB	36 dB

Source: EPA Victoria, 2011.

Noise management of construction activities often takes an adaptive approach. This means that management of noise impacts are adapted in response to weather conditions, surrounding noise conditions and noise complaints. Noise impacts are subjective and strict compliance with the EPA's assessment criteria may not correlate with annoyance for particular residents. In view of this,

negotiations with affected residents can play an important role in determining acceptable noise impact outcomes on a case-by-case basis, based on feedback from impacted residents.

4.10.2 Conclusions

Further noise monitoring studies are required in the project area to determine background noise levels and set a baseline level to use for monitoring during construction and operation activities.

5 Conclusion

This report has provided an overview of the physical context and key environmental and social features of the project area and surrounding region for the Glenaladale Mineral Sands Project. It has also outlined key environmental and social issues likely to be encountered during project construction, operations, decommissioning and rehabilitation of the Fingerboards Mine.

Key features of the East Gippsland region are its significant natural assets including declared 'heritage rivers', Ramsar listed wetlands, national parks and reserves which attract many tourists. It comprises diverse flora and fauna communities, many of which do not exist or are rare in other parts of Victoria. The majority of private land within the region has been cleared for agriculture and is used for grazing, dairy, meat production, forestry and irrigated horticulture. Surface water and groundwater are recognised by the community as high-value resources in the region.

The project area and immediate surrounds are dominated by grazing, dairy, irrigated horticulture, hobby farms, plantations, state forest, and residential, leisure and commercial uses in small rural towns. Surface water and a number of shallow groundwater bores are used for stock and domestic uses. There are known areas of cultural heritage sensitivity within and adjacent to the project area, particularly near fresh watercourses. The project area is also well serviced by the existing road network and other infrastructure.

It is expected that the project will require an EES under the Victorian *Environment Effects Act 1978* and a referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) . Once the project description and footprint are established, key issues that are likely to need to be further investigated as a part of this process include:

- Presence of and potential impacts on nationally (EPBC Act) or state-listed vegetation communities and Ecological Vegetation Classes (EVCs) within the project area.
- Presence of and potential impacts on habitat and/or flora and fauna species listed under Victorian and Australian legislation.
- Presence of and potential impacts on significant Aboriginal and non-Indigenous cultural heritage areas or sites within the project area.
- Presence of Native Title interests within the project area.
- Presence of infrastructure (roads, power, water, telecommunication and gas) that may need to be diverted or relocated during the life of the project.
- Competing uses of finite groundwater and surface water resources with other licensed groundwater and surface water users including irrigators, stock farmers, domestic users.
- Changes to soil structure and fertility, soil chemistry and landform relating to project construction and operations activities.
- Changes in the local population due to an influx of workers associated with employment opportunities for the project and the associated effects on the availability and affordability of housing, accommodation and social services.
- Changes to private property or townships access associated with road closures, temporary diversions or detours, during the life of the project.
- Changes in noise emissions associated with project construction and operations activities.
- Changes in particulate matter concentrations associated with project construction and operations activities.

- Change to the landscape during the construction and operation of the project and its effects on the landscape values and visual amenity of the area.
- Temporary use of agricultural land for the development of an extractive industry and the influence this has on the availability of agricultural land in the area.

6 Glossary

The following glossary technical terms, acronyms and abbreviations are defined in the context of their use in this baseline report. Some definitions have been adapted from the Macquarie Dictionary, online dictionaries and encyclopaedias.

6.1 Units and Symbols

° degrees.
% percentage.
°C degrees Celsius.
µg microgram.
µg/m^3 microgram per cubic metre.
GL gigalitre.
ha hectare.
km kilometre.
km/h kilometre per hour.
kg kilogram.
kV kilovolt.
m^2 square metre.
mm millimetre.
ML megalitre.
ML/year megalitres per year.
m/s metres per second.
Mt Metric tonne.
nm nanometre.
NO_2 nitrogen dioxide.
NOx nitrogen oxides.
PM particulate matter.
PM_{10} particulate matter that is 10 micrometres or less in diameter.
$PM_{2.5}$ particulate matter that is 2.5 micrometres or less in diameter.
Ppm parts per million.
SiO_2 silica.
SOx sulfur oxides.
t/annum tonnes per annum.
VOCs volatile organic compounds.

6.2 Terms and Abbreviations

A

ABS *abbr.* Australian Bureau of Statistics.
Aboriginal cultural heritage *n.* the places, objects and human remains that are significant to Aboriginal people.
Abstraction *n.* The removal of water from a resource e.g. the pumping of groundwater from an aquifer.
Aeolian *n.* Deposited by wind driven processes.
Air NEPM *abbr*. National Environment Protection Council (Ambient Air Quality) Measure.
Alluvial *adj.* is loose, unconsolidated (not cemented together into a solid rock) soil or sediments, which has been eroded, reshaped by water in some form, and redeposited in a non-marine setting.
Aquifer *n.* a water-bearing layer of sediment or rock.
Aquitard *n.* a geological formation having low (but not zero) permeability to water, such as a silty or clayey layer.
Artefact *n.* any object made or modified by a human.

B

Baseflow *n.* sustained flow of a stream in the absence of direct run-off, due to groundwater discharge.

Bioregion *n.* the national bioregion classification system categorises regions that are geographically distinct based on characteristics such as geology, landform patterns, climate and ecological features.

Bioturbation *n.* the disturbing and reworking of soil or sediment on land or the sea floor by organisms living in it.

BoM *abbr.* Bureau of Meteorology.

Bore *n.* a hole drilled in the ground to obtain samples of soil or rock, intersect groundwater for extractive use, monitoring or investigation, or for a range of other purposes. In Australia is also a commonly used term for a constructed groundwater well.

C

Catchment *n.* an area which discharges to a common point.

Colluvial *adj.* general name for loose, unconsolidated sediments that have been deposited at the base of hillslopes.

Confined aquifer *n.* an aquifer in which groundwater is confined under pressure.

Confining layer *n.* geological material through which significant quantities of water cannot move, located below unconfined aquifers, above and below confined aquifers.

D

DEHP *abbr.* Department of Environment and Heritage Protection.

Diadromous *n.* aquatic fauna that live in fresh waters but migrate back to the ocean to breed.

Discharge *n***.** removal of water from or flow out of an aquifer, including flow to surface water, another aquifer, or artificial means such as pumping. See also ‘abstraction’.

Dissolved solids *n***.** soluble compounds such as salts which are in solution.

E

Ecological community *n.* a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat

Ecological vegetation class *n.* the basic mapping units used for biodiversity planning and conservation assessment at landscape, regional and broader scales in Victoria. They are derived from large-scale forest type and plant community mapping and are based on: plant communities and forest types; ecological information relevant to the species that comprise the communities; and information that describes variation in the physical environment.

Ecosystem *n.* a system made up of the community of living organisms (animals, plants, and microorganisms), which are interrelated to each other and the physical and chemical environment in which they live.

EIS *abbr.* environmental impact statement.

EPA Victoria *n.* Environment Protection Authority Victoria. Exists as an authority to ensure the protection of beneficial uses of the environment from adverse impacts of wastes and unwanted noise.

EPBC Act *abbr. Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*.

Ephemeral *adj.* lasting for a very short time

EPP *abbr.* Environmental Protection Policy.

Eutrophication *n.* a form of water pollution involving an excess of mineral nutrients such as nitrates and phosphorus leaching from soils; often the result of pollution from sewage effluent, soil fertilisers, etc.

EVC *abbr.* Ecological vegetation class.

F

Formation *n.* A geological structure such as a rock mass or layer.

Freshwater *n.* water containing low salt concentrations, typically less than 1,000 mg/L.

G

Graminoids *n.* are grasses, which are monocotyledonous, usually herbaceous plants with narrow leaves growing from the base.

Groundwater *n***.** any sub-surface water, generally present in an aquifer or aquitard.

Groundwater basin *n***.** contains one or more groundwater catchments within a geological basin. Basins may extend off shore or across State boundaries. In some cases, a basin may be broken into one or more sub-basins to reflect administrative management boundaries.

Groundwater catchment *n.* an area containing a connected groundwater resource, bring together the input (recharge) areas, use (demand) areas and discharge areas.

Groundwater flow *n.* the movement of water in an aquifer.

Groundwater Management Area (GMA) *n.* a discreet area where groundwater of a suitable quality for irrigation, commercial or domestic and stock use is available or expected to be available.

Groundwater Management Unit (GMU) *n.* comprised of either a groundwater management area and/or a water supply protection area.

H

Heavy mineral concentrate *n*. an assemblage of titanium and zirconium minerals derived from the processing of a heavy mineral ore. It typically contains ilmenite, zircon, rutile and leucoxene.

HMC *abbr.* heavy mineral concentrate.

Hydraulic Conductivity *n*. A standard measure of the permeability of a geological formation or its ability to transmit groundwater flow.

Hydraulic Gradient *n*. The slope of the watertable in an unconfined aquifer, or the potentiometric surface in a confined aquifer.

Hydrogeology *n.* The study of the inter-relationships of geologic materials and processes with water, especially groundwater.

I

ILUA *abbr.* Indigenous Land Use Agreements.

Infrastructure *n.* the supporting installations and services that supply the needs of a project.

L

Lacustrine *adj***.** pertaining to produced by or formed in a lake.

Landform *n.* a feature (largely defined by its form and location in the landscape) of topography caused by geomorphologic processes.

LGA *abbr.* Local Government Area.

N

N/A *abbr.* not applicable.

Native Title *n.* in Australia, communal, group or individual rights and interests of Aboriginal peoples or Torres Strait Islanders in relation to their connection to land or water and whose possession under their traditional law or customs is recognised by Australian law; established by the *Native Title Act 1993*.

Native vegetation *n.* trees, shrubs, herbs and grasses that have grown naturally in an area before European arrival.

O

Outcrop *n*. An exposure of bedrock.

P

Perennial *n.* plant that lives for more than two years.

Perched aquifer *n*. An unconfined aquifer of limited extent located above the true watertable.

Permeability *n***.** The ability to transmit fluids through a porous medium.

Permissible consumptive volume *n*. the total volume of water that can be taken in an area or water system over a period of time.

Project area *n.* the total area potentially disturbed by proposed project activities

R

Ramsar wetlands *n.* a site protected by an international treaty on the conservation and wise use of wetlands and their resources.

RCS *abbr*. respirable crystalline silica.

Recharge *adj*. addition of water to or flow into an aquifer (generally) from rain. Also used to describe water entering an aquifer from surface water, groundwater, or artificial means.

Remnant vegetation *n***.** native vegetation remaining after widespread clearing has taken place.

Riparian *n.* of, relating to or located on the banks of a river or stream.

Runoff Rain *n*. water that flows across the land surface without entering the sub-surface.

S

Saline Water *n.* water containing high levels of dissolved salts, typically between 10,000 and 40,000 mg/L. (Compare Fresh, Brackish and Brine).

Saturated Zone *n.* the zone in which the voids in the rock are completely filled with water. The watertable represents the top of the saturated zone in an unconfined aquifer.

Scarred tree *n.* trees which have had bark removed.

Sediment Unconsolidated *n.* geological material which has been formed by a process of deposition as discrete particles.

SEIFA *abbr*. socio-economic Indices for areas.

SEPP AAQ *abbr.* State Environment Protection Policy (Ambient Air Quality).

SEPP AQM *abbr.* State Environment Protection Policy (Air Quality Management).

Sensitivity *n.* determined from its susceptibility or vulnerability to threatening processes, and as a consequence of its intrinsic value. Attributes that define sensitivity (e.g. formal status, rarity, resilience, intactness) can be revised by technical specialists to reflect the specific focus of the technical study.

Specific storage *n.* the amount of water that a portion of an aquifer releases from storage, per unit mass or volume of aquifer, per unit change in hydraulic head, while remaining fully saturated.

Specific yield *n.* the ratio of the volume of water a rock will release by gravity drainage to the bulk volume of the rock.

Spring *n*. the land to which water rises naturally from below the ground and the land over which the water then flows.

Storativity *n.* the storage coefficient is the volume of water released from storage per unit decline in hydraulic head in the aquifer, per unit area of the aquifer. Storativity is a dimensionless quantity, and ranges between 0 and the effective porosity of the aquifer.

Stygofauna *n.* fauna that live within groundwater systems, such as caves and freshwater aquifers and within the pore spaces of limestone, calcrete or laterite, but are also found in marine caves and wells along coasts.

T

TDS. *abbr.* Total Dissolved Solids.

Tributaries *n*. rivers or streams flowing into a larger river or lake.

TSF *abbr.* tailings storage facility.

U

Unconfined aquifer *n*. an aquifer with no confining layer between the watertable and the ground surface where the watertable is free to rise and fall.

W

WSPA *abbr.* Water Supply Protection Area is an area declared under section 27 of the Water Act 1989 to protect the groundwater or surface water resources through the development of a management plan which aims for equitable management and long-term sustainability.

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Watertable *n*. the top of the saturated zone in an unconfined aquifer.

Well *n.* A hole drilled into a groundwater resource (aquifer), oil or gas resource reservoir) and constructed with a casing and screen or similar. In Australia also commonly referred to as a ‘bore’.

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Attachment A - EPBC Act Protected Matters Report

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Australian Government

Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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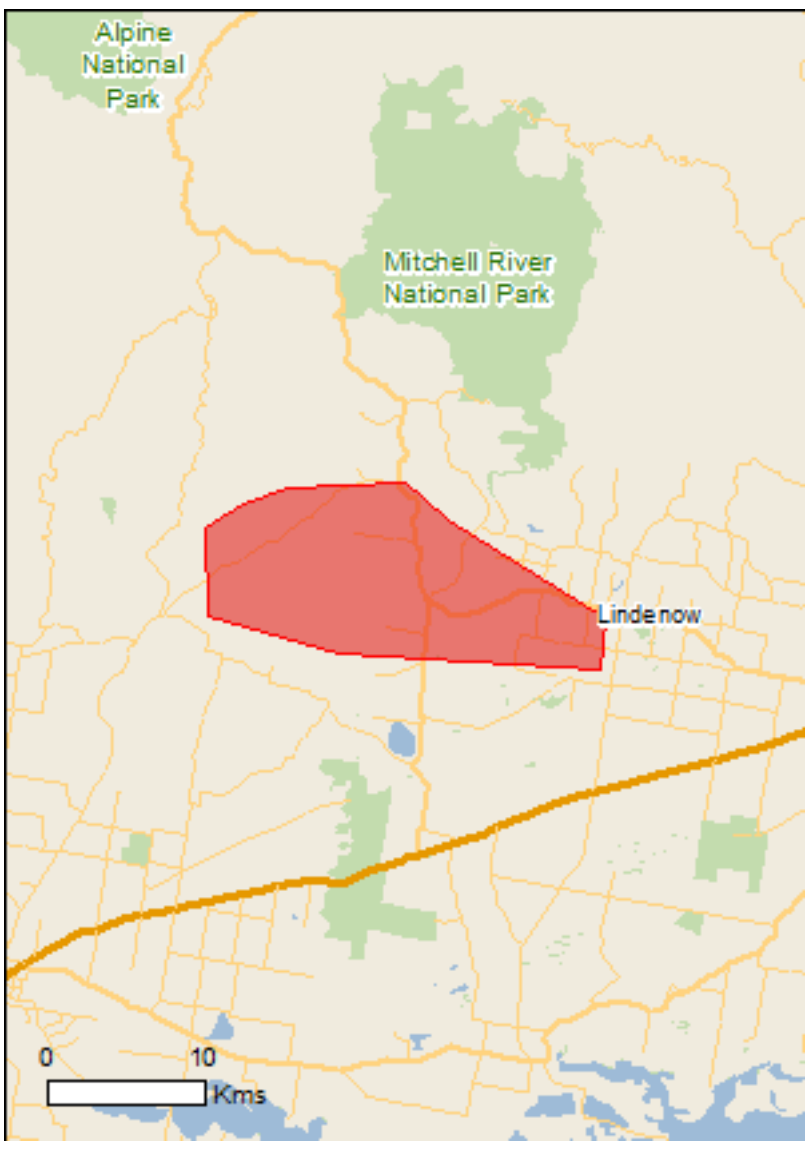

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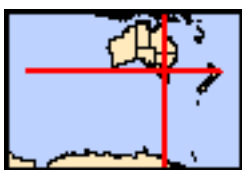

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	19
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	37
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Gippsland lakes	Upstream from Ramsar

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Gippsland Red Gum (Eucalyptus tereticornis subsp. mediana) Grassy Woodland and Associated Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat likely to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat likely to occur within area
Insects		

Name	Status	Type of Presence
[Synemon plana](#)		
Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
[Dasyurus maculatus maculatus (SE mainland population)](#)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
[Petrogale penicillata](#)		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
[Potorous tridactylus tridactylus](#)		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
[Pseudomys novaehollandiae](#)		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
[Pteropus poliocephalus](#)		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
[Commersonia prostrata](#)		
Dwarf Kerrawang [87152]	Endangered	Species or species habitat likely to occur within area
[Glycine latrobeana](#)		
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area
[Thesium australe](#)		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
[Xerochrysum palustre](#)		
Swamp Everlasting [76215]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#)		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Haliaeetus leucogaster](#)		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
[Hirundapus caudacutus](#)		
White-throated Needletail [682]		Species or species habitat likely to occur within area
[Merops ornatus](#)		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
[Monarcha melanopsis](#)		
Black-faced Monarch [609]		Species or species habitat known to occur within area
[Myiagra cyanoleuca](#)		
Satin Flycatcher [612]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
[Rhipidura rufifrons](#)		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
[Ardea alba](#)		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
[Ardea ibis](#)		
Cattle Egret [59542]		Species or species habitat may occur within area
[Gallinago hardwickii](#)		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Pandion cristatus](#)		
Eastern Osprey [82411]		Species or species habitat may occur within area
[Rostratula benghalensis (sensu lato)](#)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
[Apus pacificus](#)		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Ardea alba](#)		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
[Ardea ibis](#)		
Cattle Egret [59542]		Species or species habitat may occur within area
[Gallinago hardwickii](#)		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Haliaeetus leucogaster](#)		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
[Hirundapus caudacutus](#)		
White-throated Needletail [682]		Species or species habitat likely to occur within area
[Lathamus discolor](#)		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
[Merops ornatus](#)		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
[Monarcha melanopsis](#)		
Black-faced Monarch [609]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Mitchell and Wonnangatta Rivers H.R	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
Gippsland RFA	Victoria

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Austrocylindropuntia spp. Prickly Pears [85132]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

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Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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