NOWA NOWA IRON PROJECT

ATTACHMENT 9 :

AQUATIC AND WETLAND ECOLOGY STUDY

Prepared for Eastern Iron Limited by Earth Systems

REVISION 1

EARTH SYSTEMS
Environment | Water | Sustainability

EASTERN IRON LIMITED

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Contents

Terminology

Term	Definition
ANFO	Ammonium Nitrate Fuel Oil
BIM	Biodiversity Interactive Map
Biodiversity	All life-forms (organisms) including plants, animals and micro-organisms
Bioregion	A landscape based approach to classifying the land surface using a range of environmental attributes such as climate, geomorphology, lithology and vegetation
Bioregional Conservation Status	An assessment of the conservation status of the native vegetation type (EVC) in the context of a particular bioregion, taking account of how commonly it originally occurred, the current level of depletion and the level of degradation of condition typical of remaining stands
BOM	Bureau of Meteorology
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals
CAMBA	China-Australia Migratory Bird Agreement
CMS	Convention of Migratory Species
DEPI	Department of Environment and Primary Industries
DEWHA	Department of Environment, Water, Heritage and the Arts
DPI	Department of Primary Industries (superseded by DEPI in April 2013)
DSE	Department of Sustainability and Environment (superseded by DEPI in April 2013)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
Ecological Vegetation Class (EVC)	Native vegetation classification system categorising a vegetation community based on a combination floristics, structure, life forms, ecological characteristics, and bioregions
EGL	East Gippsland Lowlands
EGU	East Gippsland Uplands
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPHC	Environment Protection and Heritage Council
Exotic/introduced species	Any species that is not native to Australia or its States and Territories. This definition can sometimes include non-indigenous vegetation.
FFG Act	Flora and Fauna Guarantee Act1988
GMA	Groundwater Management Areas
GipP	Gippsland Plain
JAMBA	Japan-Australia Migratory Bird Agreement.

Term	Definition
LAC	Limits of Acceptable Change
Native Vegetation	All vegetation that is native to Australia, and its States and Territories.
Non-indigenous (Native) Species	Australian species that are found beyond their original range
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
TSSC	Threatened Species Scientific Committee
VBA	Victorian Biodiversity Atlas

Definitions of Conservation Status of Threatened Species

Conservation Status	Definition
Commonwealth (EPBC Act 1999)	
Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual of the taxon has died
Critically Endangered (CR)	A species is Critically Endangered if it is facing an extremely high risk of extinction in the wild in the immediate future
Endangered (EN)	A species is Endangered if it is facing a very high risk of extinction in the wild in the near future but is not critically endangered
Vulnerable (VU)	A species is Vulnerable if it is facing a high risk of extinction in the wild in the medium-term future but is not critically endangered or endangered
Conservation Dependent (CD)	A species is Conservation Dependent when it is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of five years
Migratory	Migratory species listed under the international conventions and agreements Australia is party to are protected under the *Environment Protection and Biodiversity Conservation Act 1999*
Marine	Marine species listed under the international conventions and agreements Australia is party to are protected under the *Environment Protection and Biodiversity Conservation Act 1999*
Cetacean	Whales, dolphins and porpoises that are protected within Australian waters
Victorian (FFG Act 1988)	
Listed	Listed as threatened
Nominated (N)	Nominated for listing as threatened but has not yet completed the listing process. In some cases, the taxon may have received a preliminary or final recommendation indicating that it is eligible or ineligible for listing. In other cases, the nomination might not yet have been considered
Potentially Threatening Process	Processes have been listed as potentially threatening processes in accordance with Section 10 of the FFG Act.
Victorian (DEPI 2013) Advisory Lists	

Conservation Status	Definition
Extinct (EX)	A species or community is Extinct when there is no reasonable doubt that the last individual has died. A species or community is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual
Regionally Extinct (RX)	As for Extinct but within a defined region (in this case the State of Victoria) that does not encompass the entire geographic range of the taxon. A species or community is presumed Regionally Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout the region have failed to record an individual
Critically Endangered (CR)	A species or community is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see IUCN Standards and Petitions Subcommittee 2010), and it is therefore considered to be facing an extremely high risk of extinction in the wild
Endangered (EN)	A species or community is Endangered when the best available evidence indicates that it meets any of the criteria A to E or Endangered (see IUCN Standards and Petitions Subcommittee 2010), and it is therefore considered to be facing a very high risk of extinction in the wild
Vulnerable (VU)	A species or community is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see IUCN Standards and Petitions Subcommittee 2010), and it is therefore considered to be facing a high risk of extinction in the wild
Near-threatened (NT)	A species or community is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A species or community is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate
Victorian (DEPI 2013) BCS for EVCs	
Presumed Extinct (X)	Probably no longer present in the Bioregion
Endangered (E)	Contracted to less than 10% of former range; OR Less than 10% pre-European extent remains; OR Combination of depletion, degradation, current threats and rarity is comparable overall to the above: • 10 to 30% pre-European extent remains and severely degraded over a majority of this area; or • Naturally restricted EVC reduced to 30% or less of former range and moderately degraded over a majority of this area; or • Rare EVC cleared and/or moderately degraded over a majority of former area.

Conservation Status	Definition
Vulnerable (V)	10 to 30% pre-European extent remains; OR Combination of depletion, degradation, current threats and rarity is comparable overall to the above: • Greater than 30% and up to 50% pre-European extent remains and moderately degraded over a majority of this area; or • Greater than 50% pre-European extent remains and severely degraded over a majority of this area; or • Naturally restricted EVC where greater than 30% pre-European extent remains and moderately degraded over a majority of this area; or • Rare EVC cleared and/or moderately degraded over a minority of former area.
Depleted (D)	Greater than 30% and up to 50% pre-European extent remains; OR Combination of depletion, degradation and current threats is comparable overall to the above and: • Greater than 50% pre-European extent remains and moderately degraded over a majority of this area
Rare (R)	Greater than 30% and up to 50% pre-European extent remains; OR Combination of depletion, degradation and current threats is comparable overall to the above and: • Greater than 50% pre-European extent remains and moderately degraded over a majority of this area
Least Concern (LC)	Greater than 50% pre-European extent remains and subject to little to no degradation over a majority of this area

Executive Summary

Introduction

Eastern Iron Limited ('Eastern Iron'), through its wholly owned subsidiary Gippsland Iron Pty Ltd, proposes to develop the Nowa Nowa Iron Project ('the Project'). The Project is a greenfield development of a high grade magnetite/hematite deposit generally referred to as '5 Mile'. It is located approximately 7 km north of the township of Nowa Nowa, which is situated on the Princes Highway between Bairnsdale and Orbost in East Gippsland, Victoria.

Earth Systems has been commissioned by Eastern Iron to prepare this *Aquatic and Wetland Ecology Study* to support a referral to the Minister for Planning for advice as to whether an Environment Effects Statement is required for the Project pursuant to the *Environment Effects Act* 1978 ('EES Referral').

The scope of this study is limited to an assessment of wetland and aquatic aspects of the ecology in the area within and downstream of the proposed mine site. Other ecological aspects associated with the proposed mine site itself and surrounding areas have been addressed in a separate report entitled ***Flora, Fauna and Ecological Characteristics and Assessment*** (EES Referral Attachment 8).

The main aim of this *Aquatic and Wetland Ecology Study* is to identify the baseline ecological characteristics of the area downstream of the proposed mine site, and recommend key management and mitigation measures to minimise potential adverse effects on downstream species and communities.

Specific objectives of this study were to:

- Identify and assess flora, fauna and ecological communities that may be present in the tributaries, wetlands and lakes downstream of the proposed mine site;
- Determine the likelihood that threatened species and communities may reside or temporarily use areas downstream of the proposed mine site;
- Briefly outline the current disturbance status of the areas downstream of the Project, and assess the potential impacts of the proposed Project on aquatic and wetland ecology; and
- Outline mitigation and management measures that will minimise the potential for any significant impacts on aquatic and wetland characteristics.

Environmental Setting

The proposed mine site is located approximately 7 km north of the township of Nowa Nowa, 18 km northeast of Lakes Entrance and 250 km east of Melbourne in East Gippsland, Victoria. The climate of East Gippsland is temperate, with a mean annual rainfall of approximately 827 mm recorded at Lake Tyers, one of the main downstream areas. Mean maximum temperatures recorded at the nearby Lakes Entrance station are highest in January (25ºC) and mean minimum temperatures are lowest in June (14ºC). Relative humidity levels range between 68% (October) and 78% (June).

The proposed mine site (and greater region) intersects both the East Gippsland Lowlands (EGL) and East Gippsland Uplands (EGU) bioregions. To the west of Lake Tyers (around Lakes Entrance) the bioregion changes from East Gippsland Lowlands to the Gippsland Plain (GipP).

The proposed mine site occurs principally within the catchment of Boggy Creek, and is located adjacent to the boundary of the Hospital Creek Catchment. Several small creeks occur in the vicinity of the mine site area, which are ephemeral and dry for most of the year. These creeks are:

- Harris Creek;
- Gap Creek; and

- Tomato Creek.

Both Gap Creek and Tomato Creek are tributaries of Harris Creek, which flows into Yellow Waterholes Creek and subsequently into Boggy Creek approximately 4 km downstream of the mine site. A further 11 km downstream, the Boggy Creek flows into the 'Nowa Nowa Wetlands' at the northern end of Lake Tyers, which is part of the broader Gippsland Lakes. Lake Tyers is an estuary covering approximately 25 km^2, with an average depth of 3-4 m. The Gippsland Lakes system, including Lake Tyers, is listed under the Convention on Wetlands of International Importance (Ramsar Convention). The main lakes of the Gippsland Lakes system are Lake Wellington, Victoria and King, which are linked to the sea by an artificial entrance at Lakes Entrance. Notably, Lake Tyers is situated to the east of the Lakes Entrance area and does not have connectivity to the other lakes in the Gippsland Lakes system.

The proposed mine area is located within the Gippsland groundwater basin which underlies a significant proportion of the Gippsland region. There are no Groundwater Management Areas in the Nowa Nowa region.

The main land use activities within the East Gippsland region are forestry and agriculture, including dairy farming, wool production, cattle and sheep production and vegetable production. Tourism is a growing industry in East Gippsland, with the Ramsar listed wetlands, lakes, forests, rivers and the Victorian Alps key attractions.

The land in the area downstream of the proposed mine site is dominated by State Forest, with small areas of agriculture and residential areas also present. The land and waters of the Gippsland Lakes Ramsar Site are generally managed in accordance with the Gippsland Lakes Ramsar Site Strategic Management Plan. The ecological communities of the downstream region are already highly fragmented and degraded, and human resource use has modified the physical and biotic conditions of the remaining habitat. Timber harvesting, livestock grazing and agriculture and subsequent vegetation removal has increased edge effects and fragmentation. The habitats of the downstream region are being degraded by a combination of factors such as weed infestation, introduced animals, vegetation removal, salinity, alterations to nutrient cycles and dredging.

Legislative Context

The Project will need to be developed in accordance with international, Commonwealth and Victorian legislation relevant to aquatic and wetland ecology. In particular, Lake Tyers is listed under the Convention on Wetlands of International Importance which is an international treaty designed to conserve and manage the sustainable use of wetlands.

The Commonwealth's *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) gives statutory effect to the Ramsar Convention and is central to this Study.

Key Victorian legislation that may also be applicable to this Study includes:

- Environment Effects Act 1978;
- Catchment and Land Protection Act 1994;
- Coastal Management Act 1995;
- Environmental Protection Act 1970;
- Flora and Fauna Guarantee Act 1988 (FFG Act);
- Planning and Environment Act 1987; and
- Water Act 1989.

Methodology

The ***downstream region*** was defined as a zone with a 20 km radius from coordinates centred around the catchment downstream of the Project. The purpose of characterising the downstream region was to

provide a broad snapshot of the aquatic and wetland ecology of the area surrounding the downstream catchment of the Project. Characterising this broad zone also allows for spatial error in previously recorded species' or ecological communities' locations.

As part of the current Study, key areas in the downstream region were traversed on foot or by vehicle to provide an overview assessment of the entire region. All vertebrate fauna seen or heard within the downstream region were recorded. No additional detailed and/or targeted field surveys of aquatic and wetland environments downstream have been conducted at the current time.

This assessment also sought information for flora, fauna and ecological community records from the following main databases and literature sources:

- Victorian Biodiversity Atlas (VBA: DEPI 2013d);
- Biodiversity Interactive Map (BIM: DEPI 2013a);
- EPBC Act Protected Matters Search Tool (DSEWPaC 2013a);
- DEPI Threatened Species Advisory Lists (DEPI 2013c);
- Department of Sustainability, Environment, Water, Populations and Community Species Profile and Threats Database (DSEWPaC 2013b);
- Gippsland Lakes Ramsar site Ecological Character Description (DSEWPaC 2010); and
- Gippsland Lakes Ramsar site Strategic Management Plan (DSE 2003).

Key Findings

Habitats within the downstream region have been impacted by human-associated activities. The existing condition of habitat is correlated with the level of protection. For example, higher quality habitat remains in the Gippsland Lakes Ramsar Site compared to areas with lower levels of protection.

The overview field survey of the downstream region identified:

- No EPBC Act threatened species;
- 90 vertebrate fauna species;
- Three bird species protected under Migratory and Marine EPBC Act statuses;
  - Eastern great egret (*Ardea modesta*, FFG Act; Vulnerable DEPI);
  - White-bellied sea-eagle (*Haliaeetus leucogaster*, FFG Act; Vulnerable DEPI); and
  - Cattle egret (*Ardea ibis*).
- A pod of 4 to 6 Burranun dolphins (*Tursiops australis,* Nominated for listing under the FFG Act; Endangered DEPI).

Literature and data reviews of the broad downstream region identified:

- Three nationally significant ecological communities were identified by the EPBC Act search as having been modelled within the downstream region, however no field records are available to verify their presence or distribution in the area.
- Six FFG Act ecological communities, namely:
  - Coastal Moonah Woodland;
  - Dry Rainforest (Limestone) Community; and
  - Four different types of Warm Temperate Rainforest.
- 24 Ecological Vegetation Classes (EVCs), most of which (18 EVCs) are considered to cover an area less than 50% of their pre-European extent (i.e. R, D, VU, EN);
- A total of 835 flora species (including sub-species and variants);

- 275 bird species (including 11 introduced);
- 57 species of mammal, including 11 introduced;
- 17 reptile and 18 amphibian species; and
- 29 fish and three invertebrates.

Potential Impacts and Legislative Implications

Most species identified within the broad downstream region are common and widespread (94% of flora; 76% of fauna) with many being introduced to the area. The populations of these species are generally expected to be stable and secure with limited scope for any potentially significant effects of the Project. However, impacts on their welfare will need to be managed and mitigated regardless of their common conservation status.

Provided that the proposed hydrology and water quality management measures for the Project are implemented effectively, no conservation significant species or communities in the downstream region are expected to be directly impacted by the Project as:

- No vegetation is to be removed from areas downstream of the mine site as part of the Project;
- No foraging or breeding habitat will be removed;
- The Project has been designed to prevent significant changes in the quality or hydrology of water downstream;
- No threatened species have been found within the ephemeral creeks at the mine site, or in the surrounding vegetation. It is highly unlikely that any (exclusively) aquatic species exist in the water environments of the mine site as the creeks are dry for most of the year, and temporary pools only form after very heavy and lengthy downpours. Furthermore, no threatened aquatic species have been recorded in the creeks downstream of the mine site, or Lake Tyers itself, which may act as source populations for the creeks at the mine site.
- Amphibians may use the creeks, but no threatened amphibians were heard or seen using the creeks of the mine site during extensive field surveys (totalling approximately 127 hours, refer EES Referral Attachment 8). The last threatened amphibian to be recorded near to the mine site's creeks (~700 m north of Harris Creek) was in the 1960s.
- Masked owls, brown treecreepers and lace monitors may use the habitat in and around the ephemeral creeks, but they are highly mobile species, with large home ranges. Therefore, impact on these water environments is unlikely to affect any threatened terrestrial, amphibious or aquatic species.

Potential impacts of the Project on the ecological values of the downstream region, if they were to occur, would most likely occur *indirectly* if downstream surface and/or groundwater are affected due to Project activities at the mine site. This may include impacts on downstream water quality and/or hydrology.

The most pertinent Commonwealth and international legislation relevant to the Study are the EPBC Act, Ramsar Convention and several international treaties relating to migratory and marine species. The latter two items are governed under the EPBC Act.

No EPBC Act threatened fauna species and only three Migratory species were recorded during the overview field assessment. However, several threatened flora and fauna have been recorded by previous studies over the last approximately 60 years. It is highly unlikely that all of these species still occur in the region, as many have not been recorded in the last 30 years. Most of these species are unlikely to be impacted by small changes in water quality and/or hydrology caused by the Project as they are terrestrial and/or not reliant on aquatic habitats downstream of the Project. For these species to be impacted by the Project, water quality and/or the existing hydrological regime would have to be significantly compromised.

No species or communities of particular conservation concern previously recorded in the catchment downstream of the proposed mine site are considered as being at risk of being significantly indirectly

impacted in the event that there are minor changes in water quality and/or hydrology caused by the Project.

The database and literature searches conducted indicated that there are several species which *may* occur downstream that could potentially be affected by the Project. The species considered at most risk of being indirectly impacted (and of particular conservation concern) are listed below. While these species may occur within the catchment downstream of the proposed mine site, their presence has not been recorded in the area:

- Leafless tongue-orchid (Vulnerable EPBC Act; FFG Act; Endangered DEPI):
  - » May occur in other riparian zones, but never recorded in downstream region.
- Dainty bitter-cress (FFG Act; Endangered DEPI):
  - » Last recorded in downstream region in 1995;
  - » Not actually recorded downstream of the Project, found within different section of Lake Tyers.
- Slender mud-grass (FFG Act; Endangered DEPI):
  - » Last recorded in downstream region in 1996;
  - » Not actually recorded downstream of the Project, found along coast east of Lake Tyers.
- Yellow-wood (FFG Act; Rare DEPI):
  - » Last recorded downstream of the Project in riparian zone in 1992.
- Australasian bittern (Endangered EPBC Act; FFG Act; Endangered DEPI):
  - » Last recorded in downstream region in 1993.
- Green and golden bell frog (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI):
  - » Last recorded in downstream region in 1998;
  - » Last record from downstream of the Project in 1965 (museum specimen);
  - » Potentially locally extinct.
- Growling grass frog (Vulnerable EPBC Act; FFG Act; Endangered DEPI):
  - » Last recorded in downstream region in 1992;
  - » Last recorded downstream of Project in 1788;
  - » Probably regionally extinct.
- Australian grayling (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI):
  - » Never recorded in downstream region;
  - » Possibly locally extinct or insufficient surveying to detect presence.
- Eastern dwarf galaxias (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI):
  - » Never recorded in downstream region;
  - » Possibly locally extinct or insufficient surveying to detect presence.

Management and Mitigation

Measures to avoid, minimise and manage potential impacts on flora and fauna in the downstream region will be required during all phases of the Project, including the planning, construction, operating and closure phases. These measures will need to be continuously monitored for their efficiency and effectiveness, and improved if necessary. Management measures will need to be conducted in consultation and in conjunction with the Commonwealth and Victorian governments.

Mitigation, management and monitoring measures to assist in protecting aquatic and wetland environments associated with the Project should be outlined in an *Environmental Management Plan*, including:

- Regular monitoring of surface and ground water hydrology and quality. Monitoring should include up-gradient / upstream and down-gradient / downstream locations (of the Project facilities) to ensure any impacts are identified and suitable management responses can be implemented;
- Appropriate management of erosion and sediment transport at the mine site;
- Development and implementation of a rehabilitation and closure plan that allows for the progressive rehabilitation over the Project life and ensures long-term risks to downstream water quality are minimal.

Surveying and monitoring programs may be required for the species at highest risk of impact from the Project (as listed above). These programs may be triggered at any time during the life of the mine by:

- Any significant hydrology and/or water quality changes caused by the Project (i.e. not by other sources);
- Determination by Commonwealth or Victorian agencies of the need for further surveying and monitoring of threatened populations (in response to the Project); and/or
- Identification that the Project is impacting upon (or potentially impacting upon) threatened species.

All surveying, monitoring and species-specific management programs would need to be developed and implemented in consultation with the Commonwealth and Victorian Governments.

The Gippsland Lakes wetlands are monitored for changes in criteria (ecological characteristics) that qualified the Gippsland Lakes for inclusion in the Ramsar Convention listings. If it is determined that these changes exceed (or could potentially exceed) the Limits of Acceptable Change (LAC) for any of the outlined parameters in response to the Project, intensive surveying, monitoring and mitigation may be necessary (in consultation with the Commonwealth and Victorian agencies). This would need to include targeted threatened species and general surveying.

Conclusion

The downstream region has a high conservation value due to the presence of the Gippsland Lakes Ramsar Site and the likelihood of several listed communities and species occurring in the region. However, the downstream region is not pristine and has been significantly altered, developed and disturbed by human activities.

Potential effects on aquatic ecology and wetlands associated with the development of the Project are expected to be minor due to the substantial historical disturbance of the area and the implementation of strict water regulations. The impacts on aquatic ecosystems associated with the loss of the small sections of creeks potentially directly impacted by the Project mine site is not expected to be significant as they are ephemeral creeks that are dry for most of the year, and the reaches affected are also located at the headwaters of the catchment.

The potential for significant impacts associated with the Project on downstream wetlands and aquatic ecology will be limited by the Project being designed to avoid and minimise potential impacts on water quality and hydrology where possible. To further protect downstream aquatic and wetland environments, potential water quality and hydrology impacts associated with the Project will need to be carefully managed and monitored to prevent any significant changes downstream of the mine site. With the implementation of appropriate mitigation and management measures, it is considered that the Project can be successfully delivered with no significant long-term impact on aquatic flora, fauna and ecological communities in the downstream region.

1 Introduction

1.1 Background

Eastern Iron Limited ('Eastern Iron'), through its wholly owned subsidiary Gippsland Iron Pty Ltd, proposes to develop the Nowa Nowa Iron Project ('the Project'). The Project is a greenfield development of a high grade magnetite/hematite deposit generally referred to as '5 Mile'. It is located approximately 7 km north of the township of Nowa Nowa, which is situated on the Princes Highway between Bairnsdale and Orbost in East Gippsland, Victoria.

Earth Systems has been commissioned by Eastern Iron to prepare this *Aquatic and Wetland Ecology Study* to support a referral to the Minister for Planning for advice as to whether an Environment Effects Statement is required for the Project pursuant to the *Environment Effects Act* 1978 ('EES Referral').

There are spatial and landscape aspects that are relevant to the consideration of the Project. The current Study considers the ecology of the Gippsland Lakes Ramsar Site and associated tributaries located downstream of the proposed mine site. Ecological aspects associated with the proposed mine site itself, which is where the mineral extraction and infrastructure associated with the Project will occur, as well as the wider region surrounding the mine site have been addressed in a separate ***Flora, Fauna and Ecological Characteristics and Assessment*** (EES Referral Attachment 8), which should be read in conjunction with the current Study.

A key driver for the preparation of this *Aquatic and Wetland Ecology Study* is the presence of a portion of the Gippsland Lakes system located approximately 15 km downstream of the Project, which is listed as a Wetland of International Importance under the Convention on Wetlands of International Importance (i.e. Ramsar Convention). Accordingly, it is important to adequately understand the baseline ecological characteristics of aquatic and wetland areas downstream, and assess the potential for any significant effects of the Project on associated conservation values.

1.2 Objectives and Scope

The main aim of this *Aquatic and Wetland Ecology Study* is to identify the baseline ecological characteristics of the area downstream of the proposed mine site, and recommend key management and mitigation measures to minimise potential effects on downstream species and communities. Specific objectives of this study were to:

- Identify and assess flora, fauna and ecological communities that may be present in the tributaries, wetlands and lakes downstream of the proposed mine site;
- Determine the likelihood that threatened species and communities may reside or temporarily use areas downstream of the proposed mine site;
- Briefly outline the current disturbance status of the areas downstream of the Project, and assess the potential impacts of the proposed Project on aquatic and wetland ecology; and
- Outline mitigation and management measures that will minimise the potential for any significant impacts on aquatic and wetland characteristics.

1.3 Brief Project Description

The proposed Project is a greenfield development of a high grade magnetite/hematite deposit generally referred to as '5 Mile'. It is located approximately 7 km north of the township of Nowa Nowa, which is situated on the Princes Highway between Bairnsdale and Orbost in East Gippsland, Victoria. The site is wholly within the Tara State Forest (Figure 1-1).

The Project involves an open cut mining operation from a single pit with dry processing at the site to upgrade the material to a saleable product. It is anticipated that the Project will produce up to 1Mt of ore per annum, over an initial mine life of 8-10 years. The mine will be operated using a mining contractor and local employees (i.e. no onsite accommodation).

It is proposed to transport the processed ore by road to the existing South East Fibre Exports (SEFE) wharf at the Port of Eden in Edrom, NSW. The majority of the transport route between the mine and the Port is via the Princes Highway. The material will be temporarily stockpiled before being loaded onto 50-60,000t vessels and exported to international markets.

The main components of the Project at the mine site will include:

- Open Pit;
- Mine Infrastructure (includes the Run of Mine (ROM) pad, processing plant and Mine Operations Centre);
- Waste Rock Dump;
- Temporary Low Grade Ore Stockpile;
- Water Storage Infrastructure;
- Mine Access and Haul Roads; and
- Ancillary Infrastructure.

These components are depicted in Figure 1-2, whilst further details of the Project are provided in the ***Project Description and Proposed Mine Plan*** (EES Referral Attachment 1).

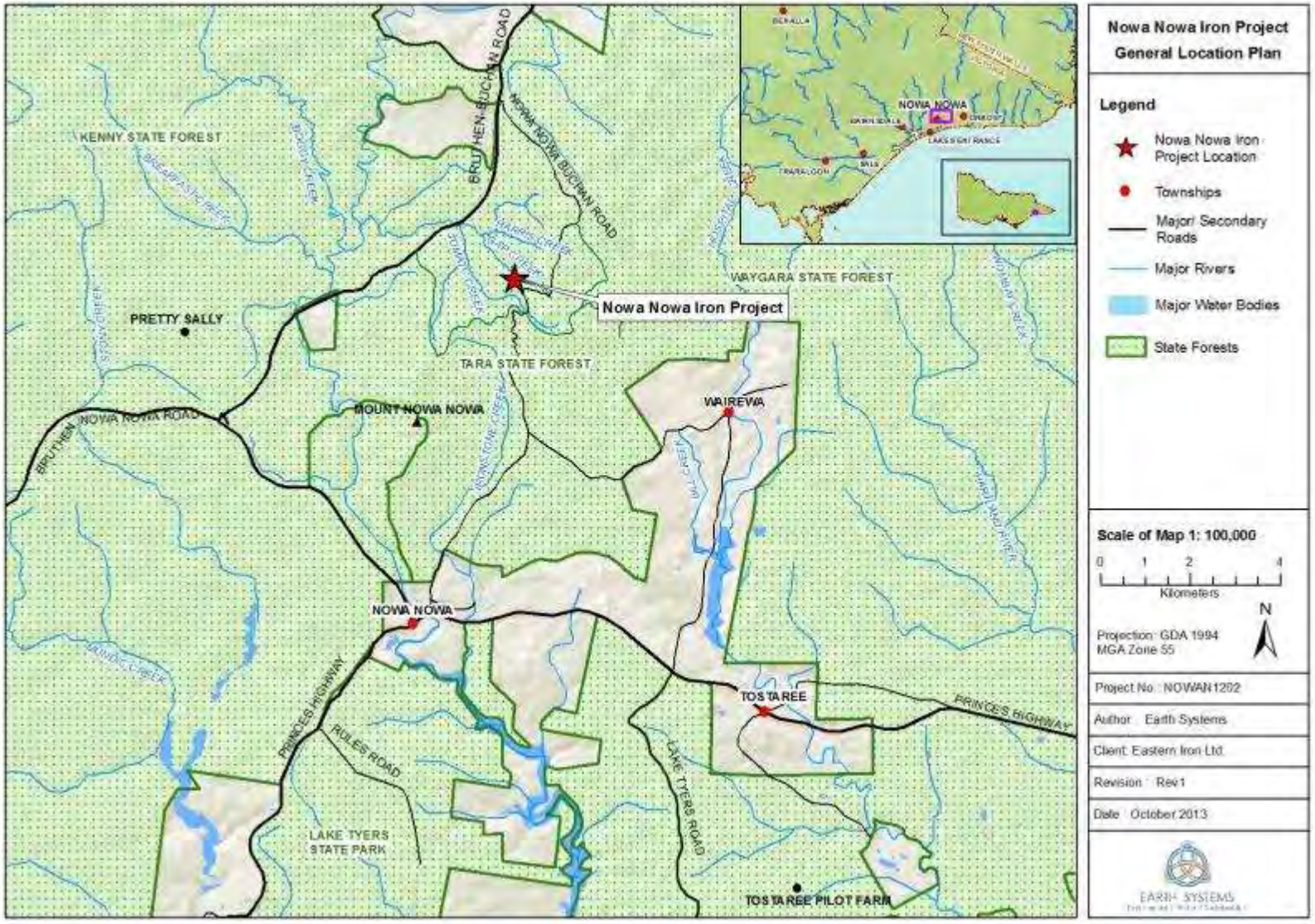

Figure 1-1 Project location within the Nowa Nowa region and East Gippsland

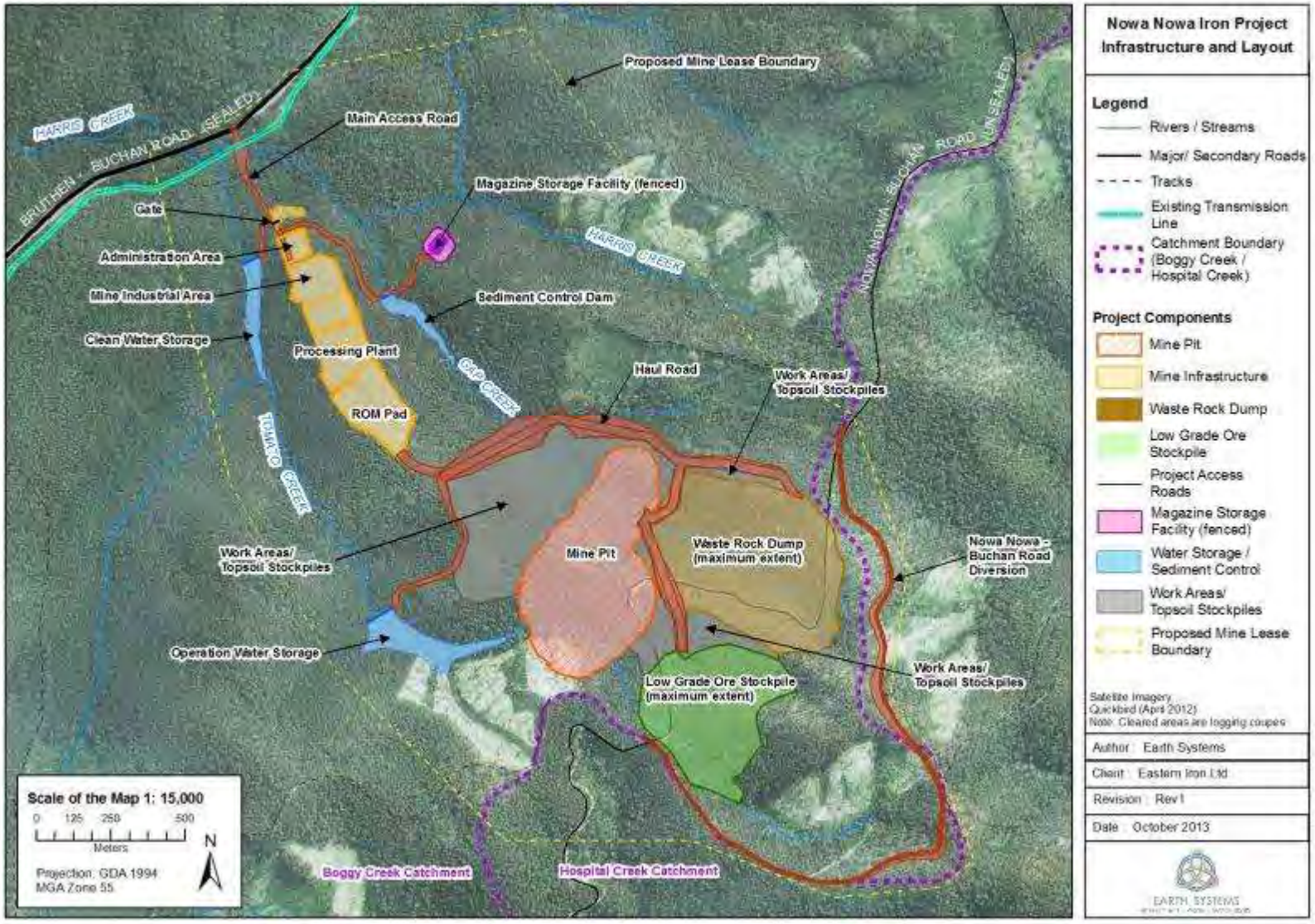

Figure 1-2 Project Infrastructure and layout showing creeks intersecting the mine site

1.4 Overview of Environmental Setting

1.4.1 Topography and Climate

The proposed mine site is located approximately 7 km north of the township of Nowa Nowa, 18 km northeast of Lakes Entrance and 250 km east of the city of Melbourne in East Gippsland, Victoria (37° 39' 45"S, 148° 6' 43"E; Figure 1-1). East Gippsland is a low-lying region with gently undulating hills flanked by coastal plains, dunefields and inlets. Drainage from the area of the proposed mine site flows south to the estuaries on the coast which form part of the Gippsland Lakes.

The climate of East Gippsland is temperate, with a mean annual rainfall of approximately 827 mm recorded at Lake Tyers, one of the main downstream areas (BOM 2013b). Mean maximum temperatures recorded at the nearby Lakes Entrance station are highest in January (25ºC) and mean minimum temperatures are lowest in June (14ºC). Relative humidity levels range between 68% (October) and 78% (June). Mean wind speeds recorded at Lakes Entrance are approximately 14 km/hr.

1.4.2 Hydrology

Surface water

Creeks in the Vicinity of the Proposed Mine Site

The proposed mine site occurs principally within the catchment of Boggy Creek, and is located adjacent to the boundary of the Hospital Creek Catchment. Several occur in the vicinity of the mine site area, which are ephemeral and dry for most of the year (Figure 1-3). These creeks are:

- Harris Creek;
- Gap Creek; and
- Tomato Creek.

Both Gap Creek and Tomato Creek are tributaries of Harris Creek, which flows into Yellow Waterholes Creek and subsequently into Boggy Creek about 4 km downstream of the mine site.

Boggy Creek

Boggy Creek is one of the two main streams of the Boggy Creek (Nowa Nowa) sub-catchment which covers 340 km^2 between Mt Victoria in the north (northwest of Buchan) and the township of Nowa Nowa in the south (Russell 1983). The second main stream-complex of the sub-catchment area is Harris Creek and its tributaries. It is a Declared Water Supply Catchment, and therefore use of land within the Catchment is regulated by the *Catchment and Land Protection Act* 1994. From the 1980's to 2007, water from Boggy Creek was abstracted for industrial purposes (e.g. sawmills) and as a drinking water supply for the Nowa Nowa township. Drinking water for the township is now sourced from the Mitchell River (Department of Health 2008). Boggy Creek flows into the Nowa Nowa Wetlands at the northern end of the Nowa Nowa arm of Lake Tyers (Figure 1-3). The Nowa Nowa Wetlands at the Nowa Nowa township is a local recreational area and provides habitat for a variety of species. The saline waters of Lake Tyers extend to this northern arm of the lake.

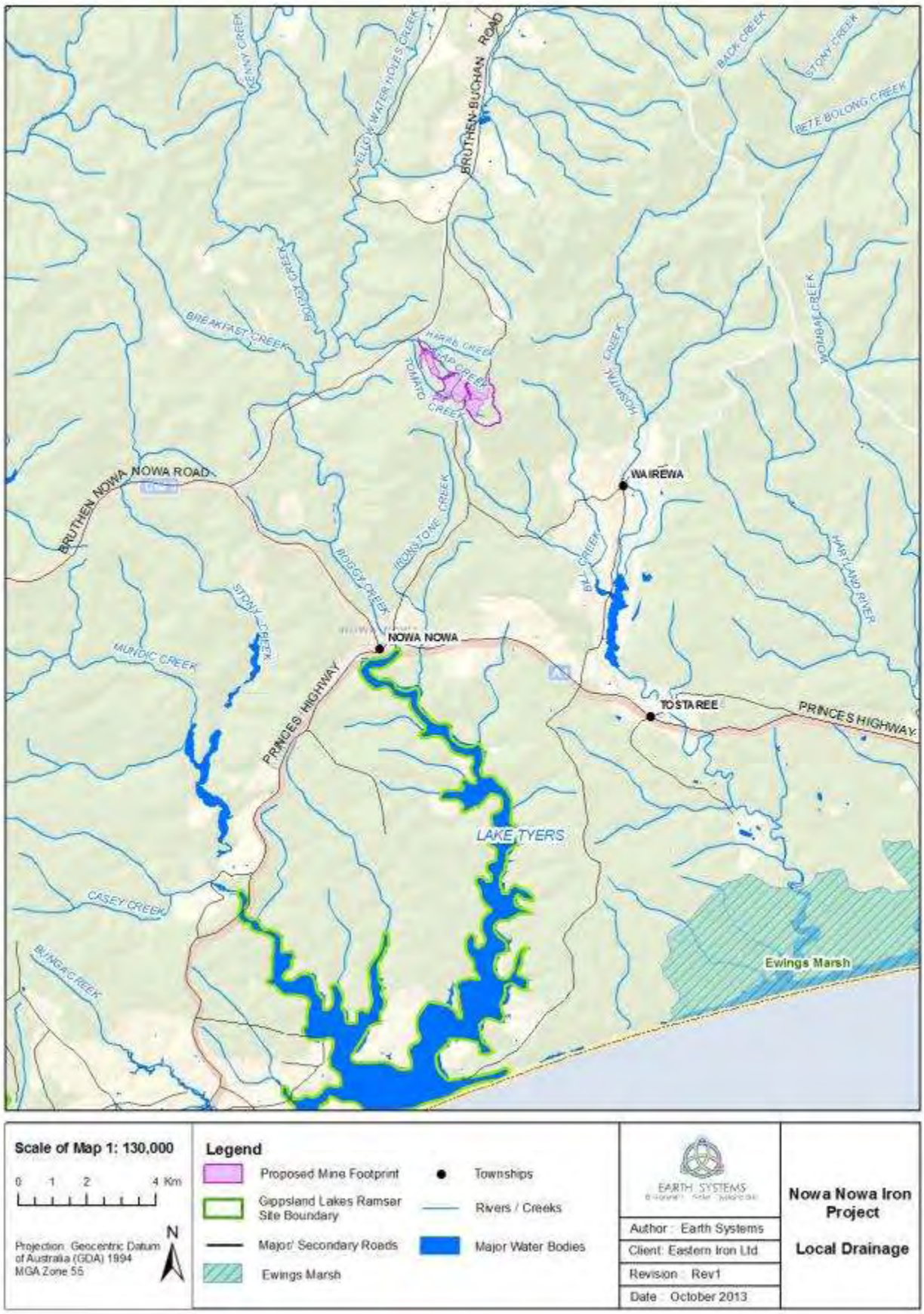

Figure 1-3 Local Drainage

Ironstone Creek

While not directly downstream of the proposed mine site, the ephemeral Ironstone Creek occurs south of the mine area and forms the second of two major tributaries draining directly into Lake Tyers (Figure 1-3). The source of Ironstone Creek is located south of Mount Nowa Nowa, approximately 2 km south of the proposed mine site. Ironstone Creek is crossed by both Nowa Nowa – Buchan Road and the Princes Highway, flowing south to join the Nowa Nowa arm of Lake Tyers just south of Nowa Nowa township.

Lake Tyers

Approximately 15 km downstream of the proposed mine site, the Boggy Creek flows into the 'Nowa Nowa Wetlands' at the northern end of Lake Tyers, which is part of the broader Gippsland Lakes (Figure 1-3). Lake Tyers is an estuary covering approximately 25 km^2, with an average depth of 3-4 m. The Gippsland Lakes system, including Lake Tyers, is listed under the Convention on Wetlands of International Importance (Ramsar Convention, refer Section 1.4.3).

The main lakes of the Gippsland Lakes system are Lake Wellington, Victoria and King, and these lakes are linked to the sea by an artificial entrance at Lakes Entrance. The artificial entrance was created in the 1880's and is often maintained by dredging sand. Notably, Lake Tyers is situated to the east of the Lakes Entrance area and does not have connectivity to the other lakes in the Gippsland Lakes system.

Lake Tyers consists of a main lake connected to two main riverine arms: Nowa Nowa and Toorloo. The estuary is intermittently blocked from Bass Strait by a sand bar which leads to variations in water quality (particularly salinity levels, dissolved oxygen concentrations, aquatic vegetation growth and turbidity levels), however, the waters are generally well-mixed as a result of wind driven circulation (DPI 2012). Consequently, Lake Tyers is predominantly made up of brackish or saline lagoons.

Groundwater

The catchment downstream of the Project is located within the Gippsland groundwater basin which underlies a significant proportion of the Gippsland region. There are no Groundwater Management Areas in the Nowa Nowa region (EGCMA 2006). Groundwater Management Areas cover areas where groundwater has been, or has the potential to be, intensively developed.

Further detail on the surface and groundwater setting of the Project is provided in the ***Surface and Ground Water Baseline and Assessment*** (EES Referral Attachment 5).

1.4.3 Gippsland Lakes Ramsar site

The Gippsland Lakes Ramsar site occurs in the broad area downstream of the proposed mine site (Figure 1-3). As discussed above, Lake Tyers is the only part of the Ramsar Site that occurs directly downstream of the Project (refer Section 1.4.2). The Gippsland Lakes area was listed under the Ramsar Convention in 1982 because it fulfilled several critical criteria, including providing essential breeding habitat for wetland species (DSEWPaC 2010). The Gippsland Lakes system is protected under the international Ramsar Convention on wetlands by the Commonwealth EPBC Act (see DSEWPaC 2010). Australia became a signatory of the Ramsar Convention in 1974 and protects all of its 64 Ramsar sites under the EPBC Act. The international governance allows for sustainable use and management of the site, and also recognises that the character of the wetlands will fluctuate/change with time.

The Ramsar boundary does not include much of the land surrounding the lakes, protecting mostly the lakes themselves. Approximately 50 m of the land surrounding Lake Tyers is within the boundary of the Ramsar Site. The Lake Tyers (Forest) Park on the north east side of the lake has been proposed as a National Park or addition to a National Park.

The Cunninghame Arm of Lake King and Mississippi Creek, Lakes Entrance, fall within the downstream region, but are not within the downstream catchment of the Project. However, fauna that use Lake Tyers

are likely to move into Lake Bunga and Lake King. Lake Bunga is between Lake Tyers and Lake King, linking the coastal dunes and inlets.

A detailed description of the ecological characteristics of the Gippsland Lakes Ramsar Site can be found in DSEWPaC (2010).

1.4.4 Landuse, Geology and Soils

The main land use activities within the East Gippsland region are forestry and agriculture, including dairy farming, wool production, cattle and sheep production and vegetable production. Tourism is a growing industry in East Gippsland, with the Ramsar listed wetlands, lakes, forests, rivers and the Victorian Alps key attractions (DSEWPaC 2010). Hikers and cyclists are attracted to the East Gippsland Rail Trail which follows the disused Bairnsdale-Orbost railway, crossing Boggy Creek and Ironstone Creek and passing through Nowa Nowa. The Lake Tyers Forest Park which extends to Mount Nowa Nowa is a destination for shore-based activities including bushwalking and camping. There are also several other national and State parks surrounding the area, particularly along the coast.

The land and waters of the Gippsland Lakes Ramsar site are generally managed in accordance with the Gippsland Lakes Ramsar Site Strategic Management Plan (DSE 2003). For a more detailed review of land and water use associated with the Project see the ***Land and Water Use Study*** (EES Referral Attachment 11).

Most of the East Gippsland region is composed of Neogene (late Tertiary) alluvial sediments (DPI 2013). These alluvial sediments form terraces and fan out from the uplands. The lowlands are sandy loams overlying clays. There has been some structural movement with early deposits being dissected with sediment composed of organic matter and iron, and volcanic intrusions.

Surface soils are moderately to highly acidic, particularly along the coast (EPHC 2011). Soils range from sandy loams to dark grey brown loamy sands. Surface soils also have a low nutrient and water holding capacity, and are particularly prone to wind erosion (if exposed). Deeper layers of heavy clay can also be moderately to strongly acidic (DPI 2013).

1.5 Bioregional Context

The proposed mine site and surrounds intersect both the East Gippsland Lowlands (EGL) and East Gippsland Uplands (EGU) bioregions. The Gippsland Plain (GipP) bioregion also occurs to the west of Lake Tyers (around Lakes Entrance); however it is not within the catchment of the Project.

The **East Gippsland Lowlands** (EGL) is formed by 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; Banksia Woodland and Riparian Scrub Complex are common along coastal areas. The **East Gippsland Uplands** (EGU) consists of tablelands and mountains up to 1400 m elevation. The vegetation is dominated by Shrubby Dry Forest and Damp Forest on the upland slopes and Wet Forest ecosystems which are restricted to the higher altitudes; Grassy Woodland, Grassy Dry Forest and Valley Grassy Forest ecosystems are associated with major river valleys.

To the west of Lake Tyers (around Lakes Entrance) the bioregion changes from East Gippsland Lowlands to the **Gippsland Plain** (GipP). The Gippsland Plain bioregion is formed by low lying coastal areas and alluvial plains with barrier dunes, floodplains and swampy flats. Vegetation is a mosaic of swampy scrub, grasslands and woodlands.

Plate 1-1 Shallows and tidal pools where Lake Tyers opens onto Bass Strait

Plate 1-2 Sand bars and tidal inlets of Lake Tyers opening onto Bass Strait

2 Legislative Context

The Project will need to be developed in accordance with several items of international, Commonwealth and Victorian legislation relevant to aquatic and wetland ecology as summarised below.

2.1.1 International

The Convention on Wetlands of International Importance (Ramsar Convention 2013) is an international treaty designed to conserve and manage the sustainable use of wetlands. Australia became a signatory in 1971 and protects its 64 Ramsar wetlands under the Commonwealth's EPBC Act (DSEWPaC 2010).

2.1.2 Commonwealth

The Commonwealth Government regulates legislation covering many aspects of the environment. The Commonwealth's *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) gives statutory effect to the Ramsar Convention and is central to this Study.

2.1.3 State

Victorian legislative items that may be applicable to this Study include:

- Catchment and Land Protection Act 1994;
- Coastal Management Act 1995;
- Crown Land (Reserves) Act 1978;
- Environment Effects Act 1978;
- Environmental Protection Act 1970;
- Flora and Fauna Guarantee Act 1988 (FFG Act);
- National Parks Act 1975;
- Planning and Environment Act 1987;
- Victoria's Biodiversity Strategy;
- Water Act 1989; and
- Wildlife Act 1975.

3 Methodology

3.1 Study Area

The ***downstream region*** was defined as a zone with a 20 km radius from coordinates centred around the catchment downstream of the Project (37° 47' 35"S, 148° 10' 14"E; Figure 3-1). The purpose of characterising this broad zone was to provide a broad snapshot of the aquatic and wetland ecology of the area surrounding the downstream catchment of the Project and allow for spatial error in previously recorded species' or ecological communities' locations. It is possible that the location details from the various flora and fauna databases have been inexactly recorded or incorrectly entered into the databases (refer Section 3.4). Additionally, many animals can move long distances and may be recorded elsewhere but still use the wetland system. Therefore the results of a literature search using the spatial confines of the downstream region should not be confused for an accurate representation of the flora and fauna resident or temporarily inhabiting the downstream region, merely what *may be* present within the area.

3.2 Overview Field Assessment

As part of the current Study, key areas in the downstream region were traversed on foot or by vehicle to provide an overview assessment of the entire region. All vertebrate fauna seen or heard within the downstream region were recorded. No additional detailed and/or targeted field surveys of aquatic and wetland environments downstream have been conducted at the current time.

Domestic species recorded were included in assessments as they are often the source of escapees into the wild (i.e. feral population sources). Additionally, some species were seen wandering the region (e.g. not tethered or in a paddock) and can influence or hybridise with other and native populations (i.e. dingoes *Canis lupus dingo*).

An overview assessment of vegetation and habitat was conducted while traversing the downstream region. Areas that were inaccessible on foot or by vehicle were assessed remotely by recent satellite imagery (Google Earth).

3.3 Literature and Database Review

This assessment also sought information for flora, fauna and ecological community records from the following main databases and literature sources:

- Victorian Biodiversity Atlas (VBA: DEPI 2013d);
- Biodiversity Interactive Map (BIM: DEPI 2013a);
- EPBC Act Protected Matters Search Tool (DSEWPaC 2013a);
- DEPI Threatened Species Advisory Lists (DEPI 2013c);
- Department of Sustainability, Environment, Water, Populations and Community Species Profile and Threats Database (DSEWPaC 2013b);

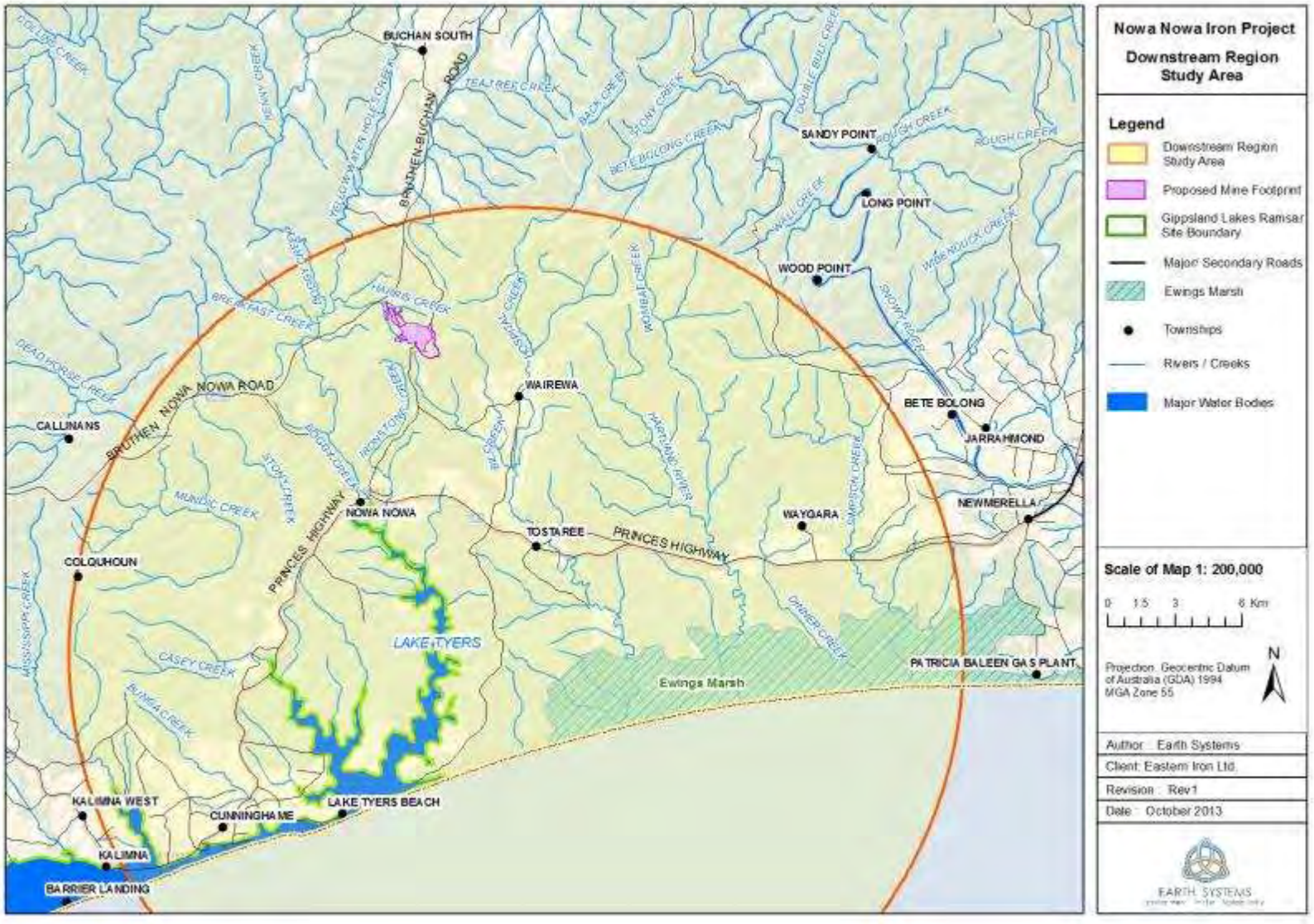

Figure 3-1 'Downstream region' study area including a portion of the Gippsland Lakes Ramsar Site

- Gippsland Lakes Ramsar site Ecological Character Description (DSEWPaC 2010); and
- Gippsland Lakes Ramsar site Strategic Management Plan (DSE 2003).

The VBA provides information on species that have been recorded in an area, for example seen, heard, or indirect evidence (e.g. tracks; DEPI 2013d). The records may be part of an official survey conducted by scientists or incidental observations by amateurs. The VBA data is much more detailed than what is provided publically by the DEPI on their BIM and therefore information sourced from the BIM supplemented data provided to us by the VBA rather than supplanting it.

Information regarding threatened species was also sought from the DEPI Advisory Lists. These lists refer to rare and threatened species in Victoria only and are not to be confused with the species listed under the FFG Act. There are no legal requirements pertaining to species in these Advisory Lists. However, information is sourced from these lists was used to supplement the other information sources for the Study.

Native vegetation in Victoria is classified according to Ecological Vegetation Classes (EVCs). These EVCs have been mapped using various sources (e.g. satellite, field) and are available through the BIM. The conservation status of EVCs is similar to the legal requirements of DEPI Advisory Lists. However, some EVCs have been encompassed under the FFG Act, either alone or in conjunction with other EVCs or communities (e.g. bird communities). The data pertaining to any FFG Act modelled communities in the region were obtained from DEPI (DEPI 2013d).

A thorough search of the literature and publically available documents was conducted to provide background information and to assess the likelihood of an impact on the ecological characteristics of the downstream region (including significant species and communities). To assess the impact, it was also necessary to determine which species and communities may be present in the region (based on database searches). It was then possible to use expert knowledge and the literature to assess the likelihood of these species and communities occurring within the downstream region over the Project life.

Species that are exclusively deep marine and have never been observed inshore have been excluded from this review as they are highly unlikely to occur in shore and thus not be impacted by the Project. Several large marine species were listed in the results of the EPBC Act Protected Matters Search, but the probability of these species occurring in-shore are little to none.

3.4 Limitations of the Data Sources

Spatial and count data was sourced from the VBA provided by the DEPI (2013a). This data is collected by scientists and amateurs and therefore may not necessarily be accurate or correct. The DEPI make every effort to check the authenticity of the data, but they cannot ensure data collection method or species identification in the field is rigorous. For example, the same individual bird may be counted more than once or similar species may be incorrectly identified. Many animals are cryptic and or nocturnal and therefore difficult even for trained personnel to correctly identify.

The number of bird species sightings is always considerably higher than any other taxon. It is not necessarily an indication that bird diversity is greater than other groups, but it may simply be an artefact of birds being more conspicuous. There are also many amateur bird observation groups that contribute to the database, much more than any other taxon (recreational-watching) group. Additionally, most of Australia's mammals and frogs are nocturnal and therefore unlikely to be observed, and reptiles are difficult to survey without the use of trapping techniques.

There is little to no previously recorded information/data regarding fish and invertebrates in the downstream region and this is probably due to the ephemeral nature of the catchments and a lack of sampling, rather than species being absent. Additionally, the number of fish and invertebrate species listed under national and State threatened species acts is low. However, this is probably due to a lack of knowledge of threatened fish and invertebrates.

Plants are known to hybridise with similar species and this makes identification very difficult. The accuracy of location data is probably improving with more people using GPS units or GPS applications on their mobile phones. However, older location records may not be as accurate.

The species data provided by DEPI only included records up to 2011, however it is unlikely that additional significant species have been found in the area since 2011.

Much of the information on vegetation communities is sourced from satellite imagery and general mapping. Vegetation is modelled on what should, and may, be there, since it would be impossible to survey all of Victoria's vegetation. Additionally, the list of EVCs present did not include mosaics and may not be completely exhaustive, as some small patches of EVCs may have been missed in the review process.

Finally, the secondary data and literature sources have been used to provide an initial assessment of what species and communities may occur in the downstream region and does not necessarily reflect what is or will be within the area.

4 Overview Field Assessment Results

4.1 Vertebrate Fauna

Overall, 90 vertebrate fauna species were observed within the downstream region (Table 4-1). One frog, one reptile, 17 mammals and 71 birds were seen, heard or evidence found of their presence. This included seven birds and nine mammal species that are not native to Australia. The most commonly sighted and widespread species (observed in most sites) was the laughing kookaburra (*Dacelo novaeguineae*). Other species were locally common, with many introduced species being very common near to and around human settlements. Of the native species, the Australian Magpie (*Gymnorhina tibicen*) was common along roadsides and in open farming areas, but less common in forested, riparian and wetland areas (e.g. Lake Tyers Plate 4-1). Common species in wetland areas included black swans (*Cygnus atratus*; Plate 4-2), Australian pelicans (*Pelecanus conspicillatus*; Plate 4-3) and white-faced herons (*Egretta novaehollandiae*; Plate 4-4).

Sambar deer (*Cervus unicolor*) were seen in several locations in the downstream region and it is highly likely that they are common and widespread. The sambar deer is nocturnal, crepuscular, shy and cryptic and therefore the individuals seen during the day are probably a fraction of the population. Domestic species such as goats (*Capra hircus*) and horses (*Equus caballus*) often escape and become feral. Although feral goats were not observed, it is expected that they are widespread in the forested areas. Horses are less likely to become feral in the downstream region because they prefer more contiguous and remote habitat (e.g. Victorian Alps). Horses are also a more costly commodity for farmers and farmers are unlikely to miss escaped horses. Other livestock may stray into forested areas and despite wild pigs/boars (*Sus scrofa*) not being observed, it is highly likely that pigs also frequent the area.

Evidence of feral cats (*Felis catus*), dogs (*Canis lupus familiaris*) and foxes (*Vulpes vulpes*) was common and widespread in forested areas. These species were also common in residential areas, but individuals seen from the two former species could have been pets. Dingoes (*Canis lupus dingo*) used to inhabit the downstream region, but it is likely that have hybridised with the feral dogs in the area.

4.2 Significant and Threatened Fauna

No EPBC Act threatened species were observed within the downstream region. Ten significant fauna were directly or indirectly observed within the downstream region in a variety of habitats (Table 4-1). Three bird species are protected under Migratory and Marine EPBC Act statuses. Two of these species, the eastern great egret (*Ardea modesta*) and the white-bellied sea-eagle (*Haliaeetus leucogaster*), are also listed under the FFG Act and Vulnerable according to DEPI Advisory Lists. The eastern great egret, white-bellied sea-eagle and cattle egret (*Ardea ibis*) are protected under the EPBC Act as they are considered internationally significant marine and migratory species and are subsequently covered under international treaties.

The three internationally significant species were observed in the wetlands and lakes of east Lakes Entrance and Lake Tyers. Eastern great egrets were observed foraging or resting within the wetlands. A juvenile white-bellied sea-eagle was observed flying over Lake Tyers beach, where Lake Tyers is separated by the ocean by sand dunes and tidal inlets. The plumage of the juvenile was relatively dark

and therefore may have been relatively young, possibly from the last breeding season (June 2012 – February 2013), or the previous year.

A few cattle egrets were regularly sighted within wetland and lake areas within the downstream region. The species is covered under international treaties, but not by any Victorian legislation because their population is generally stable and widespread (in appropriate habitat).

Five Near Threatened (DEPI Advisory Lists) bird species were observed in various locations in the downstream region. Three of these species (Pacific gull *Larus pacificus pacificus,* royal spoonbill *Platalea regia,* sooty oystercatcher *Haematopus fuliginosus*) were only seen along the coast, mostly on the sandy beaches. One emu (*Dromaius novaehollandiae*) was seen in the forested area surrounding the northern section of Lake Tyers. The brown treecreeper (*Climacteris picumnus victoriae*) was widespread but not common (abundant) in forested areas around wetlands and lakes. The other DSE-listed species, the lace monitor (*Varanus varius*) was seen in a few locations, but only within the forested areas.

A pod of 4 to 6 Burranun dolphins (*Tursiops australis*) was observed cooperatively hunting in the Cunninghame Arm of Lake King, Lakes Entrance (Plate 4-5). This species was previously identified as the bottlenose dolphin (*T. truncatus*) but recent evidence has identified two small resident (genetically and morphologically-distinct) populations of this newly designated species in the Gippsland Lakes (~50 individuals) and Port Phillip Bay (~90; see Charlton-Robb et al. 2011). According to locals, the pod is a common sight in the Cunninghame Arm in the colder months. This newly designated species has not been assessed by the EPBC Act, but it is assumed that it will be awarded a “Cetacean” status, similar to other *Tursiops* species. However, the species has been “Nominated” for listing under the FFG Act and has been awarded an “Endangered” status by the DEPI. Considering only two small distinct populations have been identified, these conservation listings were inevitable.

4.3 Habitat and Vegetation Condition and Distribution

All habitat (and vegetation) within the downstream region has been impacted by human-associated activities (Plate 4-6). Although much of the downstream region has not been extensively cleared, like other areas in Victoria, vegetation has been selectively and comprehensively harvested and removed for residential/industrial development. For a detailed evaluation of land use see ***Land and Water Use Study*** (EES Referral Attachment 11).

A few small patches of high quality habitat remain along the edges of Lake Tyers. In general, good quality habitat can be found between Lake Tyers and Hospital Creek (to the east). This forested area between Lake Tyers and Hospital Creek has been proposed for protection under the National Parks Act and would therefore be protected much more extensively than it is currently.

Despite this area’s proposed inclusion under the National Parks Act, it has experienced human-associated disturbance in the past. An approximate 2 km^2 parcel of land in the north-east corner of Lake Tyers Park was harvested between 1960 and 1969 (DEPI 2013a). Additionally, Hartland State Forest has been sporadically harvested, east of Lake Tyers Park and north of Ewing Morass Wildlife Reserve (east of Lake Tyers). These patches have been chiefly harvested using seed tree and single tree selection techniques, mostly between 1960 and 1979. A few patches were harvested between 2000 and 2009.

The condition of habitat is correlated with the level of protection. For example, higher quality habitat remains in areas with the highest level of protection. The high quality habitat that remains along the edge of Lake Tyers is protected under the EPBC Act and hence awarded the highest level of protection.

Habitat within the Lake Tyers Park is managed for sustainable use and therefore is regularly disturbed by logging, recreational and development activities.

Several environmental weeds, particularly blackberry (*Rubus fruticosus*), were common along the creeks and tributaries that fed into Lake Tyers. These weeds were much more prevalent in agricultural areas, where the riparian vegetation had been removed or drastically altered.

Overall, the majority of remaining native habitat is fragmented and degraded because most is not awarded the highest protection (currently disturbed) and has been disturbed in the past. Some areas of high quality habitat remain, and more habitat can be improved and further protected if areas around Lake Tyers are protected under the National Parks Act.

Table 4-1 Vertebrate fauna observed in the overview assessment of the downstream region; taxa classification, conservation status and if introduced (ordered by taxa and conservation status)

Class	Order	Family	Common Name	Scientific Name	EPBC Act	Treaty	FFG Act	DSE	Origin
Amphibia	Anura	Myobatrachidae	Victorian smooth froglet	*Geocrinia victoriana*					
Aves	Pelecaniformes	Ardeidae	Eastern great egret	*Ardea modesta*	M; Marine	CAMBA JAMBA	L	VU	
	Falconiformes	Accipitridae	White-bellied sea-eagle	*Haliaeetus leucogaster*	M; Marine	CAMBA	L	VU	
	Ciconiiformes	Ardeidae	Cattle egret	*Ardea ibis*	M; Marine	CAMBA JAMBA			
	Passeriformes	Climacteridae	Brown treecreeper	*Climacteris picumnus victoriae*				NT	
	Struthioniformes	Dromaiidae	Emu	*Dromaius novaehollandiae*				NT	
	Charadriiformes	Laridae	Pacific gull	*Larus pacificus pacificus*				NT	
	Pelecaniformes	Threskiornithidae	Royal spoonbill	*Platalea regia*				NT	
	Charadriiformes	Haematopodidae	Sooty oystercatcher	*Haematopus fuliginosus*				NT	
	Psittaciformes	Psittaculidae	Australian king parrot	*Alisterus scapularis*					
	Passeriformes	Cracticidae	Australian magpie	*Gymnorhina tibicen*					
	Pelecaniformes	Pelecanidae	Australian pelican	*Pelecanus conspicillatus*					
	Passeriformes	Corvidae	Australian raven	*Corvus coronoides*					
	Ciconiiformes	Threskiornithidae	Australian white ibis	*Threskiornis molucca*					
	Anseriformes	Anatidae	Australian wood duck	*Chenonetta jubata*					
	Passeriformes	Meliphagidae	Bell miner	*Manorina melanophrys*					
	Anseriformes	Anatidae	Black swan	*Cygnus atratus*					
	Passeriformes	Campephagidae	Black-faced cuckoo-shrike	*Coracina novaehollandiae*					
	Accipitriformes	Accipitridae	Black-shouldered kite	*Elanus axillaris*					
	Falconiformes	Falconidae	Brown falcon	*Falco berigora*					

Class	Order	Family	Common Name	Scientific Name	EPBC Act	Treaty	FFG Act	DSE	Origin
	Passeriformes	Acanthizidae	Brown thornbill	*Acanthiza pusilla*					
	Columbiformes	Columbidae	Brush bronzewing	*Phaps elegans*					
	Anseriformes	Anatidae	Chestnut teal	*Anas castanea*					
	Passeriformes	Turdidae	Common blackbird	*Turdus merula*					Introduced
	Columbiformes	Columbidae	Common bronzewing	*Phaps chalcoptera*					
	Passeriformes	Sturnidae	Common myna	*Acridotheres tristis*					Introduced
	Passeriformes	Sturnidae	Common starling	*Sturnus vulgaris*					Introduced
	Charadriiformes	Sternidae	Crested tern	*Thalasseus bergii*					
	Psittaciformes	Psittaculidae	Crimson rosella	*Platycercus elegans*					
	Anseriformes	Anatidae	Domestic goose	*Anser anser*					Introduced
	Gruiformes	Rallidae	Dusky moorhen	*Gallinula tenebrosa*					
	Psittaciformes	Psittaculidae	Eastern rosella	*Platycercus eximius*					
	Passeriformes	Cinclosomatidae	Eastern whipbird	*Psophodes olivaceus*					
	Gruiformes	Rallidae	Eurasian coot	*Fulica atra*					
	Passeriformes	Petroicidae	Flame robin	*Petroica phoenicea*					
	Psittaciformes	Cacatuidae	Galah	*Eolophus roseicapilla*					
	Psittaciformes	Cacatuidae	Gang-gang cockatoo	*Callocephalon fimbriatum*					
	Passeriformes	Artamidae	Grey butcherbird	*Cracticus torquatus*					
	Passeriformes	Pachycephalidae	Grey shrike-thrush	*Colluricincla harmonica*					
	Passeriformes	Passeridae	House sparrow	*Passer domesticus*					Introduced
	Coraciiformes	Halcyonidae	Laughing kookaburra	*Dacelo novaeguineae*					
	Suliformes	Phalacrocoracidae	Little pied cormorant	*Microcarbo melanoleucos*					
	Passeriformes	Corvidae	Little raven	*Corvus mellori*					
	Passeriformes	Meliphagidae	Little wattlebird	*Anthochaera chrysoptera*					

Class	Order	Family	Common Name	Scientific Name	EPBC Act	Treaty	FFG Act	DSE	Origin
	Passeriformes	Monarchidae	Magpie-lark	*Grallina cyanoleuca*					
	Charadriiformes	Charadriidae	Masked lapwing	*Vanellus miles*					
	Psittaciformes	Psittaculidae	Musk lorikeet	*Glossopsitta concinna*					
	Passeriformes	Meliphagidae	Noisy miner	*Manorina melanocephala*					
	Anseriformes	Anatidae	Pacific black duck	*Anas superciliosa*					
	Passeriformes	Artamidae	Pied currawong	*Strepera graculina*					
	Charadriiformes	Haematopodidae	Pied oystercatcher	*Haematopus longirostris*					
	Gruiformes	Rallidae	Purple swamphen	*Porphyrio porphyrio*					
	Psittaciformes	Psittaculidae	Rainbow lorikeet	*Trichoglossus haematodus*					
	Psittaciformes	Psittaculidae	Rainbow lorikeet	*Trichoglossus haematodus*					
	Passeriformes	Meliphagidae	Red wattlebird	*Anthochaera carunculata*					
	Columbiformes	Columbidae	Rock dove	*Columba livia*					Introduced
	Passeriformes	Locustellidae	Rufous songlark	*Cincloramphus mathewsi*					
	Passeriformes	Pachycephalidae	Rufous whistler	*Pachycephala rufiventris*					
	Charadriiformes	Laridae	Silver gull	*Larus novaehollandiae*					
	Strigiformes	Strigidae	Southern boobook	*Ninox novaeseelandiae*					
	Passeriformes	Pardalotidae	Spotted pardalote	*Pardalotus punctatus*					
	Columbiformes	Columbidae	Spotted turtle-dove	*Streptopelia chinensis*					Introduced
	Ciconiiformes	Threskiornithidae	Straw-necked Ibis	Threskiornis spinicollis					
	Psittaciformes	Cacatuidae	Sulphur-crested cockatoo	*Cacatua galerita*					
	Passeriformes	Maluridae	Superb fairy-wren	*Malurus cyaneus*					
	Falconiformes	Accipitridae	Wedge-tailed eagle	*Aquila audax*					
	Passeriformes	Hirundinidae	Welcome swallow	*Petrochelidon neoxena*					
	Pelecaniformes	Ardeidae	White-faced heron	*Egretta novaehollandiae*					

Class	Order	Family	Common Name	Scientific Name	EPBC Act	Treaty	FFG Act	DSE	Origin
	Passeriformes	Corcoracidae	White-winged chough	*Corcorax melanorhamphos*					
	Passeriformes	Rhipiduridae	Willie wagtail	*Rhipidura leucophrys*					
	Pelecaniformes	Threskiornithidae	Yellow-billed spoonbill	*Platalea flavipes*					
	Psittaciformes	Cacatuidae	Yellow-tailed black-cockatoo	*Calyptorhynchus funereus*					
Mammalia	Cetacea	Delphinidae	Burranun dolphin	*Tursiops australis*			N	EN	
	Diprotodontia	Macropodidae	Black wallaby	*Wallabia bicolor*					
	Carnivora	Felidae	Cat	*Felis catus*					Introduced
	Artiodactyla	Bovidae	Cattle	*Bos taurus*					Introduced
	Diprotodontia	Phalangeridae	Common brushtail possum	*Trichosurus vulpecula*					
	Diprotodontia	Pseudocheiridae	Common ringtail possum	*Pseudocheirus peregrinus*					
	Diprotodontia	Vombatidae	Common wombat	*Vombatus ursinus*					
	Carnivora	Canidae	Dog	*Canis lupus familiaris*					Introduced
	Diprotodontia	Macropodidae	Eastern grey kangaroo	*Macropus giganteus*					
	Lagomorpha	Leporidae	European rabbit	*Oryctolagus cuniculus*					Introduced
	Artiodactyla	Bovidae	Goat	*Capra hircus*					Introduced
	Perissodactyla	Equidae	Horse	*Equus caballus*					Introduced
	Carnivora	Canidae	Red fox	*Vulpes vulpes*					Introduced
	Artiodactyla	Cervidae	Sambar deer	*Cervus unicolor*					Introduced
	Artiodactyla	Bovidae	Sheep	*Ovis aries*					Introduced
	Monotremata	Tachyglossidae	Short-beaked echidna	*Tachyglossus aculeatus*					
	Chiroptera	Molossidae	White-striped freetail bat	*Tadarida australis*					
Reptilia	Squamata	Varanidae	Lace monitor	*Varanus varius*				EN	

Key: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; M – Migratory; L – Listed; I – Insufficient Data; NT – Near Threatened; CAMBA – China-Australia Migratory Bird Agreement; JAMBA – Japan-Australia Migratory Bird Agreement.

Plate 4-1 Lake Tyers within the Gippsland Lakes Ramsar site

Plate 4-2 Black swan *Cygnus atratus* on the beach of Cunninghame Arm of Lake King, Gippsland Lakes

Plate 4-3 Australian pelican *Pelecanus conspicillatus* in Cunninghame Arm of Lake King

Plate 4-4 White-faced heron *Egretta novaehollandiae* at the entrance of Lake Tyers into Bass Strait

Plate 4-5 Burranun dolphins *Tursiops australis* in Cunninhame Arm, Lake King

Plate 4-6 Urban development around the Cunninghame Arm of Lake King, Lakes Entrance

5 Ecological Communities and Flora with Potential to Inhabit the Region

The literature and database sources indicate that several significant ecological communities and flora have been recorded within the downstream region. It is likely that many of these communities and species are present within the downstream region, if they have not been removed since their inclusion in the data sources. Some species and communities are assumed to be present (by the literature) based on remote assessment and it appears that no onsite evaluation exists. Therefore, this section lists communities and species that have been recorded and/or have been assumed to exist within the downstream region, and discusses the likelihood that they continue to inhabit the region.

The downstream region encompass several significant ecological communities and species that are listed separately (under legislation) as outlined in the following sections.

5.1 Significant Wetlands and Ecological Communities

Gippsland Lakes Ramsar Site

As described in Section 1.4.3, the Gippsland Lakes Ramsar Site occurs in the broad area downstream of the proposed mine site (Figure 3-1). The Gippsland Lakes system is protected under the international Ramsar Convention on wetlands by the Australian Commonwealth EPBC Act (see DSEWPaC 2010). The main lakes of the Gippsland Lakes system are Lake Wellington, Victoria and King, which are linked to the sea by an artificial entrance at Lakes Entrance. Notably, Lake Tyers is situated to the east of the Lakes Entrance area and does not have connectivity to the other lakes in the Gippsland Lakes system.

The Gippsland Lakes system supports a wide range of habitats, inclusive of:

- 'Marine subtidal aquatic beds' (waterbodies with seagrass and/or algae species present).
- 'Coastal brackish or saline lagoons' (waterbodies generally).
- 'Fringing wetlands', often brackish but sometimes freshwater and sometimes hypersaline, that are vegetated with a wide range of vascular and non-vascular plants.

Lake Tyers is considered to be composed primarily of Coastal Brackish or Saline Lagoons (that also may include marine subtidal aquatic beds) (DSE, 2003). Approximately 540 flora species, of which at least 25% are non-indigenous, and 300 species of indigenous fauna have been identified within the Gippsland Lakes Ramsar Site. Of these species, 41 (6 flora and 35 fauna) are listed under the Flora and Fauna Guarantee Act 1988 and 12 of these have Action Statements prepared under the Act.

The Gippsland Lakes RAMSAR accreditation is attributed to the site meeting a number of criteria for identifying wetlands of international importance. The site is considered to meet Ramsar Nomination Criteria 1, 2, 4, 5, 6 and 8, as follows (Ramsar Convention 2013):

- Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.
- Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.
- Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.
- Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
- Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
- Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

5.2 Listed EPBC Act Significant Communities

Three nationally significant ecological communities were identified by the EPBC Act search of the downstream region. A description and discussion of these follows:

Gippsland Red Gum (Eucalyptus tereticornis subsp. mediana) Grassy Woodland and Associated Native Grassland

The Gippsland Red Gum grassy woodland and associated native grassland is listed as Critically Endangered under the EPBC Act (DSEWPaC 2013b). According to ecological modelling and mapping, this significant community is likely to occur/occurs around Lake King, Lakes Entrance, and along the coast towards the south-western most tip of Lake Tyers (within the downstream region; Environmental Resources Information Network 2008). The community has a very restricted geographic range, only being present in East Gippsland, but it does extend west beyond the edge of the Gippsland Lakes Ramsar site.

The community is dominated by a tree canopy of Gippsland Red Gum and the undergrowth is dominated by grasses or grass-like herbs and forbs (DEWHA 2010). It can occur in two forms, the grassy woodland is dominated by a tree canopy and a grassy ground layer. Alternatively, the tree canopy can be sparse or largely absent and the community is dominated by grasses. The grassy woodland is the most common form and the ground layer can consist of wildflowers including lilies and orchids interspersed with grasses.

The community is located within the Gippsland Plain and East Gippsland Lowland bioregions. It is associated with several Ecological Vegetation Classes (EVCs), including two ecological communities listed as threatened under the FFG Act (DEWHA 2010). These are the Central Gippsland Plains Grassland Community and the Forest Red Gum Grassy Woodland Community. These two FFG Act communities have not been modelled within the downstream region. The community is also associated with a mosaic of different EVCs, some of which may be within the downstream region.

Although the sources suggest that Gippsland Red Gum grassy woodland and associated native grassland occurs between Lake King and Lake Tyers, there are no records of it ever being found or described in the downstream region. Seven of the nine other *Eucalyptus* species that typically occur in the community have been recorded in the downstream region but not all between Lake Tyers and Lake King (DEWHA 2010). Additionally, several of the key ecological communities (for this community) that may suggest its presence elsewhere have not been recorded within the downstream region. Therefore, it is unlikely that this community exists within the downstream region. No fine scale spatial representations of this community could be found in the literature or database sources.

Littoral Rainforest and Coastal Vine Thickets of Eastern Australia

The EPBC Act lists the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia as Critically Endangered (DSEWPaC 2013b). The community is highly fragmented and somewhat degraded, but exists in remnant patches along the eastern coast of Australia (DEWHA 2009). Based on vegetation modelling, the community is likely to occur from Cape York in Queensland to Lakes Entrance in Victoria. It has been suggested that the North Arm section of Lake King (within the downstream region) was part of the historic range of the community (Peel 2007).

Since the community exists along much of the eastern coast of Australia, species composition can vary greatly. However there are some commonalities between the patches. The community will generally occur within 2 km of the coast, on off-shore islands or adjacent to estuaries or other large bodies of brackish/salt water (DEWHA 2009). Most communities will have a tree-dominated canopy and a sparse ground layer.

The Victorian sections of this community have only recently been described and therefore detailed information is not readily available. However, remote assessment suggests that it is restricted to East Gippsland and a portion of the Victorian Alps (TSSC 2008, Davies & Goldsmith 2010). In Victoria, the tree-dominated and sparse ground layer can include several species of fern.

The literature is not clear regarding exact locations, but it appears that the community may exist in three locations within the downstream region. Firstly, the EPBC Act policy statement suggests that there is a patch of the community at Ninety Mile Beach, Lakes Entrance (DEWHA 2009). Of nine key species included in the community's policy statement, only three have been recorded in the downstream region and none along Ninety Mile Beach.

Preliminary work conducted for the addition of Victorian Littoral Rainforests into the EPBC Act-listed community, identified that there are large and significant stands of native vegetation (mostly Littoral Rainforest) around Lake Tyers (Peel 2007, Peel 2010). Many sources mention a Littoral Rainforest community or EVC as being evidence of the community's presence in Victoria, but no Littoral Rainforest EVC or community is listed or described by the DSE.

These sources also suggest that the Littoral Rainforest is associated with the FFG Act-listed Warm Temperate Rainforest communities (Davies & Goldsmith 2010, Peel 2010). There are several small patches of Warm Temperate Rainforest around Lake Tyers and this may be where the Littoral Rainforest patches occur, but this is not clear. The literature has also indicated there are patches of the Littoral Rainforest community around Ewing's Marsh. Similar to Lake Tyers, there are patches of the Warm Temperate Rainforest (no Littoral) and potentially these are the patches the sources are referring to.

It is unclear from the sources where the community is and what constitutes its presence. It is possible the exact location may be protected to prevent vandalism. If the sources are correct, there are probably a few very small (and potentially degraded) patches of this community within the downstream region.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

The White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland community is listed as Critically Endangered under the EPBC Act as there are few remnants. The community is patchy and rare because the historic range included high quality soils that were cleared for agriculture. The remaining patches are so fragmented and degraded that a true representation of the original matrix probably does not exist (Thiele & Prober 2000).

This community can be either woodland or derived grassland (grassy woodland where the trees have been removed). The ground layer can be composed of a sparse, patchy shrub layer, native tussock grasses and herbs and a tree canopy usually of White Box (*Eucalyptus albens*), Yellow-Box (*E. melliodora*) and Blakely's Red Gum (*E. blakeli*) (Yates & Hobbs 1997). The tree canopy dominates this ecological community and the three main species can be interspersed with other tree species (Thiele & Prober 2000). The dominant life forms in the original community ground layer were herb and grasses, particularly Kangaroo Grass (*Themeda triandra*) and Snow Grass (*Poa sieberiana*). Consequently, it is possible for the community to exist without the tree canopy.

It is unclear whether this nationally significant community is present within the downstream region. There are several key trees that characterise this community but these have not been recorded within the region. A few of the trees that are considered as secondary indicators of the community's presence have been recorded in the region. However, there is little detailed information regarding the location of this community or the EVCs that constitute it. Consequently, if the community did exist in the region, it is probably fragmented and within small patches.

5.3 FFG Act Modelled Communities

Six ecological communities that have been modelled and listed under the FFG Act have been mapped within the downstream region (Table 5-1). Coastal Moonah Woodland is restricted to the coast around Lakes Entrance, which is within the Cunninghame Arm of Lake King. The Dry Rainforest (Limestone) Community is found in three small remnant patches around Lake Tyers. A mosaic of the different types of Warm Temperate Rainforests have been modelled as occurring throughout the downstream region, particularly along very small creeks that empty into Lake Tyers.

The Coastal Moonah Woodland that has been modelled around Cunninghame Arm of Lake King consists of the Coastal Dune Scrub/Coastal Dune Grassland Mosaic and is dominated by Moonah (*Melaleuca lanceolata lanceolata*; Turner & Tonkinson 2003). Despite these modelled patches around Lake King, the most characteristic indicator of this community, the moonah tree, has not been recorded in the downstream region. Of the other seven species that characterise the community, three have been recorded in the area (i.e. small-leaved clematis *Clematis microphylla*, coast tea-tree *Leptospermum laevigatum* and kidney-weed *Dichondra repens;* Turner & Tonkinson 2003). Similarly, although the community has been modelled (from satellite imagery and EVCs) a detailed survey of all potential occurrences of the community does not appear to have been conducted. Nonetheless, the community is probably present along the coast.

The Dry Rainforest (Limestone) Community is found in three small remnant patches around Lake Tyers, isolated to fireproof niches (e.g. deep rocky gorges) and valleys (DSE 2009). The trees that dominate the community have not been recorded, yet the community has still been identified around Lake Tyers. Some of the secondary components (including shrubs and ground layer) have been recorded on site. Since the community has only been modelled and not confirmed by surveys, it is unlikely that it exists in its original state and is probably highly degraded.

A mosaic of the different types of Warm Temperate Rainforests have been modelled as occurring throughout the downstream region, particularly along very small creeks that empty into Lake Tyers. Of the six plant species that typically dominate the Warm Temperate Rainforest (Coastal East Gippsland), four have been recorded in the area. Similarly, some of the species dominating two of the other Warm Temperate Rainforest communities have been recorded in the area (DSE 2009). Two of four and seven of 11 species of the East Gippsland Alluvial Terraces and Far East Gippsland, respectively, were recorded in the downstream region. Surprisingly, no dominant species of the Cool Temperate Overlap, Howe Range have been found in the downstream region. Despite some dominant species being absent, it is highly likely that patches of remnant Warm Temperate Rainforest line some of the creeks on site.

Table 5-1 FFG Act modelled communities within the downstream region

FFG No.	FFG Name	EVC Name	EVC No.	EVC Bioregion/s
460	Coastal Moonah Woodland	Coastal Dune Scrub/Coastal Dune Grassland Mosaic	1	GipP
387	Dry Rainforest (Limestone)	Dry Rainforest	34	EGL
362	Warm Temperate Rainforest (Coastal E. Gippsland)	Warm Temperate Rainforest	32	EGL
363	Warm Temperate Rainforest (Cool Temperate Overlap, Howe Range) Community	Warm Temperate Rainforest	32	EGU
274	Warm Temperate Rainforest (E. Gipps. Alluvial Terraces)	Warm Temperate Rainforest	32	EGL
364	Warm Temperate Rainforest (Far East Gippsland)	Warm Temperate Rainforest	32	EGL, EGU

EGL – East Gippsland Lowlands; EGU – East Gippsland Uplands; GipP– Gippsland Plain

5.4 Ecological Vegetation Classes

Twenty-four Ecological Vegetation Classes (EVCs) may be present within the downstream region, most of which (18 EVCs) are considered to cover an area less than 50% of their pre-European extent (i.e. R, D, VU, EN). Four EVCs are considered as Endangered and have probably contracted to 10 to 30% of their pre-European extent (DEPI 2013b).

Eighteen of the 24 EVCs that may be present within the downstream region are considered to be regionally/locally threatened. However, not all of these locally threatened EVCs are included under the FFG Act. Most of these EVCs may be locally rare but not threatened throughout Victoria and therefore not qualify for the FFG Act. Therefore, they are not considered as nationally or State significant communities, although native vegetation legislation still applies to their conservation and management.

Table 5-2 List of Ecological Vegetation Classes (EVCs) that may be present within downstream region based on vegetation mapping and modelling (DEPI 2013a, DEPI 2013b)

EVC Name	Bioregion/s	EVC No.	BCS	Description
Warm Temperate Rainforest	GipP	32	EN	Generally occupies gullies and slopes where mean annual rainfall is >700 mm. Closed forest along small streams and dominated by non-eucalypt canopy, with understorey of trees and shrubs and a

EVC Name	Bioregion/s	EVC No.	BCS	Description
				matrix of ferns.
Dry Rainforest	EGL	34	EN	Open or closed non-eucalypt low forest or tall shrubland (15 m tall). Occurs in areas of relatively low rainfall and restricted to cliffs, gorges and rock screes.
Swamp Scrub	GipP	53	EN	Closed scrub layer (8 m) on alluvial deposits along streams or on poorly drained sites. Dominated by Swamp Paperbark, *Melaleuca ericifolia,* with occasional ground layer of moss or herbs
Limestone Pomaderris Shrubland	GipP	133	EN	Open woodland (10 m) or shrubland with emergent eucalypts (5 m) occurring on steep limestone cliffs with understorey of medium shrubs
Coast Banksia Woodland	GipP	2	VU	Restricted to coasts behind Coastal Dune Scrub; dominated by woody overstorey of Coast Banksia *Banksia integrifolia* (15 m). Medium shrub layer and understorey of herbs and sedges
Damp Sands Herb-rich Woodland	EGL, GipP	3	VU	Low, grassy or braken dominated eucalypt and banksia woodland or open forest (15 m tall). Large shrub layer and ground layer dominated by herbs, grasses and orchids.
Clay Heathland	EGU, EGL	7	VU	Dominated by a heathy shrub with or without eucalypt overstorey. Ground layer dense and species rich
Estuarine Wetland	EGL	10	VU	Dominated by grasses and herbs, often fringed by a tall scrub layer. Grows on fertile edges of estuaries, creeks, rivers and lagoons with intermediate salinity conditions.
Coastal Lagoon Wetland	EGL	11	VU	Vegetation dominated by grasses and a tall shrub layer. Occupies margins of coastal freshwater lagoons
Wet Swale Herbland	EGL	12	VU	Occupies seasonally inundated dune swales often forming between coastal dune barrier and hinterland hills. Typically dominated by rushes, sedges and herbs
Limestone Box Forest	EGL, GipP	15	VU	Open eucalypt forest (20 m tall) with tall shrub understorey and a grass and herb-rich ground layer. Occurs on soils derived from Tertiary limestones located around coastal streams, gullies and lakes
Valley Grassy Forest	GipP	47	VU	Open forest (20 m) with variety of eucalypts and a sparse shrub layer. Ground layer consists of herbs, lilies, grasses and sedges
Plains Grassy Forest	GipP	151	VU	Open forest (20 m) with heathy shrub layer and grass, sedge and herb ground layer. Occurs on lowland plains and old river terraces
Coastal Saltmarsh	EGL	9	D	Range of plant species including succulent herbs, shrubs, rushes and sedges. Occurs on or above marine/estuary tidal flats.
Riparian Forest	EGL	18	D	Tall forest along river banks and alluvial deposits. Dominated by tall eucalypts (30 m) with secondary tree layer of acacias; scattered dense patches of shrubs, ferns, grasses and herbs
Coastal Dune Scrub	GipP	160	D	Closed scrub layer (5 m) on dunes along ocean, bay beaches and lake shores.
Blackthorn Scrub	EGL	27	R	Open woodland with few emergent trees, with small tree or large shrub layer (6 m tall). Ground layer sparse and species-poor due to low site quality

EVC Name	Bioregion/s	EVC No.	BCS	Description
Warm Temperate Rainforest	EGL, EGU, GipP	32	R	Generally occupies gullies and slopes where mean annual rainfall is >700 mm. Closed forest along small streams and dominated by non-eucalypt canopy, with understorey of trees and shrubs and a matrix of ferns.
Coastal Saltmarsh	GipP	9	LC	Range of plant species including succulent herbs, shrubs, rushes and sedges. Occurs on or above marine/estuary tidal flats.
Lowland Forest	EGU, EGL, GipP	16	LC	Very widespread, found in the foothills of the Great Dividing Range from East Gippsland to the western edge of the downstream region. The understorey varies from shrubby to heathy to sedgy and may even be grassy as fertility increases.
Shrubby Dry Forest	GipP	21	LC	Occurs on a range of rock types in the foothills associated with shallow rocky sites on exposed aspects such as ridges. Open forest consisting of a range of eucalypts, medium to low shrub layer and tussock-forming grasses
Damp Forest	EGL, EGU	29	LC	It is dominated by a tall eucalypt layer over a shrub layer of broad-leaved species typical of wet forest mixed with elements from dry forest types such as prickly or small-leaved shrubs. The ground layer includes forbs and grasses as well as moisture-dependent ferns.
Riparian Scrub	EGL	191	LC	Dense scrubland (6 m tall) with occasional eucalypts; understorey is often species-poor. Occurs along creeks and minor tributaries
Shrubby Damp Forest	GipP	316	LC	Occurs in gullies on fertile soil at elevations above 500 m. Canopy includes a variety of eucalypt species (30 m) and some acacias in the understorey. Dense mid shrub layer and a sparse ground cover of grasses and herbs

Key: BCS – Bioregion Conservation Status; EN – Endangered; VU – Vulnerable; D – Depleted; R – Rare; LC – Least Concern; EGL – East Gippsland Lowlands; EGU – East Gippsland Uplands; GipP– Gippsland Plain

5.5 Flora

5.5.1 Flora Previously Recorded within the Region

A total of 835 flora species (including sub-species and variants) have been recorded within the downstream region. One hundred and twenty three of these species are introduced (not Australian) and 15 species that are native but some stands may be alien (beyond species normal range). Australian flora is often planted elsewhere (also called non-indigenous) and can become just as invasive as non-Australian flora.

Of the 712 native flora species previously recorded in the region, only three are nationally threatened. All of these three species are considered as Vulnerable under the EPBC Act, however the thick-lip spider-orchid (*Caladenia tessellata*) is not recognised under State legislation (Annex 1). The other two, the Colquhoun grevillea (*Grevillea celata*) and limestone blue wattle (*Acacia caerulenscens*), are protected under State legislation and several specimens of each species have been identified within the downstream region.

Another four species are listed under the FFG Act and DEPI (Annex 1). Forty-three flora species are solely recognised by DEPI Advisory Lists. Many of these threatened species have been recorded within the forested areas around Lake Tyers, particularly between Lake Tyers and Hospital Creek.

5.5.2 Threatened Species with Potential to Inhabit Region

The literature and database searches indicated that 69 threatened flora species may grow within the downstream region (Annex 1). According to the literature, the EPBC Act maroon leek-orchid (*Prasophyllum frenchii*) and leafless tongue-orchid (*Cryptostylis hunteriana*) may grow in the area. Other than these two orchid species, a further 17 DEPI listed species may grow within the downstream region.

Several Commonwealth and State significant species were identified as being historically present or may grow within the downstream region. There are three possible reasons why some species have not been recorded recently or ever within the area. Firstly, a lack of, or limited, onsite surveying has resulted in a gap in the records. For example, the maroon leek-orchid has been described as being within the Gippsland Lakes Coastal Park (Duncan 2010), but this was not included in the data from the VBA. Secondly, the species are in such low numbers to make detection very difficult to impossible. Lastly, that many of the species have become locally/regionally extinct due to environmental pressures/stress (e.g. habitat destruction).

5.6 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystems that are partially or completely dependent on underground water for their survival and health. Groundwater can provide a reliable water supply when it is close to the surface and when rainfall is infrequent or low. Groundwater can provide water to plants, wetlands, streams and some animals. The main types of GDEs are:

- Terrestrial vegetation;
- Wetlands;
- Coastal estuarine and near shore marine systems;
- River base flow systems;
- Aquifer and cave ecosystems; and
- Terrestrial fauna (direct drinking source).

GDEs may be reliant on surface expression of groundwater, subsurface groundwater and/or subterranean groundwater.

All five of the main types of GDEs listed above may be present within the downstream region. The BOMs Atlas identified that Lake Tyers and tributaries have high potential for groundwater interaction where the vegetation may be reliant on subsurface and surface expression of groundwater. All land surrounding these creeks and lakes have no potential for reliance on surface expression of groundwater. Whereas, the land to the east and west have low and moderate (respectively) reliance on subsurface groundwater. No assessment of subterranean groundwater reliance has been conducted. Similarly, no field based assessment of GDEs appears to have been previously conducted within the downstream region.

6 Fauna with Potential to Inhabit the Downstream Region

6.1 Birds

6.1.1 Birds Previously Recorded in the Downstream Region

Two hundred and seventy-five birds (including 11 introduced) have been recorded in the downstream region, according to the VBA database. The majority of these species are common and widespread to Australia and/or Victoria. Most of the introduced species have been recorded close to human settlements, such as Lakes Entrance.

Internationally and Nationally Significant Species

The number of species recorded within the downstream region included 75 significant and threatened species (Annex 2). Forty-one of these species are listed under the EPBC Act regarding their threatened, marine and/or migratory status (Annex 2). Of these 41, 16 species are also listed under the FFG Act and DEPI, and another eight are covered under only DEPI lists. Most of these species are unlikely to be residents or regularly seen within the downstream region.

Several of these species are solely covered by international treaties and therefore are governed by the same prohibitions (e.g. killing, trading) as species that are listed as threatened under the EPBC Act. For example, species listed and protected under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) have been categorised as being in danger of extinction throughout, or a significant proportion of, their range (CMS 2013). Although these species may not be threatened in Australia, they may be elsewhere.

Twenty-one of the migratory and/or marine species over-winter in Australia and therefore are only seasonal visitors to the region. Although these 21 species may be seasonal visitors, most are Antarctic breeding birds and the downstream region is within the very edge of their range, making it highly unlikely that they will be seen or landing along the coast.

The fairy tern (*Sternula nereis nereis*) is the only nationally threatened species that may breed in the area and may be seen regularly. In fact, there are a few known nesting sites along the coast within the downstream region, one on a small island within the coastal inlets of Lake Tyers. This species was not seen during field assessments.

Other than the fairy tern, eight of these internationally and nationally significant species may reside within the downstream region. Two of these (eastern great egret, white-bellied sea-eagle) were seen during field assessments for the current Study and the others have been seen regularly along the coast in the past few years. Not all of these species will breed within the downstream region as there is limited (protected) nesting locations, but sometimes they will form mixed seabird colonies (e.g. Mud Island, Port Phillip Bay). Obviously, the sea-eagle would nest elsewhere, but as a juvenile was seen in the area, it is likely there is a successful breeding pair nearby.

State Recognised Species

Nineteen FFG Act listed species have been recorded in the area. All of these species are recognised by DEPI Advisory Lists (Annex 2). Some of these species have been recorded frequently within the downstream region and therefore they may be residents or frequent visitors. The remaining 15 (of 75) species that have been recorded in the area are recognised solely on DEPI Advisory Lists.

Only one of these species, the Pacific gull (*Larus pacificus*), was seen during field assessments. The gull was seen regularly along the coast around Lake Tyers and Lakes Entrance, but is unlikely to breed in these more exposed locations (e.g. to humans, dogs). Most gulls build nests on the ground and therefore these gulls may breed on one of the nearby offshore islands or small islands within Lake Tyers, perhaps in a mixed seabird colony.

6.1.2 Other Threatened Bird Species with Potential to Inhabit the Region

It is possible that another 15 international, Commonwealth and State recognised bird species (i.e. not including subspecies) may visit or inhabit the downstream region, but have not been previously recorded. Thirteen of these species are listed under the EPBC Act (nine internationally) and most are unlikely to frequent the area as they are Antarctic breeding seabirds. Of the two species not covered by the EPBC Act, one was seen during field assessments (brown treecreeper) and was widespread (but not common) in forested areas. The other species is only likely to visit the area occasionally (Annex 2).

6.2 Mammals

6.2.1 Mammals Previously Recorded in the Downstream Region

Fifty-seven species of mammal, including 11 introduced, have been recorded in the downstream region. Fourteen of these 57 are recognised under international and Commonwealth legislation (Annex 3), however most of these species have not been recorded in the area for at least 10 years. Most of these species are unlikely to use the area frequently and some may have become regionally or locally extinct. The distribution and abundance of exclusively marine species (Cetaceans) is not fully understood, but it is the smaller dolphin species that are more likely to come in close to the shore or into the lakes. Most of the larger Cetaceans may come into the Lakes system if sick or injured (e.g. July 2013 southern right whale *Eubalaena australis* stranded in Lakes Entrance).

Most of the nationally threatened terrestrial mammal species are unlikely to be resident because their populations are not stable, habitat is probably too disturbed and fragmented and under increasing pressure from introduced predators and stressors. Small populations of the spot-tail quoll (*Dasyurus maculatus maculatus*), southern brown bandicoot (*Isoodon obesulus obesulus*) and long-nosed potoroo (*Potorous tridactylus tridactylus*) may exist in (semi) protected areas where suitable habitat is found. However, connectivity is relatively poor between remnant patches of semi-protected areas as residential and agricultural land development is high, leaving large tracts of area open. These species will not cross such open areas or habitat.

Seven species listed under only State legislation have also been absent from records in recent years. However for two of these species (greater glider *Petauroides volans*, eastern pygmy possum *Cercartetus nanus*) this may be due to the cryptic and nocturnal nature of many mammals rather than not being resident.

6.2.2 Other Threatened Species with Potential to Inhabit the Region

Seven significant mammal species that have not been officially recorded in the area, but according to the literature, may use the downstream region. One of these species, the Burranun dolphin was observed during the field assessment and it is likely that this was previously recorded (in databases) as the bottlenose dolphin. The dingo (*Canis lupus dingo*) is the only non-EPBC Act species that may use the area and has not been recorded, but it is likely that any historic population of dingoes in the area hybridised with feral dogs (*Canis lupus familiaris*). Therefore any dogs in the area are probably dingo/domestic dog hybrids and do not qualify as a dingo.

6.3 Reptiles and Amphibians

6.3.1 Herpetofauna Previously Recorded in the Downstream Region

Seventeen (17) reptile and 18 amphibian species have been recorded within the downstream region (none introduced; Annex 4). Herpetofauna (reptiles and amphibians) are less well studied than mammals and birds and therefore the fewer number of species should not be interpreted as a region being home to few species. These species are cryptic and hard to survey without techniques targeted to detecting their presence (e.g. pit-fall traps).

Of the 35 herpetofauna species previously recorded, two reptiles and five frogs are recognised by the State and Commonwealth governments (Annex 4). Similar to mammals, these species have not been recorded recently (< 10 years) and therefore most are probably locally extinct.

One EPBC Act Endangered leatherback turtle (*Dermochelys coriacea*) washed up on the coast in 1985. This large sea turtle is unlikely to beach along the coast, because only sick, dead and nesting females will (typically) seen on land. The species is more normally seen far from the coast and not often within Victorian waters.

Although the lace monitor (*Varanus varius*) has not been recorded officially in the area since 2002, the species was seen during field assessments. Lace monitors have relatively large home territory ranges and therefore are in low densities, making them less likely to be sighted frequently.

The two frog species, the green and golden bell frog (*Litoria aurea*) and growling grass frog (*L. raniformis*), are considered Vulnerable under the EPBC Act and have been recorded within the downstream region. The former has been recorded more frequently (or in greater numbers) but neither has been recorded in the last 15 years. The green and golden bell frog is unlikely to be common or widespread, with most of the records from Hospital Creek, Ewing's Marsh or the habitat between the marsh and Lake Tyers. Considering there are no recent records (of this frog) and the overall population trend is in rapid decline, even the population around Ewing's Marsh and Hospital Creek may have become extinct or drastically reduced. The growling grass frog has only been recorded twice, despite sufficient habitat being present, and recently this species' population has contracted west and is predominantly found around Melbourne.

6.3.2 Other Threatened Species with Potential to Inhabit the Region

One international and Commonwealth protected sea turtle (loggerhead turtle *Caretta caretta*) may be very infrequently seen feeding within Victorian waters, off the coast of the downstream region (Annex 4). It is highly unlikely that any loggerhead turtles will come close to shore, unless sick or injured.

A further three significant frog species may inhabit the downstream region but have not been previously recorded. Two of these species are listed under the EPBC Act. Habitat is present for all amphibian species but it is likely that many of these species have become regionally extinct. There are many threatening processes that occur in the downstream region that may impact on the success of these species. It is highly likely that threats such as pollution, habitat fragmentation and introduced predators limit the survival and range of these species.

6.4 Fish and Invertebrates

Twenty-nine fish and three invertebrates have been recorded in the downstream region. However none of these species are considered threatened by the various agencies.

According to literature sources, 26 significant fish species may inhabit the downstream region (Annex 5). Two of these fish species are considered as Vulnerable by the EPBC Act, Australian grayling (*Prototroctes maraena*) and eastern dwarf galaxias (*Galaxiella pusilla*).

These searches did not identify any invertebrate species. A search of Victorian threatened invertebrate literature suggests that most species present in East Gippsland would not occur in the downstream region, either due to them being never recorded nearby or the habitat being inappropriate.

There is high quality habitat for a range of fish and invertebrate species, but the paucity of records is probably a lack of detailed surveying.

7 Potential Impacts

There are many sources of disturbance within the downstream region and the area continues to be impacted from a number of anthropogenic activities. Reviews of the ecologically important characteristics of the Gippsland Lakes Ramsar site (including the downstream region) have been published and provide much more detailed information regarding the impacts (potential and realised) than this review (see Harris et al. 1998, Webster et al. 2001, DSE 2003, EGCMA 2005, DSEWPaC 2010, DSE 2011). Therefore a full description of current impacts is not discussed here but a few key aspects are summarised below.

7.1 Current Key Threatening Processes

The downstream region's resources have been developed for many purposes including urban water supplies, to support agricultural activities, industry and cooling water for electricity generation (DSEWPaC 2010). Since European settlement approximately 160 years ago, the downstream region has been under an altered, anthropogenic-caused disturbance regime.

The habitat of the downstream region is being degraded by a combination of factors such as weed infestation, introduced animals, vegetation removal, salinity, alterations to nutrient cycles and dredging (DSE 2003). For example, altered nutrient and sediment loads from habitat clearance and agriculture inputted into the lakes and wetlands have created secondary problems, including regular algal blooms (Webster et al. 2001). Since Victoria's ecological characteristics are still under threat, several key threatening processes have been listed under the Flora and Fauna Guarantee (FFG) Act because they must be controlled and managed to prevent further biodiversity declines.

Nearly all of the threatening processes listed under the FFG Act occur or have the potential to occur within the downstream region (Table 7-1). Habitat fragmentation and degradation and introduced animals and plants feature prominently in the current threats to the downstream region (Table 7-1). Degradation of waterways and changes in the fire regime are also major contributors to biodiversity loss and continue to impact heavily on the abiotic and biotic processes of the downstream region.

7.1.1 Habitat Degradation, Weed Infestation and Introduced Animals

The downstream region is already highly fragmented and degraded, and human resource use has modified the physical and biotic conditions of the remaining habitat. Timber harvesting, livestock grazing and agriculture is common within the downstream region and subsequent vegetation removal has increased edge effects and fragmentation. Increased edge effects are created by the remaining fragments (after clearing) having a larger edge than the previous contiguous forest (Hobbs & Huenneke 1992). In the downstream region, the fragments are typically surrounded by areas of low biodiversity and simple structure (e.g. roads, buildings). The edges are exposed to increased light (solar radiation), different temperatures, wind and generally a different climate to previous (Murica 1995). Altered microclimate can encourage or decrease plant growth and consequently can change floristic structure.

The edges of fragmented habitat are also particularly exposed to weed invasion. Wind, water, pollinators and animals distribute weeds, especially in exposed edges. The area has a high weed load; at least 123 species of weeds grow within the area and this is probably a conservative estimate. The edges, especially along roads, erode more quickly without vegetation and rain erodes this further. The spread and invasion of environmental weeds has been listed under the FFG Act (Table 7-1) as a threatening

process, including the blackberry (*Rubus fruticosus*) which was encountered along many of the region's stream banks during field surveys.

Many key threatening processes involve the destruction caused by introduced animals, particularly large herbivores and predators. Sambar deer and rabbits were observed within the forested areas of the downstream region and feral pigs and goats are likely to be widespread. These herbivores reduce biomass and biodiversity of native vegetation through high intensity grazing. The larger, hoofed herbivores also increase soil disturbance, trample vegetation and compete with indigenous herbivores.

In general, introduced animals compete with indigenous fauna for already limited resources. Additionally, disturbance-tolerant native species can outcompete locally indigenous fauna for resources. For example, the presence of noisy miners (*Manorina melanocephala*) is often associated with a decrease in bird species diversity and abundance as they are a particularly aggressive native honeyeater (e.g. Grey et al. 1997). Noisy miners are also highly abundant on fringes and edges of remnant vegetation and appear to force out indigenous species. Consequently, the presence of noisy miners has been listed under the FFG Act as a threatening process (Table 7-1)

The region also had no large predators before European settlement (except the dingo) and therefore the introduction of highly efficient predators (i.e. feral dogs, cats, red foxes) dramatically increased the predation pressure. In some areas these predators can be responsible for up to 80% of native animal deaths (e.g. Smith et al. 2003). However, dogs, cats and foxes also prey upon introduced mammals and birds, with some evidence suggesting that they control other introduced animal populations (e.g. Brunner et al. 1975, Paltridge et al. 1997). Despite these introduced species being a high management priority (i.e. listed as threatening processes), there have been few recent published scientific studies investigating the impact these species are currently having on native species populations. Overall, the downstream region's biodiversity has shifted towards a system where introduced and disturbance-tolerant species are common and specialist and disturbance intolerant species have become threatened.

7.1.2 Waterway Degradation and Fire

There is an artificial opening to the sea at Lakes Entrance that has had a significant impact on the water regimes of the Gippsland Lakes (DSE 2003). The artificial opening requires periodic dredging to maintain the connection, and this has led to stratification of freshwater and salt water. The stratification creates oxygen depletion in the lower, saline layers (Harris et al. 1998). Additionally, the waters within Lake Tyers and Lake King are heavily used for recreation and industry and support several large towns. Demand on water resources is projected to rise, particularly upstream, with an increase in industrial, agricultural and urban development (see DSE, 2003 and DSEWPaC, 2010 for further information).

Fragmentation, agriculture and silviculture has caused substantial soil disturbance. This soil disturbance includes erosion, altered nutrient regimes and sediment transport. Altered nutrient cycles and input, particularly nitrogen and phosphorus, in low fertility systems often decreases species richness (Hobbs & Huenneke 1992). Increased nutrients and turbidity in the lakes can lead to extensive blue-green algae bloom and it can take months for the system to recover (DSE 2003). Hence, several threatening processes that relate to waterway degradation have been listed under the FFG Act (Table 7-1).

Much of the downstream region is prone to fire. Historically, fire had a very important role in Australian vegetation regeneration, particularly in grasslands. Fire can stimulate or maintain high productivity and can influence species diversity and floristic structure (Hobbs & Huenneke 1992). However, fire can increase the likelihood of invasion as it removes much of the canopy and temporarily fertilises the soil. The downstream area has been transformed from a typically wet forested and wetland area to a more open and dry system. It is highly likely this has dramatically altered the fire regime. Since the area is

frequented by an extensive human population (i.e. resident and tourists), the likelihood of arson is also high. The most recent (widespread) fires in the area were in 2007.

Overall, there are many current threats to the ecological characteristics of the downstream region and they are likely to continue and may intensify.

Table 7-1 Threatening processes occurring, or have the potential to occur, in the downstream region that have been considered sufficiently severe to warrant listing under the Victorian Flora and Fauna Guarantee Act (FFG Act)

Threatening Process	System/s Affected	Impact Outcomes and Listed Under the FFG Act as…
Degradation of waterways and catchments	Waterways	Alteration to the natural flow regimes of rivers and streams Alteration to the natural temperature regimes of rivers and streams Removal of wood debris from Victorian streams Prevention of passage of aquatic biota as a result of the presence of instream structures The discharge of human-generated marine debris into Victorian marine or estuarine waters Wetland loss and degradation as a result of change in water regime, dredging, draining, filling and grazing
Increased sediment and pollutant input due to human activities	Rivers, streams, estuaries and marine environments	Increase in sediment input into Victorian rivers and streams due to human activities Input of organotins to Victorian marine and estuarine waters Input of petroleum and related products into Victorian marine and estuarine environments Input of toxic substances into Victorian rivers and streams
Collection of native orchids	Orchid biodiversity, conservation and management	Collection of native orchids
Degradation and fragmentation of native vegetation	All habitat, including waterways and catchments	Degradation of native riparian vegetation along Victorian rivers and streams Habitat fragmentation as a threatening process for fauna in Victoria Loss of hollow-bearing trees from Victorian native forests Loss of coarse woody debris from Victorian native forests and woodlands Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases
High frequency fire and inappropriate fire regimes	All native vegetation	High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition Inappropriate fire regimes causing disruption to sustainable ecosystem processes and resultant loss of biodiversity
Bycatch	Seabirds	Incidental catch (or bycatch) of seabirds during longline fishing operations
Introduction of non-native animals	All habitats	Degradation and loss of habitats caused by feral horses (*Equus caballus*)

Threatening Process	System/s Affected	Impact Outcomes and Listed Under the FFG Act as…
		Reduction in biodiversity of native vegetation by sambar deer (*Cervus unicolor*) Reduction in biomass and biodiversity of native vegetation through grazing by the rabbit *Oryctolagus cuniculus* Soil degradation and reduction of biodiversity through browsing and competition by feral goats (*Capra hircus*) Predation of native wildlife by the cat, *Felis catus* Predation of native wildlife by the red fox *Vulpes vulpes* Introduction of live fish into waters outside their natural range within a Victorian river catchment after 1770
Introduction of 'environmental weeds'	All habitats	Invasion of native vegetation by 'environmental weeds' Invasion of native vegetation by blackberry *Rubus fruticosus* L. agg Introduction and spread of Spartina to Victorian estuarine environments
Introduction or altered distribution of native animals and plants beyond their normal range (non-indigenous)	All habitats	Reduction in biodiversity resulting from noisy miner (*Manorina melanocephala*) populations in Victoria Spread of *Pittosporum undulatum* in areas outside its natural distribution
Introduction and spread of non-native insects	Native flora and fauna	The introduction and spread of the large earth bumblebee *Bombus terrestris* into Victorian terrestrial environments Threats to native flora and fauna arising from the use by the feral honeybee *Apis mellifera* of nesting hollows and floral resources Loss of biodiversity in native ant populations and potential ecosystem integrity following invasion by Argentine ants (*Linepithema humile*)
Introduction and spread of plant and animal pathogens	Flora and fauna	Infection of amphibians with Chytrid Fungus, resulting in chytridiomycosis The spread of *Phytophthora cinnamomi* from infected sites into parks and reserves, including roadsides, under the control of a State or local government authority Use of *Phytophthora*-infected gravel in construction of roads, bridges and reservoirs

7.2 Overview of Potential Project Impacts

The downstream region does not include the proposed mine site, and consequently it is beyond the scope of this study to discuss direct or indirect impacts associated with the mine site (e.g. vegetation removal). For a discussion of the potential impacts associated with the development of the mine site, see ***Flora, Fauna and Ecological Characteristics and Assessment*** (EES Referral Attachment 8).

No removal of vegetation or foraging/breeding habitat is expected to occur in the downstream region as a result of the Project. Potential impacts of the Project, if they were to occur, would most likely arise because surface and/or groundwater are affected due to Project activities at the mine site. This may include impacts on downstream water quality and/or hydrology. The potential for water related impacts associated with the Project will be limited by the Project being designed to avoid and minimise potential impacts on water quality and hydrology where possible. A detailed *Environmental Management Plan* will also be required to ensure that potential impacts on downstream water resources are appropriately managed and monitored.

Potential impacts of the Project on water quality and hydrology have been assessed in detail in the ***Surface and Ground Water Baseline and Assessment*** (EES Referral Attachment 5). Key potential impacts highlighted by this study included:

- Surface water flows are likely to be interrupted in Tomato and Gap Creeks associated with the construction of the Operations Dam, Clean Water Dam and Sediment Control Dam. Notably, no significant impact on flows in Harris Creek are expected;
- The most significant potential water quality effect during the construction of the proposed Project is likely to be associated with erosion of disturbed land surfaces and resulting increases in water turbidity (suspended solids loads) in downstream surface waters;
- There may be potential for AMD / salinity generation from geological waste materials including waste rock, low grade ore, pit wallrock, and ROM Pad / Temporary ore stockpile. Notably, drainage from the waste rock dump, low grade ore stockpile, open pit and ROM pad will be contained on-site for operational mine water use. Water quality will also be monitored and treated, if required, to minimise the risk of potential water quality effects downstream of these facilities; and
- There should be limited downstream water quality effects associated with nutrients, pathogens and hazardous materials during operations if all management and treatment measures are effectively implemented.

Key potential impacts on aquatic and wetland ecology for the downstream region associated with any significant residual effects on water quality and hydrology associated with the Project are summarised below.

7.2.1 Wetland Communities, GDEs and Flora

Hydrology

During operations, the Project is expected to result in a minor reduction in flows downstream of the mine site in the Boggy Creek catchment. This may impact upon communities and flora downstream as reduced water availability for plants can decrease productivity and increase morbidity. Decreased water levels can also result in an increase in nutrient, sediment and salinity concentrations. However, it is expected that there will be only a minor impact on the normal background variation in downstream flows into Lake Tyers from the Boggy Creek catchment as only a very small proportion of the catchment will be affected by the

mine site (~1.7% of Boggy Creek catchment area affected above where the creek discharges into Lake Tyers, and no impact on the catchment of Ironstone Creek which also flows into Lake Tyers, refer EES Referral Attachment 5).

Water Quality - Nutrients, Salinity and Turbidity

For the current Project, the greatest risk of increased turbidity will be during the construction phase, due to erosion of disturbed land surfaces. In the absence of appropriate management, waste waters (e.g. sewage) from the administration and process facilities will comprise a potential source of nutrients that may be released into the receiving environment. Spills of ANFO in the open pit and explosives residues are potential sources of elevated nitrogen concentrations in surface water run-off. This has the potential to generate elevated nutrient (nitrogen) concentrations in waters draining from Project facilities. Fertilisers may be applied during progressive rehabilitation and revegetation activities during operations. Run-off from recently revegetated areas may be elevated in nutrients.

Significantly increased nutrients and turbidity from erosion of sediment (e.g. from soil disturbance at the mine site) can lead to extensive and lengthy blue-green algal blooms (DSE 2003). Nutrients can also accumulate along the bottom of streams and lakes in calmer conditions and enhance eutrophication (Webster et al. 2001). Nitrogen and phosphorus are important nutrients in aquatic systems and phosphorus is considered the limiting nutrient for phytoplankton production in freshwater systems (Rabalais 2002). One of the main consequences of eutrophication is cyanobacterial (blue-green algae) blooms (Conley et al. 2009). Lake Tyers experiences occasional cyanobacterial blooms from agricultural and stormwater run-off (EGCMA 2005) and it is likely that Ewing's Marsh and Lake King also experience occasional blooms.

In the event that the Project significantly increased salinity downstream, impacts would be dependent on the level of change in saline concentrations. An influx of saline (sea) water into freshwater systems can cause stratification of the water and result in the lower, saltier layers becoming oxygen depleted (Harris et al. 1998). Less oxygen available for uptake by aquatic plant roots can lead to a decrease in photosynthesis and general productivity. However, these processes can also occur naturally, particularly during drought periods (Webster et al. 2001) and therefore additional input of nutrient and salinity levels during extreme weather events may exacerbate the problem even further.

The Project has been designed to avoid and minimise potential downstream water quality risks (refer EES Referral Attachment 5). Key design features and controls for nutrients and turbidity for the Project include:

- Progressive rehabilitation and revegetation of disturbed areas.
- The Sediment Control Dam would allow for the settling of suspended solids prior to the release of water from site. The Sediment Control Dam would be the secondary source of water for the Project.
- During construction, the Project area will be graded and surface water diversion channels will be installed to ensure that the majority of Project drainage reports to the Sediment Control Dam.
- During construction the Clean Water Dam would allow for the settling of suspended sediments from the access road and the downstream face of the Operations Dam wall.
- A wastewater treatment system will be constructed to effectively reduce nutrient (eg. phosphorus and nitrogen) concentrations and pathogens from Project sewage and wastewaters.
- Monitoring of Project and downstream surface water quality.

Water Quality - Acid Metalliferous Drainage

It is expected that the Project will be designed and managed to ensure no significant impacts from acid metalliferous drainage occur for downstream waterways. In the absence of appropriate management, water that is significantly affected by acid metalliferous drainage can have a very low pH level, which can

be deadly to most aquatic organisms, including riparian and aquatic plants, and lead to degradation of aquatic ecosystems.

A common product of acid metalliferous drainage erosion and sulphide oxidation is iron hydroxide (Blowes et al. 2003). This and other precipitates (e.g. oxyhydroxides) can coat the surface of streams and aquatic vegetation, reducing exposure to light and hence photosynthesis. Reduced plant productivity and direct uptake of extraneous metals may cause *en-masse* die-off and reduce plant biodiversity if acid metalliferous drainage is concentrated. Direct uptake of excess metals and nutrients may not necessarily kill the plant, but be stored in their tissues (i.e. available to consumers).

The Project has been designed to avoid and minimise potential downstream water quality risks (refer EES Referral Attachments 5 and 6). Key design features and controls related to AMD management include:

- Use of benign and non-acid forming (NAF) waste rock material (See *EES Referral Attachment 6 – Geochemical Assessment*) in construction of key facilities including water storage dam walls, waste rock dump / low grade ore stockpile toes, run of mine (ROM) pad and other facilities.
- The Operations Dam would receive drainage from the open pit, pit dewatering bores, the waste rock dump, low grade ore stockpile and the ROM pad during operations. The Operations Dam would be designed and managed to ensure zero discharge during the operations phases of the Project.
- Implementation of management measures to ensure the long term geochemical stability of the proposed Project geological materials including waste rock, low grade ore, pit wallrock, ROM pad / temporary ore stockpile
- Monitoring of Project and downstream surface water quality and hydrogeology (including groundwater levels and quality).

7.2.2 Fauna

Water Quality - Altered Nutrients and Salinity

Significant alterations in nutrient ratios (particularly nitrogen and phosphorus) can affect aquatic ecosystems. As with other compounds, nutrients can bioaccumulate and biomagnify up the food chain. Additionally, stratification of saline layers with freshwater can deplete oxygen in the lower saltier layers, increasing fauna die-off.

Water Quality - Acid Metalliferous Drainage

In the absence of appropriate management, water affected by acid metalliferous drainage can have a very low pH level. Low pH can impact upon calcium metabolism, protein synthesis, alter gill membrane processes and in general will result in hypoxia and death (Fromm 1980). Additionally as pH decreases, the bioavailability of metals increases (Batty et al. 2010).

Acid drainage can cause further release of metals into the environment which can become available to biological organisms. Animals can ingest the metals through contaminated sediments and food (including leaf litter), and aquatic fauna can be exposed directly through their gills (Jennings et al. 2008). Some ions can be transported across gill membranes and, in general, can impair respiration (Fromm 1980). Precipitates from the drainage can also coat the surface of streams, subsequently coating micro- and macroinvertebrates that inhabit the benthic environment. If the coating is extensive, sedentary invertebrates are probably the first to be impacted, particularly those with thin cuticles (Batty et al. 2010). The response of invertebrate species to acid metalliferous drainage appears to be species-specific and it is therefore difficult to predict the impact on significant (threatened) species.

Water Quality – Other Pollutants

For the proposed Project no chemical reagents are required for the processing of ore. However hydrocarbons will be used on-site during operations predominantly for the re-fuelling and maintenance of the mining fleet, other site vehicles and the maintenance of the process plant. Environmental pollutants can have serious impacts on fauna if they move through the trophic levels in an ecosystem. Additionally, the severity of the impact is dependent on the concentration of bioavailable toxins/metals in the system (Siegel 2001). Toxins have the potential to bioaccumulate and biomagnify as they move higher in the food chain. Biomagnification (pollutants transferred from food resulting in higher concentration in an organism) and bioaccumulation (chemical concentration of pollutant in the organism relative to its environment and food) are most concerning in higher order species, particularly predators (Mann et al. 2011).

Hydrology

As the potential for changes in the background variation in downstream flows associated with the Project for the Boggy Creek catchment is expected to be very minor (refer EES Referral Attachment 5), impacts related to changes in hydrology are not expected to significantly impact on fauna. Additionally, the creeks are ephemeral and dry for most of the year, with rare pooling of water immediately after very heavy downpours.

7.3 Potential Impacts on Commonwealth and State Threatened Species

Most species identified within the broad downstream region are common and widespread (94% of flora; 76% of fauna) with many being introduced to the area. Therefore their populations of these species are generally expected to be stable and secure with limited scope for any potentially significant effects attributable to the Project. However, impacts on their welfare will need to be managed and mitigated regardless of their common conservation status.

Based on available information, an assessment of potential direct and indirect impacts for nationally and State threatened species is provided below.

7.3.1 Direct Impacts

Provided that the proposed hydrology and water quality management measures for the Project are implemented effectively, no conservation significant species or communities in the downstream region are expected to be directly impacted by the Project as:

- No vegetation is to be removed from areas downstream of the mine site as part of the Project;
- No foraging or breeding habitat will be removed;
- The Project has been designed to prevent significant changes in the quality or hydrology of water downstream;
- No threatened species have been found within the ephemeral creeks at the mine site, or in the surrounding vegetation. It is highly unlikely that any (exclusively) aquatic species exist in the water environments of the mine site as the creeks are dry for most of the year, and temporary pools only form after very heavy and lengthy downpours. Furthermore, no threatened aquatic species have been recorded in the creeks downstream of the mine site, or Lake Tyers itself, which may act as source populations for the creeks at the mine site. In addition, aquatic freshwater species would be unlikely to be able to use Lake Tyers as a refuge when the creeks upstream are dry due to the saline conditions of Lake Tyers for most of the year. Lake Tyers

was found to be equivalent to sea water in summer and layered fresh and brackish water in winter (see EES Referral Attachment 5).

- Amphibians may use the creeks, but no threatened amphibians were heard or seen using the creeks of the mine site during extensive field surveys (totalling approximately 127 hours, refer EES Referral Attachment 8). The last threatened amphibian to be recorded near to the mine site's creeks (~700 m north of Harris Creek) was in the 1960s.
- Masked owls, brown treecreepers and lace monitors may use the habitat in and around the ephemeral creeks, but they are highly mobile species, with large home ranges. Therefore, impact on these water environments is unlikely to affect any threatened terrestrial, amphibious or aquatic species (see EES Referral Attachment 8).

7.3.2 Indirect Impacts

Many of the threatened species observed in assessments (see Sections 4, 5 and 6) will not be indirectly impacted by minor changes (if they occur) in downstream water quality because they:

1. Are not semi-aquatic, amphibious, or aquatic;
2. Do not rely on semi-aquatic, amphibious, or aquatic food resources and would therefore not ingest affected food or water and can find alternative food and water resources; and
3. Do not rely on semi-aquatic, amphibious, or aquatic habitat.

In the event that there are minor changes in water quality and/or hydrology caused by the Project, the species considered at most risk of being indirectly impacted (and of particular conservation concern) are listed below. While these species *may* occur within the downstream region, their presence has not been recorded in the area:

Leafless tongue-orchid (Vulnerable EPBC Act; FFG Act; Endangered DEPI)

- Species is reported to occur alongside freshwater wetlands;
- Most of Lake Tyers may be unsuitable due to it being brackish;
- May occur in other riparian zones, but never recorded in downstream region;
- Some habitat is present but species is very rare and therefore *unlikely* to be present (see Annex 1 for assessment);
- If present within Lake Tyers, could potentially be indirectly impacted by:
  - Excessive drying or flooding; or
  - Altered salinity and nutrient levels in soils near waterways.

Dainty bitter-cress (FFG Act; Endangered DEPI)

- Grows in moist habitats;
- Last recorded in downstream region in 1995;
- Not actually recorded downstream of the Project, found within different section of Lake Tyers;
- Some habitat is present and therefore is *potentially* present (see Annex 1 for assessment);
- If present downstream of the Project, could potentially be indirectly impacted by:
  - Excessive drying or flooding;
  - Altered salinity and nutrient levels; or
  - Excessive algal blooms.

Slender mud-grass (FFG Act; Endangered DEPI)

- Grows in and around ephemeral or permanent pools and watercourses;
- Last recorded in downstream region in 1996;
- Not actually recorded downstream of the Project, found along coast east of Lake Tyers;
- Is *likely* to be present in region (see Annex 1 for assessment);
- If present downstream of the Project, could potentially be indirectly impacted by:
  - Excessive drying or flooding;
  - Altered salinity and nutrient levels; or
  - Excessive algal blooms.

Yellow-wood (FFG Act; Rare DEPI)

- Grows in warmer rainforests;
- Last recorded downstream of the Project in riparian zone in 1992;
- *Potentially* in remnant patches of Warm Temperate Rainforests along edges of Lake Tyers (see Annex 1 for assessment);
- If still present downstream of the Project, could potentially be indirectly impacted by:
  - Excessive drying or flooding; or
  - Altered salinity and nutrient levels in soils.

Australasian bittern (Endangered EPBC Act; FFG Act; Endangered DEPI)

- Inhabits reedbeds, swamps, streams and estuaries;
- Last recorded in downstream region in 1993;
- Forages on crustaceans, fish, snakes and fruit;
- *Potentially* present in suitable habitat (see Annex 1 for assessment);
- Could potentially be indirectly impacted if food source is impacted due to:
  - Loss of food sources by excessive drying, flooding, salinity (etc.) causing food die-off; or
  - Bioaccumulation/magnification of toxins from food sources.

Green and golden bell frog (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI)

- Inhabits freshwater and terrestrial habitats in coastal plains;
- Breeding habitat includes swamps and dams;
- Last recorded in downstream region in 1998;
- Last record from downstream of the Project in 1965 (museum specimen);
- Potentially locally extinct, unlikely to be present (see Annex 4 for assessment);
- If present, could potentially be indirectly impacted if food source is impacted due to:
  - Loss of food sources by excessive drying, flooding, salinity (etc.) causing food die-off; or
  - Bioaccumulation/magnification of toxins from food sources.
- Could also be indirectly impacted by:
  - Excessive drying or flooding;
  - Altered salinity and nutrient levels in soils; or

  - » Reduction in breeding habitat (less water).

Growling grass frog (Vulnerable EPBC Act; FFG Act; Endangered DEPI)

- Inhabits emergent vegetation, saline marshes and swamps;
- Breeding habitat includes swamps and dams;
- Last recorded in downstream region in 1992;
- Last recorded downstream of Project in 1788;
- Probably regionally extinct, *unlikely* to be present (see Annex 4 for assessment);
- If present downstream of the Project, could potentially be indirectly impacted if food source is impacted due to:
  - » Loss of food sources by excessive drying, flooding, salinity (etc.) causing food die-off; or
  - » Bioaccumulation/magnification of toxins from food sources.
- Could also be indirectly impacted by:
  - » Excessive drying or flooding;
  - » Altered salinity and nutrient levels in soils; or
  - » Reduction in breeding habitat (less water).

Australian grayling (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI)

- Adults inhabit creeks and rivers, usually in cool, clear waters;
- Never recorded in downstream region;
- Possibly locally extinct or insufficient surveying, but has *potential* to be present due to habitat being present (see Annex 5 for assessment);
- Could potentially be indirectly impacted if food source is impacted due to:
  - » Loss of food sources by excessive drying, flooding, salinity (etc.) causing food die-off;
  - » Bioaccumulation/magnification of toxins from food sources.
- Could also be indirectly impacted by:
  - » Excessive drying or flooding;
  - » Altered salinity and nutrient levels in soils; or
  - » Reduction in breeding habitat (less water).

Eastern dwarf galaxias (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI)

- Emergent vegetation along still or slow-flowing water;
- Adults can live in ephemeral and permanent habitats;
- Never recorded in downstream region;
- Possibly locally extinct or insufficient surveying, but has *potential* to be present due to habitat being present (see Annex 5 for assessment);
- Could potentially be indirectly impacted if food source is impacted due to:
  - » Loss of food sources by excessive drying, flooding, salinity (etc.) causing food die-off; or
  - » Bioaccumulation/magnification of toxins from food sources.
- Could also be indirectly impacted by:

- Excessive drying or flooding;
- Altered salinity and nutrient levels in soils; or
- Reduction in breeding habitat (less water).

8 Legislation and Policy Implications

8.1 Commonwealth Legislation

The most pertinent Commonwealth legislation relevant to the Study is the EPBC Act. Amongst other matters, the EPBC Act gives statutory effect to the Ramsar Convention and several international treaties relating to migratory and marine species.

One of the primary aims of the EPBC Act is to provide for the conservation of biodiversity and the protection of the environment. The Act has outlined several matters of national environmental significance (MNES), including:

- Wetlands of International Importance (Ramsar Convention);
- Listed threatened species and ecological communities;
- Migratory species protected under international agreements; and
- Commonwealth marine areas.

Under the Act, actions that are likely to have a significant impact upon matters of national environmental significance require approval from the Minister for the Environment.

No EPBC Act threatened fauna species and only three Migratory species were recorded during the overview field assessment. However, several threatened flora and fauna have been recorded by previous studies over the last approximately 60 years. It is highly unlikely that all of these species still occur in the region, as many have not been recorded in the last 30 years. Most of these species are unlikely to be impacted by small changes in water quality and/or hydrology caused by the Project as they are terrestrial and/or not reliant on aquatic habitats downstream of the Project. For these species to be impacted by the Project, water quality and/or the existing hydrological regime would have to be significantly compromised.

No species or communities of particular conservation concern previously recorded in the catchment downstream of the proposed mine site are considered as being at risk of significant indirect impact in the event that there are minor changes in water quality and/or hydrology caused by the Project.

However, based on the database and literature searches conducted indicated that there are several species which *may* occur downstream that could potentially be affected.

The species considered at most risk of being indirectly impacted (and of particular conservation concern) are listed below. While these species may occur within the catchment downstream of the proposed mine site, their presence has not been recorded in the area:

- Leafless tongue-orchid (Vulnerable EPBC Act; FFG Act; Endangered DEPI):
  - May occur in other riparian zones, but never recorded in downstream region.
- Australasian bittern (Endangered EPBC Act; FFG Act; Endangered DEPI):
  - Last recorded in downstream region in 1993.
- Green and golden bell frog (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI):
  - Last recorded in downstream region in 1998;
  - Last record from downstream of the Project in 1965 (museum specimen);

  - Potentially locally extinct.
- Growling grass frog (Vulnerable EPBC Act; FFG Act; Endangered DEPI):
  - Last recorded in downstream region in 1992;
  - Last recorded downstream of Project in 1788;
  - Probably regionally extinct.
- Australian grayling (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI):
  - Never recorded in downstream region;
  - Possibly locally extinct or insufficient surveying to detect presence.
- Eastern dwarf galaxias (Vulnerable EPBC Act; FFG Act; Vulnerable DEPI):
  - Never recorded in downstream region;
  - Possibly locally extinct or insufficient surveying to detect presence.

The Project will be referred to the Commonwealth Minister for the Environment in accordance with the EPBC Act. Depending on the designation of the development and/or whether further assessment is required, targeted surveys may be required for any of the abovementioned species. Any surveys will be undertaken in consultation with the State and Commonwealth Government.

8.2 State Legislation

8.2.1 Environment Effects Act 1978

The *Environment Effects Act 1978* provides for assessment of projects that are capable of having a significant effect on the environment. If it is deemed that the Project may have a significant effect on the environment, the Minister responsible for administering the *Environment Effects Act 1978* may ask the Proponent to prepare an *Environmental Effects Statement* (EES).

The EES process provides for the analysis of potential effects on environmental characteristics and the means of avoiding, minimising and managing adverse impacts. It also includes public involvement and the opportunity for an integrated response to a proposal. Additionally, the *Environment Effects Act* 1978 works in conjunction with the Commonwealth EPBC Act to allow for a bilateral agreement between the State and Commonwealth governments regarding awarding accreditation for the proposed Project, where an EES is required.

8.2.2 Flora and Fauna Guarantee Act 1988

The *Flora and Fauna Guarantee Act 1988* (FFG Act) was established to provide a legal framework for enabling and promoting the conservation of Victoria's native flora and fauna, and to enable management of potentially threatening processes. One of the main features of the Act is the listing process, whereby native species, communities and potentially threatening process are listed in the schedules of the Act.

Permits are required from the DEPI if it the proposed Project is likely to impact on FFG Act listed threatened communities on public land. In the event that water quality/hydrology is significantly altered by the Project, a preliminary assessment has determined that the species at most risk include dainty bitter-cress, slender mud-grass and yellow-wood (i.e. not EPBC Act listed species). However, the former two species have never been recorded in the downstream catchment (of the Project) and all three species have not been recorded in the downstream region for nearly 20 years.

9 Management and Mitigation

Measures to avoid, minimise and manage impacts on flora and fauna will be required during all phases of the Project, including the planning, construction, operating and closure phases. These measures will need to be continuously monitored for their efficiency and effectiveness, and improved if necessary. Management measures will need to be conducted in consultation and in conjunction with the Commonwealth and Victorian governments.

Key mitigation, management and monitoring measures to be outlined in the *Environmental Management Plan* to ensure downstream ecological values are protected should include:

- Regular monitoring of surface and ground water hydrology and quality. Monitoring will include up-gradient / upstream and down-gradient / downstream locations (of the Project facilities) to ensure any impacts are identified and suitable management responses can be implemented;
- Appropriate management of erosion and sediment transport at the mine site;
- Appropriate management of hazardous materials on site (e.g. hydrocarbons); and
- Development and implementation of a rehabilitation and closure plan that allows for the progressive rehabilitation over the Project life and ensures long-term risks to downstream water quality are minimal.

9.1 Surveying and Monitoring Programs

Surveying and monitoring programs may be required for the species at highest risk of impact from the Project (as listed in Section 8.1). These programs may be triggered at any time during the life of the mine by:

- Any significant hydrology and/or water quality changes caused by the Project (i.e. not by other sources);
- Determination by Commonwealth or Victorian agencies of the need for further surveying and monitoring of threatened populations (in response to the Project);
- Identification that the Project is impacting upon (or potentially impacting upon) threatened species.

All surveying, monitoring and species-specific management programs would need to be developed and implemented in consultation with the Commonwealth and Victorian Governments.

10 Summary and Conclusions

The downstream region has a high conservation value due to the presence of the Gippsland Lakes Ramsar Site and the likelihood of several listed communities and species occurring in the region. However, the downstream region is not pristine and has been significantly altered, developed and disturbed by human activities.

The majority of species present or likely to be present with the downstream region are common and widespread species (94% of flora; 76% of fauna) with many being introduced to the area. Therefore their populations are stable and secure and impacts on most populations are expected to be negligible. However, impacts on their welfare will be managed and mitigated regardless of their common conservation status.

Potential effects on aquatic ecology and wetlands associated with the development of the Project are expected to be minor due to the significant historical disturbance of the area and the implementation of strict water regulations. The impacts on aquatic ecosystems associated with the loss of the small sections of creeks potentially directly impacted by the Project mine site is not expected to be significant as they are ephemeral creeks that are dry for most of the year, and the reaches affected are also located at the headwaters of the catchment.

No conservation significant species or communities in the downstream region are expected to be directly impacted by the Project as:

- No vegetation is to be removed from areas downstream of the mine site as part of the Project;
- No foraging or breeding habitat will be removed; and
- The Project has been designed to prevent significant changes in the quality or hydrology of water downstream.

Potential impacts of the Project on the ecological values of the downstream region, if they were to occur, would most likely occur indirectly if downstream surface and/or groundwater are affected due to Project activities at the mine site. This may include impacts on downstream water quality and/or hydrology.

No species of particular conservation concern previously recorded in the downstream region are expected to be significantly impacted in the event that there are minor changes in water quality and/or hydrology caused by the Project. However, database and literature searches indicate that several species protected under the EPBC Act and FFG Act *may* occur within the downstream region (although) their presence has not been recorded in the area. All surveying, monitoring and species-specific management programs would be conducted and compiled in consultation with the Commonwealth and Victorian Governments.

The potential for impacts associated with the Project on downstream wetlands and aquatic ecology will be limited by the Project being designed to avoid and minimise potential impacts on water quality and hydrology where possible. To further protect downstream aquatic and wetland environments, potential impacts associated with the Project will need to be carefully managed and monitored to prevent any significant changes downstream of the mine site. With the implementation of appropriate mitigation and management measures, it is considered that the Project can be successfully delivered with no significant long-term impact on aquatic flora, fauna and ecological communities in the downstream region.

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12 Annexes

Annex 1 Threatened flora that has been recorded or has the potential to grow within the downstream region (ordered by conservation importance)

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Maroon leek-orchid	*Prasophyllum frenchii*	EN	L	EN			Habitat present but is very rare orchid	Grassland and grassy woodland habitats, soils generally damp but well drained	Herb
Leafless tongue-orchid	*Cryptostylis hunteriana*	VU	L	EN			Habitat present but is very rare orchid	Wide variety of habitats including heathlands dry sclerophyll forests, forested wetlands, freshwater wetlands, grasslands	Herb
Limestone blue wattle	*Acacia caerulescens*	VU	L	VU	1964	2010	Patches or isolated specimens likely; habitat present; literature confirms presence	Restricted to the Lakes Entrance-Buchan district, where is known only from the Swan Reach-Tambo Upper region and Lake Tyers north to the Murrindal area. Present in Lake Tyers Forest Park, where there is a 'significant population'	Tree
Colquhoun grevillea	*Grevillea celata*	VU	N	VU	1971	2009	Patches or isolated specimens likely; habitat present	Occurs on red siliceous or pale granitic sands, or gravelly clay-loams	Shrub
Thick-lip spider-orchid	*Caladenia tessellata*	VU			1991	2007	Habitat present but is very rare orchid	Grows in heathland and grassy or sedgy open forests in well drained sand and clay loams	Herb
Dainty bitter-cress	*Cardamine tryssa*		L		1995	1995	Patches or isolated specimens likely; habitat present	Moist habitats	Herb
Slender mud-grass	*Pseudoraphis paradoxa*		L	EN	1976	1996	Potentially widespread	Grows in and around ephemeral or permanent pools and watercourses	Aquatic grass
Heath spider-orchid	*Caladenia peisleyi*		L		2007	2008	Patches or isolated specimens likely; habitat present	Heathland, grassy woodland or forests	Herb
Yellow-wood	*Acronychia oblongifolia*		L	R	1944	1944	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in all types of warmer rainforest and on their margins, also in regrowth rainforest, widespread in coastal districts	Shrub -tree
Slender bitter-cress	*Cardamine tenuifolia*			EN			Potential due to presence of sufficient habitat, but may be absent/locally extinct	In swamps, moist habitats	Herb

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Black stem	*Adiantum formosum*			VU	1979	1979	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in colonies in rainforest or open forest, or on alluvial flats near streams	Fern
Coastal greenhood	*Pterostylis alveata*			VU	2006	2006	Patches or isolated specimens likely; habitat present	Sites include the seasonally damp transition zone on the margins of shallow freshwater marshlands	Herb
Creeping loosestrife	*Lysimachia japonica*			VU	1997	1997	Patches or isolated specimens likely; habitat present	Grows in moist situations, in and on margins of rainforest, on stream banks and in swamps	Herb
Dune fan-flower	*Scaevola calendulacea*			VU	1980	1980	Potentially widespread	Widespread, a sand stabilizer on coastal dunes	Shrub
Eastern bitter-cress	*Cardamine microthrix*			VU			Potential due to presence of sufficient habitat, but may be absent	Chiefly along waterways and adjacent low-lying areas	Herb
Naked sun-orchid	*Thelymitra circumsepta*			VU			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in mountainous districts with high rainfall, often inconspicuous among shrubs and tussocks	Herb
Spotted gum	*Corymbia maculata*			VU			Patches or isolated specimens likely; habitat present	Community dominant, in open forest on somewhat infertile and drier sites on shales and slates	Tree
Viscid daisy-bush	*Olearia viscosa*			VU	1911	1971	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Coastal scrub and rainforest margins wet and dry eucalypt forest, from the coast to steep hillsides usually at lower altitudes	Shrub
Woolly waterlily	*Philydrum lanuginosum*			VU	1991	1991	Potentially widespread	Grows along banks and margins of streams and other waterways, and in swamps	Aquatic perennial
Birch pomaderris	*Pomaderris betulina subsp. betulina*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Open forest	Shrub
Blotched hyacinth-orchid	*Dipodium variegatum*			R	1996	2005	Patches or isolated specimens likely; habitat present	Wet sclerophyll forest to heath, on a variety of soils	Herb

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Boomerang wattle	*Acacia amoena*			R	1976	1976	Patches or isolated specimens likely; habitat present	Grows in tableland areas of moderate elevation, on rocky slopes and along watercourses, in low open forest	Shrub
Coast grey-box	*Eucalyptus bosistoana*			R	1944	2002	Potentially widespread	Habitat is near streams in lowland areas on better quality soils, particularly over limestone	Tree
Coast groundsel	*Senecio spathulatus*			R			Potential due to presence of sufficient habitat, but may be absent	Specialised coastal species occurring mostly on frontal dunes and forming low, broad clumps	Herb
Coast mistletoe	*Muellerina celastroides*			R	1980	1980	Patches or isolated specimens likely; habitat present	Occurs in coastal areas in sclerophyll forest and rainforest, usually parasitic	Parasitic shrub
Cobra greenhood	*Pterostylis grandiflora*			R			Potential due to presence of sufficient habitat, but may be absent	Common on moist, shady slopes in sclerophyll forest	Herb
Common spleenwort	*Asplenium trichomanes*			R	1993	1993	Patches or isolated specimens likely; habitat present	Occurring almost worldwide in a variety of rocky habitats	Fern
Creeping rush	*Juncus revolutus*			R	1971	1971	Patches or isolated specimens likely; habitat present	Mostly in somewhat saline habitats	Herb
Dune groundsel	*Senecio spathulatus var. latifructus*			R	1992	1992	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Mostly frontal dunes	Herb
Dune wood-sorrel	*Oxalis rubens*			R			Potential due to presence of sufficient habitat, but may be absent	Commonly grows on islands, beaches and coastal sand dunes	Herb
Dwarf brooklime	*Gratiola pumilo*			R	1995	1995	Patches or isolated specimens likely; habitat present	Permanently or seasonally damp to swampy ground, and may colonise areas of cleared scrub	Herb
Eastern pomaderris	*Pomaderris discolor*			R	1992	1992	Potentially widespread	Generally grows in open forests	Shrub
Eastern Weft-moss	*Thuidium cymbifolium*			R	1901	1901	Patches or isolated specimens likely; habitat present	Occurs in moist environments	Bryophyte

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Forest bitter-cress	*Cardamine papillata*			R	1984	1984	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Hilly to mountainous areas	Herb
Forest red-box	*Eucalyptus polyanthemos subsp. longior*			R	1988	1993	Potentially widespread	Found on hillsides and in gullies on shallow soils derived from sedimentary rock or alternatively in open flat country on deep loam soils	Tree
Fringed helmet-orchid	*Corybas fimbriatus*			R	1942	1979	Patches or isolated specimens likely; habitat present	Common in moist forests in coastal districts	Herb
Gippsland stringybark	*Eucalyptus mackintii*			R	1954	2001	Potentially widespread	Dry sclerophyll forest or woodland on shallow poor soils on rises	Tree
Golden pomaderris	*Pomaderris aurea*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Temperate forests	Shrub
Heath platysace	*Platysace ericoides*			R	2005	2005	Patches or isolated specimens likely; habitat present	Coastal heath, scrubby heath and sclerophyll woodland	Shrub
Limestone pomaderris	*Pomaderris oraria subsp. calcicola*			R	1927	2006	Particularly in Limestone Pomaderris Shrubland EVC	Coastal dunes, cliffs, and estuary shorelines	Shrub
One-flower early nancy	*Wurmbea uniflora*			R	1992	1992	Patches or isolated specimens likely; habitat present	Grows in marshy places	Herb
Parsley xanthosia	*Xanthosia leiophylla*			R	1980	1980	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Moist to well drained heathy woodland	Shrub
Rough-fruit pittosporum	*Pittosporum revolutum*			R			Patches or isolated specimens likely; habitat present	Rainforest, wet sclerophyll forest, and in dry sclerophyll forest in the south of the range; chiefly in coastal districts	Shrub

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Rough-grain love-grass	*Eragrostis trachycarpa*			R	1971	1971	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in woodland and native pasture	Tussock grass
Ruddy blown-grass	*Lachnagrostis scabra*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in damp ground, including seepage slopes, stream banks and swamps	Grass
Salt lawrencia	*Lawrencia spicata*			R	1985	1992	Patches or isolated specimens likely; habitat present	Coastal saltmarsh, estuaries and river banks and occasionally near inland salt lakes	Herb
Sandfly zieria	*Zieria smithii subsp. smithii*			R	1991	1991	Patches or isolated specimens likely; habitat present	Widespread on the coast and ranges	Shrub
Slender bog-sedge	*Schoenus lepidosperma subsp. pachylepis*			R	2001	2001	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grass-like; coastal areas	Herb
Slender wire-lily	*Laxmannia gracilis*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Usually grows in woodland or open stony areas, on sandstone- or granite-derived soils	Herb
Small fork-fern	*Tmesipteris parva*			R			Patches or isolated specimens likely; habitat present	Usually epiphytic on treeferns, widespread but not common, in rainforest and moist eucalypt forest	Epiphyte
Small wax-lip orchid	*Glossodia minor*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Widespread in coastal and near-coastal districts, especially in heath	Forb
Snowy river wattle	*Acacia boormanii*			R	1987	1987	Patches or isolated specimens likely; habitat present	Sclerophyll woodland and forest, often in gullies and along streams	Shrub
Southern blue-gum	*Eucalyptus globulus subsp. globulus*			R	2007	2008	Patches or isolated specimens likely; habitat present	Wet forest in sheltered sites in coastal ranges	Tree

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Spicy everlasting	*Ozothamnus argophyllus*			R	1937	1984	Patches or isolated specimens likely; habitat present	Grows in woodland and on edges of rainforest, on granite or basalt; chiefly on the escarpment ranges	Shrub
Spurred helmet-orchid	*Corybas aconitiflorus*			R	1942	1995	Patches or isolated specimens likely; habitat present	Widespread in sclerophyll forest, particularly in coastal and near-coastal localities	Herb
Stalked adder's-tongue	*Ophioglossum reticulatum*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Poorly known species. In other countries it grows fully exposed sandy soil along the river and in laterite areas during the wet season	Forb
Twin-flower tea-tree	*Leptospermum emarginatum*			R			Patches or isolated specimens likely; habitat present	Grows along river banks and rocky creeks	Shrub
Varied mitrewort	*Mitrasacme polymorpha*			R	1991	1991	Patches or isolated specimens likely; habitat present	Widespread, often growing in sandy soil overlying sandstone, mainly coastal districts	Herb
Violet westringia	*Westringia glabra*			R	1952	2002	Potentially widespread	Grows in low open woodland and shrubland, in skeletal soils of steep rocky gorges	Shrub
Wallaby-bush	*Beyeria lasiocarpa*			R	1979	1979	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in wet sclerophyll forest or in moist gullies along the coast and in rocky situations on the ranges	Shrub -tree
Woolly-head pomaderris	*Pomaderris eriocephala*			R			Potential due to presence of sufficient habitat, but may be absent/locally extinct	Open forest	Shrub
Yellow Milk-vine	*Marsdenia flavescens*			R	1980	1980	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows in subtropical and dry rainforest; widespread, chiefly in coastal districts	Climber
Coast stackhousia	*Stackhousia spathulata*			DD	1984	1996	Patches or isolated specimens likely; habitat present	Grows in heath and dry sclerophyll forest in sandy regions, often near beaches or lagoons; widespread in coastal districts	Herb

Common Name	Scientific Name	EPBC Act	FFG Act	DSE	Recorded in downstream region between years		Likelihood of future presence and justification	Habitat /Species Characteristics	Type
Floating bur-reed	*Sparganium subglobosum*			DD	1980	1999	Potentially widespread	Grows in still or slow-flowing fresh water	Aquatic perennial
Hypsela	*Hypsela tridens*			DD	1970	1970	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Grows on the edges of lakes, pools and slow-moving streams	Herb
Long-flower beard-heath	*Leucopogon juniperinus*			DD			Patches or isolated specimens likely; habitat present	Grows in dry and wet sclerophyll forest and woodland on various soils over shale or sandstone	Shrub
Perennial blown-grass	*Lachnagrostis perennis*			DD	1991	1991	Potential due to presence of sufficient habitat, but may be absent/locally extinct	Temperate areas	Grass
Southern bristle-sedge	*Chorizandra australis*			DD	1991	1991	Patches or isolated specimens likely; habitat present	Moist, wetlands habitats	Grass
Upright panic	*Entolasia stricta*			DD	1972	1972	Patches or isolated specimens likely; habitat present	Grows in scrub in dry areas on sandy or sandstone-derived soils	Other grass

Key: EN – Endangered; VU – Vulnerable; L - Listed; N – Nominated; R – Rare; DD – Data deficient; general information sourced from various literature (Maslin & Court 1989, Walsh & Entwisle 1993, Backhouse & Jeanes 1995, Entwisle et al. 1996, Walsh & Entwisle 1996)

Annex 2 Significant bird species present and may inhabit the downstream region (ordered by conservation status importance)

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Orange-bellied parrot	*Neophema chrysogaster*	CR		L	CR			***H/U -*** Species population too small and is monitored too closely to not be recorded in area	Breeds in Tasmania in open forest copse in heath. Winters in mainland coastal saltmarsh, dunes, damp grasslands
Regent honeyeater	*Anthochaera phrygia*	EN; M	JAMBA	L	CR	1967	1967	***U -*** Habitat present in forested areas but species too rare; more likely further north	Open forests, woodlands, especially near blossoming eucalypts and mistletoe
Australasian bittern	*Botaurus poiciloptilus*	EN		L	EN	1966	1993	***P -*** Habitat present; probably present in small numbers	Reedbeds, swamps, streams, estuaries
Eastern bristlebird	*Dasyornis brachypterus brachypterus*	EN		L	EN	1987	1988	***P -*** Habitat present, but may be locally extinct or in very low numbers	Heathland, swamp shrubland or coastal riparian scrub
Swift parrot	*Lathamus discolor*	EN; Marine		L	EN	1910	1986	***U -*** Habitat present but species very uncommon; may forage in wetland area; may breed in forested areas further north	Drier open forests, woodlands, parks, gardens
Wandering albatross and sub-species	*Diomedea exulans sp.*	VU/EN; Marine; M	Bonn	L	EN	1986	1986	***S -*** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal seas, occurs in Australian waters only during non-breeding season
Grey-headed albatross	*Thalassarche chrysostoma*	EN; Marine; M	Bonn	L	VU			***S -*** May be seen during winter, but probably a fly-over in-shore	Oceanic, occurs in Australian waters only during non-breeding season
Southern giant petrel	*Macronectes giganteus*	EN; Marine; M	Bonn	L	VU	1989	1989	***S -*** May be seen during winter, but probably a fly-over in-shore	Oceanic, bays, occurs in Australian waters only during non-breeding season
Southern and northern royal albatross	*Diomedea epomophora sp.*	VU/EN; Marine; M	Bonn	L	VU			***S -*** May be seen during winter, but probably a fly-over in-shore	Oceanic, occurs in Australian waters only during non-breeding season
Australian painted	*Rostratula australis*	VU;	CAMBA	L	CR			***U -*** Habitat present; probably present in	Shallow terrestrial freshwater

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
snipe		Marine; M						small numbers	(occasionally brackish) wetlands, including temporary and permanent lakes, swamps. Also wet grassland or saltmarsh, dams and bore drains
Fairy tern (Australian)	*Sternula nereis nereis*	VU; Marine		L	EN	1975	2007	***R*** **-** Habitat present; may breed in area	Coasts, estuaries, breed on sandy beaches and sand pits
Shy albatross and sub-species	*Thalassarche cauta sp.*	VU; Marine; M	Bonn	L	VU	1977	1986	***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season
Fairy prion	*Pachytila turtur*	VU			VU	1979	1979	***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal breeding islands, occurs in Australian waters only during non-breeding season
Black-browed albatross	*Thalassarche melanophris*	VU; Marine; M	Bonn	I	VU	1977	1977	***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season
Northern giant-petrel	*Macronectes halli*	VU; Marine; M	Bonn	L	NT			***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceans, bays, occurs in Australian waters only during non-breeding season
Buller's albatross	*Thalassarche bulleri*	VU; Marine; M	Bonn	L				***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season
Blue petrel	*Halobaena caerulea*	VU; Marine						***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, occurs in Australian waters only during non-breeding season
White-bellied storm-petrel	*Fregetta grallaria grallaria*	VU; Marine						***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, occurs in Australian waters only during non-breeding season
Campbell albatross	*Thalassarche melanophris impavida*	VU; Marine; M	Bonn					***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Grey-tailed tattler	*Tringa brevipes*	M; Marine	Bonn CAMBA JAMBA ROKAMBA	L	CR	1992	1992	***S*** **-** Habitat present; migrates to Australia during non-breeding season, but may be locally extinct	Estuaries, mangroves, rocky coasts, reefs
Great knot	*Calidris tenuirostris*	M; Marine	Bonn CAMBA JAMBA ROKAMBA	L	EN	1975	2003	***S*** **-** Habitat present; migrates to Australia during non-breeding season	Tidal mud-flats, rarely inland
Eastern great egret	*Ardea modesta (also Egretta alba, Ardea alba)*	M; Marine	CAMBA JAMBA	L	VU	1972	2008	***R*** **-** Habitat present; may breed in area	Wide range of wetland habitats, e.g. inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial
Little tern	*Sternula albifrons sinensis*	M; Marine	Bonn CAMBA JAMBA ROKAMBA	L	VU	1953	2007	***R*** **-** Habitat present; may breed in area	Coasts, estuaries, breed on sandy beaches and sand pits
White-bellied sea-eagle	*Haliaeetus leucogaster*	M; Marine	CAMBA	L	VU	1975	2008	***R*** **-** Habitat present; may breed in area	Large rivers, fresh and saline lakes, reservoirs, coastal seas, islands
Caspian tern	*Hydroprogne caspia*	M; Marine	CAMBA JAMBA	L	NT	1975	2008	***R*** **-** Breeds on off-shore islands during summer; may forage further inland	Coastal, inland saline water
Lesser sand plover	*Charadrius mongolus*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		CR	1986	1999	***S*** **-** Habitat present; migrates to area during summer (non-breeding), but rare	Coastal, rarely inland
Grey plover	*Pluvialis squatarola*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		EN	1977	1980	***U*** **-** May be seen during winter, but may be locally extinct	Shallows of fresh and saltwater wetlands, intertidal flats

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Red knot	*Calidris canutus*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		EN	1977	2000	***S*** **-** Habitat present; migrates to area during summer (non-breeding), but rare	Tidal mud-flats, rarely inland
Pacific golden plover	*Pluvialis fulva*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		VU	1977	1977	***U*** **-** May be seen during winter, but may be locally extinct	Shallows of fresh and saltwater wetlands, intertidal flats
Whimbrel	*Numenius phaeopus*	M; Marine	CAMBA JAMBA		VU	1999	1999	***S*** **-** Habitat present; migrates to area during summer (non-breeding), but rare	Coastal estuaries, mud flats, mangroves, sandpits
Eastern curlew	*Numenius madagascarensis*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		NT	1975	2005	***R*** **-** Habitat present; may breed in area	Coastal estuaries, mud flats, mangroves, sandpits
Latham's snipe	*Gallinago hardwickii*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		NT	1965	1980	***S*** **-** Habitat present; migrates to area during summer (non-breeding), but rare	Occurs in permanent and ephemeral wetlands usually open, freshwater wetlands with low, dense vegetation
Sanderling	*Calidris alba*	M; Marine	Bonn CAMBA JAMBA ROKAMBA		NT	1980	1996	***S*** **-** Habitat present; migrates to area during summer (non-breeding), but rare	Sandy beaches, rare inland
Bar-tailed godwit	*Limosa lapponica*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1975	2008	***R*** **-** Habitat present	Tidal flats, rarely inland
Black-faced monarch	*Monarcha melanopsis*	M; Marine	Bonn					***R*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	East coast forests

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Cattle egret	*Ardea ibis*	M; Marine	CAMBA JAMBA			1977	2000	***R*** **-** Habitat present; may or may not breed in area	Pasture, among stock, occasionally shallows of wetlands
Common greenshank	*Tringa nebularia*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1977	1980	***S*** **-** Habitat present; migrates to Australia during non-breeding season, but may be locally extinct	Wetlands, estuaries, mangroves, rocky coasts, reefs
Common tern	*Sterna hirundo*	M; Marine	CAMBA JAMBA ROKAMBA			1953	2005	***R*** **-** Habitat present; may breed in area	Oceans, bays
Curlew sandpiper	*Calidris ferruginea*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1975	2000	***R*** **-** Habitat present	Coastal, inland mud-flats
Fork-tailed swift	*Apus pacificus*	M; Marine	CAMBA JAMBA ROKAMBA			1986	2006	***S*** **-** Habitat present; migrates to area during summer	Many habitats, migrant during summer
Little curlew	*Numenius minutus*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1979	1979	***U*** **-** Habitat present, but may locally extinct, seasonal visitor if present	Pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs
Rainbow bee-eater	*Merops ornatus*	M; Marine	JAMBA			1987	1987	***H/U*** **-** Typical habitat absent; may occasionally visit area	Open country, sand dunes, banks
Red-necked stint	*Calidris ruficollis*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1972	2005	***S*** **-** Habitat present; migrates to area during summer (non-breeding)	Coastal, inland shores
Ruddy turnstone	*Arenaria interpres*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1972	2008	***S*** **-** Habitat present; migrates to area during summer (non-breeding), but rare	Rocky shores with seaweed

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Rufous fantail	*Rhipidura rufifrons*	M; Marine	Bonn					***R*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	Wet forests, occasionally in open forests
Satin flycatcher	*Myiagra cyanoleuca*	M; Marine	Bonn					***R*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	Tall and medium open forests, often at height
Sharp-tailed sandpiper	*Calidris acuminata*	M; Marine	Bonn CAMBA JAMBA ROKAMBA			1975	2005	***S*** **-** Habitat present; migrates to area during summer (non-breeding)	Coastal, interior wetlands
Short-tailed shearwater	*Puffinus tenuirostris*	M; Marine	JAMBA ROKAMBA			1977	2007	***S*** **-** Habitat present; breeds in area (incl. Phillip Island)	Coastal, oceanic
White-tailed tropicbird	*Phaethon lepturus*	M; Marine	CAMBA JAMBA			1986	1986	***H/U*** **-** Usually over north west Australia, either misidentified or vagrant	Oceanic, coastal breeding islands, occurs in north west Australian waters
White-throated needletail	*Hirundapus caudacutus*	M; Marine	CAMBA JAMBA ROKAMBA			1977	2003	***S*** **-** Habitat present; migrates to area during summer (non-breeding)	Coastal and mountainous regions; migrant in summer
Hooded plover	*Thinornis rubricollis*	Marine		L	VU	1972	2008	***R*** **-** Habitat present; may breed in area	Ocean beaches, rarely coastal lakes
Arctic jaeger	*Stercorarius parasiticus*	Marine	JAMBA			1977	1981	***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season
Great skua	*Catharacta skua*	Marine						***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal breeding islands, occurs in Australian waters only during non-breeding season
Long-tailed jaeger	*Stercorarius longicaudus*	Marine	JAMBA			1985	1985	***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Intermediate egret	*Ardea intermedia*			L	EN	1990	2004	***R*** **-** Habitat present; may breed in area	Wetlands, open water bodies
Blue-billed duck	*Oxyura australis*			L	EN	1977	2008	***P*** **-** Habitat present, but may be locally extinct in areas	Swamps, wetlands, estuaries, rivers
Freckled duck	*Stictonetta naevosa*			L	EN	2007	2007	***P*** **-** Habitat present, but may be locally extinct or in very low numbers	Shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps
Ground parrot	*Pezoporus wallicus wallicus*			L	EN	1980	1981	***U*** **-** Habitat present, but may locally extinct	Coastal heathlands with very dense cover
Little egret	*Egretta garzetta nigripes*			L	EN	1975	2008	***R*** **-** Habitat present; may breed in area	Vegetated wetlands
Masked owl	*Tyto novaehollandiae*			L	EN	1976	2011	***R*** **-** Habitat present; likely to forage along rivers/creeks and around lagoons, provided suitable prey habitat exists. May roost in area	Forests, woodlands, caves. Roosts in tree hollows, dense foliage, out-buildings, caves
Baillon's crake	*Porzana pusilla palustris*			L	VU	1977	1977	***U*** **-** Habitat present, but may locally extinct	Sedge beds and riparian areas
Chestnut-rumped heathwren	*Calamanthus pyrrhopygus pyrrhopygius*			L	VU	1977	1992	***P*** **-** Some habitat present, but probably not sufficient for large population	Coastal heath, mountain and hinterland areas, dense undergrowth of forests and woodlands
Glossy black-cockatoo	*Calyptorhynchus lathami lathami*			L	VU	1993	1993	***U*** **-** Habitat absent; may be in forested areas to the north	Open forest, especially in she-oaks
Sooty owl	*Tyto tenebricosa*			L	VU	1977	2011	***R*** **-** Habitat present; likely to forage along rivers/creeks and around lagoons, provided suitable prey habitat exists. May roost in area	Closed and tall forests, especially in gullies; roost in tree hollows, caves by day; active in canopy at night
Grey goshawk	*Accipiter novaehollandiae*			L	VU	1977	1988	***R*** **-** Habitat present, but may be locally	Open forests, woodlands

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
	novaehollandiae							extinct or in very low numbers	
Lewin's rail	*Lewinia pectoralis pectoralis*			L	VU	1977	1997	***U*** **-** Habitat present, but may locally extinct	Vegetated wetlands
Painted honeyeater	*Grantiella picta*			L	VU	2006	2007	***R*** **-** Habitat present; may breed in area, but rare	Open box-ironbark forests, woodlands, especially with mistletoe
Powerful owl	*Ninox strenua*			L	VU	1983	2008	***R*** **-** Habitat present in forested areas; more likely further north	Tall open forests, woodlands, roost in large trees in gullies
Square-tailed kite	*Lophoictinia isura*			L	VU	1977	2007	***R*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	Open forests, riverine woodlands, scrubs, heathlands
Diamond firetail	*Stagonopleura guttata*			L	NT	1977	1981	***P*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	Grassy woodland
Hooded robin	*Melanodryas cucullata cucullata*			L	NT	1976	1986	***U*** **-** Habitat present, but may locally extinct	Open woodland, dominated by acacia and eucalypts
Magpie goose	*Anseranas semipalmata*			L	NT	1986	1986	***U*** **-** Habitat present, but may locally extinct	Coastal areas, sometimes further inland estuaries
Turquoise parrot	*Neophema pulchella*			L	NT	1993	1993	***P*** **-** Habitat may be sufficient	Open forests; eucalyptus woodlands and open forests, with a ground cover of grasses and low understorey of shrubs
Australasian shoveler	*Anas rhynchotis*				VU	1978	2008	***R*** **-** Habitat present	Heavily vegetated swamps
Black falcon	*Falco subniger*				VU	1979	1981	***P*** **-** Habitat present, but may be locally extinct or in very low numbers	Open grasslands and woodlands, mostly in semi-arid areas
Hardhead	*Aythya australis*				VU	1977	2005	***R*** **-** Habitat present; may breed in area	Deep vegetated swamps, wetlands, large open water bodies

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Musk duck	*Biziura lobata*				VU	1970	2008	***R*** **-** Habitat present; may breed in area	Permanent swamps with dense vegetation; large open lakes, tidal inlets and bays
Azure kingfisher	*Alcedo azurea*				NT	1972	2008	***R*** **-** Habitat present	Rivers, creeks, mangroves
Black-faced cormorant	*Phalacrocorax fuscescens*				NT	1979	2008	***R*** **-** More likely to be seen closer to Bass Strait	Marine, offshore rocky islands, islets, outer harbour beacons
Brown treecreeper	*Climacteris picumnus victoriae*				NT			***R*** **-** Habitat present	Temperature or dry forests, can live in disturbed forests
Common diving petrel	*Pelanoides urinatrix*				NT	1998	1998	***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, coastal, occurs in Australian waters only during non-breeding season
Nankeen night heron	*Nycticorax caledonicus hillii*				NT	1965	2007	***P*** **-** Habitat present, but may be locally extinct or in very low numbers	Swamps, inter-tidal flats, estuaries, rivers
Pacific gull	*Larus pacificus*				NT	1972	2008	***R*** **-** Habitat present; may breed in area	Coastal areas, sometimes further inland estuaries
Pied cormorant	*Phalacrocorax varius*				NT	1972	2007	***R*** **-** Habitat present; may breed in area	Large areas of water, coastal or inland lakes, rivers and mangrove line estuaries
Royal spoonbill	*Platalea regia*				NT	1972	2008	***R*** **-** Habitat present; may breed in area	Shallows of fresh and saltwater wetlands, intertidal flats
Sooty oystercatcher	*Haematopus fuliginosus*				NT	1977	2008	***R*** **-** Habitat present; may breed in area	Coastal, rocky coastline, occasionally estuaries
Spotted harrier	*Circus assimilis*				NT	1986	1987	***R*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	Open grassland, crops and windbreaks
Spotted quail-thrush	*Cinclosoma punctatum*				NT	1977	2007	***R*** **-** Habitat present; may forage in wetland area; may breed in forested areas further north	Sclerophyll forests, ideally on leaf-littered rocky ridges with short grass tussocks

Common Name	Scientific Name	Conservation Status				Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	Treaty	FFG Act	DSE				
Whiskered tern	*Chlidonias hybridus javanicus*				NT	1977	1977	***S*** **-** Habitat present; but rare	Breeds in colonies on inland marshes
White-fronted tern	*Sterna striata*				NT			***S*** **-** May be seen during winter, but probably a fly-over in-shore	Oceanic, rocky reefs, in Australia during non-breeding season

Key: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; M – Migratory; L – Listed; I – Insufficient Data; NT – Near Threatened; Bonn – Bonn Convention; CAMBA – China-Australia Migratory Bird Agreement; JAMBA – Japan-Australia Migratory Bird Agreement; ROKAMBA – Republic of Korea-Australia Migratory Bird Agreement; H/U – Highly unlikely; U – Unlikely; P – Potential resident or visitor; R – Resident; S – Seasonal visitor. Information sourced including (Simpson & Day 1999)

Annex 3 International, Commonwealth and State recognised mammalian species that have and/or may inhabit the downstream region (in order of conservation status importance)

Common Name	Scientific Name	Conservation Status			Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE				
Spot-tailed quoll	*Dasyurus maculatus maculatus*	EN	L	EN	1986	1999	***U* -** Habitat present, species too rare and may locally extinct	Temperate and subtropical rainforests in mountain areas, lowland forests, open and closed woodlands and River Red Gum (*E. camaldulensis*) forests
Southern brown bandicoot	*Isoodon obesulus obesulus*	EN	L	NT	1959	1980	***U* -** Habitat present, but may locally extinct	Variety of habitats including heathland, heathy open forest and woodland
Southern right whale	*Eubalaena australis*	EN; Cetacean; Marine	L	CR	1983	2001 (2013)	***U* -** May be seen infrequently, too little known about biology	Little known of habitat requirements but appears to prefer deeper water
Brush-tailed rock-wallaby	*Petrogale penicillata*	VU	L	CR			***H/U* -** Habitat absent	Rocky escarpments, granite outcrops and cliffs, which have caves and ledges for shelter and face north for warmth
New Holland mouse	*Pseudomys novaehollandiae*	VU	L	VU			***U* -** Habitat may be sufficient, but no records in area	Coastal areas and up to 100 km inland, vegetated sand dunes, open woodland with a heathland understorey
Grey-headed flying-fox	*Pteropus poliocephalus*	VU	L	VU	1989	1989	***U* -** Some habitat present; may be seen flying over	Utilises vegetation communities including rainforests, open forests, closed and open woodlands, swamps
Long-nosed potoroo	*Potorous tridactylus tridactylus*	VU	L	NT	1972	1996	***U* -** Habitat absent; more likely in forested areas	Open forest and woodland and the ecotone in-between; found in areas with *Eucalyptus sieberi, E. globoidea, E. muellerana, E. baxteri* and *E. cypellocarpa*. Tree height varies from 20–40 m
New Zealand fur-seal	*Arctocephalus forsteri*	Marine		VU	1977	1977	***H/U* -** Will only beach on remote or human undisturbed beaches; no breeding colonies nearby	Beaching and/or breeding on off-shore rocky islands; sometimes on beaches; individual in 1977 probably sick
Brush-tailed phascogale	*Phascogale tapoatafa tapoatafa*		L	VU	1970	1970	***H/U* -** Some habitat may be present, but probably locally extinct	Open forests, typically associated with box, ironbark and stringybark forests
Common bent-wing bat	*Miniopterus schreibersii GROUP*		L		1964	1993	***P* -** Habitat present, but may be locally extinct in areas	Roosts in caves, old mines, road culvets. Forages above canopy of forested areas. Species is being reclassified into several

Common Name	Scientific Name	Conservation Status			Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE				
								subspecies and therefore here included as "group"
Eastern horseshoe bat	*Rhinolophus megaphyllus*		L	VU	1964	1998	***U*** **-** Recorded in area; may be roosting in northern caves	Cave roosting species generally associated with closed tropical forest habitats and hot humid roosting sites
White-footed Dunnart	*Sminthopsis leucopus*		L	NT	1978	1979	***P*** **-** Habitat may be present, but population in low numbers	Occurs in forests and woodlands with an open understorey of low density vegetation
Burranun dolphin	*Tursiops australis*	N/A	N	EN			***R*** **-** Habitat present; may breed in area	Recently named species; two known populations; one in Port Phillip Bay; the other in the Gippsland Lakes and surrounding ocean
Eastern pygmy possum	*Cercartetus nanus*		I	NT	1992	1993	***R*** **-** Habitat present; may breed in area	Temperate rainforest, dry and wet sclerophyll forest, banksia woodland, and coastal heath
Southern myotis	*Myotis macropus*			NT	1993	1993	***P*** **-** Habitat present, but may be locally extinct in areas	Preferred habitat is riparian. Roosts in caves, mines, tree hollows and in dense vegetation near slow-flowing or still water (including estuaries)
Greater glider	*Petauroides volans*			VU	1978	2000	***R*** **-** Habitat present; may breed in area	Wet sclerophyll forest, needs large tree hollows for shelter
Dingo	*Canis lupus dingo*		L	DD			***U*** **-** Habitat present, but probably hybridised with feral dogs	Variety of habitats
Bottlenose dolphin	*Tursiops truncatus*	Cetacean			1981	2003	***P*** **-** Habitat present, but local Burranun dolphins may restrict distribution	Common throughout tropical and temperate oceans, inshore and offshore, bays, estuaries. May hybridise and /or compete with local (new species) population of Burranun dolphins
Common dolphin	*Delphinus delphis*	Cetacean			1972	1972	***P*** **-** Habitat present, but local Burranun dolphins may restrict distribution	Common throughout tropical and temperate oceans, more common in deep water
Dusky dolphin	*Lagenorhynchus obscurus*	Cetacean					***H/U*** **-** Some habitat present; but more likely offshore	Throughout southern oceans, very rarely seen during summer
Pygmy sperm whale	*Kogia breviceps*	Cetacean			1980	1982	***U*** **-** Some habitat present; but more likely offshore	Tropical and temperate oceans, more common in deep ocean near continental shelf

Common Name	Scientific Name	Conservation Status			Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE				
Risso's dolphin	*Grampus griseus*	Cetacean					***U -*** Some habitat present; but more likely offshore	Subtropical and temperate oceans, usually offshore around continental shelf but can be seen occasionally inshore
Australian fur-seal	*Arctocephalus pusillus*	Marine					***H/U -*** Will only beach on remote or human undisturbed beaches; no breeding colonies nearby	Beaching and/or breeding on off-shore rocky islands; sometimes on beaches
Leopard seal	*Hydrurga leptonyx*	Marine			1989	1989	***H/U -*** Will only beach on remote or human undisturbed beaches	Throughout southern oceans, occasional visitor to Australian waters

Key: EN – Endangered; VU – Vulnerable; N/A – Not Assessed; L – Listed; I – Invalid/rejected; N - Nominated; DD – Data deficient; H/U – Highly unlikely; U – Unlikely; P – Potential resident or visitor; R – Resident. Information sourced from literature (e.g. Menkhorst 1984, Menkhorst 1995)

Annex 4 Threatened reptiles and amphibians that have been recorded, and may inhabit, the downstream region (in order of taxon, then conservation status importance

Common Name	Scientific Name	Conservation Status			Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE				
Giant burrowing frog	*Heleioporus australiacus*	VU	L	CR			***U* -** Habitat present, lack of records probably due to insufficient surveying	Occur in a wide range of forest communities including montane sclerophyll woodland, montane riparian woodland, as well as wet and dry sclerophyll forest
Littlejohn's tree frog	*Litoria littlejohni*	VU	L	EN			***U* -** Habitat present, lack of records probably due to insufficient surveying	Forest, coastal woodland and heath from 100 to 950 m above sea level. Breeding habitat may be temporary pools, deep permanent pools or rock-lined rivers
Growling grass frog	*Litoria raniformis*	VU	L	EN	1979	1992	***U* -** Habitat present, but may be regionally extinct, beyond normal/current range	Amongst emergent vegetation, in or at the edges of still or slow-flowing water bodies such as lagoons, swamps. Also in open grassland, open forest, and ephemeral and permanent non-saline marshes and swamps
Green and golden bell frog	*Litoria aurea*	VU	I	VU	1963	1998	***U* -** Habitat present, but may be locally extinct in areas	Lentic and terrestrial habitats in the coastal plains and lowland forest, damp forest, shrubby dry forest, and cleared pastoral areas. Breeding habitat includes dams and swamps
Martin's toadlet	*Uperoleia martini*			CR	1963	1993	***P* -** Habitat present, but may be locally extinct in areas	Adults are found in dry forest, woodlands, shrublands, grasslands, and open and disturbed areas. Mostly near water, but also in dry depressions that flood in winter or spring. Eggs are unknown. Tadpoles are aquatic
Southern toadlet	*Pseudophryne semimarmorata*			VU	1961	1993	***P* -** Habitat present, but may be locally extinct in areas	Adults in dry forest, woodland, shrubland, grassland, and heaths; under leaf litter and other debris in moist soaks and depressions
Tyler's toadlet	*Uperoleia tyleri*			DD			***U* -** Habitat present, lack of records probably due to insufficient surveying	Adults are found in dry forest, woodlands, shrublands, grasslands, and open and disturbed areas. Egg habitat is unknown. Tadpoles are aquatic
Dendy's toadlet	*Pseudophryne dendyi*			DD	1961	1977	***P* -** Habitat present, but may be locally extinct in areas	Adults most often in damp leaf litter and can be in both wet and dry forests and alpine areas
Leatherback turtle	*Dermochelys coriacea*	EN; M (Bonn); Marine	L	CR	1985	1985	***H/U* -** May feed offshore but will not beach	Tropical and temperate oceans; seen feeding in Victorian waters

Common Name	Scientific Name	Conservation Status			Recorded in downstream region between years		Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE				
Loggerhead turtle	*Caretta caretta*	EN; M (Bonn); Marine					***H/U -*** May feed offshore but will not beach	Tropical and temperate oceans; seen feeding in Victorian waters
Lace monitor	*Varanus varius*			EN	1975	2002	***R -*** Habitat present; may breed in area	Common; semi-arboreal, forested areas

Key: VU – Vulnerable; L – Listed; DD –Data deficient; U – Unlikely; P – Potential resident or visitor; R – Resident; Information sourced from literature (e.g. Gillespie 1996, Penman et al. 2004, Swanson 2007)

Annex 5 Threatened fish species that may inhabit the downstream region*

Common Name	Scientific Name	Conservation Status			Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE		
Eastern dwarf galaxias	*Galaxiella pusilla*	VU	L	EN	***P*** **-** Habitat present, insufficient surveying	Found in vegetation along the edge of still or slow-running waters like swamps, drainage ditches and backwaters of creeks. Adults live in both ephemeral and permanent habitats.
Australian grayling	*Prototroctes maraena*	VU	L	VU	***P*** **-** Habitat present, insufficient surveying	Adults inhabit creeks and rivers, usually in cool, clear waters over gravel bottoms in sections alternating between pools and rapids.
Brushtail pipefish	*Leptoichthys fistularius*	Marine			***P*** **-** Habitat present, insufficient surveying	Found in moderate to shallow depths. Inhabit seagrass
Bullneck seahorse	*Hippocampus minotaur*	Marine			***P*** **-** Habitat present, insufficient surveying	Its natural habitats are open seas, shallow seas, subtidal aquatic beds, coral reefs, estuarine waters, and karsts.
Common seadragon	*Phyllopteryx taeniolatus*	Marine			***P*** **-** Habitat present, insufficient surveying	It is usually found in areas ranging from shallow estuaries to deep offshore reefs
Crested pipefish	*Histiogamphelus briggsii*	Marine			***P*** **-** Habitat present, insufficient surveying	Marine; brackish; reef-associated
Deepbody pipefish	*Kaupus costatus*	Marine			***U*** **-** Habitat present, insufficient surveying	Found over seagrass and algal beds
Double-end pipehorse	*Syngnathoides biaculeatus*	Marine			***P*** **-** Habitat present, insufficient surveying	Occur in protected coastal shallows over or among algae, seagrasses, or floating weeds
Hairy pipefish	*Urocampus carinirostris*	Marine			***P*** **-** Habitat present, insufficient surveying	Inhabit lower reaches of rivers, estuaries or other protected inshore habitats. Found mostly in algal or *Zostera* beds, rarely at depths of more than a few meters
Halfbanded pipefish	*Mitotichthys semistriatus*	Marine			***U*** **-** Habitat present further out in Bass Strait	Found amongst eelgrass
Javelin pipefish	*Lissocampus runa*	Marine			***U*** **-** Habitat present further out in Bass Strait	Usually encountered in algal beds and rubbly substrates near rocky reefs
Knifesnout pipefish	*Hypselognathus rostratus*	Marine			***U*** **-** Habitat present further out in Bass Strait	Inhabits moderate offshore depths
Longsnout pipefish	*Vanacampus poecilolaemus*	Marine			***P*** **-** Habitat present, insufficient surveying	Reported from estuaries and shallow weedy bays
Mother-of-pearl pipefish	*Vanacampus margaritifer*	Marine			***P*** **-** Habitat present, insufficient surveying	Occurs in coastal and estuarine waters usually in algal beds and rubbly or muddy areas

Common Name	Scientific Name	Conservation Status			Future likelihood in downstream region and justification	Habitat Characteristics
		EPBC Act	FFG Act	DSE		
Port Phillip pipefish	*Vanacampus phillipi*	Marine			***P*** **-** Habitat present, insufficient surveying	Widespread and common in bays and estuaries along the south coast
Red pipefish	*Notiocampus ruber*	Marine			***U*** **-** Habitat present further out in Bass Strait	Occurs in inshore waters of the continental shelf
Rhino pipefish	*Histiogamphelus cristatus*	Marine			***U*** **-** Habitat present further out in Bass Strait	Usually seen in seagrass areas
Ringback pipefish	*Stipecampus cristatus*	Marine			***P*** **-** Habitat present, insufficient surveying	Sparse sea-grasses near tidal channels in large estuaries
Robust pipehorse	*Solegnathus robustus*	Marine			***P*** **-** Habitat present, insufficient surveying	Occurs in coastal waters
Sawtooth pipefish	*Maroubra perserrata*	Marine			***P*** **-** Habitat present, insufficient surveying	The species can be found on coastal rocky reefs and estuaries in temperate marine waters
Short-head seahorse	*Hippocampus breviceps*	Marine			***U*** **-** Habitat present further out in Bass Strait	Sargassum, sponge reefs in deeper water, or rock reef covered in macro algae
Spotted pipefish	*Stigmatopora argus*	Marine			***U*** **-** Habitat present further out in Bass Strait	The species is usually found in seagrass beds and weedy areas on rocky reefs
Tucker's pipefish	*Mitotichthys tuckeri*	Marine			***U*** **-** Habitat present further out in Bass Strait	Lives among kelp, sometimes among floating *Sargassum*
Upside-down pipefish	*Heraldia nocturna*	Marine			***P*** **-** Habitat present, insufficient surveying	Protected bays and estuaries down to a depth of about 20 m, where it is usually seen in pairs in caves and under ledges
White's seahorse	*Hippocampus whitei*	Marine			***P*** **-** Habitat present, insufficient surveying	Its natural habitat is subtidal aquatic beds
Widebody pipefish	*Stigmatopora nigra*	Marine			***P*** **-** Habitat present, insufficient surveying	Usually occurs in estuaries where it is common in seagrass beds or in weedy areas on rocky reefs

**No threatened species recorded in area, thus no VBA Presence column*

Key: EN – Endangered; VU – Vulnerable; L – Listed; U – Unlikely; P – Potential resident or visitor