



***Cardno
Ecology Lab***

Shaping the Future

Marine and Freshwater Studies



Mannering Colliery Extension Mining Aquatic Ecology Assessment

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Executive Summary

Cardno (NSW/ACT) Pty Ltd trading as Cardno Ecology Lab has been commissioned by Centennial Manning Pty Limited (Centennial Manning) to undertake an assessment of impacts on aquatic ecology of the proposed extension of mining in the Fassifern and Great Northern coal seams beneath the southern section of Lake Macquarie (Central Coast, NSW).

Manning Colliery proposes to mine by bord and pillar method in five new areas of the Fassifern Seam and additional areas of the Great Northern Seam. Centennial Manning will be seeking a modification to the Manning Colliery Project Approval (PA 06_0311) for the Extension of Mining Project subject to Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The combined extraction from the Fassifern and Great Northern Seams will only involve first workings and not exceed the already approved 1.1 Million tonnes of run of mine (ROM) coal per annum or predicted subsidence levels of < 20 millimetres (refer to Seedsman Geotechnics Pty Ltd 2011). The mining method has been designed to provide long-term stability beneath foreshore areas and other natural and man-made features. No change to surface infrastructure or coal handling is required for the project as production rates will not exceed current capacity and operations will continue within the existing approval limits and controls.

The main issue to be considered in the assessment is the potential for subsidence of the lake bed from subsurface mining to affect estuarine ecosystems. The specific aims of the aquatic ecology assessment were to:

- Review relevant legislation and policy;
- Review existing information on the aquatic habitats, biota and fisheries of south-western Lake Macquarie;
- Assess threatened species, populations and communities likely to be present within or adjacent to the proposed extension of mining;
- Assess the likely impacts of the proposed extension of mining, including cumulative impacts, on estuarine habitats, threatened and protected species, populations and ecological communities; and
- Identify appropriate mitigation and/or monitoring measures as appropriate.

Literature was sourced from Cardno Ecology Lab's extensive library of scientific journals and technical reports and the internet to outline existing information on the aquatic ecology of the study area.

Several important and sensitive habitats, including seagrasses, mangroves and saltmarsh were found to occur within the study area, which supports a broad assemblage of marine invertebrates and fish typical to those found in NSW estuaries. The conditions within Lake Macquarie are, however, heavily influenced by surface run-off from the urbanised and industrially developed catchment in which it is situated, large sediment loads, siltation and turbidity.

In order to assess the potential impacts of the proposal on threatened and protected species, relevant State and Commonwealth threatened species databases were searched. Searches were carried out in July 2011 for species of marine fish, mammals, reptiles, algae and shorebirds known or likely to occur within the study area. Database searches identified 15 species of marine mammals, 29 species of fish (including 22 species of seahorses and pipefish), six species of marine reptiles, 40 species of birds (estuarine shorebirds only), one endangered population (the seagrass, *Posidonia australis*) and one endangered ecological community (coastal saltmarsh) that occur within the Lake Macquarie and Wyong LGAs.

The principal physical impact resulting from underground coal mining is subsidence, i.e. lowering of the surface above areas that are mined. Subsidence may result in areas of foreshore above the Mean High Water Mark, previously unexposed to tidal inundation becoming wetted at high tides and areas below this level becoming inundated for a longer period of time. Subtidally the seabed may become deeper in affected areas.

As seagrasses and algae are photosynthetic (i.e. they require light to grow) increased depth has implications for the distribution and condition of these habitats. Other habitats such as saltmarshes and mangroves only occur at certain levels of the shore and increased depth may result in landward migration. Unless the shore landward of the saltmarsh/mangrove habitat is suitable then this may result in a net loss of habitat.

Given the limited extent of where the proposed extension of mining would overlap with sensitive habitats and the minimal amount of predicted subsidence (< 20 millimetres), the direct impacts to these habitats is considered to be negligible. Any indirect impacts on fisheries resources and threatened species, populations and ecological communities (including matters of NES), would also be unlikely and as such, no significant impact on these species would be expected. There is potential for cumulative impacts to occur as a result of other mining activities within the region, however, Centennial Mannering currently manages and monitors for potential impacts in relation to their existing mining activities within Lake Macquarie. Any cumulative impacts outside of the management of Centennial Mannering would require management at the catchment level. No specific mitigation or monitoring of the aquatic environment is recommended for the proposed extension of mining at Mannering Colliery.

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Glossary of Terms and Abbreviations

Benthic	Living on or in the seabed.
DSEWPac	Department of Sustainability, Environment, Water, Population and Communities (formerly the Department of Environment Water, Heritage and the Arts).
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services.
Ecological Community	Populations of species that occur together (often delimited by a geographic boundary).
EP&A	Environmental Planning and Assessment Act.
Estuarine	Habitat lying at the interface between freshwater and marine environments; usually the mouths of streams and rivers.
FM Act	Fisheries Management Act.
Habitat	Any area occupied, or periodically or occasionally occupied, by fish or marine vegetation (or both), and includes any biotic or abiotic component.
Intertidal	The portion of shoreline between low and high tide marks, that is intermittently submerged.
Invasive Marine Pests	Organisms (usually transported by humans) which successfully establish themselves and then overcome otherwise intact, pre-existing native ecosystems.
Macroalgae	Large aquatic photosynthetic plants that can be seen without the aid of a microscope.
Macrobenthos	The collection of organisms attached to or resting on the bottom sediments (i.e. epifauna) and those which burrow into the sediments (i.e. infauna).
Macrofauna	Organisms associated with sediment and retained in a sieve of 1.0 millimetres.
Microalgae	Unicellular, microscopic algae (less than 0.062 millimetres) that occur on the seabed.
NP&W Act	National Parks and Wildlife Act.
OEHS	Office of Environment and Heritage (formerly the Department of Environment and Climate Change).
Population	Any collection of potentially interbreeding organisms in a given area.
SCA	State Conservation Area
Threatened Species	Species listed under NSW or Commonwealth legislation as endangered or vulnerable. For the purpose of this assessment, it also includes species that are listed as 'protected' under the FM Act.

1 Introduction

Cardno (NSW/ACT) Pty Ltd trading as Cardno Ecology Lab has been commissioned by Centennial Coal Company to undertake an assessment of impacts on aquatic ecology of the proposed extension of mining in the Fassifern and Great Northern coal seams beneath the southern section of Lake Macquarie (Central Coast, NSW).

Manning Colliery is an underground coal mine which is wholly owned and operated by Centennial Manning Pty Ltd (Centennial Manning), a subsidiary of Centennial Coal Company (Centennial). Manning Colliery is located approximately 40 kilometres south of Newcastle. The Manning surface facilities (including administration building, workshops and local crushing facility) are located nearby to Vales Point Power Station, 3 kilometres south of Manning Park. Manning Colliery is located within the proclaimed mine subsidence districts of West Lake Macquarie and Swansea – north entrance and is within both the Lake Macquarie and Wyong Local Government Areas (LGAs).

Manning Colliery was granted Project Approval by the then Minister for Planning under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act) on 12 March 2008 to undertake mining in the Fassifern seam by bord and pillar methods, producing up to 1.1 Million tonnes of run of mine (ROM) coal per year.

Manning Colliery proposes to mine by bord and pillar method in five new areas of the Fassifern Seam and additional areas of the Great Northern Seam as indicated in **Figure 1**. Centennial Manning will be seeking a modification to the Manning Colliery Project Approval (PA 06_0311) for the Extension of Mining Project subject to Section 75W of the EP&A Act.

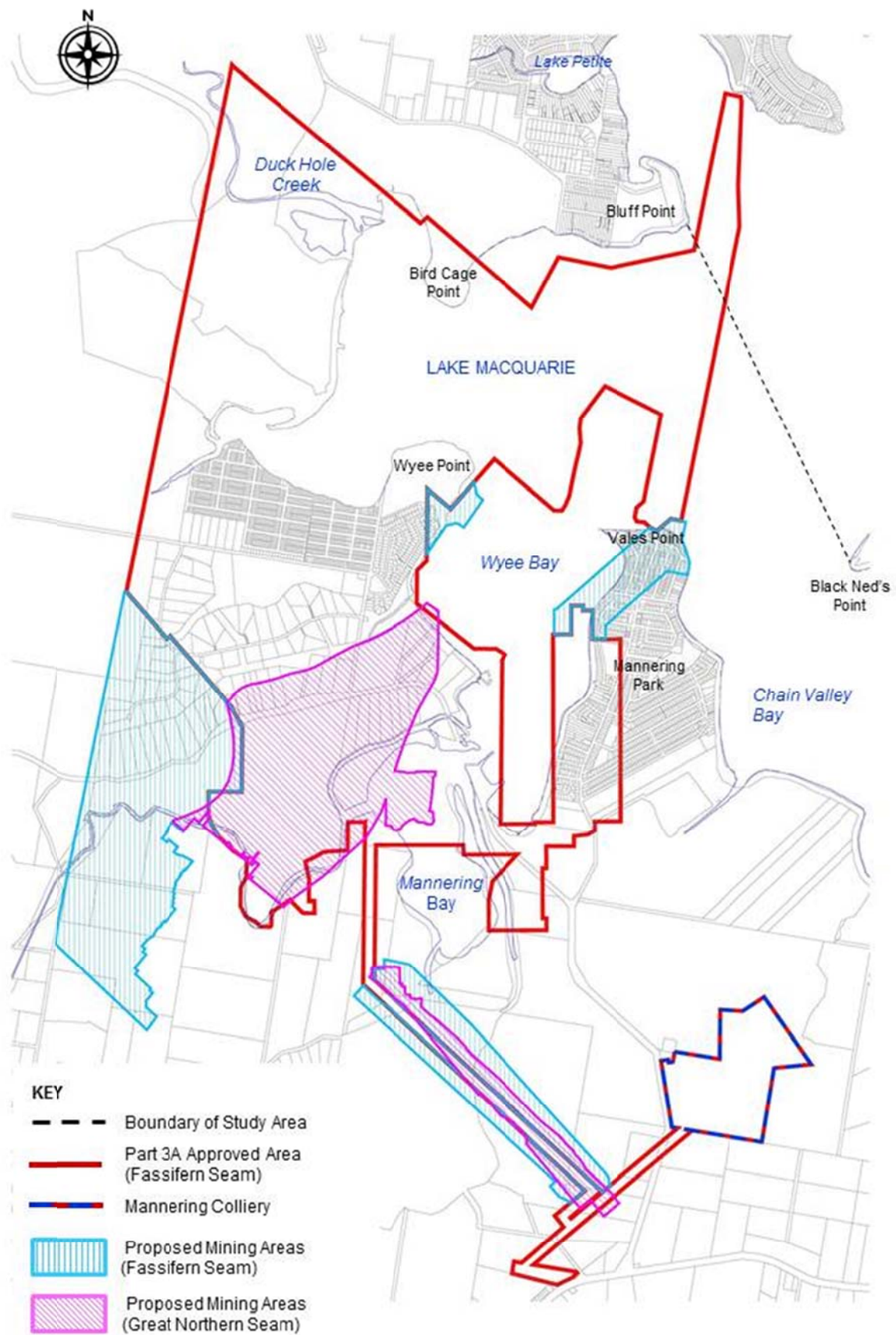
The combined extraction from the Fassifern and Great Northern Seams will only involve first workings and not exceed the already approved 1.1 Million tonnes of ROM coal per annum or predicted subsidence levels of < 20 millimetres (refer to Seedsman Geotechnics Pty Ltd 2011). The mining method has been designed to provide long-term stability beneath foreshore areas and other natural and man-made features.

No change to surface infrastructure or coal handling is required for the project as production rates will not exceed current capacity and operations will continue within the existing approval limits and controls.

The main issue to be considered in the assessment is the potential for subsidence of the lake bed from subsurface mining to affect estuarine ecosystems. Significant subsidence could destabilise aquatic vegetation and affect estuarine invertebrates and microalgae that live in the upper layers of the lake bed sediments. This aquatic ecology assessment includes:

- A review of relevant legislation and policy;
- A review of existing information on the aquatic habitats, biota and fisheries of south-western Lake Macquarie
- Assessment of threatened species, populations and communities present within or adjacent to the proposed extension of mining.
- Assessment of impacts of the proposed extension of mining, including cumulative impacts, of the proposed Project on estuarine habitats, threatened and protected species, populations and ecological communities; and
- Identification of appropriate mitigation and/or monitoring as appropriate.

Figure 1: Manning Colliery Project Application Areas.



2 Relevant Legislation and Policy

2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is administered by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) and aims to:

- Provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance (NES);
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;
- Promote the conservation of biodiversity; and
- Provide for the protection and conservation of heritage.

In the aquatic environment, the Act lists the following matters of NES relevant to this study:

- Nationally threatened species and ecological communities; and
- Migratory species.

Threatened fauna and flora are listed in any one of the following categories as defined in Section 179 of the EPBC Act as:

- Extinct;
- Extinct in the wild;
- Critically endangered;
- Endangered;
- Vulnerable; or
- Conservation dependent.

Species listed as 'extinct' or 'conservation dependent' are not considered matters of NES (protected matters). Under the EPBC Act any action that has, will have, or is likely to have a significant impact on a matter of NES is required to undergo an assessment and approvals process. Matters of NES cover a range of issues including Ramsar wetlands and migratory species listed under international treaties such as the Australian agreements with Japan (JAMBA), China (CAMBA), Republic of Korea (ROKAMBA), for migratory birds and the Bonn Convention.

2.2 Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act provides a framework for environmental planning in NSW and includes provisions to ensure that proposals with the potential to significantly affect the environment are subject to detailed assessment. The EP&A Act details various planning instruments including State Environmental Planning Policies and Local Environment Plans and specifies which types of developments require development consent.

The objectives of this Act include:

- The proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment;
- The protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats; and
- Promoting ecologically sustainable development.

2.3 Threatened Species Conservation Act 1995 (TSC Act)

In NSW, the TSC Act, administered through the Office of Environment and Heritage (OEH) includes provisions to declare and protect threatened species, populations and ecological communities. Species populations and communities identified as 'endangered' 'critically endangered' and 'vulnerable' are listed in Schedules 1, 1A and 2 of the TSC Act, respectively. The TSC Act also lists 'key threatening processes' that may threaten the survival of those species, populations and ecological communities. Marine birds, mammals and reptiles are included in schedules of the TSC Act. In addition, the TSC Act provides for the identification of habitat that is critical to the survival of an endangered species, population or ecological community.

2.4 Fisheries Management Act 1994 (FM Act)

Provisions for the protection of fish and marine plants are administered through the NSW Department of Primary Industries (DPI) under the FM Act. Threatened species populations and communities identified as 'endangered' 'critically endangered' and 'vulnerable' are listed in Schedules 4, 4A and 5 of the FM Act, respectively. The FM Act also lists 'key threatening processes' that may threaten the survival of those species, populations and ecological communities. Part 2 (19) of the FM Act allows for the declaration of 'protected species', which, though not currently declining, must be protected, so they do not become threatened in future. Provisions for the protection of aquatic habitats and aquatic reserves (administered by OEH) are included under Part 7 of the FM Act. In addition, Division 3 Part 7A of the FM Act provides for the identification of habitat that is critical to the survival of an endangered species, population or ecological community.

2.5 National Parks and Wildlife Act 1974 (NPW Act) and the National Parks and Wildlife Regulation 2002 (NPWR).

Under the NP&W Act, the Director-General of the National Parks and Wildlife Service is responsible for the care, control and management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and State game reserves. State conservation areas, karst conservation reserves and regional parks are also administered under the Act. The Director-General is also responsible under this legislation for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW. The National Parks and Wildlife Regulation which came into effect on 1 September 2002, governs various activities under the NP&W Act, including:

- The regulation of the use of national parks and other areas administered by the NPWS (Part 2);
- The preservation of public health in Kosciuszko National Park (Part 3);
- Licences and certificates (Part 4);
- The protection of fauna (Part 5) including the protection of certain types of marine mammals (Division 3A);
- The exemption of Aboriginal people from the restrictions imposed by various sections of the Act on the hunting of certain animals and the gathering of certain plants (Part 6);
- Boards of management and plans of management in relation to Aboriginal land (Part 7); and
- Advisory committees constituted under section 24 of the NP&W Act (Part 8).

2.6 Coastal Protection Act 1979

The objectives of this Act include:

- To protect, enhance, maintain and restore the environment of the coastal region, its associated ecosystems, ecological processes, biological diversity and water quality;
- To encourage, promote and secure the orderly and balanced utilisation and conservation of the coastal region and its natural and man-made resources, having regard to the principles of ecologically sustainable development; and

- To recognise and foster the significant social and economic benefits to the State that result from a sustainable coastal environment, including:
 - Benefits to the environment; and
 - Benefits to urban communities, fisheries, industry and recreation.

2.7 NSW Policy for the Conservation of Fish, Marine Vegetation and Aquatic Habitats

The following general policies are identified in the 'Policy and Guidelines for Aquatic Habitat Management and Fish Conservation' (quoted from Smith and Pollard 1999):

- a) Fish and their aquatic habitats are important natural resources and impacts on these resources must be assessed in all development and planning procedures, using a precautionary approach.
- b) Aquatic habitats must be protected when the habitat is important to maintain biodiversity at the ecosystem, species or genetic levels or is required to maintain harvestable fish populations.
- c) Habitats of protected or threatened fish must be afforded special protection.
- d) Protected areas (such as Aquatic Reserves and Marine Parks) and critical fish habitats should be given priority in the consideration of development of plans, in assessing the impacts of developments, and in determining applications.
- e) Terrestrial areas adjoining freshwater, estuarine and coastal habitats should be carefully managed in order to minimise land-use impacts on these aquatic habitats. As a precautionary approach, foreshore buffer zones at least 50 metres wide should be established and maintained, with their natural features and vegetation preserved. Such buffer zones may need to be fenced or marked by signs. The width of these buffer zones may need to be increased to 100 metres or more where they are adjacent to ecologically sensitive areas.
- f) Pollution of waterways should be avoided by:
 - Identification of point-source and diffuse pollutant discharges;
 - Prevention or minimisation of such discharges;
 - Effective treatment of any continuing discharges;
 - Disposal of wastes to alternative land sites, or to processing facilities.
- g) Free passage should be maintained for migratory fish species. Unlicensed barriers should be removed or fish passage facilities installed.
- h) Alien, exotic or introduced fish species should not be released into any waterway without the approval of NSW Fisheries.
- i) Where developments or activities are likely to affect fish or fish habitats, NSW Fisheries needs to be provided with sufficient information to assess their impacts, including: contact details, type, purpose and time of activity, location (map and photographs), habitat type and area affected, monitoring and proposed environmental compensation.
- j) Environmental compensation needs to be integrated into the planning process. Where, despite mitigation, a significant environmental impact is unavoidable, environmental compensation should be provided. This would normally require the creation of new habitat (of the type lost) and on a 2:1 basis to account for the indirect as well as the direct impacts of development.
- k) Degraded aquatic habitats should be rehabilitated, wherever possible, to repair past environmental damage.
- l) Environmental monitoring is needed to determine if the assessment of the environmental impacts of a development were accurate. Monitoring needs to be undertaken in a scientifically rigorous manner, with impact and multiple control sites, surveys over time and statistical analyses. As a general rule, a change of 20 % in a biological indicator (e.g. abundance,

richness, biomass) one year after the impact should be regarded as a major impact and require environmental compensation.

3 Existing Information

3.1 Regional Context

Lake Macquarie is located 15 kilometres south of Newcastle and 150 kilometres north of Sydney. It is the largest coastal lake in New South Wales, with an open water area of 115.1 square kilometres and a perimeter of 196.15 kilometres (OzCoasts 2010). The overall condition of the lake is scored as 'very good' according to the NSW State of the Catchments Draft Technical Report (NSW Department of Planning 2008), this is based on seven indicators; Chlorophyll a and turbidity, area of macroalgae, seagrass and mangrove and the estuarine fish community index. The lake is also used for a wide range of recreational activities such as recreational fishing, boating, water-skiing and bathing. There are approximately 2149 berths for vessels and four ramps within the estuary (OzCoasts 2010). Many camping and caravan reserves provide holiday and semi-permanent accommodation for visitors to the area.

The catchment at the northern end of the lake is industrialised and urbanised with a lead–zinc smelter, steel foundry, fertilizer plant, collieries and a number of sewage outflows. The focus of this study, however, is on the south west part of the lake which includes the area south west of a line drawn between Bird Cage Point and Black Ned's Point (**Figure 1**). This area is less developed with extensive bushland, although there are collieries, the Vales Point Power Station and residential development at Manning Park and Wyee Point. A significant part of the foreshore has been designated as part of the Lake Macquarie State Conservation Area.

An environmental management plan has been developed for the Lake Macquarie estuary (Syme *et al.* 1997) and identifies a number of issues which are being addressed. This includes measures to reduce high pollutant loads entering the estuary (including metal contaminants), erosion and sedimentation control, managing damage to seagrass beds from moorings and addressing declining recreational catch rates and conflict between excessive seagrass growth and navigation/recreational uses.

3.2 Physical Environment

Lake Macquarie is a wave-dominated estuary, which means the estuary has a high sediment trapping efficiency, naturally low turbidity and salt wedge/partially mixed circulation where there is likely to be sedimentation.

The total catchment area is 786 square kilometres (OzCoasts 2010) and falls under the jurisdiction of the Hunter-Central Rivers Catchment Management Authority (CMA). The estuary is 24 kilometres long, from north to south and 3.2 kilometres at its widest point from east to west.

The lake bed is generally flat, averaging seven metres in depth but is deeper (approximately 11 metres) off Pulbah Island. Depth within the study area does not generally exceed five metres apart from the main channel between Bluff Point and Black Ned's Point where maximum depth is approximately 10 metres. Manning Bay and the southern part of Wyee Bay does not exceed two metres depth.

Swansea Channel, a tidal inlet of approximately 4 kilometres in length, connects the lake to the ocean. Tidal ventilation through Swansea Channel is restricted; for a spring tidal range of 1.25 metres at the entrance, the associated range within the lake is approximately 0.06 metres. The mean lake level is typically super-elevated 0.07 metres above mean sea level. It has been estimated that only 1 % of the lake volume exchanges with ocean waters during an average tidal cycle (OzCoasts 2010).

The water quality within Lake Macquarie is affected by surface run-off and point source discharges. Water quality has been monitored in Lake Macquarie since 1983 by the Hunter Water Corporation and results of this monitoring are summarised in Syme *et al.* (1997) as part

of the Lake Macquarie Estuary Management Study. Urban run-off was considered to be the largest influence to water quality as it contributed to a significant proportion of nutrient input and sediment nutrient release rate. Construction sites and urban development were also considered to contribute to large sediment loads, siltation and turbidity. Sewage, powerboat engines and sedimentation caused from erosion also contributed to decreased water quality.

Water temperatures within Lake Macquarie are typical of temperate NSW estuaries although the temperatures of embayments receiving discharges from the major power stations at the southern periphery have been shown to be higher than elsewhere in the estuary by 0.5 – 1.0°C (WBM 1996). Mean annual salinity is between 32 – 34 parts per thousand (ppt). Mean annual pH ranges between 8.1 and 8.4, typical of temperate estuarine water bodies. Dissolved oxygen (DO) levels are found to be typical at full saturation (WBM 1996).

3.3 Flora and Fauna

3.3.1 Estuarine Vegetation

3.3.1.1 Seagrasses

Seagrass beds often support a rich variety of animals and algae and act as sources of food (mainly indirectly via epiphytes and detritus) and provide shelter for numerous species (Keough and Jenkins 1995 in Creese *et al.* 2009). They also baffle water currents, causing them to release their sediment loads, thus maintaining water quality (Smith and Pollard 1999) and help prevent erosion by stabilising sediments and assisting in the removal of nutrients from the water (Smith *et al.* 1997). Loss of seagrass can result in the destabilisation of sediments, removal of potential nursery habitats for fishes and a decrease in primary productivity of estuaries. Some water birds, for example black swans and some herbivorous fish, feed on the algal epiphytes of seagrasses. Many organisms also benefit from the organic matter released by the slow bacterial and fungal breakdown of seagrass detritus.

Depending on the species of seagrass, recovery of beds from disturbances can be slow. For all these reasons, seagrass beds are seen as critically important biogenic habitats in estuaries and consequently their distribution patterns and changes in their size over time have been documented as a means of monitoring the ecological health of estuaries (Williams *et al.* 2007, Roper *et al.* 2009).

Seagrass maps for the whole of Lake Macquarie were produced by DPI, in response to targets set by the NSW Natural Resource Commission to improve the condition of estuaries and coastal lake ecosystems by 2015. These maps have been overlayed onto a map of the existing and proposed mining areas and are used as the basis for the current assessment (**Figure 2**).

In Lake Macquarie, the majority of the foreshore area is fringed by seagrass beds with four species occurring; eel grass (*Zostera capricorni*), paddle weed (*Halophila ovalis*), *Ruppia* sp. and strapweed (*Posidonia australis*). *Zostera* fringes the majority of the study area with the exception of Manning Bay and the southern part of Wyee Bay which is dominated by *Halophila ovalis*. Fringing sections of Wyee Bay and shallow inlets in the western part of the study area are composed of mixed beds of *Zostera* and *Halophila*. The distribution of seagrass beds within the study area is generally limited to within the two metre depth contours (**Figure 2**). Gray and Nankivell (2007) also mapped seagrass distribution and condition within the study area using transects. The distribution as mapped by Gray and Nankivell (2007) is generally consistent with that of DPI, although in some areas *Halophila ovalis* is more widespread. For example along the eastern side of Chain Valley Bay, a fringing patch of *Halophila* occurs landward of *Zostera* beds. Similarly, mixed beds of *Zostera* and *Halophila* extend northwards along the eastern shore of Wyee Bay beyond that indicated on DPI maps. *Zostera* also appears to occur within the southern part of Manning Bay where only *Halophila* had previously been mapped. The condition of seagrass within the study area was also described in terms of density (i.e. percentage cover) and patchiness (i.e. whether there are individual strands or clumps or continuous beds of relatively even distribution). This is described by Gray and Nankivell (2007), anti-clockwise from Duck Hole Creek around to Chain Valley Bay:

Uniform beds of medium density (15 – 50 % cover) *Zostera* dominated the shoreline from Duck Hole Creek south where it was then replaced by patchy beds of mixed *Zostera* and *Halophila* into the small embayment within the southwest corner of the Bay. The eastern shoreline of Wyee Point had patchy mixed beds of sparse to dense *Halophila* and *Zostera*. Sparse *Halophila* grew in a thin monospecific bed on the outer edge of this bed.

The southern part of Wyee Bay was dominated by moderate to dense *Halophila* which grew as monospecific beds along the south and the east shores and as mixed beds with moderate to dense *Zostera* along the western shoreline of the bay. *Halophila* was thickest along the southmost and eastern shorelines of Wyee Bay. Further north towards Vales Point, the monospecific beds of *Halophila* narrowed considerably. Mannering Bay was dominated by mixed beds of sparse to medium density *Zostera* and sparse to moderate *Halophila* with monospecific beds of *Halophila* along the southern shoreline. The western shore of Chain Valley Bay consisted of monospecific *Zostera* beds of varying density and consisting of patches greater than 10 m diameter or continuous beds. The eastern shore was generally dominated by *Zostera* but had mixed patches of *Zostera* and *Halophila* and monospecific beds of *Halophila*.

In general, seagrass communities in Lake Macquarie appear to have declined since the earliest survey in 1953 (King and Barclay 1986). Wood (1959) estimated the area of seagrass at 25.48 square kilometres, whereas surveys conducted in the 1980s calculated the total areas to be 13.39 square kilometres (West *et al.* 1985) and 14.17 square kilometres (King and Barclay 1986) respectively. Researchers attributed this decrease to a rise in turbidity caused by human activity (King and Hodgson 1986). However, from 2000–2004, there has been a general increase in the cover of seagrasses in Lake Macquarie, believed to be due to a reduction in light penetration following a period of lower freshwater inputs. According to Creese *et al.* (2009) the total area of seagrass in Lake Macquarie was 15.311 square kilometres. This is the third largest estuarine seagrass area in NSW (OzCoasts 2010).

The overall degree of change in the distribution and extent of seagrass beds is difficult to assess as seagrasses exhibit a high degree of natural seasonal variation and there may also be differences in sampling methodology during different surveys. King and Hodgson (1986) found that winter seagrass biomass is usually significantly greater than summer biomass therefore some surveys could relate to seasonal change rather than long term changes.

WBM (1996) and Australian Water and Coastal Studies (1995) identified a number of potential threats to seagrass within Lake Macquarie which included:

- Scouring from swing moorings;
- Physical damage from jetskis and boating;
- Smothering from high sedimentation;
- Nutrient enrichment;
- Haul netting;
- Thermal discharges; and
- Shading from foreshore development (e.g. pontoon, jetties etc.).

CSIRO (2007) assessed the changes in the percent cover of seagrass in Wyee Bay between 1980 and 2007 in relation to the likely changes by the Vales Point Power Station cooling water discharge on behalf of Connell Wagner. Data collected in 2007 indicated that the percent cover of *Zostera* was generally higher in the shallow inshore areas of Wyee Bay and lower in deeper water. Analysis of a long-term monitoring database indicated that the cooling water plume released from the power station had several effects on seagrasses within Wyee Bay such as:

- Replacement of the *Zostera* in the southern areas of Wyee Bay by the more thermally tolerant *Halophila*; and
- Increased area and percent cover of *Zostera* following the management of cooling water and ash dam discharges and the diversion of direct urban sewage discharges in 1994.

- Effects of the Vales Point Power Station cooling water plume were considered to have moderate effects on seagrass beds within Wyee Bay when the effects of siltation from the catchment were also taken into account.

All of the above mentioned issues may therefore have a cumulative impact on the seagrass assemblage and distribution within the study area in addition to natural patterns in variation and requires consideration when attempting to design an appropriate monitoring program.

Seagrasses are protected in NSW and a permit is required from DPI to undertake works or activities that may harm them. Populations of *Posidonia australis* that occur in Lake Macquarie are listed as 'endangered' under Schedule 4 of the FM Act. Although *Posidonia australis* does occur within Lake Macquarie, it has not been mapped within the study area.

3.3.1.2 Mangrove

The term 'mangrove' is a description of an estuarine habitat but also refers to the trees that grow in these habitats. Mangrove trees are just like ordinary trees, with roots, stems and leaves, but they have adapted to live in saltwater. They live in soft muddy sediments in more sheltered areas. As mud is generally low in oxygen, the roots of the mangrove trees are quite shallow and close to surface oxygen. This also means that the root system must be extensive to provide a stable base for the tree (Chapman and Underwood 1995). Large numbers of mangrove trees often occur together and are described as mangrove forests.

Mangroves grow along the shores of most NSW estuaries, with the general exception of those that are intermittently opened and closed (West *et al.* 1985). Mangroves often occur seaward of saltmarshes and are subject to regular tidal inundation. As well as stabilising shorelines, mangroves are thought to contribute significantly to estuarine productivity, trap sediment and pollutants (Burchmore *et al.* 1993) and provide important habitat for many species of invertebrates and juvenile fish and (Smith and Pollard 1999). Mangroves also provide shelter and roosting habitat for birds, some small mammals and reptiles.

NSW mangrove forests consist of only two species, river mangrove (*Aegiceras corniculatum*) and grey mangrove (*Avicennia marina*), although *A. marina* is most commonly found in Lake Macquarie. Mangroves are found in areas throughout Lake Macquarie with a significant area within Swansea channel. A total mangrove area of 1.130 square kilometres has been recorded within Lake Macquarie (Creese *et al.* 2009).

Mangroves have been mapped fringing the shallow inlets in the western part of the study area, the southernmost part of Chain Valley Bay, around Manning Bay and within the south western part of Wyee Bay (**Figure 2**). These areas are characterised by shallow, intertidal, muddy soft sediment environments. Like seagrasses mangroves are also protected under the FM Act.

3.3.1.3 Saltmarsh

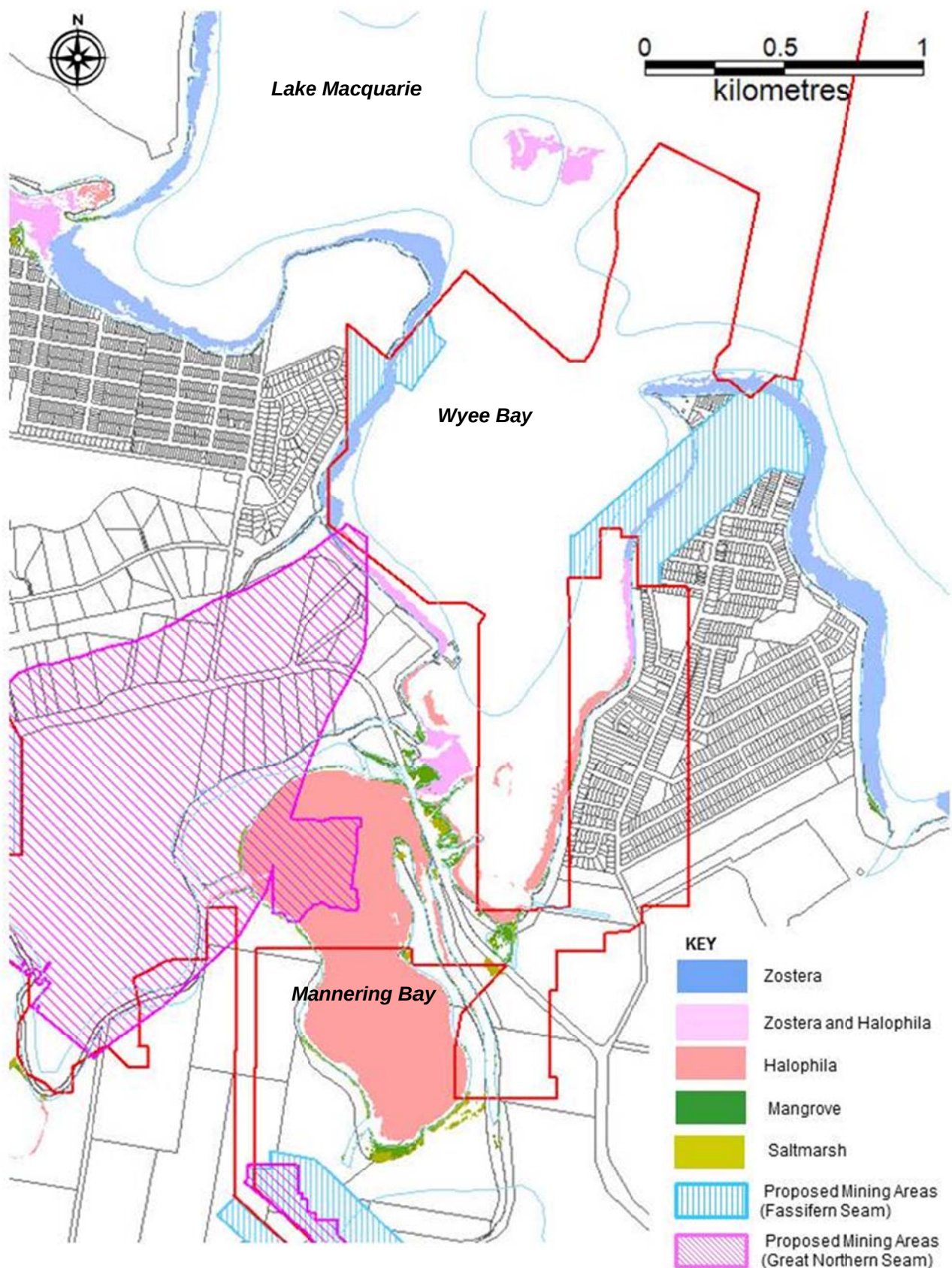
Saltmarshes are estuarine habitats that occur high on the shore, typically just above the mean high water mark. Saltmarshes are often found behind, or close to mangrove forests and occur in soft, water-logged sediments. Saltmarsh habitats consist of small succulent plants, grasses, rushes, sedges and herbaceous plants; including *Baumea juncea*, *Juncus kraussii*, *Sarcocornia quinqueflora*, *Sporobolus virginicus* and *Suaeda australis* (Morrisey 1995). Like mangroves, saltmarshes are believed to have important physical and biological functions in estuarine ecosystems. Because of their close proximity to the land, saltmarshes are often threatened by human development and it has been estimated that approximately 50 % of the saltmarshes of NSW have been destroyed since 1788 (Morrisey 1995). Estuarine saltmarsh found within Lake Macquarie consists of the herbs *Sarcocornia quinqueflora*, *Quinqueflora* sp., *Einadia hastata*, *Salicornia repens* and *Suaeda australis*, and the grasses *Zoysia macrantha* and *Sporobolus virginicus*. Creese *et al.* 2009 recorded a total saltmarsh area of 0.752 square kilometres in Lake Macquarie.

The value of saltmarsh communities and the threat they are under has recently been recognised, resulting in the declaration of coastal saltmarsh communities as an Endangered

Ecological Community under the TSC Act. Reclamation of estuarine foreshores and the introduction of invasive species are considered to be major threats to saltmarsh.

Saltmarsh cover within the study area is fragmented and limited to the southern part of Chain Valley Bay, the southern shore of Mannering Bay and the southern part of Wyee Bay (**Figure 2**).

Figure 2: Map of estuarine vegetation within the study area mapped by DTIRIS (Creese et al. 2009).



3.3.1.4 Macroalgae

Macroalgae are true photosynthetic organisms which grow in the photic zone of coastal regions where light penetrates sufficiently for photosynthesis to occur. In clear waters, macroalgae can survive and grow at depths of over 200 metres, but in turbid waters this may be reduced to only a few metres (Millar 2011). Macroalgae are an important resource as food and/or shelter for a large range of fish and invertebrates and may act as a nursery habitat for juvenile fish. Certain species respond to increases in nutrients and for that reason can be an indicator of water quality. Under certain conditions macroalgae can bloom in large quantities although have not been found to be toxic. Macroalgae can be damaged directly by boating related activities, dredging, reclamation and foreshore development. The diversity and distribution of macroalgae is generally influenced by:

- Seabed morphology and topography;
- Nutrient upwelling;
- Tidal flushing (in relation to Intermittently Closed and Open Lakes and Lagoons);
- Natural weather events;
- The introduction of introduced or pest species.

Gray and Nankivell (2007) recorded several species of macroalgae within the study area from Bluff Point, around to Chain Valley Bay. These included Brown algae (*Cystoseira trinodis* and *Sargassum* sp.), which was common on the rocky shores around the point. Red algae (*Corallina officinalis*, *Gracilaria perplexa* and *Hypnea* spp.) were also present on these rocky shores. Green algae (*Microdictyon umbilicatum*), was also abundant forming patches between areas of seagrass. *Cystoseira trinodis* and *Gracilaria* spp. were present along the eastern shoreline of Wyee Bay. Red algae (*Gracilaria secundata* and *Hypnea* spp.) were abundant between patches of seagrass at the entrance to Manning Bay and *Chaetomorpha* sp. and *Hinksia mitchellae* present in small patches within Manning Bay. *Chaetomorpha* sp., *Hypnea* sp and *Gracilaria* spp. were prolific in southern parts of Wyee Bay. *Gracilaria* spp. *Hinksia mitchellae* *Chaetomorpha* sp. and *Codium* spp. were occasionally present along the northern shoreline of Vales Point. Brown alga (*Cystoseira trinodis*), red algae (*Hypnea* spp. and *Gracilaria perplexa*) and green algae (*Codium fragile*, *Codium spongiosum* and *Ulva rigida*) were present within Chain Valley Bay along the shoreline south of Black Ned's Point. Macroalgae is also protected under the FM Act.

3.3.2 Benthic Assemblages

3.3.2.1 Microalgae

Benthic microalgae are primary producers that use light penetrating the water column to grow and reproduce. Microalgae are generally less than 0.062 millimetres and invisible to the naked eye. They occur attached to sediment particles or in spaces among particles and may be found in numbers of up to 4×10^8 photosynthetic protists per $1 \text{ cm}^2 \times 10 \text{ cm}$ deep (Fenchel 1992). Microalgae are an important food source for other micro and macrobenthic organisms such as molluscs, worms and small crustaceans such as amphipods. The latter are important food sources for fish and larger mobile invertebrates such as prawns. Benthic microalgae also oxygenate the upper sediment layers, which may enhance nutrient cycling (Caffrey and Kemp 1990, Christensen *et al.* 1990, Eyre and Ferguson 2002). Microalgae require light to grow and therefore reduced light penetration associated with increased water depth may affect distribution and primary production and have implications for consumers higher up the food chain.

3.3.2.2 Macrobenthos

'Macrobenthos' is a term used to collectively describe macroinvertebrates and the benthic sediments in which they live. The most comprehensive study of macrobenthic communities of Lake Macquarie was conducted by MacIntyre (1959) between 1953 and 1956 (AWACS 1995). 400 sampling sites within Lake Macquarie were analysed. MacIntyre divided the bed into three zones: seagrass beds (occupying 23.5 % in 1956), mud slopes around the lake perimeter (16

%) and mud basins (60.5 %). Following this study, sampling was carried out between July 1977 and September 1979 by Robinson (unpublished). The groups of invertebrates found in association with different habitat types, including seagrasses were presented. The most numerically dominant species found in association with seagrass beds were (in order of dominance) the bivalve *Anadara trapezia*, the gastropod *Velacumantus australis*, the polychaete worm *Notomastus torquatus*, the gastropod *Nassarius burchardi* and the bivalve *Trichomya hirsuta*. In comparison with MacIntyre's earlier studies, Robinson found there had been a general shift in the distribution of a large number of filter feeding bivalves from the 'slope' zone into the seagrass zone such that the dominant species in the slope zone had been replaced by polychaete worms. The fauna found in the 'mud zone' of the Lake appeared to have remained relatively constant and where the polychaete fauna had remained depauperate over the long term.

The Ecology Lab (1991) undertook a study to describe the benthic communities in the vicinity of ash-dam discharge outlets in Lake Macquarie. Within this study, Lake Petite (just north of the study area), was sampled as a control location. The most common taxa found were polychaetes (Opheliidae and Spionidae), along with dead bivalves (Tellinidae) and mud whelks (Batillariidae). The Ecology Lab (2008) also undertook a baseline survey of benthic assemblages using a ponar grab at Bardens Bay (north – eastern area of Lake Macquarie) where a total of 24 samples were collected. A relatively diverse assemblage of invertebrates were recorded, including 17 different families of polychaete worms (dominated by cirratulids, capitellids and magelonids), nine families of crustaceans including amphipods, tanaids, cumaceans, decapods and copepods and 14 families of gastropod and bivalve molluscs. The diversity and abundance of species found in these surveys would be fairly typical of that expected in a temperate NSW estuary.

3.3.3 Fisheries Resources

Approximately 232 species of fish have been recorded in Lake Macquarie (Lake Macquarie City Council 2006a) from various different surveys. Abundant fish populations were observed in the vicinity of seagrass beds during baseline investigations conducted near Bardens Bay (The Ecology Lab 2008). Species of fish observed included yellowfin bream (*Acanthopagrus australis*), luderick (*Girella tricuspidata*), whiting (*Sillago* sp.) and mullet (Family Mugilidae). Many small juveniles of these and other species were observed associated with the seagrass beds. Syngnathids (i.e. pipefish and seahorses) commonly occur within seagrass beds and may be permanent residents all year round whereas many fish species only spend a small part of their life-history, often juvenile stages within the shelter of the seagrass beds. Swansea channel harbours a large number of different species of fish due to the diverse habitat it provides including weed beds, rocky reefs, soft substratum and artificial structure.

After many years of public discussion and consultation with various interest groups, commercial fishing ended in Lake Macquarie on 1 May 2002, with the lake being declared a Recreational Fishing Haven (Steffe *et al.* 2005). The commercial fishing annual catch in 2001 was approximately 300 tonnes.

DPI undertook two daytime recreational fishing surveys within Lake Macquarie, one before the Recreational Fishing Haven zoning (pre-RFH) between March 1999 and February 2000 and one survey after (post-RFH) between December 2003 and November 2004 (Steffe *et al.* 2005). The two recreational fishing surveys provide evidence of a relatively productive recreational fishery in Lake Macquarie and indicated that the post-RFH recreational fishery was very different to that prior to the implementation of the RFH. The recreational harvest of dusky flathead (*Platycephalus fuscus*), tailor (*Pomatomus saltatrix*), sand whiting (*Sillago cilliata*), trumpeter whiting (*Sillago maculata*) and large-toothed flounder (*Pseudorhombus arsius*) had increased significantly in abundance and weight during the post-RFH survey year. The recreational harvest of common squid (*Loligo* sp.), yellow-finned leatherjacket (*Meuschenia trachylepis*) and sand mullet (*Myxus elongatus*), however, had decreased significantly during the post-RFH survey year by number and weight.

Recreational angling effort in Lake Macquarie was lower in winter and spring compared to that of summer and autumn and overall was greatest in the northern part of the lake where greater angling effort occurs from boats (Virgona 1983). As Lake Macquarie has little tidal movement, there are few places where fish naturally gather on the tides to feed (Ross 1995). For this reason, the fast flowing Swansea Channel is a popular recreational fishing location. The fish caught by recreational fishers in Lake Macquarie are similar to other estuaries in NSW and are dominated by eight species (NSW DPI 2001). These are yellowfin bream (*Acanthopagrus auratus*) dusky flathead (*Platycephalus fuscus*), luderick (*Girella tricuspidata*), snapper (*Pagrus auratus*), tailor (*Pomatomus saltatrix*), tarwhine (*Rhabdosargus sarba*), whiting (Sillaginidae) and leatherjackets (Monacanthidae). The first four species have life-history stages generally dependent on estuaries for all their main ecological requirements, whereas the latter four species are dependent on estuarine habitats as juveniles only. All species are likely to occur in association with seagrass beds and subtidal macroalgae.

3.3.4 Threatened and Protected Species, Populations and Ecological Communities

3.3.4.1 Database Searches

For the purposes of this assessment, 'threatened species' refers to any estuarine or coastal species, populations or ecological communities and their habitats as defined and listed under Schedules 4 or 5 of the FM Act, Schedules 1 or 2 of the TSC Act, or Subdivisions C or D of the EPBC Act. This assessment also includes any species of fish listed as protected under the FM Act.

In order to assess the potential impacts of the proposal on threatened and protected species, relevant State and Commonwealth threatened species databases were searched. Threatened or protected species listed under relevant schedules of the Commonwealth EPBC Act, NSW TSC Act and the FM Act were identified using the following online tools:

- EPBC Environmental Reporting Tool (DSEWPAC 2011),
- Atlas of NSW Wildlife (OEH 2011); and
- NSW Threatened Species Database.

Searches were carried out in July 2011 for species of marine fish, mammals, reptiles, algae and shorebirds. For searches using the EPBC Environmental Reporting Tool and the Atlas of NSW wildlife, the local government areas of Lake Macquarie and Wyong were identified as the most relevant to the study area. Search results are provided in **Appendix A**.

These database records were used to produce a comprehensive list of all threatened and protected species, populations and communities that have previously been recorded within the study area.

For the FM Act, TSC Act and EPBC Act to have relevance there must be a likelihood that one or more threatened species occur in or encroach upon the study area which could then be potentially impacted upon by the proposed Project.

Species listed under State legislation that may occur in the study area and have potential to be affected by the proposal were assessed under the NSW Assessment of Significance Guidelines (NSW DPI 2007). Note that species listed as 'protected' do not require assessment of significance under State legislation.

As the Commonwealth assessment guidelines accept assessments using the State assessment format, only species that were not already assessed under the NSW Assessment of Significance, were assessed under the EPBC Significant Impact Guidelines 1.1.

Database searches identified 15 species of marine mammals, 29 species of fish (including 22 species of seahorses and pipefish), 6 species of marine reptiles, 40 species of birds (estuarine shorebirds only), one endangered population (the seagrass, *Posidonia australis*) and one endangered ecological community listed under the threatened species Schedules that occur within the Lake Macquarie and Wyong LGAs (**Table 1**).

Table 1: Species known or predicted to occur in the study area as listed under the NSW Fisheries Management Act 1994 (FM Act), the NSW Threatened Species Conservation Act 1995 (TSC Act) and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

PE = presumed extinct, CE = critically endangered, E = endangered, V = vulnerable, CD = Conservation Dependant, M = migratory, L = listed, Cet= cetacean and P = protected. Source: NSW Threatened Species Database, Atlas of NSW Wildlife and the EPBC Environmental Reporting Tool (accessed July 2011). Note that all native species are protected under the NSW Parks and Wildlife Act 1974

Scheduled Species	Common Name	Status under TSC/FM Act	Status under EPBC Act
1. Marine Mammals:			
<i>Balaenoptera acutorostrata</i>	Dwarf minke whale	P	Cet
<i>Balaenoptera edeni</i>	Bryde's whale	P	Cet, M
<i>Caperea marginata</i>	Pygmy right whale	P	Cet, M
<i>Delphinus delphis</i>	Common dolphin	P	Cet
<i>Dugong dugon</i>	Dugong	E	Cet, M
<i>Eubalaena australis</i>	Southern right whale	V	Cet, E, M
<i>Grampus griseus</i>	Risso's dolphin	P	Cet
<i>Lagenorhynchus obscurus</i>	Dusky dolphin	P	Cet, M
<i>Megaptera novaeangliae</i>	Humpback whale	V	Cet, V, M
<i>Orcinus orca</i>	Killer whale	P	Cet, M
<i>Stenella attenuata</i>	Spotted dolphin	P	Cet
<i>Tursiops aduncus</i>	Indian Ocean bottlenose dolphin	P	Cet, M
<i>Tursiops truncatus</i>	Bottlenose dolphin	P	Cet
<i>Arctocephalus pusillus doriferus</i>	Australian fur seal	V	L
<i>Arctocephalus forsteri</i>	New Zealand fur seal	V	L
2. Fish			
<i>Carcharodon carcharias</i>	Great white shark	V	V, M
<i>Carcharias taurus</i> (East Coast)	Grey nurse shark	CE	CE
<i>Epinephelus coioides</i>	Estuary cod	P	
<i>Paraplesiops bleekeri</i>	Eastern blue devil fish	P	
<i>Pristis zijsron</i>	Green sawfish	PE	V
<i>Prototroctes maraena</i>	Australian grayling	P	
<i>Rhincodon typus</i>	Whale shark		M, V
<i>Acentronura tentaculata</i>	Shortpouch pygmy pipehorse	P	L
<i>Festucalex cinctus</i>	Girdled pipefish	P	L
<i>Filicampus tigris</i>	Tiger pipefish	P	L
<i>Heraldia nocturna</i>	Upside-down pipefish	P	L
<i>Hippichthys penicillus</i>	Beady pipefish	P	L
<i>Hippocampus abdominalis</i>	Eastern potbelly seahorse	P	L

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Scheduled Species	Common Name	Status under TSC/FM Act	Status under EPBC Act
<i>Hippocampus whitei</i>	White's seahorse	P	L
<i>Histiogamphelus briggsii</i>	Briggs' crested pipefish	P	L
<i>Lissocampus runa</i>	Javelin pipefish	P	L
<i>Maroubra perserrata</i>	Sawtooth pipefish	P	L
<i>Notiocampus ruber</i>	Red pipefish	P	L
<i>Phyllopteryx taeniolatus</i>	Weedy seadragon	P	L
<i>Solegnathus spinosissimus</i>	Spiny pipehorse	P	L
<i>Solenostomus cyanopterus</i>	Blue-finned ghost pipefish	P	L
<i>Solenostomus paegnius</i>	Rough-snout ghost pipefish	P	L
<i>Solenostomus paradoxus</i>	Harlequin Ghost pipefish	P	L
<i>Stigmatopora argus</i>	Spotted pipefish	P	L
<i>Stigmatopora nigra</i>	Wide-bodied pipefish	P	L
<i>Syngnathoides biaculeatus</i>	Double-ended pipehorse	P	L
<i>Trachyrhamphus bicoarctatus</i>	Short-tailed pipefish	P	L
<i>Urocampus carinirostris</i>	Hairy pipefish	P	L
<i>Vanacampus margaritifer</i>	Mother-of-pearl pipefish	P	L
3. Marine Reptiles			
<i>Caretta caretta</i>	Loggerhead turtle	E	E, M
<i>Chelonia mydas</i>	Green turtle	V	V, M
<i>Dermochelys coriacea</i>	Leatherback turtle	V	E, M
<i>Eretmochelys imbricata</i>	Hawksbill turtle		V, M
<i>Natator depressus</i>	Flatback turtle		V, M
<i>Pelamis platurus</i>	Yellow-bellied seasnake	P	L
4. Estuarine Shorebirds			
<i>Actitis hypoleucos</i>	Common sandpiper		L, M
<i>Arenaria interpres</i>	Ruddy turnstone		L, M
<i>Botaurus poiciloptilus</i>	Australasian bittern	V	
<i>Burhinus grallarius</i>	Bush stone curlew	E	
<i>Calidris acuminata</i>	Sharp-tailed sandpiper		L, M
<i>Calidris alba</i>	Sanderling	V	L, M
<i>Calidris canutus</i>	Red knot		L, M
<i>Calidris ferruginea</i>	Curlew sandpiper		L, M
<i>Calidris melanotos</i>	Pectoral sandpiper		L, M
<i>Calidris ruficollis</i>	Red-necked stint		L, M
<i>Calidris tenuirostris</i>	Great knot	V	L, M
<i>Charadrius bicinctus</i>	Double-banded plover		L, M

Scheduled Species	Common Name	Status under TSC/FM Act	Status under EPBC Act
<i>Charadrius leschenaultii</i>	Greater sand plover	V	M
<i>Charadrius mongolus</i>	Lesser sand plover	V	L, M
<i>Charadrius ruficapillus</i>	Red-capped plover		L
<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	E	L
<i>Gallinago hardwickii</i>	Latham's snipe		L, M
<i>Gallinago megala</i>	Swinhoes snipe		L
<i>Gallinago stenura</i>	Pin-tailed snipe		L
<i>Gygis alba</i>	White tern	V	
<i>Sterna albifrons</i>	Little tern	E	
<i>Sterna fuscata</i>	Sooty tern	V	
<i>Haematopus fuliginosus</i>	Sooty oystercatcher	V	
<i>Haematopus longirostris</i>	Pied oystercatcher	E	
<i>Heteroscelus brevipes</i>	Grey-tailed tattler		L, M
<i>Himantopus himantopus</i>	Black winged stilt		L
<i>Ixobrychus flavicollis</i>	Black bittern	V	
<i>Limicola falcinellus</i>	broad-billed sandpiper	V	M
<i>Limosa laponica</i>	Bar-tailed godwit		L, M
<i>Limosa limosa</i>	Black-tailed godwit	V	L, M
<i>Numenius madagascariensis</i>	Eastern curlew		L, M
<i>Numenius minutus</i>	Little curlew		L, M
<i>Numenius phaeopus</i>	Whimbrel		L, M
<i>Pluvialis fulva</i>	Pacific golden plover		L, M
<i>Pluvialis squatarola</i>	Grey plover		L, M
<i>Recurvirostra novaehollandiae</i>	Red-necked avocet		L
<i>Rostratula australis</i>	Painted snipe	E	L, M
<i>Sterna albifrons</i>	Little tern		L, M
<i>Tringa stagnalis</i>	Marsh sandpiper		L, M
<i>Xenus cinereus</i>	Terek sandpiper	V	L, M

5. Endangered Population

Posidonia australis Strapweed
(Lake Macquarie Population)

6. Endangered Ecological Communities

Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East corner bioregions

Marine Mammals

The majority of the marine mammals listed in **Table 1** live predominantly offshore or in coastal waters, rarely entering the relatively narrow entrance channel and main basin of Lake Macquarie. Some species, for example southern right whales (*Eubalaena australis*) and humpback whales (*Megaptera novaeangliae*), are frequently observed in adjacent coastal waters during their annual migrations along the NSW coast to breeding grounds in warmer waters but would be very unlikely to travel into Lake Macquarie. Furthermore, there are no known resting breeding or calving areas within the region. The New Zealand fur seal (*Arctocephalus forsteri*) and Australian fur seal (*Arctocephalus pusillus doriferus*) are known to occasionally frequent adjacent coastal waters to forage and could also forage and/or rest within the estuary on occasion, however, these species have not been recorded within the estuary and would also be unlikely to occur there or take up residence there. The common dolphin (*Delphinus delphis*) and offshore bottlenose dolphins (*Tursiops truncatus*) are offshore species and not often sighted close to shore. The Indian Ocean bottlenose dolphin (*Tursiops aduncus*) is an inshore species that occasionally forage inside estuaries and may occur within the study area. However, no resident populations have been observed in this area and any animals in the vicinity are likely to be transient and therefore unlikely to be either directly or indirectly affected by the minimal level of subsidence predicted in relation to the proposed extension of mining. Any impacts to these species are considered highly unlikely.

Dugongs (*Dugong dugon*) mainly occur in northern Australia but there is evidence to suggest that they occasionally occur well beyond the southern limit of their accepted range into NSW (Allen *et al.* 2004). Individuals that have been recorded in NSW are mostly thought to be non-breeding vagrants that are influenced by warm currents and the availability of seagrass further south. They are most commonly found in shallow protected waters where they graze on large amounts of seagrass. The dugong does not breed in NSW, however, habitat and resources within the state remain important to visiting individuals (DECCW 2008). The dugong is threatened by coastal development and poor catchment management leading to siltation and the loss of seagrass beds. Isolated dugong populations are vulnerable to local extinction as a result of losing seagrass beds after stochastic events such as floods or cyclones among other issues. Dugongs have not been recorded within Lake Macquarie itself although there are two records of it occurring in Swansea Channel.

Fish

The grey nurse shark (*Carcharias taurus*) typically occurs on shallow, coastal rocky reefs with sandy gutters within the reef matrix often the preferred microhabitat (Last and Stevens 1994). Although it is probable that grey nurse sharks would enter estuaries to forage on occasion there is no evidence to suggest that they depend on estuarine habitat in particular. Similarly, black cod (*Epinephelus daemeli*) are mostly found in caves and gutters in coastal areas and adults are highly territorial, usually adopting a cave as a core territory (I&I NSW 2009). Black cod have been observed by divers or caught by anglers in estuaries, however, the locations of these occurrences has generally been at the mouths of estuaries and involved juvenile fish.

The whale shark (*Rhincodon typus*) has a typically tropical distribution and would rarely occur in NSW waters. The green sawfish (*Pristis zijsron*) is presumed extinct with the last recorded sighting in NSW over thirty years ago at Yamba (northern NSW) and the species is therefore very unlikely to occur within the study area.

Great white sharks (*Carcharodon carcharias*) occur from cold temperate to tropical waters and generally frequent coastal waters, often close to shore. They also swim into bays and estuaries. The sharks do not appear to frequent specific habitats, although they may take up residence adjacent to rocky shores, particularly where seals or sea lions are present. There is no evidence to suggest that great white sharks depend on estuarine habitat in particular, but it is probable that juvenile great white sharks would enter estuaries to forage on occasion (Environment Australia 2002). In the event that any of these species of fish were present within the estuary it would be unlikely that the minimal level of predicted subsidence (< 20 millimetres) and subsequent impact to benthic habitats would pose any significant threat to these species.

Marine Turtles

Most turtle species are predominantly oceanic, particularly the hawksbill turtle (*Eretmochelys imbricata*), and the leatherback turtle (*Dermochelys coriacea*), while the flatback turtle (*Natator depressus*) is a vagrant to NSW waters and typically confined to warmer tropical waters (Environment Australia 2003). Thus, these species are unlikely to be found in Lake Macquarie.

The loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*) are typical of tropical and subtropical waters of Australia, but are known to frequent the NSW coast and associated estuaries, where they feed or may establish populations near warm water outfalls (Environment Australia 2003). Both species are known to utilise seagrass habitat to forage, and have been recorded within Lake Macquarie. There are 85 records of green turtles occurring within Lake Macquarie and Swansea Channel. Like many marine turtles, these two species have low fertility rates and are under threat from pollution and critical habitat loss among other issues (Environment Australia 2003). Any significant impacts to seagrass habitat as a result of mine subsidence could therefore indirectly affect these species.

Estuarine Shorebirds

Of the listed birds, several have been recorded in Lake Macquarie, many of which are also migratory. These include wading birds such as curlews, oystercatchers, plovers, bitterns, godwits and sandpipers and diving birds such as terns. Note that seabirds such as albatross, petrels and shearwaters may occur within the study area on occasion but they have not been included in the assessment as they spend the majority of their lives at sea and it would be very unlikely for them to be affected by the proposed extension of mining. Only species likely to occur in estuarine habitats were therefore considered further in the assessment of significance. This included five species listed as 'endangered' and 12 species listed as vulnerable under the TSC Act and 26 listed under the EPBC Act as 'migratory'. As the potential impacts to estuarine shorebirds are likely to be similar, they have been assessed as a single group.

Estuarine Vegetation

Sand spurge (*Chamaesyce psammogeton*) grows on sand-dunes and exposed headlands in coastal areas. It may occur on the exposed dunes and headlands on the seaward side of the Lake but would be unlikely to occur within the sheltered estuarine environment of the study area.

Ecological Communities

Saltmarsh is listed as an endangered ecological community in NSW. Mapping by Creese *et al.* 2009 indicates that saltmarsh occurs within the study area along the south, south-west foreshore of Wyee Bay, the southern part of Manning Bay and fringing parts of Chain Valley Bay.

Endangered Populations

The seagrass *Posidonia australis* listed as an endangered population in Lake Macquarie under schedule 4 of the FM Act. Habitat maps of Lake Macquarie produced by I&I NSW (Creese *et al.* 2009) indicate that *Posidonia* beds do not occur within the study area.

Protected Species

Estuary cod (*Epinephelus coioides*), giant Queensland grouper (*Epinephelus lanceolatus*) and 22 species of syngnathiformes (seahorses, seadragons, pipefish, pipehorses and seamoths) are listed as protected under the FM Act. Estuary cod generally occur in more tropical waters although may be found as far south as Sydney. Adults are often associated with rocky reef habitat in the lower reaches of estuaries and would be unlikely to be found within the study area, however, juveniles are more likely to be associated with soft sediments and seagrass beds and could therefore potentially be found in the study area. Seahorses and pipefish regularly occur in seagrass habitat and it is likely that they occur within the study area.

3.3.4.2 Assessments of Significance

Assessments of significance under State and Commonwealth legislation were carried out for species that may occur within the study area and could potentially be affected by the proposed extension of mining activity.

Under the TSC/FM Act this applies to species, populations and communities listed as endangered, critically endangered and vulnerable, but do not apply to 'protected species'. Under the EPBC Act, this applies to species listed as extinct in the wild, critically endangered, endangered, vulnerable or migratory and also to ecological communities that are endangered or critically endangered. The following species and populations were assessed:

1. Marine mammals

- Dugong

2. Reptiles

- Loggerhead turtle (*Caretta caretta*)
- Green turtle (*Chelonia mydas*)

3. Estuarine Birds

- Common sandpiper (*Actitis hypoleucos*)
- Ruddy turnstone (*Arenaria interpres*)
- Australasian Bittern (*Botaurus poiciloptilus*)
- Bush stone Curlew (*Burhinus grallarius*)
- Sharp-tailed sandpiper (*Calidris acuminata*)
- Sanderling (*Calidris alba*)
- Red knot (*Calidris canutus*)
- Curlew sandpiper (*Calidris ferruginea*)
- Pectoral sandpiper (*Calidris melanotos*)
- Red-necked stint (*Calidris ruficollis*)
- Great knot (*Calidris tenuirostris*)
- Double-banded plover (*Charadrius bicinctus*)
- Greater sand plover (*Charadrius leschenaultia*)
- Lesser sand plover (*Charadrius mongolus*)
- Red-capped plover (*Charadrius ruficapillus*)
- Black-necked stork (*Ephippiorhynchus asiaticus*)
- Latham's snipe (*Gallinago hardwickii*)
- Swinhoe's snipe (*Gallinago megala*)
- Pin-tailed snipe (*Gallinago stenura*)
- White tern (*Gygis alba*)
- Little tern (*Sterna albifrons*)
- Sooty tern (*Sterna fuscata*)
- Sooty oystercatcher (*Haematopus fuliginosus*)
- Pied oystercatcher (*Haematopus longirostris*)
- Grey-tailed tattler (*Heteroscelus brevipes*)
- Black winged stilt (*Himantopus himantopus*)
- Black bittern (*Ixobrychus flavicollis*)
- Broad-billed sandpiper (*Limicola falcinellus*)
- Bar-tailed godwit (*Limosa lapponica*)
- Black-tailed godwit (*Limosa limosa*)
- Eastern curlew (*Numenius madagascariensis*)
- Little curlew (*Numenius minutus*)
- Whimbrel (*Numenius phaeopus*)
- Pacific golden plover (*Pluvialis fulva*)
- Grey plover (*Pluvialis squatarola*)
- Red-necked avocet (*Recurvirostra novaehollandiae*)
- Painted snipe (*Rostratula australis*)

- Marsh sandpiper (*Tringa stagnatilis*)
- Terek sandpiper (*Xenus cinereus*)

The assessments of significance are provided in **Appendix B** for assessment under the TSC/FM Act and **Appendix C** for species assessed under the EPBC Act. Note that all estuarine birds and marine turtles were grouped together as the potential impacts would be similar.

No Key Threatening Processes (KTPs) were identified that could occur, or be exacerbated as a result of the proposed extension of mining that could potentially affect a threatened species and were therefore not considered for further assessment.

3.4 Areas of Conservation Significance

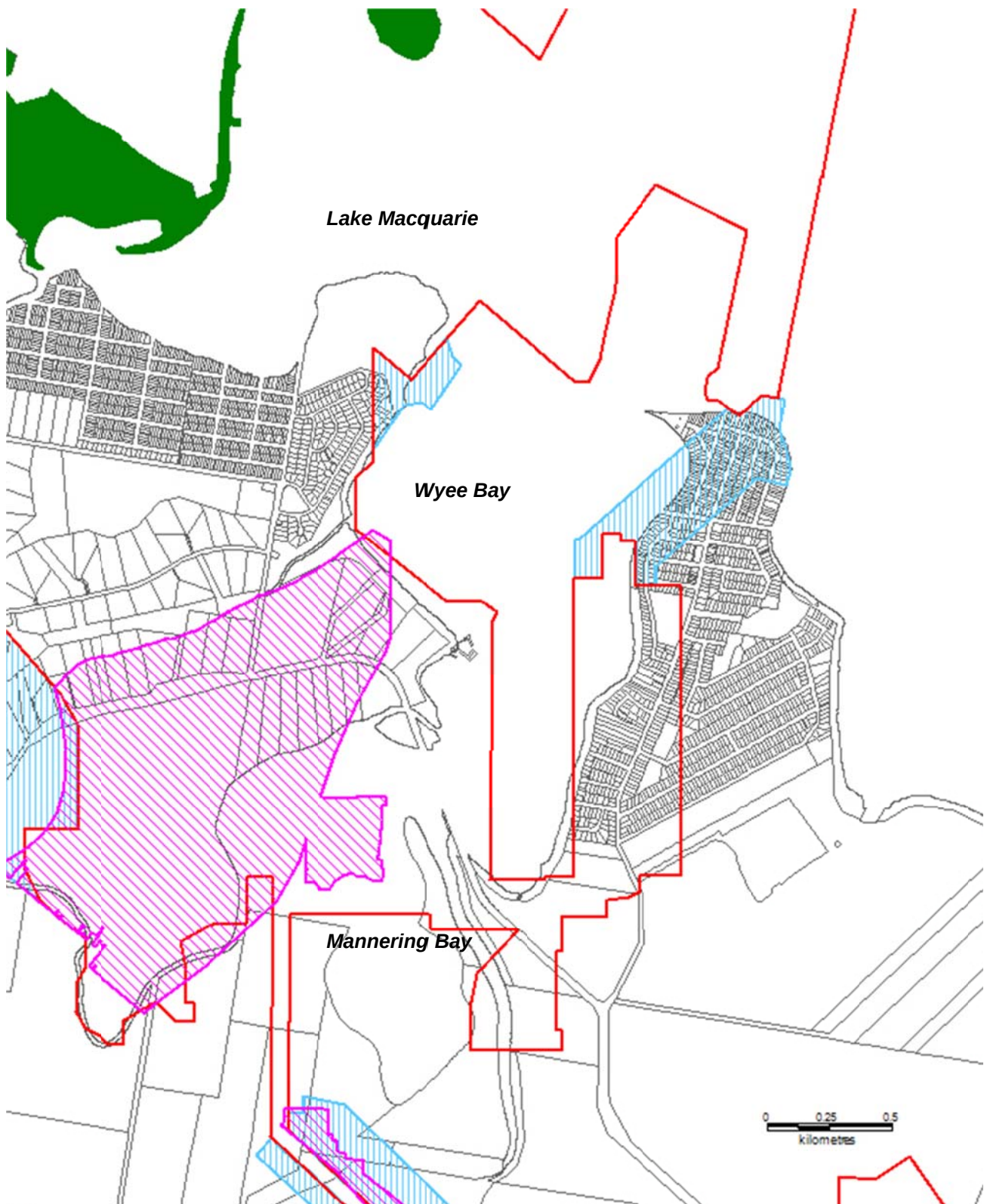
3.4.1 State Conservation Areas

State Conservation Areas (SCAs) are reserved under the NP&W Act to protect and conserve areas that contain significant or representative ecosystems, landforms or natural phenomena or places of cultural significance, that are capable of providing opportunities for sustainable visitor use and enjoyment, the sustainable use of buildings and structures or research and that are capable of providing opportunities for uses permitted under other provisions of the Act. The bushland and open space of Lake Macquarie SCA, established in 1996, lines 16 kilometres of foreshore in six different sections around the lake (DECCW 2008). The pied oystercatcher (*Haematopus longirostris*), which is listed as 'endangered' under the TSC Act is known to occur within the SCA as well as over 400 species of native plants. SCAs which occur within the study area include the Morisset and Chain Valley Bay portions of the SCA. The Morisset portion of the SCA conserves 174 hectares and 4 kilometres of foreshore around the Morisset Hospital complex. The Chain Valley Bay portion of the SCA conserves 272 hectares of bushland behind 600 metres of foreshore on the south eastern side of the lake (**Figure 3**). Locals and anglers are the main users of this section of the park (NP&WS 2005).

3.4.2 Wetlands

Wetlands cover a wide range of habitats, including lakes, lagoons, estuaries, rivers, floodplains, swamps, bogs, billabongs, marshes and coral reefs. Wetlands can be fresh, brackish or saline and include seagrass beds, mangroves and saltmarshes as described in **Section 3.3**.

Figure 3: State Conservation Areas (highlighted in green)



3.5 Impacts of Underground Mining on Estuarine Ecosystems

The principal physical impact resulting from underground coal mining is subsidence i.e. lowering of the surface above areas that are mined (Booth *et al.* 1998, Holla and Barclay 2000). Vertical displacement of low lying foreshores can expose natural and man-made features to an increased frequency of flooding, to a risk of being permanently inundated or to a risk of flooding that may not have existed previously (NSW DoP 2008).

Studies that have documented the effects of coal extraction on the aquatic biota of estuarine ecosystems are limited, but have been documented in a strategic review of impacts of potential underground mining in the Wyong Local Government Area (NSW DoP 2008). According to the review, a number of subsidence events have occurred in the Newcastle coalfield in the late 1980s and early 1990s, resulting in four incidents of unplanned inundation of the foreshores of Lake Macquarie and Lake Munmorah, to the south of Lake Macquarie. Subsidence beneath the lakes was since controlled by the use of 'bord and pillar' mining, partial pillar extraction and restricting the width of the longwall panels. Despite this, extraction beneath parts of Lake Munmorah and Budgewoi Lake (from 140 – 180 metres depth cover) has resulted in unplanned subsidence of up to 1 metre along sections of foreshore at Lake Munmorah (at Colongra Swamp on the Lake's western shore) and Buff Point (on the northern shore of Budgewoi Lake). Duchatel (1998) reported on the effects of mine subsidence to the foreshores and freshwater wetland at Colongra (Lake Munmorah). Approximately four hectares of wetland foreshore was subsided by 900 millimetres allowing saline water to flow into the freshwater swamp behind the more elevated foreshore. Widespread mortality of plants and associated wildlife was predicted and management strategies to deal with the problem were recommended (Roberts 2000). The Colongra Swamp area has recently been listed as part of a Nature Reserve. Subsidence has also occurred along the foreshore at Chain Valley Bay in Lake Macquarie, resulting in inundation of saltwater and the loss of riparian vegetation along the subsided shoreline (NSW DoP 2008).

The Tuggerah Lakes Estuary Process Study (Roberts 2000) identifies subsidence as an important issue affecting aquatic habitats, with particular reference to the potential effects on fringing wetland habitats such as seagrass beds. The main concern with regard to seagrass is the potential to alter the mean depth of seagrass habitat. Given that there is suitable substratum available, the depth limit and extension of seagrass beds, has been found to be constrained by light penetration underwater (Duarte 1991) which decreases with depth. The depth limit of seagrass beds is not established as a sharp threshold, but involves the gradual decline in abundance from the depth where maximum biomass is observed to their depth limit. Increased depth (e.g. as a result of mining subsidence) is therefore considered to lead to a decrease in the distribution of seagrass and may alter assemblages of benthic macroinvertebrates (Roberts 2000).

There are, however, several other factors which may affect seagrass growth and distribution as discussed in **Section 3.3.1**. It is notable that the methods of mining employed at Mannering Colliery have been designed for minimal surface subsidence (20 millimetres).

4 Assessment of Impacts

4.1 Description of Proposal

Mannering Colliery proposes to mine by bord and pillar method in five new areas of the Fassifern Seam and additional areas of the Great Northern Seam. The combined extraction from the Fassifern and Great Northern Seams will only involve first workings only and not exceed the already approved 1.1 Million tonnes of ROM coal per annum. No change to surface infrastructure or coal handling is required for the project as production rates will not exceed current capacity and operations will continue within the existing approval limits and controls.

The main issue to be considered in the assessment is the potential for subsidence of the lake bed from subsurface mining to affect estuarine ecosystems. The mining method has been designed to provide long-term stability beneath foreshore areas and other natural and man-made features. According to the subsidence report prepared by Seedsman Geotechnics Pty Ltd 2011, the predicted subsidence levels would be limited to less than 20 millimetres.

4.2 Physical Impacts Associated with Mine Subsidence

As described in **Section 3.4** the principal physical impact resulting from underground coal mining is subsidence i.e. lowering of the surface above areas that are mined (Booth *et al.* 1998, Holla and Barclay 2000). Subsidence may result in areas of foreshore above the mean high water mark, previously unexposed to tidal inundation becoming wetted at high tides and areas below this level becoming inundated for a longer period of time. Subtidally the seabed may become deeper in affected areas. The extent of the morphological changes to the foreshore and seabed will, however, be dependent on the slope and topography of the shore. A greater surface area would be affected where the shoreline is flat and gradually sloping as opposed to areas where it is steeper. It is likely that any impacts of subsidence will be localised and based on the proposed extension of mining would potentially be limited to five distinct regions of the study area where the proposed extension of mining overlaps with foreshore areas. These regions include:

1. Western shore of Wyee Point (Fassifern Seam). The area covers approximately 330 metres of foreshore, 5919 square metres of seagrass habitat and a total of 30,970 square metres of subtidal seabed.
2. Western shore of Wyee Bay (Great Northern Seam). The area covers approximately 235 metres of foreshore, 3901 square metres of seagrass habitat and a total of 11,130 square metres of subtidal habitat.
3. Mannering Bay (Great Northern Seam). The area covers approximately 950 metres of foreshore, 2874 square metres of seagrass within the Bay and a total of 148,600 square metres of subtidal seabed. Approximately 2200 sq. m of saltmarsh also falls within this area along the western shore of the Bay.
4. Eastern Shore of Wyee Bay (Fassifern Seam). The area covers approximately 455 m of foreshore, 7500 square metres of seagrass habitat and a total of 76,660 square metres of subtidal seabed.
5. Vales Point (Fassifern Seam). The area covers approximately 505 metres of foreshore, 5959 square metres of seagrass habitat and a total of 10,670 square metres of subtidal seabed.

4.3 Impacts to Flora and Fauna

4.3.1 Estuarine vegetation

Estuarine vegetation potentially affected by the proposed extension of mining includes seagrasses (*Zostera* and *Halophila*), mangrove and saltmarsh. Seagrass beds fringe the

majority of Lake Macquarie and within the study area large continuous beds occur in the areas identified in Section 4.2, where there is potential for subsidence. Under existing conditions, the outer extent of seagrass beds that fringe the majority of Wyee Bay and Chain Valley Bay, is likely to be constrained by the depth to which sufficient light can penetrate the water column. This appears to vary between two and five metres.

Deepening of the Lake bed as a result of subsidence could reduce the overall amount of light reaching seagrasses and consequently affect seagrass growth. The severity of the potential impact would depend on the size of the area affected, which, in turn would be dependent on the topography of the seabed at the point of subsidence. Impacts are likely to be greater for areas of gradually sloping flat seabed (e.g. within Mannering Bay which is uniformly < 2 metres depth) rather than the more steeply sloping areas where seagrass fringes the shore (e.g. around Vales Point).

Although some seagrass may be lost due to reduced photosynthetic capacity, new beds could potentially develop (or existing beds expand), in shallow areas that become deeper and remain inundated for longer periods of time. Colonisation of new beds may only occur where there is suitable soft sediment habitat available but not where seawalls or steeply sloping banks would preclude this.

Based on subsidence levels of < 20 millimetres, impacts to seagrass beds could result in subtle morphological and/or photo-adaptive changes such as reduced biomass, decreased productivity and longer shoot lengths (as described in **Section 4.2**). However, it is unlikely that any reduction in seagrass cover would be detectable. Tolerance to light reduction also varies among species, *Halophila* spp. for example, has low minimum light requirements as indicated by the ability to colonise greater water depths than other species (Butler and Jerkanoff 1999). As different species of seagrasses are adapted to living at different depths and light levels, a change in species composition may occur. The extent to which this occurs would depend on the topography of the Lake but an increase in depth of up to 20 millimetres is likely to have a minimal effect.

Mangroves and saltmarsh occur above the proposed extension of mining activities within the Great Northern Seam. The overall effect of increased depth would be potentially greater and more prolonged inundation of existing intertidal areas. These habitats may potentially expand landward into low-lying areas, but where the existing shoreline is steep, intertidal areas may recede. Saltmarsh may also be replaced with mangroves which are more tolerant of intertidal conditions.

Based on previous studies carried out in Lake Macquarie, green, red and brown macroalgae is likely to occur along rocky foreshores and among seagrasses within the study area. Macroalgae are an important resource as food and/or shelter for fish and invertebrates and may act as a nursery habitat for juvenile fish and play a role in nutrient cycling. As macroalgae are also photosynthetic and require light to grow, changes in depth which result in less light penetration could impact on growth and distribution. However, given the minimal amount of predicted subsidence, it is unlikely that species assemblages associated with mangroves, saltmarsh and/or macroalgae would be lost as a result of a minimal increase in depth. It is, however, possible that species composition of these assemblages could be altered, whereby species adapted for slightly deeper water outcompete with other species. This would be unlikely to result in any detectable impact within the study area.

4.3.2 Benthic Assemblages

For the purpose of this assessment, benthic assemblages considered include microalgae (photosynthetic algae generally < 0.062 millimetres which occur on the surface of the seabed) and benthic macrofauna (organisms > 1 millimetre that live in association with the seabed). Microalgae are the main primary producers in most intertidal or shallow subtidal soft sediments (Connell and Gillanders 2007). The density of microalgae is light dependent and highest at the sediment surface and in shallow water. Microalgae can act as a sink for nitrogen, stabilise sediments by exuding extra polymeric substances and are an important source of food for

herbivorous demersal fish and macrofauna (Dye and Lasiak 1987). Increased depth in subtidal areas affected by the proposed extension of mining could potentially affect microalgae density by reducing light penetration. This could indirectly affect higher trophic levels, alter the sediment composition and affect nutrient cycling. However, given the area of subtidal seabed potentially affected by the proposed extension of mining is small in comparison with the amount of similar habitat within the study area, it is unlikely that a decrease in density of microalgae would have a significant impact on other ecosystem components, although this may contribute cumulatively with other anthropogenic impacts within the study area.

4.3.3 Fisheries Resources

Fish would not be directly impacted by the proposed extension of mining. The extensive seagrass beds, within Lake Macquarie do, however, provide an important nursery habitat for many species of economically important fish including yellowfin bream (*Acanthopagrus auratus*), luderick (*Girella tricuspidata*), whiting (*Sillago* sp.) and mullet (Mugilidae). Loss of seagrass and other important habitats such as mangroves, saltmarsh, macroalgae and benthic ecosystem components could indirectly affect the fish populations that utilise these habitats for food and shelter. As the impacts on these ecosystem components are considered to be negligible, significant impacts on fisheries resources within the study area would not be expected.

4.3.4 Threatened and Protected Species

4.3.4.1 Assessments of Significance (State Legislation)

Assessments of significance were undertaken for the following species known to occur within the study area that have potential to be affected by the proposal:

- Dugong (*Dugong dugon*);
- Loggerhead turtle (*Caretta caretta*);
- Green turtle (*Chelonia mydas*); and
- Estuarine shorebirds (assessed as a group).

Results of the assessments are given in **Appendix B** and **C**. The dugong (*Dugong dugon*), green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*) have all been recorded in Lake Macquarie and are known to feed on, or forage within, seagrass habitats. Any potential reduction in seagrass has the potential to affect these species. However, given that dugongs rarely occur within Lake Macquarie (there are only two records of the species occurring within Swansea Channel) and that no measurable effect on seagrass distribution is expected, the proposed extension of mining is not considered to affect a viable population. Furthermore, any individual dugongs that could occur as far south as Lake Macquarie are likely to be vagrants and not part of a resident population.

Marine turtles, particularly green turtles (*Chelonia mydas*) are not uncommon within Lake Macquarie and are likely to feed on seagrass within the study area. Loggerhead turtles (*Caretta caretta*) do not feed on seagrass but forage within seagrass habitat for other prey species.

This area of habitat is not, however, critical to the species survival and any potential impacts on seagrass habitat would not limit the availability of seagrass as a food source for these species.

There are 39 species of estuarine shorebird that have been recorded within the study area that could potentially be affected by alteration of habitat as a result of subsidence related to the proposal. The predicted level of subsidence (< 20 millimetres) in foreshore areas is not, however, considered likely to have an effect on the habitat utilised by these species, such that it would cause any observable alteration to their behaviour or habitat requirements.

The proposal is not, therefore, considered to affect any of these species such that a species impact statement is recommended.

4.3.4.2 Assessment of Significance (Commonwealth Legislation)

The dugong (*Dugong dugon*) is also listed under the EPBC Act as 'migratory' and the loggerhead turtle (*Caretta caretta*) listed as both 'migratory' and 'endangered'. Five species of estuarine bird are also listed under the EPBC Act and international agreements for the protection of migratory birds. As these species are matters of NES an assessment of significance was undertaken according to EPBC Act 'significant impact guidelines 1.1'. Results of the assessments are given in **Appendix C**. Based on this assessment the proposed extension of mining is considered unlikely to have a significant impact on matters of NES.

4.3.4.3 Other Listed and Protected Species

Seahorses, pipefish and sea dragons (Syngnathidae) are 'listed' under the EPBC Act and 'protected' under the FM Act and although these species are not subject to assessments of significance, they require consideration in relation to the proposed Project. Seahorses and pipefish occur in seagrass beds (Kuitert 2000) and could therefore be indirectly affected as a result of any impact to seagrass habitat. It is unlikely that the potential minor impacts to seagrass described in **Section 4.3.1** would affect populations of these species as there would be extensive seagrass and soft sediment habitats for these species to assimilate into if there were any minor alteration of immediate habitat.

4.4 Areas of Conservation Significance

As described in **Section 3.4** there have been documented events where unplanned subsidence of up to 1 metre has occurred in parts of Lake Munmorah, Budgewoi Lake and Lake Macquarie resulting in the inundation of foreshores by salt water and loss of riparian vegetation. Since these events, which occurred over 10 years ago, mining methods have been largely modified to ensure minimal impacts from subsidence and there have been no such events since. Furthermore, no areas of conservation significance occur within or near to the proposed extension of mining and no impacts to areas of conservation significance are expected.

4.5 Cumulative Impacts

Cumulative impacts on the environment result from the incremental impact of an action when added to past, existing and reasonably foreseeable future actions regardless of who is carrying out those actions (Canter 1996).

The predicted impact of 20 millimetres of subsidence on aquatic components of the study area is likely to be negligible in isolation, but when coupled with other anthropogenic stressors has potential to cause a measurable impact. Potential stressors likely to exacerbate the effects of subsidence include those which have potential to increase turbidity and/or alter sea level resulting in poorer light penetration. These include, but are not limited to:

- Increasing urban/industrial development within the catchment;
- Climate change resulting in more severe wet weather/storm events and sea level rise;
- Surface run-off resulting in increased turbidity;
- Point source pollution;
- Increased recreational boating; and
- Other mining activities within Lake Macquarie which have potential to cause subsidence.

Centennial Coal operates Myuna Colliery to the north of the study area. A separate environmental assessment has been prepared to manage the predicted subsidence impacts associated with this colliery including a Seagrass Management Plan. Other companies also operate within the Great Northern and Fassifern Seams beneath Chain Valley Bay. The total area of Lake Macquarie potentially affected by mining activity alone is therefore substantially more than that addressed in the current assessment. Provided that appropriate mitigation and management of seagrass beds and other subtidal habitats is implemented for individual project application areas, any cumulative impacts outside of the management of Centennial Manning would be limited. At most, cumulative impacts might result in minor and undetectable changes

associated with the 20 millimetre subsidence predictions (as described in Sections 4.3.1 and 4.3.2). It is likely that the diffuse and less predictable impacts occurring at a catchment scale (e.g. from surface run-off and increased development) would have a greater overall impact on aquatic ecosystem health rather than potential cumulative impacts of mining activity.

5 Conclusion

Within the footprint of the proposed extension of mining at Mannering Colliery the subsidence report (Seedsman Geotechnics Pty Ltd 2011) predicts subsidence of < 20 millimetres. Although sensitive habitats are known to occur within the study area, including seagrasses, mangroves, saltmarsh and State Conservation Areas, the direct impacts to these habitats is considered to be negligible and limited to areas where the proposed extension of mining overlaps with these habitats. Any indirect impacts on fisheries resources and threatened species, populations and ecological communities (including matters of NES), would also be unlikely and as such no significant impact on these species would be expected. Several impacts have been identified that might cumulatively impact upon the ecological values of the aquatic environment, specifically by affecting depth and turbidity which in turn may affect light penetration. This includes other existing mining activities within Lake Macquarie, climate change and sea level rise as well as increasing urban development. The impacts of these broader issues are difficult to predict, however, Centennial Mannering currently manages and monitors for potential impacts in relation to their existing mining activities within Lake Macquarie. Any cumulative impacts outside of the management of Centennial Mannering would require management at the catchment level, as such, no specific mitigation or monitoring of the aquatic environment is recommended for the proposed extension of mining at Mannering Colliery.

6 Acknowledgements

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7 References

- Allen, S., Marsh, H. and Hodgson, A. (2004). Occurrence and Conservation of the Dugong (Sirenia: Dugongidae) in New South Wales. *Proceedings of the Linnean Society of NSW*. 125: 211–216.
- Australian Water and Coastal Studies Pty Ltd and J H and E S Laxton Pty Ltd (1995). Lake Macquarie Estuary Process Study - Volume 1, AWACC Report, 94/25. Prepared for: Lake Macquarie Estuary and Coastal Management Committee of Lake Macquarie City Council. Australian Water and Coastal Studies Pty Ltd, Sydney, NSW.
- Booth, C. J. Spande, E. D. Pattee, C. T. Miller, J. D. and Bertsch, L. P. (1998) Positive and negative effects of longwall mine subsidence on a sandstone aquifer. *Environmental Geology* 34: 223-233.
- Burchmore, J. J. Pollard, D. A. Middleton, M. J. and Williams, R. J. (1993). *Estuarine Habitat Management Guidelines*. NSW Fisheries.
- Butler, A. and Jerkanoff, P. (1999). *Seagrass in Australia*. CSIRO Publishing. Collingwood, VIC.
- Caffrey J. M. and Kemp W. M. (1990). Nitrogen cycling in sediments with estuarine populations of *Potamogeton perfoliatus* and *Zostera marina*. *Marine Ecology Progress Series* 66: 147–160.
- Canter, L. W. (1996). *Environmental Impact Assessment, Second Edition*, New York: McGraw-Hill Book Co., Inc.
- Chapman, M. G. and Underwood, A. J. (1995). Mangrove Forests. In: *Coastal Marine Ecology of Temperate Australia*, Underwood, A. J. and Chapman, M. G., (eds.). University of New South Wales Press Ltd, Sydney. pp. 187-204.
- Christensen, P. B., Nielsen L. P., Sørensen J. and Revsbeck N. P. (1990). Denitrification in nitrate-rich streams: diurnal and seasonal variation related to benthic oxygen metabolism. *Limnology and Oceanography* 35: 640–651.
- Connell, S. D. and Gillanders, B. M. (2007). *Marine Ecology*. Oxford University Press, South Melbourne, Vic. pp. 630.
- Creese, R. G. Glasby, T. M. West, G. and Gallen, C. (2009). Mapping the habitats of NSW estuaries. Report to the Hunter Rivers Catchment Management Authority. Industry and Investment NSW. Fisheries Final Report Series No. 113.
- CSIRO (2007). Statistical Analysis of Seagrass and Macroalgae Percent Cover in Wyee Bay Compared to Background Locations in Lake Macquarie. Technical Memorandum, August 2007.
- Department of Environment and Climate Change (2007). *Threatened Species Assessment Guidelines: The Assessment of Significance*, August 2007.
- Department of Environment Climate Change and Water (2008). DECCW, Canberra. Accessed July 2011. <http://www.environment.nsw.gov.au/determinations/DugongEndSpListing.htm>
- Department of Sustainability, Environment, Water Population and Communities (DSEWPAC) (2011). EPBC Environmental Reporting Tool. Viewed July 2011. <http://www.environment.gov.au/epbc/pmst/index.html>.
- Duarte, C. M. (1991). Seagrass depth limits. *Aquatic Botany* 40: 363-377.
- Duchatel, K. (1998). Colongra wetland subsidence impact assessment. Sainty and Associates Pty Ltd, Potts Point.

- Dye, A. H. and Lasiak, T. A. (1987). Assimilation efficiencies of fiddler crabs and deposit feeding gastropods from tropical mangrove sediments. *Comparative Biochemistry and Physiology*. 87A 2: 341-344.
- Environment Australia (2002). White Shark (*Carcharodon carcharias*) Recovery Plan. <http://www.environment.gov.au/coasts/publications/gwshark-plan/index.html>
- Environment Australia (2003). Recovery Plan for Marine Turtles in Australia. Prepared by the Marine Species Section, Approvals and Wildlife Division, Environment Australia in consultation with the marine turtle recovery team.
- Eyre, B. D. and Ferguson, A. J. P. (2002). Comparison of carbon production and decomposition, benthic nutrient fluxes and denitrification in seagrass, phytoplankton, benthic microalgae- and macroalgae dominated warm-temperate Australian lagoons. *Marine Ecology Progress Series* 229: 43-59.
- Fenchel, T. (1992). What Can Ecologists Learn From Microbes: Life Beneath a Square Centimetre of Sediment Surface, *Functional Ecology* 6: 499-507.
- Gray, R. and Nankivell, A. (2007). Aquatic Vegetation Mapping of Lake Macquarie. Southern Cross University.
- Holla, L. and Barclay, E. (2000). Mine Subsidence in the Southern Coalfield, NSW, Australia. NSW Department of Mineral Resources.
- Industry and Investment NSW (I&I NSW) (2009). Black Cod (*Epinephelus daemeli*) Draft Recovery Plan. Fisheries Conservation and Aquaculture Branch, Port Stephens Fisheries Institute.
- Keough, M. J. and Jenkins, J. P. (1995). Seagrass meadows and their inhabitants. In: *Coastal Marine Ecology of Temperate Australia* pp. 221-39. UNSW, Sydney.
- King, R. J. and Barclay, J. B. (1986). Aquatic angiosperms in coastal saline lagoons of New South Wales. III. Quantitative assessment of *Zostera capricorni*. *Proceedings of the Linnean Society of NSW* 109: 41-50.
- King, R. J. and Hodgson, B. R. (1986). Aquatic angiosperms in coastal saline lagoons of New South Wales. IV. Long-term changes. *Proceedings of the Linnean Society of NSW* 109: 51-60.
- Kuiter, R. H. (2000). Guide to Sea Fishes of Australia. New Holland Publishers, Australia, pp. 434.
- Last, P. R. and Stevens, J. D. (1994). Sharks and Rays of Australia. CSIRO, Australia. pp. 513.
- MacIntyre, R. J. (1959). Some aspects of the ecology of Lake Macquarie, NSW, with regard to the alleged depletion of fish. VII. The benthic macrofauna. *Australian Journal of Marine and Freshwater Research* 10: 341-353.
- Millar, A. (2011). Primefact 947 - Macroalgae factsheet. Industry and Investment NSW. Cronulla, Sydney.
- Morrissey, D. (1995). Saltmarshes. In: *Coastal Marine Ecology of Temperate Australia*, Underwood, A. J. and Chapman, M. G., (eds). University of New South Wales Press Ltd, Sydney. pp. 152-170.
- NSW Department of Planning (2008). Impacts of Potential Underground Mining in the Wyong Local Government Area – Strategic Review. NSW Department of Planning, NSW.
- NSW DPI (2006). Primefacts 21. Mine subsidence. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/56763/Mine_Subsidence_-_Primefact_21-final.pdf.
- NSW DPI (2001). Recreational Fishing Areas: Lake Macquarie Issues Paper. 35 pp.

- NSW Parks and Wildlife Service (2011). Atlas of NSW Wildlife. Viewed July 2011.
<http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp>
- NSW Parks and Wildlife Service (NP&WS 2005). Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve Plan of Management.
- Office of Environment and Heritage (OEH)(2011). Viewed July 2011.
<http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>
- OzCoasts (2010). OzCoasts. Accessed May 2010. <http://www.ozcoasts.org.au/index.jsp>.
- Roberts, D. E. (2000). Tuggerah Lakes Estuary Process Study. Wyong Shire Council.
- Roper, T., Creese, R. G., Scanes, P., Stephens, K., Dela-Cruz, J. and Coates, B. (2009). Estuaries and Coastal Lakes – Technical Report. NSW State of Catchments 2008. DECCW NSW. 213 pp.
- Ross, J. (1995). Fish Australia: the essential fishing companion. Viking, Penguin Books, Victoria, Australia. 498 pp.
- Seedsman Geotechnics Pty Ltd (2011). Centennial Manning Pty Ltd – Section 75W Assessment Great Northern and Fassifern Seams. Final Report for Centennial Manning Pty Ltd, August 2011.
- Smith, A. K. Holliday, J. E. and Pollard, D. A. (1997). Management of seagrass habitats in NSW estuaries Wetlands (Australia). 16(2): 48-55.
- Smith, A. K. and Pollard, D. A. (1999). Policy and Guidelines Aquatic Habitat Management and Fish Conservation: 1999 Update, Policy and Guidelines Aquatic Habitat Management and Fish Conservation , 1999 Update. NSW Fisheries, Port Stephens Research Centre.
- Steffe, A. S. Murphy, J. J. Chapman, D. J. and Gray, C. C. (2005). An assessment of changes in the daytime recreational fishery of Lake Macquarie following the establishment of a 'Recreational Fishing Haven'. NSW Department of Primary Industries - Fisheries Final Report Series No. 79.103 pp.
- Syme, W., Witt, C., Morton, R., Pocock and McAlister A. (1997). Lake Macquarie Estuary Management Plan, WBM Oceanics Australia (1997).
- The Ecology Lab Pty Ltd (1991). The Impacts of Ash Dam Discharges on the Aquatic Environment of Lake Macquarie. Prepared for The Electricity Commission of NSW. The Ecology Lab Pty Ltd, Balgowlah, Sydney.
- The Ecology Lab Pty Ltd (2008). Concept Plan for Trinity Point Marina and Mixed Use Development - Aquatic Ecological Investigations, Prepared for: Johnson Property Group. The Ecology Lab Pty Ltd, Brookvale, NSW.
- Virgona, J. L. (1983). Lake Macquarie Fish Study. Prepared for the Electricity Commission for NSW State Fisheries.
- WBM Oceanics Australia (1996). Lake Macquarie Estuary Management Study. WBM Oceanics Qld.
- West, R. J., Thorogood, C. A., Walford, T. R. and Williams, R. J. (1985). An estuarine inventory for New South Wales, Australia. Division of Fisheries, NSW Department of Agriculture, Sydney, Australia.
- Williams, R. J., West, G., Morrisson, D. and Creese, R. G. (2007). Estuarine Resources of NSW. In: The NSW Comprehensive Assessment Toolkit. CD ROM ISBN 0 7347 5805 7.
- Wood, E. J. F. (1959). Some aspects of the ecology of Lake Macquarie, NSW with regard to the alleged depletion of fish. VI. Plant Communities and their Significance. Australian Journal of Marine and Freshwater Research. 10: 322-340.

8 Appendices

Appendix A: Threatened Species Search Results.

Appendix B: Threatened Species Assessment (State).

Appendix C: Threatened Species Assessment of Significance (Commonwealth).

Appendix A

Threatened Species Search Results



Australian Government

Department of Sustainability, Environment,
Water, Population and Communities

EPBC Act Protected Matters Report

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

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

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

LGA LAKE MACQUARIE, NSW

Report created: 21/07/11 17:24:45



[Summary](#)

[Details](#)

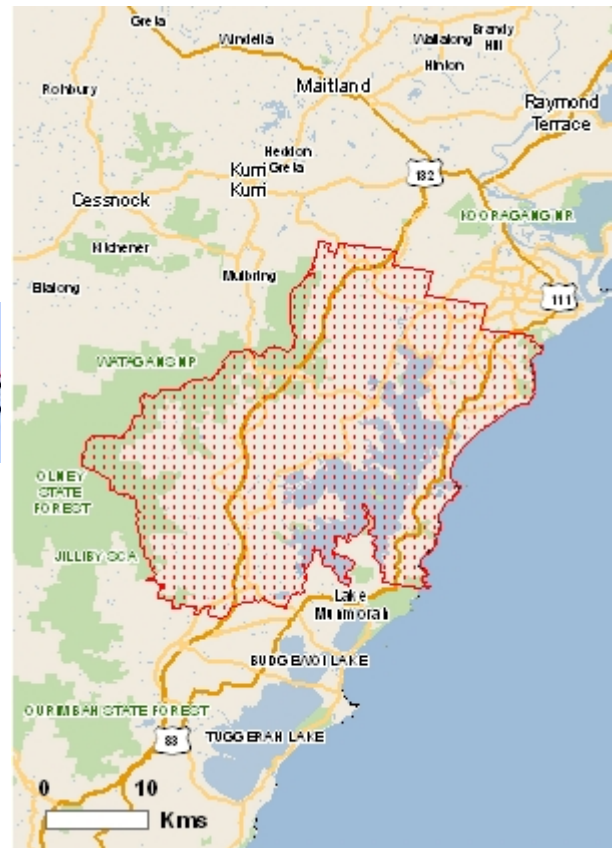
[Matters of NES](#)

[Other matters protected by
the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	2
Threatened Species:	49
Migratory Species:	52

Other Matters Protected by the EPBC Act

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

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

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

Commonwealth Lands:	8
Commonwealth Heritage Places:	None
Listed Marine Species:	70
Whales and Other Cetaceans:	12

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

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

Place on the RNE:	30
State and Territory Reserves:	12
Regional Forest Agreements:	1
Invasive Species:	17
Nationally Important Wetlands:	2

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR Sites) [\[Resource Information \]](#)

Name	Proximity
Hunter estuary wetlands	Within 10km of Ramsar site

Threatened Ecological Communities [\[Resource Information \]](#)

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

Name	Status	Type of Presence
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans antipodensis		
Antipodean Albatross [82269]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans gibsoni		
Gibson's Albatross [82271]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area

[Macronectes halli](#)

Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
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[Pterodroma neglecta neglecta](#)

Kermadec Petrel (western) [64450]	Vulnerable	Species or species habitat may occur within area
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[Rostratula australis](#)

Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche bulleri](#)

Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche cauta cauta](#)

Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche cauta salvini](#)

Salvin's Albatross [82343]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche cauta steadi](#)

White-capped Albatross [82344]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche melanophris impavida](#)

Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
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FROGS[Heleioporus australiacus](#)

Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
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[Litoria aurea](#)

Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
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[Litoria littlejohni](#)

Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
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[Mixophyes balbus](#)

Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
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[Mixophyes iteratus](#)

Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
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MAMMALS[Chalinolobus dwyeri](#)

Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
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[Dasyurus maculatus maculatus \(SE mainland population\)](#)

Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
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[Eubalaena australis](#)

Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
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[Megaptera novaeangliae](#)

Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
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[Petrogale penicillata](#)

Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
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[Potorous tridactylus tridactylus](#)

Long-nosed Potoroo (SE mainland) [66645] Pseudomys novaehollandiae	Vulnerable	Species or species habitat may occur within area
New Holland Mouse [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area

PLANTS

Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area
Angophora inopina		
[64832]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Diuris praecox		
Newcastle Doubletail [55086]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii		
Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa		
Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Microtis angusii		
Angus's Onion Orchid [64530]	Endangered	Species or species habitat likely to occur within area
Pterostylis gibbosa		
Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Rhizanthella slateri		
Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Syzygium paniculatum		
Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Tetratheca juncea		
Black-eyed Susan [21407]	Vulnerable	Species or species habitat likely to occur within area

REPTILES

Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area

Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

SHARKS

Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Migratory Species [[Resource Information](#)]

Name	Status	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding likely to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]		Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy		Species or species habitat may occur within area

Albatross [64697]		
Thalassarche impavida		
Campbell Albatross [64459]		Species or species habitat may occur within area
Thalassarche salvini		
Salvin's Albatross [64463]		Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]		Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Breeding may occur within area
Myiagra cyanoleuca		

Satin Flycatcher [612] Rhipidura rufifrons	Breeding likely to occur within area
Rufous Fantail [592] Xanthomyza phrygia	Breeding may occur within area
Regent Honeyeater [430]	Species or species habitat likely to occur within area
Migratory Wetlands Species	
Ardea alba	
Great Egret, White Egret [59541] Ardea ibis	Breeding likely to occur within area
Cattle Egret [59542] Arenaria interpres	Breeding likely to occur within area
Ruddy Turnstone [872]	Species or species habitat known to occur within area
Calidris acuminata	
Sharp-tailed Sandpiper [874]	Species or species habitat known to occur within area
Calidris canutus	
Red Knot, Knot [855]	Species or species habitat known to occur within area
Calidris ferruginea	
Curlew Sandpiper [856]	Species or species habitat known to occur within area
Calidris ruficollis	
Red-necked Stint [860]	Species or species habitat known to occur within area
Charadrius bicinctus	
Double-banded Plover [895]	Species or species habitat known to occur within area
Charadrius leschenaultii	
Greater Sand Plover, Large Sand Plover [877]	Species or species habitat known to occur within area
Charadrius mongolus	
Lesser Sand Plover, Mongolian Plover [879]	Species or species habitat known to occur within area
Gallinago hardwickii	
Latham's Snipe, Japanese Snipe [863] Heteroscelus brevipes	Species or species habitat may occur within area
Grey-tailed Tattler [59311]	Species or species habitat known to occur within area
Limicola falcinellus	
Broad-billed Sandpiper [842]	Species or species habitat known to occur within area
Limosa lapponica	
Bar-tailed Godwit [844]	Species or species habitat known to occur within area
Numenius madagascariensis	
Eastern Curlew [847]	Species or species habitat known to occur within area
Numenius phaeopus	

Whimbrel [849]	Species or species habitat known to occur within area
Pluvialis fulva	
Pacific Golden Plover [25545]	Species or species habitat known to occur within area
Rostratula benghalensis s. lat.	
Painted Snipe [889]	Species or species habitat may occur within area
Tringa stagnatilis	
Marsh Sandpiper, Little Greenshank [833]	Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land - Director of War Service Homes
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Telstra Corporation Limited
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Breeding likely to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Species or species habitat known to occur within area
Charadrius bicinctus		

Double-banded Plover [895]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]		Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding likely to occur within area
Numenius madagascariensis Eastern Curlew [847]		Species or species habitat known to occur within area

[Numenius phaeopus](#)

Whimbrel [849]

Species or species habitat known to occur within area

[Pluvialis fulva](#)

Pacific Golden Plover [25545]

Species or species habitat known to occur within area

[Recurvirostra novaehollandiae](#)

Red-necked Avocet [871]

Species or species habitat known to occur within area

[Rhipidura rufifrons](#)

Rufous Fantail [592]

Breeding may occur within area

[Rostratula benghalensis s. lat.](#)

Painted Snipe [889]

Species or species habitat may occur within area

[Sterna albifrons](#)

Little Tern [813]

Species or species habitat may occur within area

[Thalassarche bulleri](#)

Buller's Albatross [64460] Vulnerable

Species or species habitat may occur within area

[Thalassarche cauta \(sensu stricto\)](#)

Shy Albatross, Tasmanian Shy Albatross [64697]

Species or species habitat may occur within area

[Thalassarche impavida](#)

Campbell Albatross [64459]

Species or species habitat may occur within area

[Thalassarche salvini](#)

Salvin's Albatross [64463]

Species or species habitat may occur within area

[Thalassarche steadi](#)

White-capped Albatross [64462]

Species or species habitat may occur within area

[Tringa stagnatilis](#)

Marsh Sandpiper, Little Greenshank [833]

Species or species habitat known to occur within area

Fish

[Acentronura tentaculata](#)

Shortpouch Pygmy Pipehorse [66187]

Species or species habitat may occur within area

[Festucalex cinctus](#)

Girdled Pipefish [66214]

Species or species habitat may occur within area

[Filicampus tigris](#)

Tiger Pipefish [66217]

Species or species habitat may occur within area

[Heraldia nocturna](#)

Upside-down Pipefish, Eastern
Upside-down Pipefish, Eastern
Upside-down Pipefish [66227]

Species or species habitat may occur within area

[Hippichthys penicillus](#)

Beady Pipefish, Steep-nosed Pipefish [66231]

Species or species habitat may occur within area

[Hippocampus abdominalis](#)

Bigbelly Seahorse, Eastern
Potbelly Seahorse, New Zealand
Potbelly Seahorse [66233]

Species or species habitat may occur within area

[Hippocampus whitei](#)

White's Seahorse, Crowned
Seahorse, Sydney Seahorse
[66240]

Species or species habitat may occur within area

[Histiogamphelus briggsii](#)

Crested Pipefish, Briggs'
Crested Pipefish, Briggs'
Pipefish [66242]

Species or species habitat may occur within area

[Lissocampus runa](#)

Javelin Pipefish [66251]

Species or species habitat may occur within area

[Maroubra perserrata](#)

Sawtooth Pipefish [66252]

Species or species habitat may occur within area

[Notiocampus ruber](#)

Red Pipefish [66265]

Species or species habitat may occur within area

[Phyllopteryx taeniolatus](#)

Common Seadragon, Weedy
Seadragon [66268]

Species or species habitat may occur within area

[Solegnathus spinosissimus](#)

Spiny Pipehorse, Australian
Spiny Pipehorse [66275]

Species or species habitat may occur within area

[Solenostomus cyanopterus](#)

Robust Ghostpipefish,
Blue-finned Ghost Pipefish,
[66183]

Species or species habitat may occur within area

[Solenostomus paegnius](#)

Rough-snout Ghost Pipefish
[68425]

Species or species habitat may occur within area

[Solenostomus paradoxus](#)

Ornate Ghostpipefish, Harlequin
Ghost Pipefish, Ornate Ghost
Pipefish [66184]

Species or species habitat may occur within area

[Stigmatopora argus](#)

Spotted Pipefish, Gulf Pipefish
[66276]

Species or species habitat may occur within area

[Stigmatopora nigra](#)

Widebody Pipefish,
Wide-bodied Pipefish, Black
Pipefish [66277]

Species or species habitat may occur within area

[Syngnathoides biaculeatus](#)

Double-end Pipehorse,
Double-ended Pipehorse,
Alligator Pipefish [66279]

Species or species habitat may occur within area

[Trachyrhamphus bicoarctatus](#)

Bentstick Pipefish, Bend Stick
Pipefish, Short-tailed Pipefish
[66280]

Species or species habitat may occur within area

[Urocampus carinirostris](#)

Hairy Pipefish [66282]

Species or species habitat may occur within area

[Vanacampus margaritifer](#)

Mother-of-pearl Pipefish
[66283]

Species or species habitat may occur within area

Mammals

[Arctocephalus forsteri](#)

New Zealand Fur-seal [20]

Species or species habitat may occur within area

[Arctocephalus pusillus](#)

Australian Fur-seal,
Australo-African Fur-seal [21]

Species or species habitat may occur within area

Reptiles

Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
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Whales and Other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	Status
Natural	
Glenrock Ornithological Area NSW	Indicative Place
Awabakal Nature Reserve NSW	Registered
Fennell Bay Reserve (Public Reserve R 38237) NSW	Registered
Pulbah Island Nature Reserve NSW	Registered
Reserve R 81914 Tingira Heights Fossil Insect Beds NSW	Registered
Indigenous	
Swansea Heads Area NSW	Indicative Place
Historic	
Burwood Colliery Managers residence and staff housing (former) NSW	Indicative Place
Cottage NSW	Indicative Place
Cottage NSW	Indicative Place
Edgeworth Public School Buildings NSW	Indicative Place
Hillsborough Canine Showground NSW	Indicative Place
Little Pelican Cottages NSW	Indicative Place
Morisset Showground NSW	Indicative Place
Mulbring Valley Landscape Conservation Area NSW	Indicative Place
Nissen Type Residence NSW	Indicative Place
Ocean View Hotel NSW	Indicative Place
Pensioners Hall NSW	Indicative Place
Rathmines Seaplane Base (former) NSW	Indicative Place
Residence NSW	Indicative Place
The Bennals NSW	Indicative Place
The Gables NSW	Indicative Place
Toronto Railway Station and Masters Room NSW	Indicative Place
Toronto to Fassifern Rail Corridor NSW	Indicative Place
War Memorial NSW	Indicative Place
Yarragee NSW	Indicative Place
Cooranbong Post Office (former) NSW	Registered
Dobell House NSW	Registered
Lambton Colliery Structures and Buildings NSW	Registered
Public School NSW	Registered
Toronto Hotel NSW	Registered

State and Territory Reserves

[Resource Information]

Jilliby, NSW
 Awabakal, NSW
 Munmorah, NSW
 Watagans, NSW
 Wallarah, NSW
 Sugarloaf, NSW
 Glenrock, NSW
 Lake Macquarie, NSW
 Pulbah Island, NSW
 Tingira Heights, NSW

The Hunter Lakes, NSW
Blue Gum Hills, NSW

Regional Forest Agreements

[[Resource Information](#)]

Note that all areas with completed RFAs have been included.

[North East NSW RFA, New South Wales](#)

Invasive Species

[[Resource Information](#)]

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

Name	Status	Type of Presence
Mammals		
Capra hircus		
Goat [2]		Species or species habitat may occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat may occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Alternanthera philoxeroides		
Alligator Weed [11620]		Species or species habitat may occur within area
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat may occur within area
Chrysanthemoides monilifera		
Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana		
Broom [67538]		Species or species habitat may occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Nassella trichotoma		
Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat may occur within area
Pinus radiata		

Radiata Pine Monterey Pine,
Insignis Pine, Wilding Pine
[20780]

Species or species habitat may occur within area

[Rubus fruticosus aggregate](#)

Blackberry, European
Blackberry [68406]

Species or species habitat likely to occur within area

[Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji](#)

Willows except Weeping
Willow, Pussy Willow and
Sterile Pussy Willow [68497]

Species or species habitat may occur within area

[Salvinia molesta](#)

Salvinia, Giant Salvinia,
Aquarium Watermoss, Kariba
Weed [13665]

Species or species habitat may occur within area

[Ulex europaeus](#)

Gorse, Furze [7693]

Species or species habitat may occur within area

Nationally Important Wetlands

[Resource Information]

[Jewells Wetland, NSW](#)

[Lake Macquarie, NSW](#)

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

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EPBC Act Protected Matters Report

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

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

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

LGA WYONG, NSW

Report created: 21/07/11 17:25:29



[Summary](#)

[Details](#)

[Matters of NES](#)

[Other matters protected by
the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	2
Threatened Species:	53
Migratory Species:	57

Other Matters Protected by the EPBC Act

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

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

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

Commonwealth Lands:	4
Commonwealth Heritage Places:	None
Listed Marine Species:	77
Whales and Other Cetaceans:	12

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

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

Place on the RNE:	9
State and Territory Reserves:	11
Regional Forest Agreements:	1
Invasive Species:	17
Nationally Important Wetlands:	4

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR Sites) [\[Resource Information \]](#)

Name	Proximity
Hunter estuary wetlands	Upstream from Ramsar site

Threatened Ecological Communities [\[Resource Information \]](#)

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

Name	Status	Type of Presence
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans antipodensis		
Antipodean Albatross [82269]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans gibsoni		
Gibson's Albatross [82271]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area

[Macronectes halli](#)

Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
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[Pterodroma neglecta neglecta](#)

Kermadec Petrel (western) [64450]	Vulnerable	Species or species habitat may occur within area
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[Rostratula australis](#)

Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche bulleri](#)

Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche cauta cauta](#)

Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche cauta salvini](#)

Salvin's Albatross [82343]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche cauta steadi](#)

White-capped Albatross [82344]	Vulnerable	Species or species habitat may occur within area
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[Thalassarche melanophris impavida](#)

Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
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FISH[Macquaria australasica](#)

Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
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[Prototroctes maraena](#)

Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
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FROGS[Heleioporus australiacus](#)

Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
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[Litoria aurea](#)

Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
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[Litoria littlejohni](#)

Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
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[Mixophyes balbus](#)

Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
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[Mixophyes iteratus](#)

Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
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MAMMALS[Chalinolobus dwyeri](#)

Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
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[Dasyurus maculatus maculatus \(SE mainland population\)](#)

Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
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[Eubalaena australis](#)

Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
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[Megaptera novaeangliae](#)

Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys novaehollandiae		
New Holland Mouse [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
PLANTS		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area
Angophora inopina		
[64832]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Diuris praecox		
Newcastle Doubletail [55086]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii		
Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa		
Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Pimelea curviflora var. curviflora		
[4182]	Vulnerable	Species or species habitat may occur within area
Prostanthera askania		
Tranquility Mintbush [64958]	Endangered	Species or species habitat likely to occur within area
Prostanthera junonis		
Somersby Mintbush [64960]	Endangered	Species or species habitat likely to occur within area
Rhizanthella slateri		
Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Syzygium paniculatum		
Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush	Vulnerable	Species or species habitat likely to occur within area

Cherry, Scrub Cherry, Creek
Lilly Pilly, Brush Cherry
[20307]

[Tetratheca glandulosa](#)

Glandular Pink-bell [2350]	Vulnerable	Species or species habitat likely to occur within area
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[Tetratheca juncea](#)

Black-eyed Susan [21407]	Vulnerable	Species or species habitat likely to occur within area
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REPTILES

[Caretta caretta](#)

Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
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[Chelonia mydas](#)

Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
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[Dermochelys coriacea](#)

Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
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[Eretmochelys imbricata](#)

Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
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[Hoplocephalus bungaroides](#)

Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
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[Natator depressus](#)

Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
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SHARKS

[Carcharias taurus \(east coast population\)](#)

Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat may occur within area
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[Carcharodon carcharias](#)

Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
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[Pristis zijsron](#)

Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
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[Rhincodon typus](#)

Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
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Migratory Species [Resource Information]

Name	Status	Type of Presence
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Migratory Marine Birds

[Apus pacificus](#)

Fork-tailed Swift [678]		Species or species habitat may occur within area
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[Ardea alba](#)

Great Egret, White Egret [59541]		Species or species habitat may occur within area
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[Ardea ibis](#)

Cattle Egret [59542]		Species or species habitat may occur within area
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[Diomedea antipodensis](#)

Antipodean Albatross [64458]		Species or species habitat may occur within area
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[Diomedea gibsoni](#)

Gibson's Albatross [64466] Macronectes giganteus		Species or species habitat may occur within area
Southern Giant-Petrel [1060] Macronectes halli	Endangered	Species or species habitat may occur within area
Northern Giant-Petrel [1061] Sterna albifrons	Vulnerable	Species or species habitat may occur within area
Little Tern [813] Thalassarche bulleri		Breeding likely to occur within area
Buller's Albatross [64460] Thalassarche cauta (sensu stricto)	Vulnerable	Species or species habitat may occur within area
Shy Albatross, Tasmanian Shy Albatross [64697] Thalassarche impavida		Species or species habitat may occur within area
Campbell Albatross [64459] Thalassarche salvini		Species or species habitat may occur within area
Salvin's Albatross [64463] Thalassarche steadi		Species or species habitat may occur within area
White-capped Albatross [64462]		Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni		
Bryde's Whale [35] Caperea marginata		Species or species habitat may occur within area
Pygmy Right Whale [39] Carcharodon carcharias		Species or species habitat may occur within area
Great White Shark [64470] Caretta caretta	Vulnerable	Species or species habitat may occur within area
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768] Eretmochelys imbricata	Endangered	Species or species habitat likely to occur within area
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43] Megaptera novaeangliae		Species or species habitat may occur within area
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca		
Killer Whale, Orca [46] Rhincodon typus		Species or species habitat may occur within area

Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Breeding may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Breeding likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Breeding may occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Roosting known to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Roosting known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris		
Great Knot [862]		Roosting known to occur within area
Charadrius bicinctus		
Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus		
Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Heteroscelus brevipes		
Grey-tailed Tattler [59311]		Roosting known to occur within area
Limosa lapponica		
Bar-tailed Godwit [844]		Roosting known to occur within area

Limosa limosa Black-tailed Godwit [845]	Roosting known to occur within area
Numenius madagascariensis Eastern Curlew [847]	Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]	Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]	Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]	Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]	Roosting known to occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]	Species or species habitat may occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]	Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]	Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land - Australian Postal Commission

Commonwealth Land - Director of War Service Homes

Commonwealth Land - Australian & Overseas Telecommunications Corporation

Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Roosting known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area

Calidris ferruginea			Roosting known to occur within area
Curlew Sandpiper [856]			
Calidris melanotos			Roosting known to occur within area
Pectoral Sandpiper [858]			
Calidris ruficollis			Roosting known to occur within area
Red-necked Stint [860]			
Calidris tenuirostris			Roosting known to occur within area
Great Knot [862]			
Charadrius bicinctus			Roosting known to occur within area
Double-banded Plover [895]			
Charadrius mongolus			Roosting known to occur within area
Lesser Sand Plover, Mongolian Plover [879]			
Charadrius ruficapillus			Roosting known to occur within area
Red-capped Plover [881]			
Diomedea antipodensis			Species or species habitat may occur within area
Antipodean Albatross [64458]			
Diomedea gibsoni			Species or species habitat may occur within area
Gibson's Albatross [64466]			
Gallinago hardwickii			Roosting known to occur within area
Latham's Snipe, Japanese Snipe [863]			
Gallinago megala			Roosting likely to occur within area
Swinhoe's Snipe [864]			
Gallinago stenura			Roosting likely to occur within area
Pin-tailed Snipe [841]			
Haliaeetus leucogaster			Species or species habitat likely to occur within area
White-bellied Sea-Eagle [943]			
Heteroscelus brevipes			Roosting known to occur within area
Grey-tailed Tattler [59311]			
Himantopus himantopus			Roosting known to occur within area
Black-winged Stilt [870]			
Hirundapus caudacutus			Species or species habitat may occur within area
White-throated Needletail [682]			
Lathamus discolor			Species or species habitat likely to occur within area
Swift Parrot [744]	Endangered		
Limosa lapponica			Roosting known to occur within area
Bar-tailed Godwit [844]			
Limosa limosa			Roosting known to occur within area
Black-tailed Godwit [845]			
Macronectes giganteus	Endangered		Species or species habitat may occur within area
Southern Giant-Petrel [1060]			
Macronectes halli	Vulnerable		Species or species habitat may occur within area
Northern Giant-Petrel [1061]			
Merops ornatus			Species or species habitat may occur within area
Rainbow Bee-eater [670]			
Monarcha melanopsis			Breeding may occur within area
Black-faced Monarch [609]			
Myiagra cyanoleuca			Breeding likely to occur within area
Satin Flycatcher [612]			

[Numenius madagascariensis](#)

Eastern Curlew [847]

Roosting known to occur within area

[Numenius minutus](#)

Little Curlew, Little Whimbrel [848]

Roosting likely to occur within area

[Numenius phaeopus](#)

Whimbrel [849]

Roosting known to occur within area

[Pluvialis fulva](#)

Pacific Golden Plover [25545]

Roosting known to occur within area

[Pluvialis squatarola](#)

Grey Plover [865]

Roosting known to occur within area

[Rhipidura rufifrons](#)

Rufous Fantail [592]

Breeding may occur within area

[Rostratula benghalensis s. lat.](#)

Painted Snipe [889]

Species or species habitat may occur within area

[Sterna albifrons](#)

Little Tern [813]

Breeding likely to occur within area

[Thalassarche bulleri](#)

Buller's Albatross [64460] Vulnerable

Species or species habitat may occur within area

[Thalassarche cauta \(sensu stricto\)](#)

Shy Albatross, Tasmanian Shy Albatross [64697]

Species or species habitat may occur within area

[Thalassarche impavida](#)

Campbell Albatross [64459]

Species or species habitat may occur within area

[Thalassarche salvini](#)

Salvin's Albatross [64463]

Species or species habitat may occur within area

[Thalassarche steadi](#)

White-capped Albatross [64462]

Species or species habitat may occur within area

[Tringa stagnatilis](#)

Marsh Sandpiper, Little Greenshank [833]

Roosting known to occur within area

[Xenus cinereus](#)

Terek Sandpiper [59300]

Roosting known to occur within area

Fish

[Acentronura tentaculata](#)

Shortpouch Pygmy Pipehorse [66187]

Species or species habitat may occur within area

[Festucalex cinctus](#)

Girdled Pipefish [66214]

Species or species habitat may occur within area

[Filicampus tigris](#)

Tiger Pipefish [66217]

Species or species habitat may occur within area

[Heraldia nocturna](#)

Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]

Species or species habitat may occur within area

[Hippichthys penicillus](#)

Beady Pipefish, Steep-nosed Pipefish [66231]

Species or species habitat may occur within area

[Hippocampus abdominalis](#)

Bigbelly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]

Species or species habitat may occur within area

[Hippocampus whitei](#)

White's Seahorse, Crowned
Seahorse, Sydney Seahorse
[66240]

[Histiogamphelus briggsii](#)

Crested Pipefish, Briggs'
Crested Pipefish, Briggs'
Pipefish [66242]

[Lissocampus runa](#)

Javelin Pipefish [66251]

[Maroubra perserrata](#)

Sawtooth Pipefish [66252]

[Notiocampus ruber](#)

Red Pipefish [66265]

[Phyllopteryx taeniolatus](#)

Common Seadragon, Weedy
Seadragon [66268]

[Solegnathus spinosissimus](#)

Spiny Pipehorse, Australian
Spiny Pipehorse [66275]

[Solenostomus cyanopterus](#)

Robust Ghostpipefish,
Blue-finned Ghost Pipefish,
[66183]

[Solenostomus paegnius](#)

Rough-snout Ghost Pipefish
[68425]

[Solenostomus paradoxus](#)

Ornate Ghostpipefish, Harlequin
Ghost Pipefish, Ornate Ghost
Pipefish [66184]

[Stigmatopora argus](#)

Spotted Pipefish, Gulf Pipefish
[66276]

[Stigmatopora nigra](#)

Widebody Pipefish,
Wide-bodied Pipefish, Black
Pipefish [66277]

[Syngnathoides biaculeatus](#)

Double-end Pipehorse,
Double-ended Pipehorse,
Alligator Pipefish [66279]

[Trachyrhamphus bicoarctatus](#)

Bentstick Pipefish, Bend Stick
Pipefish, Short-tailed Pipefish
[66280]

[Urocampus carinirostris](#)

Hairy Pipefish [66282]

[Vanacampus margaritifer](#)

Mother-of-pearl Pipefish
[66283]

Mammals

[Arctocephalus forsteri](#)

New Zealand Fur-seal [20]

[Arctocephalus pusillus](#)

Species or species habitat may occur within area

Species or species habitat may occur within area

Species or species habitat may occur within area

Species or species habitat may occur within area

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Species or species habitat may occur within area

Species or species habitat may occur within area

Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
Whales and Other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis		
Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within
Grampus griseus		
Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata		
Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus		
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [[Resource Information](#)]

Note that not all Indigenous sites may be listed.

Name	Status
Natural	
Possum Park NSW	Indicative Place
Indigenous	
Norah Head NSW	Registered
Historic	
The Entrance Carousel NSW	Indicative Place
Alison Homestead NSW	Registered
Felton Mathews Tree NSW	Registered
Norah Head Lighthouse NSW	Registered
Norah Head Lightstation Group NSW	Registered
Noraville NSW	Registered
Old Maitland Road Section NSW	Registered

State and Territory Reserves [[Resource Information](#)]

Bar, NSW
 Tuggerah, NSW
 Jiliby, NSW
 Munmorah, NSW
 Richters Caves, NSW
 Lake Macquarie, NSW
 Colongra Swamp, NSW
 Tuggerah, NSW
 Warrawolong, NSW
 Palm Grove, NSW
 Wyrabalong, NSW

Regional Forest Agreements [[Resource Information](#)]

Note that all areas with completed RFAs have been included.

[North East NSW RFA, New South Wales](#)

Invasive Species [[Resource Information](#)]

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

Name	Status	Type of Presence
Mammals		
Capra hircus		
Goat [2]		Species or species habitat may occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat may occur within area

[Vulpes vulpes](#)

Red Fox, Fox [18]

Species or species habitat likely to occur within area

[Alternanthera philoxeroides](#)

Alligator Weed [11620]

Species or species habitat may occur within area

[Asparagus asparagoides](#)

Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]

Species or species habitat may occur within area

[Chrysanthemoides monilifera](#)

Bitou Bush, Boneseed [18983]

Species or species habitat may occur within area

[Genista sp. X Genista monspessulana](#)

Broom [67538]

Species or species habitat may occur within area

[Lantana camara](#)

Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]

Species or species habitat likely to occur within area

[Lycium ferocissimum](#)

African Boxthorn, Boxthorn [19235]

Species or species habitat may occur within area

[Nassella trichotoma](#)

Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]

Species or species habitat may occur within area

[Pinus radiata](#)

Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]

Species or species habitat may occur within area

[Rubus fruticosus aggregate](#)

Blackberry, European Blackberry [68406]

Species or species habitat likely to occur within area

[Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji](#)

Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]

Species or species habitat may occur within area

[Salvinia molesta](#)

Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]

Species or species habitat may occur within area

[Ulex europaeus](#)

Gorse, Furze [7693]

Species or species habitat may occur within area

Nationally Important Wetlands

[Resource Information]

[Tuggerah Lake, NSW](#)

[Colongra Swamp, NSW](#)

[Wyong Racecourse Swamp, NSW](#)

[Budgewoi Lake Sand Mass, NSW](#)

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)

- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- Other groups and individuals

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

Please feel free to provide feedback via the [Contact Us](#) page.

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Last updated: Thursday, 16-Sep-2010 09:13:25 EST

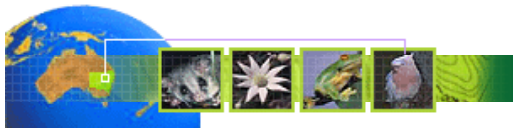
[Department of Sustainability, Environment, Water, Population and Communities](#)

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NSW National Parks & Wildlife Service atlas of nsw wildlife



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Search Results

Your selection: Fauna, threatened species, LGA - LAKE MACQUARIE returned a total of 1937 records of 73 species.

Report generated on 22/07/2011 - 10:54 (Data valid to 25/04/2010)

[view map](#)

[view map](#)

[search again](#)

[clear selection](#)

[search again](#)

[clear selection](#)

Choose up to 3 species to map.

** Exotic (non-native) species*

	Map	Scientific Name	Common Name	Legal Status	Count	Info
Amphibia						
Hylidae						
	☐	Litoria aurea	Green and Golden Bell Frog	E1	1	
	☐	Litoria brevipalmata	Green-thighed Frog	V	3	
	☐	Litoria littlejohni	Littlejohn's Tree Frog	V	14	
Myobatrachidae						
	☐	Crinia tinnula	Wallum Froglet	V	28	
	☐	Mixophyes balbus	Stuttering Frog	E1	72	
	☐	Mixophyes iteratus	Giant Barred Frog	E1	23	
	☐	Pseudophryne australis	Red-crowned Toadlet	V	23	
Aves						
Acanthizidae						
	☐	Pyrrholaemus saggitatus	Speckled Warbler	V	2	
Accipitridae						
	☐	Circus assimilis	Spotted Harrier	V	1	
	☐	Hieraaetus morphnoides	Little Eagle	V	3	
	☐	Lophoictinia isura	Square-tailed Kite	V	2	
	☐	Pandion haliaetus	Osprey	V	23	
Anatidae						
	☐	Oxyura australis	Blue-billed Duck	V	1	
Ardeidae						
	☐	Ixobrychus flavicollis	Black Bittern	V	10	
Burhinidae						
	☐	Burhinus grallarius	Bush Stone-curlew	E1	1	
Cacatuidae						
	☐	Callocephalon fimbriatum	Gang-gang Cockatoo	V	30	
	☐	Calyptorhynchus lathami	Glossy Black-Cockatoo	V	100	
Charadriidae						
	☐	Charadrius leschenaultii	Greater Sand-plover	V	2	
	☐	Charadrius mongolus	Lesser Sand-plover	V	8	
Ciconiidae						
	☐	Ephippiorhynchus asiaticus	Black-necked Stork	E1	20	
Climacteridae						
	☐	Climacteris picumnus	Brown Treecreeper	V	7	
Columbidae						
	☐	Ptilinopus regina	Rose-crowned Fruit-Dove	V	3	

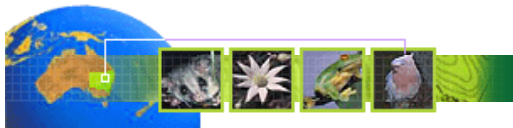
	☐ <i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	2	
Diomedidae					
	☐ <i>Diomedea exulans</i>	Wandering Albatross	E1	2	
	☐ <i>Thalassarche cauta</i>	Shy Albatross	V	1	
	☐ <i>Thalassarche melanophris</i>	Black-browed Albatross	V	1	
Estrildidae					
	☐ <i>Stagonopleura guttata</i>	Diamond Firetail	V	1	
Haematopodidae					
	☐ <i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	3	
	☐ <i>Haematopus longirostris</i>	Pied Oystercatcher	E1	15	
Jacanidae					
	☐ <i>Irediparra gallinacea</i>	Comb-crested Jacana	V	3	
Laridae					
	☐ <i>Sterna albifrons</i>	Little Tern	E1	8	
	☐ <i>Sterna fuscata</i>	Sooty Tern	V	1	
Meliphagidae					
	☐ <i>Epthianura albifrons</i>	White-fronted Chat	V	12	
	☐ <i>Xanthomyza phrygia</i>	Regent Honeyeater	E1	33	
Neosittidae					
	☐ <i>Daphoenositta chrysoptera</i>	Varied Sittella	V	32	
Petroicidae					
	☐ <i>Melanodryas cucullata</i>	Hooded Robin	V	1	
	☐ <i>Petroica boodang</i>	Scarlet Robin	V	8	
Pomatostomidae					
	☐ <i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	1	
Procellariidae					
	☐ <i>Puffinus carneipes</i>	Flesh-footed Shearwater	V	2	
Psittacidae					
	☐ <i>Glossopsitta pusilla</i>	Little Lorikeet	V	61	
	☐ <i>Lathamus discolor</i>	Swift Parrot	E1	44	
	☐ <i>Neophema pulchella</i>	Turquoise Parrot	V	6	
Rostratulidae					
	☐ <i>Rostratula benghalensis australis</i>	Painted Snipe (Australian subspecies)	E1	2	
Scolopacidae					
	☐ <i>Calidris tenuirostris</i>	Great Knot	V	3	
	☐ <i>Xenus cinereus</i>	Terek Sandpiper	V	1	
Strigidae					
	☐ <i>Ninox connivens</i>	Barking Owl	V	5	
	☐ <i>Ninox strenua</i>	Powerful Owl	V	102	
Tytonidae					
	☐ <i>Tyto novaehollandiae</i>	Masked Owl	V	56	
	☐ <i>Tyto tenebricosa</i>	Sooty Owl	V	21	
Mammalia	Map Scientific Name	Common Name	Legal Status	Count	Info
Balaenidae					
	☐ <i>Eubalaena australis</i>	Southern Right Whale	V	1	
Dasyuridae					
	☐ <i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	15	
	☐ <i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	2	
Dugongidae					

☐	Dugong dugon	Dugong	E1	3	
Emballonuridae					
☐	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	4	
Macropodidae					
☐	Macropus parma	Parma Wallaby	V	2	
☐	Petrogale penicillata	Brush-tailed Rock-wallaby	E1	5	
Molossidae					
☐	Mormopterus norfolkensis	Eastern Freetail-bat	V	59	
Petauridae					
☐	Petaurus australis	Yellow-bellied Glider	V	230	
☐	Petaurus norfolcensis	Squirrel Glider	V	201	
Phascolarctidae					
☐	Phascolarctos cinereus	Koala	V	33	
Potoroidae					
☐	Potorous tridactylus	Long-nosed Potoroo	V	2	
Pteropodidae					
☐	Pteropus poliocephalus	Grey-headed Flying-fox	V	141	
Vespertilionidae					
☐	Chalinolobus dwyeri	Large-eared Pied Bat	V	12	
☐	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	8	
☐	Kerivoula papuensis	Golden-tipped Bat	V	10	
☐	Miniopterus australis	Little Bentwing-bat	V	118	
☐	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	106	
☐	Myotis macropus	Southern Myotis	V	30	
☐	Scoteanax rueppellii	Greater Broad-nosed Bat	V	46	
☐	Vespadelus troungtoni	Eastern Cave Bat	V	9	
Reptilia					
	Map Scientific Name	Common Name	Legal Status	Count	Info
Cheloniidae					
☐	Caretta caretta	Loggerhead Turtle	E1	2	
☐	Chelonia mydas	Green Turtle	V	89	
Elapidae					
☐	Hoplocephalus stephensii	Stephens' Banded Snake	V	5	

* Exotic (non-native) species

Choose up to 3 species to map.

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Search Results

Your selection: Fauna, threatened species, LGA - WYONG returned a total of 2335 records of 86 species.

Report generated on 22/07/2011 - 10:52 (Data valid to 25/04/2010)

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Choose up to 3 species to map.

** Exotic (non-native) species*

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Amphibia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Hylidae						
	☐	Litoria aurea	Green and Golden Bell Frog	E1	14	
	☐	Litoria brevipalmata	Green-thighed Frog	V	22	
	☐	Litoria littlejohni	Littlejohn's Tree Frog	V	15	
Myobatrachidae						
	☐	Crinia tinnula	Wallum Froglet	V	92	
	☐	Heleioporus australiacus	Giant Burrowing Frog	V	47	
	☐	Mixophyes balbus	Stuttering Frog	E1	107	
	☐	Mixophyes iteratus	Giant Barred Frog	E1	10	
	☐	Pseudophryne australis	Red-crowned Toadlet	V	59	
Aves						
Acanthizidae						
	☐	Pyrholaemus saggitatus	Speckled Warbler	V	1	
Accipitridae						
	☐	Hieraaetus morphnoides	Little Eagle	V	8	
	☐	Lophoictinia isura	Square-tailed Kite	V	1	
	☐	Pandion haliaetus	Osprey	V	16	
Ardeidae						
	☐	Botaurus poiciloptilus	Australasian Bittern	V	7	
	☐	Ixobrychus flavicollis	Black Bittern	V	22	
Burhinidae						
	☐	Burhinus grallarius	Bush Stone-curlew	E1	3	
Cacatuidae						
	☐	Callocephalon fimbriatum	Gang-gang Cockatoo	V	53	
	☐	Calyptorhynchus lathami	Glossy Black-Cockatoo	V	120	
Charadriidae						
	☐	Charadrius leschenaultii	Greater Sand-plover	V	1	
	☐	Charadrius mongolus	Lesser Sand-plover	V	7	
Ciconiidae						
	☐	Ephippiorhynchus asiaticus	Black-necked Stork	E1	39	
Climacteridae						
	☐	Climacteris picumnus	Brown Treecreeper	V	1	
Columbidae						
	☐	Ptilinopus magnificus	Wompoo Fruit-Dove	V	1	
	☐	Ptilinopus regina	Rose-crowned Fruit-Dove	V	1	
		Ptilinopus superbus	Superb Fruit-Dove	V	5	

☐					
Diomededidae					
☐	Diomedea exulans	Wandering Albatross	E1	2	
☐	Thalassarche melanophris	Black-browed Albatross	V	6	
Estrildidae					
☐	Stagonopleura guttata	Diamond Firetail	V	1	
Haematopodidae					
☐	Haematopus fuliginosus	Sooty Oystercatcher	V	42	
☐	Haematopus longirostris	Pied Oystercatcher	E1	40	
Jacanidae					
☐	Irediparra gallinacea	Comb-crested Jacana	V	5	
Laridae					
☐	Gygis alba	White Tern	V	1	
☐	Sterna albifrons	Little Tern	E1	108	
Meliphagidae					
☐	Epthianura albifrons	White-fronted Chat	V	1	
☐	Grantiella picta	Painted Honeyeater	V	24	
☐	Xanthomyza phrygia	Regent Honeyeater	E1	18	
Neosittidae					
☐	Daphoenositta chrysoptera	Varied Sittella	V	34	
Petroicidae					
☐	Petroica boodang	Scarlet Robin	V	2	
☐	Petroica phoenicea	Flame Robin	V	1	
Pomatostomidae					
☐	Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	1	
Procellariidae					
☐	Macronectes giganteus	Southern Giant Petrel	E1	4	
☐	Pterodroma leucoptera leucoptera	Gould's Petrel	V	2	
☐	Pterodroma neglecta neglecta	Kermadec Petrel (west Pacific subspecies)	V	2	
☐	Pterodroma solandri	Providence Petrel	V	2	
☐	Puffinus assimilis	Little Shearwater	V	1	
☐	Puffinus carneipes	Flesh-footed Shearwater	V	4	
Psittacidae					
☐	Glossopsitta pusilla	Little Lorikeet	V	37	
☐	Lathamus discolor	Swift Parrot	E1	117	
Scolopacidae					
☐	Calidris alba	Sanderling	V	3	
☐	Calidris tenuirostris	Great Knot	V	12	
☐	Limicola falcinellus	Broad-billed Sandpiper	V	4	
☐	Limosa limosa	Black-tailed Godwit	V	2	
☐	Xenus cinereus	Terek Sandpiper	V	6	
Strigidae					
☐	Ninox connivens	Barking Owl	V	4	
☐	Ninox strenua	Powerful Owl	V	90	
Tytonidae					
☐	Tyto novaehollandiae	Masked Owl	V	28	
☐	Tyto tenebricosa	Sooty Owl	V	45	
Insecta	Map Scientific Name	Common Name	Legal Status	Count	Info

Petaluridae					
☐	Petalura gigantea	Giant Dragonfly	E1	2	
Mammalia					
	Map Scientific Name	Common Name	Legal Status	Count	Info
Balaenidae					
☐	Eubalaena australis	Southern Right Whale	V	7	
Balaenopteridae					
☐	Megaptera novaeangliae	Humpback Whale	V	1	
Burramyidae					
☐	Cercartetus nanus	Eastern Pygmy-possum	V	17	
Dasyuridae					
☐	Dasyurus maculatus	Spotted-tailed Quoll	V	41	
Emballonuridae					
☐	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	4	
Macropodidae					
☐	Macropus parma	Parma Wallaby	V	10	
☐	Petrogale penicillata	Brush-tailed Rock-wallaby	E1	4	
Molossidae					
☐	Mormopterus norfolkensis	Eastern Freetail-bat	V	37	
Otariidae					
☐	Arctocephalus forsteri	New Zealand Fur-seal	V	4	
☐	Arctocephalus pusillus doriferus	Australian Fur-seal	V	2	
Peramelidae					
☐	Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1	1	
Petauridae					
☐	Petaurus australis	Yellow-bellied Glider	V	281	
☐	Petaurus norfolcensis	Squirrel Glider	V	143	
Phascolarctidae					
☐	Phascolarctos cinereus	Koala	V	47	
Physeteridae					
☐	Physeter macrocephalus	Sperm Whale	V	2	
Potoroidae					
☐	Potorous tridactylus	Long-nosed Potoroo	V	2	
Pteropodidae					
☐	Pteropus poliocephalus	Grey-headed Flying-fox	V	57	
Vespertilionidae					
☐	Chalinolobus dwyeri	Large-eared Pied Bat	V	3	
☐	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	42	
☐	Kerivoula papuensis	Golden-tipped Bat	V	47	
☐	Miniopterus australis	Little Bentwing-bat	V	39	
☐	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	113	
☐	Myotis macropus	Southern Myotis	V	44	
☐	Scoteanax rueppellii	Greater Broad-nosed Bat	V	65	
Reptilia					
	Map Scientific Name	Common Name	Legal Status	Count	Info
Cheloniidae					
☐	Chelonia mydas	Green Turtle	V	7	
Elapidae					

Varanidae	☐	Hoplocephalus bitorquatus	Pale-headed Snake	V	2	
	☐	Hoplocephalus bungaroides	Broad-headed Snake	E1	1	
	☐	Hoplocephalus stephensii	Stephens' Banded Snake	V	7	
	☐	Varanus rosenbergi	Rosenberg's Goanna	V	2	

** Exotic (non-native) species*

Choose up to 3 species to map.

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Species

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Wyong CMA sub-region

Below is a list of the 129 threatened species found in the Wyong sub-region. You can also see a list of:

- [threatened algae](#)
- [threatened animals](#)
- [threatened communities](#)
- [threatened fungi](#)
- [threatened plants](#)
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Threatened species known or predicted to occur in the Wyong CMA sub-region

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Scientific Name	Common Name	Type of species	Level of Threat	Known or Predicted to occur
Acacia bynoeana	Bynoe's Wattle	Plant > Shrubs	Endangered	Known
Angophora inopina	Charmhaven Apple	Plant > Trees	Vulnerable	Known
Anseranas semipalmata	Maggie Goose	Animal > Birds	Vulnerable	Known
Anthochaera phrygia	Regent Honeyeater	Animal > Birds	Critically Endangered	Known
Astrotricha crassifolia	Thick-leaf Star-hair	Plant > Shrubs	Vulnerable	Predicted
Botaurus poiciloptilus	Australasian Bittern	Animal > Birds	Endangered	Known
Burhinus grallarius	Bush Stone-curlew	Animal > Birds	Endangered	Known
Caladenia porphyrea	Caladenia porphyrea	Plant > Orchids	Endangered	Known
Caladenia tessellata	Tessellated Spider Orchid	Plant > Orchids	Endangered	Known
Calidris alba	Sanderling	Animal > Birds	Vulnerable	Known
Calidris tenuirostris	Great Knot	Animal > Birds	Vulnerable	Known
Callistemon linearifolius	Netted Bottle Brush	Plant > Shrubs	Vulnerable	Known
Callocephalon fimbriatum	Gang-gang Cockatoo	Animal > Birds	Vulnerable	Known
Calyptorhynchus lathamii	Glossy Black-cockatoo	Animal > Birds	Vulnerable	Known
Caretta caretta	Loggerhead Turtle	Animal > Reptiles	Endangered	Known
Cercartetus nanus	Eastern Pygmy-possum	Animal > Marsupials	Vulnerable	Known
Chalinolobus dwyeri	Large-eared Pied Bat	Animal > Bats	Vulnerable	Known
Chamaesyce psammodeton	Sand Spurge	Plant > Herbs and Forbs	Endangered	Known
Charadrius leschenaultii	Greater Sand-plover	Animal > Birds	Vulnerable	Known
Charadrius mongolus	Lesser Sand-plover	Animal > Birds	Vulnerable	Known
Circus assimilis	Spotted Harrier	Animal > Birds	Vulnerable	Known
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Animal > Birds	Vulnerable	Known
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
Corybas downlingii	Red Helmet Orchid	Plant > Orchids	Endangered	Known
Crinia tinnula	Wallum Froglet	Animal > Amphibians	Vulnerable	Known
Cryptostylis hunteriana	Leafless Tongue Orchid	Plant > Orchids	Vulnerable	Known
Cynanchum elegans	White-flowered Wax Plant	Plant > Epiphytes and climbers	Endangered	Known
Darwinia glaucophylla	Darwinia glaucophylla	Plant > Shrubs	Vulnerable	Known
Dasypus maculatus	Spotted-tailed Quoll	Animal > Marsupials	Vulnerable	Known
Dermochelys coriacea	Leathery Turtle	Animal > Reptiles	Vulnerable	Known
Diuris bracteata	Diuris bracteata	Plant > Orchids	Endangered	Known
Diuris praecox		Plant > Orchids	Vulnerable	Known

	Rough Double Tail				
Epacris purpurascens var. purpurascens	Epacris purpurascens var. purpurascens	Plant > Shrubs	Vulnerable	Known	
Ephippiorhynchus asiaticus	Black-necked Stork	Animal > Birds	Endangered	Known	
Eucalyptus camfieldii	Camfield's Stringybark	Plant > Mallees	Vulnerable	Known	
Eucalyptus oblonga - endangered population	Eucalyptus oblonga (Narrow-leaved Stringybark) population at Bateau Bay, Forresters Beach and Tumby Umbi	Plant > Endangered Populations	Endangered Population	Known	
Eucalyptus parramattensis subsp. decadens	Eucalyptus parramattensis subsp. decadens	Plant > Trees	Vulnerable	Known	
Eucalyptus parramattensis subsp. parramattensis - endangered population	Eucalyptus parramattensis C. Hall, subsp. parramattensis in the Wyong and Lake Macquarie local government areas	Plant > Endangered Populations	Endangered Population	Known	
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Animal > Bats	Vulnerable	Known	
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known	
Genoplesium insignis	Variable Midge Orchid	Plant > Orchids	Endangered	Known	
Glossopsitta pusilla	Little Lorikeet	Animal > Birds	Vulnerable	Predicted	
Grantiella picta	Painted Honeyeater	Animal > Birds	Vulnerable	Known	
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Plant > Shrubs	Vulnerable	Known	
Haematopus fuliginosus	Sooty Oystercatcher	Animal > Birds	Vulnerable	Known	
Haematopus longirostris	Pied Oystercatcher	Animal > Birds	Endangered	Known	
Heleioporus australiacus	Giant Burrowing Frog	Animal > Amphibians	Vulnerable	Known	
Hibbertia procumbens	Spreading Guinea Flower	Plant > Shrubs	Endangered	Known	
Hieraetus morphnoides	Little Eagle	Animal > Birds	Vulnerable	Known	
Hoplocephalus bitorquatus	Pale-headed Snake	Animal > Reptiles	Vulnerable	Known	
Hoplocephalus bungaroides	Broad-headed Snake	Animal > Reptiles	Endangered	Known	
Hoplocephalus stephensii	Stephens' Banded Snake	Animal > Reptiles	Vulnerable	Known	
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known	
Irediparra gallinacea	Comb-crested Jacana	Animal > Birds	Vulnerable	Known	
Ixobrychus flavicollis	Black Bittern	Animal > Birds	Vulnerable	Known	
Kerivoula papuensis	Golden-tipped Bat	Animal > Bats	Vulnerable	Known	
Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion	Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Critically Endangered Ecological Community	Known	
Lathamus discolor	Swift Parrot	Animal > Birds	Endangered	Known	
Limicola falcinellus	Broad-billed Sandpiper	Animal > Birds	Vulnerable	Known	
Limosa limosa	Black-tailed Godwit	Animal > Birds	Vulnerable	Known	
Litoria aurea	Green and Golden Bell Frog	Animal > Amphibians	Endangered	Known	
Litoria brevipalmata	Green-thighed Frog	Animal > Amphibians	Vulnerable	Known	
Litoria littlejohni	Littlejohn's Tree Frog	Animal > Amphibians	Vulnerable	Known	
Littoral Rainforest in the New South Wales North Coast, Sydney	Littoral Rainforest in the New South Wales North Coast, Sydney	Community > Threatened Ecological	Endangered Ecological Community	Predicted	

Basin and South East Corner Bioregions	Basin and South East Corner Bioregions	Communities			
Lophoictinia isura	Square-tailed Kite	Animal > Birds	Vulnerable	Predicted	
Low woodland with heathland on indurated sand at Norah Head	Low woodland with heathland on indurated sand at Norah Head	Community > Threatened Ecological Communities	Endangered Ecological Community	Known	
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known	
Macropus parma	Parma Wallaby	Animal > Marsupials	Vulnerable	Known	
Maundia triglochinos	Maundia triglochinos	Plant > Herbs and Forbs	Vulnerable	Known	
Melaleuca biconvexa	Biconvex Paperbark	Plant > Trees	Vulnerable	Known	
Melaleuca groveana	Grove's Paperbark	Plant > Shrubs	Vulnerable	Predicted	
Melithreptus uularis uularis	Black-chinned Honeyeater (eastern subspecies)	Animal > Birds	Vulnerable	Known	
Miniopterus australis	Little Bentwing-bat	Animal > Bats	Vulnerable	Known	
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Animal > Bats	Vulnerable	Known	
Mixophyes balbus	Stuttering Frog	Animal > Amphibians	Endangered	Known	
Mixophyes iteratus	Giant Barred Frog	Animal > Amphibians	Endangered	Known	
Mormonotus norfolkensis	Eastern Freetail-bat	Animal > Bats	Vulnerable	Known	
Myotis macropus	Southern Myotis	Animal > Bats	Vulnerable	Known	
Neophema pulchella	Turquoise Parrot	Animal > Birds	Vulnerable	Known	
Nettapus coromandelianus	Cotton Pygmy-goose	Animal > Birds	Endangered	Known	
Ninox connivens	Barking Owl	Animal > Birds	Vulnerable	Known	
Ninox strenua	Powerful Owl	Animal > Birds	Vulnerable	Known	
Oxyura australis	Blue-billed Duck	Animal > Birds	Vulnerable	Known	
Pandion haliaetus	Osprey	Animal > Birds	Vulnerable	Known	
Petaurus australis	Yellow-bellied Glider	Animal > Marsupials	Vulnerable	Known	
Petaurus norfolkensis	Squirrel Glider	Animal > Marsupials	Vulnerable	Known	
Petrogale penicillata	Brush-tailed Rock-wallaby	Animal > Marsupials	Endangered	Known	
Petroica boodang	Scarlet Robin	Animal > Birds	Vulnerable	Known	
Petroica phoenicea	Flame Robin	Animal > Birds	Vulnerable	Known	
Phascogale tapoatafa	Brush-tailed Phascogale	Animal > Marsupials	Vulnerable	Known	
Phascogale cinerea	Koala	Animal > Marsupials	Vulnerable	Known	
Planigale maculata	Common Planigale	Animal > Marsupials	Vulnerable	Known	
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Animal > Birds	Vulnerable	Known	
Potorous tridactylus	Long-nosed Potoroo	Animal > Marsupials	Vulnerable	Known	
Prostanthera askania	Tranquillity Mintbush	Plant > Shrubs	Endangered	Known	
Prostanthera junonis	Somersby Mintbush	Plant > Shrubs	Endangered	Known	
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Animal > Rodents	Vulnerable	Known	
Pseudophryne australis	Red-crowned Toadlet	Animal > Amphibians	Vulnerable	Known	
Pteropus poliocephalus	Grey-headed Flying-fox	Animal > Bats	Vulnerable	Known	
Ptilinopus magnificus	Wompoo Fruit-dove	Animal > Birds	Vulnerable	Known	
Ptilinopus regina	Rose-crowned Fruit-dove	Animal > Birds	Vulnerable	Known	
Ptilinopus superbus	Superb Fruit-dove	Animal > Birds	Vulnerable	Known	
Pyrrholaemus sagittatus	Speckled Warbler	Animal > Birds	Vulnerable	Known	
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known	
River-Flat Eucalypt Forest on Coastal Floodplains of the New	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North	Community >	Endangered Ecological		

South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coast, Sydney Basin and South East Corner Bioregions	Threatened Ecological Communities	Community	Known
Rostratula benghalensis australis	Painted Snipe (Australian subspecies)	Animal > Birds	Endangered	Predicted
Rutidosis heterogama	Heath Wrinklewort	Plant > Herbs and Forbs	Vulnerable	Known
Saccolaimus flaviventris	Yellow-bellied Sheath-tail-bat	Animal > Bats	Vulnerable	Known
Scoteanax rueppellii	Greater Broad-nosed Bat	Animal > Bats	Vulnerable	Known
Senecio spathulatus	Coast Groundsel	Plant > Herbs and Forbs	Endangered	Known
Stagonopleura guttata	Diamond Firetail	Animal > Birds	Vulnerable	Known
Sterna albifrons	Little Tern	Animal > Birds	Endangered	Known
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Syzygium paniculatum	Magenta Lilly Pilly	Plant > Trees	Endangered	Known
Tetratheca glandulosa	Tetratheca glandulosa	Plant > Shrubs	Vulnerable	Known
Tetratheca juncea	Black-eyed Susan	Plant > Shrubs	Vulnerable	Known
Thelymitra sp. Adorata	Wyong Sun Orchid	Plant > Orchids	Critically Endangered	Known
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Thylogale stigmatica	Red-legged Pademelon	Animal > Marsupials	Vulnerable	Predicted
Turnix maculosa	Red-backed Button-quail	Animal > Birds	Vulnerable	Known
Tyto novaehollandiae	Masked Owl	Animal > Birds	Vulnerable	Known
Tyto tenebricosa	Sooty Owl	Animal > Birds	Vulnerable	Known
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Varanus rosenbergi	Rosenberg's Goanna	Animal > Reptiles	Vulnerable	Known
Vespadelus trougtoni	Eastern Cave Bat	Animal > Bats	Vulnerable	Known
Xenus cinereus	Terek Sandpiper	Animal > Birds	Vulnerable	Known
Zannichellia palustris	Zannichellia palustris	Plant > Aquatic plants	Endangered	Known

Appendix B

Threatened Species Assessment (State)

Appendix B. 'Assessment of Significance' for threatened species, populations and communities protected under the TSC and FM Act.

Dugong (*Dugong dugon*)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Dugongs prefer warmer waters, ranging from tropical to warm temperate seas, typically occurring around northern Australia; however, they are occasionally sighted well beyond the southern limit of their accepted range into NSW (Allen *et al.* 2004). The dugongs recorded in NSW are generally considered to be non-breeding vagrants that are influenced by warm currents and the availability of seagrass further south. They surface only to breathe and never come on to land. They like to live in large herds, but due to declining numbers are often now found in smaller 'family' groups of between one to three animals.

The largest remaining dugong population in the world is the northern Australian population, which in 1991 was estimated at approximately 70,000 (QLD Department of Environment and Resource Management 2010). Although dugongs only occur in shallow areas where they feed exclusively on seagrass, they also migrate between areas. They undergo large scale movements, regularly moving in and out of their preferred habitat and ranging into northern NSW. Dugongs have been recorded from a number of NSW estuaries where suitable seagrass habitat occurs, including Swansea Channel near Lake Macquarie, Wallis Lake, Port Stephens and Brisbane Water (Allen *et al.* 2004), however, occurrences are rare.

Dugongs are slow moving and spend their lives within estuarine waters which make them vulnerable to anthropogenic disturbances. They may be threatened by coastal development and poor catchment management leading to siltation and the loss of seagrass beds.

Dugong populations are vulnerable to local extinction as a result of losing seagrass beds after stochastic events such as floods or cyclones. Dugongs are also threatened by incidental mortality in commercial gillnets, entanglement in shark nets and collisions with boats (Marsh *et al.* 1999, Smith 2001). In Moreton Bay, there is an average of 15 recorded human induced deaths to dugongs each year, most due to boat strike (Chilvers *et al.* 2005).

The main issue potentially affecting dugongs as a result of the proposed extension of mining would be subsidence. Subsidence may result in an increase in depth in parts of the Lake, which, in turn, could result in the loss of seagrass if it is at the limit of its depth range.

Dugongs potentially dependent on that seagrass habitat could therefore be affected.

Although there is substantial seagrass habitat in the study site, dugongs have not been recorded within the protected waters of Lake Macquarie. The only sighting in this area was a cow/calf pair travelling seaward out of the Swansea Channel in 2003.

On this basis, it is unlikely that a viable local population of dugongs would occur in the area. Furthermore, the predicted level of subsidence (< 20 mm) is not expected to have a measurable effect on seagrass distribution within the Lake. It is not expected their life cycles would be adversely affected or be placed at risk of extinction by the proposal.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not Applicable

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
Not applicable

d) In relation to the habitat of a threatened species, population or ecological community:

- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and**
ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and
iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Given the minimal level of subsidence expected (< 20 mm) it is unlikely that seagrass habitat could become fragmented and isolated and the extent of the overall impact is likely to be very minor in terms of scale. Such minor impacts to seagrass are not considered to affect the long term survival of dugong populations and would not affect the occasional vagrants that have been reported to occur in Lake Macquarie on rare occasions.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No dugong critical habitat occurs within or near to the study areas and would therefore not be affected by the proposal.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan for this species; however in NSW, OEH has prepared Priority Action Statements to promote the recovery of threatened species within NSW. They include the following priority actions for dugongs:

- This species is included in the threat abatement actions pertaining to the "Death or injury to marine species following capture in shark control programs on ocean beaches" KTP (Low priority); and
- The impacts of estuarine and coastal marine development on potential dugong habitat e.g. *Halophila* spp. seagrass meadows in northern NSW should be considered by consent and determining authorities (Medium priority).

There is also an approved Status Report and Action Plan (UNEP) for Australia and other countries. The proposal would not, however, affect any of the proposed action plans.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The action proposed does not constitute a key threatening process and would not result in the operation of or increase the impact of a key threatening process.

Conclusion: Given that dugongs may occur only on occasion, if at all, within Lake Macquarie and that the potential impacts on seagrass habitat would be minimal, the proposal is not considered to affect a threatened population of dugongs. No species impact statement is recommended.

Marine Turtles

There are two listed marine turtles: green turtle (*Chelonia mydas*; status – vulnerable) and loggerhead turtle (*Caretta caretta*; status - threatened) that have been recorded in Lake Macquarie. For the purpose of this study, they are grouped as they have similar distribution and share many similar ecological requirements.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Both species of marine turtles, the green and loggerhead turtle prefer warmer waters, ranging from warm to tropical temperate seas. For a large part of their life cycle, marine turtles are pelagic, particularly loggerheads, while green turtles tend to stay in coastal waters and may even take up residence in some areas. Adult green turtles feed mostly on seaweeds and seagrasses, although immature greens are carnivorous.

Both of these species are vulnerable to hunting through much of their range. They are most vulnerable when they come ashore to nest; where adults, eggs and hatchlings are subject to direct harvesting, predation by natural fauna, domestic pets, feral animals and various forms of human disturbance. By-catch of marine turtles in fisheries, marine debris, coastal development, loss of habitat and deterioration of water quality are also a significant threats to the species. Lake Macquarie is outside the nesting range of both of these species and existing disturbances to the local beaches (e.g. humans, pets and feral animals) would make it almost impossible for nesting in these areas. Moreover, although these turtles (in particular the green turtle) are not uncommon in the area, it is unlikely that there is a viable local population within the study area.

The main issue potentially affecting marine turtles as a result of the proposed extension of mining would be subsidence. Subsidence may result in an increase in depth in parts of the Lake, which, in turn, could result in the loss of seagrass if it is at the limit of its depth range. Green turtles potentially dependent on seagrass habitat could therefore be affected if the level of subsidence was significant and seagrass distribution and density was likely to be affected. The predicted level of subsidence (< 20 mm) is not, however, expected to have a measurable effect on seagrass distribution within the Lake.

On this basis, it is unlikely that a viable local population of any marine turtles would be placed at risk of extinction by the proposal.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered populations of marine turtles are identified in the legislation.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and**
- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The extensive seagrass beds within the study area theoretically provide habitat for marine turtles. Given the minimal level of subsidence predicted (< 20 mm), the extent of the potential impact on seagrass habitat is not likely to be measurable and is not likely to result in areas of seagrass becoming fragmented and/or isolated.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No listed critical habitat for marine turtles occurs within or in the vicinity of the study area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is an approved 'Recovery Plan for Marine Turtles in Australia' (Environment Australia 2003). The proposal would not, however, affect any of the recovery actions proposed under the plan.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The action proposed does not constitute a key threatening process and would not result in the operation of or increase the impact of a key threatening process.

Conclusion: Marine turtles, particularly green turtles, are not uncommon within Lake Macquarie and are likely to utilise seagrass habitat within the existing mining consent and project application area. This area of habitat is not, however, critical to the species survival and any potential impacts on seagrass habitat would be minimal. The proposal is not therefore, considered to affect a threatened population of marine turtle such that a Species Impact Statement is recommended. Management and monitoring as described in Section 6 should be carried out to ensure minimal impact to seagrass habitat.

Estuarine Birds

There are 17 species of estuarine birds listed as either vulnerable or threatened under State legislation that have been recorded within the study area. Species are grouped together as they have similar distribution and many similar ecological requirements and include:

- Australasian bittern (*Botaurus poiciloptilus*)
- Bush stone curlew (*Burhinus grallarius*)
- Sanderling (*Calidris alba*)
- Great knot (*Calidris tenuirostris*)
- Greater sand plover (*Charadrius leschenaultia*)
- Lesser sand plover (*Charadrius mongolus*)
- Black-necked stork (*Ephippiorhynchus asiaticus*)
- White tern (*Gygis alba*)
- Little tern (*Sterna albifrons*)
- Sooty tern (*Sterna fuscata*)
- Sooty oystercatcher (*Haematopus fuliginosus*)
- Pied oystercatcher (*Haematopus longirostris*)
- Black bittern (*Ixobrychus flavicollis*)
- Broad-billed sandpiper (*Limicola falcinellus*)
- Black-tailed godwit (*Limosa limosa*)
- Painted snipe (*Rostratula australis*)
- Terek sandpiper (*Xenus cinereus*)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Shore birds or 'waders' are those birds commonly found on coastal shores, including beaches, rocky shores, mudflats, tidal wetlands and lagoons. These include plovers and sandpipers, stone-curlews, snipes and oystercatchers among others (Birds Australia 2009). Wading birds feed on marine invertebrates (including molluscs, worms and crustaceans), small fish that live within intertidal sand and mudflats. Small reptiles, earthworms, seeds and vegetation may also form part of their diet. Waders feed in the shallows or over exposed mud by probing their long slender bills into the substratum. Bill length, legs, body-structure, size and foraging techniques may subtly or markedly differ between groups of waders (Pizzey and Knight 1997). Important nesting areas may include sandbanks, sandpits, and islands in estuaries, mangroves and riparian vegetation adjacent to the waterway. Nesting often takes place close to the ground which can make these birds vulnerable to disturbance. Subsidence as a result of mining activity has potential to alter the profile of foreshores and wetlands and intertidal habitat utilised by estuarine birds. The predicted extent of subsidence (< 20mm) is not, however, considered to have an adverse effect on the habitat or resources of these species such that a viable local population could be put at risk of extinction. Furthermore, it is unlikely that the proposal would cause any observable alteration to the behaviour or habitat values of estuarine birds within the study area.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered populations of estuarine birds are identified in the legislation.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**
- ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and**
- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**
- iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

Intertidal foreshores and wetlands within the existing mining consent and project application area provide suitable habitat for a number of estuarine birds. The extent to which this habitat could be altered as a result of subsidence predicted from the proposed extension of mining would be negligible. It would be highly unlikely that habitat could become fragmented or isolated as a result of the proposal. Furthermore, there is no habitat of importance to the long-term survival of a species within the existing mining consent and project application area.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No listed critical habitat for estuarine birds is known to occur within the study area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no approved recovery plan for species of estuarine bird relevant to the proposal.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The action proposed does not constitute a key threatening process and would not result in the operation of or increase the impact of a key threatening process.

Conclusion: A number of threatened species of estuarine birds have been recorded within Lake Macquarie and are likely to utilise intertidal and foreshore habitat within the study area. The proposal is not, however, considered to affect a threatened species of estuarine bird such that a Species Impact Statement is recommended.

Appendix C

Threatened Species Assessment (Commonwealth)

Appendix C. 'Assessment of Significance' for threatened species, populations and communities protected under the EPBC Act.

Dugong (*Dugong dugon*)

Status: migratory

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species;*
No area of habitat that supports an ecologically significant proportion of a dugong population would be affected by the proposal. Dugongs would rarely enter into the study area and the few that have been recorded within this region, are likely to be vagrants from southern Queensland populations. The area of habitat potentially affected by this proposal is not critical habitat of the dugong and does not occur in an area where the species is declining.
- *Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species; or*
The proposal is not considered to result in an invasive species becoming established in an area of habitat important for the dugong.
- *Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.*
- Impacts of mining related subsidence could potentially impact upon seagrass habitat (within parts of the study area) which is a source of food for the dugong. However, given the negligible level of predicted subsidence (< 20 mm) and that dugong rarely occur within the study area, the lifecycle of an ecologically significant proportion of the population would not be affected.

Conclusion:

The proposal would not result in a significant impact on this species, or its key habitat requirements.

Green Turtle (*Chelonia mydas*)

Status: vulnerable

Seven of the nine criteria provided under the EPBC Act 'Significant Impact Guidelines' for an endangered species are very similar to criteria used to assess this species under the Assessment of Significance under State legislation (**Appendix B**). Hence, it is not considered that the proposal would:

- *Lead to a long-term decrease in the size of a population of a species;*
- *Reduce the area of occupancy of an important population;*
- *Fragment an existing population into two or more populations;*
- *Adversely affect habitat critical to the survival of a species;*
- *Disrupt the breeding cycle of a population;*
- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline; or*

In addition, it is not expected that the proposal would:

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;*
- *Introduce disease that may cause the species to decline; or*
- *Interfere substantially with the recovery of the species.*

Conclusion:

The proposal would not result in a significant impact on this species, or its necessary habitat requirements.

Loggerhead Turtle (*Caretta caretta*)

Status: endangered

Seven of the nine criteria provided under the EPBC Act 'Significant Impact Guidelines' for an endangered species are very similar to criteria used to assess these species under the assessment of significance under State legislation (**Appendix B**). Hence, it is not considered that the proposal would:

- *Lead to a long-term decrease in the size of a population;*
- *Reduce the area of occupancy of the species;*
- *Fragment an existing population into two or more populations;*
- *Adversely affect habitat critical to the survival of a species;*
- *Disrupt the breeding cycle of a population;*
- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline; or*

In addition, it is not expected that the proposal would:

- *Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat; or*
- *Introduce disease that may cause the species to decline;*
- *Interfere with the recovery of a species.*

Conclusion:

The proposal would not result in a significant impact on this species, or its defined habitat requirements.

Estuarine Birds

Status: migratory

There are 27 species of estuarine birds that are known to occur within the study area and are listed as 'migratory' under the EPBC Act (refer to **Table 1**). For the purpose of this study, they are grouped here as they have similar ecological requirements. Species include:

- Common sandpiper (*Actitis hypoleucos*)
- Ruddy turnstone (*Arenaria interpres*)
- Bush stone curlew (*Burhinus grallarius*)
- Sharp-tailed sandpiper (*Calidris acuminata*)
- Sanderling (*Calidris alba*)
- Red knot (*Calidris canutus*)
- Curlew sandpiper (*Calidris ferruginea*)
- Pectoral sandpiper (*Calidris melanotos*)
- Red-necked stint (*Calidris ruficollis*)
- Great knot (*Calidris tenuirostris*)
- Double-banded plover (*Charadrius bicinctus*)
- Greater sand plover (*Charadrius leschenaultia*)
- Lesser sand plover (*Charadrius mongolus*)
- Latham's snipe (*Gallinago hardwickii*)
- Grey-tailed tattler (*Heteroscelus brevipes*)
- Broad-billed sandpiper (*Limicola falcinellus*)
- Bar-tailed godwit (*Limosa lapponica*)
- Black-tailed godwit (*Limosa limosa*)
- Eastern curlew (*Numenius madagascariensis*)
- Little curlew (*Numenius minutus*)
- Whimbrel (*Numenius phaeopus*)
- Pacific golden plover (*Pluvialis fulva*)

- Grey plover (*Pluvialis squatarola*)
- Painted snipe (*Rostratula australis*)
- Little tern (*Sterna albifrons*)
- Marsh sandpiper (*Tringa stagnatilis*)
- Terek sandpiper (*Xenus cinereus*)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- *substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species;*

Subsidence as a result of the proposed extension of mining has potential to alter the profile of foreshores, wetlands and intertidal habitat which is utilised by estuarine birds. The predicted extent of subsidence is not, however, considered to have an adverse effect on the habitat or resources of these species such that a local population could be put at risk. Furthermore, it is unlikely that the proposal would cause any observable alteration to the behaviour or habitat values of estuarine birds within the study area.

In addition, it is not expected that the proposal would:

- *result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species; or*
- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.*

Conclusion:

The proposal is not considered to result in a significant impact on these species, or their obligatory habitat requirements.