BELL BAY PULP MILL PROJECT
MARINE AND MIGRATORY AVIFAUNA
EFFECTS STATEMENT

Gunns Ltd

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1. EXECUTIVE SUMMARY

Gunns Limited is proposing to develop a new pulp mill at Bell Bay on the shores of the Tamar Estuary near Georgetown in northern Tasmania. The proposal includes three main components: a water supply pipeline from Trevallyn Dam near Launceston to the pulp mill just south of Georgetown, the pulp mill and associated infrastructure, such as a storage reservoir and solid waste disposal area, and an effluent pipeline from the mill to an outfall near Five Mile Bluff on the coast of Bass Strait.

Freehills Lawyers, on behalf of Gunns Limited, commissioned Brett Lane & Associates Pty Ltd to investigate the potential impacts of the mill and associated infrastructure on marine and migratory avifauna listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, the Tasmanian Threatened Species Protection Act 1995 and other fauna of conservation significance listed by the Department of Primary Industries and Water (DPIWE 2004), and to recommend measures to mitigate the effects of the project on these species. This investigation supplements those documented in the Draft Integrated Impact Statement (Draft IIS).

The output of effluent in Bass Strait waters 3 km offshore from the coast near Five Mile Bluff may affect organisms that form part of the food web in which marine and migratory bird depend. The extent of this impact is not fully understood and has been subject to an exhaustive literature review by Toxikos Pty Ltd (2006). This review has focussed specifically on the risk of bioaccumulation of persistent dioxins in the effluent. Among other impacts, the current report assesses the risk to migratory and marine birds from this potential impact.

The Tamar Estuary is an area of high ecological value. Some shorebirds occur here in nationally significant numbers (Watkins 1993). Tenth Island and the north coast of Tasmania near Low Head have breeding populations of listed marine species (e.g. Little Penguin and Black-faced Cormorant).

This report identifies marine and migratory seabirds and shorebirds that inhabit the areas potentially affected by the proposal. Key species assessed include Little Penguin, Black-faced Cormorant, Australasian Gannet, albatrosses, giant-petrels, shearwaters, Fairy Prion, Common Diving-Petrel, White-bellied Sea-Eagle and a variety of gulls, terns and migratory and resident shorebirds.

Potential risks to these species arising from the project include bioaccumulation in the food web adjacent to the effluent outfall (assessed as minimal in the two species examined in detail by Toxikos Pty Ltd 2006: Little Penguin and White-bellied Sea-Eagle), increased noise and lights on the shores of the Tamar Estuary, disturbance during construction (Tamar Estuary and Bass Strait coast) and physical alteration of beach habitats on the Bass Strait coast.

Mitigation and monitoring measures suggested include:

- Collection of baseline information on dioxin levels in key locally breeding fish-eating species such as Little Penguin, Black-faced Cormorant and White-bellied Sea-Eagle, and for comparative purposes, Silver Gull, using non-destructive sampling methods;
- Carry out a survey in the early stages of the breeding season of the Hooded Plover (August to October) to determine whether this species is nesting within the construction zone at Five Mile Beach;
- Avoid, as far as possible, disturbance by outfall pipe construction works to Hooded Plover nest sites during the breeding season (late August to March);
- Replace beach sands (if significantly altered in form), after the outfall pipe is installed.

2. INTRODUCTION

Gunns Limited has proposed construction of a new pulp mill to be located at Bell Bay on the shores of the Tamar Estuary near Georgetown in northern Tasmania. The proposal includes three main infrastructure components:

- A water supply pipeline to supply the mill from the Trevallyn Dam on the South Esk River near Launceston;
- The pulp mill and associated infrastructure, including a storage reservoir and solid waste disposal site;
- An effluent pipeline and outfall to transport treated effluent from the mill to an outfall 3 km offshore from a point near Five Mile Bluff on the shores of Bass Strait.

The output of effluent in Bass Strait waters 3 km offshore from the coast near Five Mile Bluff may affect organisms that form part of the food web in which marine and migratory bird depend. The extent of this impact is not fully understood and has been subject to an exhaustive literature review by Toxikos Pty Ltd (2006). This review has focussed specifically on the risk of bioaccumulation of persistent dioxins in the effluent. Among other impacts, the current report assesses the risk to migratory and marine birds from this potential impact.

Notwithstanding its history of disturbance, the Tamar Estuary and adjacent parts of Bass Strait are recognised as an area of high ecological value. Some shorebirds using the study area have been recorded in nationally significant numbers (Watkins 1993). Also within the study area, Tenth Island and the north coast near Low Head have breeding populations of listed marine species such as Little Penguin and Black-faced Cormorant.

Gunns Limited has produced a Draft Integrated Impact Statement (Draft IIS) in which terrestrial fauna has been covered. On behalf of Gunns Limited, Freehills Lawyers has engaged Brett Lane & Associates Pty Ltd to produce a supplementary report on the potential impacts and mitigation measures for marine and migratory avifauna (birds) on the nearby Tamar Estuary and in southern Bass Strait that might be affected by the pulp mill, including effluent in the outfall area.

This report examines the marine and migratory avifauna present or potentially present on and near the pulp mill site and areas affected by the water supply and effluent pipelines, and by effluent at the outfall and nearby parts of Bass Strait. This assessment has excluded marine invertebrates of the intertidal zone and marine mammals, as these fell outside the scope of this investigation.

As part of this investigation, an assessment of the existing diversity, status and threats in relation to marine and migratory birds was made in the marine waters surrounding the effluent outfall and in nearby parts of the Tamar

Estuary. In addition, potential impacts and mitigation measures for the project are considered. This investigation has relied partly upon information from the Terrestrial Fauna report submitted during the IIS process (part of volume 13 of the Draft IIS, GHD 2006) and updated information from relevant sources.

The Draft IIS report has been relied upon (supplemented by an independent site inspection in September 2006) for information on existing habitat conditions for migratory and marine birds, and for information on potential project impacts. In addition, a literature review of potential bioaccumulation of dioxins in the effluent from the proposed pulp mill undertaken by Toxikos Pty Ltd (2006) has been reviewed in this report.

This report is divided into the following sections:

Section 3 provides an outline of the methodology for this impact assessment.

Section 4 provides a discussion on the legislative context of significant marine and migratory avifauna impacts arising from the development.

Section 5 provides an account of the factors used to determine the significance of avifauna affected by the development.

Section 6 provides an overview of the key fauna of the study area.

Section 7 provides an overview of potential impacts on migratory and marine birds of the proposed pulp mill.

Section 8 suggests mitigation measures for key marine and migratory avifauna in the pulp mill project area.

Section 9 provides a reference list.

This report was prepared by a team from Brett Lane & Associates Pty Ltd comprising Peter Lansley (Zoologist) and Brett Lane (Principal Consultant).

Note that the scientific names for all bird species mentioned in this report are provided in Table 2.

3. METHODOLOGY

3.1. Existing conditions

3.1.1. Study area

Figure 1 shows the extent of the study area for this impact assessment.

While it is recognised that the effects of pulp mill effluent may not extend to the limits of this study area (based on modelling in the Draft IIS), it was chosen to capture all species likely to be present regularly in the vicinity of and including the area most affected by the effluent plume.

In general, most terrestrial ecosystems are not considered in this report as they have little relevance to marine and migratory birds inhabiting the study area. However, where relevant, discussion is extended to include rocky, sandy and muddy coasts, cliff tops and headlands, fore-dunes, and coastal paddocks and wetlands to a distance of approximately 500 metres inland where these may be used as roosting or nesting sites by migratory and marine species (e.g. Oystercatchers).

The study area is located in the Flinders bioregion (IBRA 5) along the Bass Strait coast and a few kilometres inland, and the Tasmanian Northern Midlands bioregion, extending south to beyond Launceston.

The study area comprises three local government areas: West Tamar, situated west of the Tamar Estuary; Georgetown, east of the Tamar Estuary and north of Launceston; and, Launceston in the southern parts of the estuary, east of the Tamar River.

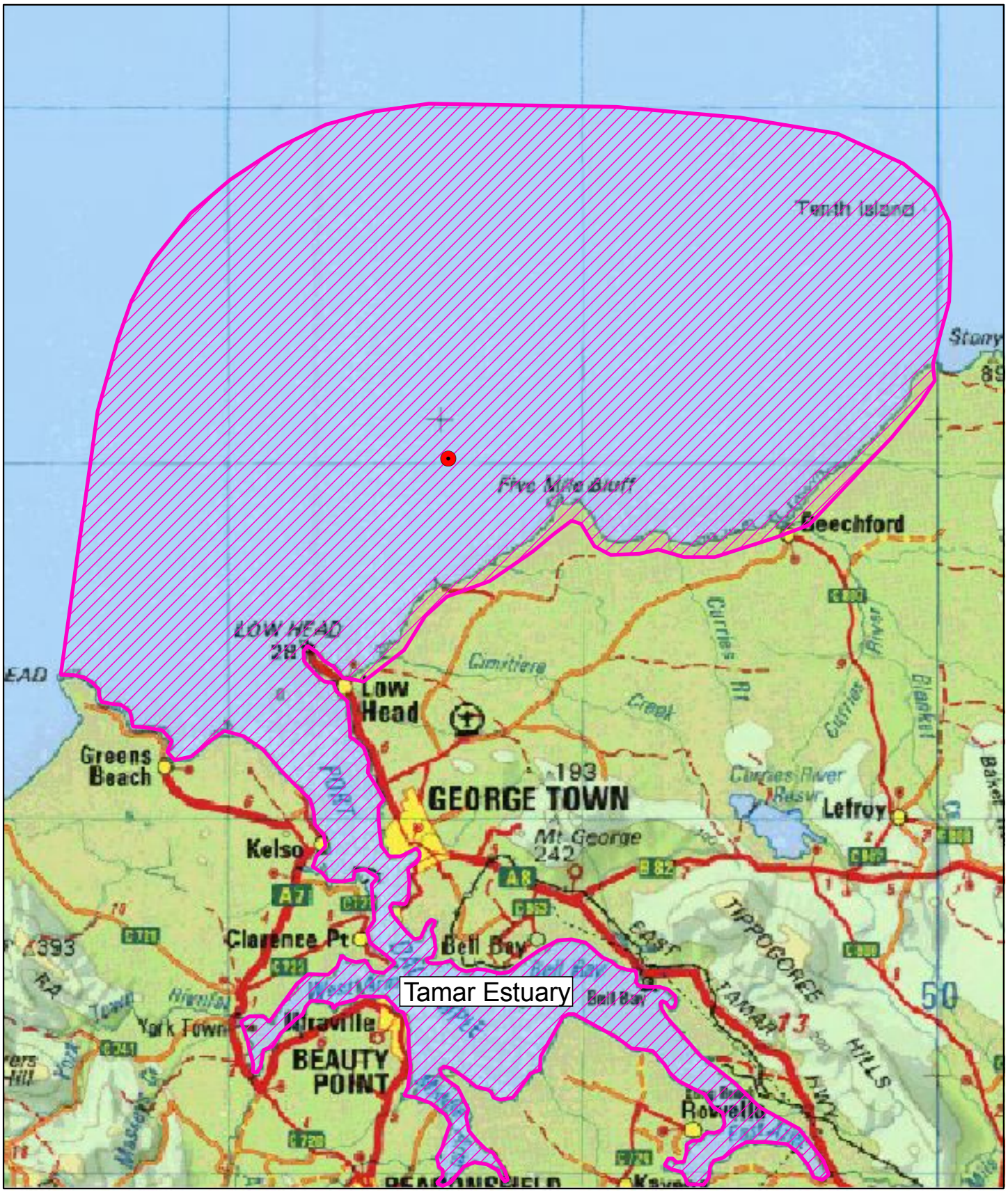
3.1.2. Bird species considered

Emphasis has been placed on species of conservation significance (see Section 6.2). Bird species of conservation significance include:

- Migratory and marine bird species that are listed on any international treaty;
- Migratory and marine bird species listed as nationally significant either threatened, migratory or marine under the *Environment Protection and Biodiversity Conservation Act 1999* or Garnett & Crowley (2000); and
- Some birds have been grouped together for the purposes of discussion and presentation throughout this report. This allows a clear understanding of the functional ecological groups that occur and co-exist together in the Estuary and near-shore waters. It combines those species that are considered to be under similar influence from physical and biological processes, and utilise similar resources. Such functional groups of birds will often behave similarly, rely on similar habitats and flock together to breed, feed and/or roost.

Figure 1: Map showing the extent of the study area for the current impact assessment.

Study Area



Legend

- Effluent Outfall
- Study Area

The Study Area extends further to the South following the Tamar Estuary

0 1,250 2,500 5,000 7,500 10,000 Metres

Bell Bay Pulp Mill Project		
Figure 1: Study Area		
Client: Gunns Ltd / Freehills Pty Ltd		
Project No.: 6128	Date: 05/12/2006	Created by: I. Mau / P.S. Lansley

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3.2. Sources of Information

3.2.1. Avifauna

Sources dealing with the migratory and marine avifauna of the study area were reviewed for this assessment. They were used to draw up a list of species potentially occurring in the study area. The list was vetted based on knowledge of the avifauna of Bass Strait and the shorebirds of Tasmania and south-eastern Australia. The sources are listed below.

- Draft Bell Bay Pulp Mill IIS terrestrial fauna report (Volume 13, Appendix 30)(this covers some shorebirds);
- EPBC Act Protected Matters Search Tool (DEH 2006);
- Action Plan for Australian Birds (Garnett and Crowley 2000);
- Seabird Atlas of South-Eastern Australia (Reid et al. 2002);
- Birdata (Birds Australia Atlas of Australian Birds online database);
- Tasmania's Offshore Islands: Seabirds and other Natural Features (Brothers, N. et al. 2001: Hobart: Tasmanian Museum and Art Gallery);
- DPIWE Threatened Fauna Manual (Bryant and Jackson 1999);
- Shorebirds in Australia (Lane 1987)
- A National Plan for Shorebird Conservation in Australia (Watkins 1993);
- The Stilt (journal of the Australasian Wader Studies Group); and
- Corella Seabird Islands Series.

Details of published material are included in the references section of this report.

3.3. Limitations

This assessment was a desktop study involving limited fieldwork. The coastal fieldwork involved inspections of habitat and limited bird observations of marine habitat near the proposed outfall from 25th to 27th September 2006. Ground truthing of some desktop data was undertaken. Table 2 summarises those bird species recorded during the field surveys and in the GHD IIS fauna surveys. Collation and review was undertaken using data and resources available at the time of the study, and every effort was made to base the assessment on the most recent and accurate information available.

The impact assessment carried out here is necessarily general due to incomplete knowledge of seabird and shorebird distribution and use of the study area, and poor understanding of their diet in the study area. The limitations of this assessment are described below.

The available data on marine birds provides limited information on their use of the study area. The best data (Reid et al. 2002) provides little more than occurrence data of each species in an area extending approximately from Devonport to Bridport and gives an indication of relative abundance. Precise feeding locations or foraging patterns for most species of shorebirds within the study area are undocumented and the available information comes from early 1980's data in Lane (1987) and Watkins (1993) for species occurring in significant numbers, and more recent (post-1998) Birdata (Birds Australia, Atlas of Australian Birds online maps) for other species of shorebirds and terns.

Literature review and calculations on estimated levels of bioaccumulation of dioxins in marine seabirds and intertidal zone shorebirds is available for only two species - Little Penguin and White-bellied Sea-Eagle, and it is recognised that available data relating to some prey of these two species is deficient (Toxikos Pty Ltd 2006). In the context of a wider environmental monitoring program for the project, consideration should be given to the dioxin monitoring suggested in section 8.

4. POLICY AND LEGISLATION

This section outlines the key international, commonwealth and state level legislation and policies related to significant avifauna.

4.1. Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Sites of international significance (e.g. Ramsar Wetlands) and matters of national environmental significance are covered by the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This requires that any action that will or is likely to significantly affect Ramsar wetlands, nationally threatened species and listed migratory and marine species (such as penguins, albatross, shorebirds and terns) not be undertaken without Commonwealth assessment and approval.

The Commonwealth Department of Environment and Heritage has issued "Significant Impact Guidelines" for matters of national environmental significance that provide a framework for assessing the impacts of actions on matters of national environmental significance. The Significant Impact Guidelines are summarised in Appendix 1 for each of these three matters of national environmental significance - (1) threatened species, (2) listed migratory and marine species and (3) wetlands of international significance. These criteria are based on the most recent guidelines (May 2006).

4.2. Threatened Species Protection Act 1995

The Tasmanian *Threatened Species Protection Act 1995* (TSP Act) protects threatened flora and fauna in Tasmania by: identification of critical habitat; production of recovery and threat abatement plans; imposition of interim protection orders; and provision for public authority land management agreements. The Act has effect over all land tenures in Tasmania (DPIWE 2000). The TSP Act aims to promote recognition and management of the key threatening processes affecting native flora and fauna.

A Scientific Advisory Committee endorses a priority list of threatened species for Tasmania, based on quantifiable criteria. This list places threatened species in four categories: extinct, endangered, vulnerable and rare at risk.

4.3. DPIW list of species of conservation significance

DPIW has also produced a list of fauna species of conservation significance in relation to the Bell Bay Pulp Mill project (DPIWE 2004), however that list contains only two species of EPBC Act listed migratory or marine species - The Pink Robin and the Satin Flycatcher and these are both marine overfly species (i.e. not dependent on the marine and coastal environment), and consequently are not within the scope of this assessment.

5. SIGNIFICANCE OF MARINE AND INTERTIDAL BIRDS

This section describes the significant marine and intertidal birds of the study area. These are determined by using criteria for conservation significance based on policy, legislation and regional ecological assessments and plans. These criteria (see below) take into account matters that are protected by legislation (EPBC Act, TSP Act) as well as those not protected by legislation but otherwise considered to be of conservation significance (DPIWE 2004).

Conservation significance is assessed in this report at a range of scales, including international, national and state. At smaller geographic scales (e.g. regional or local), there are probably insufficient data available to determine significance levels. Criteria used for determining the conservation significance of flora and fauna at the three relevant scales are presented below.

5.1. Determining levels of Zoological Significance

International significance applies to areas of habitat that support ecologically significant populations of birds covered by international agreements, or numbers of waterbirds that meet the criteria for internationally important wetlands under the Ramsar Convention (International agreements such as Japan-Australia Migratory Bird Agreement JAMBA, China-Australia Migratory Bird Agreement CAMBA, Bonn Convention and the Ramsar convention are taken into account under the schedules of the EPBC Act). The threshold for an internationally significant population of a waterbird species is the regular occurrence of 1% of the flyway population (Watkins 1993). Tasmania is part of the East Asian - Australasian flyway.

National zoological significance applies to an area that supports one or more of the attributes described below.

- A population of one or more bird species listed as nationally threatened by Garnett and Crowley (2000), or listed on the schedules of the *Environment Protection and Biodiversity Conservation Act 1999*.
- Numbers of migratory or non-migratory shorebirds that meet the criterion of Watkins (1993) for national significance, namely, more than 1% of the national population of a shorebirds species.

State zoological significance applies to an area when it supports one or more of the following attributes

- A population of at least one bird species threatened in Tasmania, as listed by under the *Threatened Species Protection Act 1995*.
- A bird species listed by DPIW as being of fauna conservation significance in Tasmania for the purposes of the Bell Bay pulp mill project under the Brief for consultants (DPIWE 2004).

As it is not always possible to confirm the presence of some bird species, due to seasonal or behavioural difficulties in detection, the foregoing significance levels can be qualified by the word "potential" where habitat attributes are considered suitable for a species of a particular level of conservation significance.

5.2. Breeding seabirds

A number of species of seabird breed in the study area, including on Tenth Island (see Figure 1) in Bass Strait and near Low Head on the Bass Strait coast. These are considered fauna of conservation significance, since they are listed marine species under the EPBC Act. They include:

- Little Penguin (breeding is recorded on the mainland around Low Head);
- Black-faced Cormorant (Brothers et al. 2001 recorded a colony of 15 to 20 nests on Tenth Island); and
- Pacific Gull (may breed in the area: breeding has been recorded at Trevallyn, near Launceston (Higgins and Davies 1996) but further details are lacking. Brothers et al. (2001) included Tenth Island as part of the breeding distribution of Pacific Gull on their map, but not in their text).

Other non-migratory shorebirds that breed or potentially breed in the study area are Hooded Plover, Red-capped Plover, Pied Oystercatcher and Sooty Oystercatcher.

6. MIGRATORY AND MARINE BIRDS OF THE STUDY AREA

This section summarises the key bird habitats of the area likely to be affected by the proposed pulp mill.

6.1. Avifauna habitats

The proposed pulp mill potentially affects a number of migratory and marine bird habitats. The key habitats are listed below.

- Offshore marine waters of southern Bass Strait (offshore from an area extending from Bell Buoy Beach to West Head), including Tenth Island;
- Coastal beaches, headlands, rock platforms and spits, occurring in a narrow zone along the coast from West Head, and Low Head to Bell Buoy Beach;
- Intertidal zones of the Tamar Estuary, comprising mudflats, sandy shorelines and shallow estuarine waters of the Tamar Estuary downstream of Launceston and downstream from the pulp mill site at Bell Bay; and
- Non-tidal coastal wetlands (some areas close to Launceston may fit into this category).

These habitats are extensive throughout the study area. A small proportion of these habitats will be affected by the proposed development, as described below.

The effluent plume will cover an area of offshore marine waters of up to 500 metres from the outfall diffuser (Vol 18, Draft IIS, sections 6.6.3, 6.6.4 and 6.7). Beyond the effluent plume levels of dioxin have been modelled at levels not exceeding water quality objectives.

A narrow zone of habitat adjacent to the route of the effluent pipeline, where it crosses the sandy coast of Bass Strait will also be temporarily affected during construction (see Figure 2). Construction methods similar to those used for the construction of the underground component of the Basslink powerline will be used to construct the effluent pipeline at this point. A trench and construction zone about 20 to 25 metres wide (Draft IIS Vol 16, App. 50, p. 5) will be quickly rehabilitated. The depth of the pipeline will not affect the longshore movement of beach material. Consequently, habitats for coastal marine and migratory birds will only be significantly affected for the short period of construction (c. six to eight months).

The area of the Tamar estuary affected by the proposed pulp mill comprises a small proportion of its shoreline adjacent to the mill site. Direct effects will be confined to a zone about 150m along the shore where the wharf is proposed. This area is dominated by a steep, rocky shore and lacks an extensive intertidal zone due to its gradient (see Figure 3). The nearest wider, muddy

shores suitable for migratory shorebirds occur across the estuary from the mill site.

The characteristics of these habitats are described in more detail below.

Figure 2: Approximate location (arrow) of the shoreline crossing for the effluent pipeline, Bass Strait coastline.

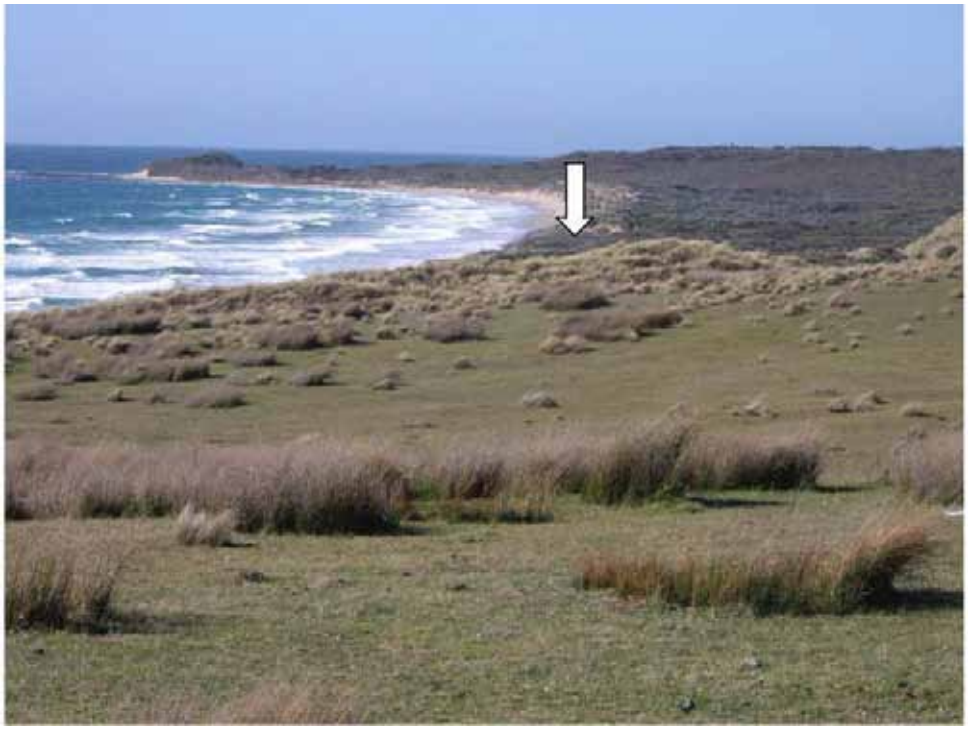

Figure 3: Proposed wharf site' Tamar Estuary shoreline.

6.1.1. Offshore marine waters of southern Bass Strait

Offshore marine habitat is the most extensive bird habitat in the study area. As described above, the proposed effluent plume will affect a small proportion of this habitat. The habitat comprises marine waters seaward of approximately 500m offshore from the northern coast of Tasmania. These waters support a range of marine birds that depend for food on free-swimming marine fauna, notably fish, squid and crustaceans. The marine bird species here include:

- Little Penguin;
- Wandering Albatross;
- Shy Albatross;
- Black-browed Albatross (winter - spring);
- Yellow-nosed Albatross;
- Southern Giant-Petrel (winter);
- Northern Giant-Petrel (winter);
- Short-tailed Shearwater (summer);
- Fluttering Shearwater (autumn-winter);
- Fairy Prion;
- White-faced Storm-Petrel (spring-summer);
- Common Diving-Petrel;
- Black-faced Cormorant;
- Australasian Gannet;
- Arctic Jaeger (summer);
- Silver and Pacific Gulls;
- Crested Tern.

Scientific names of these species can be found in Table 2.

Tenth Island (see Figure 1) is a sea bird breeding island that is included in the offshore marine waters habitat because birds breeding here are likely to forage over that habitat. It is a bare rock of 0.09 ha situated some 13 km from the effluent outfall which supports an Australian Fur Seal colony. A colony of Black-faced Cormorant (15 - 20 nests) has been recorded here and Pacific Gull may also breed there (Brothers et al. 2001).

6.1.2. Inshore marine waters, coastal beaches and spits

Inshore waters are defined for this report as those within approximately 500 metres of the coastline (see Figure 3). It is a highly productive habitat that supports many of the offshore marine species listed above, as well as birds from nearby intertidal zones and coastal fishing species, such as terns. Many of these birds move regularly between intertidal areas, coastal, non-tidal habitats (see below) and inshore marine waters.

Coastal beaches and spits are highly dynamic environments, regularly altered in shape and extent by wave activity. They generally support open, sandy or shelly areas, backed by dense coastal vegetation, such as grassy shrubland. The area of grassy shrubland and open sandy and shelly habitat changes regularly. Vegetation succession and wave and storm activity push these changes and the birds of coastal beach environments are adapted to these regular changes.

Open sandy or shelly areas above high tide mark that have not yet become vegetated, are an important roosting site for cormorants, terns and gulls. This habitat meets the requirements for the threatened Hooded Plover, which breeds along beaches on coastlines around Tasmania and is likely to do so within the study area.

6.1.3. Intertidal Areas

The zone between high and low tide mark is rocky, sandy or muddy. The intertidal zone is particularly important for shorebirds, including international migratory species, as well as for ducks and swans.

Rocky intertidal shores occur at the development site (see Figure 3) and near Georgetown and probably elsewhere in the study area.

Sandy intertidal shores on the estuary are generally of lower productivity as a source of food for shorebirds, but at high tide, they offer a safe roosting location for gulls, terns and oystercatchers. On 27 September 2006, a high tide roost comprising 70 Pied and 14 Sooty Oystercatchers was observed near Kelso opposite Georgetown, not far from the entrance of the Tamar Estuary. This is an indication that significant numbers of these two species may still congregate at nearby sites in the Tamar Estuary. Similarly, a flock of 11 Eastern Curlews was found on intertidal flats just north of Georgetown, on 25 September 2006. It is likely that the Tamar Estuary is an important site for this species whose population is recognised as continuing to decrease in Tasmania and elsewhere (Reid and Park 2003).

Along the Bass Strait coastline, sandy shores provide habitat for the listed Hooded Plover and a small number of shorebirds of other species (e.g. Red-capped Plover). Being of lower productivity, such ocean beach habitats support only small number of these species.

Muddy intertidal shores can be wide but are limited to the more sheltered parts of the coast, particularly along the western shore of the Estuary opposite the development site and just north of Georgetown. They are among the most productive habitats for birds in the Estuary. They support a diverse range of benthic fauna that provides food for shorebirds, swans and teal. Key species of conservation significance that use this part of the study area are listed below under the shorebirds section. The White-bellied Sea-Eagle, listed as vulnerable under the TSP Act (and a listed migratory species under the EPBC Act) also uses this habitat.

6.1.4. Non-tidal coastal wetlands

Near Launceston, there are several wetlands that may form useful habitats for marine and migratory birds. Two such areas close to the pulp mill water supply pipeline footprint are:

- The Tamar River Conservation Area Centre, on the opposite side of the river estuary from the water supply pipeline route. It supports reed beds and has avifauna more characteristic of freshwater habitats, such as Purple Swamphen;
- Dredge spoil lagoons along the West Tamar Highway. The muddy shorelines and open lagoons of these artificial wetlands may form useful roosting and foraging sites for a number of shore birds.

A very small proportion of these habitats on the estuary will be affected temporarily (up to six to eight months) by construction of the water supply pipeline for the project.

6.2. Significant fauna species and populations

The bird species discussed in this investigation include those that are considered to be of conservation significance and that may potentially be affected by the Bell Bay pulp mill project. For the purposes of this report, birds have been classed as belonging to three groups. Species within these groups are considered to be under the influence of similar ecological and physical processes. The potential impact pathways from the Bell Bay pulp mill project are considered to be different in these three groups. The three groups are:

- Breeding seabirds;
- Non-breeding seabirds; and
- Shorebirds.

6.2.1. Breeding seabirds (Listed Marine species under EPBC Act)

A number of species of seabird breed in the study area:

- Little Penguin (*Eudyptula minor*);

- Black-faced Cormorant (*Phalacrocorax fuscescens*); and
- Pacific Gull (*Larus pacificus*).

They are summarised in Table 1.

Table 1. Summary of seabird species that breed in Bell Bay pulp mill effluent outfall study area.

Species	Description	Study area location	Population estimate
Little Penguin	Common in Bass Strait. Breeding recorded from September to December in Tasmania. Require soil or rock crevices for nesting site.	Low Head.	Not known
Black-faced Cormorant	Common in Bass Strait. Breeding season all year but mainly Sept.-Dec. Require flat rock ledges on which to nest.	Tenth Island.	15 – 20 pairs (Brothers et al. 2001)
Pacific Gull	Widespread in small numbers in Tamar Estuary and along Bass Strait coast. Nests on sand or rock islands, preferring areas of low vegetation cover.	Trevallyn (Higgins & Davies 1996) – precise location not documented; possibly Tenth Island (Brothers et al. 2001)	Not known

In addition to the seabirds that breed in the study region, non-breeding seabirds in the region are also listed marine species under the EPBC Act. None of these species are threatened. Those species that breed within Tasmanian waters, but are not confirmed as breeding in the study region, are:

- Short-tailed Shearwater (also listed under JAMBA);
- Fairy Prion;
- White-faced Storm-Petrel;
- Common Diving-Petrel;
- Australasian Gannet;
- Silver Gull; and
- Crested Tern.

Although the above species are not recorded as breeding locally within the study area, it is probable that the bulk of individuals visiting the study area are from Tasmanian breeding sites.

6.2.2. Non-breeding seabirds (Listed Threatened species under EPBC Act)

A number of seabird species listed threatened species under the EPBC Act may also visit the effluent outfall area during their foraging:

- Wandering Albatross;
- Shy Albatross;
- Black-browed Albatross;
- Southern Giant-Petrel; and,
- Northern Giant-Petrel.

Of these species one, the Shy Albatross breeds in western Bass Strait (Albatross Island) but not in the study area. The others are regular non-breeding visitors from breeding grounds a significant distance away in the sub-Antarctic.

Seabirds that breed elsewhere often forage during their non-breeding period in Bass Strait waters, including in the study area. Many of these species do not breed until several years old and in this period they spend their entire time at sea and may enter the study area to forage. Generally these species forage over immense areas of the Southern Ocean in their extensive search for food and will therefore not be confined to one particular area such as the study area. A number of other seabirds have been recorded from the study area as beached exhausted birds or dead birds washed up along the shoreline, however only regularly occurring species are considered here.

6.2.3. Non-breeding seabirds(Listed Marine species but not Threatened under the EPBC Act)

Another group of seabirds occurring in the study area are regular visitors that do not breed in the Tasmanian region, and are not listed as threatened under the EPBC or TSP Acts. Nevertheless, these species are listed marine species under the EPBC Act and are considered in this assessment of project impacts. The include:

- Yellow-nosed Albatross;
- Fluttering Shearwater; and,
- Arctic Jaeger.

Their use of the study area is similar to that described for the previous group of seabirds.

6.2.4. Shorebirds (Listed Migratory species under the EPBC Act)

The Tamar Estuary is considered an important site for shorebirds (Watkins 1993).

The majority of the shorebird species that occur in the Tamar Estuary are migratory, breeding in the northern hemisphere and spending their non-breeding season in the southern hemisphere.

These species are listed on and therefore subject to the provisions of three international treaties:

- Bonn Convention - Convention on Migratory Wild Animals',
- JAMBA - an 'Agreement Between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and,
- CAMBA - an 'Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment'.

In addition to the listed migratory species, Tamar Estuary holds nationally significant populations of two non-migratory shorebird species:

- Pied Oystercatcher (Lane 1987; Watkins 1993);
- Sooty Oystercatcher (Watkins 1993).

These species are not listed under the schedules of the EPBC Act or the TSP Act as threatened, marine or migratory, however the Pied Oystercatcher is included as a species of conservation significance (DPIWE 2004). The Tamar also supports nationally significant numbers of Ruddy Turnstone (Watkins 1993).

Listed migratory shorebird species listed under the EPBC Act covered by international treaties that regularly occur in the study area include:

- Bar-tailed Godwit;
- Whimbrel
- Eastern Curlew;
- Common Greenshank;
- Terek Sandpiper;
- Common Sandpiper;
- Grey-tailed Tattler;
- Ruddy Turnstone;
- Red Knot;
- Red-necked Stint;

- Sharp-tailed Sandpiper;
- Curlew Sandpiper;
- Pacific Golden Plover;
- Grey Plover;
- Double-banded Plover;

In addition two resident shorebirds are covered under the EPBC Act within the provisions of the Bonn Convention:

- Red-capped Plover;
- Hooded Plover.

The eastern population of the Hooded Plover, which includes mainland south-eastern Australia and Tasmania, is considered vulnerable by Garnett and Crowley (2000).

Three species of tern are here considered shorebirds since they usually occur only along sandy shorelines and shallow inshore or estuarine waters:

- Caspian Tern;
- Fairy Tern;
- Little Tern.

Of these, two (Caspian and Little Tern) are covered under the EPBC Act by international treaties protecting migratory species. The Fairy Tern is a listed marine species under the EPBC Act, as well as listed as 'rare' under Tasmania's TSP Act.

Additional species of tern also occur in the study area. These are listed in Table 2 and are of conservation significance.

Table 2. Summary of conservation status and occurrence of migratory and marine birds that occur or are likely to occur in the areas affected by the proposed Bell Bay pulp mill.

English name	Scientific name	category	EPBC Act threat-ened	EPBC Act marine	EPBC Act migra-tory	Garnett & Crowley 2000	TSP Act status	Conser-vation signifi-cance in Tas.	Predicted or recorded effluent pipeline and outfall	Recorded in study area during field surveys+
Antarctic Prion	*Pachyptila desolata*	non-breeding seabird		Ma		-	-	no	yes	
Arctic Jaeger	*Stercorarius parasiticus*	non-breeding seabird		Ma	Mi	-	-	no	yes	
Australasian Gannet	*Morus serrator*	breeding seabird		Ma		-	-	yes	yes	yes
Australian Hobby	*Falco longipennis*	terrestrial or freshwater		-	L	-	-	yes	yes	
Australian Pelican	*Pelecanus conspicillatus*	terrestrial or freshwater		Ma		-	-	yes	yes	yes
Bar-tailed Godwit	*Limosa lapponica*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Black-browed Albatross	*Thalassarche melanophris s.l.*	non-breeding seabird	Vul	Ma	L	NT	End	yes	yes	
Black-faced Cormorant	*Phalacrocorax fuscescens*	breeding seabird		Ma		-	-	no	yes	yes
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	terrestrial or freshwater		Ma		-	-	no	yes	
Blue-winged Parrot	*Neophema chrysostoma*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Brown Falcon (Tasmanian)	*Falco berigora tasmanicus*	terrestrial or freshwater		-	L	-	-	no	yes	yes
Brown Goshawk	*Accipiter fasciatus*	terrestrial or freshwater		Ma	L	-	-	no	yes	
Cape Petrel	*Daption capense*	non-breeding seabird		Ma		-	-	no	yes	
Caspian Tern	*Sterna caspia*	breeding shorebird		Ma	Mi	-	-	yes	yes	
Clamorous Reed Warbler	*Acrocephalus stentoreus*	terrestrial or freshwater		Ma	L	-	-	no	yes	
Collared Sparrowhawk	*Accipiter cirrhocephalus*	terrestrial or freshwater		-	L	-	-	no	yes	
Common Diving-Petrel	*Pelecanoides urinatrix*	breeding seabird		Ma		-	-	no	yes	

English name	Scientific name	category	EPBC Act threat-ened	EPBC Act marine	EPBC Act migra-tory	Garnett & Crowley 2000	TSP Act status	Conser-vation signifi-cance in Tas.	Predicted or recorded effluent pipeline and outfall	Recorded in study area during field surveys+
Common Greenshank	*Tringa nebularia*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Crested Tern	*Sterna bergii*	breeding seabird		Ma	Mi	-	-	no	yes	yes
Curlew Sandpiper	*Calidris ferruginea*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Double-banded Plover	*Charadrius bicinctus*	migratory shorebird		Ma	L	-	-	no	yes	
Eastern Curlew	*Numenius madagascariensis*	migratory shorebird		Ma	Mi	-	End	yes	yes	yes
Fairy Prion	*Pachyptila turtur s.l.*	breeding seabird		Ma		-	-	no	yes	
Fairy Tern	*Sterna nereis*	breeding shorebird		Ma		-	Rare	yes	yes	
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Flame Robin	*Petroica phoenicea*	terrestrial or freshwater		Ma		-	-	yes	yes	
Fluttering Shearwater	*Puffinus gavia*	non-breeding seabird		Ma		-	-	no	yes	
Forest Raven	*Corvus tasmanicus*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Great Skua	*Catharacta skua*	non-breeding seabird		Ma		-	-	no	yes	
Grey Plover	*Pluvialis squatarola*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Grey-tailed Tattler	*Heteroscelus brevipes*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Hooded Plover	*Thinornis rubricollis*	breeding shorebird		Ma	L	Vul	-	yes	yes	yes
Horsfield's Bronze-cuckoo	*Chrysococcyx basalis*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Latham's Snipe	*Gallinago hardwickii*	terrestrial or freshwater		Ma	Mi	-	-	yes	yes	
Little Egret	*Egretta garzetta*	terrestrial or freshwater		Ma		-	-	no	yes	
Little Penguin	*Eudyptula minor*	breeding seabird		Ma		-	-	yes	yes	yes

English name	Scientific name	category	EPBC Act threat-ened	EPBC Act marine	EPBC Act migra-tory	Garnett & Crowley 2000	TSP Act status	Conser-vation signifi-cance in Tas.	Predicted or recorded effluent pipeline and outfall	Recorded in study area during field surveys+
Little Tern	*Sterna albifrons*	breeding shorebird		Ma	Mi	-	End	yes	yes	
Musk Duck	*Biziura lobatus*	terrestrial or freshwater		Ma		-	-	no	yes	
Northern Giant-Petrel	*Macronectes halli*	non-breeding seabird	Vul	Ma	L	NT	Rare	yes	yes	
Pacific Golden Plover	*Pluvialis fulva*	migratory shorebird		Ma	Mi	-	-	no	yes	
Pacific Gull	*Larus pacificus*	breeding seabird		Ma		-	-	yes	yes	yes
Pallid Cuckoo	*Cuculus pallidus*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Peregrine Falcon	*Falco peregrinus*	terrestrial or freshwater			L	-	-	no	yes	
Pied Oystercatcher	*Haematopus longirostris*	breeding shorebird		-		-	-	yes	yes	yes
Pink Robin	*Petroica rodinogaster*	terrestrial or freshwater		-		-	-	yes	yes	
Purple Swamphen	*Porphyrio porphyrio*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Red Knot	*Calidris canutus*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Red-capped Plover	*Charadrius ruficapillus*	breeding shorebird		Ma		-	-	no	yes	
Red-necked Stint	*Calidris ruficollis*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Richard's Pipit	*Anthus novaeseelandiae*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Ruddy Turnstone	*Arenaria interpres*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Satin Flycatcher	*Myiagra cyanoleuca*	terrestrial or freshwater		Ma	L	-	-	yes	yes	
Sharp-tailed Sandpiper	*Calidris acuminata*	migratory shorebird		Ma	Mi	-	-	no	yes	
Shining Bronze-cuckoo	*Chrysococcyx lucidus plagosus*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Short-tailed Shearwater	*Puffinus tenuirostris*	breeding seabird		Ma	Mi	-	-	yes	yes	

English name	Scientific name	category	EPBC Act threat-ened	EPBC Act marine	EPBC Act migra-tory	Garnett & Crowley 2000	TSP Act status	Conser-vation signifi-cance in Tas.	Predicted or recorded effluent pipeline and outfall	Recorded in study area during field surveys+
Shy Albatross	*Thalassarche cauta s.l.*	breeding seabird	Vul	Ma	L	Vul	Vul	yes	yes	yes
Silver Gull	*Larus novaehollandiae*	breeding seabird		Ma		-	-	no	yes	yes
Silvereye	*Zosterops lateralis*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Slender-billed Prion	*Pachyptila belcheri*	non-breeding seabird		Ma		-	-	no	yes	
Sooty Oystercatcher	*Haematopus fuliginosus*	breeding shorebird				-	-	no	yes	
Southern Giant-Petrel	*Macronectes giganteus*	non-breeding seabird	End	Ma	L	Vul	Vul	yes	yes	
Swamp Harrier	*Circus approximans*	terrestrial or freshwater			L	-	-	yes	yes	yes
Swift Parrot	*Lathamus discolor*	terrestrial or freshwater	End	End, Ma		End	End	yes	yes	
Terek Sandpiper	*Xenus cinerea*	migratory shorebird		Ma	Mi	-	-	yes	yes	
Tree Martin	*Hirundo nigricans*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Wandering Albatross	*Diomedea exulans s.l.*	non-breeding seabird	Vul	Ma	L	Vul	End	yes	yes	
Welcome Swallow	*Hirundo neoxena*	terrestrial or freshwater		Ma		-	-	no	yes	yes
Whimbrel	*Numenius phaeopus*	migratory shorebird		Ma	Mi	-	-	yes	yes	
White-bellied Sea-eagle	*Haliaeetus leucogaster*	terrestrial or freshwater		Ma	Mi	-	Vul	yes	yes	
White-faced Storm-Petrel	*Pelagodroma marina*	breeding seabird		Ma		-	-	no	yes	
White-fronted Tern	*Sterna striata*	breeding seabird		Ma		-	Vul	yes	yes	
White-throated Needletail	*Hirundapus caudacutus*	terrestrial or freshwater		Ma	Mi	-	-	no	yes	
Yellow-nosed Albatross	*Thalassarche chlororhynchos s.l.*	non-breeding seabird		Ma	L	-	-	no	yes	

Notes:
+ = refers to the current fieldwork, as well as that reported in GHD (2006).
End = Endangered
Mi= listed Migratory species under JAMBA or CAMBA
Ma = listed Marine or Marine overfly species under EPBC
Vul = Vulnerable
NT = Near Threatened
L = Listed under the Bonn convention on migratory wild animals
breeding seabird = marine species that breeds in Tasmania
non-breeding seabird = marine species that does not breed in Tasmania
migratory shorebird = intertidal species that breeds in n. hemisphere (exception - Double-banded Plover breeds in NZ)
breeding shorebird = intertidal species that breeds in Tasmania
terrestrial or freshwater = land based species; note, some also use intertidal zones or shallow marine waters, e.g. Australian Pelican, Black Swan and Chestnut Teal

7. POTENTIAL IMPACTS OF THE PROJECT

This section describes the impacts of the Bell Bay pulp mill project that may affect the coastal ecosystems of the Tamar Estuary and Bass Strait marine waters and the marine and migratory birds that feed in this area. These species are listed as shorebirds or seabirds in Table 2 of this report.

Potential impact mechanisms that may affect these habitats as a result of the Bell Bay pulp mill project fall into three categories: 1) bioaccumulation of dioxins from mill effluent; 2) direct physical removal of potential habitat on the coast; and 3) indirect habitat changes due to noise, disturbance and light spillage from the new pulp mill.

These impacts can arise from a number of activities associated with pulp mill activities in the study area. These are listed below and discussed in detail in the following sub-sections:

- Effluent release 3 km offshore in Bass Strait;
- Removal of shoreline for the shipping wharf at the pulp mill site;
- Physical removal of sand and beach materials during construction of the effluent outfall pipeline where it crosses the beach between Four Mile Bluff and Five Mile Bluff (see Figure 2);
- New light source at night from the pulp mill; and
- Increased noise and activity levels during construction of the wharf and effluent outfall and during operation of the pulp mill and wharf.

The likely significance of these impacts is considered below.

7.1. Effluent release

Effluent from the pulp mill would be released via an outfall pipe 3 km offshore in Bass Strait. This effluent would contain pollutants that have the potential for bioaccumulation (specifically dioxins), possibly contaminating higher order consumers in the marine food web in the area, including seabirds. Contamination potentially affects the top predators of marine ecosystems more than lower trophic levels. Elsewhere, accumulation of toxins in marine birds has been recorded and it has caused a range of effects that in some circumstances have lead to reduced breeding success and chick survival, ultimately affecting regional populations. The risk of this occurring due to effluent release from the proposed pulp mill is explored below.

Table 3: Diet and conservation status of listed migratory and marine birds predicted to occur in the area potentially impacted by the proposed Bell Bay pulp mill.

English name	Scientific name	Category	EPBC Act threat-ened	TSP Act status	Conser vation signifi-cance in Tas.	Main diet (1)
Antarctic Prion	*Pachyptila desolata*	non-breeding seabird		-	no	Krill
Arctic Jaeger	*Stercorarius parasiticus*	non-breeding seabird		-	no	Kleptoparasitic: fish, birds, carrion, molluscs, crustaceans
Australasian Gannet	*Morus serrator*	breeding seabird		-	yes	Small fish
Australian Pelican	*Pelacanus conspicillatus*	freshwater or seabird		-	yes	Fish; scavenges other meat
Bar-tailed Godwit	*Limosa lapponica*	migratory shorebird		-	yes	Worms, molluscs, crustaceans, insects
Black-browed Albatross	*Thalassarche melanophris*	non-breeding seabird	Vul	End	yes	Krill and fish, some cephalopods
Black-faced Cormorant	*Phalacrocorax fuscescens*	breeding seabird		-	no	Small fish
Cape Petrel	*Daption capense*	non-breeding seabird		-	no	Krill, cephalopods, fish
Caspian Tern	*Sterna caspia*	breeding shorebird		-	yes	Small fish

English name	Scientific name	Category	EPBC Act threat-ened	TSP Act status	Conser vation signifi-cance in Tas.	Main diet (1)
Common Diving-Petrel	*Pelecanoides urinatrix*	breeding seabird		-	no	Krill, copepods
Common Greenshank	*Tringa guttifer*	migratory shorebird		-	yes	Molluscs and crustaceans
Crested Tern	*Sterna bergii*	breeding seabird		-	no	Fish, some prawns and squid
Curlew Sandpiper	*Calidris ferruginea*	migratory shorebird		-	yes	Invertebrates, worms, molluscs, crustaceans, insects
Double-banded Plover	*Charadrius bicincta*	migratory shorebird		-	no	Molluscs, worms, insects, crustaceans, spiders
Eastern Curlew	*Numenius madagascariensis*	migratory shorebird		End	yes	Crabs and small molluscs
Fairy Prion	*Pachyptila turtur s.l.*	breeding seabird		-	no	Krill
Fairy Tern	*Sterna nereis*	breeding shorebird		Rare	yes	Small fish
Fluttering Shearwater	*Puffinus gavia*	non-breeding seabird		-	no	Small fish, some krill
Great Skua	*Catharacta skua*	non-breeding seabird		-	no	Kleptoparasitic; generalist scavenger

English name	Scientific name	Category	EPBC Act threat-ened	TSP Act status	Conser vation signifi-cance in Tas.	Main diet (1)
Grey Plover	*Pluvialis squatorola*	migratory shorebird		-	yes	Molluscs, insects, crustaceans, polychaetes
Grey-tailed Tattler	*Heteroscelus brevipes*	migratory shorebird		-	yes	Polychaetes, molluscs crustaceans, insects
Hooded Plover	*Thinornis rubricollis*	breeding shorebird		-	yes	Polychaetes, molluscs, crustaceans, insects
Little Egret	*Egretta garzetta*	Freshwater / estuarine		-	no	Fish, frogs, insects
Little Penguin	*Eudyptula minor*	breeding seabird		-	yes	Small fish, some cephalopods and crustaceans
Little Tern	*Sterna albifrons*	breeding shorebird		End	yes	Small fish
Northern Giant-Petrel	*Macronectes halli*	non-breeding seabird	Vul	Rare	yes	Generalist scavenger
Pacific Golden Plover	*Pluvialis fulva*	migratory shorebird		-	no	Molluscs, worms, insects, crustaceans, spiders
Pacific Gull	*Larus pacificus*	breeding seabird		-	yes	Scavenger: offal, fish, cephalopods
Pied Oystercatcher	*Haematopus longirostris*	breeding shorebird		-	yes	Molluscs, worms, crabs, small fish

English name	Scientific name	Category	EPBC Act threat-ened	TSP Act status	Conser vation signifi-cance in Tas.	Main diet (1)
Red Knot	*Calidris canutus*	migratory shorebird		-	yes	Worms, bivalves, gastropods, crustaceans, echinoderms
Red-capped Plover	*Charadrius rupicapillus*	breeding shorebird		-	no	Worms, molluscs, small crustaceans
Red-necked Stint	*Calidris ruficollis*	migratory shorebird		-	yes	Polychaetes, bivalves, crustaceans, insect larvae
Ruddy Turnstone	*Arenaria interpres*	migratory shorebird		-	yes	Insects, worms, crustaceans, molluscs, spiders
Sharp-tailed Sandpiper	*Calidris acuminata*	migratory shorebird		-	no	Seeds, worms, molluscs, crustaceans, insects
Short-tailed Shearwater	*Puffinus tenuirostris*	breeding seabird		-	yes	Fish, cephalopods, krill
Shy Albatross	*Thalassarche cauta*	breeding seabird	Vul	Vul	yes	Cephalopods and fish
Silver Gull	*Larus novaehollandiae*	breeding seabird		-	no	Generalist scavenger
Slender-billed Prion	*Pachyptila belcheri*	non-breeding seabird		-	no	Krill
Sooty Oystercatcher	*Haematopus fuliginosus*	breeding shorebird		-	no	Molluscs, crustaceans, polychaetes, ascidians, echinoderms, small fish

English name	Scientific name	Category	EPBC Act threat-ened	TSP Act status	Conser vation signifi-cance in Tas.	Main diet (1)
Southern Giant-Petrel	*Macronectes giganteus*	non-breeding seabird	End	Vul	yes	Generalist scavenger
Terek Sandpiper	*Xenus cinerea*	migratory shorebird		-	yes	Crustaceans, insects
Wandering Albatross	*Diomedea exulans*	non-breeding seabird	Vul	End	yes	Cephalopods, some fish, rarely crustaceans
Whimbrel	*Numenius phaeopus*	migratory shorebird		-	yes	Worms, crustaceans
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Freshwater, estuarine or coastal predator		Vul	yes	Fish, birds, some reptiles
White-faced Storm-Petrel	*Pelagodroma marina*	breeding seabird		-	no	Pelagic crustaceans, some small fish
White-fronted Tern	*Sterna striata*	breeding seabird		Vul	yes	Small fish
Yellow-nosed Albatross	*Thalassarche chlororhynchos.*	non-breeding seabird		-	no	Fish, some cephalopods

(1) Sources: Marchant and Higgins 1990, 1993; Higgins and Davies 1996.

Note: This table includes only those listed migratory or marine species dependent upon marine waters or estuaries in Tasmania. Terrestrial or freshwater species that only fly over Bass Strait are excluded.

Significant mortality of albatross and petrel species in Australian waters including those off Tasmania has been documented due to by-catch in long-line fishing operations (e.g. Baker et al. 2002). Other threatening processes acting upon marine birds that were listed by Baker et al. (2002) include ingestion of, and entanglement in marine debris (e.g. discarded fishing nets or line), overfishing of bird prey species, predation by feral pests at breeding colonies, erosion and loss of coastal and island breeding sites by human and stock trampling, and contamination by pollutants. The last process includes oil spills.

Contamination by pollutants is considered a less significant issue for albatross and petrel conservation than overfishing and fishing bycatch, or predation by feral pests on the breeding grounds. Although mitigation measures have been put in place for long-line fishing by-catch and strategies implemented for dealing with events such as oil spills, the relative mortality due to contamination by pollutants has not been measured. The effect of the dioxin in the pulp mill effluent on seabirds in the study area has been assessed by Toxikos Pty Ltd (2006), based on extensive literature review. Toxikos Pty Ltd (2006) selected dioxins as potential pollutants because of the potential for bioaccumulation in marine organisms, including birds. Their review, together with additional relevant discussion is summarised below.

Some marine and migratory bird species are potentially at risk from the effects of bioaccumulation. Resident species of seabird breeding in Bass Strait are more likely to be affected by bioaccumulation arising from ingestion by lower trophic order prey in and surrounding the effluent plume. Potentially affected species include Little Penguin, Silver Gull, Pacific Gull, Kelp Gull, Australasian Gannet, Black-faced Cormorant, Crested Tern, White-bellied Sea-Eagle and Hooded Plover.

Toxikos Pty Ltd (2006) examined two particular bird species as sentinel species to investigate the potential effects of contaminant bioaccumulation in their body. By selecting as examples species that mainly eat fish, calculations were performed to give an indication of any ill effects based on recommended maximum levels of toxicity of key dioxins present in the effluent compared to the average time spent within the expected effluent plume.

Toxikos Pty Ltd (2006) used guidelines from Environment Canada and the US EPA, where thresholds of toxicity above which harmful effects in fish-eating birds may be expected are: 4.75 pg TEQ per gram of diet in tissue residue (where TEQ is the contaminant toxicity equivalent), and an average daily intake of 14,000 pg TEQ per kilogram of bodyweight. A dilution factor of 1 in 100, i.e. one one-hundredth of the concentration released into the environment, is assumed (this is known as the DV100). This is a conservative figure since expected exposures are lower than the DV100.

A BSAF (biota sediment accumulation factor) was applied to each species or prey group known from the Little Penguin and White-bellied Sea-Eagle diets and factored proportionately to calculate the concentration of dioxins entering each species via their diet.

It was found that the average concentration of dioxin for the Little Penguin was 0.093 pg TEQ/gram wet weight of diet. For White-bellied Sea-Eagle, a concentration of 0.16 pg TEQ/gram wet weight of diet was found.

Average daily dose was calculated using an area use factor (taking into account home range versus the expected area of Dy100), ingestion rates and bodyweights, to arrive at figures of 2.5 pg TEQ/kg body weight/day for the Little Penguin and 13.2 pg TEQ/kg body weight/day for the White-bellied Sea-Eagle.

These figures indicate that dioxin levels predicted for both Little Penguin and White-bellied Sea-Eagle are below the guideline levels of dietary residue set for fish-eating birds by Environment Canada and the US EPA. The guideline levels are calculated as a low risk level of ingestion, above which harmful effects upon the species may result.

In many of the other species (i.e. Silver Gull, Pacific Gull, migratory and resident shorebirds including the Hooded Plover), bioaccumulation is expected to be lower than for fish-eating species because of the more generalised diets (or specialised diets mainly lacking fish) of the latter (see Table 3). Due to dilution of the plume, it is also expected that the prey species of these inshore species are less likely to be affected by exposure to effluent plume dioxins than the fish eaten by marine seabirds that normally forage in the zone 3 km offshore (Table 3).

The Australasian Gannet, Black—faced Cormorant and Crested Tern are fish eating species (see Table 3) that may be affected in similar ways to the Little Penguin and White-bellied Sea-Eagle. It would therefore be expected that bioaccumulation of dioxins in these three species would be below guideline levels, particularly the Australasian Gannet which does not breed near the Tamar Estuary. The closest active breeding site is at Black Pyramid in western Bass Strait, 220 km from the outfall (Marchant and Higgins 1990).

Other information implicates decreases in the populations of the two Giant-Petrel species (*Macronectes* spp.) due to agricultural pesticide ingestion (Baker et al. 2002). Because these species are migratory omnivorous scavengers, most commonly spending the months May to September in Bass Strait waters (Reid et al. 2002), and because they traverse a large area of ocean in the course of their normal foraging routines, they are expected to be affected by the pulp mill effluent less than resident species that have a predominantly fish diet. The proportion of time that individuals of this species would spend in the area most affected by the plume would be minimal.

The area affected by the effluent plume and, therefore, the proportion of the available prey for foraging seabirds likely to be affected by dioxins, is limited. The seabirds that occur in the study area move across significant distances to forage and would therefore spend most of their time foraging on prey from areas other than that affected by the effluent plume.

Based on the extent of the plume and related prey effects, and the usual behaviour of foraging seabirds, the probability of a significant proportion of a

seabird's population in Tasmania being affected through bioaccumulation of effluent dioxins from the proposed mill is considered to be very low.

7.2. Construction of wharf

Construction of the wharf on the rocky shore adjacent to the new pulp mill site would create short-term disturbance of the surrounding estuary. Given that the shoreline at this point is almost entirely rocky and adjacent to a very deep part of the estuary, few migratory or marine birds are expected to use it. It is therefore unlikely that any significant impacts on populations of these species would result from this disturbance.

The nearest habitats regularly used by shorebirds lie north of Georgetown, around the corner from and north of the proposed wharf. Additional habitats occur on the western side of the estuary over 1 kilometre away. This distance is considered sufficiently great that disturbance to birds here from the construction of the proposed wharf is highly unlikely.

Ship movements will involve slow-moving vessels likely to create limited wake that is not expected to significantly increase wave action at the shoreline. It is understood that the net increase in shipping movements within this part of the estuary is likely to be small. Intertidal habitats in the estuary will therefore not be subject to significantly different levels of shipping wake from the current levels.

The impact of increased noise during construction is discussed later in this section.

7.3. Removal of sand from beach at outfall crossing

The removal of sand for construction of the effluent outfall pipeline is a temporary environmental effect that will last from six to eight months. It will occur across a distance of up to 25 metres in width (Draft IIS Vol. 16, App. 50,p. 5).

Temporary disturbance from construction works may affect beach-nesting shorebirds such as the Hooded Plover and Red-capped Plover, and those shorebirds that feed or roost in such habitat such as Pied Oystercatcher and Sooty Oystercatcher, Silver and Pacific Gulls and Crested Terns. The dunes behind the beach at the proposed outfall crossing point are limited in extent, so are unlikely to be important habitat for nesting Hooded Plovers. For other species, disturbance may occur out to a distance of several hundred metres from the works area. This may cause some nesting pairs of these species to move further up or down the beach to nest. Roosting seabirds, such as gulls and terns, are likely to move a similar distance away to roost on nearby parts of the beach. These effects are temporary and are not expected to significantly disrupt populations of the affected species.

Direct habitat impacts are considered to be temporary given the rapid accretion and erosion of sand due to wind and wave action. It is therefore expected that this impact would be ameliorated within a few weeks after completion of construction works.

7.4. Lighting at night

Migratory birds and seabirds have been found vulnerable to increased light and are prone to disorientation and to collisions with structures that are artificially lit (Montevecchi 2006; Gauthreaux and Belser 2006). Young, fledgling birds are more prone to collision than adults. Most importantly, this applies to nocturnally active birds, whether feeding or returning to colonies. Phases of the moon have also been found to have an influence on seabird behaviour around lit structures. Generally, activity at breeding colonies is found to be less during full moon phases. During new moon phase, this activity is greater, and more birds have been found to be attracted to and collide with artificial light sources at this time.

In summary, increases in background light and activity may:

- Disorientate breeding birds returning to colony at night;
- Decrease the amount of time birds attend to their nests;
- Displace birds from breeding or feeding grounds.

Increased levels of light at night may have detrimental effects on breeding colonies and long distance migratory birds, and may disorientate birds returning to breeding colonies after dark. The most significant lit structure near marine and estuarine habitats will be the proposed wharf on the eastern side of the Tamar estuary. No significant shorebird habitats or marine bird foraging habitats or breeding colonies exist near the proposed wharf, so such effects are extremely unlikely. For the same reason, effects on migratory and marine birds from the lights of the nearby mill (inland slightly) are equally unlikely to lead to impacts on their behaviour or populations.

Although theoretically susceptible, shorebirds are unlikely to be adversely affected by artificial lighting as they have been regularly recorded foraging and roosting in environments subject to high levels of artificial lighting in urban areas (B. Lane, pers. obs.). Given the distance of the pulp mill from areas of habitat (i.e. shorebird feeding sites on the opposite side of the Tamar Estuary) and existing light sources, such as Georgetown and the woodchip mill, it is considered that lighting from the pulp mill will not have a significant incremental impact on foraging shorebirds across the estuary.

7.5. Increase in noise levels

Hearing is an important sense that is used for communication, feeding and predator avoidance in birds. Generally, increases in ambient noise levels may cause disturbance and decreased ability to detect sounds against background noise. This in turn may lead to changes in behaviour, increased stress, and decreased feeding and breeding success, and potentially increased chance of predation.

Little specific information exists on the effect of underwater and airborne noise on seabirds or shorebirds. There is no evidence that seabirds communicate by sound while under water (Mustoe 2006) and furthermore, most seabirds are visual feeders, relying more on vision while feeding. The

large areas covered during foraging by seabirds would expose individual birds to noise from construction works for the offshore effluent pipeline for a brief period of time rather than continuously. Impacts are therefore unlikely to be sustained or significant.

The feeding method of migratory and resident shorebirds involves probing soft mud or sandy substrates to extract benthic invertebrate prey. Noise impacts would therefore be airborne and subject to attenuation at increasing distance. Given that there appear to be no suitable foraging or roost sites in the vicinity of the pulp mill site or near the construction areas for the water supply and effluent pipelines, from which most noise would be generated, it is highly probable that there would be little impact upon shorebird foraging in any of the significant shorebird habitats identified in this report.

7.6. Conclusions

In conclusion, the impacts of the proposed pulp mill and its associated works are summarised below.

- No significant habitat for migratory or marine bird species will be removed for construction of the project.
- No significant population effects on seabirds are expected as a consequence of permanent additional sources of noise, light and human activity associated with the development.
- No significant effects are expected on migratory or resident shorebirds in the Tamar's main shorebird habitats as these occur at least one kilometre or more from the proposed mill and wharf site.
- Shipping movements in the Tamar estuary are not expected to change greatly with the advent of the pulp mill and ship wake effects no coastal habitats for shorebirds are therefore unlikely to change significantly.
- Construction impacts in shorebird habitats (Tamar Estuary and Bass Strait beach) are unlikely to affect shorebirds and roosting seabirds significantly.
- Construction effects on foraging seabirds are not expected to disrupt the foraging activities of marine birds significantly.
- Dioxins in effluent are not anticipated to accumulate in marine bird prey species in concentrations that represent a risk to the individuals of those species foraging in the vicinity of the effluent outfall (Toxikos Pty Ltd 2006).

8. MITIGATION

Mitigation and monitoring measures should aim to minimise impacts on the breeding and non-breeding seabirds and migratory and resident shorebirds. The mitigation measures and recommendations are based on the existing knowledge of the ecology, breeding biology and feeding behaviour of the marine and migratory birds that occur in the study area. They take into consideration all the potential impacts on marine and migratory birds from works associated with the Bell Bay Pulp Mill Project.

Consideration should be given to the monitoring and mitigation measures described below.

- Non-destructive sampling should be considered of local populations of local fish eating birds such as the Little Penguin, Australasian Gannet, Black-faced Cormorant and White-bellied Sea-Eagle (if possible) to provide baseline data on dioxin residue levels in these species prior to effluent being released from the pulp mill into Bass Strait. It is also recommended that comparative data for a common coastal omnivore, the Silver Gull also be obtained.
- Post-operational monitoring of dioxin levels in these species should be considered for an acceptable period to test the levels of bioaccumulation predicted by Toxikos Pty Ltd (2006).
- Installation of the effluent outfall pipeline on the shore of Bass Strait could overlap with the breeding season of the Hooded Plover, which runs from late August to March (Marchant and Higgins 1993), and other resident shorebirds. If construction commences within this period, consideration should be given to a pre-construction check of a 200m wide zone either side of the construction zone to check for breeding birds before construction begins. Any nests should be clearly marked and construction activities kept on the opposite side of the pipeline alignment from the breeding birds. The beach profile in this area should be restored to its original shape after construction is completed.

9. REFERENCES

Baker, G. B., Gales, R., Hamilton, S., Wilkinson V. (2002). Albatrosses and petrels in Australia: a review of their conservation and management. Emu, 102: 71-97.

Brothers, N., Pemberton, D., Pryor, H., and Halley, V. (2001). Tasmania's Offshore Islands: Seabirds and other Natural Features, Tasmanian Museum and Art Gallery, Hobart.

DPIWE (Department of Primary Industries, Water and Environment) (2000) Threatened Species Strategy for Tasmania, Threatened Species Unit, Nature Conservation Branch, Hobart.

DPIWE (Department of Primary Industries, Water and Environment) (2004), 'A brief for Consultants: Reporting on the impact of proposed activities on natural values and providing recommendations for mitigating impacts on these values , Nature Conservation Branch, Hobart.

Garnett, S. T. and Crowley, G. M. (2000) The Action Plan for Australian Birds 2000, Natural Heritage Trust, Canberra.

Gauthreaux, S.A. Jr. and Belser, C.G. (2006) Effects of Artificial Night Lighting on Migrating Birds. In: Ecological Consequences of Artificial Night Lighting. (Ed). Rich, C. and Longmoore, T. Island Press, Washington.

Higgins, P. J. and Davies, S. J. J. F. (1996) The Handbook of Australian, New Zealand and Antarctic Birds, Volume 3: Snipe to Pigeons, Oxford University Press, Melbourne.

Lane, B. (1987), Shorebirds in Australia, Nelson Publishers, Melbourne.

Marchant, S. and Higgins, P. J. (1990) Handbook of Australian, New Zealand & Antarctic Birds, Volume 1 Ratites to Ducks, Oxford University Press, Melbourne.

Marchant, S. and Higgins, P. J. (1993) Handbook of Australian, New Zealand & Antarctic Birds, Volume 2 Raptors to Lapwings, Oxford University Press, Melbourne.

Montevecchi, W.M. (2006) Influences of Artificial Light on Marine Birds. In: Ecological Consequences of Artificial Night Lighting. (Ed). Rich, C. and Longoore, T. Island Press, Washington.

Mustoe, S. (2006) 'Marine Mammal and Little Penguin Impact Assessment', Draft report produced for Maunsell. 4 August 2006 Version 1.0.

Reid, T., and Park, P. (2003), 'Continuing decline of Eastern Curlew (Numenius madagascariensis) in Tasmania', Emu 103: 279-283.

Toxikos Pty Ltd (2006) 'Marine Impact Assessment - Bell Bay Pulp Mill Effluent', Report for Gunns Limited, November 2006.

Watkins, D. (1993) 'A National Plan for Shorebird Conservation in Australia', Australasian Wader Studies Group, Royal Australasian Ornithologists Union and World Wide Fund For Nature, RAOU Report No. 90.

Appendix 1: Summary of significant impact guidelines under the EPBC Act.

Listed threatened species and ecological communities

An action will require approval under the EPBC Act if it is likely to have a significant impact on species that are:

- extinct in the wild;
- critically endangered;
- endangered; or
- vulnerable.

An action will also require approval under the EPBC Act if it is likely to have a significant impact on an ecological community listed as:

- critically endangered; or
- endangered.

The significant impact guidelines criteria are different for each of the above categories. These are as follows.

Extinct in the wild

"An action is likely to have a significant impact on extinct in the wild species if there is a real chance or possibility that it will:

- *adversely affect a captive or propagated population or one recently introduced/reintroduced to the wild; or*
- *interfere with the recovery of the species or its reintroduction into the wild."*

Critically endangered and endangered species

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

- *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 the species is likely to decline;*
- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;*
- *introduce disease that may cause the species to decline; or*

- *interfere with the recovery of the species."*

Vulnerable species

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

- *lead to a long-term decrease in the size of an important population of a species;*
- *reduce the area of occupancy of an important population;*
- *fragment an existing important population into two or more populations;*
- *adversely affect habitat critical to the survival of a species;*
- *disrupt the breeding cycle of an important population;*
- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*
- *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."*

Critically endangered and endangered communities

'An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- *reduce the extent of an ecological community;*
- *fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;*
- *adversely affect habitat critical to the survival of an ecological community;*
- *modify or destroy abiotic(non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;*
- *cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;*
- *cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:*
    - *assisting invasive species, that are harmful to the listed ecological community, to become established; or*

- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants in the ecological community which kill or inhibit the growth of species in the ecological community; or

- *interfere with the recovery of an ecological community."*

Listed migratory species

Listed migratory species include species listed in:

- appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a Range State under the Convention;
- the Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); and
- the Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Any native species identified in an international agreement approved by the Commonwealth Environment Minister are also included in this category.

The Administrative Guidelines on significance for listed migratory species state:

'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 regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;*
- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or*
- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

An area of 'important habitat' for a migratory species is:

- *habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or*
- *habitat that is of critical importance to the species at particular life? cycle stages; and/or*
- *habitat utilised by a migratory species which is at the limit of the species range; and/or*
- *habitat within an area where the species is declining."*

Wetlands of International importance

"Approval is required for an action occurring within or outside a declared Ramsar wetland if the action has, will have, or is likely to have a significant impact on the ecological character of the Ramsar wetland."

This clause under the EPBC Act has no relevance to this study because there are no declared Ramsar wetlands in the study area. The closest are within the same drainage catchment i.e. the Lower Ringarooma River Floodplain (>80km from the study area) and Little Waterhouse Lake (>50km), both of which are situated beyond the region likely to be affected by the pulp mill project.

Listed Marine Species

Listed marine species fall under the category of "other matters of national significance" under the EPBC Act. It is a list established under the Act that provides protection for these species. The Act states that:

"it is an offence to kill, injure, take, trade, keep, or move any member of a listed marine species on Commonwealth land or in Commonwealth waters without a permit."

The gazetted list of marine species has been updated by a Ministerial declaration dated 14 August 2000 under s248 of the EPBC Act.