

Port of Hastings Development Project Waterbirds Desktop Review and Study Design

DRAFT REPORT

Prepared for AECOM and GHD Joint Venture

18 December 2014

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In May 2016 the Special Minister of State asked Infrastructure Victoria to provide advice on the future capacity of Victoria's commercial ports. Specifically, the Minister has asked for advice on when the need for a second container port is likely to arise and which variables may alter this timeline. The Minister has also asked for advice on where a second container port would ideally be located and under what conditions, including the suitability of, and barriers to investing in, sites at the Port of Hastings and the Bay West location.

In undertaking this task, Infrastructure Victoria reviewed work that was completed as part of the Port of Hastings development project before it was cancelled in 2014. This document forms part of the initial work undertaken for the proposed port development at Hastings. Infrastructure Victoria considers that much of the previous Hastings work, although preliminary in nature, is relevant and suitable for informing a strategic assessment. Therefore, Infrastructure Victoria has made the reports previously commissioned for the development project part of the evidence base on which Infrastructure Victoria will use in providing the Minister with advice.

The opinions, conclusions and any recommendations in this document are based on conditions encountered and information reviewed at the date of preparation of the document and for the purposes of the Port of Hastings Development Project.

Infrastructure Victoria and its consultants have used the information contained in these reports as an input but have not wholly relied on all the information presented in these reports.

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Glossary of Terms

Term	Description
Authority	Port of Hastings Development Authority
Transport infrastructure development area	Road and provision for rail corridors and associated rail marshalling staging areas to connect the port with the state and national transport networks.
Marine development area	Marine components of the project including shipping channels, swing basins, anchorage and aids for navigation connecting the port to Bass Strait as well as dredging and dredge material management.
Port landside development area	Port precinct and port environs within the area zoned as Special Use Zone 1 (SUZ1) for port related activities, and the container terminal at Long Island Point which extends into the intertidal area of Western Port. Also includes the SUZ1 area at Crib Point and the Stony Point jetty.
Project	Port of Hastings Development Project
Project area	Area where the project is located
Study area	Area considered by this assessment

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1. Introduction

1.1 Context

1.1.1 Project overview

The Victorian Government has identified the Port of Hastings as a key area for port expansion.

An expanded Port of Hastings will increase capacity and competition in the container ports sector servicing Melbourne and Victoria helping to manage the expected growth in container trade.

The Port of Hastings Development Authority (the Authority) and its board were established in January 2012 under the *Transport Integration Act 2010*. The primary objectives of the Authority are to:

- manage and operate the Port of Hastings; and
- facilitate the development of the Port of Hastings as a viable alternative to the Port of Melbourne as a container port to increase capacity and competition in the container ports sector to accommodate future growth in trade, consistent with the vision statement and the transport system objectives.

Over the next three to four years, the Authority will be working to develop a business case for an expanded Port of Hastings and undertake comprehensive environmental assessment. This business case will include:

- preferred project design/scope (including transport connections)
- necessary environmental approvals (including impact assessment)
- preferred governance and delivery strategy

In May 2014, the Port of Hastings Development Project was declared a 'Major Transport Project' under the *Major Transport Project Facilitation Act 2009* (MTPF Act).

In July 2014, the then Minister for Ports, Mr David Hodgett, formally appointed the Authority as the Project Proponent under the MTPF Act

1.1.2 Environmental and social studies

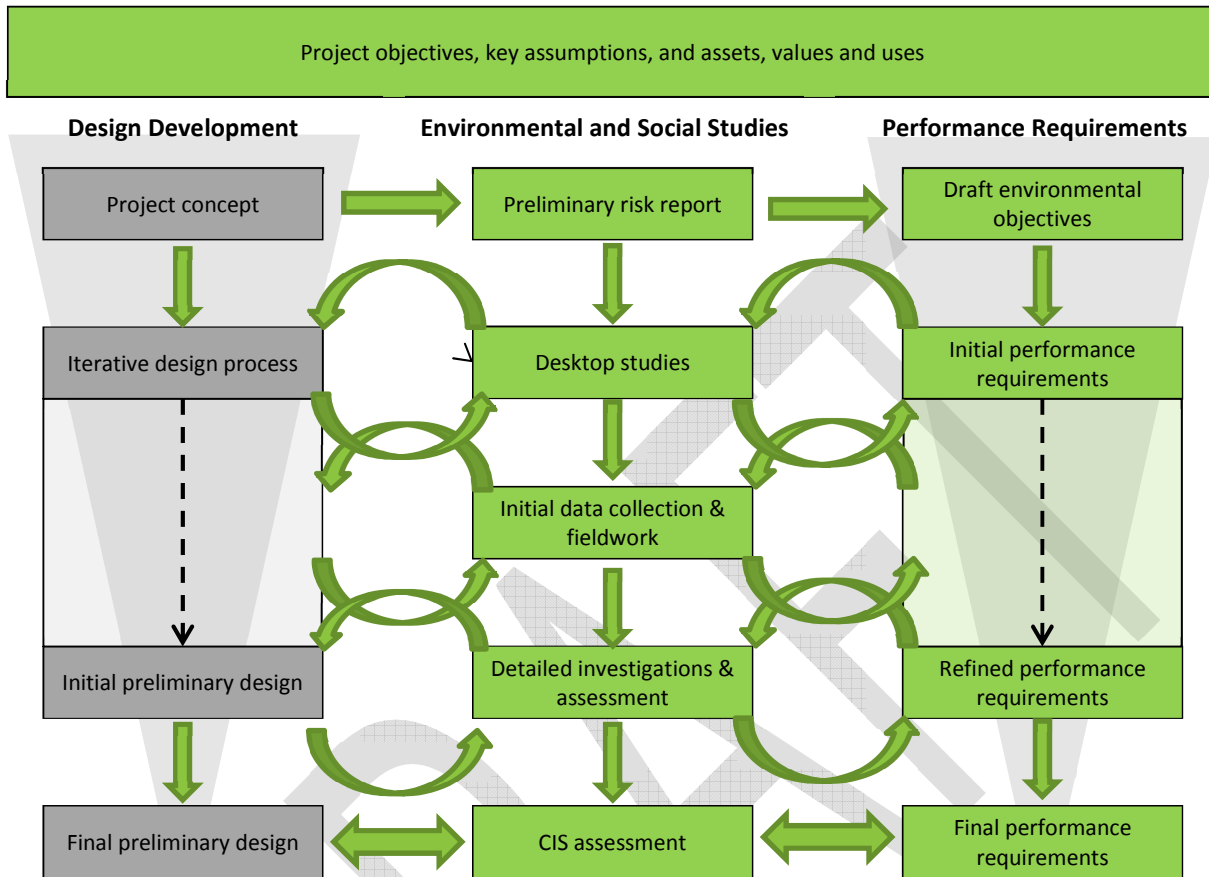
The overall design methodology for the Project involves an iterative design process which has commenced and will continue for around two years. The design process will cycle and re-cycle the evolving design through an evaluation process. This allows design options to be tested and evaluated against economic, environmental, social and other objectives and associated criteria. Performance requirements will be developed as an integral part of the design process to clearly define the environmental and social outcomes that the Project must achieve in its implementation phases. A preliminary design will be developed through the iterative design process and will demonstrate the way in which the Authority considers the Project could be developed so as to achieve the performance requirements.

Environmental and social studies are required for the Project to inform the design development process and to assess the Project in accordance with the Approvals Strategy previously adopted by the Authority. An overview of the framework for the environmental and social studies and their relationship with the design process is shown in Figure 1.

As shown in Figure 1, a stepwise approach is being employed to implement the environmental and social studies for the Project. This reflects both the integrated relationship between the studies and the iterative design development process and their ultimate purpose of informing assessment under the Major Transport

Projects Facilitation Act 2009 (MTPF Act) and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Figure 1 Framework for environmental and social studies



The key steps in the implementation of the environmental and social studies are:

- Undertake an initial assessment of needs using an issues screening process to identify priorities for studies
- Initiate environmental and social investigations required to support the design development process
- Undertake desktop reviews (this report) to complete the assessment of the adequacy of existing information and confirm methodology for any further existing conditions investigations, including field work (where required)
- At the relevant stage of project definition and taking into account emerging performance requirements, undertake field and other investigations to characterise existing conditions
- Following the issue of the preliminary design, undertake risk and impact assessments to support preparation of the Comprehensive Impact Statement (CIS).

Currently, the Project has progressed to the stage of initiating early phase environmental and social investigations (desktop studies) to support the design development. Through the issues screening process, collection of baseline information on waterbirds has been identified as a priority environmental study. This technical work will be conducted in conjunction with other technical studies to inform later phases of the Project.

1.2 Purpose and scope of this Report

The purpose of this report is to present a desktop review of the adequacy of existing information and confirm methodology for any further existing conditions investigations, including field work (where required) for waterbirds.

The scope of this report includes:

- Identifying the key questions to be addressed by a waterbirds baseline study in support of investigations being completed for the Project
- Review of existing background and historical data to identify its suitability to define existing conditions for waterbirds in support of design decision making, impact assessment, identification of relevant management and mitigation measures and development of performance requirements
- Identifying gaps in existing data or additional information needs which should be addressed to adequately inform design decisions, impact assessment, performance requirements and approvals
- Defining a waterbirds study method which will address any identified information requirements.

Detailed consideration of Little Penguins is outside the scope of this report and will be considered as part of a separate study by the Phillip Island Nature Park.

1.3 Limitations

The contents of this document reflect Biosis' current position on the subject matter of this document. It is provided for discussion or information purposes and is intended to be a guide only. The contents of this document should not be relied upon as representing Biosis' final position on the subject matter, except where stated otherwise. Any views expressed by Biosis in this document may change as a consequence of Biosis finalising formal technical studies or specifications, or legislative, or procedure and regulatory developments. Any figures provided are indicative only, are subject to change and are dependent upon a number of factors.

2. Waterbirds – background information

2.1 Waterbirds and ecological guilds

For the purposes of this project the term 'waterbirds' is used to encompass all species of birds that are wholly or substantially reliant on the waters of Western Port. This follows the definition in the Ramsar Convention (1971) in which 'waterfowl' are defined as "birds ecologically dependent on wetlands" (The Convention on wetlands text, as amended in 1982 and 1987

http://ramsar.rgis.ch/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1-31-38^20671_4000_0_)

The marine environment is integral to the ecology of such birds whilst they use Western Port. A number of other terms are used but usually these cover a subset of waterbirds as defined here. The term 'seabirds' is used in some of the relevant literature and is a loose subset of taxa that are more wholly reliant on open and deeper water than are some other species. The terms 'shorebirds' and 'waders' are largely interchangeable.

Birds are often considered in terms of 'guilds'. These are groupings of taxa that have similar ecologies (in particular similar feeding strategies), regardless of their taxonomic relationships. Guilds provide a useful break-down for a project such as this where impacts are required to be assessed and where functional ecological relationships may be of utility in evaluation of risk and impact pathways. Table 1 provides a list of the bird guilds included in this review along with a brief description of the characters that define them.

Table 1. Guilds of birds covered by this report.

Waterbird guild	Description	Typical species	Relevant ecological characters
Australasian shorebirds (waders)	All Australasian resident shorebird species. Also the trans-Tasman migratory species, Double-banded Plover.	plovers, lapwings, avocets, stilts and oystercatchers	Daily utilise terrestrial/shoreline roosting sites. Feed on benthic infauna of intertidal zones. Year-round residents. Double-banded Plover is routinely present in SE Australia Feb - Sept.
Ducks	All dabbling, diving and surface feeding waterfowl, excluding geese and swans	Chestnut and Grey Teal, Australian Shelduck, Pacific Black Duck, Musk Duck	Daily utilise terrestrial/shoreline roosting sites. Forage in freshwater, estuarine & shallow, sheltered near-shore marine environments.
Fishers	All fish-eating freshwater, estuarine and marine species, excluding most seabirds	cormorants, pelicans, terns, Little Penguin, White-bellied Sea-eagle	Daily utilise terrestrial/shoreline roosting sites & feed on near-surface fish/invertebrates at sea.
Grebes	Small surface-diving birds	Australasian, Hoary-headed and Great Crested Grebe	Daily utilise terrestrial/shoreline roosting sites. Forage mostly for invertebrates and small fish in freshwater, estuarine & shallow, sheltered near-shore marine. Daily require terrestrial/shoreline roosting sites.

Waterbird guild	Description	Typical species	Relevant ecological characters
Gulls	Scavenging species that are often thought of as members of the seabird guild, but unlike seabirds are regular users of estuarine environments	Pacific and Silver Gulls	Daily utilise terrestrial/shoreline roosting sites. Regular users of estuarine & near-shore marine environments. Substantially scavengers.
Large wading birds	All long-legged, large-bodied wading birds that are not annual transequatorial migrants	herons, ibis, spoonbills and egrets	Daily utilise terrestrial/shoreline roosting sites. Feed on benthic infauna of intertidal & shallow water zones. Utilise freshwater & estuarine environments. Generally feed on larger-bodied prey than waders.
Holarctic shorebirds (waders)	Transequatorial migrants that typically breed in the Arctic (above 60° latitude) and spend the nonbreeding period during the austral summer in southerly latitudes.	sandpipers, curlews, godwits and plovers	Daily utilise terrestrial/shoreline roosting sites. Feed on benthic infauna of intertidal zones. Most species routinely present in SE Australia Aug/Sept – April. A small portion of the populations of a few species often remain in SE Australia during austral winter.
Rails	Freshwater and estuarine edge-feeders, mostly skulk in dense vegetation but coots feed from open freshwater	coots and swampheens	Daily utilise terrestrial/shoreline roosting sites. Freshwater and estuarine edge-feeders, largely reliant on dense vegetation but coots feed from open freshwater.
Large herbivores	Swans and geese	Black Swan, Cape Barren Goose, Magpie Goose	Daily utilise terrestrial or shoreline roosting sites. Obligatory herbivores. Black Swan feeds on seagrass regularly occurring in intertidal areas and on shallow marine waters in Western Port.
Pelagic birds	Species that feed in pelagic environments & generally only breed on-shore	giant-petrels, petrels, prions, shearwaters, albatrosses, storm-petrels	Routinely do not come ashore in Western Port. Feed on fish, squid, etc in pelagic environments. A few species use embayments including open waters of Western Port.

2.2 Overview of waterbird dynamics and population assessment

The mobility of birds means that many species range widely and of the guilds considered here none are wholly reliant on, or contained by Western Port. This, and a number of other influences, means that an array of factors – many of which are external to Western Port – affect the abundance and spatial and temporal use of the bay by almost all waterbird species.

A relatively small number of the species that use Western Port are sedentary. One example is the Hooded Plover *Thinornis rubricollis*. Many other species that have capacity for wide-ranging movements may not move widely if Western Port permanently provides all of their requirements. Of the species known to nest at Western Port, the majority do so on French Island and other small islands where foxes are not present (Hansen *et al.* 2011).

The very great majority of waterbirds that use Western Port are nomadic or migratory.

Nomadic species in Australasia have substantial capacity to move across the continent and the wider region to take advantage of suitable resources as and where they are available. These birds are thus well suited to dealing with continentally unpredictable rainfall and drought and consequent wetting and drying of wetlands. Other than pelagic birds, fishers that are strongly tied to marine environments, obligate migrants and the few sedentary species, all waterbirds using Western Port have nomadic ability.

A large portion of the birds using Western Port are migratory. Migrants make regular annual movements, often along defined flyways, between areas where they breed and areas they use during the non-breeding portion of the year. Many have very specific annual routines and their migrations are highly predictable. The majority of shorebirds using Western Port breed in high latitudes of the northern hemisphere and are known as Holarctic species. These migrants are in southern Australia during the austral spring-summer. Some non-breeding individuals may remain here for our winter but the majority depart and the bulk of their populations are absent during the austral winter. The Double-banded Plover *Charadrius bicinctus* breeds in New Zealand and is present in southern Australia during winter. Many pelagic birds including petrels, giant-petrels, shearwaters, albatrosses and some terns breed on islands of the Southern Ocean and are present in southern Australian waters only during the austral winter. Short-tailed Shearwaters *Ardenna tenuirostris* breed in colonies in southern Australia coastal locations, including at Phillip Island, and migrate annually to the northern Pacific Ocean.

The following factors are some of the natural and anthropogenic influences that may affect the seasonal, annual and long-term variability in waterbird usage of Western Port as a whole. Some of them will also affect variable usage within Western Port. These affects are widely discussed in the literature.

- Continental and regional drought and rainfall events
- Natural environmental variables affecting breeding success at distance breeding sites
- Climate change
- Freshwater flow regulation and water extraction
- Variable abundance of prey species within and outside Western Port
- Loss of key wetland sites due to human developments, such as major wetland reclamation in north Asia
- Commercial and recreational fishery impacts on waterbird prey species and by-catch of pelagic birds
- Recreational use of coastal locations by people and companion animals

2.3 Significance of Western Port to waterbirds

Western Port is internationally recognised as an area of significant habitat for waterbirds including many species that are threatened or are protected as international migratory species.

- Western Port is internationally recognised as an area of significant habitat for waterfowl and migratory birds and is listed under the Ramsar Convention. It is worth noting that the name of the Ramsar Convention in full is the "Convention on Wetlands of International Importance especially as Waterfowl Habitat". Western Port Ramsar site encompasses the majority of Western Port, excluding the land areas of French Island and Phillip Island. The southern boundary of the Ramsar site extends from the Phillip Island bridge around the north coast of the island to the eastern end of Silverleaves Estate (near Cowes) and then in a straight line westwards to Point Leo on the western shore of Western Port.
- One hundred and fifteen waterbird species have been recorded within the Ramsar site (Kellogg Brown & Root 2010).

- Waterbirds are identified by the Western Port Ecological Character Description (ECD) as a critical component of the Ramsar site (Kellogg Brown & Root 2010). Three of the five criteria required to satisfy the listing of the site in 1982 directly relate to waterbirds within the site.
- In 2010, Western Port was also listed as an Important Bird Area (BirdLife International) on the basis that it regularly supports more than 1% of the global population of Eastern Curlew, Red-necked Stint and Australian Pied Oystercatcher, plus declining numbers of two threatened species, Fairy Tern and Orange-bellied Parrot.
- Many waterbird species that use Western Port are protected under international agreements for the protection of migratory birds to which Australia is a signatory (CAMBA, JAMBA, ROKAMBA and the Convention on Migratory Species (or 'Bonn Convention')).

Appendix A tabulates waterbird species that are listed as threatened or protected under specific provisions for migratory and marine species under Commonwealth and Victorian legislation and policy.

Extensive long-term monitoring of waterbird numbers has been conducted in Western Port by a range of government agencies and NGOs.

While a number of seabirds are known to utilize the waters of Western Port, populations of those species are not reliant on the bay and many of them have wide pelagic or near-shore distributions. The most important values of Western Port for waterbirds are in the extensive shoreline, shallow and intertidal environments it provides. Loyn *et al.* (2001) summarize these values as follows:

[Western Port] contains 27,000 ha of intertidal mudflat and is an important habitat for migratory waders, being ranked third in the State and among the top twenty in Australia in terms of wader numbers (Lane 1987, Dann 1994) and the number of species meeting criteria for international importance (maximum counts >1% of estimated flyway populations) (Watkins 1993).

2.4 Key habitats within Western Port

Key habitats for waterbirds with Western Port are detailed in Hansen *et al.* (2011) and summarized in their figure reproduced as Figure 2, below.

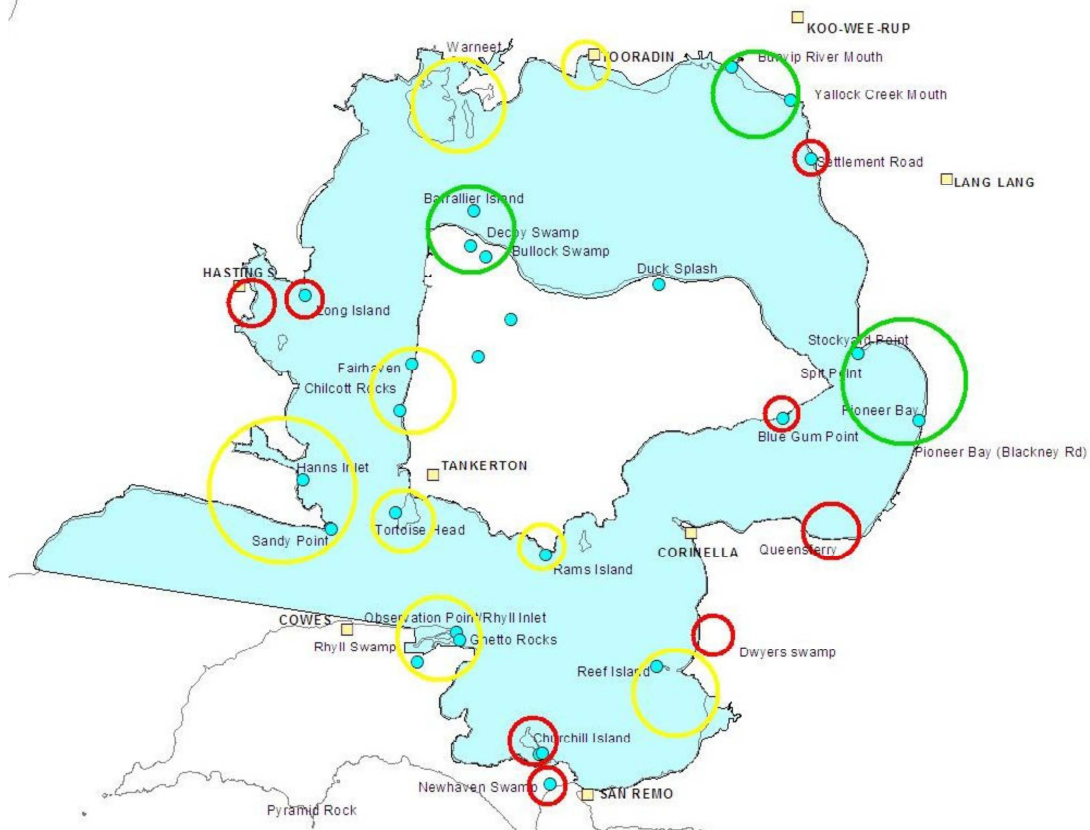


Figure 2 (reproduced from Hansen *et al.* 2011). Distribution of sites in Western Port and their relative 'importance', based upon rankings of total abundance and number of species. Green circles show the three highest-ranked sites, red circles the eight lowest-ranked sites, and the yellow circles are sites intermediate in importance. Blue shading indicates the Ramsar site. Individual monitoring sites are shown as small blue circles.

Given that the Project is centred on Hastings, the primary habitats that are expected to be most likely and/or most substantially influenced by it are those within and close to, the Lower North Arm and those close to ship passage to Hastings from south-west of Phillip island. These are:

- Barrallier Island/NW French Island
- Fairhaven
- Tortoise Head
- Sandy Point/Hanns Inlet
- Warneet
- Long Island
- Hastings Bight

3. Key questions

The Project has potential for direct and indirect impacts on migratory and other shorebirds, waterfowl and seabirds. These impacts may be broadly grouped into four categories:

- Direct loss of habitat, especially areas used for foraging and for roosting
- Direct loss of habitat through sedimentation, hydrodynamics and disturbance effects
- Indirect impacts through loss of trophic resources such as infauna and fish species
- Accidental impacts, such as petrochemical spills.

Key questions to be considered by the waterbirds study will therefore include:

- Which species are of primary importance or concern?
 - *Are there listed threatened or migratory species that may be affected?*
 - *Are deleterious effects likely to be significant (as defined by relevant government policies)?*
 - *Are important sites for particular species (regardless of their conservation status) likely to be effected?*
- What are the extent, quality and locations of waterbird habitats within Western Port?
 - *What are the seasonal and diel trends in waterbird use of habitats?*
 - *What is the relative importance to waterbirds and to particular species of habitat within the Lower North Arm?*
 - *For specific locations of key waterbird resources, what is their dependency on trophic resources?*
 - *Are waterbirds likely to be affected by impacts on trophic resources at key locations?*
 - *How important is habitat within Western Port relative to other waterbird habitats in Victoria?*
- How can impacts on waterbirds in Western Port be measured/predicted?
 - *How does the current baseline compare to the 1982 Ramsar baseline as defined by limits of acceptable change outlined in the Western Port Ramsar Ecological Character Description (Kellogg Brown & Root 2010)?*
 - *What is the correlation between area of habitat and number of waterbirds?*
 - *What effects on trophic resources for waterbird species may occur? Can these be measured?*
 - *What other disturbance effects should be considered?*
 - *What are the long term trends in waterbird presence in Western Port?*
 - *What external influences on waterbirds need to be considered by the Project?*

4. Review of existing information

A review of existing background and historical data on waterbirds was carried out to ascertain the current level of information available to determine existing conditions for waterbirds for the Project. The review was concentrated on published information related to waterbirds of Western Port and publications that reviewed and encompassed previous studies. Much relevant information about waterbird ecology and conservation is contained in additional published information from the wider distributions of many species but comprehensive coverage of all such for the purposes of this initial desktop assessment was not feasible. The bibliography provided by Hansen *et al.* (2011) should be consulted for many applicable references. Key publications of potential and specific relevance are summarised in Table 2.

4.1 Primary findings

With the exception of Biosis Research (2009) (which is largely incorporated in Hansen *et al.* 2011), and surveys undertaken by Arthur Rylah Institute in 2014 (Menkhorst *et al.* 2014) none of the existing published information was designed to inform assessment of any potential effects of the Port of Hastings Development Project.

The two principal published reports of relevance are Hansen *et al.* (2011) and Dann *et al.* (2003). These are both based on systematic bird monitoring regimes.

Hansen *et al.* (2011) provides background information for 66 species. The report reviews systematic investigations spanning 37 years primarily carried out by specialist bird interest groups. The surveys were mostly land-based and the coverage is thus substantially focused on coastal and near-shore species. The report outlines long-term numerical trends for the portions of the populations that utilize Western Port for many of those species. It details the localities of important roosting and foraging sites for many species, with an emphasis on shorebirds. Surveys undertaken in 2014 (Menkhorst *et al.* 2014 and associated data) provide additional counts for 43 of the same species from sites in North Arm for summer and autumn 2014.

Dann *et al.* (2003) documents a four-year investigation of seabirds within Western Port, excluding the Upper North Arm and Corinella segment. The surveys were boat-based and specifically excluded areas of less than two metres water-depth. The primary value of the study is its documentation of 25 species within Western Port, but it is not specific about areas utilized by the species recorded. It reports seasonal use by a number of species but highlights the degree of unpredictability of such use and variability in numbers of many species.

The two principal reports are substantially complementary in their coverage of species. There is some overlap in species reported but they largely report on different suites of species and in combination cover the entire waterbird fauna of Western Port.

The other literature falls essentially into two categories. The first are broad-scale evaluations of the conservation status and trends in the national and international populations of waterbird species and guilds. The second are specific investigations of the biology or conservation of particular species, sometimes at particular locations. This body of information has relevance to the Project assessment in understanding population dynamics of waterbirds and the role that Western Port plays within that wider context. Knowledge of the ecology of particular species is relevant to understanding how effects, including indirect effects, of the Project might influence those species, such as via trophic pathways.

The ultimate objective of investigations for assessment of the Port of Hastings Development Project will be to evaluate potential impacts and risks it poses to waterbirds.

The present review has highlighted that there is a relatively poor current understanding of even some fundamental aspects of waterbird ecology within Western Port. For example, Dann *et al.* (2003) suggest that observed influxes of some seabird species into portions of Western Port may occur in response to seasonal occurrence of juvenile clupeoid fish species. However, those authors are clear that for seabirds (largely fishers and some pelagic species) details of ecological functions and relationships are largely unknown and speculative –even for common species. These factors include aspects such as the spatial and temporal variables influencing food resources and their availability to waterbirds. Writing in 2003, those authors reiterated Norman (1992) in saying that there was a lack of detail about local foraging by many seabird species. No published studies are known to have provided substantial further information for the majority of seabirds in Western Port since that time.

The work documented by Hansen *et al.* (2011) provides good baseline information about sites within Western Port that are of value to a range of species and particularly the locations of important roosting and foraging areas for shorebirds. However, an impact assessment will require more than knowing where key resources are located. It will be necessary to understand *how* the Project might affect birds at particular places, especially if its effects are indirect. It will also require an understanding of *when* effects might occur given that the biology of the various waterbirds operates to highly seasonal and daily regimes.

Table 2. Summary of relevant publications

Title	Scope/Abstract	Geographic Coverage /Relevance	Taxa covered	Relevance to Port of Hastings assessment
Western Port Welcomes Waterbirds: waterbird usage of Western Port. (Hansen, B., Menkhorst, P. & Loyn, R. 2011)	The project aimed at improving understanding of waterbird population dynamics and habitat use in Western Port. Primary focus was intertidal and coastal habitats within Western Port Ramsar site. Waterbird usage data spanning 37 years were collated. The dataset was analysed to identify trends in species abundance, important high-tide roosting sites and low-tide foraging areas. Movement patterns of two small shorebird species were also explored. Roosting sites were ranked by importance for waterbirds generally, and for shorebirds in particular, using a quantitative ranking system. Threats potentially impacting on important roosting and foraging sites were identified and management recommendations provided.	Western Port. Survey methods primarily shore-based	Waterbirds, except pelagic seabirds	Details locations of key resources to substantial suite of waterbird species that may be affected, especially shorebirds. Provides quantified background population trends of species within Western Port. Routine shorebirds analyses current to 2009. Additional surveys undertaken in 2010/11. 1997 - 2009 drought affected some waterbirds.
Waterbird surveys of the Port of Hastings and north-west Western Port, 2014. (Menkhorst, P., Rogers, D. and Stamation, K. 2014.) & associated data.	Provides additional data to that of Hansen <i>et al.</i> (2011) for summer and autumn 2014 for sites in North Arm.	North Arm sites	Waterbirds, except pelagic seabirds	Specific to sites within North Arm that may be affected by the project.
Distribution and abundance of seabirds in Western Port, Victoria. (Dann, P.; Arnould, J.P.Y.; Jessop, R. & Healy, M. 2003)	Boat-based survey of distribution, abundance and biomass of seabirds in Western Port between 1991 and 1994. 25 seabirds and 9 waterbird species were recorded. Abundance and distribution of different species varied seasonally and annually and may be linked to available habitat within the bay.	Western Port. Survey method boat-based, excluded areas of less than 2 metres water-depth.	Waterbirds, except taxa confined to areas of less than 2 metres water-depth	Particular value is information about pelagic seabird use of Western Port. Locations within Western Port are not detailed. Data is from 4 years of surveys but now 20 years old.
Important wader sites in the East Asian-Australasian Flyway: 1. Western Port, Victoria, Australia. (Loyn, R.H., Dann, P. & McCulloch, E. 2001)	Summarizes values of Western Port to shorebirds of the East Asian-Australasian flyway.	Western Port	Migratory shorebirds	Information is substantially incorporated into the later work by Hansen <i>et al.</i> (2011).
Flora and Fauna assessment of Port of Hastings Stage One Investigation area, Victoria. (Biosis Research 2009)	Flora and fauna surveys of the study site, including some North Arm shorebird sites.	Some North Arm, Western Port, including Port of Hastings	Shorebirds	Short-term investigation, results incorporated into Hansen <i>et al.</i> 2011.

Title	Scope/Abstract	Geographic Coverage /Relevance	Taxa covered	Relevance to Port of Hastings assessment
The influence of climate variability on numbers of three waterbird species in Western Port, Victoria, 1973-2002. (Chambers, L.E. & Loyn, R.H. 2006)	Explores long-term waterbird counts from Western Port of Black Swan, White-faced Heron and Grey Teal and compared to climatic data at local and continental scales.	Western Port	Black Swan, White-faced Heron, Grey Teal	Provides background information relevant to influence of climate change on 3 species.
Migratory Shorebirds of the East Asian - Australasian Flyway: Population Estimates and Internationally Important Sites. (Bamford, M.; Watkins, D.; Bancroft, W.; Tischler, G. & Wahl, J. 2008)	Article summarises the various migratory wader groups, their populations and internationally significant sites for each species. It also breaks down the international sites found in each country.	East-Asian - Australasian Flyway	All migratory shorebird species	Provides background information for entire East Asian - Australasian Flyway population estimates for migratory shorebirds.
A framework for monitoring the status of populations: An example from wader populations in the East Asian-Australasian flyway. (Amano, T.; Szekely, T.; Koyama, K.; Amano, H. & Sutherland, W.J. 2010)	This study focuses on shorebird populations in the East Asian-Australasian flyway, and offers a three-step framework for monitoring the status of populations. The framework considers the entire flyway populations and is not applicable to individual sites. Population changes of waders are quantified by estimating population indices from nationwide survey data in Japan between 1975 and 2008. Second, species characteristics shared by declining waders are identified using a phylogenetic comparative method. Finally, based on the revealed characteristics of declining species, composite indices are created for monitoring changes in wader communities in the East Asian-Australasian flyway. The population indices revealed that 12 species out of 41, and 16 out of 42 have declined significantly during spring and autumn migration, respectively, in at least one of the past 10, 20 or 30 year-periods.	East Asian-Australasian flyway	Ruddy Turnstone, Dunlin, Bar-tailed Godwit, Whimbrel, Black-winged Stilt	Provides background information for entire East Asian - Australasian Flyway population trends for migratory shorebirds.
Long-term trends of shorebird populations in eastern Australia and impacts of freshwater extraction (Nebel, S., Porter, J.L. & Kingsford, R.T. 2008)	Reports results of a large-scale aerial shorebird survey, sampling about a third of the Australian continent over a period of 24 years (1983–2006). Migratory shorebirds have declined by 73%, Australian resident shorebirds by 81%. Loss of wetlands due to river regulation is a significant contributor to the drastic decline in shorebird numbers in Australia.	Eastern Australia	Shorebirds	Provides background information related to continental declines of shorebirds

Title	Scope/Abstract	Geographic Coverage /Relevance	Taxa covered	Relevance to Port of Hastings assessment
Abundance, diet and feeding behaviour of the Whimbrel <i>Numenius phaeopus variegatus</i> in Rhyll Inlet, Victoria. (Dann, P. 1993)	Reports the numbers, diet and behaviour of Whimbrels 1977-1978. Maximum numbers for each year were 22 in Summer 1977 and 28 in Autumn 1978.	Western Port	Whimbrel	Provides example information for one species of migratory shorebird at a location within Western Port.
Roost availability may constrain shorebird distribution: Exploring the energetic costs of roosting and disturbance around a tropical bay. (Rogers, D.L., Piersma, T. & Hassell, C.J. 2006.)	Investigation of variables influencing shorebird usage of high tide roost sites.	Roebuck Bay, North-western Australia	Shorebirds	Provides information that may be relevant to determination of preferential use of roost sites at Western Port.
Determinants of preferred intertidal feeding habitat for Eastern Curlew: A study at two spatial scales. (Finn, P.G.; Catterall, C.P. & Driscoll, P.V. 2007)	The study found that Curlews preferred less resistant substrates which was mainly composed of sandy sites within	Moreton Bay, Qld.	Eastern Curlew	Provides example information for one species of migratory shorebird at a location in Queensland.

5. Information requirements

The information reviewed in section 4 has been considered with respect to the key questions listed in section 3. Table 3 presents the key questions, a summary of existing information and its capacity to answer the questions, and any additional information requirements.

Table 3. Current information & information requirements relative to key questions about waterbirds

Key question	Existing information available to answer question?	Information requirements
Are there listed threatened or migratory species that may be affected?	Information is available for Western Port generally (see Appendix A).	Specifics to be determined contingent on Project design
Are deleterious effects likely to be significant (as defined by relevant government policies)?	Unknown	To be determined contingent on Project design & specific information about sites used by relevant species.
Are important sites for particular species (regardless of their conservation status) likely to be effected?	Unknown	To be determined contingent on Project design & specific information about sites used by relevant species.
What are the extent, quality and locations of waterbird habitats within Western Port?	Known for shorebirds. Not for most other species.	For all species further specific information (e.g. quantified areas of key habitats) will be required in order to measure potential effects.
What are the seasonal and diel trends in waterbird use of habitats?	Seasonal information known for migratory species. Seasonal/annual influences unknown for all other species & not feasible to obtain. Diel activity patterns unknown for all species.	Field investigation into diel activity patterns for species that may be affected by 24 hour Project activities (construction or operational).
What is the relative importance to waterbirds and to particular species of habitat within the Lower North Arm?	Relative importance of sites throughout Western Port ranked by pooled numbers of species and total abundance by Hansen <i>et al.</i> (2011). Appears to principally relate to shorebirds.	
For specific locations of key waterbird resources, what is their dependency on trophic resources?	Unknown specifically for Western Port.	Investigate whether specific studies from elsewhere are applicable.
How important is habitat within Western Port relative to other waterbird habitats in Victoria?	Generally known. Bamford <i>et al.</i> (2008) provides relevant information for important shorebird sites.	
How does the current baseline compare to the 1982 Ramsar baseline as defined by the limits of acceptable change?	Ecological Character Description for the site and a discussion of Acceptable Limits of Change for waterbird abundance is contained in Kellogg Brown & Root (2010). Information in Hansen <i>et al.</i> (2011) provides information about baseline for many species as at 2011.	Would require updating to be current to commencement of project construction in order to provide valid benchmark against which to measure project-specific ALC.

Key question	Existing information available to answer question?	Information requirements
What is the correlation between area of habitat and number of waterbirds?	Unknown	Some relevant data may be available for shorebirds from DEPI (from data summarized in Hansen <i>et al.</i> 2011). GIS information may be required. Field investigations will be required to obtain current measures.
What other disturbance effects of the Project should be considered?	Not applicable	Information about potential effects of noise, artificial light, dredging, ship movements, etc. will need to be fully evaluated. Literature review related to all such effects will be required contingent on Project design.
What effects on trophic resources for waterbird species may occur? Can these be measured?	Unknown.	Will require information from Project studies of hydrodynamics, benthic infauna & fish (possibly others) & will be contingent on Project design.
What are the long term trends in waterbird presence in Western Port?	Trends for number of species are provided in Hansen <i>et al.</i> (2011).	Field investigation to add current data to that provided by existing data.

5.1 Prerequisites to assessment of Project effects on waterbirds

Following the information review undertaken it is apparent that some investigations will be necessary to appropriately inform an impact assessment for the Port of Hastings Development Project. The assessment will need to be able to evaluate potential impacts against Significant Impact criteria defined for the EPBC Act and limits of acceptable change defined in the Ecological Character Description. It is anticipated that further project-specific assessment guidelines will also be provided by relevant authorities.

Waterbirds are a key consideration in the designation of Ramsar sites. The majority of Western Port is a Ramsar site and an Ecological Character Description for the site (Kellogg Brown & Root 2010) provides information about waterbirds and a discussion of Acceptable Limits of Change for waterbird abundance there. It bases this on long-term count data including those for 1982, the year of Ramsar listing (now summarized in Hansen *et al.* 2011). This is likely to be considered in evaluation of potential impacts of the Project. The Ecological Character Description says the following related to Acceptable Limits of Change for waterbirds:

Based on BOCA survey data since 1973 and considering natural variability, a decline in the mean or maximum counts of 20 per cent over a five year period for the nonpelagic guilds ... is considered an appropriate limit of acceptable change (R. Loyn [ARI] 2009, pers. comm., 20 July). As waterbird numbers within the site can ultimately be influenced by extrinsic factors it is recommended that this limit of acceptable change only be applied unless it can be demonstrated that fluctuating numbers have resulted from external factors.

Additional investigations are required to clarify relationships between waterbirds and habitat availability.

It is not proposed here that major new baseline investigations of waterbird ecologies, such as studies of diets or distribution or density of prey resources, should be undertaken, but it is clear that there is not currently a sufficient basis for evaluating all potential effects of the Project.

An assessment of potential impacts of the Port of Hastings Development Project will need to be able to evaluate them relative to background data for specific locations (e.g. particular shorebird roost and foraging sites). In order to do that, detailed existing data for such sites will be required. Hansen *et al.* (2011) provide

long-term mean values and trends for a number of key locations and these will be useful, however none of the existing published information provides specific values for all locations that might be affected directly or indirectly by the Project. Raw data on which Hansen *et al.* (2011) was based is collated by DEPI and access to that data should be sought in order to facilitate such analyses.

Given the importance of Western Port to shorebirds (including Australasian shorebirds, large wading birds and Holarctic shorebirds) we consider that primary focus of further investigations should be on these guilds and on other listed threatened species.

In light of numerous effects on populations of relevant species that are external to Western Port as outlined above, it will not be possible to quantify effects on waterbird populations in absolute terms (e.g. measured by changes in absolute numbers of birds of particular species). Measuring changes in extent and/or availability of key foraging and roosting habitats is a feasible mechanism for quantifying effects of the Project. In order to achieve that it will be necessary to first have a good understanding of the specific locations and to measure the geographic extent of key resources used by significant waterbird species, especially listed threatened species and migratory shorebirds, and their temporal nature of their use of them.

One aspect that has been previously shown to be of importance is the 24-hour cycle of shorebird activity. This will be informative in relation to potential effects of both construction and operational phases of the Project. Biosis used thermal imaging technology to determine the extent of shorebird nocturnal foraging activity and to locate night-time roost locations and count birds using them in the Ralph's Bay area of southern Tasmania in 2008 for the Lauderdale Quay development proposal (Aqueenal and Biosis Research 2008).

For identified threatened species that may be affected, a specific investigation of literature (including unpublished academic theses) will be required to fully inform understanding of their dependence on trophic resources. In turn, this will be of value to assess the nature and degree of possible indirect impacts. Where studies of particular species are not available, information about closely related species may be informative. Information from Project studies of hydrodynamics, sediment dynamics, benthic infauna, fish and possibly other investigations will be of particular value to determination of possible effects on waterbirds.

A comprehensive desktop assessment of potential effects on waterbirds of noise, artificial light, dredging, ship movements, and any other identified likely effects of the Project will be required.

Existing information does provide long-term information about long-term trends in waterbird usage of Western Port up to 2010. For specific locations, particularly within Lower North Arm, further data should be collected using the same regime as used in previous studies, to ensure that the Project assessment is current and that long-term trends do not have a knowledge gap for the most recent years.

6. Proposed study methods

6.1 Study framework

It is vital that a framework for impact assessment is developed and approved by relevant authorities. As discussed above, there are many external effects on populations of relevant species. It is not considered feasible to quantify effects on waterbird populations in absolute terms (e.g. measured by changes in absolute numbers of birds of particular species).

Measuring changes in extent and/or availability of key foraging and roosting habitats is a feasible mechanism for quantifying effects of the Project. Relative to birds that forage in open water, shorebird foraging habitats are more readily measured and baseline and future data for these measures will be able to be compared as a means to assess change. This is the primary framework for proposed further investigations. It is considered suitable to meet the requirements of relevant legislation and government policies used for impact assessment.

6.2 Regulatory requirements

The principal regulatory requirements and guidelines that would guide the study method are criteria set out in *Environment Protection and Biodiversity Conservation Act 1999 Significant Impact Guidelines 1.1* (DoE 2013) and *Draft Significant Impact Guidelines for 36 Migratory Shorebird Species - Migratory species EPBC Policy Statement 3.21* (DEWHA 2009).

Specific guidelines under a CIS assessment process are also expected to be prepared.

6.3 Study prerequisites

The rationale for proposed investigations is as outlined in section 5.1, above. Its fundamental aims are to improve knowledge specifically to inform assessment of Project impacts on waterbirds. Information drawn from the following will be used to determine specific aspects of the investigation.

Understanding of specific trophic resource requirements and ecological responses of selected key species will be informed by a review of species-specific literature (published and unpublished). Where studies of particular species are not available, information about closely related species will be considered.

Information required to quantify waterbird roost and foraging sites will entail GIS analyses of data obtained from field investigations (set out below). Pre-existing data about waterbird roost and foraging sites curated by DEPI, may be of value to these analyses. Relevant data will be sought from DEPI.

When a preliminary design for the Port of Hastings Project is sufficiently advanced to inform required analyses, an assessment will be made of potential effects on waterbirds of noise, artificial light, dredging, ship movements, and any other identified likely effects of the Project.

6.4 Field data collection

6.4.2 Spatial

It is intended to replicate as closely as possible the methodology used for previous studies of waterbirds in Western Port to facilitate valid comparisons. In order to maintain primary focus on potential areas of most-likely impact, the following locations within Lower North Arm are proposed:

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- (1) areas adjacent the port landside development
 - (2) Hastings Bight and adjacent western shoreline of Western Port
 - (3) Middle Spit mud banks, Barrallier Island and north-west French Island
 - (4) western shoreline of French Island

6.4.3 Temporal

Waterbird surveys will be conducted (weather and other contingencies permitting) at each of the four areas (two people per site) over five consecutive days in each of four seasons. The surveys will target times of low- and high-tides.

A small number of nocturnal surveys will be undertaken using thermal imaging techniques. The aim of these surveys will be to obtain information about shorebird foraging activity at night and to obtain information about nocturnal roost site usage.

6.4.4 Survey metrics

All species of waterbirds will be counted during surveys and the intent will be to obtain simultaneous counts at all locations.

GIS methods will be used to quantify areas of key roost and foraging areas at peak low and high tides.

6.4.5 Data analysis and reporting

Data would be analysed against existing information and evaluated for any changes against previously documented usage by waterbird species. To the extent feasible, this would also consider broader environmental influences relative to potential impacts of the project and describe the relative importance of Western Port habitat with respect to other key sites in for waterbirds in south-eastern Australia.

The numbers of each species present would be determined and locations or areas of key foraging and roosting habitat for waterbird species mapped at peak low- and high tides. Results would also be correlated with those of other Project environmental studies such as characterisation of substrates and sediment dynamics; of intertidal benthic fauna; marine fish and of seagrass.

6.5 Reporting

An existing conditions report will be prepared that contains an analysis of results against existing information and evaluate any change against previously documented usage by waterbird species in Western Port and relevant areas of Victoria. This will include development of qualitative models to support a systems approach to understanding of trophic interactions across Western Port. Ecological responses of waterbird guilds to a range of stressors would also be defined particularly as informed by ultimate design of the Project.

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Appendix A

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Appendix A.1: Listed waterbird species

Notes to table A.1:

EPBC Act:

Threat status

EX - Extinct

CR - Critically Endangered

EN - Endangered

VU - Vulnerable

CD - Conservation dependent

Other protected status

MA – marine

Mi - migratory

DSE 2013:

ex - extinct

cr - critically endangered

en - endangered

vu - vulnerable

nt - near threatened

dd - data deficient

rx - regionally extinct

FFG Act:

L - listed as threatened under FFG Act

Most recent database records are from the Victorian Biodiversity Atlas.

A1.1 Listed waterbird species

The following table includes all waterbirds listed under provisions of relevant legislation and the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013) that have potential to occur within the study area. The list of species is sourced from the Victorian Biodiversity Atlas and the Protected Matters Search Tool (DoE; accessed on 27.11.14). Taxa are listed by guild and scientific name.

TableB2.1: Listed fauna species recorded, or predicted to occur, within Western Port.

Scientific name	Common name	Guild	Likelihood of occurrence: Negligible /Low /Medium /High	Conservation status			Most recent database record	Other records
				EPBC	DSE	FFG		
<i>Charadrius bicinctus</i>	Double-banded Plover	Australasian shorebirds	H	Mi, Ma			2011	PMST
<i>Charadrius ruficapillus</i>	Red-capped Plover	Australasian shorebirds	H	Ma			2011	PMST
<i>Glareola maldivarum</i>	Oriental Pratincole	Australasian shorebirds	L	Mi, Ma			1974	
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	Australasian shorebirds	H		nt		2012	
<i>Himantopus himantopus</i>	Black-winged Stilt	Australasian shorebirds	H	Ma			2012	PMST
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	Australasian shorebirds	H	Ma			2011	PMST
<i>Thinornis rubricollis</i>	Hooded Plover	Australasian shorebirds	H	VU, Ma	vu	L	2012	PMST
<i>Anas rhynchotis</i>	Australasian Shoveler	Ducks	H		vu		2012	
<i>Aythya australis</i>	Hardhead	Ducks	H		vu		2012	
<i>Biziura lobata</i>	Musk Duck	Ducks	H	Ma	vu		2012	
<i>Oxyura australis</i>	Blue-billed Duck	Ducks	H		en	L	2010	
<i>Stictonetta naevosa</i>	Freckled Duck	Ducks	H		en	L	2006	
<i>Chlidonias hybrida</i>	Whiskered Tern	Fishers	L	Ma	nt		2011	
<i>Chlidonias leucopterus</i>	White-winged Black Tern	Fishers	L	Mi, Ma	nt		1974	
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	Fishers	H	Ma			2012	PMST
<i>Eudyptula minor</i>	Little Penguin	Fishers	H	Ma			2012	PMST
<i>Fregata minor</i>	Great Frigatebird	Fishers	N	Mi, Ma			1902	
<i>Gelochelidon nilotica</i>	Gull-billed Tern	Fishers	L	Ma	en	L	2011	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Fishers	H	Mi, Ma	vu	L	2012	PMST
<i>Hydroprogne caspia</i>	Caspian Tern	Fishers	H	Mi, Ma	nt	L	2012	
<i>Morus serrator</i>	Australasian Gannet	Fishers	H	Ma			2011	
<i>Onychoprion fuscata</i>	Sooty Tern	Fishers	N	Ma			-	PMST
<i>Pelecanus conspicillatus</i>	Australian Pelican	Fishers	H	Ma			2012	
<i>Phalacrocorax fuscescens</i>	Black-faced Cormorant	Fishers	H	Ma	nt		2012	
<i>Phalacrocorax varius</i>	Pied Cormorant	Fishers	H		nt		2012	

Scientific name	Common name	Guild	Likelihood of occurrence: Negligible /Low /Medium /High	Conservation status			Most recent database record	Other records
				EPBC	DSE	FFG		
<i>Sterna hirundo</i>	Common Tern	Fishers	H	Mi, Ma			2004	
<i>Sterna paradisaea</i>	Arctic Tern	Fishers	H	Ma			1960	
<i>Sterna striata</i>	White-fronted Tern	Fishers	H	Ma	nt		2007	
<i>Sternula albifrons</i>	Little Tern	Fishers	H	Mi, Ma	vu	L	2008	PMST
<i>Sternula nereis</i>	Fairy Tern	Fishers	H	VU, Ma	en	L	2011	PMST
<i>Thalasseus bergii</i>	Crested Tern	Fishers	H	Ma			2012	PMST
<i>Larus dominicanus</i>	Kelp Gull	Gulls	H	Ma			2012	PMST
<i>Larus pacificus</i>	Pacific Gull	Gulls	H	Ma	nt	I	2012	PMST
<i>Leucophaeus pipixcan</i>	Franklin's Gull	Gulls	N	Ma			2004	
<i>Actitis hypoleucos</i>	Common Sandpiper	Holarctic shorebirds (waders)	H	Mi, Ma	vu		2011	PMST
<i>Arenaria interpres</i>	Ruddy Turnstone	Holarctic shorebirds (waders)	H	Mi, Ma			2011	PMST
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Holarctic shorebirds (waders)	H	Mi, Ma			2012	PMST
<i>Calidris alba</i>	Sanderling	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2007	
<i>Calidris canutus</i>	Red Knot	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2008	PMST
<i>Calidris ferruginea</i>	Curlew Sandpiper	Holarctic shorebirds (waders)	H	Mi, Ma			2011	PMST
<i>Calidris melanotos</i>	Pectoral Sandpiper	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2004	
<i>Calidris minuta</i>	Little Stint	Holarctic shorebirds (waders)	N	Mi, Ma			2001	
<i>Calidris ruficollis</i>	Red-necked Stint	Holarctic shorebirds (waders)	H	Mi, Ma			2012	PMST
<i>Calidris subminuta</i>	Long-toed Stint	Holarctic shorebirds (waders)	H	Mi, Ma	nt		1980	
<i>Calidris tenuirostris</i>	Great Knot	Holarctic shorebirds (waders)	L	Mi, Ma	en	L	2008	PMST
<i>Charadrius leschenaultii</i>	Greater Sand Plover	Holarctic shorebirds (waders)	H	Mi, Ma	vu		2008	PMST
<i>Charadrius mongolus</i>	Lesser Sand Plover	Holarctic shorebirds (waders)	H	Mi, Ma	vu		2008	PMST
<i>Gallinago hardwickii</i>	Latham's Snipe	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2008	PMST
<i>Gallinago megala</i>	Swinhoe's Snipe	Holarctic shorebirds (waders)	N	Mi, Ma			-	PMST
<i>Gallinago stenura</i>	Pin-tailed Snipe	Holarctic shorebirds (waders)	N	Mi, Ma			-	PMST
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	Holarctic shorebirds (waders)	M	Mi, Ma			1997	PMST
<i>Limosa lapponica</i>	Bar-tailed Godwit	Holarctic shorebirds (waders)	H	Mi, Ma			2012	PMST
<i>Limosa limosa</i>	Black-tailed Godwit	Holarctic shorebirds (waders)	H	Mi, Ma	vu		2012	
<i>Numenius madagascariensis</i>	Eastern Curlew	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2012	PMST
<i>Numenius minutus</i>	Little Curlew	Holarctic shorebirds (waders)	H	Mi, Ma			-	PMST
<i>Numenius phaeopus</i>	Whimbrel	Holarctic shorebirds (waders)	H	Mi, Ma	vu		2012	PMST
<i>Philomachus pugnax</i>	Ruff	Holarctic shorebirds (waders)	H	Mi, Ma			1998	
<i>Pluvialis fulva</i>	Pacific Golden Plover	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2011	PMST

Scientific name	Common name	Guild	Likelihood of occurrence: Negligible /Low /Medium /High	Conservation status			Most recent database record	Other records
				EPBC	DSE	FFG		
<i>Pluvialis squatarola</i>	Grey Plover	Holarctic shorebirds (waders)	H	Mi, Ma	nt		2001	PMST
<i>Tringa brevipes</i>	Grey-tailed Tattler	Holarctic shorebirds (waders)	H	Mi, Ma	cr	L	2011	PMST
<i>Tringa glareola</i>	Wood Sandpiper	Holarctic shorebirds (waders)	H	Mi, Ma	vu		2003	PMST
<i>Tringa incana</i>	Wandering Tattler	Holarctic shorebirds (waders)	L	Mi, Ma			-	PMST
<i>Tringa nebularia</i>	Common Greenshank	Holarctic shorebirds (waders)	H	Mi, Ma			2012	
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Holarctic shorebirds (waders)	H	Mi, Ma			2006	PMST
<i>Tryngites subruficollis</i>	Buff-breasted Sandpiper	Holarctic shorebirds (waders)	L	Mi, Ma			1953	
<i>Xenus cinereus</i>	Terek Sandpiper	Holarctic shorebirds (waders)	M	Mi, Ma	en	L	2011	PMST
<i>Anseranas semipalmata</i>	Magpie Goose	Large herbivores	M		nt	L	2007	
<i>Cereopsis novaehollandiae</i>	Cape Barren Goose	Large herbivores	H	Ma	nt		2012	
<i>Ardea intermedia</i>	Intermediate Egret	Large Wading Birds	L	Ma	cr	L	2012	
<i>Ardea modesta</i>	Eastern Great Egret	Large Wading Birds	H	Mi, Ma	vu	L	2012	PMST
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Large Wading Birds	H	EN	en	L	2007	PMST
<i>Bubulcus ibis</i>	Cattle Egret	Large Wading Birds	H	Mi, Ma			2010	PMST
<i>Egretta garzetta</i>	Little Egret	Large Wading Birds	H	Ma	en	L	2009	
<i>Nycticorax caledonicus hillii</i>	Nankeen Night Heron	Large Wading Birds	H	Ma	nt		2012	
<i>Platalea regia</i>	Royal Spoonbill	Large Wading Birds	H		vu		2012	
<i>Plegadis falcinellus</i>	Glossy Ibis	Large Wading Birds	L	Mi, Ma	nt		2006	
<i>Rostratula australis</i>	Australian Painted Snipe	Large Wading Birds	L	VU, Mi, Ma	cr	L	1974	PMST
<i>Threskiornis molucca</i>	Australian White Ibis	Large Wading Birds	H	Ma			2012	
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	Large Wading Birds	H	Ma			2012	
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	Pelagic birds	L	Mi, Ma			1981	PMST
<i>Ardenna grisea</i>	Sooty Shearwater	Pelagic birds	L	Mi, Ma			1977	
<i>Ardenna tenuirostris</i>	Short-tailed Shearwater	Pelagic birds	H	Mi, Ma			2011	PMST
<i>Daption capense</i>	Cape Petrel	Pelagic birds	H	Ma			1986	
<i>Diomedea epomophora</i>	Royal Albatross	Pelagic birds	N	VU, Mi, Ma	vu	L	1976	PMST
<i>Diomedea exulans</i>	Wandering Albatross	Pelagic birds	L	VU, Mi, Ma	en	L	1983	PMST
<i>Diomedea exulans amsterdamensis</i>	Amsterdam Albatross	Pelagic birds	N	EN, Mi, Ma			-	PMST
<i>Diomedea exulans exulans</i>	Tristan Albatross	Pelagic birds	N	EN, Mi, Ma			-	PMST
<i>Diomedea gibsoni</i>	Gibson's Albatross	Pelagic birds	N	VU, Mi, Ma		L	-	PMST
<i>Diomedea sanfordi</i>	Northern Royal Albatross	Pelagic birds	N	EN, Mi, Ma			-	PMST
<i>Fregetta grallaria grallaria</i>	White-bellied Storm-Petrel	Pelagic birds	N	VU, Ma			-	PMST
<i>Fulmarus glacialis</i>	Southern Fulmar	Pelagic birds	L	Ma			2007	

Scientific name	Common name	Guild	Likelihood of occurrence: Negligible /Low /Medium /High	Conservation status			Most recent database record	Other records
				EPBC	DSE	FFG		
<i>Garrodia nereis</i>	Grey-backed Storm-Petrel	Pelagic birds	N	Ma			1986	
<i>Halobaena caerulea</i>	Blue Petrel	Pelagic birds	L	VU, Ma			2000	PMST
<i>Lugensa brevirostris</i>	Kerguelen Petrel	Pelagic birds	N	Ma			1981	
<i>Macronectes giganteus</i>	Southern Giant-Petrel	Pelagic birds	L	EN, Mi, Ma	vu	L	1985	PMST
<i>Macronectes halli</i>	Northern Giant-Petrel	Pelagic birds	L	VU, Mi, Ma	nt	L	1996	PMST
<i>Pachyptila belcheri</i>	Slender-billed Prion	Pelagic birds	L	Ma			2007	
<i>Pachyptila desolata</i>	Antarctic Prion	Pelagic birds	L	Ma			1998	
<i>Pachyptila salvini</i>	Salvin's Prion	Pelagic birds	N	Ma			2000	
<i>Pachyptila turtur</i>	Fairy Prion	Pelagic birds	H	Ma	vu		2008	
<i>Pachyptila vittata</i>	Broad-billed Prion	Pelagic birds	L	Ma			1986	
<i>Pelagodroma marina</i>	White-faced Storm-Petrel	Pelagic birds	N	Ma	vu		2010	
<i>Pelecanoides urinatrix</i>	Common Diving-Petrel	Pelagic birds	H	Ma	nt		2008	
<i>Pterodroma lessonii</i>	White-headed Petrel	Pelagic birds	L	Ma			1982	
<i>Pterodroma leucoptera</i>	Gould's Petrel	Pelagic birds	N	Mi, Ma			1972	
<i>Pterodroma mollis</i>	Soft-plumaged Petrel	Pelagic birds	M	Ma			-	PMST
<i>Puffinus gavia</i>	Fluttering Shearwater	Pelagic birds	H	Ma			2008	
<i>Puffinus huttoni</i>	Hutton's Shearwater	Pelagic birds	N	Ma			2006	
<i>Stercorarius parasiticus</i>	Arctic Jaeger	Pelagic birds	H	Mi, Ma			2007	
<i>Stercorarius pomarinus</i>	Pomarine Jaeger	Pelagic birds	N	Mi, Ma			1977	
<i>Stercorarius skua</i>	Great Skua	Pelagic birds	L	Ma			1965	PMST
<i>Thalassarche bulleri</i>	Buller's Albatross	Pelagic birds	L	VU, Mi, Ma		L	-	PMST
<i>Thalassarche cauta</i>	Shy Albatross	Pelagic birds	H	EN, Mi, Ma	vu	L	2009	PMST
<i>Thalassarche chlororhynchos</i>	Yellow-nosed Albatross	Pelagic birds	L	VU, Mi, Ma	vu	L	1981	
<i>Thalassarche chrysostoma</i>	Grey-headed Albatross	Pelagic birds	L	EN, Mi, Ma	vu	L	1974	PMST
<i>Thalassarche melanophris</i>	Black-browed Albatross	Pelagic birds	H	VU, Mi, Ma	vu	I	2008	PMST
<i>Thalassarche melanophris impavida</i>	Campbell Albatross	Pelagic birds	L	VU, Mi, Ma			-	PMST
<i>Thalassarche salvini</i>	Salvin's Albatross	Pelagic birds	M	VU, Mi, Ma			-	PMST
<i>Lewinia pectoralis</i>	Lewin's Rail	Rails	H	Mi	vu	L	2011	
<i>Porzana pusilla</i>	Baillon's Crake	Rails	H	Ma	vu	L	2011	
<i>Porzana tabuensis</i>	Spotless Crake	Rails	H	Ma			2011	

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