DELIVERING OUR TRANSPORT FUTURE NOW

north-south corridor
northern connector

Project Impact Report

An environmental, social and economic assessment

Technical Reports

Government of South Australia
Department for Transport, Energy and Infrastructure

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Fauna

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Technical Report No. 4

Government of South Australia
Department for Transport, Energy and Infrastructure

Northern Connector
Technical Report
Fauna

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Executive Summary

This report details information about the faunal groups and their associated habitats in and adjacent to the project area. In particular, the report considers the avifauna associated with the project area and the region, both through a review of past reports relevant to the project, including Environmental and Biodiversity Services Pty Ltd (EBS) (2009), and additional surveys. Relevant background information was summarised. Species of national and State conservation significance were assessed and the likely impacts of the project were discussed. Adverse effects are mostly likely to be confined to bird species and their habitat.

Over 200 bird species have been recorded in the region and about 128 bird species in the project area during past and current surveys since the 1980s. Of these, 65 species of national (44) or State (11) significance were identified as potentially occurring or having been recorded in the region. Other potentially occurring species listed in the Protected Matters search using EPBC Act databases have a low risk of occurrence in the project area. Some do not occur here.

Major effects of the Northern Connector project on faunal groups and their habitat, and especially bird species, of conservation significance were determined and discussed, with consideration of suitable habitats in the region and wider region. Mitigation measures and suggestions of how to minimise the effects are also outlined, including possible landscaping, revegetation and habitat management of sites.

Fourty eight threatened bird species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth, EPBC Act) occur in or adjacent to the project area. All are migratory and/or marine species and five are threatened species listed under Schedules of the EPBC Act. Twenty five species of international migratory shorebirds have been recorded in the project area or region in varying numbers. Some of these have not been recorded in the project area and the remainder occur in small numbers not exceeding the flyway population thresholds. It is concluded that all would experience few to minimal adverse effects from the removal of small areas of habitat associated with the project.

Most adverse effects will be direct and associated with habitat removal and plus temporary impacts during construction in the Barker Inlet North Wetlands and potentially in the North Arm Creek.

It was considered that there is a relatively low risk of a significant impact (as defined by the EPBC Act Significant Impact Guidelines) on a few species, including the Orange-bellied Parrot (*Neophema chrysogaster*), Australian Painted Snipe (*Rostratula australis*) and White-bellied Sea-eagle (*Haliaeetus leucogaster*), plus small numbers of migratory shorebirds and aquatic bird species.

The project may affect small areas of potential foraging habitat of the critically endangered Orange-bellied Parrot. Population numbers of this species in the wild are currently low, estimated at about 50 birds, with limited chance of recovery. Part of the project area, as a component of the wider coastal part of the region was part of the parrot's traditional foraging range. However, very few sightings of the species

have been recorded in the past 20 years, with the most recent being at Chapman Creek in 2006 well to the north of the north-most section of the project area.

It is difficult to determine the effect of the project to the White-bellied Sea-eagle (*Haliaeetus leucogaster*). One breeding pair of birds is reported to be resident in the region, possibly the wider region, although their nest and roost locations are unknown. However, they are known to forage in the region and the southern part of the project area. It is considered that any impact on this species will be confined to the construction phase of the project directly associated with the Barker Inlet Wetlands North and that this would be relatively small due to the very large range and foraging habitat available to and used by the species. It is considered very unlikely that there would be a long term impact on the species due to this proposal.

Investigations also determined that there are relatively small populations only of some migratory shorebirds and marine and aquatic birds of specific conservation significance that use the Barker Inlet Wetlands and North Arm Creek. These would be unlikely to be affected by the project due to their limited use of the affected sites plus the range and large areas of other suitable habitats present adjacent to the project area and elsewhere in the region.

Effects on species listed under the Regional Recovery Plan (2009) for the Adelaide Plains region are considered to be low.

A Referral under the EPBC Act will be made by DTEI to determine if the project is considered a 'controlled action' by the Commonwealth (i.e. whether or not the project is likely to have a significant impact on MNES, primarily as species or habitats), and to determine if further assessment and approval is required under the EPBC Act.

Most of the important areas of habitats used by a few of the resident and non-migratory state listed species will not be severely affected by the development. Some of these species are occasional visitors only or are considered to be vagrants in the region and project area. Similar to the effects of the previous Port River Expressway (PRexy) project as monitored prior to and after construction, it is predicted that the species affected by the project will temporarily move to locations outside the project area during construction. However, it is essental that similar quality habitat as removed by construction is available prior to construction or following construction. Therefore, populations and individuals of these species are expected to cope with any impacts.

For the other bird species likely to be affected, the direct impacts on habitat would be removal of:

- two areas of resting and roosting habitat in the Barker Inlet Wetland North (0.44 ha)
- relatively small areas of mangrove woodland (3.3 ha) and intertidal samphire low shrubland (0.41 ha) on North Arm Creek
- small areas of shallow water habitat which dry to mudflats (0.58 ha freshwater, 1.15 ha marine) and aquatic vegetation as tall grassland (0.21 ha) in both saline and freshwater wetlands of the Barker Inlet Wetlands North and South

- areas of deep water freshwater wetlands (3.29 ha) and associated aquatic tall grassland vegetation (0.21 ha) and sedgeland (0.11 ha) of the Barker Inlet Wetlands North and South.

The wetlands area of the Bolivar WWTP and area of the Greenfields Wetlands Stage 3 adjacent to the former Government Magazines precinct (sometimes referred to as the Magazine Road Wetlands) are considered to be most important habitats for a number of threatened bird groups and species in the region and both will be avoided by the proposal. In addition, the project has been designed to avoid the most important marine section of the Barker Inlet Wetlands North and roosting areas in the Barker Inlet Wetlands South. Consequently, preservation of these areas is assured and the impacts on their component species will not occur as a result of the project. It is anticipated that these areas will be used temporarily by birds displaced during construction.

Mammal, reptile, amphibian and fish species were also considered. Most of the effects on the central and northern section of the project area will be confined to anthropogenic areas (165 ha). There will be few additional impacts associated with these groups over those already considered for bird species i.e. a direct loss of small areas of habitat, the most important of which will be parts of the planted and remnant woodland associated with the Little Para River and Bolivar WWTP (45 ha).

Some fish species (primarily pipefish and similar species), or their habitat, protected under the EPBC Act could occur in North Arm Creek. It is also important to note that the Port River Dolphin Sanctuary is associated with part of the project area along North Arm Creek. No direct impacts to the Indo-Pacific Bottlenose Dolphins (*Tursiops aduncus*) population are expected, however impacts to their habitat, as part of the Barker Inlet, could occur if suitable management measures are not taken.

Mitigation measures

Potential mitigation measures have been considered and additional consideration of these will be part of the detailed design process associated with the proposal. It is proposed to mitigate the impacts of the project and offset the loss of native vegetation and habitat by:

- ensuring that a significant environmental benefit is achieved for the project in line with any requirements of the *Native Vegetation Act 1991* (NV Act), the NRM Act and NPW Act, primarily through funding and on-ground rehabilitation, revegetation or other works, such as control of pest plants and animals.
- providing compensatory areas and habitats by establishing areas of freshwater and estuarine wetlands specifically designed for particular avifauna groups and species. The wetlands would resemble some of the habitat types and vegetation associations proposed for removal by this proposal, but their ecological value would be enhanced to focus on suitable breeding, feeding and roosting habitats for particular bird groups and species.

1 Introduction

1.1 The Northern Connector

The proposed Northern Connector (the project) will form a strategic link in road and rail between northern regions of South Australia, and further afield, to the Port of Adelaide, Adelaide metropolitan area and southern regions (Figure 1.1).

It will be an integrated road and rail transport corridor comprising a new 15.6 km expressway standard road (three lanes in each direction) and a 30.9 km single track, national freight rail line. The road component would run west of the existing Port Wakefield Road, from the new Northern Expressway interchange with Port Wakefield Road in the north to the Port River Expressway and South Road interchange in the south (Figure 1.2). The rail component will primarily run west of the new road carriageways, and link with existing rail lines at Virginia to the north, Dry Creek to the south and Port Adelaide to the west (Figure 1.2).

The project has been developed in response to the *South Australia's Strategic Plan* (Government of South Australia 2007a) and *The 30-Year Plan for Greater Adelaide* (Department of Planning and Local Government 2010) which forecasts a significant increase in population growth, road and rail traffic, and economic expansion in the northern Adelaide region.

The Northern Connector project has also been listed as a 'project with real potential' by the Australian Government. Infrastructure Australia identified the national significance of the project and the clear and positive contribution it would make to achieving Australia's policy goals.

The Northern Connector will form an integral component of Adelaide's North–South Corridor extending from the Northern Expressway at Gawler to the Southern Expressway at Old Noarlunga (Figure 1.2), as identified in the *Strategic Infrastructure Plan for South Australia: 2010 Discussion Paper* (DTEI 2010). It is both integrated (encompassing transport and land use priorities) and multi-modal (encompassing rail and road).

It would form a new link in the Adelaide Urban National Land Transport Network, connecting the Adelaide–Perth/Darwin corridor, mining activity in the states north, the Adelaide–Sydney corridor, areas of the Riverland and Barossa Valley in South Australia, and the Sunraysia area in New South Wales and Victoria, with key freight destinations in Adelaide's north-west suburbs, including the Port of Adelaide, rail terminals, industry zones and Adelaide Airport.

The completed road link will allow a largely unimpeded journey from Port Wakefield, the Mid North, Barossa Valley and Riverland to the Port of Adelaide and the future non-stop North–South Corridor (incorporating the South Road Superway).

Key Northern Connector road benefits will be:

- improved traffic conditions, access and safety for road users and local communities along the route by reducing freight on Port Wakefield Road and Main North Road
- improved freight efficiency and export opportunities
- a safer, faster connection to suburban destinations such as Adelaide Airport, sporting venues, beaches and businesses, in southern and western suburbs
- reduced travel times for commuters travelling to and from the northern suburbs
- reduced overall vehicle emissions due to smoother traffic flow.

The rail component is critical to the interstate freight network managed by Australian Rail Track Corporation. Key Northern Connector rail benefits will be:

- improved safety for road users and quality of life for nearby residents by significantly reducing freight rail traffic through suburban area to the east of Port Wakefield Road (Salisbury North and South, Parafield Gardens, Mawson Lakes)
- 'unlocked' commercial and industrial development opportunities along the corridor, including the Economic Development Precinct in Gillman and Defence SA in Port Adelaide
- a freight transport mode shift from road freight to rail freight
- less environmental impact of heavy rail freight transport through suburban communities
- improved rail freight transport efficiencies through higher speed and shorter connection to the port and intermodal facilities
- improved rail access to intermodal terminals in Adelaide and the Port of Adelaide for rail freight transport from the north and west of South Australia and from Darwin and Perth.

Construction and operation of the Northern Connector would bring significant benefits but many, often competing, environmental, social, economic and engineering issues have had to be balanced to achieve project objectives. Inevitably, due to the scale, nature and location of the project, some adverse impacts would occur. Where possible, measures will be put in place to minimise and/or offset these impacts.

The release of this *Project Impact Report* is part of the project's planning and environmental impact assessment processes. It represents a key aspect in determining the appropriate location and extent of the project to enable a corridor to be defined for future construction.

The Department for Transport, Energy and Infrastructure (DTEI) is currently seeking and investigating funding for the construction of the Northern Connector project. If approved and funded in the near future, construction could be completed by 2017.

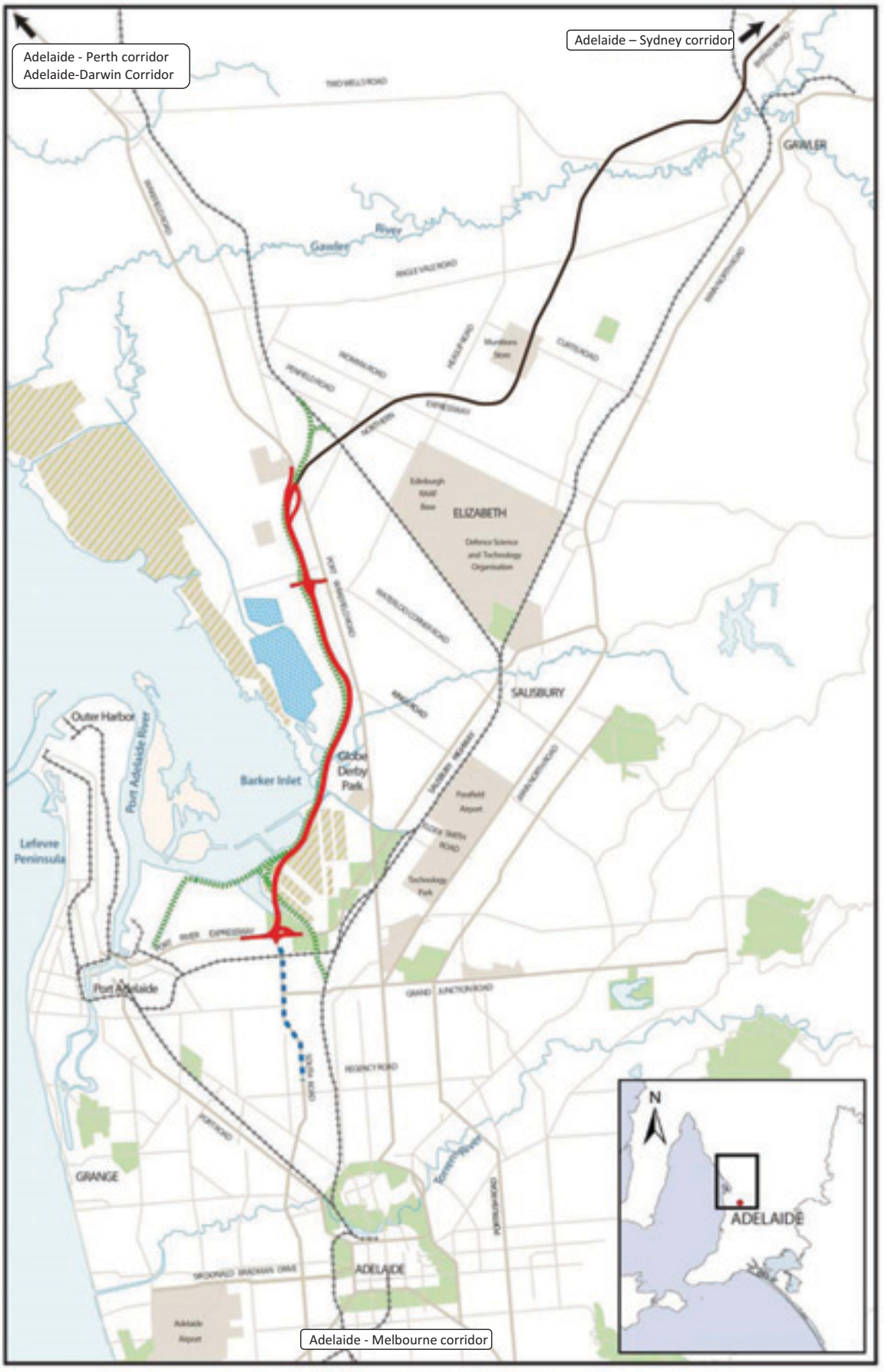


Figure 1.1. **Location Plan**

Source: DEH, DTEI, DPLG

Figure 1.2 **The Northern Connector proposed road and rail route**

1.1.1 Project area

The project, located in Adelaide's outer northern metropolitan area, approximately 12 km north of Adelaide's central business district (Figure 1.1), will pass through three council areas —City of Playford, City of Salisbury and City of Port Adelaide Enfield — and through the suburbs of Virginia, Waterloo Corner, St Kilda, Bolivar, Globe Derby Park, Dry Creek, Wingfield and Gillman.

The project area has been zoned into three sections (Figure 1.2) to facilitate design, planning and assessment of the corridor:

- Northern section — relatively low population agricultural land, typically used for horticulture
- Central section — adjacent to and immediately east of the SA Water Bolivar Wastewater Treatment Plant
- Southern section — incorporates Globe Derby Park, with a small resident population on semi-rural land holdings used for horse agistment and training facilities; open land primarily used for salt production and the Greenfields and Barker Inlet wetlands; vacant land at Gillman; and the more densely populated urban industrial area of Wingfield.

1.1.2 Main elements of the project

The main elements of the project are:

- a new road (15.6 km), three lanes in each direction, between the Northern Expressway and the South Road–Port River Expressway junction
- four road interchanges: Northern, Waterloo Corner, Bolivar (on-ramp) and Southern
- Port Wakefield Road–Waterloo Corner and Port Wakefield Road–Bolivar Road intersection upgrades to connect to the Northern Connector interchange ramps
- approximately 30.9 kilometres of standard gauge, single-track freight rail line with maintenance/access track, generally located to the west of the road carriageways
- four rail bridges separating rail freight from road traffic
- two 2 km rail passing loops at Gillman and north of Waterloo Corner interchange
- a shared-use (pedestrian and cyclist) path
- Barker Inlet north wetland modifications
- wetland offset or rehabilitation areas (for flood storage, water quality treatment and habitat)
- swale drains and detention basins

- landscaping.

1.2 Legislation and policy

The key legislation relating to faunal groups and their habitat include both:

Commonwealth legislation:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cwlth)

and South Australian legislation as the:

- *National Parks and Wildlife Act 1972* (NPW Act)
- *Native Vegetation Act 1991*
- *Natural Resources Management Act 2004* (NRM Act)
- *Development Act 1993*
- *Fisheries Management Act 2007*
- *Adelaide Dolphin Sanctuary Act 2005*
- *Mining Act 1971.*

1.2.1 Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act was developed as a legislative framework for the protection and management of Matters of National Environmental Significance (MNES). Its primary objectives relevant to the project are to:

- provide for the protection of the environment, especially MNES
- conserve Australian biodiversity
- provide a streamlined national environmental assessment and approvals process
- enhance the protection and management of important natural and cultural places
- promote ecological sustainable development through the conservation and ecologically sustainable use of natural resources.

MNES relevant to this project include nationally threatened fauna species, migratory bird species and marine species and their habitats. A search of the EPBC Act Protected Matters databases indicated that some EPBC Act listed species, or their habitat, may occur within the project area. The likelihood of these species occurring in the region and project area is considered in the report and an assessment of risk is provided. As the project may impact MNES, a referral would be required at some future stage. This will be made to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) by DTEI.

Once a project has been assessed, the DSEWPC makes a recommendation to the Minister or delegate about whether or not the project should be approved to proceed

and whether any specific conditions need to be attached to that approval. In addition to considering potential impacts on MNES in making the decision, the Minister also considers the social and economic impact of any project.

MNES relevant to the project are discussed in Chapter 3 and potential impacts to them are considered in Chapter 4. Recommendations on these MNES are presented in Chapter 5.

1.2.2 South Australian legislation

National Parks and Wildlife Act 1972 (NPW Act)

The NPW Act principally provides for the establishment and management of reserves and other areas controlled by the Department of Environment and Natural Resources, the conservation of wildlife in a natural environment, and for other purposes such as permits for the keeping of native animals and compliance.

The Act protects native flora and fauna in South Australia and lists species of State conservation significance in Schedules 7, 8 and 9, respectively classified as endangered, vulnerable and rare. A number of species listed under these schedules are known or are considered likely to occur in the project area. If native vegetation is to be removed on a project, the impacts on native vegetation are usually and primarily assessed under the Native Vegetation Act.

Native Vegetation Act 1991

The Native Vegetation Act and Regulations 2003 provide for the protection, enhancement and control the clearance of native vegetation in South Australia. The Act applies throughout the State, except some areas of metropolitan Adelaide, and covers both private and public land. The Act covers all native vegetation and dead trees that provide habitat for threatened native fauna species. The Act applies to some, not all, of the Northern Connector project site. Much of the southern section of the project area does not appear to be within the jurisdiction of the Native Vegetation Council (NVC).

It is an offence to clear native vegetation unless the clearance is in accordance with the Act. Approval to clear native vegetation can be granted by the NVC, a statutory body established under the Act. In other cases, clearance may be undertaken pursuant to ‘exemptions’ in the Native Vegetation Regulations 2003.

Natural Resources Management Act 2004 (NRM Act)

The NRM Act repeals the Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986, the Soil Conservation and Land Care Act 1997 and the Water Resources Act 1997 and incorporates the functional requirements of these Acts. The NRM Act establishes provisions for the management of the State’s natural resources and also includes the management of pest plants and animals and the land and water resources. The project area in within the regional jurisdiction of the Adelaide and Mount Lofty Ranges Natural Resources Management Board (AMLR NRM Board) and a number of reports, plans, policies, work schedules and other documents prepared by the Board are relevant to this project.

Development Act 1993

The Northern Connector project area is located in metropolitan Adelaide and the Development Act applies to the project as a whole in relation to submission of an environmental report and the need for a development approval. The provisions of the significant tree legislation under the Act also apply to the project, but this matter is primarily relevant to native and planted vegetation and it is considered in the Flora Technical Report.

Fisheries Management Act 2007

The Fisheries Management Act provides for the conservation and management of the aquatic resources of the State, the management of fisheries and aquatic reserves, the regulation of fishing and the processing of aquatic resources, the protection of aquatic habitats, aquatic mammals, some aquatic species and aquatic resources and the control of exotic aquatic organisms and disease in aquatic resources. Approval is required to disturb benthic flora and fauna in an aquatic reserve.

Adelaide Dolphin Sanctuary Act 2005

The Adelaide Dolphin Sanctuary Act provides for the conservation of dolphins and their habitat in the Port Adelaide River and Barker Inlet by protecting dolphins, key dolphin habitat and necessary habitat for the food resources used by dolphins. It formally delineates a Sanctuary boundary that extends from North Haven Marina to Port Gawler Conservation Park.

If approval is required under other legislation for activities in the Sanctuary, the approving authority is required to refer the application to the Sanctuary Minister for comment.

Mining Act 1971

The purpose of the Mining Act is to regulate and control mining operations in South Australia. It covers prospecting, exploring and mining for minerals, quarrying/extractive industries, and includes operations where minerals are recovered from the sea or a natural water supply. The Act covers mining claims, leases and licences.

The Mining Act is relevant to the current project, due to the presence of the Cheetham Saltfields. Impacts of the operating mine are managed through a Mining and Rehabilitation Plan (MARP), or its equivalent, which includes broad environmental impacts and management actions. Biodiversity issues and their management are part of the MARP.

1.2.3 South Australian policy

State policies, plans and strategies that are applicable to fauna related aspects of the project are:

- *South Australia's Strategic Plan 2007* (Government of South Australia 2007) contains both a vision and objectives for the State. Objective 3: Attaining Sustainability includes four targets for biodiversity.

- The State Government policy *No Species Loss: A Biodiversity Strategy for South Australia 2007–2017* (Government of South Australia 2007c) is the key policy for protection of biodiversity in the State and is applicable to the project.
- *Tackling Climate Change: South Australia's Greenhouse Strategy 2007-2020* (Department of Premier and the Cabinet 2007) also relates to the sustainable management of natural resources and includes requirements to assess the potential risks associated with climate change influences on native and invasive species.
- The *South Australian Biosecurity Strategy 2008-2013* (Draft for public consultation) (Government of South Australia 2008) is a risk management framework that provides a summary review of threats posed by pests in the State, plus potential implementation requirements.
- *Estuaries Policy and Action Plan for South Australia* (2005) developed to improve the management and health of South Australia's estuaries.
- *Coast Protection Board Strategic Plan 2009-2014* (Government of South Australia 2009) was established to ensure that new development is not at risk from current and future hazards and plan for resilience in coastal ecosystems to adapt to the impacts of climate change.

In addition to these policies, DTEI has a range of environmental policy, planning and management documents which will apply to the proposal in relation to assessments and protection of natural resources. From an environmental perspective, some of the most important documents include:

- *Environmental Code of Practice for Construction - road, rail and marine facilities* (DTEI 2008a)
- *Contractor's Environmental Management Plan Guidelines for Construction - road, rail and marine facilities* (DTEI 2009a)
- *Project Environmental Management Plan Guidelines for Construction - road, rail and marine facilities* (DTEI 2009b)
- *Protecting Waterways Manual* (Transport SA 2002).
- Care, Control and Management of Roads by the Commissioner of Highways (Section 26 of the *Highways Act 1926*) Operational Instruction 20.1
- Environmental Approval Procedures Operational Instruction 21.1.

DTEI has also established policy and guideline documents relating to the specific requirements for the clearance of indigenous native and planted vegetation and fauna habitat management, including:

- *DTEI Vegetation Removal Policy* – which details the procedures and approvals required to undertake pruning, removal and clearance of vegetation or any other action that causes the destruction of vegetation associated in maintenance and construction works undertaken by, or on behalf of, the Department.

- *Fauna Impact Assessment Guidelines* – which provides basic information about the assessment and mitigation requirements for fauna.

Additional specific policies applicable to the proposal include the environmental and sustainability policies and development plans for the City of Playford, City of Salisbury and City of Port Adelaide Enfield.

2 Assessment methodology

Initial fauna surveys were undertaken across the entire project area and in surrounding areas during spring and summer 2008–09 by Environment and Biodiversity Services (EBS). These initial assessments included avifauna (birds), herptofauna (reptiles and amphibians) and fish and were used to inform the route selection and early planning phase of the project.

Following these assessment and further environmental, planning, social, economic and engineering investigations, the location and position of the rail corridor was significantly changed in the Southern section of the project to avoid the high quality habitat areas of the Greenfields Wetlands Stage 3. This has significantly reduced the type and amount of environmental effects of the project and mean the initial avifauna assessments are no longer relevant or appropriate for the Southern section of the project area. In addition, a wide range of additional information and data were released over 2009 to early 2011, much of which is directly relevant to the project.Additional avifauna assessments were undertaken by KBR in 2010–11. The relevant fauna assessments of both investigations (EBS 2008–09 and KBR 2010–11) are used in the following fauna assessment.

BS (2009) provides some useful observation and background information that are relevant to the current Technical Report, especially in relation to the location of the central and northern areas affected by the project. Consequently, EBS data and information have been referred to extensively and are used with permission from EBS through DTEI in the current report. Its bird data records from 2009 are provided in Appendix B.

A literature survey and accession of database records from State and Federal government authorities provided data which were compiled and checked to provide a comprehensive model of the former and current occurrence of fauna species, and their habitat, present or thought to be present. Historical data are available from a range of sources. For example, records for Cheetham saltfields and environs are available for over 60 years, with detailed population data for some species available since 1985 (Close and McCrie 1976, Day 1997, Penrice Soda Products Pty Ltd (Penrice) 1998, D. Close, J. Cox and R. Attwood, pers. comm., 2005 to 2010). Species lists and notes about many species are also available for the Greenfields and Barker Inlet Wetlands since their construction in the 1990s (Cox 1993, 2008; Cowley 2002).

Additional data for the Barker Inlet Wetlands, including historical information, are summarised in KBR (2004), which includes a review of field observations made over November 2003 to February 2004 at this and other nearby sites. Species lists for the Barker Inlet region and wetlands and observations of fauna in both areas were provided by the wetlands rangers for these areas since 2002.

Paton et al. (1991) provides a summary of avifauna associated with Buckland Park Lake and historical survey data for this site and the adjacent region are available from Day (1997), the Birds Australia library and Birdpedia. Data for the Port Gawler

Conservation Park are summarised in ANCA (1996) with additional data from Birds Australia and Birdpedia.

KBR, as Kinhill Engineers Pty Ltd (Kinhill), Brown & Root Services (BRS) and KBR, has been involved in a wide range of environmental impact assessments in the region since the 1980s, with a number of terrestrial and marine vegetation and fauna projects being undertaken. Over 2000 to 2011 it completed a series of surveys on behalf of DTEI and other government and private industry groups, both as part of this current project and as part of other projects, such as the Port Expressway, Northern Expressway and the upgrade of Port Wakefield Road (e.g. BRS 2000, 2001; KBR 2003, 2005, 2007, 2009).

Marine species of conservation significance listed under the EPBC Act were included in the current assessment, based on the consideration that the project traverses marine areas and may adversely affect marine habitats and species. The project is entirely confined to coastal waters under the jurisdiction of the State. Information from additional sources and references was also used and integrated with other data held by DTEI, including updated or revised information (see Section 3). Field surveys which targeted avifauna in the southern section of the project area were also conducted to supplement the existing data sources (Section 2.1.1). The locations of key areas referred to in the report are illustrated in Figure 2.1.

To better define the assessment, the study area was considered using two categories, terrestrial and marine. Terrestrial sites are the land areas with soil substrates and include freshwater sites, such as watercourses, drains and constructed wetlands. Marine sites are those subject to daily tidal inundation with few or no artificial controls (e.g. levees or other barriers).

The current report is primarily focussed on the southern section of the project area. Information from EBS (2009) remains relevant to the central and northern section of the project.

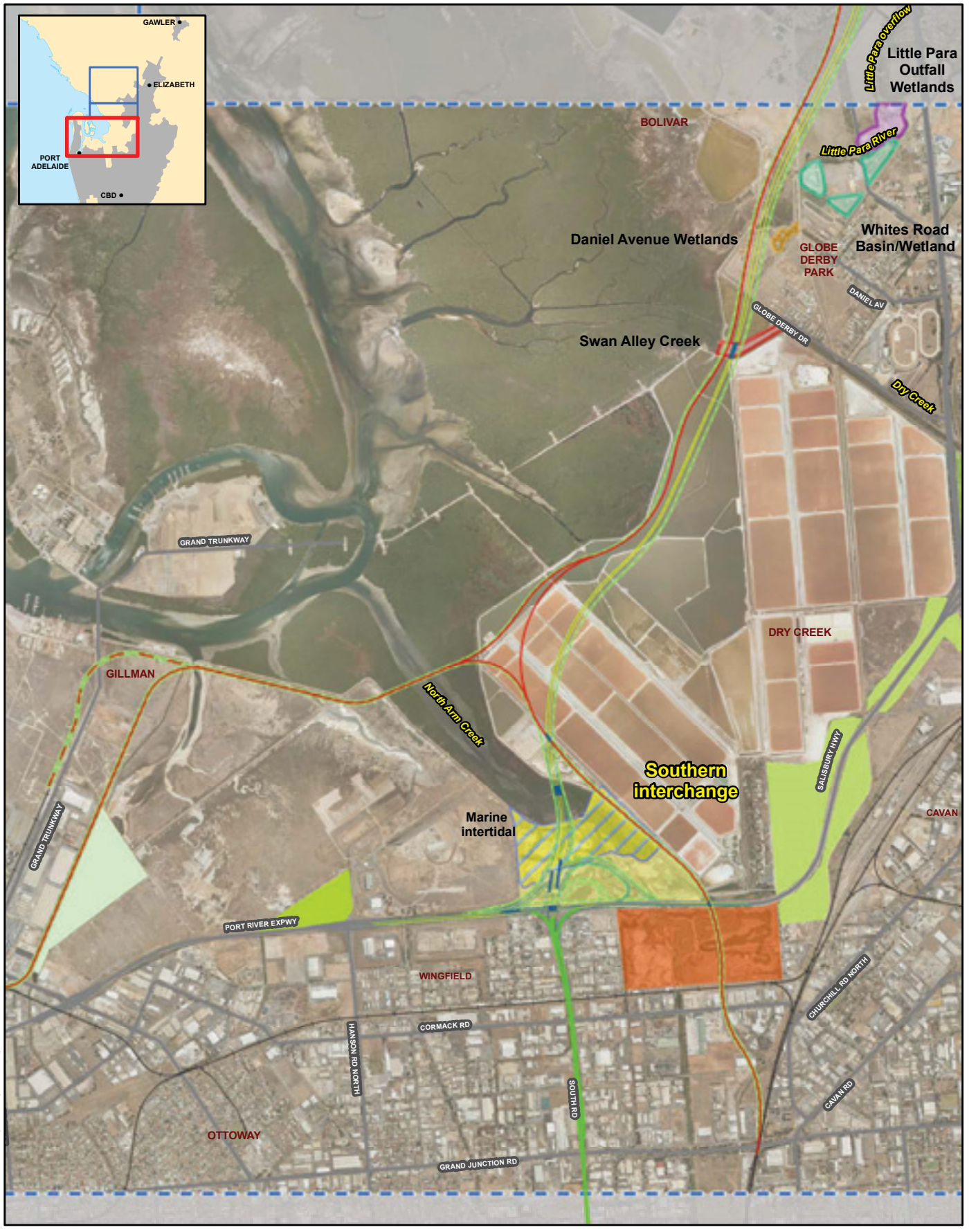


Figure 2.1 **Wetland Habitats in the project area Southern section**

2.1 Terrestrial

In addition to the review of additional literature and data, field observations as habitat assessments and bird surveys were undertaken during 2010 and 2011.

Detailed mapping of habitats from aerial photography and field validation of habitats and species using habitats was undertaken as part of the assessment.

2.1.1 Avifauna

Table 2.1 summarises the location of assessment sites in the region and project area undertaken by KBR. Most of the surveys used the '2 ha 20 minutes or longer' procedure of Birds Australia (Barrett et al. 2003). Assessments were generally carried out for one to three hours at dawn or dusk, on days with minimal wind (to reduce background disturbance which can inhibit the identification of bird calls). Surveys were also undertaken at other times of the day and early evening so as to provide some assessment of the diurnal variation in species and populations using particular sites.

Opportunistic sightings in the study area and region, including road killed animals, were recorded. Particular attention was focused on the presence or absence of specialised wetlands species that are cryptic, such as rails, crakes and bitterns; trans-equatorial migratory shorebirds; and nationally threatened species.

Additional data from Birds SA were obtained and records on Birdpedia were consulted.

Data collection and management

Assessed locations were recorded on a recent aerial photograph of the project area provided by DTEI and/or by using a Garmin 12 Geographic Positioning System (GPS).

Field notes were recorded for each location, especially on habitat type and composition, species use, the presence of threatened species, abundance and threats, and photographs were used to record many locations. Photographs were obtained using a Nikormat SLR camera with 55 mm macro lens and an Olympus C-300 digital camera.

Data management included depiction of recorded information onto ArcInfo GIS. GIS spatial datasets have been created from GPS records collected during field assessments and ground-truthing activities and via desktop digitising. Data captured during field visits was recorded initially using a non-differential Garmin 12 GPS, in degrees minutes and seconds. Data were downloaded and converted to decimal degrees, and then finally to GDA94, Zone 54. Where data were not captured via GPS, it was digitised manually using ESRI ArcMap 9.2 software, based on information visible on the raster image supplied by DTEI in March 2011. All datasets were manipulated using ESRI ArcGIS 10 software. Shapefiles were created of each individual dataset, for classification, statistical analysis where

relevant, and final report presentation. Metadata have been provided to DTEI for the project's GIS database.

Table 2.1 Avifauna field survey sites, 2010/11

Date	Location
28 December 2010	Magazine Creek and The Range Wetlands, Gillman and adjacent areas
29 December 2010	Magazine Creek (northern areas) and Barker Inlet to North Arm Creek
29 January 2011	North Arm Creek
2 February 2011	Barker Inlet Wetlands North (western and central sections)
9 February 2011	Northern section of Gillman and North Arm Creek
12 February 2011	Magazine Creek and The Range Wetlands. Gillman and associated areas
15 February 2011	Barker Inlet North, Greenfields Wetlands and Dry Creek
18 February 2011	Barker Inlet Wetlands South
19 February 2011	North Arm Creek and marine section of Barker Inlet Wetlands North
22 March 2011	North Arm Creek and Barker Inlet Wetlands North

2.1.2 Mammals

Observations during field surveys provided opportunistic records of mammals. No other specific survey methods were used during the assessment period.

2.1.3 Reptiles and amphibians

Observations during field surveys provided opportunistic records of reptiles and amphibians. No other specific surveys were undertaken by KBR.

No targeted surveys of amphibians were undertaken by KBR; however, EBS (2009) and other regional reports provide suitable data for these faunal groups.

2.1.4 Other fauna

No specific surveys were undertaken of fish or invertebrates. Information on these fauna was obtained from EBS (2009) and other literature, including Waterwatch databases for the region.

2.2 Marine

2.2.1 Avifauna

Field surveys by KBR included marine waterways and wetlands. See Section 2.1.1 for details of methodology. Regional information was obtained from a range of sources, including historical information and databases for the region. It must be

noted that there is some overlap between the species using marine areas and other wetlands, such as freshwater, in the region and the project area.

2.2.2 Other fauna

Even though no specific marine mammal surveys were conducted, comprehensive reports and literature are available. The relevant reports have been summarised in Section 3.1.4 and provide information on the types of fauna present and identify those issues that may or are likely to impact on these fauna. Information on records in the area are summarised in Section 3.1.4.

Data on fish and invertebrate species were provided by EBS (2009) and some additional consideration of these groups is included here.

2.3 Nomenclature and significance criteria

The taxonomy of fauna follows the state listings of Robinson et al. (2000) as updated by the following sources:

- Avifauna — Christidis and Boles (2008)
- Mammals — Menkhorst and Knight (2004)
- Reptiles and amphibians — Wilson and Swan (2008) as updated by Hutchinson (2010a, 2010b).

2.3.1 Significance criteria

Taxa are the categories into which plants and animals are classified (e.g. family, genus, species or subspecies) or specific examples of these categories (e.g. *Canis lupus dingo*, the subspecies of dog that is found wild in Australia).

The following criteria have been applied to determine the significance of species:

- Local: All indigenous fauna are significant at a local level because of the overall decline in this component of the fauna since European settlement, and the continued incremental loss of habitat and reduction in abundance because of development.
- Regional: A taxon is considered significant at a regional level if it has a disjunctive distribution, an unusual ecological occurrence, extraordinary concentration such as colonial nesting, roosting or feeding sites, or if it is substantially depleted or restricted in the region.
- State: A taxon is considered significant at State level if it is listed as, endangered, vulnerable, or rare under the NPW Act. Species protected by international migratory species agreements (e.g. migratory birds under CAMBA, JAMBA or ROKAMBA) are also considered to be of State significance.
- National: Nationally significant taxa that are endemic to Australia are of international significance (IUCN) or listed in the EPBC Act.

The classifications for denoting the conservation status of wildlife taxa in South Australia are the IUCN Red List Categories as prepared by the IUCN Species Survival Commission and approved by the IUCN Council.

Definitions of these terms are provided below:

- Extinct: Taxa not definitely located in the wild during the past 50 years.
- Endangered: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that may be extinct but have definitely been seen in the wild in the past 50 years.
- Vulnerable: Species believed likely to move into the endangered category in the near future if the casual factors continue operating. Included are taxa of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; species with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.
- Rare: Taxa with small populations that are not at present endangered or vulnerable, but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.
- Indeterminate: Taxa known to be endangered, vulnerable or rare, but where there is not enough information to indicate which of the 3 categories is appropriate.
- Insufficiently known: Taxa that are suspected but not definitely known to belong to any of the above categories. In general this is because of lack of information (unknown is also applied as an equivalent, alternative category).
- Threatened: This general term is used to denote species which are endangered, vulnerable, rare, indeterminate, or insufficiently known.

2.4 Limitations

Above average rainfall and relatively few periods of hot weather occurred during the current assessment period of December 2010 to March 2011. Only a limited number of surveys were undertaken at each site in order to provide information about diurnal variation. Therefore, the chance of observing some seasonally occurring avifauna species was reduced and some of the avifauna data collected may not be reflective of the actual fauna present on a local or regional basis, long term basis or in times of below average rainfall. Annual and seasonal variation data are, however, available in the literature, especially through various KBR and DTEI reports and from Birds SA, for some sites in the region.

3 Existing conditions

For biological matters, both past and present conditions can influence the distribution of species. In particular, the past distribution of species available from historical accounts can help in understanding changes in current native and introduced fauna populations and provide data with which to assess future predictions. This section discusses both past and present information relevant to the distribution of fauna.

3.1 Existing conditions within the project area and region

This section reviews the current land use, the occurrence of natural and Pre-European settlement habitats and regional fauna information.

3.1.1 Current land use

The Northern Adelaide Plains, on which the project is located, are the most southern parts of the Eyre and Yorke Block bioregion and in the Flinders Lofty Block bioregion (IBRA 6.1, Thackway and Cresswell 1995). For the project, the Adelaide Plains region is defined as Onkaparinga Estuary to Port Wakefield and east to the foothills of the Mount Lofty Ranges. The project is located on the coastal fringe and Northern Adelaide Plains as defined in Figure 1.2.

Much of the southern section of the region was originally used as holding paddocks for livestock prior to processing in the adjacent abattoir and in other industries associated with processed livestock. Most of the region is now urban or commercial-industrial in character, with major road and rail transport corridors connecting Port Adelaide and other areas of Adelaide and South Australia. As the urbanisation of Adelaide increases, the pressure on the natural environment also increases. The 30-year plan for greater Adelaide outlines some of the future possibilities for development, including the area in and around the Northern Connector project; indeed, the Northern Connector project was created as part of this plan for transport in the wider region (Government of South Australia 2010).

Mining of salt at the Dry Creek Saltfields (currently the Cheetham Saltfields) is a major land use in the southern section, while smaller areas for conservation and recreation are also present (Laut et al. 1977). Horticulture and agricultural land uses were the major land use (historically) and continue to occur in the central and northern parts of the project area. The formal areas reserved for nature conservation in the region are the Torrens Island Conservation Park, Port Gawler Conservation Park, Adelaide Dolphin Sanctuary, Barker Inlet Aquatic Reserve and St Kilda-Chapman Creek Aquatic Reserve.

The current highly modified regional and local landscape has few natural historical ecosystem features remaining except along its western boundary. Extending from the Mount Lofty Ranges, westerly flowing watercourses with riparian areas, ephemeral ponds and wetlands still extend to floodplains and coastal marine areas, but the drainage patterns are now altered, confined and include constructed

wetlands, levee banks, flood control sites, drains and shallow open water areas managed for commercial salt harvesting.

Remnant coastal landscape features include tidal flats and creeks, saltmarshes, ridges, intertidal coastal areas and extensive mangrove woodlands, including along most of the tidal inlets, such as North Arm Creek. The modification of the landscape to improve stormwater management at the southern end of the project area, especially the complex mosaic of the Greenfields and Barker Inlet wetlands commenced in 1990, followed by The Range and Magazine Creek wetlands. These have replicated some of the coastal wetland ecosystems historically associated with the wider region from Dry Creek to Port Adelaide south to Glenelg (Twidale et al. 1976). The wetlands were specifically designed to provide a means of biologically cleaning stormwater and areas for flood detention, but all wetlands are now equally important as habitat for a range of faunal groups, especially bird species.

The design and construction of the northern interchange for the South Road Superway project implicates part of the Barker Inlet Wetlands, as does the potential relocation of railway lines as part of the current proposal. This area of the site was originally severely degraded due to its low lying elevation and the construction of levees to limit marine incursions. At the time of construction of the wetlands, the site comprised salt scalds, stranded and supra-tidal samphire low shrubland and anthropogenic grassland and herbland.

The water drainage channels and pond systems constructed for salt harvesting (at Dry Creek) and wastewater treatment (at Bolivar) provide areas of permanent surface water storage. These artificial dams and ponds occupy large areas and are very noticeable in the landscape. They provide wetland and other habitats for faunal groups, especially birds, although their actual use varies considerably according to water quality and location.

The current landscape features include levee banks that provide access routes throughout most low lying areas, largely for the control and maintenance of salt evaporation ponds, sewerage treatment areas and protection of low lying areas from flooding. These levee banks allow for a range of habitats influenced by factors such as access to fresh or saline water or elevation above low lying areas.

3.1.2 Current natural environments

The Northern Adelaide Plains is classified as ‘fragmented’ (McIntyre and Hobbs 2000), indicating that 40% to 90+% of the remnant vegetation has been destroyed. Although 53.5% of the Parham environmental association, in which much of the project is located, is remnant, this total is so large since it includes the relatively intact coastal fringe of mangrove and samphire associations. All other areas of native vegetation are highly fragmented, isolated, reduced in structural and species diversity, reduced in habitat value and vulnerable to invasion by environmental weeds and feral animals.

Although the Northern Adelaide Plains are considered to be fragmented, they have also been highlighted as a region of high ecological importance (Berkinshaw 2004a). According to Caton et al. (2009), the coastal area in and around the Barker Inlet has a medium conservation priority, while having a high threat value associated mainly with sea level rise and disturbance to native vegetation. The remnant vegetation in the project area is considered to be of conservation significance at a landscape scale to the whole Adelaide Plains region (KBR 2007, EBS 2009).

The narrow band of relatively intact to intact coastal vegetation from the southern section of the project area north to Port Wakefield and Clinton along Gulf St Vincent is continuous. It is predominantly a mixture of samphire and mangrove vegetation communities with small areas of bare ground, shrubland and woodland vegetation, providing a number of habitats for fauna species. This region, especially the Barker Inlet to St Kilda coastal area, is particularly important for a range of avifauna, with over 120 species recorded from both marine and terrestrial areas. Detailed reviews and information is provided in AMLR NRM Board (2008), Johnston and Weibkin (2008) and Daniels et al. (2010).

Mangrove areas are also important to the fishing industry since they provide important ecosystem functions, such as breeding areas for a range of marine species, including a number of fish and crustacean species of commercial and recreation significance. They also protect the coast against storms and play a slow but continuous role in 'land building' (City of Salisbury 2008). Mangrove communities, particularly those in the Port River and Barker Inlet region, have been and are under pressure from various threats, such as the high level of nutrients and other contaminants entering the ocean from stormwater, wastewater treatment plants and industrial outfalls (Baker 2004).

Landscape modifications have most noticeably been the almost total loss of terrestrial habitats, especially native sedgeland, grassland and woodland. The extensive mangrove forests remain because of the low value of saline areas for agricultural and industrial development. For example, the loss of Thatching Grass (*Gahnia filum*) sedgelands in the region has led to a suspected local extinction of the Yellowish Sedge-skipper Butterfly (*Hesperilla donnysa donnysa*) (Coleman and Coleman 2000).

Parts of the Saltfields and the Port River estuary have been identified as areas of international importance in South Australia for shorebirds (Watkins 1993). The Saltfields are ranked fourth in importance in South Australia. They consist of two types of habitat, the concentration ponds that occur along the coast adjacent to and north of the project area, with the northern areas providing important habitat, and the crystallisation ponds at Dry Creek, which are of limited habitat value (Day 1997). Wilson (2000) confirmed the Port River–Barker Inlet area as an important site for wading birds. Artificial wetlands, such as the salt ponds and the Bolivar WWTP areas, are valued for supplying habitat for a variety of species, mainly waders and waterbirds. These areas have thus been included in the boundary of the Barker Inlet and St Kilda Wetland of National Importance [SA005] (Environment Australia 2001).

Relatively large areas with conservation values close to the project site include Little Para Estuary, Greenfields Wetlands, Bolivar WWTP, the northern section of the Dry Creek Saltfields and areas such as the Thompson Creek and Little Para Linear Park (Berkinshaw 2004a, City of Port Adelaide Enfield 2007, Coleman and Cook 2009, KBR 2004). Other areas in the wider region with important conservation values include Buckland Park (grassland, chenopod shrubland), Buckland Park Lake (aquatic ecosystem), the banks and western floodplain of the Gawler River (River Red Gum and Black Box woodlands) and Port Gawler Conservation Park (mangrove woodland and coastal shrublands) and the Samphire Coast region from about Light Beach to Port Parham. Small marine and terrestrial areas, including remnant roadside vegetation and stormwater treatment freshwater wetlands used for conservation are present in local council areas, especially the City of Port Adelaide Enfield and the City of Salisbury.

Biodiversity values for the region therefore include a diversity of fauna, and especially avifauna habitat areas. Areas of known ecosystem conservation value and species, particularly birds and marine species, of national and State conservation significance are present.

3.1.3 Pre-European settlement habitats

Detailed records of the pre-European fauna present in the region are available from the South Australian Museum historical databases, with summaries available from Twidale et al. (1976), Daniels and Tait (2005) and Daniels et al. (2010).

Historically, the landscape supported large expanses of swamps and coastal saltmarsh communities, including saline aquatic, semi-aquatic and supra-tidal chenopod and samphire low shrublands in areas that are subject and adjacent to tidal inundation (Kraehenbuehl 1996, Graham et al. 2001, Coleman and Cook 2008). Shrublands subject to periodic shallow freshwater inundation from flood events with relatively intact riparian ecosystems (Dry Creek and the Gawler and Little Para rivers) also provided a suite of wetland and woodland habitats. Floodplain shrublands, such as those dominated by lignum and chenopods, were extensive, whilst other shrublands occupied a mosaic of niches (including *Nitraria billardierei*, *Atriplex paludosa* ssp. *paludosa* and *Maireana* spp.).

Terrestrial vegetation types included sedgelands (*Gahnia filum*) and grasslands (*Lomandra effusa, Austrodanthonia* spp., *Austrostipa* spp. and a range of summer growing species) with River Red Gum (*Eucalyptus camaldulensis)* and Black Box (*E. largiflorens*) woodlands and grassy woodlands along the major rivers, creeks and extending out into floodplains (Berkinshaw 2004a). Open grassy Mallee Box (*E. porosa*) woodlands and mallee dominated scrublands inland from the coast featured on rises and plains. Native pine woodlands would have also occurred on sandy rises (Kraehenbuehl 1996).

With white settlement, the extinction of many of the smaller to medium sized mammals, plus a number of bird species from in and around Adelaide and including the project area occurred. Major causes were habitat clearance and other direct

pressures and competition, the loss of habitat and/or predation by introduced species. Micro-chiropteran bats and some groups of birds are some of the few faunal groups to have survived relatively unscathed.

3.1.4 Background and regional fauna information

EBS (2009) summarised many of the vertebrate faunal group characteristics of the region and project area. No BDBSA fauna assessment sites are located in the region of interest, although there are a number of sub-regions and sites for which historical data are available from Birds SA and individuals with a long term interest in the region (Cox 1998, Day 1997, 2005). Bird species data comprise most of the records available *viz*. 139 bird species (and over 200 species in the wider region), along with 16 mammal, 34 reptile and 5 amphibian species. The current report also considers additional information of a historical nature, such as PPK Consultants et al. (1992) and the reports established as part of the MFP feasibility study, plus more recent studies (AECOM and KBR 2009, KBR 2007, 2009, 2010) and reviews (Coleman and Cook 2009, Daniels et al. 2010, Purnell et al. 2009, 2010, Shepherd et al. 2008). Some of these reports provide information on both the marine and terrestrial environments.

Terrestrial

Shorebirds include a range of migratory species recognised and protected by the EPBC Act and international migratory bird agreements to provide for the conservation of these migratory species in Australia (JAMBA, CAMBA, ROKAMBA). Australia is also a signatory to the Ramsar Convention for the conservation and 'wise use' of wetlands. In addition to those of international significance, 851 other wetlands in Australia have been identified as nationally important (Department of the Environment and Heritage (Cwlth) 2005, 2006), of which one is located within the project area, the Barker Inlet site [SA005].

A Wildlife Conservation Plan for Migratory Shorebirds has been prepared for this group of bird species (DEH 2006). This Plan covers 36 species of which 31 are present, or likely to be present at some stage, within the project area and adjacent region. These species use a range of terrestrial and marine habitats in the region.

For migratory shorebird species in the East Asia-Australasian flyway, sites in Australia are classified as internationally important if they support 1% of this flyway population and nationally important if the area supports 0.1% of the flyway population (Bamford et al. 2008, Purnell et al. 2009). The recent assessment and identification of shorebird habitat in South Australia is part of an Australia-wide project, and priority action by the AMLR NRM Board, to understand the distribution of the group, recognise the important habitat areas and to therefore aid their protection and long-term survival (Purnell et al. 2009, 2010).

Little to nil remnant native vegetation is present in and around the current Northern Expressway, adjacent to the northern section of the Northern Connector project area

(DTEI 2007). This lack of habitat reduces faunal group diversity to mostly introduced and cosmopolitan native species and restricts many native fauna to the scattered trees and remnant habitats along watercourses, drains and revegetated sites and wetlands, including those within and adjacent to the current project area. With a few exceptions, the areas of remnant vegetation around the Northern Expressway and Port Wakefield Road, and the northern section of the Northern Connector project area, are small, in poor condition and quality, and dominated by weeds and introduced fauna (KBR 2007). The Dry Creek drainage line was also assessed as part of DTEI (2007) and was found to be a relatively insensitive wetland with few habitats and bird species. Very few migratory shorebirds or aquatic birds were recorded here.

Purnell et al. (2010) identified four habitat types as being of of priority to conserve for the protection of shorebirds in Gulf St Vincent, namely, tidal flats, sandy shores, salt marsh and saltpans, and commercial salt fields and artificial wetlands. Some of these sites are marine and some are terrestrial, but as a combination all of these sites offer a variation in habitats, food species and abundance, tide conditions, human interference and the diversity and abundance of the shorebirds themselves, depending on time, season and conditions. In summary, the mosaic of artificial and natural shorebird habitats in the coastal wetlands of Gulf St Vincent is important to shorebird survival and they provide equally valuable habitat for aquatic and marine bird species too. However, not all areas of each such habitat are important and not all used equally by shorebirds.

DEH (Cwlth) (2005) estimated that approximately 50% of Australia's non-tidal wetlands have been converted to other uses since European settlement. Consequently, these artificial wetlands have assumed a significant role in the conservation of some bird species. Most of the wetlands and freshwater sites in the project area are, indeed, artificial ('man-made'), but they provide the same or similar resources as the natural environments and birds have readily adapted to these conditions.

During the impact assessment of the Northern Expressway and upgrade of Port Wakefield Road proposal studies, KBR (2007) identified that no EPBC Act listed significant bird species was likely to be affected. It also recognised that the wetlands, watercourses, constructed stormwater wetlands and estuarine system in the region provide habitat and resources for a variety of species conservation significance (BRS 2000, 2001; KBR 2007). A similar opinion was provided in Kinhill Stearns (1985) and SEA Gas (2001), primarily in relation to the avifauna using Barker Inlet and around Torrens Island.

Saltfields, both in South Australia and elsewhere in Australia and the world can provide havens for shorebirds, primarily because they provide a sufficient habitat for feeding and roosting with limited disturbance factors (Purnell et al. 2010). A section of the Dry Creek Saltfields (Penrice [Cheetham] site 47, located north of St Kilda and distant from the project area) is an internationally significant site for migratory shorebirds that use the East Asian-Australiasian flyway (Bamford et al. 2008). This is supported by both historical and current data reported by Purnell et al. (2010), who state that some of the artificial wetlands of parts of the Saltfields support the

greatest abundance of migratory shorebirds in the region with up to 9,100 Red-necked Stint and 2,130 Sharp-tailed Sandpiper seasonally present. Day (2004) and Watkins (1993) recorded a wide range of other shorebird species occurring within the Saltfields, including Red-capped Plover, Curlew Sandpiper, Banded Stilt, Greenshank, Red-necked Avocet and Marsh Sandpiper. Both the northern section of the Dry Creek Saltfields and Price Saltfields (in the northern part of the Gulf) had the highest abundance and diversity of shorebirds of the 17 sites surveyed in the Gulf of St. Vincent; nine species were observed at Dry Creek (Purnell et al 2009).

According to Coleman and Cook (2009), habitat for Red-necked Stint and Sharp-tailed Sandpiper is present almost continuously along much of the eastern coastline of Gulf St Vincent between Barker Inlet and Middle Spit. However, this mapping of all areas of potential habitat as being significant is extremely coarse and is not supported by current or historical data for each of the species. These species are confined to relatively small areas within the region and it is these high use/high value areas that Purnell et al. (2009, 2010) are currently trying to determine.

Purnell et al. (2009) recorded a marked decline in the numbers of some migratory species, such as a decrease of 85% in Curlew Sandpiper at the Dry Creek Saltfields between 1986 and 2009. However, they indicate that the changes in numbers are most likely to be due to events and impacts at other areas of the Flyway in the northern hemisphere.

As part of identifying threats to shorebirds, Purnell et al. (2009) identified that any extensions to the Northern Expressway as part of the Northern Connector project and urban development of the southern section of the Saltfields as threats to shorebirds. They indicate that these developments could result in the loss of habitat and increased disturbance to the known 15,000 shorebirds that use the northern section of the Saltfields and the mass displacement of the migratory birds.

Rufous Night Heron (also known as a Nankeen Night Heron, *Nycticorax caledonicus*), Little Egret (*Egretta garzetta*), Eastern Curlew (*Numenius madagascariensis*) and Whimbrel (*Numenius phaeopus*) were recorded during fauna surveys of Torrens Island as part of the Wasleys Pipeline EIS study (Kinhill Stearns 1985). Both Rufous Night Heron and Little Egret were breeding on Torrens Island. The Little Egret record was particularly important, because old and active nests were observed, indicating a long term occupation at the site. Eastern Curlew and Whimbrel, two of the larger migratory shorebird species, were observed on the intertidal flats around Point Grey and the western shores of Torrens Island. White-browed Scrubwren and Slender-billed Thornbill were also recorded in mangrove and samphire habitat and could occur in adjacent mainland areas i.e. within part of the current project area. More recent surveys in the Gillman and Dry Creek region have not recorded the Thornbill.

Good quality fauna habitats in the wider area surrounding the current project are almost non-existent as a result of extensive vegetation degradation and clearance. The lack of native mammals is due to current land use and the number of introduced predatory species present, including cat, fox and dog. Native mammal species are restricted to some of the micro-chiropteran bats, two possum species and a few

other species that are adapted to semi-aquatic or urban and agricultural environments (BRS 2000, 2001). The reptile species present are generally common in the region and elsewhere including Eastern Bearded Dragon *(Pogona barbata),* Sleepy Lizard *(Tiliqua rugosa),* Eastern Bluetongue Lizard (*T. scincoides)* and Eastern Brown Snake(*Pseudonaja textilis)*. The lack of habitat and presence of predators is likely to be responsible for the relatively few records of smaller native species combined with the lack of surveys (BRS 2000, 2001).

One of the few fauna surveys in the region was on Torrens Island (Kinhill Stearns 1985). Many of those mammal species captured were introduced species, including European rabbit (*Oryctolagus cuniculus*), House Mouse (*Mus musculus*) and Black Rat (*Rattus rattus*). Seven reptile species were recorded.

Marine

The Gulf of St. Vincent region is the second most important area for shorebirds in South Australia (Purnell et al. 2009). The area includes locations within and adjacent to the Northern Connector project area, namely Barker Inlet Wetlands, Magazine Road Wetlands (part of Greenfield Wetlands Stage 3) and parts of the Dry Creek Saltfields (Purnell et al. 2009).

The current Northern Connector route includes the Barker Inlet, specifically by two crossings of North Arm Creek, as well as other smaller creeks and two outlets associated with the Barker Inlet, namely Magazine Creek and Dry Creek channel. All of these wetlands are part of two important conservation areas, the Barker Inlet Aquatic Reserve and the Adelaide Dolphin Sanctuary.

The Barker Inlet region has been subject to various recent studies, especially as it provides freshwater and tidal (estuarine and marine) wetlands and riparian habitat for various faunal groups, and in the context of this project, bird species (Birds South Australia records, KBR 2009, 2010).

KBR (2009) reviewed the Barker Inlet South Wetlands and noted that it was primarily a habitat for aquatic species due to the areas of deep water, with relatively few areas of habitat for shorebirds. Masked Lapwing, Black-winged Stilt and Black-fronted Dotterel were species present here. One area of potential importance for migratory wading birds and other shorebirds was the large, bare area associated with the antennae paddock and smaller areas of open land and samphire shrubland east of the paddock. These sites were used as resting and roosting areas by species such as Silver Gull, Welcome Swallow and Fairy martin, with less frequent use by Australian Pelican, Australian White Ibis and some duck species. However, should other more suitable areas be disturbed, then parts of these southern wetlands may be used as temporary resting and roosting areas by a wider range of species, including shorebirds.

Mangrove and samphire habitat make up much of the vegetation around the edges of the Barker Inlet. Mangrove and samphire ecosystems have been severely modified in Adelaide since white settlement (PPK Consultants 1992), including reducing the area available for mangrove and samphire vegetation due to clearing

for development and the construction of levees in the Wingfield area (Fargher Maunsell 1984). This prevents the landward growth and extension of habitat, especially as a responsee to sea-level rise. In 1975, the mangrove forests between Port Gawler and Torrens Island, included as part of the Barker Inlet, were well developed and extended 1 km or more inland (Butler et al. 1975), providing very good habitat for a variety of species. Mangroves are important roosting and breeding areas for species such as White-faced Heron and Rufous Night-heron, in addition to providing feeding and roosting areas used by other terrestrial bird species (PPK Consultants 1992). The mangroves are also significant at a regional level, while saltmarsh was considered to be the most important bird habitat present in and around the Dry Creek area by PPK Consultants (1992). Past records indicate that species of conservation significance may be present in and around Gillman and Dry Creek as Elegant Parrot, Peregrine Falcon and Little Egret (PPK Consultants 1992). Based on recent surveys, this is considered to be an over-estimation of the importance of saltmarsh in the region and an under-estimation of the number of bird species of conservation significance.

Increasing boat traffic resulting in more erosion from boat wakes and propeller wash and fuel and oil spills, was outlined as the main threats to the mangroves in the Barker Inlet, while alterations of water course flow patterns (namely the River Torrens and Dry Creek), reclamation of land for development, pollution and implications of the Torrens Island Power Station outlet of warm water from the cooling towers of the power station were also listed as possible threats (Butler et al. 1975).

Fargher Maunsell (1984) identified the release of metals and nutrients from sediments of the adjacent landfill site at Wingfield as another possible threat. Many of these issues still apply, particularly from future industrial development and expansion of infrastructure in the region. These issues could affect the fauna in the area, particularly the complex ecological relationships that exist between mangroves and their associated fauna. Historical records identified North Arm Creek as having low aquatic species diversity possibly because of the prolonged periods of low dissolved oxygen in the water column (particularly during neap tides), in addition to the release of metals and nutrients from sediments related to the Wingfield landfill.

Individual records of rare shorebirds to the region are known, especially at the Dry Creek (northern sections) and Price saltfields. These include Hudsonian Godwit (*Limosa haemastica*), Red-necked Phalarope (*Phalaropus lobatus*), American Golden Plover (*Pluvialis dominica*) and Cox's Sandpiper (*Calidris paramelanotus*) (Pectoral x Curlew Sandpiper hybrid) (Purnell et al. 2009).

DTEI (2009, 2010) reviewed the environmental impact of construction of the South Road Superway project. Apart from a few records of thirteen bird species of conservation significance in the Barker Inlet Wetlands North and South, it was considered that there was no impediment to the project based on fauna habitat and species.

KBR (2009, 2010) recorded various species of State conservation significance from both the southern and northern Barker Inlet wetlands, with Musk Duck (*Biziura*

lobata), which is listed as rare under the NPW Act) being a breeding resident. Regional records from DENR indicated that six species of State significance have been recorded as individuals or in small numbers in the past in the Barker Inlet Wetlands South (DTEI 2009a). These wetlands primarily provide habitat for aquatic bird species as a result of large areas of deep water and there are relatively few areas of shallow water that would attract large populations of shorebirds here. A few shorebird species were recorded in small numbers during past surveys, including a few individuals of the EPBC Act listed species Little Egret, Cattle Egret, Wood Sandpiper and Sharp-tailed Sandpiper.

Purnell et al. (2009) noted that bird surveys in and around the Barker Inlet would underestimate bird numbers, including migratory shorebirds, because of the lack of access through the large stands of mangroves. They consider that there would be gaps in knowledge in and around the Barker Inlet and the seaward side of the Saltfields.

BRS (2001) and AECOM and KBR (2009) considered the impact of noise on wetland birds within the western side of the Barker Inlet North wetlands as part of the initial impact studies of the Port River Expressway (PRexy) and following its construction. As a result of construction of PRexy, road traffic noise levels were considered to have increased by 6 dB(A), up to levels of approximately 63 dB(A) at the bird survey sites. Despite the increased traffic noise exposure at the bird survey resting and roosting sites assessed as time series observations annually over six years, no obvious changes in the abundance and diversity of species was observed over the assessment period. This suggests that bird species using the survey sites have tolerated, or habituated to, the increased traffic noise exposure up to levels of about 63 dB(A) as well as the increased amount of visual disturbance due to vehicles (AECOM and KBR 2009).

Mangroves and seagrasses of the Barker Inlet and elsewhere along the Gulf are of historical and local importance to recreational and commercial fishing (Fargher Maunsell 1984). These habitats are part of a nursery area for species such as Western King Prawns (*Penaeus latisulcatus*), while the Port Adelaide River estuary region is a major King George Whiting (*Sillaginodes puncata*), Garfish (*Hyporhampus melanochir*) and Yellow Eye-mullet (*Aldrichetta forsteri*) nursery (Kinhill Delfin 1990, Kinhill Stearns 1985). Other species as Yellow-fin Whiting (*Sillago schomburgikii*), Jumper Mullet (*Liza argentea*) and various benthic fauna are resident in the estuary (Kinhill Delfin 1990, Kinhill Stearns 1985).

The sediment under and around the mangroves between Port Gawler and Torrens Island is recorded as soft and rich in organic matter, providing suitable habitat to support various invertebrate groups, especially molluscs, annelids and arthropods (Butler et al. 1975). However, this is not true for all areas and North Arm Creek is considered to be of relatively poor ecological quality by Fargher Maunsell (1984).

Samphire regions and low-lying tidal drainage areas, such as those around the Port River estuary system are breeding sites for a number of insects and other invertebrates. Many of these form part of the intricate food chain for other species (Kinhill Delfin 1990). Impacts to marine aquatic fauna generally occur due to

suspended sediment smothering them, especially by the abrasive action of the material and ability to clog gill membranes (particularly for filter feeds and juveniles). However, very high concentrations of suspended material would be required to have such an impact (Kinhill Stearns 1985).

3.2 Survey results for the project area

3.2.1 Habitats

Habitats considered in this report were initially based on data in EBS (2009) and then modified by information in the literature and from the field surveys. The value of each habitat to faunal groups and species varies considerably depending on the health and quality of vegetation and the type of habitat required by particular faunal groups. Figures 3.1 to 3.2 illustrate the habitats affected by the project in the southern section of the project area. Figure 3.3 to 4 considers the habitats in the central and northern sections of the project area as per EBS (2009).

Terrestrial

Limited remnant terrestrial habitat is available in the region and the project area. Most woodland habitat involving native species has been planted and remnant understorey habitat is confined to small, isolated patches.

Woodlands

Of the eucalypt woodlands across the project area, the largest patch of remnant woodland is along the Little Para River. Many of the trees at this site are large remnant River Red Gums. A wide range of other eucalypt tree species has been planted at this site and around the adjoining wetlands. The younger eucalypts scattered among the older growth trees have recreated a multi-aged woodland, further enhancing the ecological value of this habitat. This patch of riparian woodland constitutes a regionally significant habitat, given that most old growth native trees on the Adelaide Plains occur as individuals or in small patches associated with parklands or roadside vegetation (Paton 2001).

The larger trees provide a multitude of different sized hollows, used as breeding and/or shelter sites by a range of bird and mammal species. The smaller younger eucalypts planted in the area also provide breeding habitat to tree nesting birds and feeding resources to other woodland bird species. The groundcover through much of this woodland also provides useful habitat to woodland birds.

A larger area of planted eucalypt woodland is along the eastern boundary of Bolivar WWTP. There is little groundcover at the southern end of this plantation due to livestock grazing. This plantation is linked to the riparian woodland along Little Para River by a strip of younger plantation eucalypts. Old growth River Red Gums are also scattered through the paddocks between these sites. Bird use of each of these woodland habitats will depend on roosting, feeding and breeding requirements of each bird, and age, species composition and structure of the woodland.

Important tracts of remnant woodland occur along the Gawler River and on the Gawler River floodplain to the north of the project area, especially around Buckland Park and to the east of the project area along the Little Para River, which includes Kaurna Park (Burton Wetlands) and The Paddocks Wetlands.

Areas of woodland have been planted in the wetlands in the project area. These vary in composition and function and large numbers of *Casuarina glauca* (Grey (Swamp) She-oak) have been used to screen areas and to provide habitat along waterways. A range of other native tree species, mostly dryland Eucalypts, has been used in other sites.

Shrublands

Native shrubland habitat across the project area is interspersed with exotic pasture grasses between saltmarsh areas to the west and the suburbs to the east.

Numerous small patches of Cottonbush (*Maireana aphylla*) are also scattered throughout this area in the central section of the project area. On the flat plains further south between wetland and saltmarsh habitat is another small patch of low shrubland which contains Nitre Bush (*Nitraria billardierei*) and Coastal Saltbush (*Atriplex paludosa*). There are only a few other small patches of shrublands in the region. Low shrublands are primarily located north of St Kilda and inland from Port Gawler near Middle Beach.

Shrubland habitat provides useful feeding and nesting habitat for a number of birds on the Adelaide Plains. However, the clearing of shrublands has led to the decline or loss of a number of native birds from the area. It is likely that fragmentation and isolation of these patches of habitat in the project area have made them unsuitable for use by the bird species that would have originally inhabited these areas. Despite their degraded and fragmented state, this habitat still provides shelter, feeding and breeding resources for a range of small passerines such as fairy wrens and thornbills.

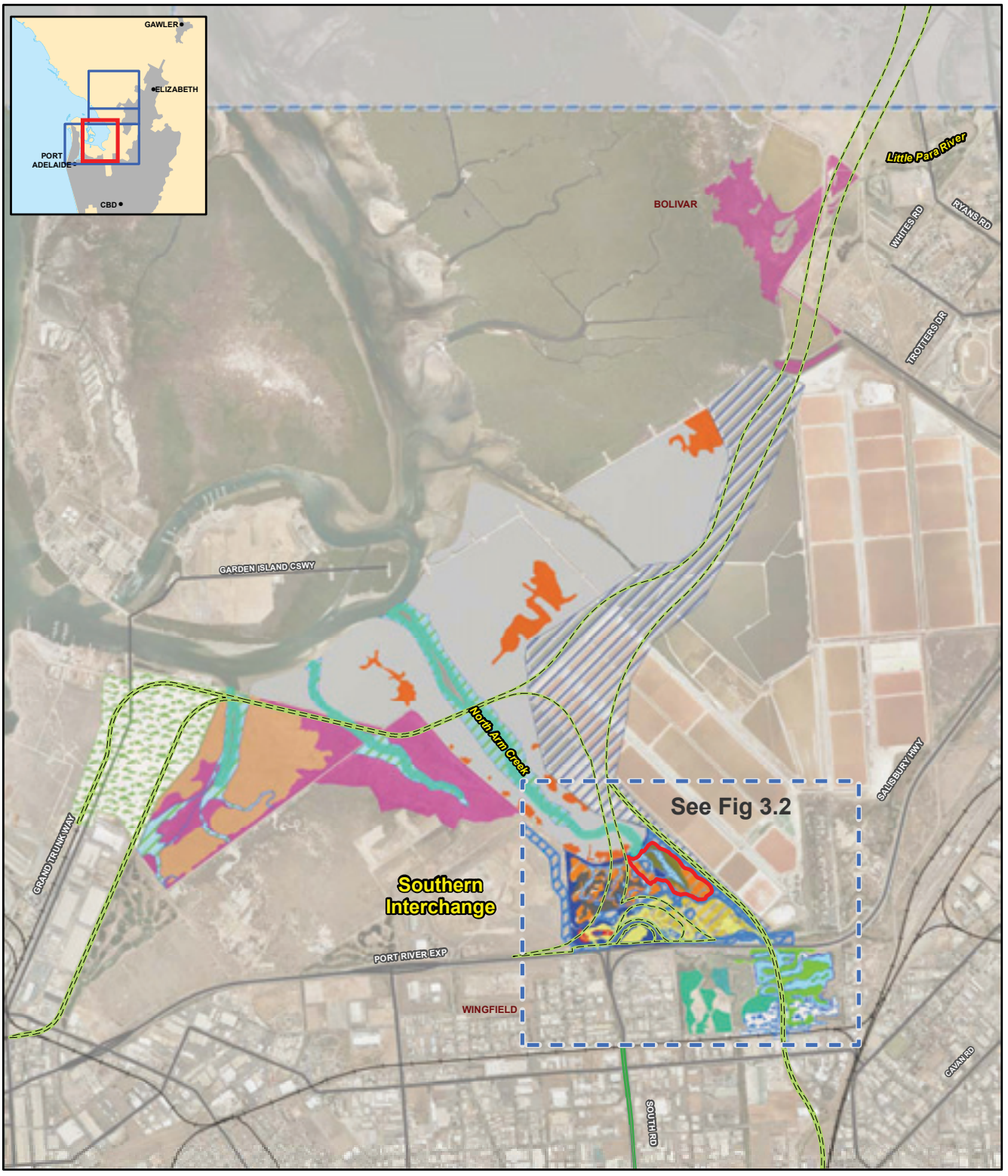
Most large areas of shrublands in the region and at the stormwater treatment freshwater wetlands across the project area have been planted and their understorey is dominated by introduced grasses and herbs. Areas of higher ground include remnant supra-tidal samphire shrublands and supplementary plantings of salt tolerant species, especially various saltbush and other chenopod species, has been undertaken. Areas of planted woodland are interspersed between shrublands at some sites, such as through the Barker Inlet Wetlands South.

Anthropogenic grasslands and herbfields

Paddocks and open areas containing introduced annual and perennial pasture grasses and herbs are dominant across the project area, between the saltmarsh/salt fields/sewage settling ponds to the west and the suburbs to the east. This habitat type provides a food resource for some native bird species such as pigeons and pipits and a number of introduced bird species. Open grasslands near wetlands can also be used as feeding areas by the Australian Shelduck, Australian Wood Duck, Black-tailed Native-hen and Cape Barren Goose.

Freshwater habitats

Freshwater wetland is now a major habitat type in the project area. Most of the wetlands have been constructed since the early 1990s for water quality treatment, stormwater storage and recovery, flood mitigation and habitat enhancement. The largest wetlands are the wastewater ponds at Bolivar WWTP located in the northern section of the project area. The WWTP contains large open water areas that are heavily used by waterbirds. Smaller freshwater wetlands in the southern section of the project area include the constructed stormwater wetlands as the Barker Inlet



NORTH

0 1

Kilometers

Figure 3.1 **Fauna Habitat within corridor Southern section**

- Northern Connector boundary
- Existing railway
- Existing roads
- Deep open water (freshwater)
- Important bird roosting areas - Non EPBC Act (bare ground)
- Salt fields
- Samphire very low shrubland (Sarcocornia)
- Planted woodland and shrubland
- Tall aquatic grassland (Typha and Phragmites)
- Anthropogenic grassland and herbland +/- shrubs
- Shallow water and sedgeland (important bird habitat)
- Samphire low shrubland and bare ground (salt scalds) (important bird habitat)
- Anthropogenic grassland and shrubland
- Samphire low shrubland (supratidal) and anthropogenic grassland
- Bare ground and salt scalds with occasional Tecticornia
- Deep freshwater with areas of tall aquatic grassland
- Planted shrubland +/- woodland species
- Shallow freshwater drying to mudflats, with aquatic grassland and sedgeland
- Shallow marine and freshwater flow paths
- Grey mangrove woodland
- Important habitat area (marine)
- Shallow salt water and intertidal mudflats and salt flats
- Shallow water and mudflats
- Supratidal samphire
- Samphire low shrubland (Tecticornia +/- Sarcocornia) (supratidal and intertidal)
- Deeper salt water (channel)
- Intertidal samphire (Sarcocornia and Tecticornia)

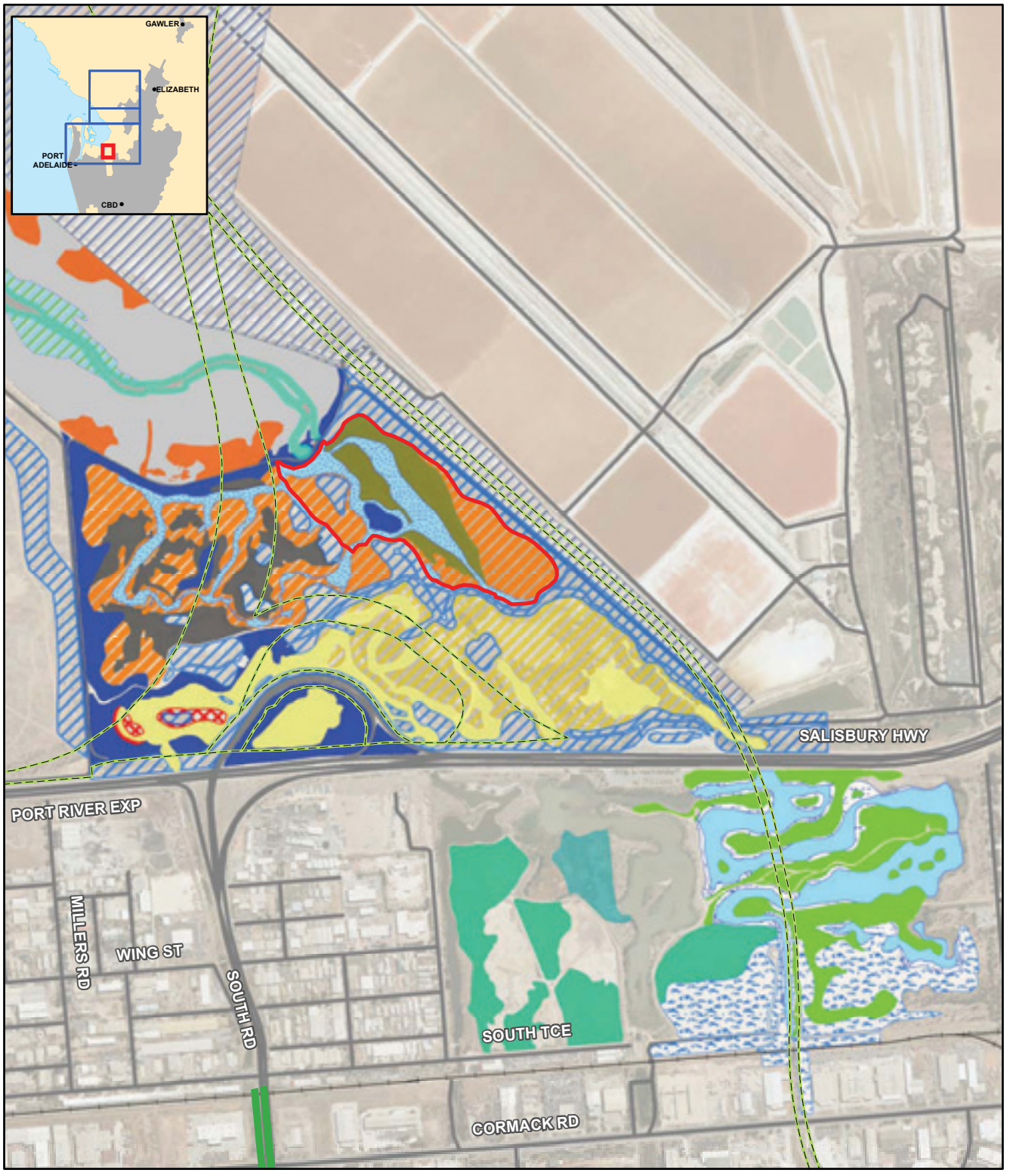


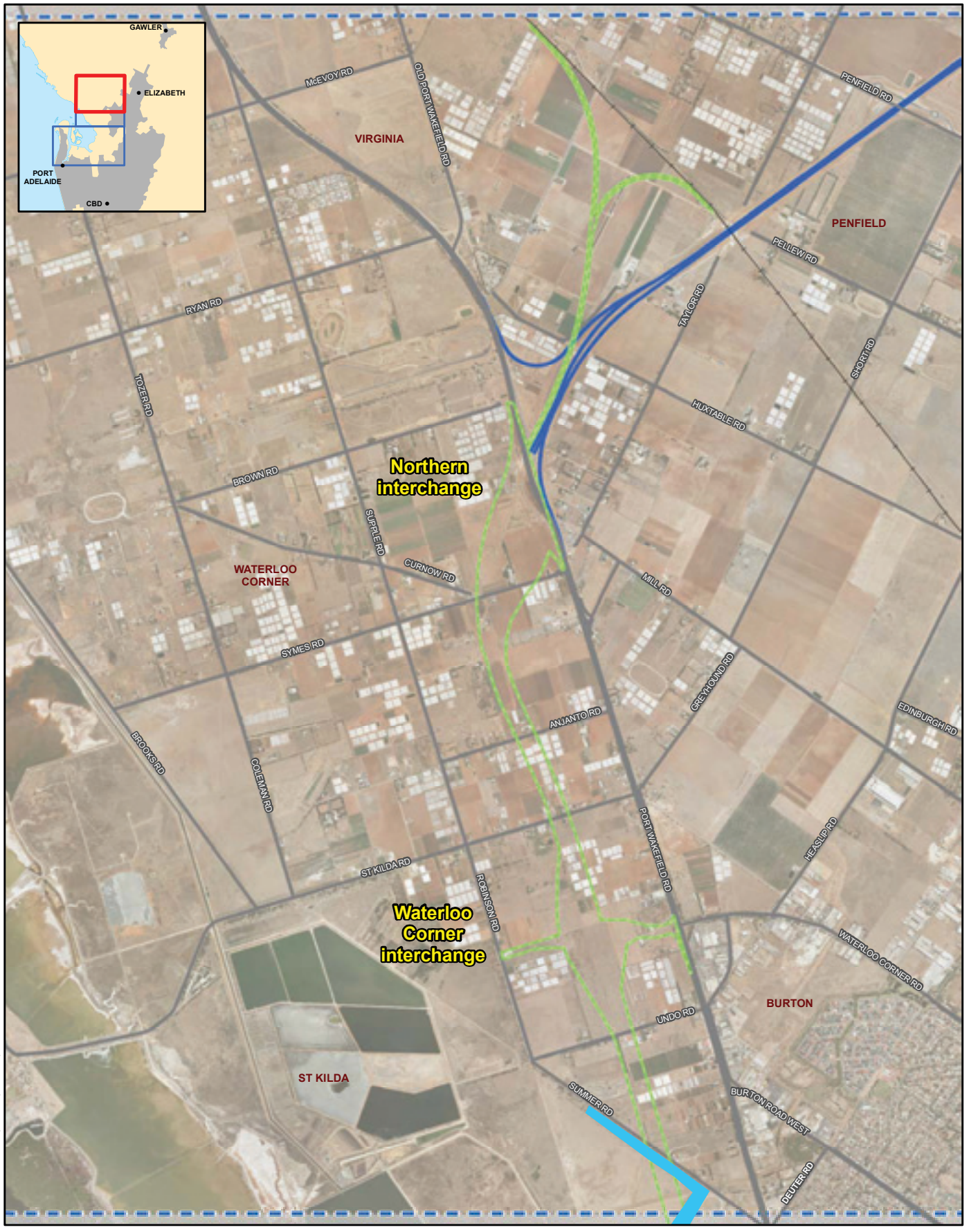
Figure 3.2 **Fauna Habitat Barker inlet wetlands and North Arm Creek**

- Northern Connector boundary
- Existing railway
- Existing roads
- Deep open water (freshwater)
- Important bird roosting areas - Non EPBC Act (bare ground)
- Salt fields
- Samphire very low shrubland (Sarcocornia)
- Planted woodland and shrubland
- Tall aquatic grassland (Typha and Phragmites)
- Anthropogenic grassland and herbland +/- shrubs
- Shallow water and sedgeland (important bird habitat)
- Samphire low shrubland and bare ground (salt scalds) (important bird habitat)
- Important habitat area (marine)
- Bare ground and salt scalds with occasional Tecticornia
- Deep freshwater with areas of tall aquatic grassland
- Planted shrubland +/- woodland species
- Shallow freshwater drying to mudflats, with aquatic grassland and sedgeland
- Shallow marine and freshwater flow paths
- Grey mangrove woodland
- Shallow salt water and intertidal mudflats and salt flats
- Shallow water and mudflats
- Supratidal samphire
- Samphire low shrubland (Tecticornia +/- Sarcocornia) (supratidal and intertidal)
- Deeper salt water (channel)
- Intertidal samphire (Sarcocornia and Tecticornia)

Source: DEH, DTEI, DPLG, EBS

Figure 3.3 **Fauna Habitats within corridor Central section**

- Northern Connector boundary
- Existing roads
- Woodland Habitat



Source: DEH, DTEI,DPLG, EBS

Figure 3.4 **Fauna habitat within corridor Northern section**

Wetlands (north and south) and the Greenfields Wetlands complex. A cluster of much smaller freshwater wetlands are adjacent to the Little Para River.

The size and structure of wetlands, as well as the diversity and condition of the plant communities present, influence the suitability and resultant use of these sites by birds and other fauna. The availability of different habitat types, such as open water, shallow water and vegetated or open banks, influences the presence or absence of birds.

Open freshwater

Most open water habitat is part of the constructed wetlands and is present, usually as relatively deep water, when a wetland is at full capacity. The extent of open, deep water and shallow water in a wetland is dependent on their function and construction. The ratio is variable as the wetland dries out and refills. This is largely influenced by the seasons and the inflow of stormwater, but also by management of the wetland.

Open water is used as foraging habitat by a range of aquatic waterfowl (e.g. Black Swan, Pacific Black Duck, Chestnut and Grey Teal, Hardhead, Eurasian Coot, grebes, and Little Pied and Little Black Cormorants). Areas of semi-permanent water are available in most of the freshwater wetlands in the project area; the size of open water varies with the structure and size of the wetland and with seasonal and climatic conditions. The largest area of open water is at the Bolivar WWTP sewage settling ponds. Smaller areas of open water are present in the Greenfields Wetlands, the Barker Inlet Wetlands and in the Magazine Creek and The Range Wetlands where there is a complex system of channels and pools.

In the greater region, a wide range of other freshwater wetlands provide open water habitat suitable for waterfowl. The only other substantial freshwater habitat on the Adelaide Plains is Buckland Park Lake at the mouth of the Gawler River. This lake is outside the project area, but is part of a wetland system of national significance that supports a high abundance and diversity of waterfowl and other birds (Paton et al. 1991, Morelli and de Jong 1995). Filling of Buckland Park Lake depends mostly on winter flows from the Gawler River, with the lake usually drying out through most of spring and summer. In recent years the lake has not filled due to lower rainfall and diversion of water upstream. Other smaller freshwater wetlands in the Adelaide Plains with areas of open water are the stormwater Paddocks Wetlands in Para Hills and smaller stormwater wetlands in the region.

Shallow freshwater and mudflats

The suitability of a freshwater wetland to a wide range of birds is influenced by the extent of shallow water and mudflats available. These areas are used as foraging habitat by a range of birds including waders, herons, egrets and stilts. EBS (2009) noted that the sewage settling ponds at Bolivar WWTP provided the largest areas of shallow freshwater in the region and project area (and the largest number of birds recorded) in addition to the largest area of open water habitat. These data are similar to the observations of Paton (2001) who recorded this site being used regularly and extensively by many thousands of aquatic and migratory bird species.

Greenfields Wetlands Stage 3 and parts of the adjacent Barker Inlet Wetlands North had the second largest area of shallow freshwater in the project area. Both are managed specifically for stormwater treatment, but both also provide areas of

shallow water and suitable foraging habitat, albeit smaller than Bolivar WWTP. Smaller areas of shallow freshwater habitat are also available at Greenfields Wetlands Stage 1 and Barker Inlet Wetlands South. All of these constructed wetlands also have deeper water channels, which are habitat for species that prefer open water and areas of reeds, such as ducks, swans and coots.

Buckland Park Lake is the largest area of freshwater wetland in the region (when it contains water, such as during 2010/11). It is regularly visited by a large range and number of wading birds and many other aquatic and terrestrial species during spring and summer (Paton et al. 1991). At its maximum, Buckland Park Lake extends to approximately 1.5 km^2 of freshwater feeding habitat for aquatic and wading birds, including shorebirds and up to 16 species of raptors (Close and McCrie 1986).

Tall grassland (reeds)

Reeds occur at the water's edge in shallow water or above the high water mark in wet areas. They grow 2 to 4 m in height and provide dense grassland habitat, so they are components of both open and shallow water habitats. Aquatic birds such as moorhens, swamp hens, crakes, grebes, rails and bitterns use reeds, especially when flooded, as breeding, foraging and roosting habitat. *Phragmites australis* (Common Reed) and *Typha domingensis* (Bulrush, Cumbungi) are the dominant plant species. This habitat is also used by non-aquatic bird species such as Clamorous Reed-warbler and Little Grassbird. The presence or absence of open, protected and sheltered areas along the bank of a wetland also influences the use of a site as a roosting area for a range of waterfowl and other birds. Generally wetlands with a mix of reedbeds and open areas attract the largest diversity and number of birds.

Reed habitat is available across the region and project area. Although Bolivar WWTP provides suitable foraging habitat for waterfowl, the absence of vegetation means that few waterbirds breed at this site. Birds that prefer to forage among reeds and other aquatic vegetation are mostly absent.

The Greenfields Wetlands Stages 1, 2 and 3, and both Barker Inlet Wetlands North and South contain a diverse array of reedbeds along their banks. Reeds also occur along the Little Para River wetlands. The breeding activity of birds is best documented from Greenfields Wetlands Stages1 and 3, where 53 bird species have been recorded breeding (Cox 1993).

Large areas of reeds also occur at Buckland Park Lake, which is considered to be the most important breeding site in the Adelaide region for a range of waterfowl (Morelli and de Jong 1995). Other smaller freshwater wetlands with aquatic grasslands are present in the region, such as the Paddocks Wetlands in Para Hills. Tall dense reedbeds fringe and occur throughout the constructed freshwater and estuarine wetlands along the Onkaparinga Estuary. They provide the most important habitat for avifauna of conservation significance in that region (DTEI 2009).

Low Sedgeland

Sedgeland communities typically occupy the floodplain areas and riparian zones along watercourses and the banks of freshwater wetlands, consequently they are primarily a component habitat of shallow water wetlands. Sedge species such as *Bolboschoenus*, which is the dominant species in the project area, grow up to 50 cm in height and most often occur in and adjacent to the taller reed beds near the

water's edge. Some bird species such as Ballion's Crake, Painted Snipe and Australasian Shoveler use sedgeland habitats for breeding. Many other species also forage in or along the edge of this habitat type, including bitterns, rails and crakes.

Most sedgelands in the project area have been planted or allowed to colonise wetlands for the purpose of wetland restoration to assist in the control of stormwater pollution. A diverse sedgeland community is located in the freshwater wetlands in the project area, especially at Greenfields Wetlands Stage 3. Smaller patches of sedge also occur along parts of the Little Para River, Dry Creek and along some drains, with small areas at Buckland Park Lake, and most of the other freshwater wetlands in the region. Most naturally occurring sedgeland habitat across the broader Adelaide Plains has been cleared.

Shrubland

Most shrublands across the project area, including at the stormwater treatment freshwater wetlands, have been planted. The Adelaide Plains region has little remnant native shrubland vegetation in total and even less in association with wetland habitats. However, a small remnant area occurs in the western area of the Gawler River and Buckland Park Lake region. At the most extensive planted shrubland community, Greenfields Wetlands and Barker Inlet, a wide range of native shrubs line the banks, the outer perimeter of the sites and in areas of higher elevation constructed as part of deepening of aquatic pathways. Two of the dominant planted tall shrub species are Swamp Paperbark (*Melaleuca halmaturorum*) and Lignum (*Muehlenbeckia florulenta*). Shrublands along the margins of wetlands provide breeding habitat (especially when partly flooded) for a range of wetland bird species. For example, the Australian Shoveler, Blue Billed Duck and Freckled Duck are known to breed in shrublands elsewhere, although this has not been recorded in the project area. This vegetation type also provides foraging and breeding habitat for a range of terrestrial bird species such as Magpie Lark, Willie Wagtail, Silvereye and a number of honeyeater and fairy wren species. Introduced species such as Common Starling, Rock Dove and Spotted turtle-dove use these areas extensively in the project area.

Marine

Saline environments

Saline wetlands occur along the western side of the project area and support a number of different habitats such as open saline water, shallow saline water and mudflats, rocky banks, intertidal samphire flats, samphire shrublands and mangroves. The size and structure of these environments, as well as the diversity and condition of the plant community present, influences the suitability and resultant use of these sites by birds and other fauna. The availability of different habitat types in a saline wetland typically indicates its value to different bird species and thus the importance of each site.

Open salt water

Extensive areas of open saline water in the project area are mostly found in the crystallisation fields, concentration ponds, channels and drains of the Cheetham Saltfields. The value of the salt fields varies markedly. The crystallisation ponds offer little habitat to bird species, while the habitat value for birds from the concentration ponds increases to the north towards St Kilda. Large numbers of shorebirds can be observed in the three large ponds directly south of St. Kilda and around Chapman Creek. Other smaller areas include the middle of the channel of Swan Alley Creek. A much larger extent of open saline water habitat is available off-site in neighbouring Barker Inlet and Port River, and in the lower reaches of North Arm Creek and Swan Alley Creek, and elsewhere in the northern salt fields.

Open areas of salt water are used for feeding by a range of bird species, including Banded Stilt, Australian Pelican, Silver Gull, Little Pied Cormorant, Great Cormorant and Little Black Cormorant. Numerous tern species forage in this habitat. White-bellied Sea-eagle, Whistling Kite and Osprey also hunt over open water in coastal marine environments.

Shallow salt water and mudflats

Large areas of shallow saline water occur in the saltfields, which contain water that is pumped from the sea through a series of artificial lagoons of progressively greater salinity (Crawford 1975). Water at the northern end is of a similar salinity to seawater; at the southern end of the saltfields in project area, the water is highly saline.

Parts of the saltfields are heavily used as foraging areas by a wide range of local shorebirds, as well as a large number of northern hemisphere and Australian seasonal migrants (Close and McCrie 1986). The largest concentration of shorebirds is found in the central part of the salt fields between St Kilda and Port Gawler (well to the north and west of the project area); bird use of the more saline saltfields in and near the crystallisation fields and the southern part of the project area is much lower to almost nil.

The shallow foraging habitat created in parts of the saltfields resemble that available naturally on the coastal mudflats of Barker Inlet at the Port River mouth to the west of the project area. These tidal mudflats provide vast areas of potential foraging habitat for a wide range of wading birds at low tide. Due to their use by a large number of resident and migratory waders this saltfield habitat and the mudflats of the Port River estuary and mouth have been identified as areas of international importance for shorebirds (Watkins 1993), and part of a Wetland of National Importance (Barker Inlet and St Kilda) (Environment Australia 2001) .

Other extensive areas of shallow saltwater occur along the tidal channels between the western boundary of Bolivar WWTP and the saltfields and along the entire eastern coastline of Gulf St Vincent.

Elevated bare areas, rock outcrop and rocky banks

Large areas of bare ground and small areas of rocky banks, mostly as calcrete but including the saltfield embankments and small shell-grit islands across the Saltfields provide resting and roosting habitat for aquatic and shorebirds. They are also actual or potential breeding habitat for species such as Red-capped Plover and Masked Lapwing.

Intertidal samphire low shrubland

This habitat is usually adjacent to open shallow water areas and it is vegetated with salt tolerant saltmarsh plant species dominated by samphires as *Tecticornia* spp. and *Sarcocornia* spp., with the distribution of each species controlled by elevation and the amount of inundation. The former is subject to less frequent inundation and the latter is subject to inundation on a daily basis.

All samphire habitats are at least partly inundated by the sea at high tide and will also tolerate inundation by freshwater. Much of this habitat type has been cleared or reclaimed for the Dry Creek Saltfields and other uses in the southern part of the region around Port Adelaide, Dry Creek and Gillman, but remnant patches are scattered across the project area. Intertidal samphire habitat occurs in the zone parallel to the coastline, between the mangroves to the west and the land to the east. About 80% of this habitat type has been lost across the north-eastern section of Gulf St Vincent (Edyvane 1999).

The largest areas of intertidal samphire in the project area occur along the western boundary of the saltfields where it is regularly inundated by high tide waters and appears to be in relatively good condition. Areas of intertidal samphire habitat are located in Barker Inlet Wetlands North between the constructed freshwater wetlands and the mangroves of North Arm Creek, as well as in North Arm Creek. This saltmarsh is surrounded by a sea wall and tidal activity is regulated by control structures. The low-lying parts of the saltmarsh at this site are regularly inundated by saltwater and by freshwater as part of management of floods. See Appendix A for photographs of this site. Saltmarsh also exists along parts of other marine creeks, such as Swan Alley Creek throughout open areas in the Mangrove woodlands. Patches of saltmarsh occur further north, adjacent to the saltponds and Bolivar WWTP in the project area and along the Gulf coastline.

Some areas of tidal saltmarsh habitat can be used by a similar range of species that forage on tidal mudflats, including some marine, aquatic, migratory shorebirds and local resident wading birds use these areas, primarily the bare mud areas exposed at high tide. However, by observation the number and diversity of species is relatively small.

Areas of intertidal samphire occur along the coastline to the north. A large area of intertidal samphire at Clinton Conservation Park around 100 km north of the project area is considered to resemble much of the original habitat of the area occupied by the Dry Creek Saltfields (Close and McCrie 1986).

Supratidal samphire low shrubland

This habitat is more akin to a terrestrial habitat than marine and in many cases in the region it is part of the terrestrial environment. It is dominated by samphire species such as *Tecticornia* spp. (especially *T. pergranulata* in the project area) and it is not regularly inundated by high tides or marine incursions. In some cases, it is completely cut-off from seawater by levees and sea walls and remains stranded inland on salty land which receives freshwater as rainfall and runoff as the only water source. This type of samphire habitat exists in numerous areas across the project area and, like intertidal saltmarsh, is fragmented. Relatively large areas of supratidal samphire and stranded supratidal samphire in the project area occur at Barker Inlet Wetlands North, in the DTEI land adjacent to Greenfield Wetlands and around Gilman. The condition of much of this area of samphire habitat is relatively

poor and by observation, only a few fauna species are resident or use the habitat intermittently. Within the Barker Inlet Wetlands supplementary planting of shrubs has been undertaken in this habitat.

Smaller patches of supratidal and stranded samphire in similar condition are present in the other wetlands in the region, between the settling ponds of Bolivar WWTP and between the boundary road and salt fields of Dry Creek Saltfields.

This type of samphire habitat is of limited value to most faunal groups. However, it can be a wildlife corridor from the coastal fringe to terrestrial habitats and is used as part of the air space by a wide range of bird species which overfly the habitat.

It is not used as primary habitat by species such as Slender-billed Thornbill (Gulf St Vincent subspecies), which is confined to the better quality areas of samphire habitat, but this species may use it as a link between better quality areas during expansion of its population. It is a potential, though marginal, foraging habitat of the migratory Orange-bellied Parrot and other *Neophema* parrots elsewhere. It may also be used as an occasional breeding site for species such as stilts, plovers and dotterels.

When low lying mud-flats are covered by high tides, waders may use some areas of supratidal samphire to roost, although they invariably chose bare areas in the areas of shrubland. In the project area, this habitat is of low value for most fauna, especially birds.

Grey Mangrove woodland

The most extensive area of mangroves in Gulf St Vincent occurs in the Barker Inlet–Port River mouth, which fringes the western side of the project area. The woodland occurs as a monospecific stand of Grey Mangrove (*Avicennia marina* var. *resinifera*). This habitat provides roosting, foraging and breeding sites for a wide range of marine and terrestrial birds. Corridors of mangrove extend inland in the project area, at North Arm Creek and Swan Alley Creek. At North Arm Creek tall old-growth mangrove forest and woodland is interspersed with saltmarsh habitat; at Swan Alley the mangroves appear to have recolonised the narrow drainage line, as the plants are of a range of ages and are thinly spread along the banks. Areas of colonising mangrove occur at a range of sites, such as the western end of Dry Creek drain and around parts of the marine section of the Barker Inlet Wetlands North.

The mangroves provide essential ecosystem functions that contribute to the status of the area as a site of international and national significance for coastal and wading birds (Watkins 1993, Morelli and de Jong 1995). One of the key threatening processes to mangrove communities is habitat fragmentation through clearance (Berkinshaw 2004a). Additional pressures of effluent disposal and increased nutrient loads have contributed to the loss of mangroves along the metropolitan coast (Edyvane 1999). The mangrove habitat that extends north along the coast around the Port Gawler and Buckland Park Lake region to the head of the Gulf is of similar value for birds. However, the close proximity of mangrove habitat to saltmarsh and freshwater habitats in the project area is an important factor for the bird community at the site.

3.2.2 Fauna groups and species

Terrestrial

Avifauna

Over 200 bird species have been recorded in the wider region historically, with about 140 species in the region, and probably, in the project area. About 128 species have been recorded in the constructed wetlands since the 1990s. Some of these species are vagrants with one to a few records for each species. Sites assessed in 2010/11 included both terrestrial (freshwater) and marine habitats and observations were also made in the Barker Inlet Wetlands North as assessed in EBS (2009) so as to provide additional data for this site.

The sites with the highest diversity were the Barker Inlet Wetlands North, freshwater (29 species) and the northern part of the marine section (32 species) and Magazine Creek Wetlands (28 aquatic and 13 terrestrial species). The highest number of birds (abundance) was recorded at the Barker Inlet Wetlands North (freshwater as aquatic species and the northern part of the marine area as aquatic and marine species). Based on previous data and current observations, the shallow water marine section of this wetland is known to provide habitat for at least 15 species and larger numbers of migratory shorebirds than most other habitats (EBS 2009) and all 7 species of shorebirds recorded in 2010/11 were in this habitat or along the margin of the marine and freshwater wetlands. This particular area provided habitat for the largest number of marine, aquatic and shorebird species recorded in 2010/11.

Barker Inlet Wetlands South had moderate species diversity and abundance (32 species in the aquatic areas), primarily due to the large amount of deep water and limited number of aquatic habitats present. Very few wading or shorebirds were recorded here. However, the area of bare ground, supratidal samphire shrubland and shallow water in and adjacent to the communications antennae paddock and the area of land to the east provides an area of important resting and roosting habitat for some birds. During the limited observations made over 2009 to 2011, up to about 5,000 birds have been recorded here, especially Silver Gull, but also including Welcome Swallow, Fairy Martin, Australian Pelican, White Ibis and some tern and duck species.

The areas and habitats with the least species included The Range Wetlands (15 aquatic, 11 terrestrial), stranded and supratidal samphire shrublands (8 species, of which 5 were terrestrial), anthropogenic grasslands and herblands (1 marine, 13 terrestrial species), bare salt flat sites throughout the project area (9 species, of which 5 were terrestrial species) and along North Arm Creek (14 aquatic species, 12 terrestrial species).

Of the sites surveyed, the Greenfields Wetlands Stage 3 was observed to be the most important in the region, with areas being used for feeding, roosting, breeding and nesting of a range of aquatic, shorebird and terrestrial species (45 species). In

comparison, Barker Inlet Wetlands North was of less importance for species of conservation significance, but had many more 'common' species.

Observations and past records indicate that the Barker Inlet Wetlands North (freshwater) includes two important roost and rest areas for various bird species (AECOM and KBR 2009). However, relatively few shorebirds have been recorded here, with small numbers only present (up to about 35 birds from 6 species over 2003 to 2011). Consequently, these do not constitute important habitat for species of national conservation significance.

EBS (2009) data indicated that the largest number and greatest diversity of bird species in the project area were recorded on the WWTP ponds at Bolivar (more than 9,000 birds and 59 species) (See Appendix B). A relatively large number of birds were recorded at the freshwater section of Barker Inlet Wetlands North, with an average of 738 birds recorded per survey. Species diversity at the Barker Inlet Wetlands North was relatively high, with 47 species recorded. At the neighbouring Greenfields Wetlands Stage 3, an average of 524 birds was sighted per survey and a total of 36 species.

Of the saltwater wetlands, the highest abundance and diversity of birds was recorded in the large area of shallow saltwater of the northern part of Barker Inlet Wetlands North (not including North Arm Creek), with an average 739 birds recorded per survey. This observation accords with regional observations of others (Cowley 2002) and observations during 2010/11. A comparable number of birds (715) were recorded per survey in the tidal samphire–saltmarsh habitat along the western boundary of the salt fields to the north of the project area. However, bird diversity was much higher in the Barker Inlet Wetlands North saltwater wetland, with 27 species recorded, than in the tidal saltmarsh on the salt field's boundary where 11 species were recorded. This is clearly indicative of the local value of this section of the Barker Inlet Wetlands North area of marine wetland.

In contrast, a lower diversity of birds was recorded in the crystallisation ponds of the salt fields. These ponds are hypersaline and very few birds are recorded using this habitat (Cox 1994). Bird use of the ponds increased north of Bolivar WWTP, where an average of 344 birds of seven species was recorded per survey. These concentration ponds provide extremely valuable shallow water and mudflat habitat for a wide range of shorebirds, and the rocky banks and islands provide roosting habitat.

Based on the data for 2009 and that for 2010/11, there are some interesting differences. The most obvious is the lack of some bird species in 2010/11, especially tern species, banded stilt and most species of migratory shorebirds. This observation is corroborated by Birds SA and the abundance of freshwater available in other regions due to the above average rainfall is considered to have resulted in the dispersal of many species over 2010/11.

The threatened species observed, known to occur or potentially present in the project area and region are listed in Table 3.1. Of the species observed, many are vagrants, occasional visitors or rare birds for this region.

Table 3.1 Threatened (nationally and State listed) bird species present or potentially present in the terrestrial and marine habitats of the project area and region

Scientific name	Common name	EPBC listed	NPW listed
Actitis hypoleucos	Common Sandpiper	Ma, Mi	R
Anhinga novaehollandiae	Australasian Darter		R
Apus pacificus	Fork-tailed Swift	Mi	
Ardea alba	Great Egret	Ma, Mi	
Ardea ibis	Cattle Egret	Ma, Mi	R
Ardea intermedia	Intermediate Egret	Ma, Mi	R
Arenaria interpres	Ruddy Turnstone	Ma, Mi	R
Biziura lobata	Musk Duck	Ma, Mi	R
Botaurus poiciloptilus	Australasian Bittern	EN	V
Calidris acuminata	Sharp-tailed Sandpiper	Ma, Mi	
Calidris alba	Sanderling	Ma, Mi	R
Calidris ferruginea	Curlew Sandpiper	Ma, Mi	
Calidris melanotos	Pectoral Sandpiper	Ma, Mi	R
Calidris ruficollis	Red-necked Stint	Ma, Mi	
Calidris subminuta	Long-toed Stint	Ma, Mi	R
Calidris tenuirostris	Great Knot	Ma, Mi	R
Cereopsis novaehollandiae	Cape Barren Goose		R
Cladorhynchus leucocephalus	Banded Stilt		V
Charadrius bicinctus	Double-banded Plover	Ma, Mi	
Charadrius leschenaultii	Greater Sand Plover	Ma, Mi	R
Charadrius mongolus	Lesser Sand Plover	Ma, Mi	R
Charadrius ruficapillus	Red-capped Plover	Ma	
Chlidonias leucopterus	White-winged Black Tern	Ma, Mi	
Coturnix ypsilophora	Brown Quail		V
Egretta garzetta	Little Egret	Ma, Mi	R
Egretta sacra	Eastern Reef Egret	Ma, Mi	R
Falco peregrinus	Peregrine Falcon		R
Falcunculus frontatus	Crested Shrike-tit		R
Gallinago hardwickii	Latham's Snipe	Ma, Mi	R
Glareola maldivarum	Oriental Pratincole	Ma, Mi	

Haematopus fuliginosus	Sooty Oystercatcher		R
Haematopus longirostris	Australian Pied Oystercatcher		R
Haliaeetus leucogaster	White-bellied Sea-Eagle	Ma, Mi	E
Heteroscelus brevipes	Grey-tailed Tattler	Ma, Mi	R
Hirundapus caudacutus	White-throated Needletail	Mi	
Lewinia pectoralis	Lewin's Rail		V
Limicola falcinellus	Broad-billed Sandpiper	Ma, Mi	
Scientific name	Common name	EPBC listed	NPW listed
Limosa lapponica	Bar-tailed Godwit	Ma, Mi	R
Limosa limosa	Black-tailed Godwit	Ma, Mi	R
Macronectes giganteus	Southern Giant-Petrel	EN, Ma, Mi	V
Macronectes halli	Northern Giant-Petrel	VU, Ma, Mi	
Neophema chrysogaster	Orange-bellied Parrot	CR, Ma, Mi	E
Neophema chrysostoma	Blue-winged Parrot		V
Neophema elegans	Elegant Parrot		R
Neophema petrophila	Rock Parrot		R
Numenius madagascariensis	Eastern Curlew	Ma, Mi	V
Numenius phaeopus	Whimbrel	Ma, Mi	R
Oxyura australis	Blue-billed Duck		R
Pandion haliaetus	Eastern Osprey	Ma, Mi	E
Philomachus pugnax	Ruff	Ma	R
Plegadis falcinellus	Glossy Ibis	Ma, Mi	R
Pluvialis fulva	Pacific Golden Plover	Ma	R
Podiceps cristatus	Great Crested Grebe		R
Porzana tabuensis	Spotless Crake		R
Rostratula australis	Australian Painted Snipe	VU, Ma, Mi	V
Sternula albifrons	Little Tern	Ma, Mi	E
Sterna caspia	Caspian Tern	Ma, Mi	
Sterna hirundo	Common Tern	Ma, Mi	R
Sternula nereis	Fairy Tern		E
Stictonetta naevosa	Freckled Duck		V
Thinornis rubricollis	Hooded Plover	VU, Ma	V
Tringa nebularia	Common Greenshank	Ma, Mi	
Tringa. stagnatilis	Marsh Sandpiper	Ma, Mi	
Tringa glareola	Wood Sandpiper	Ma, Mi	R
Xenus cinereus	Terek Sandpiper	Ma, Mi	R

Conservation ratings: EPBC Act: CR= Critically Endangered, EN = Endangered, VU = Vulnerable, Ma - marine (Cwlth) Mi - migratory (Cwlth). National Parks and Wildlife (NPW) Act Schedules: E = Endangered; V = Vulnerable; R = Rare.

Other listed avifauna

According to the Protected Matters Search using the databases established under EPBC Act (Appendix C), other bird species were listed as marine or migratory or species which have habitat that may occur in the project area. However, most of these species are rare visitors to the region. Any records of these species are likely to be due to the predictive nature of the databases or a rare occurrence in the region. Species in this category are Red Knot (*Calidris canutus),* Oriental Plover (*Charadrius veredus),* Gibson's Albatross (*Diomedea gibsonii),* Swinhoe's Snipe (*Gallinago megala),* Pin-tailed Snipe (*Gallinago stenura), himantopus)*, Little Curlew (*Numenius minutus),* Red-necked Phalarope (*Phalaropus lobatus),* Grey Plover (*Pluvialis squatarola),* Buller's Albatross (*Thalassarche bulleri),* Shy Albatross (*Thalassarche cauta),* Campbell Albatross (*Thalassarche impavida)* and Common Redshank (*Tringa tetanus).*

Mammals

Sixteen (16) mammal species have been recorded in or adjacent to the Northern Connector project area (EBS 2009) (Table 3.2). Six of the species are introduced; the remaining native species are predominantly bat species. Of the native mammal species recorded, some are likely to be present only in woodlands in the northern section of the project area, such as the Common Brushtail Possum (*Trichosurus vulpecula*) and Common Ringtail Possum (*Pseudocheirus peregrinus*). There is minimal habitat available for larger mammals and most woodland has been removed in the past for agriculture and other developments. It is considered likely that all introduced mammal species previously recorded or likely to occur in the project area would continue to occur throughout the region and project area.

Reptiles and amphibians

Of the 34 reptile species previously recorded in or adjacent to the project area, many are from historical records in the region and these species are considered unlikely to occur in the project area (EBS 2009).

The reptile species considered to have a high or moderate likelihood of occurring in the project area are relatively common across the Adelaide region and are not listed as being of national or state conservation significance (Table 3.3). Several species are also considered to have a low likelihood of occurrence in the project area based on current known distribution and habitat preferences (EBS 2009).

Overall, the lack of remnant vegetation, previous disturbance to most of the project area and current land uses in and adjacent to the project area have had a significant adverse impact on reptile diversity and abundance. Woodland and shrubland habitats in the project area offer moderate–high quality habitat for reptiles. Areas of higher quality contain habitat features such as leaf litter, logs and dense shrubs would be preferentially used as refuge sites (EBS 2009).

Five (5) frog species are known to occur in the project area (Table 3.4) (EBS 2009). Both Common Eastern Froglet (*Crinia signifera*) and Spotted Grass Frog (*Limnodynastes tasmaniensis,* SCR) are abundant here subject to seasonal

variation in conditions and both species occupy a wide range of habitats from roadside drains to wetlands.

Table 3.2 Mammal species previously recorded in or adjacent to the project area and region

Species name	Common name	EPBC Act	NPW Act	Likelihood of occurrence	Likely habitat
Austronomus australis	White-striped Freetail-bat			High	Roosting – Woodland Foraging – Freshwater Wetlands, Woodlands, Shrublands
Chalinolobus gouldii	Gould's Wattled Bat			High	Roosting – Woodland Foraging – Freshwater Wetlands, Woodlands, Shrublands
Chalinolobus morio	Chocolate Wattled Bat			Moderate	Roosting – Woodland Foraging – Freshwater Wetlands, Woodlands, Shrublands
**Felis catus*	Semi-feral and domestic Cat			High	All habitats except aquatic
**Lepus capensis*	Brown Hare			Observed	All habitats except aquatic
**Mus musculus*	House Mouse			High	All habitats except aquatic
Nyctophilus geoffroyi	Lesser Long-eared Bat			High	Roosting – Woodland Foraging – Freshwater Wetlands, Woodlands, Shrublands
**Oryctolagus cuniculus*	European Rabbit			Observed	All habitats except aquatic
Pseudocheirus peregrinus	Common Ringtail Possum			Low	Dens (hollows and dreys) and foraging – Woodland
Rattus fuscipes	Bush Rat			Very Low	Marginal habitat along Little Para River
**Rattus norvegicus*	Brown Rat			High	Anthropogenic areas
**Rattus rattus*	Black Rat			High	All habitats except aquatic
Tachyglossus aculeatus	Short-beaked Echidna			Low	Foraging – Woodlands, Shrublands, Grasslands
Trichosurus vulpecula	Common Brushtail Possum		R	Low	Dens (hollows) and foraging – Woodland
Vespadelus darlingtoni	Large Forest Bat			High	Roosting – Woodland Foraging – Freshwater Wetlands, Woodlands, Shrublands
**Vulpes vulpes*	European Red Fox			High	All habitats except aquatic

Based on EBS (2009) and DTEI (2007). Data sources: BDBSA; Coleman 2008; observations in project area during past and current surveys.
* introduced species.
Conservation ratings: EPBC Act: EN = Endangered; VU = Vulnerable; National Parks and Wildlife (NPW) Act: E = Endangered; V = Vulnerable; R = Rare.

Table 3.3 Reptile species previously recorded in or adjacent to the project area and region

Species name	Common name	EPBC Act	NPW Act	Likelihood of occurrence	Likely habitat
Aprasia inaurita	Red-tailed Worm-lizard			Low	Woodland and shrubland areas
Aprasia striolata	Lined Worm-lizard			Low	Woodland and shrubland areas
Bassiana duperreyi	Eastern Three-lined Skink			Low	Woodland and shrubland areas
Christinus marmoratus	Southern Marbled Gecko			High	All vegetation types and urban areas
Cryptoblepharus plagiocephalus	Desert Wall Skink			Moderate	Woodland areas
Ctenophorus pictus	Painted Dragon			High	Shrubland areas
Ctenotus orientalis	Eastern Spotted Skink			Low	Woodland and shrubland areas
Delma molleri	Adelaide Snake-lizard			Moderate	Woodland and shrubland areas
Demansia psammophis	Yellow-faced Whipsnake			Low	Woodland and shrubland areas
Gehyra variegata	Tree Dtella			Low	Woodland areas
Hemiergis decresiensis	Three-toed Earless Skink			Moderate	Woodland and shrubland areas
Hemiergis peronii	Four-toed Earless Skink			High	Woodland and shrubland areas. Anthropogenic areas
Heteronotia binoei	Bynoe's Gecko			Moderate	Woodland and shrubland areas
Lampropholis guichenoti	Garden Skink			High	Woodland and shrubland areas
Lerista bougainvillii	Bougainville's Skink			High	Woodland and shrubland areas
Lerista dorsalis	Southern Four-toed Slider			High	Woodland and shrubland areas
Lerista punctatovittata	Spotted Slider			Low	Woodland and shrubland areas
Lialis burtonis	Burton's Legless Lizard			Low	Woodland and shrubland areas
Menetia greyii	Dwarf Skink			High	Woodland and shrubland areas
Morethia adelaidensis	Adelaide Snake-eye			High	Woodland and shrubland areas
Morethia boulengeri	Common Snake-eye			High	Woodland and shrubland areas
Morethia obscura	Mallee Snake-eye			Moderate	Woodland and shrubland areas

Species name	Common name	EPBC Act	NPW Act	Likelihood of occurrence	Likely habitat
Pogona barbata	Eastern Bearded Dragon			High	Woodland and shrubland areas
Pseudomoia entrecasteauxii	Southern Grass Skink			Low	Woodland and shrubland areas
Pseudonaja textilis	Eastern Brown Snake			High	Woodland and shrubland areas. Anthropogenic areas
Pygopus lepidopodus	Common Scaly-foot			Moderate	Woodland and shrubland areas
Ramphotyphlops australis	Southern Blind Snake			Low	Woodland and shrubland areas
Ramphotyphlops bituberculatus	Rough-nosed Blind Snake			Moderate	Woodland and shrubland areas
Suta flagellum	Mallee Black-headed Snake			Low	Woodland and shrubland areas
Tiliqua adelaidensis	Pygmy Bluetongue Lizard	EN	E	Very Low	Grassland and shrubland areas
Tiliqua occipitalis	Western Bluetongue Lizard			Moderate	Woodland and shrubland areas
Tiliqua rugosa	Sleepy Lizard			High	Woodland and shrubland areas. Anthropogenic areas
Tiliqua scincoides	Eastern Bluetongue Lizard			High	Woodland and shrubland areas. Anthropogenic areas
Tympanocryptis lineata	Five-lined Earless Dragon			Low	Woodland and shrubland areas

Data source: EBS (2009), BDBSA, Walker Corporation (2009).
Conservation ratings: EPBC Act: EN = Endangered, VU = Vulnerable; National Parks and Wildlife (NPW) Act: E = Endangered, V = Vulnerable, R = Rare.

Table 3.4 Amphibian species recorded in the project area and region

Species name	Common name	EPBC Act	NPW Act	Likelihood of occurrence	Likely habitat
Crinia signifera	Common Eastern Froglet			High	Recorded during current surveys
Limnodynastes dumerili	Banjo Frog (SCR)			High	Recorded during current surveys
Limnodynastes tasmaniensis	Spotted Grass Frog (SCR)			High	Recorded during current surveys
Litoria ewingi	Brown Tree Frog			High	Recorded during current surveys
Neobatrachus pictus	Painted Frog			High	In and adjacent to freshwater wetlands

Data source: BDBSA, EPA Frogwatch, Waterwatch, past and current surveys. SCR = southern call race.

Other fauna

No surveys were undertaken to specifically assess freshwater fish or invertebrates by EBS or KBR. Freshwater fish and invertebrate records for the region are available in Cowley (2002), Cox (1998), DTEI (2007) and various Waterwatch databases (2007, 2009) and publications. A number of native freshwater fish species have been recorded in the Greenfields Wetlands (Cox 1998), including Common Galaxias (*Galaxias maculatus*) and Congolli (*Pseudaphritis urvilli*). Both have been recorded in the Little Para River and are likely to be present in all of the Barker Inlet Wetlands, with Cowley (2002) recording both species in Barker Inlet Wetlands North and South. The introduced species, Plague Minnow (Mosquitofish) (*Gambusia holbrooki*) and European Carp (*Cyprinus carpio*), are also present in most freshwater wetlands in the region (Cowley 2002).

Marine

Avifauna

To avoid repetition, see Sections 3.2.2 and 3.2.3 for those avifaunal groups and species present in the project area. Many of the species listed occur in both freshwater and marine habitats.

Other fauna

A population of Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) lives in and around the Port Adelaide River estuary and Barker Inlet. About 30 or more individuals are seen on a regular basis in this vicinity, with around 300 more thought to visit the area. The Adelaide Dolphin Sanctuary was established for their protection and the protection of their habitat. The dolphins habitat and food requirements can all be found in the mangroves, seagrass, saltmarsh, tidal flats, tidal creeks and estuarine rivers in the region (DENR 2011).

Detailed fish surveys were not part of the current assessment or the past surveys by EBS (2009), but the region has been well studied in the past, as per the summaries in Kinhill Stearns (1985) and Butler et al. (1975). Fish species known to occur in the Port River–Barker Inlet were considered in EBS (2009). It identified 53 species (Table 3.5) and the Port River-Barker Inlet is a major nursery area for a number of species including King George Whiting (*Sillaginodes punctata*), Yellow-fin Whiting (*Sillago schomburgkii*), Southern Sea Garfish (*Hyporhamphus melanochir*), Yellow-eyed Mullet (*Aldrichetta forsteri*), Jumping Mullet (*Liza argentea*), Black Bream (*Acanthopagrus butcheri*) and Blue Swimmer Crab (*Portunus pelagicus*) (BIPEC 2004).

Table 3.5 Fish species recorded in the Port River–Barker Inlet region

Scientific	Common name	Type
Acanthopagrus butcheri	Bream, Black Bream	Commercial
Aldrichetta fosteri	Yellow Eye Mullet	Commercial
Mughil cephalus	Sea Mullet	Commercial
Myxus elongatus	Sand Mullet	Commercial
Arripis trutta	Australian Salmon	Commercial
Hyporhamphus melanochir	Garfish	Commercial
Liza argentea	Jumping Mullet	Commercial
Penaeus latisulcatus	Western King Prawn	Commercial
Portunus pelagicus	Blue Swimmer Crab	Commercial
Sillaginodes punctatus	King George Whiting	Commercial
Sillago schomburgkii	Yellow-Fin Whiting	Commercial
Sillaginodes punctatus	Spotted Whiting	Commercial
Platycephalidae spp.	Flathead	Commercial
Platycephalus bassesnsi	Southern Sand Flathead	Commercial
Platycephalus fuscus	Flathead	Commercial
Platycephalus laevigatus	Rock Flathead	Commercial
Bothidae & Pleuronectidae spp.	Flounder	Commercial
Rhombosolea tapirina	Greenback Flounder	Commercial
Argyrosomus hololepidotus	Mulloway	Commercial

Scientific	Common name	Type
Hyporhamphus regularis	River Garfish	Commercial
Sillago bassensis, Sillago flindersi, Sillago robusta	School Whiting	Commercial
Chrysophrys auratus	Snapper	Commercial
Sphyraena novaehollandiae	Snook	Commercial
Hyporhamphus melanochir	Southern Sea Garfish	Commercial
Arripis georgianus	Tommy Ruff	Commercial
Caranginae spp.	Trevally	Commercial
Arripis truttaceus	WA Salmon	Commercial
Christiceps australis	Crested Weedfish	Non-commercial
Spratelloides robustus	Blue Sprat*	Non-commercial
Pseudogobius olorum	Blue Spotted Goby	Non-commercial
Arenigobius bifrenatus	Bridled Goby	Non-commercial
Gobius lateralis	Long Fin Goby	Non-commercial
Gallogobius mucosus	Sculptured Goby	Non-commercial
Pseudaphritis urvillii	Congolli	Non-commercial
Gobiopterus semivestitus	Glass Goby	Non-commercial
Rhombosolea tapirina	Greenback Flounder	Non-commercial
Monacanthidae spp.	Leatherjacket*	Non-commercial
Enoplosus armatus	Old Wife	Non-commercial
Atherinosoma microstoma	Smallmouth Hardyhead	Non-commercial
Pseudorhombus jenynsii	Smalltooth Flounder*	Non-commercial
Favonigobius lateralis	Southern Longfin Goby*	Non-commercial
Terapontidae spp.	Striped Perch	Non-commercial
Contusus brevicaudus, Torquigener pleurogramma, Tetractenos glaber	Toadfish (Prickly, Weeping, Smooth)	Non-commercial
Galaxias kayi	Minnow	Non-commercial
Gambusia affinis	Mosquitofish**	Non-commercial
Gymnopistes marmoratus	SA Cobbler	Non-commercial
Kaupus costatus	Pipefish	Non-commercial
Melambaphes zebra	Zebra Fish	Non-commercial
Pelotes sexlineatus	Trumpeter (Striped Perch)	Non-commercial
Scorpaena ergastulorum	Red Rock Cod, gurnard	Non-commercial
Stigmatopora argus	Spotted Pipefish	Non-commercial
Stigmatopora nigra	Pipefish	Non-commercial
Trygonorhina guanerius	Southern Fiddler Ray	Non-commercial

EBS (2009) - Source: Coleman (2008); DEH (multiple authors)
* considered to be temporary visitors into the estuary. ** introduced species.

Marine invertebrates

No additional surveys were undertaken for marine invertebrates and Butler et al. (1975) provides a useful summary of these as updated in Shepherd et al. (2008). Some introduced marine pest species are also present in the region, such as European fan worm (*Sabella spallanzanii*), while suitable potential habitat is present for others, such as European green shore crab (*Carcinus maenas*) (BRS 2000).

3.2.3 Fauna species of national conservation significance

A number of species of national conservation significance have been previously recorded in or adjacent to the project area and region or are considered likely to occur in these areas. These include species of national significance listed under the EPBC Act, including migratory species and marine species. A number of bird species of State conservation significance (listed under the National Parks and Wildlife Act) are also known or considered likely to occur in the project area (see Section 3.2.4). The following discussion groups some species together based on their listing and preferred habitats and is adapted from EBS (2009).

Terrestrial

Avifauna

Migratory

Orange-bellied Parrot (*Neophema chrysogaster*) (EPBC Critically Endangered, Migratory/Marine)

The entire wild population of the Critically Endangered Orange-bellied Parrot is currently estimated at 50 individuals, with extinction likley by 2015 if current trends continue (Peter and Herrod 2010). The genetic variation in a captive population of 160 birds will not be able to support a healthy population and is only a short-term solution (Peter and Herrod 2010). Orange-bellied Parrot is a winter migrant to the mainland of Australia, arriving between February and March from breeding grounds in south-west Tasmania, and returning from late September to October. Dispersal patterns over the course of winter are poorly understood. The parrots remain for varying durations at different locations, largely dictated by the availability of food resources. Their over-wintering range is identified in maps in the National Recovery Plan for this species (Department of the Environment and Heritage 2005a), but in recent years various locations, including those in South Australia, have recorded very few, if any individuals (Peter and Herrod 2010).

On the mainland, Orange-bellied Parrots rely on coastal saltmarsh vegetation as their primary foraging habitat. Key food plants include Beaded Glasswort

(*Sarcorconia quinqueflora*), Shrubby Glasswort (*Tecticornia* (formerly*Sclerostegia*) *arbuscula*), Sea-blite (*Suaeda australis*), Samphire (*Tecticornia* spp.) and other low herbaceous plants, grasses and gramonoids. In south-eastern South Australia, dune frontages, near-coastal wetlands and saline depressions appear to be favoured, where they feed on species such as Bidgee-widgee (*Acaena novaezelandia*) and Sea-rocket (*Cakile maritima*). They also use *Sarcorconia, Suaeda* and *Tecticornia* dominated saltmarshes around low-lying saline drains, coastal lagoons and estuaries (Orange-bellied Parrot Recovery Team 2006).

For the current project, it is difficult to gauge the impact of habitat loss on the Orange-bellied Parrot due to the irregularity of their visits to the region, the lack of information on available habitat preferred in the project area, the apparent poor quality of many areas of potential habitat in the region and the lack of certainty about the numbers of birds that currently visit here. In South Australia, Orange-bellied Parrots are most often recorded in small numbers in the far South East and Coorong districts, but a decline in the number of birds at these locations suggest they may not be seen after 2011 (Peter and Herrod 2010). In the distant past, individuals have been known to disperse as far north-west as Chinamans Creek, approximately 240 km north of the project area (EBS 2009).

Of the three records in the Adelaide Plains region over th past 10 years, one was in the Northern Connector region, from the tidal saltmarsh along the western fringe of the Cheetham salt fields adjacent to Bolivar WWTP in October 2006 (54H 267560 6159082). This sighting confirms that the tidal saltmarsh habitat in the project area is potentially used by this species. The other two recent records were at Port Gawler 13 km to the north of the project area in 2006 and at the Onkaparinga River 38 km south of the project area, 10 years ago (DTEI 2009).

Targeted surveys along Gulf St Vincent over 2007 to 2010 did not sight any birds (Birds Australia 2007; Bob Green, Regional OBP coordinator, pers. comm., February 2011). The lack of recent records in the Adelaide Plains coastal area does not mean the parrots are not visiting the region, as much of their suitable foraging habitat is rarely surveyed. Numerous areas of saltmarsh habitat between Adelaide and Port Wakefield are potentially suitable foraging habitat (Birds Australia, unpublished data, 2011) and include the tidal saltmarsh adjacent to Dry Creek Saltfields, and parts of the tidal samphire in Barker Inlet Wetlands North. However, more recent assessments in these areas since 2002 have not recorded the species.

The suitability of saltmarsh habitat across the region for Orange-bellied Parrot depends largely on the condition of the samphire; poor condition plants do not flower well and produce the seeds on which the bird forages. Some areas of samphire habitat between Adelaide and Port Wakefield, including most of the supra-tidal samphire shrublands in the project area, are heavily damaged and degraded due to altered flooding regimes, unrestricted vehicle access and stock grazing. The degradation or loss of over-wintering saltmarsh habitat has been

identified as a primary threatening process for this species (Garnett and Crowley 2000).

Australasian Bittern (*Botaurus poiciloptilus*) (EPBC Endangered; NPW Vulnerable)

The Australasian Bittern is of conservation concern across its range, primarily due to the loss and degradation of wetland habitat and subsequent reductions in populations. They are a relatively poorly known species with only a handful of records reported across Australia each year. Australasian Bittern is listed as Endangered at the global level (IUCN Red List) and under the EPBC Act.

This freshwater wetland species prefers dense vegetation, especially tall reedbeds and sedges. Their distribution in South Australia is confined to the South East, Adelaide Plains, Murray Mallee and Mount Lofty Ranges regions. Numbers of the species are declining in South Australia, as freshwater habitats are degraded and lost. Most of its former strongholds in the State (Lake Alexandrina and Bool Lagoon) have been severely affected by drought in recent years; however the above average rainfall throughout south eastern Australia in 2010 and in 2011 (to date) has resulted in these and a wide range of ephemeral wetlands filling, with many observations being made of the species in these core breeding and other locations. A small breeding population has established in the project area at Greenfields Wetlands Stages 1 and 3, with an occasional record of the species in the northern most section of the Barker Inlet Wetlands North. These wetlands provide the largest stands in the region of their preferred habitat of tall reedbeds and regular standing water. The Greenfields Wetlands Stage 3 is now considered a very important wetland for the species, especially during periods of drought.

Australian Painted Snipe (*Rostratula australis*) (EPBC Vulnerable)

Painted Snipe refers to the recently identified Australian species *Rostratula australis*. All records of the previously recognised subspecies *Rostratula benghalensis australis* in Australia are now considered to be *Rostratula australis* records.

The Australian Painted Snipe has been recorded at numerous locations across the project area, region and wider region in the past (Armstrong et al. 2003, AMLR NRM Board 2008). This was not recorded during the current surveys, although it often remains undetected because of its cryptic behaviour and is migratory within Australia. In general, the distribution of the Painted Snipe across South Australia is patchy and its presence in any particular area is usually unpredictable. Some individuals are nomadic in the non-breeding season and are believed to travel widely across the landscape in search of suitable foraging areas. Other individuals are apparently resident in areas where suitable habitat exists. They have been recorded in a wide range of locations, from freshwater or brackish wetlands, which are either permanently or temporarily filled, to wet vegetation in swamps, along drainage lines or in tall grasslands.

The species distribution within South Australia is limited according to available records and their unpredictability means they are recorded irregularly (Garnett and

Crowley 2000). The species has been recorded in the Mid-North of South Australia in the Clare-Burra region, as well as in the Southern Lofty Ranges and South East. The Murray–Darling drainage system also appears to have been a key area for this species. There are also regular records from the South Australian Riverland, with sightings from Paiwalla Wetlands (Rogers et al. 2005).

The population size in South Australia is unknown but likely to be in the low hundreds. A maximum of 30 Painted Snipe have been recorded from wetlands in the South East of South Australia, and up to eight birds at a time have been seen at Greenfields Wetlands Stage 3. Large flocks are very rare and records of single birds are more common. On the Adelaide Plains single birds have been recorded from The Paddocks Wetlands in Para Hills and Edinburgh Park in Edinburgh, both sites of which are inland of the project area.

The project area, notably Greenfields Stage 3, is considered to support a large proportion of the regional population, due largely to their low numbers in the region (approximately 10 birds). Whether the region contains an 'important population' under the EPBC Act Significant Impact Guidelines (DEH 2006) is difficult to determine, given the very patchy and nomadic nature of the species. Protection of all recently used habitat is identified as a key management action for this species (Garnett and Crowley 2000).

Greenfields Wetlands Stage 3, and potentially the freshwater section of both areas the Barker Inlet Wetlands are considered to provide 'critical habitat' for this population for foraging, roosting and breeding. Habitat preferences are for areas with dense low vegetation for cover, and shallow water or exposed mud for foraging. The Barker Inlet Wetlands have small areas of suitable habitat only and there are no recorded sightings of the species here.

Within the project area they forage in shallow water and mud, and roost on the bank in areas of low sedges and samphire. Painted Snipe nest on the ground among tall reed-like vegetation near water. These wetlands are the largest stands of suitable nesting habitat in the region. Birds are considered to breed at Greenfields Wetlands Stage 3, as two adults and three juveniles have been observed here. This species preference for thick vegetation may explain why very few breeding sites have been located in South Australia. Breeding events have been documented near Strathalbyn and Goyders Lagoon in the Riverland. The regular sightings at Greenfields Wetlands Stage 3 indicates that this area supports an important population, especially as this population is at the south-western extent of the species range (Garnett and Crowley 2000). This species is also considered to be in decline, particularly in southern Australia (Garnett and Crowley 2000), although this may be due to prolonged drought conditions in south eastern Australia up to 2010.

Hooded Plover (*Thinornis rubricollis*) (EPBC Vulnerable)

The Hooded Plover is migratory and a vagrant to the project area and is considered to visit on an irregular basis. Single Hooded Plovers have been

recorded on occasions at the saltfields near St Kilda. Their preferred habitat is along sandy coastlines and they are generally observed in estuaries, coastal lakes, and less frequently at inland salt lakes. Sightings in South Australia are more often along the southern coast of Fleurieu Peninsula, Yorke Penisula and on Kangaroo Island (AMLR NRM Board 2007).

Long-toed Stint (*Calidris subminuta*) (EPBC Migratory/Marine; NPW Rare)

The Long-toed Stint migrates to Australia in spring–summer, and mostly uses shallow water habitat in freshwater wetlands in the project area for foraging. Birds were recorded at Barker Inlet Wetlands North, Greenfields Wetlands Stage 3 and a drying pond at Bolivar WWTP. They have also been recorded in the project area in the saltwater channels of Swan Alley (Dry Creek). In the Adelaide Plains, Close and McCrie (1986) show that the Long-toed Stint regularly feed and roost on the salt fields to the north, near St Kilda, and they are also regularly recorded at Buckland Park Lake.

Most sightings of Long-toed Stint in the EBS surveys were of single individuals, with one recorded in the Barker Inlet Wetlands North. The species was not recorded at any of the sites surveyed in 2010/11. Groups of up to 11 have been recorded at Greenfields Wetlands Stage 3 in the past. Slightly larger flocks have been previously recorded foraging on exposed mudflats at Buckland Park Lake, which is considered to provide the most important regional habitat for the species (Paton et al. 1991). This species is not considered to occur in numbers greater or equal to 1% of the flyway population at any one area in Australia (Watkins 1993). This is certainly the case in the Adelaide Plains region, so the population in the project area is not considered to represent an ecologically significant proportion of the population. However, the project area does contain habitat that supports a high proportion (75%) of the regional population. Given the regularity of sightings at Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North, albeit in smaller numbers at the latter site, the shallow water/mudflat habitat in these areas is considered to provide important habitat for the regional population.

Pectoral Sandpiper (*Calidris melanotus*) (EPBC Migratory/Marine; NPW Rare)

The Pectoral Sandpiper is a summer migrant to Australia from the northern hemisphere. During their over-wintering period in Australia they mostly inhabit coastal wetlands in the South East; they also occur inland on permanent and temporary wetlands.

Like the Long-toed Stint, this species is not considered to occur in numbers greater or equal to 1% of the flyway population at any one area in Australia (Watkins 1993) so the population in the project area is not considered to represent an ecologically significant proportion of the population.

Pectoral Sandpipers are common visitors to the region where they use shallow water coastal wetlands (Day 2005). They are regularly recorded at the St Kilda tidal mudflats but they use freshwater wetlands too, especially fringed with dense sedge, as they also feed and roost here. They were not recorded during the 2009

and current surveys but a high proportion of the estimated regional population use Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North (marine). Other regional records from locations with similarly habitat include Buckland Park Lake.

Common Greenshank (*Tringa nebularia*) and Marsh Sandpiper (*T. stagnatilis*) (both EPBC Migratory/Marine)

Both the Common Greenshank and Marsh Sandpiper were recorded at various freshwater wetlands across the project area including Barker Inlet Wetlands North and Greenfields Wetlands Stage 3. They are frequently recorded in the project area each year in small numbers.

Common Greenshanks occur in all types of wetlands across Australia and have a wide distribution. Approximately 1,250 birds are considered to visit the region, which represents over 1% of the estimated Australian population of 20,000 (Watkins 1993), signifying that the region is an important area for the species. However, less than 1% of the population uses the actual project area which thus does not support an ecologically significant proportion of the population.

In comparison, approximately 100 Marsh Sandpipers occur in the region, especially the northern area of the Saltfields, which is about 1% of the estimated Australian population of 9,000 birds (EBS 2009). Hence, this constitutes an area of national importance as defined by Watkins (1993), but this same definition does not apply to the southern areas of wetlands affected by the proposal.

Most observations of both species during the current survey were of birds foraging in the shallow water habitats of fresh and saltwater wetlands, as well as tidal saltmarsh areas.

Latham's Snipe (*Gallinago hardwickii*) (EPBC Migratory/Marine; NPW Rare)

Latham's Snipe is a northern hemisphere waterbird that breeds in Japan and eastern Russia, and migrates to eastern Australia during spring and summer. This listed migratory species is very nomadic during its time in Australia, although they are most commonly recorded from the wetter parts of eastern Australia. Latham's Snipe usually inhabit regions in low numbers, although at a few locations in New South Wales and Victoria, birds have been recorded gathering in their hundreds (Todd 1999). A high proportion of the small regional populationfrom the Adelaide Plains is considered to use the project area. The largest numbers in the wider region have been recorded from constructed wetlands along the Onkaparinga River.

Latham's Snipe uses a variety of freshwater or brackish wetlands, preferring to be close to shrubbery, in-stream vegetation and adjoining grassy/sedgy areas which provide shelter from predators while feeding. They also use artificial wetlands, highly degraded creeks and swamps, and wet areas among dryland grasslands (Naarding 1983). Latham's Snipe feed mainly at night, spending most of their daylight hours roosting (Marchant and Higgins 1996). Similar to the Painted Snipe, they are cryptic, which may account for the lack of sightings each year. Current threats in Australia include drainage, water division and urban development,

although the species readily occupies artificial and ephemeral swamps (Garnett and Crowley 2000).

A single Latham's Snipe was recorded during the 2009 EBS survey in a heavily vegetated drying pond at Bolivar WWTP. The year to year availability of suitable habitat for this species at Bolivar WWTP depends on the flooding and drying regime of the few ponds that contain vegetation. Suitable foraging and roosting habitat is more consistently available at a number of the managed freshwater wetlands in the region. Birds are regularly sighted in small numbers at Greenfields Wetlands Stage 3 (John Cox, pers. comm., 2008 in EBS 2009). The similar grassland and shallow freshwater habitat in parts of the neighbouring Barker Inlet Wetlands North is also likely to be of value to Latham's Snipe, although an occasional bird only is recorded here annually (Crowley 2002). It is considered that all of these wetlands provide useful, but not critical habitat for some of the regional population of the species.

Wood Sandpiper (*Tringa glareola*) (EPBC migratory/marine; NPW Rare)

An estimated 6,000 Wood Sandpiper migrate to Australia each year (Watkins 1993). Of this population approximately 100 birds are considered to visit the region which therefore constitutes an area of national importance. This region is also significant at a State level, as most sightings of this State Rare species in South Australia are from the Adelaide Plains region, particularly from the northern parts of Dry Creek Saltfields near St Kilda. Wood Sandpipers have been recorded at Bolivar WWTP and at Greenfields Wetlands Stage 3. Small numbers of this Northern Hemisphere migrant were sighted roosting on the sides of freshwater drainage lines at Bolivar WWTP; larger groups of up to 20 individuals were observed foraging in the shallow freshwater at Greenfields Wetlands Stage 3 (EBS 2009) where the species preference for shallow freshwater habitat with adjoining areas of low sedge for foraging and roosting is met.

Glossy Ibis (*Plegadis falcinellus*) (EPBC Migratory/Marine; NPW Rare)

The Glossy Ibis is a non-breeding summer visitor to South Australia from their main breeding areas in the Murray–Darling Basin of New South Wales and Victoria, the Macquarie Marshes in New South Wales, and southern Queensland. They occur across the region in relatively low numbers, and are commonly recorded from Buckland Park Lake, and other small wetlands. Most of the regional population is considered to use the project area. Single birds or small flocks have been recorded from freshwater wetlands in the project area, including Greenfields Wetlands Stage 3, Barker Inlet Wetlands North and South and Bolivar WWTP. The preferred foraging habitat of the Glossy Ibis is shallow freshwater or among the sedges alongside freshwater wetlands.

Cattle Egret (*Ardea ibis*) (EPBC Migratory/Marine; NPW Rare)

No Cattle Egrets were recorded during the EBS or current surveys, as they are mostly a non-breeding visitor to the project area in winter. This species breeds in northern Australia and only small numbers reach the region (fewer than 10). Single

birds occur regularly at the freshwater wetlands of Greenfields Wetlands Stage 3, Barker Inlet Wetlands North, as well as at Bolivar WWTP. Cattle Egrets primarily forage along the shallow margins of freshwater wetlands or in low lying grasslands.

Great Egret (*Ardea alba*) (EPBC Migratory/Marine) and Little Egret (*Egretta garzetta*) (EPBC Migratory/Marine; NPW Rare)

Great Egrets are common throughout Australia, except in the most arid areas. The Little Egret is found mainly in coastal and inland areas of northern, eastern and south-eastern Australia, although it is considered to be uncommon in the south (Carpenter and Reid 2000), contributing to its listing as Rare in the State under the NPW Act. Significant numbers of the regional population of both species occur in the project area, with a long term breeding colony of Little Egret present on Torrens Island. Despite being a resident in the area, these species are still listed under the EPBC Act.

Both species forage in both shallow water and mudflat habitat of saltwater and freshwater wetlands. Birds of both species were recorded foraging in the intertidal areas along the western boundary of Dry Creek Saltfields, North Arm Creek, The Range and Magazine Wetlands, Magazine Creek, Dry Creek, along Barker Inlet, Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North and South i.e. they use many different areas and sites in the region and are relatively common from Clinton south to at least Webb Beach. The whole region is an important foraging area for many of the birds that breed nearby.

Intermediate Egret (*Ardea intermedia*) (EPBC Migratory/Marine; NPW Rare)

The Intermediate Egret, a freshwater wetland species that breeds in other parts of Australia, is a rare visitor to the region. Its stronghold is suitable wetlands in the Murray–Darling Basin and river systems in the north of Australia. In South Australia they are infrequently recorded, with only a single bird recorded at Barker Inlet Wetlands north by EBS (2009) and none over 2010/11.

There have been several reports of it from Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North in recent years. Intermediate Egrets have also been sighted from vegetated drainage lines in golf courses and from drains and creek lines holding water across the region. They are also considered to visit mangrove swamps and tidal mudflats in the Barker Inlet through to Clinton. All of these regional wetlands are considered to provide habitat for a significant proportion of the of this State Rare species.

Sharp-tailed Sandpiper (*Calidris acuminata*) (EPBC Migratory/Marine)

The Sharp-tailed Sandpiper is a northern hemisphere migrant found in freshwater wetlands and coastal areas around Australia, with the largest numbers in the south-east (Blakers et al. 1984). Watkins (1993) identified 34 areas of international importance for Sharp-tailed Sandpipers across Australia, with Victoria and South Australia having the largest numbers of important sites. One of these sites, at the northern end of Dry Creek Saltfields, supports an estimated 9,800 birds during summer (Watkins 1993). The Sharp-tailed Sandpiper is one of the most numerous

northern hemisphere migrant shorebirds in the region, and Gulf St Vincent is considered an internationally important 'over-wintering' site, supporting up to 17,000 individuals (Watkins 1993).

Up to several hundred individuals have been regularly recorded at Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North during recent surveys, although there were very low numbers over summer in 2010/11. A large group of about 500 were also observed using a drying lagoon at Bolivar WWTP (EBS 2009). The estimated 1,000 Sharp-tailed Sandpipers using the region constitute a significant proportion of the regional population (approximately 6%) but is below 1% of the Australian population of 140,000 birds (Department of the Environment and Heritage 2005b).

In the project area, Sharp-tailed Sandpipers commonly use shallow water and mudflat habitat in the freshwater and marine wetlands of Barker Inlet Wetlands North (freshwater and marine) and Greenfields Wetlands Stage 3, and use similar habitat at Bolivar WWTP. This species also occurs extensively along the shoreline of Gulf St Vincent and in the saltfields).

Common Sandpiper (*Actitus hypoleucos*) (EPBC Migratory/Marine; NPW Rare)

An estimated 3,000 Common Sandpipers migrate to Australia from their breeding grounds in the Northern Hemisphere (Watkins 1993). They can occur singly or in small loose flocks on most types of coastal and inland wetland. Five areas of national importance and one of international importance have been identified, however they are in northern Australia (Watkins 1993). The estimated regional population of approximately 80 birds constitutes over 1% of the Australian population.

Common Sandpipers were recorded in the project area on a number of occasions by EBS and others in 2009 and in earlier years, but were not recorded during the current surveys in 2010/11. A significant proportion of the regional population is not considered to use the project area, as a few birds only are regularly recorded from Greenfields Wetlands Stage 3. Habitat is present in the salt and freshwater habitats in Barker Inlet Wetlands North, although there is no record of the species here.

Black-tailed Godwit (*Limosa limosa melanuroides*) (EPBC Migratory/Marine; NPW Rare)

An estimated 81,000 Black-tailed Godwit visit Australia (Watkins 1993). In Australia, the species is concentrated on the northern coast between Darwin and Weipa, with mainly small numbers occurring at other coastal and inland wetlands across the country (Blakers et al. 1984).

Black-tailed Godwits mainly feed in shallow salt and freshwater habitat and mudflats and have recently been recorded in the project area at Bolivar WWTP (EBS 2009). They are also recorded infrequently at Greenfields Wetlands Stage 3 and may also visit similar shallow habitat in Barker Inlet Wetlands North, although only a few birds have been recorded here, mostly in roosting habitat in the marine

section of these wetlands. A large group (over 200 individuals) roost and feed in the saltfields between St Kilda and Port Gawler, indicating that most of the regional population occurs outside the project area. As identified by Close (Birds Australia 2007) the numbers of Black-tailed Godwits visiting South Australia has declined dramatically (by approximately 78%) in the last decade, as is the trend for the closely related Bar-tailed Godwit (*Limosa lapponica*).

Oriental Pratincole (*Glareola maldivarum*) and Sanderling (*Calidris alba*) (both EPBC Migratory/Marine)

Both of these species have been recorded in the region, but are considered to be vagrant to the project area and probably only visit it very infrequently. Oriental Pratincole preferred habitat is open plains and the bare ground around swamps and claypans, while Sanderling habitat is not present (sandy coastal beaches).

Musk Duck (*Biziura lobata*) (EPBC Migratory/Marine; NPW Rare)

Musk Duck was recorded from a range of freshwater wetlands across the project area. Their preferred foraging habitat is open water areas of freshwater wetlands, while shrubs and reedbeds lining the banks are required during the breeding season. Small numbers breed in the project area, with the remaining birds visiting from neighbouring regions. Regional birds are attracted to the project area for the drought refuge afforded by the extensive areas of open water at Bolivar WWTP and in the Barker Inlet Wetlands (both North and South). A large proportion of the regional population is considered to use the project area.

Other shorebird species

Curlew Sandpiper (*Calidris ferruginea*), Terek Sandpiper (*Xenus cinereus*) and Red-necked Stint (*Calidris ruficollis*) are transequatorial migrants that use both fresh and saline shallow water. All these species, especially the latter, have been recorded foraging and roosting at Barker Inlet Wetlands North and Greenfields Wetlands Stage 3. The Double-banded Plover (*Charadrius bicinctus*), a trans-Tasman migrant that visits the project area in winter, forages on both saltwater and freshwater mudflats. It may irregularly visit the wetlands in the project area in very small number. Each of these species make extensive use of other suitable areas of habitat present in the wider region.

Mammals

No mammal species of national conservation significance has been recorded in the Northern Connector project area (EBS 2009).

Reptiles and amphibians

One species of national conservation significance, the endangered Pygmy Bluetongue Lizard (*Tiliqua adelaidensis*), has been previously recorded in the wider region, well to the north of the project area (DTEI 2007). It has not been

recorded on the Adelaide Plains since the 1950s. The species is now confined to the Mid North Region of South Australia with the nearest known population occurring near Kulparra north of Port Wakefield (Duffy et al. 2008). The project area lacks suitable habitat as this species relies on native grassland areas with spider holes which are used as refuges (Duffy et al. 2008). The age of the record, ongoing assessment of habitats across the project area since 2001, past land use and urban encroachment suggest that it is very unlikely that this species is present in the project area (EBS 2009).

None of the five frog species recorded in the freshwater wetlands across the project area is of national conservation significance (EBS 2009).

Other species

None known.

Marine

Avifauna

Non-migratory

No non-migratory nationally listed marine bird species occur are likely to occur in the project area.

Migratory

White-bellied Sea-eagle (*Haliaeetus leucogaster*) (EPBC Migratory/Marine; NPW Endangered)

White-bellied Sea-eagles are distributed around coastal and near-coastal parts of Australia, and also occur through New Guinea, Indonesia, China, south-east Asia and India. They are listed under international migratory agreements as they are considered to migrate between Australia and other countries to the north. This largely coastal raptor is listed as Endangered under the NPW Act as it is declining in South Australia. EBS (2009) noted that a pair of White-bellied Sea-eagles has frequented the area between Outer Harbor and St Kilda in recent years and is believed to breed in the area. The exact nest site location is not known and this has yet to be confirmed as of 2011. It is thought to be the only pair in the Gulf St Vincent area, with the nearest known territory located at Newland Head Conservation Park on the southern coast of the Fleurieu Peninsula. Breeding success at the Newland Head nest has been low in recent years due to increased human disturbance.

Two adult White-bellied Sea-eagles and a juvenile bird were recorded during the EBS survey on the boundary of Bolivar WWTP and Dry Creek Saltfields. This observation indicates that the pair successfully bred in the previous winter season.

These birds were also observed feeding on European Carp and waterfowl at Bolivar WWTP during the EBS survey and on similar species, specially Silver Gulls, in the Barker Inlet Wetlands (Cowley 2002). In the project area they have been recorded in Barker Inlet, Greenfields Wetlands Stage 3, Barker Inlet Wetlands North (marine section) and Magazine Creek Wetlands. They are likely to use almost all of the coastal habitat in and adjacent to the project area for foraging, and have been recorded at Buckland Park Lake (Paton et al. 1991, Walker Corporation 2009) when suitable prey species are present.

Broad-billed Sandpiper (*Limicola falcinellus*) (EPBC migratory/marine)

The Broad-billed Sandpiper is a Northern Hemisphere migrant that visits Australia in spring and summer. It is primarily a coastal species when in Australia, visiting sheltered coastal estuaries, lagoons, coastal swamps and sewage ponds. Of the four sites of national importance for this species in northern Australia, three are also of international importance (Watkins 1993). Only small numbers visit South Australia and most sightings are of single birds. No Broad-billed Sandpipers were recorded during the current survey but low numbers or single birds are commonly recorded at Greenfields Wetlands Stage 3. They are also regularly recorded in low numbers in other shallow mudflat habitat across the region, such as the saltfields, St Kilda and Buckland Park Lake. Fewer than 10 birds visit the region but most of them could use the project area at some stage.

Caspian Tern (*Sterna hirundo*), Fairy Tern (*S. nereis*), Little Tern (*S. albifrons*), Common Tern (*S. hirundo*) and Eastern Reef Egret (*Egretta sacra*) (all EPBC Migratory/Marine)

The Caspian Tern is a coastal seabird that occasionally breeds in the saltfields north of St Kilda and roosts on the margins of open water. It is common in the region, with the largest numbers in the project area occurring at Bolivar. The Fairy Tern is less common in the region and occasionally breeds in the saltfields north of St Kilda. It has been recorded in the project area. The Little Tern is occasionally seen in company with Fairy Terns in the salt fields north of St Kilda and is likely to visit Bolivar WWTP. The Common Tern is a non-breeding summer visitor, mostly found in coastal areas in small numbers . Most records of Common Terns are of single birds roosting in the saltfields, usually with other tern species. The Eastern Reef Egret is a vagrant to the area and hence is rarely seen in the region.

White-winged Black Tern (*Chlidonias leucopterus*) (EPBC Migratory/Marine)

The White-winged Black Tern migrates to Australia in spring–summer. Most reports in South Australia are from the Murray Mouth lakes but they are regularly recorded in the project area at Bolivar WWTP. They have also been recorded foraging and roosting at Greenfields Wetlands Stage 3 and are highly likely to forage over open water areas of the saltwater and freshwater habitat in Barker Inlet Wetlands North. Most birds are seen in low numbers and in mixed flocks with Whiskered Tern (*Chlidonias hybridus*). Their key habitat is around the Murray Mouth and Coorong although they may use the project area more frequently when

drought conditions and low flows in the River Murray persist. A high proportion of the regional population of the White-winged Black Tern is considered to use the region, but not the project area.

Southern Giant-Petrel (*Macronectes giganteus*) (EPBC Endangered, Migratory/Marine)

The Southern Giant-petrel is a marine seabird that visits the Gulf St Vincent mainly in winter. It has been recorded in the region at Outer Harbor and St Kilda but not within the project area. This species is considered to be largely coastal, only using the project area when flying over it, or rarely as a roost site for individual birds.

Eastern Osprey (*Pandion haliaetus*) (EPBC Migratory/Marine; NPW Endangered)

Eastern Osprey was not recorded during the past and the current surveys and the species is considered to be a vagrant to this region. The species is more frequently seen along the southern coast of the Fleurieu Peninsula, Kangaroo Island and Yorke and Eyre Peninsulas where it is known to breed. A pair of Osprey visit the Onkaparinga River occasionally, while single birds are very rarely recorded in the project area and region (DTEI 2009).

Ruff (*Philomachus pugnax*) (EPBC Migratory/Marine; NPW Rare)

The Ruff is a Northern Hemisphere migrant that visits Australia in the spring and summer. Only small to very small numbers visit South Australia and none was recorded during the current surveys. Important habitat for Ruff are not identified, as they do not meet the required numbers (greater or equal to 1% of the flyway population) (Watkins 1993). Fewer than 10 Ruff are considered to visit the region and most of them could potentially use the project area at some stage. Sightings of a few to single birds have been recorded at Greenfields Wetlands Stage 3 and the neighbouring Dry Creek salt fields area. They are also frequently recorded in low numbers further north at the saltfields around St Kilda and at Buckland Park Lake.

Fork-tailed Swift (*Apus pacificus*) and White-throated Needletail (*Hirundapus caudacutus*) (both EPBC Migratory)

Both the Fork-tailed Swift and White-throated Needletail are species that breed in Asia and migrate to Australia in summer. They are an almost entirely aerial species when in Australia, rarely coming to land. They over-fly a wide range of habitat types and when seen they are often in large numbers. None was recorded during recent surveys in the site, although there are records of the species being observed by others in 2010 and 2011 in the region and project area.

Bar-tailed Godwit (*Limosa lapponica*), Whimbrel (*Numenius phaeopus*), Grey-tailed Tattler (*Heteroscelus brevipes*), Eastern Curlew (*Numenius madagascariensis*), Great Knot (*Calidris tenuirostris*), Greater Sand Plover (*Charadrius leschenaultii*), Lesser Sand Plover (*Charadrius mongolus*), Pacific Golden Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*)

The Bar-tailed Godwit, Whimbrel, Grey-tailed Tattler, Eastern Curlew and Great Knot are migrants that forage primarily on saltwater wetlands and coastal tidal

mudflats. A range of other smaller waders also primarily use tidal saltmarsh and mudflats, including four Northern Hemisphere migrants, namely the Greater Sand Plover, Lesser Sand Plover, Pacific Golden Plover, and Ruddy Turnstone. These species are more often recorded foraging in the tidal areas near St Kilda and north of here (Close and McCrie 1986) and they may occasionally use the mudflat and tidal saltmarsh habitat along Barker Inlet. Most regional sightings of these species are from the salt fields at the northern end of the saltfields and further north along the Gulf. These areas provide high tide roost sites for these species and the shallow saltwater and mudflats in these ponds and along the coastline are also foraging habitat.

Other species

Of the marine species recorded in the Port River estuary-Barker Inlet, six are of formal conservation significance. Five species of the Syngnathinae (pipefish, seahorses and seadragons) are listed under Section 248 of the EPBC Act as listed marine species. All six species are listed as protected species under the Fisheries Management Act (SA) (General) Regulations 2007 (Regulation 6). Table 3.6 lists the species of conservation significance.

Table 3.6 Fish species of national and State conservation significance recorded in the Port River–Barker Inlet region

Family	Scientific name	Common name	Type	Conservation Listing*
Portunidae	*Portunus pelagicus*	Blue Swimmer Crab	Commercial	Protected species (FMR)
Syngnathinae	*Kaupus costatus*	Deepbody Pipefish	Non-commercial	Protected species (FMR), EPBC
Syngnathinae	*Stigmatopora argus*	Spotted Pipefish	Non-commercial	Protected species (FMR), EPBC
Syngnathinae	*Stigmatopora nigra*	Widebody Pipefish	Non-commercial	Protected species (FMR), EPBC
Syngnathinae	*Phycodurus eques*	Leafy Seadragon	Non-commercial	Protected species (FMR), EPBC
Syngnathinae	*Phyllopteryx taeniolatus*	Weedy Seadragon	Non-commercial	Protected species (FMR), EPBC

** EPBC – Environment Protection and Biodiversity Conservation Act 1999 Section 248, listed marine species. FMR – Fisheries Management Act , (General) Regulations 2007 (SA);*

3.2.4 Other Matters of National Environmental Significance

There are no nationally threatened communities present in the region. From a fauna perspective, a Regional Recovery Plan (RRP, the Plan) for species of Adelaide and the Mount Lofty Ranges has been prepared (Willson and Bignall 2009). This Plan is recognised under the EPBC Act and complies with EPBC Act requirements for a formal Recovery Plan for adoption under the Act.

The Plan divides the region into a series of sub-regions (based on landscape context) and the site is located in the Adelaide Plains sub-region. Threatened species exclude those species listed under the EPBC Act and some of the species listed in Schedules to the NPW Act. Based on analyses, each species is assigned a conservation rating for both the region and each sub-region, although these ratings are not officially recognised under legislation.

Within each sub-region, each species is further analysed and provided with a priority and threat summary. Priority includes three categories, very high, high and medium and threat summary has four categories, which are the same as for priority ranking including low also. Table 3.7 lists the fauna species in the regional recovery plan occurring in the project area. Six of these listed species are historical records and have not been observed in the area in recent years.

Table 3.7 Species of conservation significance in the Regional Recovery Plan recorded or potentially present in the project area and region

Family	Scientific name	Common name	EPBC listing	NPW listing	Regional listing (ALMR)
ARDEIDAE	*Botaurus poiciloptilus*	Australasian Bittern	E	V	V
RALLIDAE	*Porzana pusilla*	Baillon's Crake		R	R
MELIPHAGIDAE	*Melithreptus gularis gularis#*	Black-chinned Honeyeater		V	E
PHASIANIDAE	*Coturnix ypsilophora#*	Brown Quail		V	V
RALLIDAE	*Gallirallus philippensis mellori*	Buff-banded Rail			V
PACHYCEPHALIDAE	*Falcunculus frontatus frontatus#*	Crested Shrike-tit		V	V
RALLIDAE	*Lewinia pectoralis pectoralis*	Lewin`s Rail		V	V
CUCULIDAE	*Cacomantis pallidus*	Pallid Cuckoo			V
FALCONIDAE	*Falco peregrinus*	Peregrine Falcon		R	R
PSITTACIDAE	*Psephotus haematonotus*	Red-rumped Parrot			Uncommon
PACHYCEPHALIDAE	*Pachycephala rufiventris rufiventris*	Rufous Whistler			Uncommon
CUCULIDAE	*Chalcites lucidus*	Shining Bronze-Cuckoo		R	R
RALLIDAE	*Porzana tabuensis*	Spotless Crake			Uncommon
PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth			Uncommon
HIRUNDINIDAE	*Petrochelidon nigricans*	Tree Martin			Uncommon
ACCIPITRIDAE	*Haliastur sphenurus*	Whistling Kite			Uncommon
MELIPHAGIDAE	*Epthianura albifrons*	White-fronted Chat			Uncommon
ACANTHIZIDAE	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill			Uncommon
CACATUIDAE	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo		V	V
AGAMIDAE	*Tympanocryptis lineata lineata#*	Five-lined Earless Dragon			E
SCINCIDAE	*Pseudemoia entrecasteauxii#*	Southern Grass Skink			V

 # Historical record and the species have not been recorded in recent years.

Ten of the species above are listed under the National Parks and Wildlife Act (SA status) and are considered in Section 3.2.5. The remaining twelve species are not listed under State legislation, but are considered in the Regional Recovery Plan. Five and thirteen of the species in Table 3.7 are ranked as being of high and medium conservation priority respectively. Four species had no conservation priority as they were not recorded as being present in the Adelaide Plains region; however, they have been recorded at the site. Most species have a low or medium threat status. The occasional high or very high threat is usually associated with water management use or climate change, drought and severe weather.

With the exception of the spotless crake and reptile species, all species without a NPW Act listing are terrestrial bushbirds. Habitat for many of these is primarily the small area of remnant and larger area of planted woodland within the project area in and around the Little Para River and on SA Water land. These species include Pallid Cuckoo, Red-rumped Parrot, Rufous Whistler, Tree Martin, White-fronted Chat, Yellow-rumped Thornbill, Whistling Kite and Tawny Frogmouth. With one exception, while these species are occasionally recorded elsewhere, including around the Greenfields and Barker Inlet Wetlands, these areas do not provide suitable habitat and the species are visitors. The exception is White-fronted Chat, which uses shrubland and samphire habitat along the coast and has been recorded breeding in these habitats throughout the region and the project area.

The two reptile species have historically been recorded with the region, but no recent records are available of them in the region and project area.

3.2.5 Fauna species of State conservation significance

Fauna species of State conservation significance are listed under the NPW Act. Many of these species within, or expected to occur in the project area, are birds. The following discussion groups some species together based on their listing and preferred habitats, to reduce repetition in the report. Some species also have a national listing and are discussed in Section 3.2.3. They are not included here.

Terrestrial

Avifauna

Non-migratory

Little Bittern (*Ixobrychus minutes*) (NPW Endangered)

The Little Bittern was not recorded during the current survey; however, they are an extremely secretive and well camouflaged bird, which is often hard to see. They favour tall reedbeds along the banks of freshwater wetlands, especially where reeds grow over shallow water.

Little Bitterns have been previously recorded occasionally adjacent to the project area at Greenfields Wetlands Stage 1 and 3. Tall reedbed habitat also occurs at Barker Inlet Wetlands North freshwater wetlands, Greenfields Wetlands Stage 2,

and in some areas along the Little Para River. The abundance of this species across the entire project area is relatively unknown but they are expected to inhabit suitable areas of freshwater wetland habitat in low numbers. As Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North provide the largest stands of their preferred habitat, some of the regional population is expected to visit freshwater wetlands in the project area periodically. There are few records from the rest of South Australia, suggesting that the region may support a significant population during drought.

Spotless Crake (*Porzana tabuensishave*) and Lewin's Rail (*Rallus pectoralis*) (NPW Vulnerable)

Neither of these wetland birds was recorded during the survey of the project area but they are are known to be present in the region during 2010/11. Both are secretive, have cryptic habits and a preference for dense reedbeds and sedgelands. Of the small number of Spotless Crake in the region, approximately 20% are considered to inhabit freshwater wetlands in the projecrt area (EBS 2009). Small numbers have been recorded at Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North, and, possibly Barker Inlet Wetlands South. They are also likely to use Greenfields Wetlands Stage 3 for breeding. Lewin's Rail only visits the project area during autumn and winter and is rarely recorded at Greenfields Wetlands Stage 3 and some other freshwater wetlands in the region. They are widely considered to be more common than their current rate of observations suggest. Most birds visiting the region are considered to frequent the freshwater wetlands in the project area.

Blue-billed Duck (*Oxyura australis*) and Australasian Shoveler (*Anas rhynchotis*) (NPW Rare)

Blue-billed Ducks and Australasian Shovelers are nomadic and dispersive waterbirds which are regularly recorded in open water habitat across the project area. Flocks of hundreds of Blue-billed Ducks have been recorded in the past at the Bolivar WWTP and at Buckland Park Lake and similar numbers were observed at Bolivar WWTP by EBS (2009) and 10–50 Australasian Shovelers were also commonly recorded at this location. Australasian Shovelers were also recorded in lower numbers at Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North, with past records of the species in the Barker Inlet Wetlands South.

Most open water habitat in the region lies within the project area and supports a large proportion of the regional population of both species. Bolivar WWTP is a key drought refuge for the regional populations and the largest area of this habitat type in the project area. Low numbers of both species breed within the project area in the dense sedgeland and shrubland around freshwater wetlands. The largest areas of suitable breeding habitat are at Greenfields Wetlands Stage 3 and Barker Inlet Wetlands, where both species have been recorded breeding occasionally.

Cape Barren Goose (*Cereopsis novaehollandiae*) (NPW Rare)

Small numbers of Cape Barren Goose visit grasslands and wetlands in the region during summer. This species is an infrequent visitor to the project area and has been recorded in open coastal habitat throughout the region and in the Greenfields and Barker Inlet Wetlands.

Great Crested Grebe (*Podiceps cristatus*) (NPW Rare) and Freckled Duck (*Stictonetta naevosa*) (NPW Vulnerable)

Great Crested Grebe and Freckled Duck are irregular visitors to the region and they were not recorded in the current survey period. They are both waterbirds of open lagoons, lakes and wetlands and require densely vegetated areas of reeds and sedges to breed. Of the birds in the region, approximately 10% of both species are considered to occur in the project area (EBS 2009). Bolivar WWTP offers the largest area of open water habitat and attracts most birds in the project area. It is a drought refuge but offers little breeding habitat.

Both species are irregularly recorded foraging at Greenfields Wetlands Stage 3 but neither is known to breed there. In the wider region, Freckled Ducks have also been recorded at Onkaparinga River and Buckland Park Lake, where they are known to breed. Similarly, there are no confirmed on-site breeding records for Great Crested Grebes. This species is frequently recorded foraging in the saltfields north of St Kilda.

Banded Stilt (*Cladorhynchus leucocephalus*) (NPW Vulnerable)

The Banded Stilt is a non-breeding visitor to the project area that sometimes occurs in large numbers in the region. A group of 100 birds have been recorded on tidal saltmarsh to the west of Bolivar WWTP (EBS 2009). Banded Stilt prefer shallow saltwater and mudflat habitat. The largest concentrations occur in the northern part of the Dry Creek saltfields near St Kilda, where brine shrimp are a favoured food. As little of their favoured habitat type occurs within the project area, only a small number of birds have been recorded, usually with Black-winged Stilts..

Pied Oystercatcher (*Haematopus longirostris*) and Sooty Oystercatcher (*H. fuliginosus*) (both NPW Rare)

The Pied Oystercatcher is a resident wader that frequents the rocky coastline and intertidal mudflats along Gulf St Vincent. Similarly, the Sooty Oystercatcher is a coastal wader, especially of rocky shorelines. Gulf St Vincent is considered an internationally significant site for the Sooty Oystercatcher, supporting an estimated 150 individuals. Both species occasionally roost at the edge of shallow water or on rocky embankments at Outer Harbor and in the central and northern end of the Dry Creek saltfields. No Pied or Sooty Oystercatchers were recorded during the current survey.

Darter (*Anhinger melanogaster*) (NPW Rare)

The Darter is an occasional visitor to areas of open water in the region, where it is usually seen perched in dead trees, including mangroves, in or near open water. Most of the regional population occurs outside the project area but the species is

an occasional visitor to the Greenfields Wetlands Stage 3 and Barker Inlet Wetlands North.

Slender-billed Thornbill (*Acanthiza iredalei rosinae*) (NPW Vulnerable)

This subspecies of the Slender-billed Thornbill is considered to occur in four broad populations along the northern shores of Gulf St Vincent, from St Kilda to Ardrossan on the Yorke Peninsula. They are confined to samphire shrublands and fringing mangroves on narrow coastal saline mudflats, preferring stands of the taller *Tecticornia arbuscula*, a samphire whose habitat is along the high tide fringe and which is partly inundated by higher tides. The species has not been recorded in the project area for many years, although it occurs around Thompson Creek to the north i.e. in the wider region (Walker Corporation 2009).

Brown Quail (*Coturnix ypsilophora*) (NPW Vulnerable)

The Brown Quail is a species found in grasslands and heathlands and pasture grasses. The latest record of Brown Quail was in 2001–02 at Greenfields Wetlands Stage 3. At freshwater wetlands they forage among the sedgeland habitat along the fringes.

Black-chinned Honeyeater (*Melithreptus gularis gularis*) and Crested Shrike-tit (*Falcunculus frontatus*) (both NPW Vulnerable)

The Black-chinned Honeyeater inhabits woodlands and tree lined watercourses. A small, probably breeding, population has established in planted eucalypts at Kaurna Park wetlands to the northwest of the project area. Despite there being no records from the project area, this species could potentially establish at other wetlands or planted woodlands in the project area.

The Crested Shrike-tit prefers smooth or ribbon-barked eucalypts including *Eucalyptus camaldulensis* and *E. leucoxylon*. Recent records are from north of the project area along the Gawler River (Walker Corporation 2009). However, suitable habitat occurs along Little Para River and in the revegetation plantings at Bolivar WWTP. Despite neither species being recorded in the current survey from these latter locations, they may visit this habitat very irregularly and/or in low numbers.

Blue-winged Parrot (*Neophema chrysostoma*) (NPW Vulnerable)

The Blue-winged Parrot is primarily a winter-spring visitor to the region, where it occurs in low numbers. This species prefers grassy paddocks and samphire shrublands. This species has been recorded in the project area, along the outer boundary of the Dry Creek Saltfields and near intertidal saltmarsh habitat adjacent to the Bolivar WWTP.

Elegant Parrot (*Neophema elegans*) and Rock Parrot (*Neophema petrophila*) (both NPW Rare)

The Elegant Parrot is mostly a summer to autumn non-breeding visitor to the region. It generally often occurs in low numbers but large flocks (over 100) can visit the Adelaide Plains to feed in grassland and samphire shrublands north of the

project area. Elegant Parrots in relatively large numbers have been recorded 10-12 km north of the project area near the Gawler River.

The Rock Parrot also visits the region in summer-autumn and has a preference for intertidal saltmarsh and native and exotic grasslands. They are very occasionally recorded, generally in saltmarsh habitat between the Dry Creek Saltfields and the adjacent mangroves, normally only in low numbers.

Peregrine Falcon (*Falco peregrinus*) (NPW Rare)

The Peregrine Falcon occurs in low densities across most regions of the State and are more commonly recorded in areas with abundant avian prey such as riparian woodland, tree lined wetlands and the ponds at Bolivar WWTP. In the project area, a pair of breeding birds is resident at RAAF Base Edinburgh (DTEI 2007) and these birds and their progeny have been recorded hunting in a wide range of habitats, including over Barker Inlet Wetlands and along Dry Creek. The River Red Gum woodlands along Little Para River and the planted eucalypts along the eastern boundary of Bolivar WWTP provide suitable habitat for the species.

Migratory

No State listed bird species present or possibly present in the project area are considered migratory, although a number move from from region to region subject to seasonal conditions and availability of prey.

Mammal

Only one state listed rare mammal species, the Common Brushtail Possum (*Trichosurus vulpecula*), has been recorded in the site. It would mostly use the woodland areas in and around the Little Para River corridor of the project area.

Reptile and Amphibian

The Pygmy Bluetongue Lizard is the only reptile species with a status of nationally endangered). It is discussed in Section 3.2.3 and does not occur in the project area.

Other species

Thatching Grass (*Gahnia filum*) sedgelands in the region once supported the Yellowish Sedge-skipper Butterfly (*Hesperilla donnysa donnysa*) (Coleman and Coleman 2001). However, this species is suspected as being locally extinct due to major reductions in its habitat.

Marine

Avifauna

No non-migratory or migratory state listed bird species typical of a marine environment are listed as present or possibly present in the project area.

Other species

Species of listed conservation significance under SA legislation are present as considered in Table 3.6.

Others, such as Congolli, are considered to have significance under Hammer et al. (2009), although they do not have a formal conservation status.

3.2.6 Areas of significance for fauna

Based on historical and current survey data, there are a number of areas of known importance for a range of avifaunal groups in the project area and region, namely, Greenfields Wetlands Stages 1 and 3, Barker Inlet Wetlands North (marine section), Barker Inlet Wetlands North (freshwater section, primarily as two roosting areas and some of the areas of shallow water), Little Para River woodlands, including some of the SA Water revegetation areas and, possibly, North Arm Creek (for marine fauna).

In the region and wider region, the saltfields, especially around and north of about St Kilda, particularly around Chapman Creek, parts of the Port River estuary and Barker Inlet, Buckland Park Lake (when it contains water), the coastal fringe of the eastern side of Gulf St Vincent, the Bolivar WWTP ponds and surrounds and the western area of the Gawler River are the most important locations for avifauna.

The Range Wetland and Barker Inlet Wetland South are of lower values, but still provide useful habitat for some avifauna, mostly for aquatic species.

The terrestrial areas adjacent to most of the project corridor (including almost all of the Gillman region), Magazine Creek, Magazine Wetland, the dryland areas around both sections of the Barker Inlet Wetlands and the salt ponds around Dry Creek are relatively insensitive for fauna species and habitat.

4 Effects of the project upon existing conditions

4.1 Threatening processes

The project area and region in which the project is located is mostly a highly disturbed and degraded environment. The environment effects on fauna are predominately associated with the marine and wetland environment, where the extent of the effects will largely depend on the construction methodology chosen during the planning and detailed design phase. An environmentally acceptable approach is required so as to minimise the construction effects and final 'footprint' left in this area.

There are relatively few national threatening processes as listed under the EPBC Act prevailing. Semi-feral Cat and European Red Fox are present in the region and control programmes have been undertaken in the past.

As noted in EBS (2009), the operation of roads and rail are known to have adverse impacts on wildlife. The effects of roads are variable, from the most obvious impacts such as collision and road-kills, to less obvious impacts like genetic isolation of populations. The major mechanisms of impact involve:

- loss of habitat due to installation of infrastructure
- degradation of habitats by pollution from stormwater runoff and litter
- spread of weeds
- fragmentation of habitats resulting in greater edge effects in the longer term
- mortality due to vehicle strike
- disturbance (noise, visual stimuli, light)
- human access (Findlay and Bourdages 2000, Forman and Deblinger 2000).

These impacts can result in road-avoidance zones, where wildlife avoids using areas alongside roads. These disturbance zones can extend to more than 1000 m for some species, which has the potential to result in the loss of a population from an area. However, other species readily adapt to these disturbances and can occupy areas very close to the disturbance source (e.g. Forman and Deblinger 2000).

The construction of roads and rail often leads to increased fragmentation of habitat (Andrews 1990). This increases the length of edge habitat and subsequently reduces the size of interior habitat. Edges of roads increase areas where disturbance effects to fauna can occur and the location of a road can cause many animals to move to more intact habitat areas. The increased fragmentation of habitat by the Northern Connector project would have the potential to confine animals to smaller areas of core habitat, increasing the value of some habitat areas which act as refuges. This increases the pressure on these habitats, which

may or may not be able to support increased numbers of individuals. This will certainly be true for part of the Barker Inlet Wetlands North, where ecologically important areas of resting and roosting habitat will be removed. However, based on observations since 2004, these areas are not known to be important for populations of migratory wading birds and shorebirds.

The construction and operation of roads also increases the potential for introducing alien species. Roads act as dispersal corridors, enabling exotic species to penetrate previously inaccessible areas. Vehicles or vehicular effects may introduce exotic species whose impacts are particularly damaging in wetland areas or other habitats with a relatively fragile ecosystem.

However, by observation the constructed wetlands in the project area and this region are adjacent to some of the busiest highways in South Australia and they are being used by over 120 bird species, some in large numbers. This indicates that the species are able to adapt to these conditions, including threatened species, and that all will use areas of high quality habitat adjacent to major thoroughfares.

Mudflats are considered by Coleman and Cook (2009) and Purnell et al (2009) to be an important habitat for feeding by many birds present in the region and the project area, including parts of the Port River estuary, Barker Inlet and north to Port Wakefield and Clinton along the edge of Gulf St Vincent. However, by observation, many mudflats in the project area do not appear to be important for migratory shorebirds, with few to nil species being recorded along North Arm Creek during the current surveys. By observation, many of the bars and banks exposed at low tide in the region are used as resting and roosting areas by various marine and some aquatic bird species.

Both saline and some aspects of freshwater wetlands are the next most important habitat type provided for threatened bird species. Greenfields Stage 3 provides the highest quality freshwater wetland in the southern part of the project area, while both fresh and saltwater (estuarine) wetlands are present at the Barker Inlet Wetlands North. Similar to saline/estuarine mudflats, constructed wetlands provide suitable feeding grounds for various species. In addition, many resident species are able to breed in this habitat, where the edge habitat provides protection from predators. Finally, parts of these areas may provide small, but important resting and roosting sites.

Shallow saline water provides a very similar habitat to mudflats, which is reflected in a similar bird species present in this habitat type. An important inland example of this habitat is the northern marine area of Barker Inlet Wetlands North, while other areas include some of the tidal flats along the Gulf.

The mosaic of tall grasslands, shorter sedgelands and shallow water and mud flats offer foraging and roosting opportunities to a wide range of birds. The thick vegetation provides a dense shelter from predators, offering a good opportunity to rest (roost), and provide shelter for breeding. By being close to the water, food

sources are also not too far away for many waterbirds and waders. The main sedgeland habitats are present at the freshwater wetlands of the Baker Inlet North and Greenfields Stage 3 Wetlands, while smaller areas of sedgelands are also present at Greenfields Stage 1 and Barker Inlet South.

Open fresh water is of most use and importance to species such as swan, various ducks, coots and grebes. It also provides areas in which the raptor species (White-bellied Sea-eagle) can hunt for prey. Most of the large expanses of open water habitat present in the project area are associated with Bolivar WWTP, Buckland Park Lake and the intertidal creeks associated with the Barker Inlet.

The remainder of the habitats had similar rankings in the number of birds of conservation significance, including reedbeds, open saline water, supratidal samphire shrublands (saltmarsh), mudflats (freshwater), rocky banks and intertidal samphire. Most of the dryland and samphire vegetation in the region is severely degraded and in poor condition and these areas do not attract a high number or diversity of species. Nonetheless, in better condition it may provide some sort of habitat for the Orange-bellied Parrot, as well as other dryland species.

4.1.1 Terrestrial

Avifauna

The southern section of the project is likely to cause some disruption and impact to birds, mainly in the constructed wetland habitat, during construction. Currently, these wetlands provide habitat for numerous bird species, including some migratory, state and nationally listed species. However, relatively small areas of habitat will be removed, with the most important habitat areas being avoided by the project. This lessens the potential effects considerably.

Operation of the project is likely to contribute to the disturbance of a range of birds in a broad area around the development. One of the most obvious sources of disturbance is the visual impacts of cars and trucks using the road. The speed of vehicles moving past birds foraging or roosting in a nearby habitat may startle them, causing them to move further away or seek habitat elsewhere, if possible. However, based on current observations some amount of habituation to movement takes place, for example in the south area of the Barker Inlet Wetlands North, where roosting birds use areas about 60 to 70 m from the edge of PRexy. The noise produced by vehicles may also affect birds from using otherwise suitable habitat alongside the road. However, as demonstrated by AECOM and KBR (2009) at the Barker Inlet North wetlands, the noise would have to be an increase of more 6 dB(A), to levels above 63 dB(A) to have a likely impact on the diversity and abundance of birds. Noise impacts from roads on wetland bird communities have been studied in Northern Hemisphere countries, with varying results.

Specialist habitat species, such as European Bittern (*Botaurus stellaris*) and waders such as the Ruff (*Philomagnus pugnax*), were most heavily impacted by

noise. Their abundance and breeding activities in proximity of a two-lane highway reduced dramatically after its operation commenced. In contrast, population abundance of passerine birds did not show any direct response to disturbance by the highway, regardless of noise level (Hirvonen 2001).

Existing conditions in the project area suggest that a number bird species have adapted to noise levels on high volume arterial roads (such as Port Wakefield Road and Salisbury Highway). These roads were present before the wetlands were constructed and the bird species in these areas have had to adapt to the noise and traffic before using this previously unavailable habitat. Avifauna use in areas close to the Port River Expressway, which was built after the wetlands were constructed, indicates no significant change in bird species or abundance (AECOM and KBR 2009).

The project would introduce an additional major arterial road and rail lines that bird species would need time to adapt to. The main issue with the lag time between construction of the project and bird adaptation, which would vary depending on the species, is the availability of suitable habitat outside the project area. The capacity of habitats to accommodate additional birds displaced from the project area is unknown. For some species, such as those reliant on aquatic grasslands and sedgelands, the available habitat is relatively small across the Adelaide Plains region. If species, for which limited suitable habitat is available, cannot adapt quickly, they may be forced to move to different regions in search of suitable habitat. There is, therefore, potential for a long-term impact on some bird species as a result of this project in operation. Mitigation measures, to provide alternative and other rehabilitated areas of vegetation/habitat could be implemented to reduce this type of impact.

Noise and visual disturbance would be most evident for resident birds during the breeding season, when sensitivity to disturbance often increases. Negative effects of traffic on the breeding success of birds have been documented in a range of woodland and wetland bird species (Reijen and Foppen 2006). The response of resident and migratory species in the project area to auditory and visual disturbance during their breeding season has not been quantified for any species. The extent of these indirect impacts would vary between bird species based on their sensitivity or tolerance and availability of alternative habitat locations. It is noted however that this does not appear to be true for the existing wetlands adjacent to the Port River Expressway and the Salisbury Highway. Many aquatic species have been recorded to successfully breed in these areas.

Birds may collide with moving vehicles or infrastructure as they fly over the road or they may be struck by passing vehicles as they run across the road. This issue is of particular concern, as a wide range of bird species travel daily between the coastal habitats to the west, and the grassland, woodland and wetland habitats to the east. In particular, large bodied birds, such as Australian White Ibis and Australian Pelican, commonly fly at heights of 15-50 m from east to west across the site. The construction of light poles associated with the road could also

increase the incidence of bird strike. It is possible some birds could also nest on the edges of the road/rail track, especially as it had good thermal properties and was sufficiently open. Red-capped Plover is known to nest in the open areas of the Dry Creek Saltfields because it provides sufficient space to detect and avoid predators.

By observation, the most common road kill victims in freshwater wetlands in the region are usually introduced species and some aquatic species such as swamphens, coots and crakes (Cowley 2002). These birds mainly travel on foot, so must dodge traffic as they run across the road when moving between wetlands. Birds are often killed as they cross the existing highway between Barker Inlet Wetlands North and South. The use of culverts and bridges in the wetland system to allow continued water flow may provide safe passage for species and reduce the risk of bird strike for some species. However, gates across culverts and weirs to control water levels would reduce their effectiveness as passageways.

Mammals

The most obvious direct operational impact of roads on mammals is collision with traffic and potential affects from increased noise. Numerous studies in Australia have investigated the impact of road kill on local native fauna. Important populations of terrestrial mammal species of conservation significance are not present in the project area, so no significant impacts are expected. Implications to the Common Brushtail Possum are expected to be minimal, due to the lack of habitat and small populations present only along the Little Para River. For relatively common animals, road kills do not exert significant pressure on population dynamics or conservation status. They still have impacts on local populations of native species.

Reptiles and amphibians

Collision with traffic is the most likely direct impact of the project on reptiles and amphibians. Indirect impacts would be due to habitat loss and increased predation. It is possible, depending on the mediation measures, that habitat will actually be improved as a condition of approval for the project. No state or nationally listed reptile or amphibian species are recorded for the project area, so the development is unlikely to have any major impact on these fauna. All species recorded are considered to be common.

Other fauna

Implications to fish and other aquatic species would occur through run-off from roads and rail corridors contaminating the wetlands and other adjacent environments.

4.1.2 Marine

Avifauna

The project area could directly impact on marine birds by the loss and/or degradation of habitat. Many of the most important bird habitats are those on or at the waters edge, including mud flats, wetlands and shallow saline waters. These habitats supply resident birds with all their needs, including food, shelter and breeding sites, while many migratory species rely on the good habitat to supply them with enough food to travel back to their breeding grounds, most of which are in the Northern Hemisphere.

These habitats and areas can also indirectly be disturbed by the development increasing the turbidity of the water (Coleman and Cook 2009) as a result of run-off. This has implications for the birds food sources, which could be impacted by changes to water quality and hence food resources. Many of the issues outlined in the terrestrial and freshwater avifauna section also apply to marine birds (see Section 4.1.1).

Nonetheless, the most important areas for avifauna, the Greenfields Wetlands and the marine portion of the Barker Inlet Wetlands are avoided by this project.

Other fauna

No direct impacts to marine mammal species are likely to occur with the development of the project providing suitable management planning and operation occurs during construction. However, should major deterioration of mangroves, seagrass, saltmarsh, tidal flats, tidal creeks and/or estuarine rivers occur, then the resident population of Indo-Pacific bottlenose dolphins may be threatened.

Impacts to fish, including species of syngnathids protected under the EPBC Act, and aquatic invertebrates, could occur if there is direct removal of marine habitat or if changes to water quality occurred, especially during construction. This could be from contamination of the water by run-off, increased turbidity and/or changes in water temperature (if bridges shade and shelter sections of the water or the amount of open/unprotected water dramatically changes). Changes to vegetation along the waters edge may also impact fish, crustaceans and/or invertebrates through the loss or alteration of their breeding grounds.

4.1.3 Fauna species of national conservation significance

A nationally significant species that could be potentially impacted by the development of the Northern Connector project is the Orange-bellied Parrot, listed as critically endangered under the EPBC Act. Currently the condition of most of the samphire shrublands present within the impact zones of the project area is poor quality and unlikely to be suitable as feeding habitat for the species. Small areas of intertidal samphire in better condition are present, although most of these will not be affected by the project.

According to the latest surveys and trends, it is unlikely that any Orange-bellied Parrots will be seen this far north in South Australia, if at all, due to their very low population numbers in the State. Nonetheless, any damage to the better quality areas of samphire vegetation could impact on future efforts aimed at allowing the the species to recover from such current low numbers.

Based on the Significant Impact Guidelines (Department of the Environment and Heritage 2006), the project does not appear likely to exert an adverse effect on this species. Even so, a referral under the EPBC Act will be submitted to the Australian Government Minister for the Environment, so as to determine if the project is considered a controlled action and if further assessment or approval is required.

A single pair of White-bellied Sea-eagles has been observed in the region and project area. Even though this species has a large home range, it is possible the project could impact them, or their offspring, through the loss of a small area of hunting habitat and/or direct disturbance. However, the species is tolerant to the amount of current disturbance and uses a very wide range of habitats in the wider region.

Additional species will lose small areas of habitat, primarily through direct impacts and fragmentation, but not enough to significantly affect their population or abundance. Some of these species use more than one habitat type, so they have the ability to move to other preferred or similar sites in the area that are less affected (if at all) by the development. Whether these habitats can support the additional numbers of birds can not be determined. Those species whose habitat is primarily unaffected with the loss of relatively small areas of potential habitat and which are considered to have the ability to adapt to the development or to have a wide range of suitable habitats available for use elsewhere during construction and operation include Long-toed Stint, Australian Painted Snipe, Australasian Bittern, Pectoral Sandpiper, Latham's Snipe, Wood Sandpiper, Marsh Sandpiper, Broad-billed Sandpiper, White-winged Black Tern, Glossy Ibis, Cattle Egret, Great Egret, Little Egret, Intermediate Egret, Sharp-tailed Sandpiper, Common Sandpiper and Black-tailed Godwit.

Some habitat areas will not be impacted either at all or to a significant extent as a result of the project. Hence, the species in these areas are unlikely to be directly affected by the loss of habitat. However, they could be impacted indirectly through noise and visual disturbance factors during construction, such as Freckled Duck and Musk Duck.

Species which are entirely aerial when in Australia and which over-fly the area, such as Fork-tailed Swift and White-throated Needletail, are unlikely to be affected by the project.

Three species are vagrant or very rare visitors to the area, and so they will not be affected significantly by the development including, Southern Giant-Petrel, Osprey and Ruff.

Additional species, although of listed conservation significance, currently have very little suitable habitat present in the area, if at all (they are found in other areas of South Australia, outside the project area) and hence will not be impacted by the development. Any records of these species are considered to be rare visitors to the area. These include Hooded Plover and Sanderling.

As the Pygmy Bluetongue Lizard and its habitat is not considered to occur in the project area, siginificant impacts are not expected to this species.

4.1.4 Fauna species of State conservation significance

Impacts to fauna vary according to their requirements and tolerance to disturbance. State listed species are grouped according to the type of effect, if any, likely to occur due to the project.

The loss and/or degradation of habitat and hence feeding, roosting and or breeding grounds will impact the local population, but will not adversely impact on the regional or State population. Species in this category include Australasian Shoveler, Musk Duck, Blue-billed Duck and Banded Stilt.

Loss of small areas of freshwater, aquatic grassland (reed and sedge habitat) could impact the following species to a small extent, Little Bittern, Australasian Bittern, Spotless Crake and Lewin's Rail. The most important areas for these species, Greenfields Wetlands Stages 1 and 3, are outside of the areas affected by the project. Neither Little Bittern or Australasian Bittern have been confirmed as living in the Barker Inlet Wetlands North.

Some habitat areas used by other species will not be affected as a result of the project. Hence, these species are unlikely to be directly affected by the loss of habitat. However, they could be impacted indirectly. Examples of these species include Peregrine Falcon and Great Crested Grebe.

Additional species, although listed, currently have very little suitable habitat present in the area (they are found in other areas of South Australia, outside the project area) and hence will not be impacted by the development. These include Pied Oystercatcher, Sooty Oystercatcher and other marine species, such as albatross species.

Very few individuals of the following species occur in the project area (most of the population is outside the region), therefore the development is unlikey to have an adverse effect on the local populations of Darter, Blue-winged Parrot, Elegant Parrot, Rock Parrot Black-chinned Honeyeater, Crested Shrike-tit, Slender-billed Thornbill (*Acanthiza iredalei rosinae*) and Brown Quail.

4.1.5 Summary

Most of the project area is likely to experience some environmental effects to some degree. Given that most of the natural environment is already disturbed and fragmented, impacts to fauna should be minimal along most sections of the route, especially in relation to fauna of State or national conservation significance. The areas of greatest importance to various bird species, including the northern part of the saltfields, Bolivar WWTP and the Port River estuary and Barker Inlet are distant from the areas affected by the works and operation of the transport corridors. Consequently, there are no adverse effects that apply to these areas.

Within the project area, the most important areas of bird habitat, including Greenfields Stage 3 (often referred to as Magazine Road Wetlands), the northern section of the marine shallow water and intertidal samphire shrubland in the Barker Inlet Wetlands North and the roosting areas in Barker Inlet Wetlands South will not be affected.

Disturbance to the current areas of important habitat would implicate some fauna species. Of these, the most major impacts which will require some amount of off-set, are considered to be the:

- removal of two important roosting areas, a small area of shallow water wetland and a smaller area of useful marine wetland habitat in the Barker Inlet Wetlands North
- removal of mangrove woodland, intertidal samphire and mudflats at two locations along North Arm Creek.

There are other impacts, but these are considered to be less important, such as the removal of anthropogenic areas, saltfields, planted native vegetation and areas dominated by poor quality supra-tidal samphire shrubland.

Table 4.1 summarises the estimated area of disturbance according to habitat type.

Monitoring of disturbance in the key habitats and construction areas will be required, especially where important habitats of known significance are to be removed. Examples include the small islands currently used for roosting by birds in the northern area of the Barker Inlet Wetlands.

Table 4.1 Areas of habitat to be affected

Terrestrial or marine	Habitat type	Area affected (ha). Southern section	Area affected (ha). Central and northern sections
Terrestrial	Open, deep fresh water	3.60	
	Shallow fresh water drying to mudflats	0.58	
	Dryland roosting/resting sites	0.44	
	Tall grassland (reeds)	0.21	
	Sedgeland	0.11	
	Supratidal (stranded) samphire shrubland	2.22	
	Planted vegetation (shrubland)	3.66	
	Planted vegetation (woodland)	0.22	45.37
	Remnant woodland		0.41
	Anthropogenic vegetation	3.54	101.3
	Anthropogenic infrastructure	1.16	45.1
	Salt field areas	27.1	
Marine	Open and deep water	0.42	
	Shallow water flats	0.67	
	Mudflats (tidal)	0.48	0.51
	Bare flats and saline flats (no tidal influence)	1.69	
	Intertidal samphire shrubland	3.28	
	Supratidal samphire shrubland	0.72	
	Mangrove woodland	3.33	0.54

5 Safeguards and mitigation measures

5.1 Environmental management

Environmental management measures are an integral part of this road and rail project. Specific measures will be developed as part of the project's Environmental Management Plan (EMP) following project approval and these will be integral to the detailed planning stage of the project.

5.1.1 Principles adopted to minimise effects

Principles adopted during the early stages of the proposal have been associated with the planning and design of impact sites and corridors. As far as practicable, the proceeses of avoiding and minimising environmental effects on important habitat and species has been adopted throughout the proposal e.g. through re-location of impact corridors to avoid the most important habitat areas. This process has been ongoing over the past 3 years during the planning and development of the project.

5.1.2 Measures to minimise effects during planning, design, construction and post-construction

Planning and design

Impacts on vegetation and fauna in the project area have been avoided and/or minimised through the corridor selection process and the development of the proposed alignment. Initial environmental studies helped guide the corridor alignment through the project area, particularly in relation to issues such as flora and fauna, Aboriginal heritage, noise, social and contaminated land.

The outcomes of the preliminary and draft environmental studies, especially EBS (2009) and a number of other studies by DTEI, have contributed to changes being made to the proposed original project corridors, including the:

- road and rail corridors through the southern section of the project area were chosen to completely avoid the Greenfields Wetlands Stage 3 and some of the higher value sections of the Barker Inlet Wetlands North. The road corridor has been moved further west over the North Arm Creek mangroves, in order to conserve more of the Barker Inlet Wetlands North shallow freshwater habitat areas and to avoid the most important area of marine habitat in these wetlands. This has impacted upon approximately 3.3 ha of mangroves but allowed for the conservation of a larger area of wetland habitat that is of known significance for a range of avifaunal groups and species. In addition, most of the revised rail corridors are located through relatively insensitive areas of terrestrial and wetlands habitat.

- route through the central section avoids the White Road wetlands and as much of the Little Para River habitat areas as practicable
- route through the central section was chosen to avoid some of the SA Water buffer zones and revegetation plantings
- route through the northern section was chosen to avoid the patch of *Gahnia filum* habitat
- identification of possible wetland offset areas.

Further information on the project corridor assessment process is in the Project Impact Report.

Construction

Best practice environmental management would be required for the duration of the pre-construction and construction phases of the project to minimise any impacts on the local environment. This includes development of a detailed project EMP and a construction environmental management plan (CEMP). The construction area would be clearly identified with the extent of works pegged and flagged to minimise the risk of inadvertent damage. Specific management plans, such as a detailed fauna management plan, weed management plan and a soil erosion and drainage management plan, would also be developed to ensure all issues are addressed and managed accordingly.

The development of a CEMP would also incorporate and detail mitigation measures. It should include the outcomes of the environmental assessments and incorporate DTEI's environmental management policies. The CEMP should also outline the process and contingency measures for sightings of conservation significant species on or around the construction site.

The impact of construction activities on significant bird species could be reduced by timing habitat removal for the winter months. During winter, bird numbers at the freshwater and saltwater wetlands are lower and resident birds would have either finished or not commenced breeding. Bird numbers are also likely to be reduced at this time, as migratory shorebirds would have left the area and many 'resident' birds may have dispersed to other areas.

If construction must proceed during the spring and summer periods, impacts could be reduced by providing alternative habitats for birds, to compensate for the loss of foraging, roosting and breeding habitat. For waterbirds and shorebirds, suitable wetland habitats could be constructed in artificial wetlands. The construction of additional (artificial) intertidal and freshwater wetlands in and around the project area would offset the loss of wetland habitat.

Loss of shallow freshwater habitats has been minimised and the largest impact this would have on birds in the project area is the reduction in foraging habitat. There are alternative foraging habitats in the project areas, region and wider region (e.g. adjacent and other areas of constructed wetlands, Little Para River estuary,

Buckland Park Lake) but their use and value for birds at the time of construction is difficult to predict as some of these areas are annual to ephemeral in nature.

The loss of aquatic grassland and sedgeland habitat associated with the margins of the freshwater wetlands could be mitigated during the construction period for the waterbirds and shorebirds by constructing and expanding artificial wetlands prior to construction. Planted habitats take a number of years to establish but will also eventually provide suitable feeding, roosting and nesting habitat for waterbirds.

It is vital to minimise the width of the construction corridor and limit the loss and damage of habitat at the edges of the construction zone as part of the detailed design and during actual construction activities. A construction footprint minimised by containing and removing all waste products, and securing all building materials, would reduce impacts to bird and habitat areas. It will also avoid contaminating the very important wetland areas (fresh and salt water).

In addition, the likely effect of the project will vary according to the annual and seasonal conditions prevailing during construction. Prior to and during 2009, the latter of which was the end of a prolonged drought period, far greater use of the stormwater treatment wetlands in the region was made by migratory species. This was not the case in 2010 and 2011 (to date) i.e. these wetlands are an important drought refuge. Nonetheless, there are resident and short range aquatic and shorebird species that use the wetlands on a permanent basis or which visit the wetlands regularly.

Continued monitoring (fauna assessments) during construction will be required to assist contractors identify issues not previously recognised on a daily basis. This will also provide data for future projects on the impacts of various construction methods, timing and mitigation measures (as occurred during PRexy).

Operation

A range of measures can be implemented to minimise and compensate for impacts during the operation of the project. These measures include off-setting the loss of vegetation and habitats by achieving a significant environmental benefit (SEB) for the project, constructing compensatory habitat in or adjacent to the project area, completing appropriate revegetation and landscaping and/or adopting a range of environmental management actions to assist obtaining specific goals in the regional wetlands (e.g. control of pest species).

Three possible areas for rehabilitation, incorporating both marine and freshwater habitats, have been considered in the past by DTEI. Some of these areas, as well as other sites have been considered below. All will require more detailed consideration and comparative analysis once the exact area of habitat disturbance and alienation is known following detailed design.

Potential wetland development sites

Modification of parts of the Barker Inlet Wetland North adjacent to the construction sites is an option available to offset damage to habits. This type of modification specifically to enhance particular habitats used by birds was undertaken successfully in these wetlands as part of PRexy following construction of the access road from South Road onto the Salisbury Highway. The exact type of modification would depend on detailed design currently being undertaken and would also need to include consideration of water treatment detention times and stormwater ponding volumes, both of which are key operational criteria for this wetland. This specific area, especially northern parts which are currently part of the marine habitat of this wetland, could be planned to incorporate and be developed into specific habitat areas suitable for avifauna, such as roosting sites.

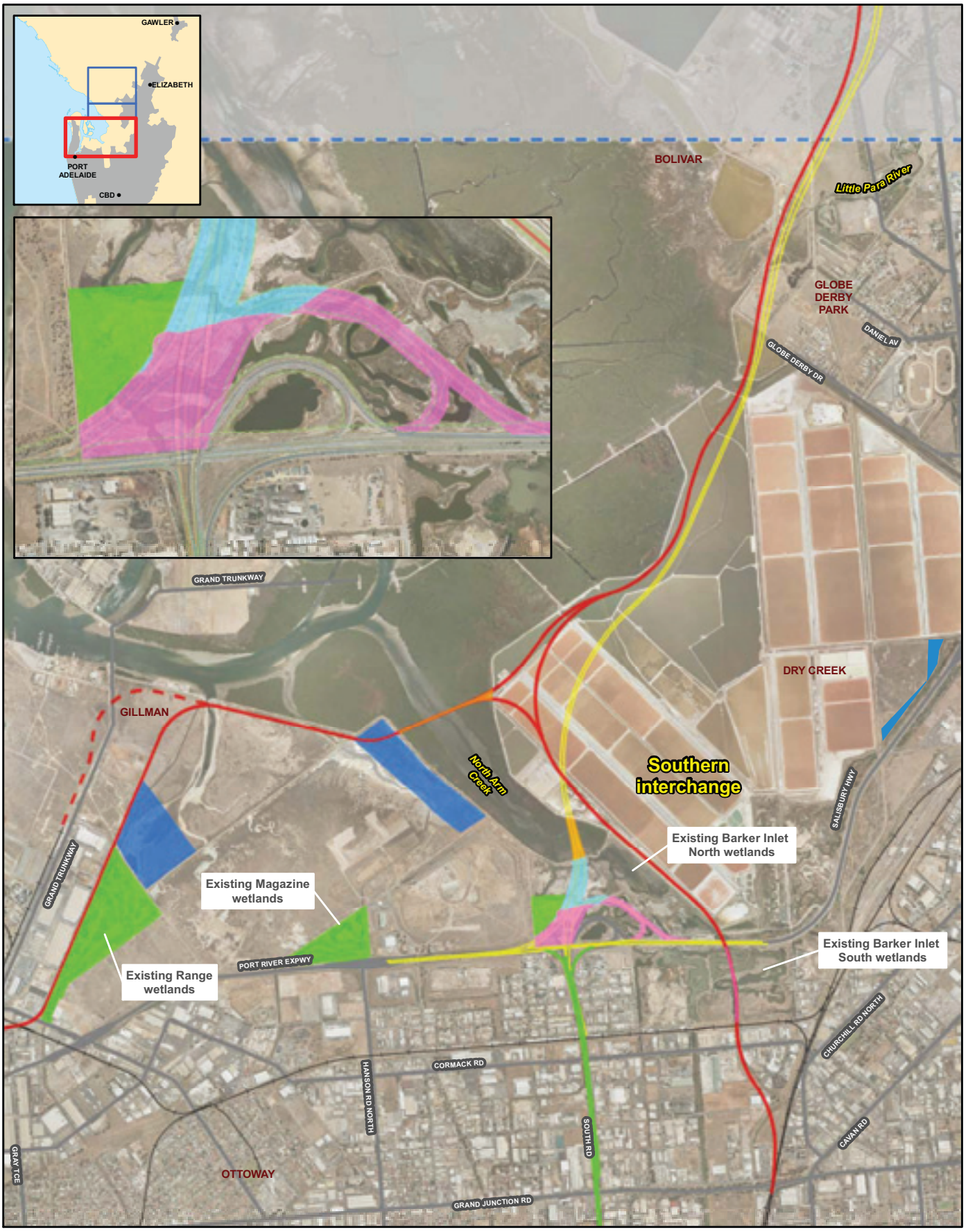
Construction of resting and roosting habitat has been undertaken in the past as part of PRexy and proven to be successful. Removal of two areas of this habitat will occur and there should be a program to establish suitable replacement roosting habitat for species prior to construction. Locations suited to this are along the western boundary of the wetlands, especially in the south west corner of the site.

The first of the potential regional habitat management site is to the north of the Magazine Creek Wetlands and including the basin of Magazine Creek (Figure 5.1). This area has already been disturbed in the past and there is the potential to create ideal avifauna habitat in this area. The drainage channel could be modified into a freshwater habitat and a mixing zone of fresh and saline habitats. However, as the site is also used as a storage basin for floodwater, there would need to be a detailed consideration of design to allow for its use as an avifauna habitat wetland.

A second rehabilitation site exists on currently disturbed land, to the north and west of The Range Wetlands and Wingfield (Figure 5.1). Either the small constructed wetlands which currently exist could be extended and/or the mostly saline wetlands south of North Arm Creek could be expanded.

Option three has the aim of replicating part of the habitat in the Greenfields Stage 3 Wetlands at and west of the Greenfields Connector Wetlands (Stage 2) in land owned by DTEI. Currently this area occurs as a narrow strip of vegetation and habitat connecting Greenfields Stages 1 and 3. To enhance this area, these wetlands could be expanded to take up some or most of the land area, which would result in them being bordered (and protected) by the saltfields on two sides.

Other potential smaller sites for rehabilitation or modification are present and could be explored further as part of the detailed planning and design process for the project.



Source: DEH, DTEI, DPLG

NORTH

0 0.5 1

Kilometres

Figure 3.5 **Areas of potential wetland offsets and or reabilitation Southern section**

Loss areas:

- Freshwater wetlands (11.7 Ha)
- Mangroves (4.6 Ha)
- Marine intertidal wetlands (5.9 Ha)

Potential offsets areas,
Combination of (loss to offset ratio 1:1.5):

- New freshwater / marine intertidal wetlands*
- Wetland modification / rehabilitation

*Area to be determined

- Northern Connector road
- Spur line to Port Flat siding
- Northern Connector rail
- South Road Superway
- Existing railway
- Existing roads

6 Conclusion

Little remnant terrestrial native vegetation and habitat remains in this mostly developed and anthropogenic landscape, restricting fauna to scattered trees and habitat along watercourses, marine environments, road side, revegetation sites and constructed wetlands. Despite this, many bird species, mostly aquatic species and shorebirds, use the areas of constructed wetlands at the southern end of the project area for feeding, roosting and breeding. Of most importance are the areas in which significant numbers of migratory birds congregate and hence, are of international importance, including the Greenfields Wetlands Stage 3. However, the most important wetlands hosting the most important species have been excluded from the development by planning and design changes in the project over the past three years. Excluding birds and some marine vertebrates (syngnathids), no national or state species of conservation significance occur; only the Common Brushtail Possum (rare SA) is a resident in small areas of the central section of the project area.

The effect of the development on local (non-migratory) species is likely to be minimal, with the route avoiding the most critical habitats. In addition, habitat types occur in the wider region, and could offer refuge areas if the primary habitat was disturbed temporarily (the long-term effect on supplementary areas is unknown). Impacts resulting in the disturbance or destruction of habitats to migratory species are of greatest importance, especially those species listed as critically endangered, such as the Orange-bellied Parrot. The health and integrity of samphire vegetation in the region could become of great importance should this species return from critically low numbers. However, current estimates do not have this species surviving in the wild past 2015.

Due to the current proximity of birds and their habitat to the current expressway and highways, increased traffic or noise is considered to be less likely a major impact issue compared to habitat loss.

Not all areas could be investigated in detail within the timeframe available. However, data were supplemented with previous surveys and background information. Some areas, such as mangrove woodlands, are difficult to assess because these areas are the hardest to access and survey. The impact of this inaccessibility may be underestimating the use of these areas by avifauna.

The constructed wetlands used for stormwater management in the project area are a mosaic of degraded terrestrial and aquatic, both freshwater and marine, habitats, with the aquatic habitats being important for a range of avifaunal groups and species. One of the most important functions of these constructed wetlands is as a drought refuge and this has been an important function over the past 10 years. However, with the advent of higher rainfall and flooding elsewhere in SA, central Australia and south eastern Australia, many species populations have been reduced markedly in numbers over 2010/11 in these wetlands.

Monitoring prior to, during and after the construction of the project will give an improved understanding of the impacts, especially once detailed planning and construction methods are known. This was undertaken as part of PRexy and monitoring data from 2003 to 2011 indicates that there was no long term adverse impact on avifauna in the Barker Inlet Wetlands as a result of construction of that project. In addition, impacts can be reduced by creating additional habitats and refuges during and after construction. A number of options for possible rehabilitation and/or restoration have been identified.

6.1 EPBC Act

Some of the species listed as being of national conservation significance under the EPBC Act have not been recorded in the region for many years and/or are unlikely to occur due to the absence of suitable habitat. The Pygmy Bluetongue Lizard has not been recorded in the wider region since 1959. The nearest current records and populations are from the South Hummocks, over 100 km north of the project area. In addition, no suitable habitat is present in the project area for this species.

The Orange-bellied Parrot is a critically endangered species, with a wild population potentially as low as 50 individuals. The most recent record of the Orange-bellied Parrot in the project area is from 2006, in the northern edge of the northern areas of the Cheetham Saltfields in saltmarsh habitat at Chapman Creek. Very few records are available this far north of South Australia for this winter migrant species, and if current trends continue, they will not longer be seen in South Australia as of 2011. It is considered that this project is unlikely to affect the viability of the species.

Many of the EPBC Act listed bird species have been recorded within or adjacent to the project area; however, some are only seen occasionally and are relatively rare visitors to the region. A species potentially of concern is the Australian Painted Snipe, a bird of freshwater and brackish wetlands. This species is at the south-western extent of its range and is generally considered to be in decline in Southern Australia. Importantly, breeding individuals have been recorded at Greenfields State 3 wetlands. This area is not affected by the project.

Other migratory species of conservation significance which use parts of the project site include Red-necked Stint, Marsh Sandpiper, Wood Sandpiper, Sharp-tailed Sandpiper and Common Sandpiper. However, all of the key areas of habitat used by these species are avoided by the project.

Species such as Red-capped Plover, Australian Painted Snipe and Latham's Snipe, Great and Little Egrets, White-bellied Sea-eagle and Glossy Ibis will have small areas of actual or potential habitat removed. The areas involved are considered to be relatively minor and confined to part of the Barker Inlet Wetlands North.

The areas of marine habitat affected by the proposal are confined to two 20 m wide corridors over North Arm Creek and about 1 ha on the western end of Dry

Creek. At these locations areas of mangrove woodland and mud flat will be affected and there may be disturbance of aquatic habitat used by pipefish. The exact impact will depend on the construction methodology used and this has yet to be considered i.e. dependent on the methods proposed by a construction contractor.

Of the species and their habitats listed under the Regional Recovery Plan for the Adelaide Plains sub-region, most species are listed under the EPBC Act or the NPW Act and potential effects on these species are considered to be low. One other group of nine woodland species is present in relatively small numbers in the region and project area. These low numbers and/or occasional visits indicate relatively low impacts as a result of the project.

Overall, it is considered unlikely that the proposal will result in significant effects under the EPBC Act, primarily due to the avoidance of most of the important avifauna habitats and the relatively small areas of habitat to be affected by construction and operation.

6.2 NPW Act

Only one species of state conservation significance that is not a bird species, Common Brushtail Possum, is likely to be resident in the woodlands adjacent to Little Para River only. The species is likely to be vagrant elsewhere. The project is unlikely to adversely impact this species.

Terrestrial woodlands are confined to the areas adjacent to the Little Para River in SA Water land at Bolivar and north of SA Water. Most of these are revegetation areas, with some remnant mature woodland and trees along the Little Para River floodplain. Minimising the impact on the areas will be a key component of the final, detailed design.

Wetlands, saltfields, saltmarsh and mangroves provide habitat and resources for a variety of state listed species, including ducks, crakes, rails, egrets and raptor species. Many arrive as vagrants and migrants, but some species may occur in large numbers.

Species such as Musk Duck, Blue-billed Duck, Australasian Shoveler and a number of terrestrial species will suffer small losses in habitat. These areas are considered as being too small to be likely to cause an adverse effect to the species populations in the project area and region.

The potential for these species to be impacted by the project would be greatly minimised in the medium term if restoration and rehabilitation of wetland habitats in the areas was undertaken.

In summary, species of State conservation significance are unlikely to be affected by the project, primarily due to the small area of habitat used by these species in relation to the wider area that is available and that will not be disturbed.

List of abbreviations

AMLR NRM Board	Adelaide and Mount Lofty Ranges Natural Resources Management Board
AWQC	Australian Water Quality Centre
BDBSA	Biological Databases of South Australia
Bolivar WWTP	Bolivar Wastewater Treatment Plant
CAMBA	China-Australia Migratory Bird Agreement
CEMP	Construction Environmental Management Plan
dB(A)	A-weighted sound pressure level, a unit of measuring environmental sound levels
DEH	Department of Environment and Heritage (Cwlth)
DEH	Department for Environment and Heritage (SA Government, previous name)
DENR	Department of Environment and Natural Resources (SA Government, current name)
DSEWPC	Department of Sustainability, Environment, Water, Populaiton and Communitites (Cwlth)
DTEI	Department for Transport, Energy and Infrastructure (SA Government)
EBS	Environmental and Biodiversity Services Pty Ltd
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeograpnic Regionalisation of Australia
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
KBR	Kellogg Brown and Root Pty Ltd.
MNES	Matters of National Environmental Significance
NPW Act	*National Parks and Wildlife Act 1972*
NRM	Natural Resources Management
NV Act	*Native Vegetation Act 1991*
NVC	Native Vegetation Council

PRexy	Port River Expressway
ROKAMBA	Republic of Korea-Australian Migratory Bird Agreement
SA Water	South Australian Water Corporation
SEB	Significant Environmental Benefit

Glossary

Adelaide Plains: the landscape scale region that extends from the Onkaparinga Estuary to Port Wakefield and east to the foothills of the Mount Lofty Ranges

Biodiversity: the variety of all life forms: the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form

Bioregion: extensive (continental scale) regions distinguished from adjacent regions by their broad physical and biological characteristics

Brackish: slightly saline water that contains dissolved salts in the range 0.5-30 ppm, being less salty than seawater (35 ppm)

Conservation: the protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment

Dispersal: movement of organisms between locations, especially relating to the movement from birth site or breeding site

Ecological community: a characteristic suite of interacting species that are adapted to particular conditions of soil, topography, water availability and climate

Ecological processes: dynamic interactions among and between biotic (living) and abiotic (non-living) components of the environment

Ecosystem: a dynamic complex of plant, animal, fungal and microorganism communities and the associated non-living environment interacting as an ecological unit

Ecosystem services: services of ecosystems beneficial to humans, such as the transformation of natural assets (soil, plants and animals, air and water) into things that we value (e.g. clean air, pollination, soil fertility)

Endemic: exclusively native to a specified region or site

Ephemeral wetlands: wetlands that temporarily hold water

Feral: a domesticated species that has escaped the ownership, management and control of people and is living and reproducing in the wild

Floodplain: a plain bordering a river and subject to flooding

Fragment: restricted areas of habitat surrounded by areas of mostly destroyed habitat (most relevant to modified landscapes)

Fragmentation/fragmented landscapes: division or separation of natural areas by the clearance of native vegetation for human land uses, isolating remnants and species and affecting genetic flow

Habitat: physical place or type of site where an organism, species or population naturally occurs together with the characteristics and conditions that render it suitable to meet the lifecycle needs of that organism, species or population

Habitat diversity: the number of different types of habitats within a given area

IBRA subregion: subdivision of a bioregion based on broad physical and biological characteristics; a system of related and interconnected landsystems within an IBRA region

Introduced species: an animal or plant that has been introduced to an area where it normally does not occur

Invasive species: any animal pest, weed or disease that can adversely affect native species and ecosystems

Land degradation: the decline in quality of natural resources of the land resulting from human activities on the land

Landform: any of the numerous features that make up the surface of the earth, such as plain, plateau or canyon

Landscape: heterogeneous area of land or sea that is of sufficient size to achieve positive results in the recovery of species or ecological communities, or in the protection and the enhancement of ecological and evolutionary processes

Landsystem: a group of local ecological communities derived from a landscape pattern of related and interconnected local ecosystems in a subregion

Marine: A species or environment found in an environment subject to daily tidal (saltwater) inundation with no artificial control (e.g. levees, barriers).

Migratory species: a mobile organism that changes habitat according to season, climate, food supply, etc often across vast distances and along defined paths

Native species: a plant or animal species that occurs naturally in South Australia

Native vegetation (as defined by the *Native Vegetation Act 1991*): a plant or plants of a species indigenous to South Australia (i.e. naturally occurring local native plants) including a plant or plants growing in or under waters of the sea but does not include plant or part of a plant that is dead nor plant intentionally sown or planted (amendments to the Act cover dead trees that provide habitat for threatened species)

Pre-European: before European settlement (1836 in South Australia)

Project area: area defined by the polygon outline that encases the project route (Figure 1.2)

Project corridor: area defined as ithe Northern Connector route, including the interchange areas and road width as shown on initial drawings and a rail corridor width of 20 m (Figure 1.2)

Refuge or refugia: region or habitat where organisms are able to persist during a period in which most of the original geographic range becomes uninhabitable

Remnant: areas of native plant communities that are found in otherwise cleared landscapes

Restoration: assisting the recovery of ecological systems to a state in which the viability of species and ecological communities, and ecosystem function, are improved

Revegetation: the process of replanting and rebuilding the soil of disturbed land; can increase the area of suitable habitat in the landscape, improve the quality of existing habitat and help to link remnant or isolated habitats through 'stepping stones' and corridors

Riparian: the area of a watercourse or other waterbody

Species: a group of organisms capable of interbreeding with each other but not with members of other species

Species diversity: variability (richness and abundance) of biota in an area; an index of community diversity that takes into account both species richness and the relative abundance of species

Subspecies: distinct geographical ranges of interbreeding natural populations of species that are reproductively isolated and possess distinguishing characteristics from other populations of the same species

Terrestrial: land-based biodiversity including inland aquatic freshwater ecosystems, such as rivers, streams, lakes, wetlands, springs, groundwater and groundwater dependent ecosystems, and the native inland aquatic species in these areas

Threatened species and/or ecological communities: a species or ecological community that is Vulnerable or Endangered

Threatening processes: the dominant limiting factors and constraints to the ongoing conservation of biodiversity

Vagrant: an individual found outside the normal distribution range of its species

Vegetation association: a stable plant community of definite composition presenting a uniform appearance and growing in more or less uniform habitat conditions

Vegetation condition: the condition, composition and density of the plants in an area

Viability: likelihood of long-term survival of the example/population of a particular ecosystem or species

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Appendix A

SITE AND HABITAT PHOTOGRAPHS

The marine tidal environment at Angas Inlet, typical of parts of Barker Inlet, is a deep waterbody bordered by mudflats and mangroves. Some of the exposed mudflats are useful roosting areas for marine bird species.

Marine tidal environment with a view of mangrove woodland and mudflats in North Arm Creek, part of Barker Inlet. Relatively few bird species present in this environment.

Marine tidal area prior to a rain event in the marine portion of Barker Inlet Wetlands North. The whole of this area is an important habitat for birds.

Marine tidal area after a rain event, floods the mudflats leaving water up to the edge of the terrestrial vegetation. The salinity in this inlet is also reduced due to the influx of freshwater.

Terrestrial environment of salt flats and shallow saltwater pools in the Barker Inlet Wetlands North, edged with dense *Sarcocornia* and areas of *Tecticornia*. Low value habitat for avifauna.

Barker Inlet North Wetlands (marine portion) with stranded samphire shrubland, planted shrubland and anthropogenic understorey, plus areas of salt flat and intertidal samphire shrubland. These areas have limited habitat value for avifauna.

Constructed island habitat in the Barker Inlet Wetlands North adjacent to the Port River Expressway (South Road overpass visible). This island provides important roosting habitat to numerous bird species.

Habitat of constructed island and edge habitat in the Barker Inlet Wetlands North (freshwater) adjacent to the Port River Expressway. The bare area around the waters edge and the low bare island are an important roosting habitat by a range of bird species.

Magazine Creek Wetlands adjacent to Whicker Road. Few areas of habitat for shorebirds present here.

Terrestrial habitat and freshwater wetland in Barker Inlet Wetlands North. Small islands provide habitat for aquatic birds as safe roosting areas. Larger shrubs, away from the water's edge provide habitat for woodland species.

Terrestrial habitat in Barker Inlet Wetlands North. Planted shrubs and low bushes and anthropogenic understorey provide limited habitat for aquatic and terrestrial bird species.

View across Barker Inlet Wetlands South (freshwater) to Rafferty Street drain. Mostly deep water habitat, with only small areas suitable for roosting habitat by shorebirds.

Barker Inlet Wetlands South. Habitat is dominated by open deep water with fringing tall grassland. Aquatic bird habitat only.

Barker Inlet Wetlands South. Small areas of shallow freshwater and bare areas habitat provides limited habitat for shorebird species. This area is dominated by aquatic birds.

Terrestrial environment of Gillman and Wingfield. Low stranded samphire shrubland and anthropogenic grassland provides limited feeding and roosting habitat for avifauna.

Greenfields Stage 3 wetlands adjacent to Magazine Road. These freshwater wetlands have shallow channels, low sedgelands and taller grasslands and samphire shrublands, plus shallow edges. Exposed mudflats provide wading bird habitat. The whole of this wetland is important bird habitat.

Appendix B

EBS (2009)
AVIFAUNA DATA

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shr ub-lan	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Platycercus elegans flaveolus	Adelaide Rosella		1																11	27
Tachybaptus novaehollandiae	Australasian Grebe	101	10		4															754
Anas rhynchotis	Australasian Shoveler	45	1	2			3													334
Falco longipennis	Australian Hobby	1																		2
Gymnorhina tibicen	Australian Magpie												1						2	7
Pelecanus conspicillatus	Australian Pelican	35	1	41	2	54	18		3						3					551
Acrocephalus australis	Australian Reed-Warbler		5	1	2	1										1		1		25
Tadorna tadornoides	Australian Shelduck	305		25	1	5	54										17			2507
Porzana fluminea	Australian Spotted Crake		2	3	5	1									2					31
Threskiornis molucca	Australian White Ibis	32	46	58	1	44	5	4		2		5	4	5	2	8			1	777
Chenonetta jubata	Australian Wood Duck		6	1		10														37
Vanellus tricolor	Banded Lapwing	4					1													36
Cladorhynchus leucocephalus	Banded Stilt								50											100
Cygnus atratus	Black Swan	316		9	14	8	1													2285

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shrub-land	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Elseyornis melanops	Black-fronted Dotterel	0	2	1																12
Elanus axillaris	Black-shouldered Kite			1																2
Limosa limosa	Black-tailed Godwit	1																		7
Gallinula ventralis	Black-tailed Native-hen	1	120	11												10				551
Himantopus himantopus	Black-winged Stilt	321	4	21	74	38	10		5	2	2	1								2589
Oxyura australis	Blue-billed Duck	114																		800
Neophema chrysostoma	Blue-winged Parrot									1	1									3
Accipiter fasciatus	Brown Goshawk	1																		1
Cincloramphus cruralis	Brown Songlark	1								1										3
Acanthiza pusilla	Brown Thornbill						1					1	1		1					6
Sterna caspia	Caspian Tern	1											1		1					3
Anas castanea	Chestnut Teal	6	7	44		5	5					1			2					270
Accipiter cirrhocephalus	Collared Sparrowhawk																		1	1
Tringa nebularia	Common Greenshank	5		3	6	2	5	1		6	28	1			1					148
Actitus hypoleucos	Common Sandpiper	1											1							2
Sturnus vulgaris	Common Starling	6	1	13	15							13	3					45	25	327

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shrub-land	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Ocyphaps lophotes	Crested Pigeon		3	2		1				4		4	2	1	4	4		8	9	101
Gallinula tenebrosa	Dusky Moorhen		6	6	2	17														68
Turdus merula	Eurasian Blackbird											25						3		105
Fulica atra	Eurasian Coot	2891	8	14	25	138														20515
Carduelis carduelis	European Goldfinch	1																	3	8
Petrochelidon ariel	Fairy Martin		1				1													10
Columbia liva	Feral Pigeon			3									3							18
Cacatua roseicapilla	Galah																		35	70
Plegadis falcinellus	Glossy Ibis	1		1																3
Pachycephala pectoralis	Golden Whistler													1						1
Phalacrocorax carbo	Great Cormorant	4				8														39
Ardea alba	Great Egret		1	1		1	1	1		1					1					11
Cracticus torquatus	Grey Butcherbird														1					1
Rhipidura albiscapa	Grey Fantail			1			1					1	1	1						6
Colluricincla harmonica	Grey Shrike-thrush						1						1		1					3

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shrub-land	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Anas gracilis	Grey Teal	2697	66	225	103	94	183													21071
Aythya australis	Hardhead	319	6	13	13	117														2453
Poliocephalus poliocephalus	Hoary-headed Grebe	128	1	3	7															921
Chrysococcyx basalis	Horsfield's Bronze-cuckoo															1				1
Mirafra javanica	Horsfield's Bushlark	1																		1
Passer domesticus	House Sparrow				5								2							15
Ardea intermedia	Intermediate Egret			1																
Gallinago hardwickii	Lathams Snipe	1																		
Dacelo novaeguineae	Laughing Kookaburra																	1	1	3
Phalacrocorax sulcirostris	Little Black Cormorant	119		7		51	1								2					923
Cacatua sanguinea	Little Corella																	2	50	104
Egretta garzetta	Little Egret				1								1		2					6
Megalurus gramineus	Little Grassbird		1	1	2	1														10
Phalacrocorax melanoleucos	Little Pied Cormorant	0	2	2	2	44		5	5			1			1					81

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shr ub-lan	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Corvus mellori	Little Raven	4				3							2				27		1	120
Cacatua tenuirostris	Long-billed Corella																		3	6
Calidris subminuta	Long-toed Stint	1		1	1															3
Grallina cyanoleuca	Magpie-lark	34	6	3	10	13			19	1						3	12	6	4	400
Tringa stagnatilis	Marsh Sandpiper	4		3	5															47
Vanellus miles	Masked Lapwing	19	3	4	8	4	5				2									199
Biziura lobata	Musk Duck	12																		82
Glossopsitta concinna	Musk Lorikeet																	5	7	23
Falco cenchroides	Nankeen Kestrel															1	1			3
Nycticorax caledonicus	Nankeen Night Heron														1					1
Phylidonyris navaehollandiae	New Holland Honeyeater		1																	1
Manorina melanocephala	Noisy Miner		8													3		3	15	72
Anas superciliosa	Pacific Black Duck	34	30	11	23	58	3												1	515
Malacorhynchus membranaceus	Pink-eared Duck	871																		6100

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shrub-land	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Porphyrio porphyrio	Purple Swamphen		3	3	3	1														28
Trichoglossus haematodus	Rainbow Lorikeet																		6	12
Anthochaera carunculata	Red Wattlebird																		2	3
Charadrius ruficapillus	Red-capped Plover	4		2	13	2	16													132
Erythrogonys cinctus	Red-kneed Dotterel	1	8	20	24	2	14				2									226
Recurvirostra novaehollandiae	Red-necked Avocet	54					5													398
Calidris ruficollis	Red-necked Stint	37			20		128													808
Psephotus haematonotus	Red-rumped Parrot																			1
Anthus novaeseelandiae	Richard's Pipit									1							1			2
Columbia liva	Rock Dove (Feral Pigeon)	9											1							64
Platalea regia	Royal Spoonbill	4	3	5	1	13														70
Pachycephala rufiventris	Rufous Whistler													1	4					9
Todiramphus sanctus	Sacred Kingfisher																	1		1
Calidris acuminata	Sharp-tailed Sandpiper	356		39	311		173				210				1					4380

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shr ub-lan	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Larus novaehollandiae	Silver Gull	299		93	3	145	95		10				1	3	10					3044
Zosterops lateralis	Silvereye														1	3				8
Lichenostomus virescens	Singing Honeyeater		1	1	1					14		2	1	1	2	3			2	46
Streptopelia chinensis	Spotted Turtle-Dove		1	2		2						1	1		2	1				22
Pardalotus striatus	Striated Pardalote																	1	5	12
Coturnix pectoralis	Stubble Quail	1																		4
Cacatua glaerita	Sulphur-crested Cockatoo																	3	5	15
Malurus cyaneus	Superb Fairy-wren		1							2		1	1	1		2		1		15
Circus approximans	Swamp Harrier		1			1														4
Petrochelidon nigricans	Tree Martin	143	9						190								67			1615
Hirundo neoxena	Welcome Swallow	21		3						15			5		13		80			455
Chlidonias hybridus	Whiskered Tern	187		39	70		4		425	100	100				25		333			3822
Haliastur sphenurus	Whistling Kite	1	1														1	0		13
Haliaeetus leucogaster	White-bellied Sea-Eagle	1							1											6
Sericornis frontalis	White-browed Scrubwren											1	1	1	1	1				7

Species name	Habitat type >	Freshwater WL					Saltwater WL		Saltmarsh		Salt ponds	Mangroves				Shrub-land	Pad-docks	Woodland		Total
	Common name	Bolivar	Whites Rd	Barker Inlet N	Greenfields	Other	Barker Inlet N	Cheetham	Cheetham	Other	Cheetham	North Arm	Swan Alley	Whites Rd	Cheetham	Whites Rd	Bolivar	L. Parra River	Bolivar	
Egretta novaehollandiae	White-faced Heron	9	8	2		1		56		50			2		25	6	8			300
Epthianura albifrons	White-fronted Chat	1			1	2	8		2	5						15				83
Lichenostomus penicillatus	White-plumed Honeyeater		2															11	9	46
Malurus leucopterus	White-winged Fairy-wren		1	1		5	3		6	2						5	7			68
Rhipidura leucophrys	Willie Wagtail	3	2	2	5	3						3		1				2	3	64
Tringa glareola	Wood Sandpiper	1			13															28
Platalea flavipes	Yellow-billed Spoonbill	2		1																17
Total		**66,953**	**1531**	**2,950**	**1,572**	**895**	**2,954**	**67**	**1,429**	**207**	**688**	**22**	**88**	**24**	**208**	**127**	**1,654**	**177**	**394**	**82,146**
Number of visits per site		7	4	4	3	3	4	2	2	2	2	4	3	2	2	2	3	2	2	
Average number of birds per survey		9,565	383	738	524	298	739	34	715	104	344	57	29	12	104	64	551	89	197	
Proportion of all birds recorded per site		81.5	1.9	3.6	1.9	1.1	3.6	0.1	1.7	0.3	0.8	0.3	0.1	0.0	0.3	0.2	2.0	0.2	0.5	
Total number of species recorded per site		**59**	**41**	**47**	**36**	**35**	**27**	**5**	**11**	**16**	**7**	**15**	**21**	**10**	**25**	**16**	**11**	**16**	**23**	

The number given to each species for each site is the average number of birds, for that site, recorded for each site visit. An average has been given in this field because sites had varying survey effort and therefore data has been calibrated to give a better representation of the number of birds utilizing a survey area at one time. The total number of observations for each species has been provided in the Totals column whilst the total number of observations for each site has been provided in the Totals row.

Appendix C

EPBC ACT
PROTECTED MATTERS SEARCH

EPBC Act Protected Matters Report: Coordinates

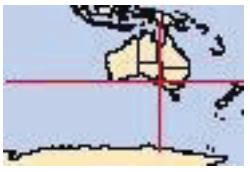
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

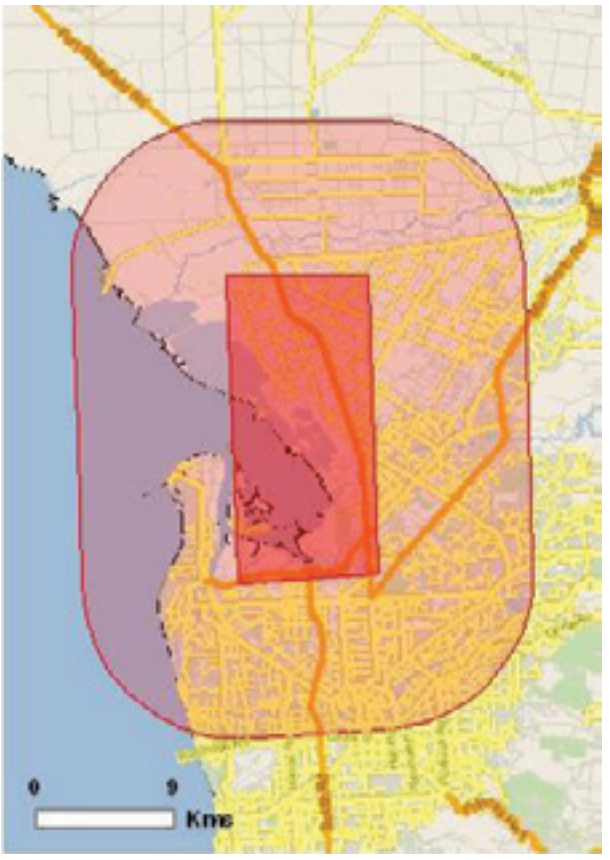
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

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

Report created: 01/02/11 14:01:11





Coordinates
Buffer: 10Km

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	7
Wetlands of International Significance (Ramsar Wetlands):	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communitites:	2
Threatened Species:	34
Migratory Species:	57

Other Matters Protected by the EPBC Act

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

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

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

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

Commonwealth Lands:	22
Commonwealth Heritage Places:	4
Listed Marine Species:	95

Whales and Other Cetaceans:	9
Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

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

Place on the RNE:	340
State and Territory Reserves:	10
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	3

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	Status
Historic	
South Australian Old and New Parliament	Listed place
The Adelaide Park Lands and City Layout SA	Listed place
Adelaide Park Lands - Additional Area along	Nominated place
Adelaide Park Lands - Additional Area and	Nominated place
Friends (Quakers) Meeting House SA	Nominated place
Port Adelaide and Gawler Reach SA	Nominated place
Union Hall SA	Nominated place

Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia	Critically Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence

BIRDS		
Cinclosoma punctatum anachoreta		
Spotted Quail-thrush (Mt Lofty Ranges) [67099]	Critically Endangered	Species or species habitat likely to occur within area
Diomedea exulans amsterdamensis		
Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans exulans		
Tristan Albatross [82337]	Endangered	Foraging, feeding or related behaviour may occur within area
Diomedea exulans gibsoni		
Gibson's Albatross [82271]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Halobaena caerulea		
Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster		
Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Pterodroma mollis		
Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri		
Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta		
Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida		
Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus		
Southern Brown Bandicoot [68050]	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Neophoca cinerea		
Australian Sea-lion [22]	Vulnerable	Species or species habitat may occur within area
PLANTS		
Caladenia tensa		

Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat likely to occur within area
Euphrasia collina subsp. osbornii		
Osborn's Eyebright [3684]	Endangered	Species or species habitat likely to occur within area
Glycine latrobeana		
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum pallidum		
Pale Leek-orchid [20351]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum pruinosum		
Plum Leek-orchid [11821]	Endangered	Species or species habitat known to occur within area
Pterostylis arenicola		
Sandhill Greenhood Orchid [17919]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cucullata		
Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area
Tecticornia flabelliformis		
Bead Glasswort [82664]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra cyanapicata		
Blue Top Sun-orchid, Dark-tipped Sun-orchid [81872]	Critically Endangered	Species or species habitat may occur within area
REPTILES		
Aprasia pseudopulchella		
Flinders Ranges Worm-lizard [1666]	Vulnerable	Species or species habitat likely to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
SHARKS		
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Migratory Species

[Resource Information]

Name	Status	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding likely to occur within area

Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]		Species or species habitat may occur within area
Diomedea dabbenena		
Tristan Albatross [66471]		Foraging, feeding or related behaviour may occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni		
Gibson's Albatross [64466]		Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Sterna albifrons		
Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri		
Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto)		
Shy Albatross, Tasmanian Shy Albatross [64697]		Species or species habitat may occur within area
Thalassarche impavida		
Campbell Albatross [64459]		Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area

Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Neophema chrysogaster		
Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Roosting known to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Roosting known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris		
Great Knot [862]		Roosting known to occur within area
Charadrius bicinctus		
Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area
Charadrius mongolus		
Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Heteroscelus brevipes		
Grey-tailed Tattler [59311]		Roosting known to occur within area
Limicola falcinellus		
Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica		

Bar-tailed Godwit [844] Limosa limosa	Roosting known to occur within area
Black-tailed Godwit [845] Numenius madagascariensis	Roosting known to occur within area
Eastern Curlew [847] Numenius minutus	Roosting known to occur within area
Little Curlew, Little Whimbrel [848] Numenius phaeopus	Roosting known to occur within area
Whimbrel [849] Pluvialis fulva	Roosting known to occur within area
Pacific Golden Plover [25545] Pluvialis squatarola	Roosting known to occur within area
Grey Plover [865] Rostratula benghalensis s. lat.	Roosting known to occur within area
Painted Snipe [889] Tringa glareola	Species or species habitat may occur within area
Wood Sandpiper [829] Tringa nebularia	Roosting known to occur within area
Common Greenshank, Greenshank [832] Tringa stagnatilis	Roosting known to occur within area
Marsh Sandpiper, Little Greenshank [833] Xenus cinereus	Roosting known to occur within area
Terek Sandpiper [59300]	Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands **[Resource Information]**

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

Defence - ADFRU ADELAIDE
Commonwealth Land - Australian Maritime Safety Authority
Commonwealth Land - Commonwealth Scientific & Industrial Research Organisation
Defence - TRANSMITTING STATION-ELIZABETH ; MT LOFTY TRANSMITTING STATION
Defence - ST KILDA TRANSMITTING STATION
Defence - EDINBURGH - RAAF BASE
Defence - BASE REPAIR FACILITY RAPIER - PENFIELD
Commonwealth Land - Australian Broadcasting Commission
Defence - Army Training Depot
Defence - HMAS ENCOUNTER
Commonwealth Land - Australian National Railways Commission
Defence - ALBERTON TRNG DEPOT
Defence - PT ADELAIDE SHIPYARD & BOATSHED (TS ADELAIDE)
Commonwealth Land - Australian Sports Commission
Defence - INSTRUMENT LANDING SYSTEM (ILS) OUTER MARKER
Commonwealth Land - Minister of Education Employment & Training
Commonwealth Land - Royal Australian Air Force Veterans Residences Trust
Defence - INSTRUMENT LANDING SYSTEM (ILS) MIDDLE MARKER

Defence - HAMPSTEAD BARRACKS
Commonwealth Land - Defence Housing Authority
Commonwealth Land -
Commonwealth Land - Defence Service Homes Corporation

Commonwealth Heritage Places [Resource Information]

Name	Status
Historic	
Salisbury Explosives Factory (former) SA	Indicative Place
Sturton Chapel and Graveyard SA	Indicative Place
North Adelaide Post Office SA	Nominated place
Parafield Airport Air Traffic Control Tower SA	Nominated place

Listed Marine Species [Resource Information]

Name	Status	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Roosting known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Roosting known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta		
Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris		
Great Knot [862]		Roosting known to occur within area
Catharacta skua		
Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus		
Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area

Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]		Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]		Foraging, feeding or related behaviour may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Larus dominicanus Kelp Gull [809]		Breeding known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Neophema chrysogaster		

Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus		
Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus		
Whimbrel [849]		Roosting known to occur within area
Phalacrocorax fuscescens		
Black-faced Cormorant [59660]		Breeding known to occur within area
Phalaropus lobatus		
Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax		
Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva		
Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola		
Grey Plover [865]		Roosting known to occur within area
Pterodroma mollis		
Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Recurvirostra novaehollandiae		
Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]		Species or species habitat may occur within area
Sterna albifrons		
Little Tern [813]		Species or species habitat may occur within area
Sterna bergii		
Crested Tern [816]		Breeding known to occur within area
Thalassarche bulleri		
Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto)		
Shy Albatross, Tasmanian Shy Albatross [64697]		Species or species habitat may occur within area
Thalassarche impavida		
Campbell Albatross [64459]		Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thinornis rubricollis		
Hooded Plover [59510]		Roosting known to occur within area
Tringa glareola		
Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Roosting known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus		
Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus		

Terek Sandpiper [59300]	Roosting known to occur within area
Fish	
Acentronura australe	
Southern Pygmy Pipehorse [66185]	Species or species habitat may occur within area
Campichthys tryoni	
Tryon's Pipefish [66193]	Species or species habitat may occur within area
Filicampus tigris	
Tiger Pipefish [66217]	Species or species habitat may occur within area
Heraldia nocturna	
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]	Species or species habitat may occur within area
Hippocampus abdominalis	
Bigbelly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]	Species or species habitat may occur within area
Hippocampus breviceps	
Short-head Seahorse, Short-snouted Seahorse [66235]	Species or species habitat may occur within area
Histiogamphelus cristatus	
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]	Species or species habitat may occur within area
Hypselognathus rostratus	
Knifesnout Pipefish, Knife-snouted Pipefish [66245]	Species or species habitat may occur within area
Kaupus costatus	
Deepbody Pipefish, Deep-bodied Pipefish [66246]	Species or species habitat may occur within area
Leptoichthys fistularius	
Brushtail Pipefish [66248]	Species or species habitat may occur within area
Lissocampus caudalis	
Australian Smooth Pipefish, Smooth Pipefish [66249]	Species or species habitat may occur within area
Lissocampus runa	
Javelin Pipefish [66251]	Species or species habitat may occur within area
Maroubra perserrata	
Sawtooth Pipefish [66252]	Species or species habitat may occur within area
Notiocampus ruber	
Red Pipefish [66265]	Species or species habitat may occur within area
Phycodurus eques	
Leafy Seadragon [66267]	Species or species habitat may occur within area
Phyllopteryx taeniolatus	
Common Seadragon, Weedy Seadragon [66268]	Species or species habitat may occur within area
Pugnaso curtirostris	
Pugnose Pipefish, Pug-nosed Pipefish [66269]	Species or species habitat may occur within area
Solegnathus robustus	
Robust Pipehorse, Robust Spiny Pipehorse [66274]	Species or species habitat may occur within area
Stigmatopora argus	

Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra		
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus		
Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris		
Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer		
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi		
Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus		
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Vanacampus vercoi		
Verco's Pipefish [66286]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri		
New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus		
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Neophoca cinerea		
Australian Sea-lion [22]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area

Whales and Other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis		
Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area

Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE **[Resource Information]**

Note that not all Indigenous sites may be listed.

Name	Status
Natural	
Buckland Park Lake SA	Indicative Place
Penrice Area SA	Indicative Place
Port Gawler Conservation Park SA	Registered
River Torrens (outside Adelaide City) SA	Registered
Torrens Island Conservation Park SA	Registered
Historic	
Glynde House SA	Identified through State processes
Korra Weera SA	Identified through State processes
St Aidans Anglican Church SA	Identified through State processes
Statue of Captain Matthew Flinders SA	Identified through State processes
Torrensville Uniting Church (former) SA	Identified through State processes
Union Building Group SA	Identified through State processes
Adelaide High School SA	Indicative Place
Administration Building SA	Indicative Place
Angas Home SA	Indicative Place
Bailey Bridge (Road Bridge) SA	Indicative Place
Balfours Rundle Mall (South Facade) SA	Indicative Place
Barton Vale House SA	Indicative Place
Bells Plumbers Shop SA	Indicative Place
Birkenhead Bridge SA	Indicative Place
Blacksmiths Shop Yatala Labour Prison (Former) SA	Indicative Place
Bon Marche Building SA	Indicative Place
Boundary Park on Little Para River SA	Indicative Place
Bragg Laboratories SA	Indicative Place
Buckland Park Homestead Estate SA	Indicative Place
CBA Bank Building (former) SA	Indicative Place
Church and Manse SA	Indicative Place
David Jones (Australia) Pty Ltd Store SA	Indicative Place
Del Monte SA	Indicative Place
Destitute Asylum - Female Section (former) SA	Indicative Place

Dwelling SA	Indicative Place
Ebenezer Chapel and Cemetery (former) SA	Indicative Place
Elephant House Adelaide Zoological Gardens SA	Indicative Place
Foot Bridge SA	Indicative Place
Foot Bridge SA	Indicative Place
Foot Underpass under Railway SA	Indicative Place
Forsyth House SA	Indicative Place
Glenside Hospital Southern Boundary Wall SA	Indicative Place
Goldsbrough House SA	Indicative Place
Grange Scout Hall SA	Indicative Place
Halletts Brick Kiln (former) SA	Indicative Place
Holland Street Bridge (tramway bridge) (former) SA	Indicative Place
House (former) SA	Indicative Place
IMFC Building SA	Indicative Place
Institute SA	Indicative Place
Kembla House SA	Indicative Place
Kent Town Brewery and Malthouse SA	Indicative Place
Lochiel Park, Lochend & Barn SA	Indicative Place
Maid and Magpie Hotel SA	Indicative Place
Mail Exchange Building (former) SA	Indicative Place
Masonic Hall SA	Indicative Place
Modbury Farm (former) SA	Indicative Place
Olympic Swimming Pool (former) SA	Indicative Place
Paralowie House and Grounds SA	Indicative Place
Post Office (former) SA	Indicative Place
Railway Bridge SA	Indicative Place
Railway Bridge SA	Indicative Place
Railway Viaduct SA	Indicative Place
Ramsgate Hotel SA	Indicative Place
Restaurant SA	Indicative Place
Road Bridge SA	Indicative Place
Rotunda Adelaide Zoological Gardens SA	Indicative Place
Royal Hotel SA	Indicative Place
Salisbury Institute SA	Indicative Place
Semaphore Cinema (former) SA	Indicative Place
Shell House (former) SA	Indicative Place
Shop SA	Indicative Place
Shops and Residences SA	Indicative Place
Smithfield Hotel SA	Indicative Place
Southwark Hotel SA	Indicative Place
Squatters Arms Hotel SA	Indicative Place
St Agnes Anglican Church SA	Indicative Place
St Augustines Catholic Church and Cemetery (former) SA	Indicative Place
St Johns Anglican Church Ruin, Cemetery, Rectory and Original Church SA	Indicative Place
St Marys Catholic Church, Hall and Cemetery SA	Indicative Place
Statue of Sir Thomas Elder SA	Indicative Place
Statue of Sir Walter Watson Hughes SA	Indicative Place

Straining Shed (former) Islington Sewage Farm SA	Indicative Place
Sunnybrae Farm (former) SA	Indicative Place
Synagogue and Shops SA	Indicative Place
Tattersalls Club Building SA	Indicative Place
Taylors Bridge SA	Indicative Place
Temple Uniting Church SA	Indicative Place
The Angle SA	Indicative Place
The Levels Homestead and Stables SA	Indicative Place
The Oaks and Outbuildings SA	Indicative Place
Thebarton Mounted Police Barracks (former) SA	Indicative Place
Torrens Island Quarantine Station SA	Indicative Place
Two Retort Buildings and Stack (former) SA	Indicative Place
Two Wells Courthouse (former) SA	Indicative Place
Uniting Church Hall, Classrooms, Store, Cottage, former Manse SA	Indicative Place
Wittbers Hop Monument SA	Indicative Place
Woodroofes Factory Facade SA	Indicative Place
Workmans Cottages SA	Indicative Place
ANZ Bank SA	Registered
ANZ Bank (part) SA	Registered
Adelaide Arcade SA	Registered
Adelaide Bottling Cellar Building SA	Registered
Adelaide Bridge SA	Registered
Adelaide City Mission Hall (former) SA	Registered
Adelaide Club SA	Registered
Adelaide Electric Supply Company (former) SA	Registered
Adelaide Fruit and Produce Exchange Facades SA	Registered
Adelaide Gaol (former) SA	Registered
Adelaide Oval Scoreboard SA	Registered
Adelaide Oval and Surrounds SA	Registered
Adelaide Railway Station SA	Registered
Admaston SA	Registered
Administration Building Yatala Labour Prison SA	Registered
Administration Building and Bays 1 - 6 Running Shed SA	Registered
Albert Bridge (road bridge) SA	Registered
Alberton Railway Station Building SA	Registered
All Saints Anglican Church (former) SA	Registered
Allan Campbell Building SA	Registered
Angas Building SA	Registered
Angle Vale Bridge (Road Bridge) (former) SA	Registered
Art Gallery of South Australia SA	Registered
Austral Hotel and Shops SA	Registered
Ayers House SA	Registered
B Division Cell Block Yatala Labour Prison SA	Registered
Balmoral House SA	Registered
Bank of Adelaide (former) SA	Registered
Bank of Adelaide (former) SA	Registered
Barker Kindergarten SA	Registered

Barr Smith Library SA	Registered
Beehive Corner Building SA	Registered
Belmont House SA	Registered
Bertram House SA	Registered
Bishops Court SA	Registered
Bonython Hall SA	Registered
Botanic Chambers SA	Registered
Botanic Garden Toolshed SA	Registered
Botanic Hotel SA	Registered
Bowden Railway Station building and western platform SA	Registered
Britannia Hotel SA	Registered
British Hotel SA	Registered
Brocas SA	Registered
Brookman Hall SA	Registered
Burley Griffin Incinerator SA	Registered
CML Building SA	Registered
Carclew SA	Registered
Cathedral Hotel SA	Registered
Chapel to Former Destitute Asylum SA	Registered
Chelsea House and Outbuildings SA	Registered
Christ Church Anglican Church SA	Registered
Christ Church Ascension Window SA	Registered
Christ Church Rectory SA	Registered
Christ In Glory Window SA	Registered
City of Adelaide Historic Layout SA	Registered
Commonwealth Savings Bank of Australia (former) SA	Registered
Congregational Church (former) SA	Registered
Cross of Sacrifice / Stone of Remembrance SA	Registered
Currie Street Model School (former) SA	Registered
Customs Boarding Station (former) SA	Registered
Customs House including former Institute SA	Registered
Darnley House and Stable (former) SA	Registered
Deep Acres Flats SA	Registered
Divett Chambers SA	Registered
Dolphin Terrace SA	Registered
Dover Castle Hotel SA	Registered
Dr Helen Mayos House SA	Registered
Drinking Fountain SA	Registered
Dwelling SA	Registered
Dwelling SA	Registered
Dwelling SA	Registered
Dwelling and former Stables SA	Registered
Eagle Star Insurance Building (former) SA	Registered
Ebenezer Chapel (former) SA	Registered
Edmund Wright House SA	Registered
Elder Hall SA	Registered
Elder House SA	Registered
Elder Park Bandstand SA	Registered
Elders Wool Store SA	Registered

Facade of Old Royal Victoria Theatre SA	Registered
Fergusons Bonded and Free Stores (former) SA	Registered
Fort Glanville SA	Registered
Fort Glanville Conservation Park SA	Registered
Fort Largs Defensible Barracks (former) SA	Registered
Four Terrace Houses SA	Registered
Fowlers Lion Factory (former) SA	Registered
Freemasons Hall SA	Registered
Friends (Quakers) Meeting House SA	Registered
Gable House SA	Registered
Gawler Chambers SA	Registered
Girls Friendly Society Building (former) SA	Registered
Glanville Hall SA	Registered
Government House and Grounds SA	Registered
Grecian Shipwreck SA	Registered
Greenways Apartments SA	Registered
Hackney Bridge (Road Bridge) SA	Registered
Hartley Building SA	Registered
Hindmarsh Post Office SA	Registered
Historical Museum SA	Registered
Holy Trinity Anglican Church SA	Registered
Horse Tram Depot (former, part) SA	Registered
House SA	Registered
House SA	Registered
House SA	Registered
House SA	Registered
House SA	Registered
House SA	Registered
House SA	Registered
House SA	Registered
House (former) SA	Registered
Huntsmans Hotel (former) SA	Registered
Hylands SA	Registered
I H C Truck Sales SA	Registered
Incinerator (former) SA	Registered
Institute Building (former) SA	Registered
Islington Railway Apprentice School SA	Registered
Islington Railway Electrical Shop SA	Registered
Islington Railway Workshops Group SA	Registered
Johns Emporium (former) SA	Registered
Keith Sheridan Institute (former) SA	Registered
Kentish Arms Hotel SA	Registered
Kingsmead SA	Registered
Kosters Premier Pottery Ltd Bottle Kiln SA	Registered
Largs Pier Hotel SA	Registered
Lewis and Webb Building (former) SA	Registered
Lochend SA	Registered
Lutheran Seminary SA	Registered
Main Gates, Botanic Gardens SA	Registered
Malcolm Reid Emporium SA	Registered
Margaret Graham Nurses Home SA	Registered

Methodist Church (former) SA	Registered
Michell Residence Garden SA	Registered
Mitchell Building SA	Registered
Mitchell Gates and Fencing SA	Registered
Montefiore SA	Registered
Mortlock Library SA	Registered
Museum of Economic Botany SA	Registered
National Bank and Oxford Hotel SA	Registered
National Bank of Australasia (former) SA	Registered
Newmarket Hotel SA	Registered
North Adelaide Conservation Area SA	Registered
North Adelaide Railway Station SA	Registered
Norwood Primary School SA	Registered
Nurney House SA	Registered
Nurney House Atrium SA	Registered
Office Building SA	Registered
Offices SA	Registered
Offices (former) Dwelling SA	Registered
Offices and Shops SA	Registered
Old Lion Hotel and Brewery Complex SA	Registered
Old Mounted Police Barracks SA	Registered
Old Parliament House SA	Registered
Opal Field House SA	Registered
Palm House, Palms and Fountain SA	Registered
Parliament House SA	Registered
Piccadilly Cinema SA	Registered
Pilot Station (former) SA	Registered
Police Station SA	Registered
Police Station SA	Registered
Police Station and Court House (former) SA	Registered
Port Adelaide Historic Precinct SA	Registered
Port Adelaide Town Centre Conservation Area SA	Registered
Port Adelaide Town Hall SA	Registered
Port Dock Hotel SA	Registered
Powder Magazine (former) and Surrounding Walls SA	Registered
Prince Alfred College (original buildings) SA	Registered
Producers Hotel (former) SA	Registered
Queens College School House (former) SA	Registered
Queens Head Hotel SA	Registered
R Fricker and Company Ltd Building SA	Registered
RAA Building SA	Registered
Railway Hotel SA	Registered
Residence (former) SA	Registered
River Torrens (within Adelaide City) SA	Registered
Rose Garden Fountain SA	Registered
Roseneath SA	Registered
Row of Cottages SA	Registered
Royal Adelaide Hospital Historic Buildings Group SA	Registered
Royal Oak Hotel SA	Registered

Ruthven Mansions SA	Registered
Salisbury Explosives Factory (former) SA	Registered
Santiago Shipwreck SA	Registered
Savings Bank of South Australia (former) SA	Registered
Schoolroom to Former Mounted Police Barracks SA	Registered
Shop SA	Registered
Shop SA	Registered
Shop and Residences SA	Registered
Six Inch Breech - Loading Gun from HMCS Protector SA	Registered
Smithfield Magazine Area SA	Registered
South African War Memorial SA	Registered
South Australian Museum SA	Registered
St Andrews SA	Registered
St Andrews Anglican Church SA	Registered
St Bartholomews Anglican Church SA	Registered
St Bartholomews Anglican Church Hall SA	Registered
St Bartholomews Anglican Church Precinct SA	Registered
St Bartholomews Anglican Church Rectory SA	Registered
St Cyprians Anglican Church SA	Registered
St Cyprians Day School (former) SA	Registered
St Dominics Priory Chapel SA	Registered
St Johns Anglican Church SA	Registered
St Margaret of Scotland Anglican Church SA	Registered
St Margarets Hospital SA	Registered
St Margarets and Coach-House (former) SA	Registered
St Peters Anglican Cathedral SA	Registered
St Peters Anglican Church Office SA	Registered
St Peters College Group SA	Registered
St Vincent Chambers SA	Registered
Staff Training School Yatala Labour Prison SA	Registered
State Bank of South Australia SA	Registered
Steam Saw Mill (former) SA	Registered
Stock Exchange SA	Registered
Sturton Chapel and Graveyard SA	Registered
Sunnyside SA	Registered
T&G Building (former) SA	Registered
Tavistock Building (former) SA	Registered
Telegraph Station (former) SA	Registered
The Adelaide Park Lands SA	Registered
The Almonds SA	Registered
The Botanic Garden of Adelaide SA	Registered
The Cottage SA	Registered
The Grange SA	Registered
The Marines SA	Registered
Time Ball Tower SA	Registered
Tobacco Factory and Warehouse (former) SA	Registered
Torrens Lake Weir and Footbridge SA	Registered
Torrens Training Depot SA	Registered
Town Hall, War Memorial and Council Chambers SA	Registered

Tropical House SA	Registered
Two Blocks of Cottage Homes SA	Registered
Two Storey Shop (former) SA	Registered
Uniting Church SA	Registered
University Foot Bridge SA	Registered
Vale House SA	Registered
Violet Bank SA	Registered
Vosz Store Offices (former) SA	Registered
Walkley House SA	Registered
Warders Tower (No 1 Post) Yatala Labour Prison (former) SA	Registered
Warehouse (former) SA	Registered
Watch House, Government House SA	Registered
Water Tower SA	Registered
Waterhouse Chambers (former) SA	Registered
Weetunga SA	Registered
Westpac Bank SA	Registered
Wests Coffee Palace SA	Registered
Yarrabee SA	Registered
Yatala Powder Magazine Yatala Labour Prison SA	Registered

State and Territory Reserves [Resource Information]

Port Adelaide River, SA
Cobbler Creek, SA
Torrens Island, SA
Adelaide Dolphin Sanctuary, SA
Unnamed (No.HA308), SA
Outer Harbour To Aldinga, SA
Port Gawler, SA
Barker Inlet - St Kilda, SA
Fort Glanville, SA
St Kilda - Chapman Creek, SA

Invasive Species [Resource Information]

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

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

Red Fox, Fox [18]	Species or species habitat likely to occur within area

Plants

Asparagus asparagoides	
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]	Species or species habitat likely to occur within area
Chrysanthemoides monilifera	
Bitou Bush, Boneseed [18983]	Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana	
Broom [67538]	Species or species habitat likely to occur within area
Lycium ferocissimum	
African Boxthorn, Boxthorn [19235]	Species or species habitat may occur within area
Nassella neesiana	
Chilean Needle grass [67699]	Species or species habitat may occur within area
Olea europaea	
Olive, Common Olive [9160]	Species or species habitat likely to occur within area
Pinus radiata	
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]	Species or species habitat likely to occur within area
Rubus fruticosus aggregate	
Blackberry, European Blackberry [68406]	Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji	
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]	Species or species habitat may occur within area
Ulex europaeus	
Gorse, Furze [7693]	Species or species habitat likely to occur within area

Nationally Important Wetlands **[Resource Information]**

Port Gawler & Buckland Park Lake, SA
Barker Inlet & St Kilda, SA
Clinton, SA

Caveat

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

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

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

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

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

Only selected species covered by the following provisions of the EPBC Act have been mapped:
- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:
- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:
- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

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

Coordinates

138.52245
-34.83915,138.51561
-34.6598,138.59859
-34.6595,138.60394
-34.8338,138.52304
-34.83915,138.52245 -34.83915

Acknowledgements

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

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

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

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

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

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

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For more information

For more information, to make an enquiry or join the mailing list contact the Northern Connector project team.
Phone: 1300 793 458 (interpreter service available)
Email: dtei.northernconnector@sa.gov.au
Visit the website: www.infrastructure.sa.gov.au and then follow the prompts.

Για περισσότερες πληροφορίες γι' αυτό το πρόγραμμα οδοποιίας τηλεφωνήστε στο **1300 793 458**. Διαθέτουμε και διερμηνείς.

Se desiderate altre informazioni su questo progetto stradale telefonate al **1300 793 458**. Ci sono interpreti a disposizione.

Để có thêm thông tin về công trình đường bộ này xin hãy gọi điện thoại số **1300 793 458**. Sẽ có phiên dịch viên.

បើចង់ទទួលពត៌មានបន្ថែមទៀតអំពីគំរោងផ្លូវថ្នល់នេះ សូមទូរស័ព្ទមកលេខ **1300 793 458** មានអ្នកបកប្រែភាសាជូន។

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