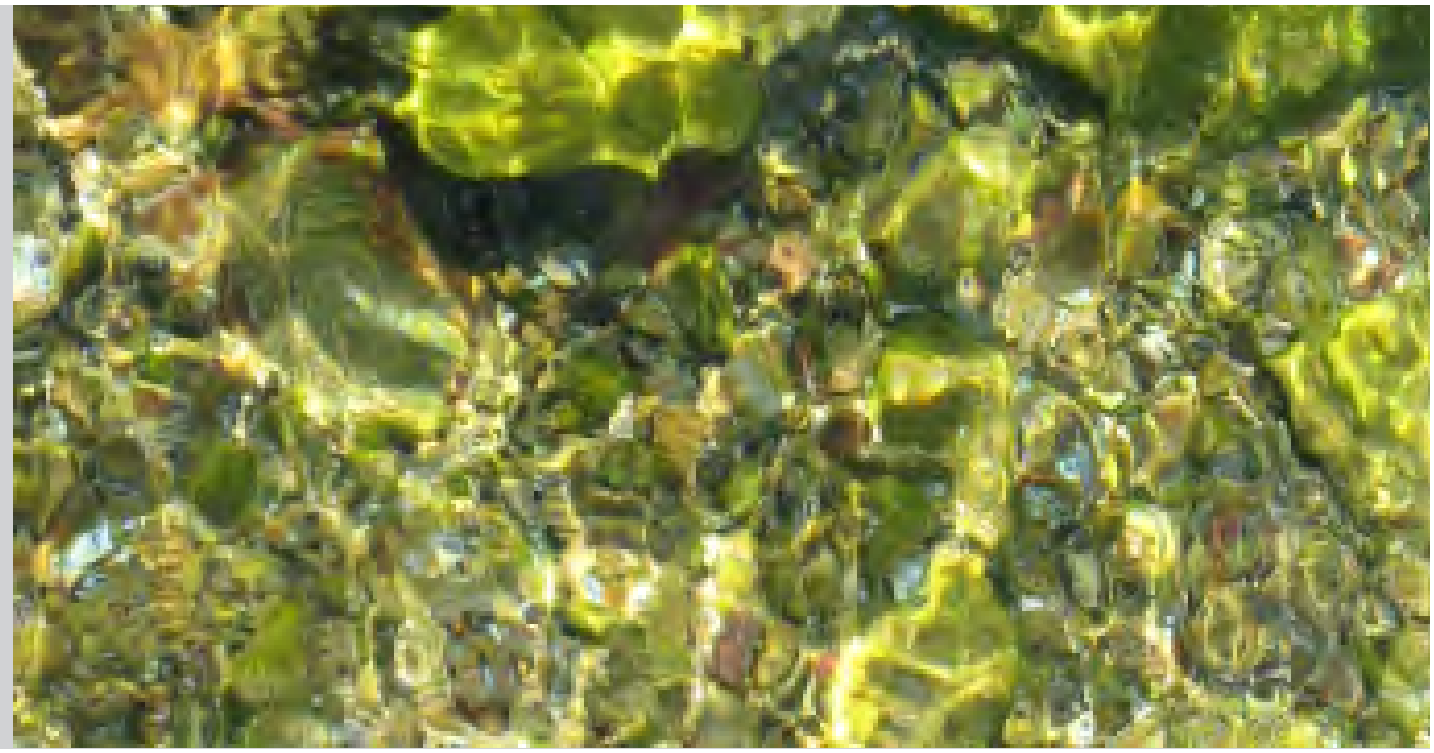

Homebush Bay Bridge | Environmental Assessment

APPENDIX L

Ecology assessment report

BIOSIS
RESEARCH

Homebush Bay Bridge: Terrestrial and Aquatic Flora and Fauna Assessment

August 2011

BIOSIS
RESEARCH

Report prepared for:

Fairmead Business Proprietary Ltd

Homebush Bay Bridge: Terrestrial and Aquatic Flora and Fauna Assessment

August 2011

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- Brett Morrisey (Consultant Botanist, Biosis Research).

ABBREVIATIONS/DEFINITIONS

CAMBA	China-Australia Migratory Bird Agreement
DECCW	NSW Department of Environment, Climate Change and Water (formerly NSW Department of Environment and Climate Change, now OEH)
DGR	Director-General Requirements
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (formerly Department of Environment, Heritage, Water and the Arts)
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
FM Act	*Fisheries Management Act* 1994
JAMBA	Japan-Australia Migratory Bird Agreement
LGA	Local Government Area
Locality	5 km radius of study area
MNES	Matter of National Environmental Significance
NPWS	NSW National Parks and Wildlife Service (now part of OEH)
OEH	Office of Environment and Heritage (formerly DECCW)
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SIS	Species Impact Statement
Study area	Area of direct impact and any areas subject to potential indirect impacts
Subject site	Area of direct impact
TSC Act	*Threatened Species Conservation Act* 1995
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies
var.	variety

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1.0 EXECUTIVE SUMMARY

Biosis Research Pty. Ltd. was commissioned by Fairmead Business Proprietary Ltd. to undertake a terrestrial and aquatic flora and fauna assessment for the proposed construction of a bridge over Homebush Bay between Wentworth Point and Rhodes Peninsula (hereafter referred to as 'the proposal').

This report assesses the ecological significance of threatened plant and animal species, endangered populations and Endangered Ecological Communities that occur, or have the potential to occur, within the area affected by the proposal, in accordance with the EP&A Act, TSC Act, FM Act and the EPBC Act.

The proposal will not involve the removal of any riparian vegetation along the banks of the Parramatta River or Homebush Bay. The foreshore within the subject site is highly modified. Planted Casuarina trees and Eucalypts occur over mown lawn on the western bank. Sparsely scattered native and exotic weeds occur on the eastern bank.

The TSC Act-listed EEC Coastal Saltmarsh is mapped as occurring within the study area and was recorded during field investigations. No threatened flora species were recorded during the field investigation however based on previous records adjacent to the study area and the habitat present, the TSC Act-listed threatened flora species Narrow-leafed Wilsonia is considered likely to occur within the study area.

The potential impacts from the construction of the bridge on Coastal Saltmarsh and Narrow-leafed Wilsonia is limited to contaminated sediment, dispersed during the construction of the bridge being deposited within foreshore vegetation. Part 3A Assessments of Significance conducted for the Coastal Saltmarsh EEC and Narrow-leafed Wilsonia concluded the proposal is unlikely to have a significant impact on this community or species.

No threatened terrestrial fauna species were recorded in the study area during the field investigation. However, potential habitat is considered to occur within the study area for 12 TSC Act-listed threatened fauna species and one endangered fauna population. Part 3A Assessments of Significance were conducted for Australasian Bittern (previously recorded in the study area), White-fronted Chat endangered population (previously recorded in the study area), and Terek Sandpiper (potential indirect impacts to limiting foraging habitat). These assessments concluded a significant impact by the proposal to be unlikely.

A Significant Impact Criteria Assessment was conducted for the Australasian Bittern (listed on both the EPBC and TSC Acts). The assessment concluded a significant impact by the proposal to be unlikely.

No migratory fauna species were recorded during the field survey however the study area is considered to support known and/or potential habitat for 37 migratory species. A Significant Impact Criteria Assessment was conducted for the migratory species and concluded a significant impact by the proposal to be unlikely.

A desktop survey of aquatic flora and fauna has been conducted within the study area. Four EPBC Act-listed turtles, three of which are also TSC Act-listed, were found to potentially occur in the study area. Such occurrences would be incidental and transient. The study area does not provide any breeding or limiting foraging resources for these species, as such, no Assessments of Significance were conducted. The EPBC Act and FM Act-listed Hairy Pipefish has previously been recorded in the study area, however no assessment requirements are triggered under this proposal.

The proposal is considered unlikely to have a significant impact on threatened species, populations or ecological communities, provided the recommendations (and associated mitigation measures) specified in Golder Associates' *Homebush Bay Bridge Contamination Management Plan for Proposed Bridge Construction* (2011) are implemented including:

- Minimise dispersal of sediment and associated contaminants.
- Minimise leaching of soil contaminants to groundwater and the receiving environment.

Table 2 of Golder Associates (2011) provides specific mitigation measures, including the use of a sediment boom and curtains; appropriate storage of fuels; and, disposal of construction waste appropriately to a licenced facility. These mitigation measures must be implemented to reduce the risks to terrestrial and aquatic flora and fauna, and their habitats.

A number of additional recommendations have been made to ensure any potential impacts on the flora and fauna of the study area are minimised, including:

- All construction machinery and stockpiles be contained within the nominated temporary construction sites.
- Appropriate sediment fencing be erected around construction sites to protect Homebush Bay and associated drainages.
- Minimise the dispersal of construction dust into Homebush Bay and nearby drainages.

- In situ water quality should be measured both inside and outside the silt curtains during construction to monitor effectiveness of control measures. Specific monitoring measures will be defined within the Construction Environmental Management Plan (CEMP) and must ensure turbidity (NTU) within the silt curtains has reached acceptable limits prior to their removal.

- Large woody debris encountered within the subject site during construction should be relocated elsewhere within the study area as opposed to being removed.

- Retain planted native tree species on the western bank of the subject site where possible. Protect all areas of retained native vegetation including scattered trees during construction by means of temporary fencing. Fencing must be installed before construction work commences.

- Replace trees that are removed during construction with native species of local provenance.

- Implement a weed control program to ensure soil disturbance resulting from the construction of the bridge does not exacerbate weed invasion within the subject site and adjoining vegetation communities.

2.0 INTRODUCTION

2.1 Background

Biosis Research Pty. Ltd. was commissioned by Fairmead Business Proprietary Ltd. to undertake a terrestrial and aquatic flora and fauna assessment for the proposed construction of a bridge over Homebush Bay between Wentworth Point and Rhodes Peninsula (hereafter referred to as 'the proposal').

This report evaluates the impact of the proposal in accordance with the requirements of the Part 3A Guidelines for Threatened Species Assessment (DEC & DPI 2005) of the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act) for threatened biota as listed under the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and the *Fisheries Management Act* 1994 (FM Act), and evaluates the impact of the proposal on Matters of National Environmental Significance (MNES) as listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) through consideration of the Significant Impact Guidelines (DEWHA 2009c).

2.1.1 Description and features of the study area

Homebush Bay is located on the southern side of the Parramatta River, on the north-eastern edge of Sydney Olympic Park, within the Canada Bay and Auburn Local Government Areas (LGA) (Figure 1).

The natural landscape of the Homebush Bay area has undergone an extensive transformation since the early 1800s with the land being used for cattle farming; salt production; woollen fabrics, skins and leather manufacturing; an abattoir; a can factory; the State Brickworks; residential development; chemical plants; and, waste dumping (UrbanFuturesGroup 2010). Land-filling took place over much of the Bay and all the wetlands. By 1988, an estimated 9 million cubic metres of waste and contaminated soils were spread over 400 ha within the 760 ha site. The waste included a variety of toxic substances including petroleum, unexploded ordnance, potential acid sulphate soils, polycyclic aromatic hydrocarbons, dredged sediments, municipal waste and industrial waste (including asbestos) (UrbanFuturesGroup 2010).

When Sydney was selected in 1993 to host the 2000 Olympics, significant and extensive remediation strategies were put in place for the suburb of Homebush Bay, the neighbouring suburb of Newington, and to some extent, Homebush Bay itself (UrbanFuturesGroup 2010). Following the 2000 Olympics, remediation has continued at Homebush Bay including the redevelopment and renewal of Rhodes Peninsula and Wentworth Point.

For the purposes of this assessment, the **subject site** (area of *direct* impact) is defined as the proposed bridge footprint and the temporary construction sites either side of the bridge (Figure 2). No naturally occurring vegetation occurs within the subject site; an area of mown lawn and planted trees occurs within the subject site on the Wentworth Point side.

Indirect impacts resulting from the disturbance of soil and sediments during bridge construction may extend further into the Bay and out into Parramatta River. Therefore, the total **study area** (subject site plus area of indirect impact) includes all of Homebush Bay and Parramatta River foreshore vegetation opposite the inlet to the Bay (Figure 2).

The **locality** is defined as the 5 km area surrounding the study area.

2.1.2 Proposed development

The Homebush Bay Bridge is proposed to be 11.5 m wide and approximately 455 m long. The bridge will be supported by five pylons spread across the Bay. Temporary construction sites will be established at both landing points of the bridge; the Wentworth Point side will cover an area of 0.74 ha and the Rhodes side will cover an area of 0.16 ha. The bridge would be designed to accommodate pedestrians, cyclists, public transport (bus) services and emergency services (UrbanFuturesGroup 2010).

The proposal would take place on land and over water that is under multiple ownership and management. The proposal would be undertaken within:

- Lot 122 DP1156412 on Wentworth Point.
- Lot 310 DP 1163025 on Rhodes Peninsula.
- Homebush Bay itself.

Construction of the bridge across the Bay will require that piles be driven through the soft sediment and into firmer ground. The construction techniques and accompanying environmental management process will be undertaken with minimal impact and disturbance upon the Bay and its sediments. Appropriate turbidity containment devices, ie. sediment boom and curtains, will be erected around piling areas to contain resuspended materials and minimise suspension of sediments and associated contaminants in the Bay (Golder Associates 2011).

2.2 Aims

The general aim of this report is to undertake a terrestrial and aquatic flora and fauna assessment of the study area and to determine the impact of the proposal on matters of conservation significance.

The specific aims are to:

- Conduct a literature review and database search for the study area focussing on threatened species, populations and ecological communities.
- Examine the nature, extent and condition of fauna habitats and vegetation associations within the study area, through a combination of desktop (aquatic and terrestrial) and field survey (terrestrial).
- Undertake targeted field surveys for habitat of threatened terrestrial species, populations and ecological communities listed under the schedules of the TSC and/or EPBC Acts that are known or likely to occur within the study area.
- Assess the potential and actual occurrence of flora and fauna species and populations of conservation significance, in particular, threatened species, populations and Endangered Ecological Communities.
- Map the locations of significant flora and fauna.
- Evaluate the impact of the proposal by undertaking impact assessments following the Part 3A Guidelines for Threatened Species Assessment (DEC & DPI 2005) of the EP&A Act for threatened biota as listed under the TSC Act and FM Act, including addressing the Director-General's Requirements (DGRs) for the proposal.
- Evaluate the impact on MNES listed under the EPBC Act for the proposal through consideration of the Significant Impact Guidelines for threatened biota and migratory species as outlined in *EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance* (DEWHA 2009c).
- Provide recommendations to minimise environmental impacts from the proposal on the natural environment, focusing on threatened species and their habitats.

3.0 LEGISLATIVE REQUIREMENTS

NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act)

The EP&A Act provides the statutory context for environmental assessment of the proposal and ultimately planning approval. The current proposal is to be assessed under Part 3A and other relevant provisions of the EP&A Act. One objective of the EP&A Act is to encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats. A second objective is to encourage the principles of ecologically sustainable development, including the precautionary principle as defined under the *Protection of the Environment Administration Act* 1991.

Part 3A of the EP&A Act provides a single assessment and approval regime for major State infrastructure projects, development that was previously classified as State significant development and other projects, plans or programs declared by the Minister for Planning. The Director-General has prepared DGRs for the environmental assessment after consulting with relevant public authorities, such as the Sydney Olympic Park Authority and NSW Maritime. Approved major projects are exempt from having to obtain various approvals normally required for developments, and are not required to prepare a Species Impact Statement (SIS). The Minister for Planning is the consent authority for all major projects and critical infrastructure assessed under Part 3A.

***Threatened Species Conservation Act* 1995 (NSW)**

The TSC Act protects all threatened plants and animals native to NSW (with the exception of fish and marine plants). It provides for the identification, conservation and recovery of threatened species and their populations and communities. It also aims to reduce the threats faced by those species.

If a planned development or activity is likely to have an impact on a threatened species, population or ecological community this must be taken into account in the development approval process. In some cases, the Minister for the Environment will also need to be consulted.

***Fisheries Management Act* 1994 (NSW)**

The object of the FM Act is to conserve threatened species, populations and ecological communities of fish and marine vegetation native to NSW and to promote ecologically sustainable development, including the conservation of biological diversity. It also aims to reduce the threats faced by native fish and marine vegetation in NSW.

As with the TSC Act and terrestrial species (see above), if a planned development or activity is likely to have an impact on an aquatic threatened species, population or ecological community this must be taken into account in the development approval process. In some cases, the Minister for the Environment will also need to be consulted.

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The EPBC Act is a Commonwealth mechanism that requires proposed actions to be assessed in terms of their potential impact upon "Matters of National Environmental Significance" (MNES). MNES currently listed under the EPBC Act are:

- World Heritage properties.
- Natural heritage places.
- Wetlands of international importance (Ramsar wetlands, CAMBA, JAMBA and ROKAMBA).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).

Where a potential impact on a MNES is likely to occur as a result of a proposed action, the significance of that impact must be assessed. Guideline criteria for determining whether an impact is significant are provided under the Act. Where a proposed action will, or is likely to, have a significant impact on a MNES, a Referral to the Commonwealth Environment Minister must be prepared. The purpose of the Referral is to determine whether a proposed action requires approval and/or controls under the EPBC Act.

4.0 METHODOLOGY

The study area was inspected on 28 March 2011 by a zoologist and botanist. The general condition of the site was assessed and observations made of plant communities, habitats and plant and animal species (as detailed below). During the site visit the weather was cloudy with showers, intermittent sunny periods, an occasional breeze, and approximately 23^{o}C.

4.1 Taxonomy

The plant taxonomy (method of classification) used in this report follows the most recent Flora of New South Wales (Harden 1990; Harden 1992; Harden 1993; Harden 2002). In the body of this report plants are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the scientific name only. Common and scientific names are included in the Appendices.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (DEWHA 2009a). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only. Common and scientific names are included in the Appendices.

4.2 Literature and database review

A full list of the documents used to prepare this report is located in *References*. However, a number of ecological studies relevant to the study area include:

- *Parramatta River Regional Environmental Study Open Space and Recreation Issue Paper 2: Natural Systems* (Department of Environment and Planning 1986).
- *Homebush Bay Development Guidelines Volume 1: Environment Strategy* (Olympic Co-ordination Authority 1995).
- *Five Sentinel Species: Restoration Ecology at Millennium Parklands* (Olympic Co-ordination Authority 2000).
- *A survey of the estuarine benthic fauna of Homebush Bay, Parramatta River, NSW* (Robinson *et al.* 1983).
- *Fish Study*. In: *Homebush Bay Ecological Studies 1993-1995* (Smith *et al.* 1996).

The following database searches were conducted:

- Records of threatened species, populations and ecological communities were obtained from the OEH Atlas of NSW Wildlife from within a 10 km radius of the study area, using the Sydney and Penrith 1:100,000 map sheets. The extracted data from the map sheets were dated January 2011.
- Records of MNES listed on the EPBC Act were obtained from the DSEWPaC Online EPBC Protected Matters Database from within a 10 km radius of the study area. This search was conducted in March 2011.
- Records of threatened and migratory birds occurring within 10 km of the study area were obtained from Bird's Australia's Atlas of Australian Birds. This search was conducted in March 2011.
- Records of threatened fish were reviewed through the NSW Fisheries Database and other aquatic fauna through the OEH Cumberland and Pittwater (Part B) CMA databases. These database searches were conducted in May 2011.

4.3 Flora survey

Plant species and their habitat were surveyed by undertaking general habitat assessments and targeted searches for threatened species previously recorded within the locality. A species inventory for the site was compiled and noxious weeds recorded.

4.3.1 Flora habitat assessment

The condition of the vegetation was assessed according to the degree to which it resembled relatively natural, undisturbed vegetation using the following criteria:

- species composition (species richness, degree of weed invasion).
- vegetation structure (representation of each of the original layers of vegetation).

The four categories used to evaluate general vegetation community condition were Good, Moderate, Poor and Unnatural as detailed below:

Good: containing a high number of indigenous species; no weeds present or weed invasion restricted to edges and track margins; vegetation community contains original layers of vegetation; vegetation layers (ground, shrub, canopy etc.) are intact.

Moderate: containing a moderate number of indigenous species; moderate level of weed invasion; weeds occurring in isolated patches or scattered throughout;

one or more of original layers of vegetation are modified; vegetation layers (ground, shrub, canopy etc.) are largely intact.

Poor: containing a low number of indigenous species; high level of weed invasion; weeds occurring in dense patches or scattered throughout; one or more of the original layers of vegetation are highly modified; one or more original vegetation layers (ground, shrub, canopy etc.) are modified or missing.

Unnatural landscape: highly modified landscape containing few or no indigenous species; exotic species dominant; original native vegetation layers removed; natural soil profile disturbed; unable to be regenerated to natural condition; high input intervention required to revegetate.

4.4 Terrestrial fauna survey

Terrestrial animal species and their habitats were surveyed by undertaking general habitat assessments and active searching and listening, as well as recording incidental observations.

4.4.1 Terrestrial fauna habitat assessment

Terrestrial fauna habitat assessments were based on the presence of one or more of the following features:

- vegetation cover.
- specific feed trees.
- size range and abundance of tree hollows.
- rock outcrops, overhangs or crevices.
- freestanding water bodies, ephemeral drainage or seepage areas.
- disturbances, including weed invasion, clearing, rubbish dumping or fire.
- potential foraging, nesting or roosting resources.
- connectivity to off site habitats.
- surrounding habitat.

The three categories used to evaluate habitat value were Good, Moderate or Poor, as detailed below:

Good: ground flora containing a high number of indigenous species; vegetation community structure, ground, log and litter layer intact and undisturbed; a high

level of breeding, nesting, feeding and roosting resources available; a high richness and diversity of native animal species.

Moderate: ground flora containing a moderate number of indigenous species; vegetation community structure, ground log and litter layer moderately intact and undisturbed; a moderate level of breeding, nesting, feeding and roosting resources available; a moderate richness and diversity of native fauna.

Poor: ground flora containing a low number of indigenous species, vegetation community structure, ground log and litter layer disturbed and modified; a low level of breeding, nesting, feeding and roosting resources available; a low richness and diversity of native animal species.

4.5 Aquatic survey

The aquatic habitat assessment was a desktop based assessment only. For the purpose of this report, descriptions of aquatic habitat are based on:

- Review of previous and relevant aquatic ecology studies and reports.
- Analysis of aerial imagery.
- Analysis of topographical maps.
- Examination of available photos of the study area.
- Extrapolation of information from the terrestrial ecology field surveys to the desktop aquatic assessment.

4.5.1 Aquatic habitat and condition assessment

The habitat assessment was based on the presence and condition of the following features:

- Pool substrate characterisation.
- Pool variability.
- Channel flow status.
- Bank vegetation.
- Bank stability.
- Width of riparian zone.
- Epifaunal substrate/available cover.

4.6 Limitations

Some plant species that occur within the locality are annuals (completing their life cycle within a single season) and are present only in the seed bank for much of the year. Other plant species are perennial, but are inconspicuous unless flowering or in fruit. Furthermore, some animal species are only detectable at certain times of the year. Therefore, as the field surveys were conducted over one day in March it is likely that some species that are present on the site were not detected.

Access to the subject site on the western foreshore was limited and this part of the subject site was viewed through a fence which allowed a general assessment of the area but not a detailed assessment. Similarly, access was restricted to the eastern foreshore due to site remediation activities and was viewed from public parkland south of the site accessed from Shoreline Drive as well as from the end of Gauthorpe Street.

The study area (area of indirect impact) is significantly larger than the subject site (area of direct impact) as this includes foreshore vegetation to the north and south of the proposed works. While the terrestrial vegetation and habitats on the northern and southern foreshores was observed, limited survey time did not allow a detailed flora or fauna survey of these areas.

Despite these limitations, the assessment of impact is based on the presence or absence of suitable habitat for threatened flora and fauna, and as such, species are taken into account during the assessment even though they may not have been detected during the survey.

Assessment of aquatic ecology is based on a desktop study only. Therefore, no fish trapping, macroinvertebrate surveys or water quality data was gathered as part of this assessment. The condition of marine vegetation (ie. information on type, species, shoot density and/or percentage cover) was not obtained. The potential presence of aquatic fauna, including threatened species, is therefore based on assumptions in relation to the presence of potential habitat as determined by the desktop assessment. Furthermore, assessment of any potential changes in water quality within Homebush Bay or the Parramatta River is not included in this report.

The NSW Fisheries Database data and records are not comprehensive. The Fisheries Database only contains information owned by Department of Primary Industries (DPI), NSW. Therefore the use of expected distributions of threatened aquatic species is a better measure of the potential occurrence of threatened species utilising the study area.

5.0 RESULTS

A list of the flora and fauna recorded during the current survey is provided in Appendix 1 and Appendix 2 respectively.

5.1 Plant communities

5.1.1 Vegetation mapping

The DECCW 2009 Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area (Vol 1 & 2) mapping as shown Figure 3 identifies four native vegetation communities occurring within the study area:

- Sydney Foreshore Shale Forest.
- Estuarine Swamp Oak Forest.
- Estuarine Saltmarsh.
- Estuarine Mangrove Forest.

Three of these vegetation communities are listed under the TSC Act as Endangered Ecological Communities (EEC):

- Sydney Foreshore Shale Forest corresponds with the EEC Sydney Turpentine-Ironbark Forest (NSW Scientific Committee 1998b).
- Estuarine Swamp Oak Forest corresponds with the EEC Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (NSW Scientific Committee 2004b) (referred to hereafter as Swamp Oak Forest).
- Estuarine Saltmarsh Corresponds with the EEC Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (NSW Scientific Committee 2004a) (referred to hereafter as Coastal Saltmarsh).

The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area (Vol 1 & 2) mapping shown in Figure 3 does not show a vegetation community occurring within the subject site.

5.1.2 Current survey

Subject site

The native vegetation within the subject site has been removed including all structural layers. The vegetation within the subject site is limited on both the east and west facing foreshores by constructed banks.

The western foreshore of the subject site, shown in Plate 1 is a concrete and stone bank reaching to the water line. No naturally occurring native plants were recorded during the current survey. Two species of planted native trees, River Sheoak (*Casuarina cunninghamiana*) and a *Eucalyptus* species were recorded on the western foreshore of the subject site. Other species recorded were annual weeds or exotic grasses.

The eastern foreshore shown in Plate 2 is a sandstone boulder constructed bank reaching to the waterline. No tree or shrub species are present within the subject site. The vegetation is dominated by annual weeds and exotic grasses. Two native species present amongst the sandstone boulders are Fishweed (*Einadia trigonos*) and Native Spinach (*Tetragonia tetragonioides*).

On the basis of the lack of natural structural layers of vegetation and high occurrence of weed species, the vegetation at both the eastern and western banks of the subject site is assessed as being an Unnatural Landscape.

Study area

The current survey verified the occurrence of the EEC Coastal Saltmarsh within the study area. This vegetation occurred in a narrow strip edged by mangroves along the edge of a walking path leading out to the Shipwreck Viewing Platform located to the south of the subject site in Homebush Bay. Coastal Saltmarsh of the study area is shown in Plate 3.

Characteristic species as listed in the NSW Scientific Committee Final Determination for Coastal Saltmarsh (NSW Scientific Committee 2004a) dominate the saltmarsh vegetation within the study area and include: Samphire (*Sarcocornia quinqueflora*), Sea Rush (*Juncus kruassii*), Knobby Club Rush (*Fecinia nodosa*), Prickly Couch (*Zoysia macrantha*) and Seablite (*Sueda australis*). Plate 4 shows typical vegetation with the area of Coastal Saltmarsh.

Bush regeneration work is evident within areas of Coastal Saltmarsh. Although weed species occur throughout the Coastal Saltmarsh including *Atriplex prostrata*, the vegetation is dominated by native species. The community is assessed as being in a Moderate condition. Revegetation was evident in areas adjoining the Coastal Saltmarsh, native species include: Fine Leaved Ironbark

(*Eucalyptus crebra*), Bangalay (*Eucalyptus botryoides*), Stiff Bottlebrush (*Callistemon rigidus*) and Boobialla (*Myoporum acuminatum*).

The area of Swamp Oak Forest EEC mapped by DECCW 2009 within the study area was inspected. Following survey this vegetation is not considered as being representative of the Swamp Oak Forest EEC as described in the NSW Scientific Committee Final Determination (NSW Scientific Committee 2004b). Swamp Oak (*Casuarina glauca*) is present, however this does not dominate the canopy and occurs amongst planted *Eucalyptus* spp. with planted native shrubs and exotic grasses comprising the mid story and ground layer. The condition of this vegetation community is assessed as being Poor.

Estuarine Mangrove Forest was observed during the current survey. This was dominated by Grey Mangrove (*Avicinnea marina)* with Native Spinach (*Tetragonia tetragonoides*) occurring at the edges. This vegetation community was assessed as being in Good condition. Estuarine Mangrove Forest occurring within the study area is show in Plate 5.

Sydney Foreshore Shale Forest is mapped as occurring along the northern bank of the Parramatta River opposite Homebush Bay (Figure 3). Only Estuarine Mangrove Forest was observed along the northern foreshore within the study area.

5.2 Flora

A list of plant species recorded from the subject site and within the study area is provided in Appendix 1.

A total of 12 plant species were recorded from the subject site (eastern and western foreshore), comprising three (25%) locally indigenous species and nine (75%) exotic species. The flora species inventory for the subject site is a reflection of the highly modified and unnatural landscapes of the eastern and western foreshores.

None of the exotic species recorded in the study area are listed under the *Noxious Weeds Act* 1993 or the *Noxious Weeds Amendment Act* 2005 for the Auburn and Canada Bay LGA's.

5.2.1 Significant flora

A total of 33 threatened plant species or their habitat have been previously recorded within a 10 km radius of the study area (OEH Atlas of NSW Wildlife and DSEWPaC Online EPBC Database) (Table 1). Of these, 30 species are listed under the TSC Act and 22 under the EPBC Act. Additionally two threatened flora populations occur within a 10 km radius of the study area. Records of 28

threatened plant species and locations of plants from the two threatened populations, occurring within 10 km of the study area, are shown in Figure 4.

No threatened plant species were recorded in the study area during the current survey. However based on the habitat assessment and as shown in Table 1, Narrow-leafed Wilsonia (*Wilsonia backhousei*) has the potential to occur within the study area. Narrow-leafed Wilsonia is listed as vulnerable on the TSC Act and has been recorded immediately adjacent to the study area previously (Figure 4). *Dillwynia tenuifolia* has also been recorded on the boundary of the study area. However this species requires habitat above the shoreline and therefore is unlikely to be impacted by the proposal.

Table 1: Terrestrial flora listed on the TSC and/or EPBC Acts that may occur in the local area

Key: 1) Listed on the EPBC Act as Extinct (X), Endangered (E) or Vulnerable (V)
2) Listed on the TSC Act as Endangered (E1), Endangered Population (E2), Presumed Extinct (E4) or Vulnerable (V)

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Campanulaceae	*Wahlenbergia multicaulis* Tadgell's Bluebell	-	E2	Grows in forest, woodland and grassland, chiefly in coastal and tablelands districts south from Sydney and the Blue Mountains, west along the Murray River to Mathoura (Harden 1992). This listing covers 13 known sites, two of which are in northern Sydney on the Hawkesbury soil landscape (Thornleigh and Mt Ku-Ring-Gai) with the remainder in inner-western Sydney on the Villawood soil landscape (Rookwood, Chullora, Bass Hill, Bankstown, Georges Hall, Campsie, South Granville and Greenacre). Found in damp, disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. In Hornsby LGA it occurs in or adjacent to sandstone gully forest. In Western Sydney it is found in remnants of Cooks River/ Castlereagh Ironbark Forest (DEC 2005Œ).	No
Convolvulaceae	*Wilsonia backhousei* Narrow-leafed Wilsonia	-	V	In NSW *Wilsonia backhousei* is found in the Southern Rivers and Sydney Metropolitan Catchment Area, specifically on the coast between Mimosa Rocks National Park and Wamberal north of Sydney (Nelson's Lake, Potato Point, Sussex Inlet, Wowly Gully, Parramatta River at Ermington, Clovelly, Voyager Point, Wollongong and Royal National Park) (DEC 2005). This is a species of the margins of salt marshes and lakes, both coastal and inland, chiefly in the Sydney district, also common at Jervis Bay (Harden 1992). Flowering occurs in spring and summer (DEC 2005).	Yes

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Dilleniaceae	*Hibbertia superans* -	-	E1	Occurs in Sydney Metropolitan and Hawkesbury/Nepean Catchment. In Sydney it is known from Castle Hill to South Maroota, but also occurs at Mt Boss, Kempsey (NSW Scientific Committee 2001b). Occurs in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides. Most occurrences are in or near Shale/Sandstone Transition Forest and are often associated with other threatened flora including *Pimelea curviflora var. curviflora, Darwinia biflora, Epacris purpurascens var. purpurascens, Leucopogon fletcheri subsp. fletcheri, Acacia bynoeana, Eucalyptus sp. Cattai* and *Persoonia hirsuta*. Flowering time is July to December (DEC 2005u).	No
Epacridaceae	*Epacris purpurascens var. purpurascens* Epacris purpurascens var. purpurascens	-	V	Located in the Hawkesbury/Nepean, Hunter/Central Rivers/and Sydney Metropolitan catchment authority region - from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South (DEC 2005l). *Epacris purpurascens var. purpurascens* grows in Dry Sclerophyll forests, scrub and swamps (Harden 1992). Specifically this species is thought to require wet heath vegetation (T. James pers. comm.). Characteristically found in a range of habitat types, most of which have a strong shale soil influence. These include ridge top drainage depressions supporting wet heath within or adjoining shale cap communities (including Shale Sandstone Transition Forest, Turpentine Ironbark Margin Forest, Stringybark/Scribbly Gum Woodland and Scribbly Gum/Grey Gum/Red Bloodwood Woodland). Also occurs in riparian zones draining into Sydney Sandstone Gully Forest, shale lenses within sandstone habitats and colluvial areas overlying or adjoining sandstone or tertiary alluvium (NPWS 2002d).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Fabaceae (Faboideae)	*Dillwynia tenuifolia* -	-	V	The core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek, Luddenham and South Maroota. Disjunct localities include: the Bulga Mountains, Kurrajong Heights and Woodford (DEC 2005j). In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland (DEC 2005j). *Eucalyptus fibrosa* is likely to be a dominant canopy species. *Eucalyptus globoidea, E. longifolia, E. parramattensis, E. sclerophylla* and *E. sideroxylon* may also be present or codominant (NPWS 2002b). Flowering occurs sporadically from August to March depending on environmental conditions. Surveys should initially concentrate in open areas within woodland/open forest, particularly targeting areas possessing laterised gravels, or low rises which have a well developed or regenerating low shrub layer (NPWS 2002b).	No
Fabaceae (Faboideae)	*Pultenaea pedunculata* Matted Bush-pea	-	E1	Restricted to the Cumberland Plain and near Merimbula where it grows in dry sclerophyll forest and disturbed sites (Harden 2002). In western Sydney it occurs in three locations: within industrial and residential areas at Villawood and Prestons, and north-west of Appin between the Nepean River and Devines Tunnel No. 2(NPWS 2002c). Associated with Hawkesbury/Nepean, Southern Rivers and Sydney Metropolitan Catchment areas. It occurs in clay or sandy clay soils (Blacktown soil landscape) on Wianamatta shale, close to localised patches of Tertiary alluvium (Liverpool) or the shale/sandstone influence (west of Appin) (DEC 2005,). At all sites there is a lateritic influence in the soil with characteristic ironstone gravels present (DEC 2005,). This species is known to occur in remnants of Cooks River Clay Plain Scrub Forest (James *et al.* 1999).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Fabaceae (Mimosoideae)	*Acacia pubescens* Downy Wattle	V	V	*Acacia pubescens* is found in Sydney Metropolitan, and Hawkesbury/Nepean Catchment Management Region, with concentrated populations around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon (NPWS 2003a). It occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravelly soils, often with ironstone. The species occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland (NPWS 2003a). Flowers from August to October. The pods mature in October to December (NPWS 2003a).	No
Fabaceae (Mimosoideae)	*Acacia terminalis ssp. terminalis* Sunshine Wattle	E	E1	Occurs in the Sydney Metropolitan Catchment Authority Region. It has very limited distribution between Botany Bay to the northern foreshore of Port Jackson (DEC 2005a). *Acacia terminalis subsp. terminalis* occurs in Coastal scrub and Dry Sclerophyll woodland on sandy soils. Most sites where it occurs are highly modified or disturbed due to surrounding urban development (DEC 2005a). Seed viability is high and recruitment occurs mainly after fire. Seeds mature in November and are dispersed by ants. Flowers in autumn (DEC 2005a).	No
Grammitaceae	*Grammitis stenophylla* Narrow-leaf Finger Fern	-	E1	Occurs in eastern NSW in the Sydney Metropolitan, Hawkesbury/Nepean, and Northern Rivers Catchment. It has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabrai (DEC 2005q). Grows in small colonies in moist places, usually on rocks or trees near streams in rainforest and moist eucalypt forest (DEC 2005q). Common vegetation communities associated are Dry Sclerophyll Forest, Forested wetlands, Freshwater wetlands, Rainforests, and wet sclerophyll forests (DEC 2005q).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Lamiaceae	*Prostanthera marifolia* -	X	E4	Grows in sclerophyll forest and woodland, usually near the coast, in sandy loamy soils, overlying sandstone; confined to the Sydney district (1992). This species was previously recorded from the Sydney harbour region and was presumed extinct. All attempts to recollect this species were unsuccessful until 2001. Woodland dominated by *Eucalyptus sieberi* and *Corymbia gumnifera*. In deeply weathered clay soil with ironstone nodules. NSW subdivisions: CC	No
Lobeliaceae	*Hypsela sessiliflora* -	X	E1	Grows in damp areas on the Cumberland Plain (Harden 1992). Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as *Cynadon dactylon* (DEC 2005v).	No
Myrtaceae	*Callistemon linearifolius* -	-	V	Occurs chiefly from Georges River to the Hawkesbury River where it grows in dry sclerophyll forest (Harden 2002), open forest, scrubland (Fairley and Moore 2000) or woodland on sandstone. Found in damp places, usually in gullies (Robinson 1994). Flowers in Spring.	No
Myrtaceae	*Darwinia biflora* -	V	V	Occurs in the following Catchment Management Authority Regions - Hawkesbury/Nepean and Sydney Metropolitan. Is found on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Most sites are on the Lucas Heights Soil Landscape where this intergrades with either the Gymea or the Hawkesbury Soil Landscapes (NPWS 2003b). Vegetation communities include: Sydney Coastal Dry Sclerophyll Forest and Sydney Coastal Heaths. Associated overstorey species include *Eucalyptus haemastoma, Corymbia gummifera* and/or *E. squamosa* (NPWS 2003b). Prefers moist shallow depressions (Robinson 1994). Flowering occurs throughout the year but is concentrated in autumn, with mature fruits being produced from May to August.	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Myrtaceae	*Darwinia peduncularis* -	-	V	Occurs in the Hawkesbury/Nepean Catchment area, from Hornsby to Hawkesbury River and west to near Glen Davis. It grows in dry sclerophyll forest on sandstone hillsides and ridges (Harden 2002). Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone. Flowers in winter to early spring (DEC 2005h).	No
Myrtaceae	*Eucalyptus camfieldii* Heart-leaved Stringybark	V	V	Restricted distribution in a narrow band from Waterfall in the south to Raymond Terrace in the north (DEC 2005m). Localised and scattered distribution in the following Catchment Management Authority Regions - Hawkesbury/Nepean, Hunter/Central Rivers, and Sydney Metropolitan. Grows in Dry Sclerophyll forest and coastal heath, in shallow sandy soils overlying exposed Hawkesbury sandstone. Occurring mainly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of *Eucalyptus. oblonga, E. capitellata* and *E. haemastoma* (DEC 2005m). Flowering period is irregular, flowers recorded throughout the year (DEC 2005m).	No
Myrtaceae	*Eucalyptus scoparia* Wallangarra White Gum	V	E1	Occurs in Queensland and recently found in NSW on the northern tablelands where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland (NSW Scientific Committee 2002b).	No
Myrtaceae	*Leptospermum deanei* -	V	V	The species grows on sandy alluvial soils and sand over sandstone on lower hill slopes and riparian zones. Associated vegetation communities include riparian shrubland, woodland and open forest. Associated species in riparian scrub are *Tristaniopsis laurina* and *Baeckea myrtifolia*; woodland species include *Eucalyptus haemastoma*; and open forest species are *Angophora costata, Leptospermum trinervium,* and *Banksia ericifolia* (DEWHA 2008a). This species occurs within the Hawkesbury/Nepean and Sydney Metro (NSW) Natural Resource Management Regions (DEWHA 2008a). Main occurrences around Hornsby, Warringah, Ku-ring-gai and Ryde LGAs (DEC 2005w). Flowers October-November. Probably killed by fire (DEC 2005w).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Myrtaceae	*Melaleuca deanei* Dean's Melaleuca	V	V	*Melaleuca deanei* occurs in Catchment Management Regions Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan. Distinctly it occurs in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas (DEC 2005{). The species grows in wet heath on sandstone (Harden 1991) and Dry Sclerophyll Forests. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate (DEC 2005{).	No
Myrtaceae	*Syzygium paniculatum* Magenta Lilly Pilly	V	V	Subtropical and littoral rainforest on sandy soils or stabilised dunes near the sea (Harden 1991). Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (DEC 2005ˆ). The species occurs in the following Catchment Authority Regions - Hunter/Central Rivers, Hawkesbury/Nepean, Sydney Metropolitan, and Southern Rivers.	No
Myrtaceae	*Triplarina imbricata* -	E	E1	Found only in a few locations in the ranges south-west of Glenreagh and near Tabulam in north-east NSW (DEC 2005‹). Also dubiously recorded from Parramatta (before 1810) . Habitat is along watercourses in low open forest with Water Gum (*Tristaniopsis laurina*).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Orchidaceae	*Caladenia tessellata* Tessellated Spider Orchid	V	E1	*Caladenia tessellata* is found in the following Catchment Management Regions Sydney Metropolitan, Southern Rivers, Hawkesbury/Nepean, and Hunter/Central Rivers. Currently known from three disjunct areas: Braidwood on southern tablelands, Ulladulla on the south coast and three populations in Wyong area on the Central Coast (DEC 2005f). It is generally found in grassy, dry sclerophyll forests/woodland, particularly those associated with clay loam, or sandy soils. However, there is one population at Braidwood in lowland on stony soil (DEC 2005f). This species only grows in very dense shrubbery in coastal areas (Bishop 1996). Flowers appear between September and November, but generally late September or early October in extant southern populations (DEC 2005f).	No
Orchidaceae	*Cryptostylis hunteriana* Leafless Tongue Orchid	V	V	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts (Harden 1993) but has also been recorded on steep bare hillsides (Bishop 1996). Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland (Bell 2001). This species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera* and *Allocasuarina littoralis;* appears to prefer open areas in the understorey of this community and is often found in association with the *Cryptostylus subulata* (DEC 2005g). It occurs in the following Catchment Management Regions Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers and Southern Rivers.	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Orchidaceae	*Genoplesium baueri* Bauer's Midge Orchid	-	V	This terrestrial orchid species grows in open sclerophyll forest or moss gardens on sandstone. Typically the habitat is a drier heathy forest (Harden 1993) (Bishop 1996). The species has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Flowers Dec - Mar (DEC 2005n).	No
Orchidaceae	*Pterostylis saxicola* Sydney Plains Greenhood	E	E1	Restricted to western Sydney between Freemans Reach in the north and Picton in the south (Hawkesbury/Nepean and Sydney Metropolitan Catchment) (DEC 2005Š). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils (DEC 2005Š). All species of *Pterostylis* are deciduous and die back to fleshy, rounded underground tuberoids. The time of emergence and withering has not been recorded for this species, however flowering occurs from October to December and may vary due to climatic conditions. The above ground parts of the plant whither and die following seed dispersal and the plant persists as a tuberoid until the next year (DEC 2005Š).	No
Poaceae	*Bothriochloa biloba* Lobed Blue-grass	V	-	Found in woodland on nutrient poor soils (Harden 1993). This species has a strong preference for heavier textured soils and has previously been recorded on volcanic soils. Restricted levels of grazing and growth of *Aristida ramosa* have been found to cause reduction and exclusion of this species (Bean 1999).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Poaceae	*Deyeuxia appressa* Deyeuxia appressa	E	E1	Only occurs in Sydney Metropolitan Catchment Region. A highly endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct (DEC 2005i). Given that *D. appressa* hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology. Flowers spring to summer and is mesophytic (grows in moist conditions) (DEC 2005i).	No
Proteaceae	*Persoonia hirsuta* Hairy Geebung	E	E1	Occurs from Gosford to Royal NP and in the Putty district from Hill Top to Glen Davis where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) or rarely on shale (NSW Scientific Committee 1998a). Two subspecies are recognised, *P. hirsuta ssp. hirsuta* (Gosford to Berowra and Manly to Royal NP) and *P. hirsuta ssp. evoluta* (Blue Mountains, Woronora Plateau and Southern Highlands). Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone and shale-sandstone transition areas (DEC 2005}).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Proteaceae	*Persoonia nutans* Nodding Geebung	E	E1	Occurs in Hawkesbury/Nepean and Sydney Metropolitan Catchment. Restricted to the Cumberland Plain between Richmond in the north and Macquarie Fields in the south. Core distribution occurs within the Penrith LGA, and to a lesser extent, Hawkesbury LGA. Small populations also occur in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs (DEC 2005~). Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland (DEC 2005~). *P. nutans* also occurs on Shale/Gravel Transition Forest and Cooks River Castlereagh Ironbark Forest (DEC 2005~). In Castlereagh Scribbly Gum Woodlands it is found in open woodland with dominant overstorey species being *Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora*. The Agnes Banks Woodlands have a similar array of tree species, with the addition of *Banksia serrata* and *Banksia aemula* (DEC 2005~). *Persoonia nutans* is found on the Agnes Banks and Berkshire Park soil landscapes. Drainage appears to influence the distribution of *P. nutans* as the species is more common on the deeper sands at Agnes Banks. At other locations on the Cumberland Plain it occurs on low rises as opposed to swales or other low lying areas (DEC 2005~).	No
Rhamnaceae	*Pomaderris prunifolia* Pomaderris prunifolia	-	E2	Known from only three sites within the listed local government areas, at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. At Rydalmere it occurs along a road reserve near a creek, among grass species on sandstone. At Rookwood Cemetery it occurs in a small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils (DEC 2005€).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Thymelaeaceae	*Pimelea curviflora var. curviflora* -	V	V	Occurring in Hawkesbury/Nepean and Sydney Metropolitan Catchment Authority Areas. Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west (DEC 2005). Occurs on lateritic soils and shale-sandstone transition soils on ridge tops in woodland. Associated with Dry Sclerophyll forests and Coastal valley grassy woodlands. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots (DEC 2005). Flowers October to May.	No
Thymelaeaceae	*Pimelea spicata* Spiked Rice-flower	E	E1	Once widespread on the Cumberland Plain, *Pimelea spicata* occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment (NPWS 2000a). In western Sydney, *P. spicata* occurs on an undulating topography of substrates derived from Wianamatta Shale in areas supporting, or that previously supported, the Cumberland Plain Woodland Vegetation Community (NPWS 2004). Associated species include: *Eucalyptus moluccana, E. tereticornis, E.crebra, Bursaria spinosa*, and *Themeda australis* (NPWS 2004). In the Illawarra region, *P. spicata* is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *Eucalyptus tereticornis, E. eugenioides, Themeda australis, and Lomandra longifolia*. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey (NPWS 2004). *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April (NPWS 2000a).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Tremandraceae	*Tetratheca glandulosa* -	V	V	Occurs in Hawkesbury/Nepean, Hunter/Central Rivers, Sydney Metropolitan Catchment Authority Regions. Restricted to the following Local Government Areas: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong (DEC 2005‰). Associated with shale-sandstone transition habitat where shale-capping occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops (DEC 2005‰). Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest. Vegetation communities correspond broadly to Benson & Howell's (2004) Sydney Sandstone Ridgetop Woodland. Common woodland tree species include: *Corymbia gummifera, C. eximia, Eucalyptus haemastoma, E. punctata, E. racemosa,* and/or *E. sparsifolia*, with an understorey dominated by species from the families *Proteaceae, Fabaceae,* and *Epacridaceae* (DEC 2005‰). Flowers July-November however residual flowers may persist until late December (DEC 2005‰).	No

Family Name	Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Study area?
Tremandraceae	*Tetratheca juncea* Black-eyed Susan	V	V	*Tetratheca juncea* occurs in the Hunter/Central Rivers catchment. Specifically to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock (NPWS 2000b). It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies (NPWS 2000b). Vegetation types associated with *Tetratheca juncea* include sandy or swampy heath, and dry sclerophyll forests (Fairley and Moore 1995; Harden 1992). Most populations occur in woodland on poor nutrient sandy soils with good drainage and low moisture levels (NPWS 2000b). The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape (NPWS 2000b). Typically found in dense understorey of grasses and canopy species including *Angophora costata, Corymbia gummifera, Eucalyptus haemastoma* and *E. capitellata* (NPWS 2000b). Flowers mostly July to Dec (Harden 1992).	No

5.3 Terrestrial fauna

5.3.1 Terrestrial fauna habitat

Suitability, size and configuration of terrestrial vertebrate fauna habitats broadly correlate to the structure, connectivity and quality of local and regional vegetation types (see Section 5.1). The terrestrial fauna habitat within the study area consists of Homebush Bay itself and the surrounding vegetation. Finer scale habitat features are limited within the study area but include rocky banks, mud flats, emergent wooden and metal structures (e.g. piers and shipwrecks), flowering trees and mown lawn. Animal species may utilise some of these features wholly or partly, in conjunction with one another, or may depend entirely on one specific habitat type.

Subject site

The subject site is largely devoid of vegetation and consequently terrestrial fauna habitat within the subject site is limited. The Wentworth Point (western) side of the subject site consists of a steeply-sloped concrete wall extending from the water's edge up to a height of approximately 2 m (Plate 1). The wall is predominantly smooth offering no roost or shelter opportunities for fauna. As the wall extends directly out of the water there is no mud flat area to provide foraging habitat for waterbirds. Further, there is no submerged or emergent vegetation. Beyond the wall lies an area of flat concrete pathways and a 3 – 6 m wide strip of mown grass running parallel to the western bank. Approximately four planted Eucalyptus trees and 10 planted River Sheoaks occur here. There is no shrub layer and no tree hollows were observed. The Glossy Black-cockatoo *Calyptorhynchus lathami* may occasionally forage on the seeds of the River Sheoaks however this potential habitat is considered marginal given its location outside forest or woodland habitat and that it does not contain a preferred species of feed tree (such as *Allocasuarina* spp.).

The Rhodes (eastern) side of the subject site is currently undergoing remediation and is largely cleared of all vegetation. A sandstone boulder constructed bank reaching to the waterline occurs between a steel fence protruding from the water and, excavated piles of soil (Plate 2 and Plate 6). Very little vegetation occurs but includes a sparse cover of weeds and grasses growing out of the sandstone wall. There is no submerged or emergent vegetation. Given the immediate proximity of the remediation site and steel fence, any potential fauna habitat opportunities along the sandstone wall are considered limited and disturbed. No threatened or migratory fauna are considered likely to utilise this area.

Within the subject site, the Bay itself (Plate 7) provides foraging habitat for birds such as cormorants, ducks, egrets and sea gulls that feed on fish or crustaceans and aquatic insects. With the exception of a couple of small emergent wooden

structures (that may provide perch sites for fauna), large woody debris (LWD) was largely absent. Examples of threatened and migratory species that may fly over the Bay through the subject site or forage within it include Osprey *Pandion haliaetus*, White-bellied Sea-eagle *Haliaeetus leucogaster* and Grey-headed Flying-fox *Pteropus poliocephalus*.

Terrestrial fauna habitats within the subject site are considered to be in Poor condition given the lack of vegetation at the water, ground and shrub levels; low abundance of trees; absence of tree hollows; absence of ground log and litter layer; absence of mud flats; lack of LWD; and, the highly disturbed nature of the site.

Study area

The western and eastern banks of the Bay stretching north and south of the subject site are also largely devoid of vegetation. The banks consist of either vertical or sloping concrete, or sandstone and shale retaining walls (Plate 8). The walls reach up to a height of approximately 2 m and some sloping sandstone and shale rock walls extend out of shallow pools and mud flats (Plate 9). Very little vegetation occurs but includes a sparse cover of weeds and grasses growing out of the sandstone and shale rock walls. There is no submerged or emergent vegetation. The common White-faced Heron *Egretta novaehollandiae* was observed perched on a rocky wall (Plate 10). Threatened and migratory waterbirds may also utilise this habitat feature as perch or shelter sites and forage within the shallows. Prey items such toadfish were observed swimming in shallow pools and crabs were observed on mud flats. Discarded and washed-up rubbish lined the Bay and mudflats.

Beyond the western and eastern banks are primarily footpaths, mown lawn, planted shrubs and buildings. Terrestrial fauna habitats within this part of the study area are limited and are likely only to support common fauna species such Masked Lapwing *Vanellus miles*, Magpie-lark *Grallina cyanoleuca*, Australian White Ibis *Threskiornis molucca*, Willie Wagtail *Rhipidura leucophrys*, Yellow-faced Honeyeater *Lichenostomus chrysops* and Rainbow Lorikeet *Trichoglossus haematodus* (all recorded during the current survey).

Both the northern and southern ends of the study area consist of mangrove vegetation (Plate 5). A small area of saltmarsh occurs within the study area amongst the mangroves at the Shipwreck Viewing Platform (Plate 4). Scattered Swamp Oaks occur at the southern end of the study area also. No hollow-bearing trees were observed within the mangroves however their presence can not be ruled out. The mangroves and limited saltmarsh vegetation provide potential habitat for threatened and migratory species, namely waterbirds such as plovers, terns and sandpipers. These species may forage amongst the mangroves and associated mud flats (Plate 11). Waterbird habitat within Homebush Bay

provides an essential link to the remaining wetlands in the Sydney region and forms part of the coastal corridor used by internationally protected migratory waders (Olympic Co-ordination Authority 1995). Individuals of the endangered population of White-fronted Chat *Epthianura albifrons* have been previously recorded within and adjacent to the study area and may utilise this habitat (Department of Environment and Planning 1986). Threatened species of microchiropteran bats that may utilise the mangrove habitat include Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* and Southern Myotis *Myotis macropus*.

As discussed above in relation to the subject site, the Bay itself provides foraging habitat for birds such as cormorants, ducks, egrets and sea gulls within the remainder of the study area (Plate 12). A number of emergent wooden (e.g. piers) and metal (e.g. shipwrecks) structures occur within the Bay and provide perch and basking sites for fauna as well as shelter opportunities (Plate 13 and Plate 14). Threatened and migratory species that may fly over the Bay or forage within it include Osprey, White-bellied Sea-eagle, Great Egret *Ardea alba* and Grey-headed Flying-fox.

The terrestrial fauna habitat occurring along the western and eastern banks of the Bay in the vicinity of the concrete, sandstone and shale rock walls is considered to be in Poor condition given the lack of vegetation cover, lack of microhabitat complexity (e.g. fallen timber, leaf litter, shrubs), limited occurrence of mud flats and, the highly disturbed and polluted nature of these areas. The terrestrial fauna habitat within the mangroves is considered to be in Moderate to Good condition providing foraging and nesting resources for a high number of threatened and migratory fauna species, albeit within a narrow band of mangroves. The area of saltmarsh is considered to be in Poor to Moderate condition in terms of fauna habitat due to its very small extent and isolation within the study area. Finally, the Bay itself is considered to be in Moderate condition in terms of fauna habitat providing a large and sheltered area of foraging habitat although highly polluted.

Beyond the study area

Beyond the mangroves outside the southern end of the study area lies mown lawn and planted garden plants as well as planted native trees and shrubs along the foreshore's cycleway (Plate 15). In addition, a large wetland containing saltmarsh known as the "waterbird refuge" occurs within Badu Mangroves south of the study area (Plate 16). This wetland is considered to be in Good condition.

Others areas outside the study area (i.e. areas that are considered as unlikely to be impacted by the proposal) that provide known or potential habitat for threatened and migratory species include Bicentennial Park, Powells and Haslams Creeks, The Brickpit, Millennium Parklands and various wetlands associated with Sydney Olympic Park. The close proximity of these various habitats to the study

area has resulted in a high number of threatened species records in the vicinity of the study area however, not all of these species are considered to have potential habitat within the study area.

5.3.2 Terrestrial animal species

Twenty-eight species of bird were recorded during the current field survey including cormorants, ducks, waders, corvids, honeyeaters and pigeons (Appendix 2).

5.3.3 Significant terrestrial animal species

A total of 90 threatened and/or migratory terrestrial animal species or their habitat (including three listed as endangered populations) have been previously recorded within a 10 km radius of the study area (OEH Atlas of NSW Wildlife, Birds Australia's Atlas of Australian Birds and DSEWPaC Online EPBC Database) (Table 2). Of these, 54 animal species are listed under the TSC Act and 60 animal species are listed under the EPBC Act (17 threatened and 44 migratory)[1]. Eighty-one threatened and/or migratory terrestrial species and three endangered populations have been previously recorded within 10 km of the study area Figure 5 .

No threatened or migratory animal species were recorded during the current survey however a number of threatened and migratory species have been previously recorded within and surrounding the study area (Figure 5). Potential habitat is considered to occur within the study area for 43 species of threatened biota (Table 2) including: 12 threatened species; 37 migratory species (where the Osprey, Greater Sand Plover *Charadrius leschenaultii*, Lesser Sand Plover *C. mongolus*, Little Tern *Sterna albifrons*, Broad-billed Sandpiper *Limicola falcinellus*, Black-tailed Godwit *Limosa limosa* and Terek Sandpiper *Xenus cinereus* are listed as both threatened and migratory); and, one endangered population (White-fronted Chat). Species with known or potential habitat in the study area have been considered further in Section 6.0 (Impact Assessment) of this report.

[1] An individual species may be listed under one or both Acts and may be listed as threatened and/or migratory.

Table 2: Terrestrial fauna listed on the TSC and/or EPBC Acts that may occur in the local area

Key: 1) Listed on the EPBC Act as Endangered (E), Vulnerable (V) or covered under migratory provisions (M) on the EPBC Act.
2) Listed on the TSC Act as Endangered (E1), Critically Endangered (C1), Endangered Population (E2) or Vulnerable (V).

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Amphibians					
Litoria aurea Green and Golden Bell Frog	V	E1	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC (NSW Government 2009). The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks (NPWS 1999e; White and Pyke 1996), although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop (DECC 2008), feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species (DEC 2005s).	No	No (although numerous records outside the study area within various Sydney Olympic Park habitats)
Litoria raniformis Southern Bell Frog	V	E1	In NSW the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral swamps or billabongs with an abundance of bulrushes and other emergent vegetation along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat. Outside the breeding season animals disperse away from the water and take shelter beneath ground debris such as fallen timber and bark, rocks, grass clumps and in deep soil cracks (Robinson 1993; DEC 2005„).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Heleioporus australiacus Giant Burrowing Frog	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks (Daly 1996; Recsei 1996). Can also occur within shale outcrops within sandstone formations. Known from wet and dry forests and montane woodland in the southern part range (Daly 1996). Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water (Barker *et al.* 1995). Spends the majority of its time in non-breeding habitat 20-250 m from breeding sites (Penman *et al.* 2008).	No	No
Mixophyes balbus Stuttering Frog	V	E1	This species is usually associated with mountain streams, wet mountain forests and rainforests (Barker *et al.* 1995). It rarely moves very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains (Barker *et al.* 1995).	No	No
Mixophyes iterates Giant Barred Frog	E	E1	Occurs along coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. Found in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m, often hiding in leaf litter near permanent fast-flowing streams. Females lay eggs onto moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched. When not breeding the frogs disperse hundreds of metres away from streams (DEC 2005o).	No	No
Pseudophryne australis Red-crowned Toadlet	-	V	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks characterised by a series of shallow pools that feed into larger semi-perennial streams (Thumm and Mahony 1997). Breeds all year round (Thumm and Mahoney 2002).	No	No
Birds					

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Haliaeetus leucogaster White-bellied Sea-eagle	M	-	A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive (Marchant and Higgins 1993). Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees (Marchant and Higgins 1993).	Yes	Yes
Hieraaetus morphnoides Little Eagle	-	V	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species (NSW Scientific Committee 2009a). It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests (Marchant and Higgins 1993).	No	No
Pandion haliaetus Osprey	M	V	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 km inland along larger rivers (Pizzey and Knight 1997). It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea (Marchant and Higgins 1993).	Yes	Yes
Nettapus coromandelianus Cotton Pygmy-goose	-	E1	The Cotton Pygmy-goose is found along the coast from Northern Queensland extending south into Victoria. It is considered a vagrant throughout the southern extent of its range (Morcombe 2003). The Cotton Pygmy-goose is rarely seen on land, preferring deep permanent water including freshwater swamps, lagoons, dams, with water lilies and other semi-emergent water plants (Pizzey and Knight 2007). In the north it will move onto the floodplains following the wet season rain.	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Stictonetta naevosa Freckled Duck	-	V	The Freckled Duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits (Simpson and Day 1996).	No	No
Apus pacificus Fork-tailed Swift	M	-	Almost exclusively aerial (foraging). The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April (Higgins 1999). Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high (Boehm 1944).	May fly over the subject site	May fly over the study area
Hirundapus caudacutus White-throated Needletail	M	-	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia (Pizzey and Knight 1997).	May fly over the subject site	May fly over the study area
Ardea alba Great Egret	M	-	Terrestrial wetlands, estuarine and littoral habitats and moist grasslands. Inland, prefer permanent waterbodies on floodplains; shallows of deep permanent lakes (either open or vegetated), semi-permanent swamps with tall emergent vegetation and herb dominated seasonal swamps with abundant aquatic flora. Also regularly use saline habitats including mangrove forests, estuarine mudflats, saltmarshes, bare saltpans, shallows of salt lakes, salt fields and offshore reefs. Breeding requires wetlands with fringing trees in which to build nests including mangrove forest, freshwater lakes or swamps and rivers (Marchant and Higgins 1990).	Yes	Yes
Ardea ibis Cattle Egret	M	-	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant and Higgins 1990).	Yes	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Botaurus poiciloptilus Australasian Bittern	E	E1	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including Typha spp. and Eleoacharis spp. (DECC 2005; NPWS 1999a). Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds (DEC 2005b).	No	Yes (but limited)
Egretta sacra Eastern Reef Egret	M	-	Widely distributed throughout a range of maritime littoral and estuarine habitats on mainland, islands and atolls. Prefers rocky shorelines. Roosts within close proximity to water, on dead or living trees, sand spits, banks, and artificial structures, such as wharfs (Marchant and Higgins 1990).	Yes	Yes
Callocephalon fimbriatum Gang-gang Cockatoo	-	V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Higgins 1999). Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest (Forshaw and Cooper 1981). In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992). It requires tree hollows in which to breed (Gibbons and Lindenmayer 1997).	No	No
Calyptorhynchus lathami Glossy Black-cockatoo	-	V	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types (NPWS 1999c). Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead (Higgins 1999).	Yes (planted Casuarina trees)	Yes (but limited)
Charadrius bicinctus Double-banded Plover	M	-	Tidal mudflats, beaches, exposed reefs, salt marshes, freshwater wetlands, inland salt lakes, short grass on golf courses, airfields (Morcombe 2003).	No	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Charadrius leschenaultia Greater Sand Plover	M	V	Entirely coastal in NSW, foraging on intertidal sand and mudflats in estuaries and roosting during high tide on sandy beaches or rocky shores. Individuals have been recorded on inshore reefs, rock platforms, small rocky islands and sand cays on coral reefs, within Australia. Occasional sightings have also occurred on near-coast saltlakes, brackish swamps, shallow freshwater wetlands and grassed paddocks (NPWS 1999d).	No	Yes
Charadrius mongolus Lesser Sand Plover	M	V	In Australia, the species is known to favour coastal environs including beaches, mudflats and mangroves. Within NSW, individuals have been observed on intertidal sand and mudflats in estuaries or roosting on sandy beaches or rocky shores at high tide (NPWS 1999f).	No	Yes
Pluvialis fulva Pacific Golden Plover	M	-	Migratory species that visits estuaries mudflats, saltmarshes and ocean shores as well as paddocks, grasslands and swamps near the coast (Pizzey and Knight 1997).	No	Yes
Pluvialis squatarola Grey Plover	M	-	Almost entirely coastal, but occasionally recorded on inland wetlands. Mainly on marine shores, inlets, estuaries and lagoons where there are nearby large tidal mudflats or sandflats for feeding and sandy beaches for roosting (Marchant and Higgins 1993).	No	Yes
Ptilinopus superbus Superb Fruit-dove	-	V	The Superb Fruit-dove's NSW distribution ranges from northern NSW to as far south as Moruya (DEC 2005†). It is found in rainforests, closed forests (including mesophyll vine forests) and sometimes in eucalypt and acacia woodlands where there are fruit-bearing trees (Higgins and Davies 1996). It forages in the canopy of fruiting trees such as figs and palms. Nests are constructed high in the canopy throughout September to January (DEC 2005†).	No	No
Cuculus saturatus Oriental Cuckoo	M	-	Canopy or shrub layer of monsoon rainforest, vine thickets, wet sclerophyll forest, or open Casuarina, Acacia or Eucalyptus woodland (Higgins 1999).	No	No
Monarcha melanopsis Black-faced Monarch	M	-	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland (Pizzey and Knight 1997).	No	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Myiagra cyanoleuca Satin Flycatcher	M	-	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey and Knight 1997).	No	Yes
Rhipidura rufifrons Rufous Fantail	M	-	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey and Knight 1997).	No	Yes
Haematopus longirostris Pied Oystercatcher	-	E1	An intertidal forager found on undisturbed sandy beaches and spits, tidal mudflats and estuaries. Its food supply (beach macroinvertebrates) have been negatively affected by human impacts (NSW Scientific Committee 2010b). The Pied Oystercatcher is restricted to the littoral zone of beaches and estuaries, nesting on the ground above the tideline. A pair will re-nest in the same spot each year, rarely shifting their territory (NSW Scientific Committee 2010b). Occasionally the Pied Oystercatcher is found in paddocks near the coast (Pizzey and Knight 1997).	No	No
Irediparra gallinacean Comb-crested Jacana	-	V	Occurs in freshwater wetlands, lagoons, Billabongs, swamps, lakes, rivers and reservoirs, generally with abundant floating aquatic vegetation (Marchant and Higgins 1993).	No	No
Sterna albifrons Little Tern	M	E1	The Little Tern favours sheltered coasts, harbours, bays, lakes, inlets, estuaries, coastal lagoons and ocean beaches especially with sand-spits and sand islets (Higgins and Davies 1996; Morcombe 2003). It forages over shallow waters close inshore or over sandbars and reefs (Morcombe 2003).	No	Yes (but limited)
Sterna caspia Caspian Tern	M	-	Usually coastal, with a preference for sheltered estuaries, inlets, bays, harbours, lagoons with muddy or sandy shores. Keeps close inshore, not out beyond reef line. Also extends well inland on fresh or salt lakes, temporary floodwaters, large rivers, reservoirs, sewage ponds (Morcombe 2003).	No	Yes (but limited)
Sterna hirundo Common Tern	M	-	Marine, typically well offshore, but also in coastal waters, sheltered bays, estuaries, and on ocean beaches (Morcombe 2003).	No	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Anthochaera Phrygia Regent Honeyeater	E	C1	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS 1999g; Pizzey and Knight 1997). Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: *E. microcarpa, E. punctata, E. polyanthemos, E. mollucana, Corymbia robusta, E. crebra, E. caleyi, C. maculata, E. mckieana, E. macrorhyncha, E. laevopinea* and *Angophora floribund*a. Nectar and fruit from the mistletoes *A. miquelii, A. pendula, A. cambagei* are also eaten during the breeding season (DEC 2005*f*). Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe haustoria. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female (DEC 2005*f*).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Epthianura albifrons White-fronted Chat (Sydney Metro CMA)	-	E2	Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which White-fronted Chats are unlikely to fly. They are isolated by even greater distances from the nearest extant populations outside the Sydney Metropolitan CMA, at Ash Island north of Newcastle and Lake Illawarra, south of Wollongong (NSW Scientific Committee 2010a). The White-fronted Chat is regarded as resident in many areas, but has been referred to as nomadic in some places. They are gregarious, although they do not form mixed species flocks (Higgins *et al.* 2001). They are usually found foraging on bare or grassy ground in wetland areas, occurring singly and in pairs, and frequently forming small flocks of up to 50 birds particularly in the non-breeding season in autumn and winter (NSW Scientific Committee 2010a). During the breeding season they form simple monogamous pairs, but will join small flocks to feed and roost. They are insectivorous, with flies and beetles being the major components of their diet, feeding from the ground or catching flying insects close to the ground (NSW Scientific Committee 2010a).	No	Yes
Merops ornatus Rainbow Bee-eater	M	-	Usually occurs in open or lightly timbered areas, often near water. Nest in embankments, including banks of creeks and rivers, in sand dunes, in quarries and in roadside cuttings. Breeding occurs from November to January. It has complex migratory movements in Australia. NSW populations migrate north for winter (Higgins 1999).	No	Yes
Acrocephalus australis Australian Reed-Warbler	M	-	This species lives singly or in pairs usually in wetlands with reeds. It feeds on insects (Blakers *et al.* 1984).	No	Yes (but limited)

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Daphoenositta chrysoptera Varied Sittella	-	V	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts (Higgins and Peter 2002; NSW Scientific Committee 2010c). The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (NSW Scientific Committee 2010c).	No	No
Petroica boodang Scarlet Robin	-	V	During the breeding season the Scarlet Robin is found in eucalypt forests and temperate woodlands, often on ridges and slopes. During autumn and winter it moves to more open and cleared areas. It has dispersive or locally migratory seasonal movements. The Scarlet Robin forages amongst logs and woody debris for insects which make up the majority of its diet (NSW Scientific Committee 2009b). The nest is an open cup of plant fibres and cobwebs, sited in the fork of a tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground (NSW Scientific Committee 2009b). It is conspicuous in open and suburban habitats (Morcombe 2003).	No	No
Glossopsitta pusilla Little Lorikeet	-	V	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes (NSW Scientific Committee 2008b).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Lathamus discolor Swift Parrot	E	E1	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects (Forshaw and Cooper 1981). The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW (Shields and Crome 1992). Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta,* Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccan*a and Blackbutt *E. pilularis* (DEC 2005‡). This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability (Pizzey and Knight 1997).	No	No
Neophema pulchella Turquoise Parrot	-	V	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and understorey of low shrubs (Morris 1980). Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies (Higgins 1999). Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist (Higgins 1999).	No	No
Rostratula australis Australian Painted Snipe	VM	E1	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters (Marchant and Higgins 1993).	No	No
Actitis hypoleucos Common Sandpiper	M	-	Inhabits a wide range of coastal and inland wetlands, often with muddy or rocky margins. Also known to occur at estuaries, billabongs, dams, pools and lakes, often associated with mangroves (Higgins and Davies 1996).	No	Yes
Arenaria interpres Ruddy Turnstone	M	-	Inhabits tidal reefs, sandy beaches, mudflats and exposed or shallow seaweed beds (Pizzey and Knight 1997).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Calidris acuminata Sharp-tailed Sandpiper	M	-	Inland waters, coastal (Simpson and Day 1996).	No	Yes
Calidris canutus Red Knot	M	-	Typically located within intertidal mudflats, sandflats and sandy beaches of sheltered coasts. Occasionally found on sandy open beaches or shallow pools, or in saline wetlands close to the coast (Higgins and Davies 1996).	No	Yes (but limited)
Calidris ferruginea Curlew Sandpiper	M	-	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland (Higgins and Davies 1996).	No	Yes
Calidris mauri Western Sandpiper	M	-	Found in tidal mudflats, and tidal wetlands (Pizzey and Knight 2007).	No	Yes (but limited)
Calidris melanotos Pectoral Sandpiper	M	-	Scarce, but regular visitor, usually recorded in summer from November to March (Slater *et al.* 2003). Widespread but scattered records in Australia. Usually found in fresh to saline wetlands, floodplains, swamps, estuaries and lagoons, sometimes with emergent or fringing vegetation such as grass (Higgins and Davies 1996).	No	Yes (but limited)
Calidris ruficollis Red-necked Stint	M	-	Inhabits mainly coastal environments; saltmarshes, tidal mudflats, saline and freshwater wetlands, sandy or shelly beaches and sewage ponds (Higgins and Davies 1996).	No	Yes
Calidris tenuirostris Great Knot	M	V	Mainly found on intertidal mudflats, sandflats and sandy beaches (Higgins and Davies 1996).	No	No
Gallinago hardwickii Latham's Snipe	M	-	Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams (Pizzey and Knight 1997).	No	Yes
Heteroscelis brevipes Grey-tailed Tattler	M	-	Found in estuaries, mangroves and tidal mudflats. Also in shallow river margins, both coastal and inland (Pizzey and Knight 1997).	No	Yes
Limicola falcinellus Broad-billed Sandpiper	M	V	Occurs in sheltered parts of coasts, such as estuaries, harbours, embayments and lagoons, which have shell or sandbanks nearby (Higgins and Davies 1996).	No	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Limosa lapponica Bar-tailed Godwit	M	-	Coastal species, usually inhabiting intertidal sandflats, spits and banks. Less frequently found in mudflats, estuaries, coastal lagoons and harbours (Higgins and Davies 1996).	No	Yes
Limosa limosa Black-tailed Godwit	M	V	Mainly coastal, usually in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats (Higgins and Davies 1996).	No	Yes (but limited)
Numenius madagascariensis Eastern Curlew	M	-	Occurs in sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats often with beds of seagrass (Higgins and Davies 1996).	No	Yes
Numenius minutus Little Curlew	M	-	Short, dry grasslands and sedgelands, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools. Mostly feed in dry grassland or sedgeland, either natural or artificial. Foraging sites usually occur within 5 km of daytime roosting sites (Higgins and Davies 1996).	No	No
Numenius phaeopus Whimbrel	M	-	Occurs in intertidal mudflats of sheltered coasts (Higgins and Davies 1996). Also in estuaries, mangroves, coral clays and exposed reefs. Roosts in trees and mangroves (Pizzey and Knight 1997).	No	Yes
Philomachus pugnax Ruff	M	-	Rare migrant from northern Eurasia (Slater *et al.* 2003) regularly visits fresh, brackish or saline wetlands with exposed mudflats at edges, usually terrestrial but sometimes found in sheltered coastal habitats (Higgins and Davies 1996).	No	Yes (but limited)
Tringa glareola Wood Sandpiper	M	-	Freshwater swamps, lakes, flooded pasture; less frequently on brackish waters, occasionally in mangroves (Morcombe 2003).	No	Yes (but limited)
Tringa stagnatilis Marsh Sandpiper	M	-	Inhabits permanent or ephemeral wetlands, including swamps, billabongs, lagoons, saltmarshes and estuaries. Forages at the edge of wetlands in shallow water (Higgins and Davies 1996).	No	Yes
Xenus cinereus Terek Sandpiper	M	V	Mainly found on saline intertidal mudflats in sheltered estuaries, embayments, harbours and lagoons (Higgins and Davies 1996).	No	Yes (but limited)

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Eudyptula minor Little Penguin (Manly Point Area)	-	E2	The Manly endangered population of Little Penguin is the only known breeding population on the mainland in NSW. A range of nest sites are utilised by the penguins at Manly including under rocks on the foreshore, under seaside houses and structures, such as stairs, in wood piles and under overhanging vegetation including lantana and under coral tree roots. Male penguins start returning to the colony in May/June to find or reconstruct a suitable burrow for nesting and to attract females. At this time they may spend all day in their burrows. Time of egg-laying varies slightly from year to year but has been recorded at Manly as early as the first week of June. The peak breeding season however is generally from July to December (DEC 2005y).	No	No (no previous records within locality)
Ninox connivens Barking Owl	-	V	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country (Pizzey and Knight 1997). Territories are typically 2000 ha in NSW habitats (DEC 2005c).	No	No (may fly over study area)
Ninox strenua Powerful Owl	-	V	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas (Debus and Chafer 1994b; Debus and Chafer 1994a). Large mature trees with hollows at least 0.5 m deep are required for nesting (Garnett 1992). Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons and Lindenmayer 1997). Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm (Gibbons and Lindenmayer 1997). It has a large home range of between 450 and 1450 ha (DEC 2005).	No	No (may fly over study area)

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Plegadis falcinellus Glossy Ibis	M	-	Terrestrial wetlands, and occasionally wet grasslands and sheltered marine habitats. Forage in shallow water over soft substrate or on grassy or muddy verges of wetlands, preferring those providing variety of water depths; avoid dry ground (Marchant and Higgins 1990).	No	Yes (but limited)
Tyto capensis Grass Owl	-	V	Occurs mainly in open tussock grassland, usually in treeless areas. Can also occur in marshy areas with tall dense tussocks of grass. Occasionally occurs in densely vegetated agricultural lands such as sugarcane fields (Higgins 1999).	No	No
Invertebrates					
Meridolum corneovirens Cumberland Plain Land Snail	-	E1	Most likely restricted to Cumberland Plain, Castlereagh Woodlands and boundaries between River-flat Forest and Cumberland Plain Woodland. It is normally found beneath logs, debris and amongst accumulated leaf and bark particularly at the base of trees. May also use soil cracks for refuge (NPWS 1999b).	No	No
Mammals					
Cercartetus nanus Eastern Pygmy-possum	-	V	Patchily distributed from the coast to the Great Dividing Range, and as far as Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Soft fruits are eaten when flowers are unavailable and it also feeds on insects (DEC 2005k; Ward and Turner 2008). Will often nest in tree hollows, but can also construct its own nest (Turner and Ward 1995). Because of its small size it is able to utilise a range of hollow sizes including very small hollows (Gibbons and Lindenmayer 1997). Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period (Ward 1990). It is mainly solitary, and each individual uses several nests. Home ranges of males are generally less than 0.75 ha, and those of females are smaller (Ward and Turner 2008).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Dasyurus maculatus maculatus Spotted-tailed Quoll (south-eastern mainland)	E	V	Occurs along the east coast of Australia and the Great Dividing Range (Belcher *et al.* 2008). Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests (Dickman and Read 1992). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas (NPWS 1999k). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage (Edgar and Belcher 1995). 70% of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage (NPWS 1999h). The home range of a female is between 180 – 1000 ha, while males have larger home ranges of between 2000 – 5000 ha. Breeding occurs from May to August (Belcher *et al.* 2008).	No	No
Dasyurus viverrinus Eastern Quoll	-	E1	This species occurs in a variety of habitats including scrub, heathland, cultivated land and dry sclerophyll forest (Strahan 1995; NPWS 1999). Den sites can consist of a number of chambers in range of structure from underground burrows, hollow logs, rock piles and hay sheds. The Eastern Quoll is a solitary feeder with males often travelling over a kilometre in a night to forage (Strahan 1995). Females restrict their movements to a few hundred metres around their dens. This species feeds on agricultural pests, insects and large animals including ground-nesting birds and small mammals (NPWS 1999).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Saccolaimus flaviventris Yellow-bellied Sheathtail Bat	-	V	Found throughout NSW (Richards 2008). They have been reported from southern Australia between January and June (Churchill 1998). Reported from a wide range of habitats throughout eastern and northern Australia, including wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and desert (Churchill 1998). They roost in tree hollows in colonies of up to 30 (but more usually two to six) and have also been observed roosting in animal burrows, abandoned Sugar Glider nests, cracks in dry clay, hanging from buildings and under slabs of rock. It is high-flying, making it difficult to detect. It forages above the canopy of eucalypt forests, but comes lower to the ground in mallee or open country (Churchill 2008; Richards 2008).	No	No
Petrogale penicillata Brush-tailed Rock-wallaby	V	E1	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices, particularly where these have a northerly aspect. Individuals defend a specific rock shelter, emerging in the evening to forage on grasses and forbs, as well as browse in drier months. Home sizes range from 2-30 ha (Eldridge and Close 1995).	No	No
Mormopterus norfolkensis Eastern Freetail Bat	-	V	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney (Churchill 1998). Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites (Churchill 2008; Hoye *et al.* 2008).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Pseudomys novaehollandiae New Holland Mouse	V	-	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The home range of the New Holland Mouse can range from 0.44 ha to 1.4 ha. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species is nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging above-ground for food, predisposing it to predation by native predators and introduced species. Breeding typically occurs between August and January, but can extend into autumn (Threatened Species Scientific Committee 2010).	No	No
Isoodon obesulus obesulus Southern Brown Bandicoot	E	E1	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time (Braithwaite 1995). A mosaic of post fire vegetation is important for this species (Maxwell *et al.* 1996).	No	No
Perameles nasuta Long-nosed Bandicoot	-	E2	The Long-nosed Bandicoot (inner west population) is found within the LGAs of Marrickville and Canada Bay and may extend into the surrounding LGAs of Canterbury, Ashfield and Leichardt (DECCW 2010). Individuals mostly shelter under older houses and buildings, and forage for invertebrates, plant roots, and hypogeal fungi in parklands and back-yards. The population is threatened by collision with vehicles; predation by dogs, cats and foxes; renovation of old buildings preventing access to nest sites; removal of vegetation; and is at risk of extinction due to local fluctuations in mortality and fecundity (NSW Scientific Committee 2008a).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Petaurus australis Yellow-bellied Glider	-	V	Restricted to tall native forests in regions of high rainfall along the coast of NSW. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types (NPWS 1999j). Live in family groups of 2-6 individuals which commonly share a number of tree hollows. Family groups are territorial with exclusive home ranges of 30-60 ha. Very large expanses of forest (>15,000 ha) are required to conserve viable populations (Goldingay 2008)	No	No
Potorous tridactylus Long-nosed Potoroo	V	V	Occurs from Queensland to Victoria, normally within 50 km of the coast (Claridge *et al.* 2007). Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer (Johnston 2008). This species appears to benefit from a lack of recent disturbance (Claridge *et al.* 2007).	No	No
Pteropus poliocephalus Grey-headed Flying-fox	V	V	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee and Ford 1999).	Yes (may fly through subject site above water)	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Chalinolobus dwyeri Large-eared Pied Bat	V	V	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley (van dyck and Strahan 2008). Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands (Churchill 2008; Hoye and Schulz 2008). Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months (Churchill 2008). The only known existing maternity roost is in a sandstone cave near Coonabarabran (Pennay 2008).	No	No
Falsistrellus tasmaniensis Eastern False Pipistrelle	-	V	Distribution extending east of the Great Dividing Range throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being found in open forests at lower altitudes (Churchill 2008). Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in forests with an open structure, or along trails (Law *et al.* 2008). Has a large foraging range, up to 136 ha (Churchill 2008; Law *et al.* 2008). Records show movements of up to 12 km between roosting and foraging sites (Menkhorst and Lumsden 1995).	No	No

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Miniopterus australis Little Bentwing-bat	-	V	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains (van dyck and Strahan 2008). Young are raised by the females in large maternity colonies in caves in summer. Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing-bat forages for small insects (such as moths, wasps and ants) beneath the canopy of densely vegetated habitats (Churchill 2008; Hoye and Hall 2008b).	No	No
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	-	V	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways (Churchill 2008; Hoye and Hall 2008a).	No	Yes (but limited)
Myotis Macropus Southern Myotis	-	V	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects (Richards *et al.* 2008).	No	Yes

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	Habitat	Potential Habitat within Subject site?	Potential Habitat within Study area?
Scoteanax rueppellii Greater Broad-nosed Bat	-	V	Occurs along the Great Dividing Range, generally at 500 m but up to 1200 m, and in coastal areas. Occurs in woodland and rainforest, but prefers open habitats or natural or human-made openings in wetter forests. Often hunts along creeks or river corridors. Flies slowly and directly at a height of 30 m or so to catch beetles and other large, flying insects. Also known to eat other bats and spiders. Roosts in hollow tree trunks and branches (Churchill 2008; Richards *et al.* 2008).	No	No
Reptiles					
Hoplocephalus bungaroides Broad-headed Snake	V	E1	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb 1996; Webb and Shine 1998).	No	No

5.4 Aquatic flora and fauna

5.4.1 Aquatic habitat

The aquatic habitat within the study area consists of all areas below the high-water mark within Homebush Bay. This area includes intertidal saltmarsh and mangrove areas; intertidal and sub-tidal mudflats; and submerged rock-wall structures.

Subject site

The subject site crosses through submerged rockwall habitat, and muddy sub-tidal areas. The rockwall present on the western side of the subject site is smooth and homogenous (Plate 1). Rockwalls of this nature typically provide poor habitat for aquatic species compared to the complex structures of natural intertidal reefs and rockpools. The rockwall on the eastern side of the subject site consists of a sandstone boulder constructed bank with a steel fence protruding from the water (Plate 2 and Plate 6). This intertidal habitat is likely to support a limited diversity of intertidal biota, such as molluscs and small crustaceans, and macro-algae.

The remaining muddy-sediment habitat is likely to support an assemblage of fish typically found in the muddy estuary habitats of Sydney Harbour and the estuarine reaches of the Parramatta River.

Study area

The study area includes an extension of the same habitats found in the subject site. Some intertidal rockwall areas of the study area provide relatively more complex structure than those found in the subject site (Plate 10), and are likely to support a greater diversity of intertidal biota.

In addition the study area also includes areas of intertidal saltmarsh and mangrove (Plates 4 and 5). Mangroves typically provide important nursery habitat for a number of fish species that occur in the estuaries they are associated with (Hutchings and Saenger 1987; Olympic Co-ordination Authority 1995).

The study area also includes artificial reef structures, including a shipwreck (Plate 14) and emerging wooden pylons (Plate 13), which are likely to support habitat for sessile flora and fauna, and provide habitat for mobile fauna typically associated with rocky reefs in the area.

Two tributary creeks of Parramatta River flow into Homebush Bay: Haslams Creek from the south-west, and Powells Creek from the south. Haslams Creek runs through Sydney Olympic Park into Homebush Bay and is severely degraded from sedimentation and contamination from chemical wastes. Despite these

impacts, the mangroves associated with Haslams Creek are in a healthy condition (Olympic Co-ordination Authority 2000). Powells Creek has been straightened and moved eastwards by reclamation works in 1948, when it was converted into a concrete stormwater canal. The original Powells Creek now exists as a closed-system wetland.

Watery habitats within the study area are likely to be of poor quality due to past contaminations and on-going sedimentation. The surrounding mangroves however are in relatively good condition.

5.4.2 Aquatic species

A series of aquatic surveys were conducted in Homebush Bay as part of the Homebush Bay Ecological Studies (Smith *et al.* 1996). These surveys included habitats within the current study area. A summary table of species recorded is supplied in Appendix 3. Robinson *et al*. (1983) surveyed the benthic fauna of the saltmarsh and mangrove areas of Homebush Bay and Powells Creek, and found an assemblage of polechaetes, molluscs and crustaceans of similar diversity to other estuarine mangrove and saltmarsh habitats subject to comparable physical factors.

5.4.3 Significant aquatic species

No threatened aquatic species have been previously recorded within 10 km of the study area. Potential habitat for two threatened fish and four threatened marine turtles (Table 3) has been previously recorded within 10 km of the study area (DSEWPaC Online EPBC Protected Matters Database). While there is potential for any of the four protected marine turtles to occur in the study area, their presence is likely to be incidental, the area is not likely to provide core habitat for these species, and the potential impacts are negligible in context of the species' overall range. The Macquarie Perch *Macquaria austalascia* has a limited range in NSW, found only to occur in the upper reaches streams above Lake Wyangala and Burrinjuck Dam (Schiller *et al.* 1997), and is not considered likely to be found in the study area. The Australian Grayling *Prototroctes maraena* is a primarily freshwater species found in the upper reaches of rivers. While the larval stage of the fish occurs in marine environments, it is unlikely that the study area provides habitat for this species.

The Hairy Pipefish *Urocampus carinirostris* has been previously recorded in the study area and is listed as "protected" under Section 19 of the FM Act.

Table 3: Aquatic fauna listed on the FM and/or EPBC Acts that may occur in the local area

Key: 1) Listed on the EPBC Act as Endangered (E), Vulnerable (V), Migratory (M) or Marine (Ma).
2) Listed on the TSC Act as Endangered (E1) or Vulnerable (V).
3) Listed on the FM Act as Vulnerable (V) or Protected (P).

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	FM Act[3]	Habitat	Potential Habitat in Study area?
Fish					
Macquaria australasica Macquarie Perch	E	-	V	Occurs within Upper Murray, Murrumbidgee and Lachlan system. Eastern population in Hawkesbury and Shoalhaven and an introduced population in the upper Yarra may have been introduced to other dams in eastern drainages of NSW. Prefers cool, clean water preferring deep slow flowing pools and lakes. Eastern populations are genetically distinct from western populations. Lay demersal eggs upstream of shallow riffled flow over gravel bottoms. Feeds on aquatic insects and crustaceans (McDowall 1996).	No (no previous records within 10 km)
Urocampus carinirostris Hairy Pipefish	Ma	-	P	Widespread along most of Australia's coast, occurring in estuaries and lower reaches of rivers with Zostera (seagrass) beds. Also observed around Sydney harbour beaches, associated with long stringy algae on low reefs and sand to 5 m (Kuiter 2000).	Yes (previously recorded in study area)
Prototroctes maraena Australian Grayling	V	-	P	Distribution includes coastal Victorian and South East New South Wales. Occurs in clear, gravely coastal streams and rivers from the sea to the first barrier up to 1000 m. Spawn in April after upstream movement, larvae migrate to marine waters and return as juveniles. Feeds on algae and aquatic and terrestrial insects (McDowall 1996).	No (no previous records within 10 km)
Marine Turtles					
Caretta caretta Loggerhead Turtle	EM	E1	-	In Australia, the Loggerhead Turtle occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia. While nesting is concentrated in southern Queensland and from Shark Bay to the North West Cape in Western Australia, foraging areas are more widely distributed. Small Loggerhead Turtles live at or near the surface of the ocean and move with the ocean currents. In eastern Australia, there is evidence that they spend around 15 years or more in the open ocean, with much of their feeding in the top 5 m of water, before recruiting to their chosen inshore or neritic feeding area. Loggerhead Turtles choose a wide variety of tidal and sub-tidal habitat as feeding areas and show fidelity to both their foraging and breeding areas (DSEWPC 2010d).	Limited (no previous records within 10 km)

Latin Name Common Name	EPBC Act[1]	TSC Act[2]	FM Act[3]	Habitat	Potential Habitat in Study area?
Chelonia mydas Green Turtle	VM	V	-	Marine species with a pan-tropical distribution throughout the world. More abundant along the tropical coasts of Australia and the Great Barrier Reef (Cogger 1992). Green Turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with driftlines and rafts of Sargassum (a floating marine plant that is also carried by currents). Once Green Turtles reach 30 to 40 cm curved carapace length, they settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The shallow foraging habitat of adults contains seagrass beds or algae mats on which Green Turtles mainly feed (DSEWPC 2010a).	Limited (no previous records within 10 km)
Eretmochelys imbricate Hawksbill Turtle	VM	-	-	Hawksbill Turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with rafts of Sargassum (a floating marine plant that is also carried by currents). Once Hawksbill Turtles reach 30 to 40 cm curved carapace length, they settle and forage in tropical tidal and sub-tidal coral and rocky reef habitat. They primarily feed on sponges and algae. They have also been found, though less frequently, within seagrass habitats of coastal waters, as well as the deeper habitats of trawl fisheries. Major nesting of Hawksbill Turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia, and in the northern Great Barrier Reef and Torres Strait (DSEWPC 2010b).	Limited (no previous records within 10 km)
Dermochelys coriacea Leathery Turtle	VM	V	-	Marine species usually sighted along the eastern seaboard often in bays, estuaries and rivers (Cogger 1992). No major nesting has been recorded in Australia, although scattered isolated nesting (one to three nests per annum) occurs in southern Queensland and the Northern Territory. Some nesting has occurred in northern NSW near Ballina. However, no nesting has occurred in Queensland or NSW since 1996. Diet is dominated by gelatinous organisms such as jellyfish, salps, squid and siphonophores (DSEWPC 2010c).	Limited (no previous records within 10 km)

5.5 Endangered populations

An endangered population is a population listed under Part 2 of Schedule 1 of the TSC Act and is defined as a population that, in the opinion of the NSW Scientific Committee, is facing a very high risk of extinction in NSW in the near future. A population is not eligible to be listed as an endangered population if it is a population of a species already listed in Schedule 1 or 1A (ie. already listed as an endangered or critically endangered species).

Two endangered populations of plant and three endangered populations of animal have been previously recorded within 10 km of the study area:

- Tadgell's Bluebell in the LGAs of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield.
- *Pomaderris prunifolia* (a shrub) population in the Parramatta, Auburn, Strathfield and Bankstown LGAs.
- White-fronted Chat population in the Sydney Metropolitan Catchment Management Authority Area.
- Little Penguin *Eudyptula minor* population in the Manly point area.
- Long-nosed Bandicoot *Perameles nasuta* population in inner western Sydney.

As shown above in Tables 1 and 2, potential habitat is only considered to occur within the study area for the White-fronted Chat endangered population. Potential impacts of the proposal on this population are discussed in Section 6.0 (Impact Assessment) of this report.

Individuals of the Gang-gang Cockatoo *Callocephalon fimbriatum* endangered population in the Hornsby and Ku-ring-gai LGAs have also been recorded within 10 km of the study area however the study area is not considered to provide habitat for individuals of this species (listed as Vulnerable on the TSC Act) or of the endangered population (Table 2).

5.6 Critical habitat

Critical habitat can de declared under both the EPBC and TSC Acts. Under the EPBC Act, it is an offence for a person to take an action that the person knows will significantly damage the critical habitat of a listed threatened species. Under the TSC Act, the declaration of critical habitat serves primarily as a guide for planning under Part 3 of the EP&A Act and a trigger which ensures a rigorous environmental assessment of all activities and developments proposed, and any

other action that has the potential to damage the species or its habitat (NPWS 2002a).

No areas of critical habitat for flora or fauna have been declared within the locality.

6.0 IMPACT ASSESSMENT

The construction of the proposed bridge will directly impact on the aquatic environs of the subject site through disturbance to soil and sediments and the water column. Direct impacts to terrestrial species and/or habitats will be limited to the loss of a small area of air space over the Bay that may provide a flight path for aerial species.

Indirect impacts that may result from the proposal include contamination of surrounding vegetation from disturbed sediment, changes in surface water flows and water quality, weed invasion, erosion and siltation, and deposition of dust. Due to the deployment of sediment booms and curtains, indirect impacts resulting from disturbed sediment are considered to be minimal (Golder Associates 2011). Further discussions of impacts that are considered relevant to the proposal are provided below. Impacts that are considered specific to threatened species are included in the Assessments of Significance (see Appendices 4 and 5).

6.1 Potential impacts of the proposal

6.1.1 Vegetation clearing and habitat loss

'Clearing of native vegetation' is listed as a Key Threatening Process (KTP) under Schedule 3 of the TSC Act, and 'Land clearance' is listed as a KTP under the EPBC Act. The Final Determination in the TSC Act for this KTP lists some of the impacts of the clearing of native vegetation on biological diversity as:

- Destruction of habitat resulting in the loss of local populations of individual species.
- Fragmentation.
- Expansion of dryland salinity.
- Riparian zone degradation.
- Increased habitat for invasive species.
- Loss of leaf litter layer.
- Loss or disruption of ecological function.
- Changes to soil biota.

No areas mapped as a native plant community will be removed by the proposal. The proposal will result in very minimal direct impacts to native vegetation with only a few scattered native herbs and planted trees likely to be removed The

extent of native vegetation cover within the subject site is described in Section 5.1.2.

6.1.2 Degradation of native riparian vegetation

'The degradation of native riparian vegetation along NSW water courses' is listed as a KTP under Schedule 6 of the FM Act. The Final Determination in the FM Act for this KTP lists some of the impacts as:

- Increasing the amount of sediment and nutrients reaching streams as runoff, and increasing light penetration of the water body.
- Reducing the inputs of organic carbon, via leaves, twigs, and branches.
- Reducing the amount of large woody debris entering the aquatic ecosystem and thereby negatively impacting on habitat and spawning sites of several vulnerable and endangered species listed under the FM Act.
- Destabilising river banks.

The proposal has minimal potential to direct impact on native riparian vegetation. The subject site is highly modified and contains no riparian vegetation. Golder Associates (2011) predict minimal spread of suspended sediments and other materials within the study area provided their mitigation measures are implemented. The riparian vegetation occurring at the northern and southern extents of the study area is therefore considered unlikely to be impacted by the proposal.

6.1.3 Removal of large woody debris

'The removal of large woody debris' is listed as a KTP under Schedule 6 of the FM Act. The Final Determination in the FM Act for this KTP lists some of the impacts of the removal of LWD as the loss of:

- Habitat for benthic plants.
- Organic enrichment by capturing detritus and contributing to secondary production by degradation of the debris itself.
- Refuges from predators and interactions between competitors.
- Velocity refuges that minimise energy costs of swimming.
- Spawning sites essential for successful reproduction.
- Refuge and spawning habitats in the riparian zone during overbank flooding.

- Erosion prevention by sedimentary stabilisation of stream banks and riparian zones.

- Temperature and drought refuges formed by scouring of deep holes adjacent to large woody debris.

The proposal is unlikely to result in the removal LWD, which is largely absent from the subject site. Mitigation measures have been prescribed in this report and include the relocation of LWD within the study area rather than removal.

6.1.4 Changes in drainage patterns and water quality

'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is a KTP listed under Schedule 3 of the TSC Act. The Final Determination for this KTP states that alteration to natural flow regimes can occur through:

- Reducing or increasing flows.

- Altering seasonality of flows.

- Changing the frequency, duration, magnitude, timing, predictability and variability of flow events.

- Altering surface and sub-surface water levels.

- Changing the rate of rise or fall of water levels.

The proposal requires the installation of five pylons in Homebush Bay, which is subject to freshwater drainage into the Parramatta River estuary. Given the small size of these pylons relative to the overall waterbody, it is highly unlikely that their presence will significantly alter freshwater flow events.

Water quality has been addressed by Golder Associates (2011). Water quality may be affected by disturbed sediments however the use of sediment booms and curtains during construction will greatly reduce the risk.

6.1.5 Installation and operation of in-stream structures

'The installation and operation of in-stream structures and other mechanisms that alter natural flow regimes of river and streams' is listed as a KTP under Schedule 6 of the FM Act. The Final Determination in the FM Act for this KTP lists some of the impacts as:

- Changes to natural seasonality and variability of flow regimes (duration, extent and rate), as a result of water regulation for flood mitigation and irrigation, impact on native species by disrupting natural environmental cues

necessary for reproductive cycles (including migration, spawning, growth and recruitment).

- Reduction of habitat due to changes in the area, frequency and duration of inundation of floodplains and terminal wetlands limits distributions and reduces spawning successes.

- Alteration to the natural flow regimes by in-stream structures and other mechanisms can cause changes in physical, chemical and biological conditions that in turn alter the biota. Disruption of ecological processes may continue long after initial flow alteration, causing continued decline in biological diversity.

As stated above in Section 6.1.4, the proposal requires the installation of five pylons in Homebush Bay which is subject to freshwater drainage into the Parramatta River estuary. Given the small size of these pylons relative to the overall waterbody, it is highly unlikely that their presence will significantly alter freshwater or tidal flow events.

The construction of the proposed bridge and associated in-stream structures has the potential to impact the aquatic habitats within the study area. Potential impacts include:

- Downstream degradation of water quality and aquatic habitat through increased sedimentation, pollutants and altered hydrology. Pollution could potentially enter waterways via runoff, airborne transport of spray and dust, or a spillage event and could result in physical or chemical changes in water quality.

- Physical changes - sedimentation can have detrimental ecological effects, including a reduction in substrate and depth heterogeneity, smothering and killing of demersal eggs, smothering of macroinvertebrates, smothering of food sources, smothering of vegetation, impacts on fish respiration (gills become clogged), reduced feeding ability, transportation of pollutants attached to sediment and reduced light penetration for aquatic vegetation.
- Chemical changes - that is, chemical contaminants with the potential to exert toxic effects at concentrations that might be encountered in the environment. Free chemicals or chemical compounds utilised during construction works could potentially be toxic to aquatic biota in small concentrations.

Again, water quality has been addressed by Golder Associates (2011). Water quality may be affected by disturbed sediments however the use of sediment booms and curtains during construction will greatly reduce the risk.

6.1.6 Weed invasion

Invasion of native plant communities by exotic perennial grasses is listed as a KTP under Schedule 3 of the TSC Act. The subject site is largely devoid of vegetation however does contain some native and exotic plants. Weed invasion has the potential to occur in all areas cleared and disturbed by the proposal. The dominant weed species present in the subject site include both herbaceous weeds and exotic perennial grasses.

Weed propagules may be dispersed during construction of the proposed bridge. Apart from altering local flora assemblages and competitively displacing native plant species, weed invasion also has the potential to modify habitat features for local fauna species. However, given that the subject site is significantly cleared of vegetation, the proposal is considered unlikely to significantly increase the prevalence of weeds. Therefore, it is also unlikely that the proposal would result in the invasion of native plant communities by weeds.

6.1.7 Erosion and siltation

Erosion and siltation can result from vegetation clearing and soil disturbance from construction. Given the highly altered nature of the subject site, erosion and siltation of terrestrial flora and fauna habitats is considered to be negligible. Impacts on water quality and aquatic habitats due to erosion and/or sedimentation have been discussed above (see Sections 6.1.2. 6.1.4 and 6.1.5).

Any attempt to control erosion or contamination will be limited by the efficacy of mitigation strategies and will depend on the type of structure(s) used and the level of maintenance throughout the construction phase of the proposal.

6.1.8 Dust and noise

Dust and noise may temporarily affect terrestrial and aquatic habitats and species during the construction phase of the proposal. Given the subject site includes a large water body, mitigation measures will need to be implemented to control the amount of dust potentially entering Homebush Bay.

Noise and vibration may result from construction activities. This may startle some fauna species and may cause temporary disruption and emigration from vegetated areas nearby to the subject site. However, noise and vibration impacts will be temporary in nature and will be subject to noise attenuation practices that would be implemented as part of a construction noise management plan.

6.2 Part 3A guidelines for threatened species assessment (EP&A Act)

The impacts of the proposal on threatened species, populations and ecological communities listed under the TSC Act have been undertaken following the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC & DPI 2005). Where threatened species, populations and/or communities **are recorded** within a study area, an impact assessment is required under the EP&A Act. When threatened species, populations and/or communities **are not recorded** during a survey, the presence of potential habitat for a species (or population or community) is used to determine the need to undertake an impact assessment under the EP&A Act. Where there is no potential habitat in the study area for threatened species, populations and/or communities, there is unlikely to be any impact and therefore these species (or populations or communities) are not required to be considered further.

Key thresholds

The Part 3A Guidelines of the EP&A Act (DEC & DPI 2005) set out a number of key thresholds which need to be addressed to justify the impacts of the proposal on threatened species, populations and ecological communities. The key thresholds are (DEC & DPI 2005):

1. Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts, will maintain or improve biodiversity values.

2. Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.

3. Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.

4. Whether or not the proposal will adversely affect critical habitat.

Based on the assessment of impact following the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act, the following conclusions have been attributed to the proposal for TSC and FM Act-listed species, populations and communities.

6.2.1 Potential impacts on endangered ecological communities

No EEC's occur within the subject site however one EEC, Coastal Saltmarsh, occurs within the study area and therefore may be subject to indirect impacts resulting from the proposal. A Part 3A Assessment of Significance has been conducted in regard to the potential impact of the proposal on the Coastal

Saltmarsh (Appendix 4). The assessment concluded that the proposal is unlikely to have a significant impact on this community.

6.2.2 Potential impacts on endangered populations

Numerous records of individuals of the White-fronted Chat endangered population have been previously made within 10 km of the study area, including one record within the study area (OEH Atlas of NSW Wildlife and Birds Australia Atlas). This species breeds and forages within saltmarsh and mangroves, both of which occur in the study area. Although the proposal would result in no direct impacts and only minimal indirect impacts, an Assessment of Significance is required due to the previous record of the species within the study area (Appendix 4). The assessment concluded a significant impact by the proposal to be unlikely.

6.2.3 Potential impacts on threatened plant species

No threatened plant species were recorded within the subject site during the current survey and no species have been assessed as potentially occurring. One threatened plant species, Narrow-leafed Wilsonia has been assessed as potentially occurring within the study area. A Part 3A Assessment of Significance has been conducted in regard to the potential impact of the proposal on Narrow-leafed Wilsonia (Appendix 4). The assessment concluded a significant impact by the proposal to be unlikely.

6.2.4 Potential impacts on terrestrial fauna

Where there is potential habitat (foraging or breeding resources) for threatened species in the study area, further consideration must be given to the potential impact of the proposal on these species. The proposal may impact on threatened species by causing any of the following:

- death or injury of individuals.
- loss or disturbance of limiting foraging resources.
- loss or disturbance of limiting breeding resources.

Limiting resources are specialised habitat components that species are dependent on for their ongoing survival. Such limiting resources are predominantly associated with specialised breeding habitats (such as tree hollows or suitable nest/maternity roost sites) that occur at low densities, with high levels of competition from a range of species. However, for some species, limiting resources include specialised foraging habitats that have a restricted distribution (e.g. Koalas feeding only on specific tree species).

Table 4 summarises the possible impacts from the proposal on the 12 TSC Act-listed threatened fauna species with known and/or potential habitat in the study area, and determines the need for Part 3A impact assessments. Based on the nature of the proposal (see Section 2.4.2), database interrogation, literature review regarding the ecology of each species, and information gathered during the field survey within the study area, 10 of these species are considered as unlikely to be subject to negative impacts resulting from the proposal. Accordingly, no Part 3A impact assessments have been prepared for these species.

Part 3A Assessments of Significance have been prepared for the remaining two species: Australasian Bittern *Botaurus poiciloptilus* and Terek Sandpiper (Appendix 4). The assessments concluded a significant impact by the proposal to be unlikely.

Table 4: Potential impact and Part 3A impact assessment requirements for threatened terrestrial fauna listed on the TSC Act with potential habitat in the study area

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Birds							
Osprey	M	V	No	No	No	No	The Osprey has been previously recorded twice within 10 km of the study area; both records fall within the locality but outside the study area (OEH Atlas of NSW Wildlife). The Osprey may forage for fish over the open water within the study area, however, the potential foraging habitat within the study area is not considered to be limiting for this highly mobile species. Construction of the bridge would result in the loss of approximately 20,000m^3 of air space over Homebush Bay in which Osprey may forage. This species usually nests within 1 km of the sea (DEC 2005|); no nest trees were observed in the study area. Even if Osprey were to nest within the study area, no known or potential nest trees will be removed by the proposal. Given the proposal would not impact limiting breeding or foraging resources, that the remainder of Homebush Bay and much of the adjoining Parramatta River would remain available for foraging, the high mobility of this species, and the lack of records within the locality (only two), it is considered unlikely that the proposal would impact on the Osprey and therefore an Assessment of Significance is not recommended for this species.

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Australasian Bittern	E	E1	No	Unlikely	No	**Yes**	The Australasian Bittern has been previously recorded three times within 10 km of the study area, including once within the study area and once just outside the study area (OEH Atlas of NSW Wildlife and Birds Australia Atlas). Breeding resources (dense and emergent reeds) are absent from the study area however this species may forage within the study area in the cover of the mangroves for frogs, fish, yabbies, spiders, insects and snails (DEC 2005b). Although the proposal would result in no direct impacts and only minimal indirect impacts, an Assessment of Significance is required due to the previous record of the species within the study area (Appendix 4).
Glossy Black-cockatoo	-	V	No	No	No	No	The Glossy Black-cockatoo has been previously recorded three times within 10 km of the study area; all records occur outside the study area and the locality (OEH Atlas of NSW Wildlife and Birds Australia Atlas). No potential breeding resources occur within the study area. The Glossy Black-cockatoo feeds almost exclusively on the seeds of Allocasuarina species (DEC 2005p), which are absent from the study area. Some planted casuarina trees occur within the subject site and have been considered marginal potential habitat for the Glossy Black-cockatoo. However, given no limiting breeding or foraging resources would be impacted, the absence of records of Glossy Black-cockatoo from the locality, and the species' high mobility, it is considered unlikely that the proposal would impact on this species and therefore an Assessment of Significance is not recommended.

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Greater Sand Plover	M	V	No	No	No	No	The Greater Sand Plover has been recorded only once within 10 km of the study area; outside of the study area but within the locality (OEH Atlas of NSW Wildlife). Further this record is dated 20 years old. No breeding habitat occurs within the study area as this species breeds in the Northern Hemisphere. No limiting foraging resources occur within the study area as this species prefers sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks (DEC 2005r). This species may forage on the mudflats amongst the mangroves on the odd occasion however is unlikely to be dependent on habitats within the study area for on-going survival. Given the above, and the predicted minimal impacts to mangroves and their associated mudflats within the study area, it is considered unlikely that the proposal would impact on this species and therefore an Assessment of Significance is not recommended for the Greater Sand Plover.
Lesser Sand Plover	M	V	No	No	No	No	The Lesser Sand Plover has been recorded only once within 10 km of the study area; outside of the study area and the locality (OEH Atlas of NSW Wildlife). Further this record is dated 27 years old. No breeding habitat occurs within the study area as this species breeds in the Northern Hemisphere. No limiting foraging resources occur within the study area as this species prefers the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats (DEC 2005x). This species may forage on the mudflats amongst the mangroves on the odd occasion however is unlikely to be dependent on habitats within the study area for on-going survival. Given the above, and the predicted minimal impacts to mangroves and their associated mudflats within the study area, it is considered unlikely that the proposal would impact on this species and therefore an Assessment of Significance is not recommended for the Lesser Sand Plover.

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Little Tern	M	E1	No	No	No	No	The Little Tern has been previously recorded three times within 10 km of the study area, including twice within the locality (OEH Atlas of NSW Wildlife and Birds Australia Atlas). No recent records have been made with the three records dating back between 13 and 26 years old. No breeding habitat occurs within the study area as this species requires sandy beaches or dunes for its nest. This species may forage on occasion with the study area over shallow water for small fish, crustaceans and insects (DEC 2005z) however, no limiting foraging resources occur. Given the above, and the predicted minimal impacts to the Bay, it is considered unlikely that the proposal would impact on this species and therefore an Assessment of Significance is not recommended for the Little Tern.
Broad-billed Sandpiper	M	V	No	No	No	No	The Broad-billed Sandpiper has been recorded only once within 10 km of the study area; just outside of the study area (OEH Atlas of NSW Wildlife). This record is 33 years old. No breeding habitat occurs within the study area as this species breeds in the Northern Hemisphere. The Broad-billed Sandpiper prefers sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs for foraging and roosting (DEC 2005e). Given the wide range of habitats this species may utilise, no limiting foraging resources are considered to occur within the study area. Given the above, and the predicted minimal impacts to saltmarsh and mangroves within the study area, it is considered unlikely that the proposal would impact on this species and therefore an Assessment of Significance is not recommended for the Broad-billed Sandpiper.

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Black-tailed Godwit	M	V	No	No	No	No	The Black-tailed Godwit has been previously recorded three times within 10 km of the study area, including twice within the locality (OEH Atlas of NSW Wildlife and Birds Australia Atlas). No recent records have been made within the locality but one record was made in 2009 approximately 7 km south-east of the study area (OEH Atlas of NSW Wildlife). No breeding habitat occurs within the study area as this species breeds in the Northern Hemisphere. The Black-tailed Godwit prefers sheltered bays, estuaries and lagoons with large intertidal mudflats, sandflats and saltmarsh for foraging (DEC 2005d). Given the wide range of habitats this species may utilise, no limiting foraging resources are considered to occur within the study area. Given the above, and the predicted minimal impacts to saltmarsh and sheltered mudflats within the study area, it is considered unlikely that the proposal would impact on this species and therefore an Assessment of Significance is not recommended for the Black-tailed Godwit.
Terek Sandpiper	M	V	No	Unlikely	No	**Yes**	The Terek Sandpiper has been previously recorded twice within 10 km of the study area, including once within the locality (OEH atlas of NSW Wildlife and Birds Australia Atlas). This species was recorded as recently as 2010. No breeding habitat occurs within the study area as this species breeds in the Northern Hemisphere. The Terek Sandpiper favours mudbanks and sandbanks located near mangroves for foraging and shelter. Although the proposal would result in no direct impacts and only minimal indirect impacts to the mangroves and associated mudflats, an Assessment of Significance is required due to the potential for the proposal to impact a limiting foraging resource (Appendix 4).
Mammals							

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Grey-headed Flying-fox	V	V	No	No	No	No	The Grey-headed Flying-fox has been previously recorded almost 80 times within 10 km of the study area, of which 15 records occur within the locality (OEH Atlas of NSW Wildlife). No records occur within the study area itself. Grey-headed Flying-foxes are likely to forage within the mangroves lining the northern and southern banks of the study area, and may fly over the Bay between foraging sites. The species is highly mobile; known to forage up to 50 km from a roost site feeding on a range of fruits and blossoms (DEC 2005t). The feeding resources provided by the mangroves are not considered to be a limiting resource for this species. Nor does any breeding habitat occur within the study area. Although construction of the bridge would result in the loss of approximately 20,000m^3 of air space over Homebush Bay through which the Grey-headed Flying-fox may fly, there is no evidence that it is a regular flight path of the species. Given the proposal would not impact limiting breeding or foraging resources, that mangroves would not be directly or significantly indirectly impacted, the absence of records of this well-recognised and conspicuous species from the study area, and the species' high mobility, it is considered unlikely that the proposal would impact on the Grey-headed Flying-fox and therefore an Assessment of Significance is not recommended for this species.

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Eastern Bentwing-bat	-	V	No	No	No	No	The Eastern Bentwing-bat has been previously recorded 24 times within 10 km of the study area, of which four records occur within the locality (OEH Atlas of NSW Wildlife). The species has not been recorded within the study area itself, but this could be due to a lack of surveys rather than the species' absence. The Eastern Bentwing-bat requires caves for breeding which are not present in the study area. A number of wooden piers within the study area may provide limited temporary roosting opportunities however none would be directly impacted by the proposal. The species may forage within the study area for flying insects. However, neither the roosting nor the foraging habitat within the study area is considered to be limiting. Although construction of the bridge would result in the loss of approximately 20,000m^3 of air space over Homebush Bay through which the Eastern Bentwing-bat my fly, the bridge may actually create temporary roosting habitat (under the bridge) and increase foraging habitat (with lighting along the bridge that would attract insects). Given the proposal would not impact limiting breeding or foraging resources, that vegetated foraging habitat (e.g. mangroves) would not be directly or significantly indirectly impacted, and the species' ability to easily manoeuvre around structures (using echolocation), it is considered unlikely that the proposal would impact on the Eastern Bentwing-bat and therefore an Assessment of Significance is not recommended for this species.

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Southern Myotis	-	V	No	No	No	No	The Southern Myotis has been previously recorded once within 10 km of the study area; outside of the study area and the locality (OEH Atlas of NSW Wildlife). This species roosts and breeds in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage (DEC 2005…). Colonies occur close to permanent water bodies. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects (Richards *et al.* 2008). The study area does not provide breeding habitat for this species. The study area provides only non-limiting roosting and foraging habitat for the Southern Myotis. Although construction of the bridge would result in the loss of approximately 20,000m^3 of air space over Homebush Bay through which the Southern Myotis my fly, the bridge may actually create temporary roosting habitat (under the bridge) and increase foraging habitat (with lighting along the bridge that would attract insects). Given the proposal would not impact limiting breeding or foraging resources, that vegetated foraging habitat (e.g. mangroves) would not be directly or significantly indirectly impacted, and the species' ability to easily manoeuvre around structures (using echolocation), it is considered unlikely that the proposal would impact on the Southern Myotis and therefore an Assessment of Significance is not recommended for this species.

6.2.5 Potential impacts on aquatic fauna

Three of the four marine turtles determined to have potential habitat in the study area are TSC Act-listed threatened fauna. Table 5 summarises the possible impacts from the proposal on these species and determines the need for Part 3A impact assessments. Given that the study area does not form a significant part of these species' habitat or range, and that their potential occurrence is likely to be incidental or transitory only, these species are considered as unlikely to be subject to negative impacts resulting from the proposal. Accordingly, no Part 3A impact assessments have been prepared for these species.

The Hairy Pipefish *Urocampus carinirostris* is listed as Protected under Section 19 of the FM Act. The protection provided for these fish relates primarily to deliberate capture, harvest, trade and possession. There are no requirements for an Assessment of significance for species listed as Protected under the FM Act.

Table 5: Potential impact and Part 3A impact assessment requirements for threatened aquatic fauna listed on the TSC Act with potential habitat in the study area

Common Name	EPBC Act	TSC Act	Potential Impacts on Threatened Species			Impact Assessment required?	Reasoning
			Individual death or injury?	Loss or disturbance of limiting foraging resources?	Loss or disturbance of limiting breeding resources?		
Marine Turtles							
Loggerhead Turtle	EM	E1	No	No	No	No	Loggerhead Turtles are known to inhabit coastal bays around Sydney, primarily associated with seagrass beds (OEH Atlas of NSW Wildlife). While there is potential for their presence in the study area, such occurrences would be incidental and transitory, therefore an Assessment of Significance is not recommended for this species.
Green Turtle	VM	V	No	No	No	No	Green Turtles are known to inhabit Sydney Harbour, primarily areas associated with seagrass beds (OEH Atlas of NSW Wildlife). While there is potential for their presence in the study area, such occurrences would be incidental and transitory, therefore an Assessment of Significance is not recommended for this species.
Leathery Turtle	VM	V	No	No	No	No	Leathery Turtles are known to inhabit coastal bays around Sydney, primarily associated with seagrass beds (OEH Atlas of NSW Wildlife). While there is potential for their presence in the study area, such occurrences would be incidental and transitory, therefore an Assessment of Significance is not recommended for this species.

6.2.6 Key threshold results

Table 6 below summarises the responses to the last three key thresholds based on the impacts described above and the Part 3A Assessments of Significance for TSC Act-listed species with potential habitat in the study area.

Table 6: Key thresholds results summary

	Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.	Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.	Whether or not the proposal will adversely affect critical habitat.
Terrestrial flora	Unlikely	Unlikely	No
Terrestrial fauna	Unlikely	Unlikely	No
Aquatic ecology	Unlikely	Unlikely	No

Maintenance of biodiversity values

The subject site is currently disturbed and largely devoid of native vegetation. The proposal will not require the removal of any EEC, native plant communities or terrestrial fauna habitats. However, the proposal would potentially result in direct impacts to the aquatic habitats of the subject site.

Provided that the mitigation measures detailed in Section 7.0 are implemented, particularly the sediment boom and curtains recommended by Golder Associates (2011), the proposal is likely to maintain the biodiversity values of the locality.

6.3 Commonwealth significant impact criteria (EPBC Act)

Under the Commonwealth EPBC Act, if the proposal has the potential to have an adverse impact on a Matter of National Environmental Significance (including threatened species, migratory species and/or ecological communities) as listed under the Act, the proposal must be referred to the Federal Minister for the Environment for further consideration. The Significant Impact Criteria are used to assess the likelihood of impact in accordance with the former Department of Environment, Heritage, Water and the Arts (DEWHA) publication *EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance* (DEWHA 2009c).

6.3.1 Potential impacts on endangered ecological communities

No EEC's listed on the EPBC Act have been recorded or are considered likely to occur within the study area.

6.3.2 Potential impacts on threatened plant species

No threatened plant species listed on the EPBC Act have been recorded or are considered likely to occur within the study area.

6.3.3 Potential impacts on terrestrial fauna

Endangered fauna

One endangered EPBC Act-listed fauna species has potential habitat within the study area: Australasian Bittern. Breeding resources (dense and emergent reeds) are absent from the study area however this species may forage within the study area in the cover of the mangroves for frogs, fish, yabbies, spiders, insects and snails (DEC 2005b). A Significant Impact Criteria Assessment has been conducted for this species (Appendix 5) and concluded a significant impact by the proposal to be unlikely.

Vulnerable fauna

One vulnerable EPBC Act-listed fauna species has potential habitat within the study area: Grey-headed Flying-fox. Grey-headed Flying-foxes are likely to forage within the mangroves lining the northern and southern banks of the study area, and may fly over the Bay between foraging sites. The species is highly mobile; known to forage up to 50 km from a roost site feeding on a range of fruits and blossoms (DEC 2005t). The feeding resources provided by the mangroves are not considered to be a limiting resource for this species. Nor does any breeding habitat occur within the study area. Although construction of the bridge would result in the loss of approximately 20,000m^3 of air space over Homebush Bay through which the Grey-headed Flying-fox may fly, there is no evidence that it is a regular flight path of the species. Given the proposal would not impact limiting breeding or foraging resources, that mangroves would not be directly or significantly indirectly impacted, the absence of records of this well-recognised and conspicuous species from the study area, and the species' high mobility, it is considered unlikely that the proposal would impact on the Grey-headed Flying-fox and therefore a Significant Impact Criteria Assessment is not recommended for this species.

Migratory fauna

The list of migratory species under the EPBC Act is a compilation of species listed under four international conventions: China-Australia Migratory Bird

Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Forty-four migratory species or their habitat have been previously recorded within 10 km of the study area. Of these, 37 species are considered to have potential habitat within the study area. Potential impacts of the proposal on these species have been assessed against the Significant Impact Criteria for migratory fauna (Appendix 5). Results of the assessment concluded a significant impact by the proposal to be unlikely.

6.3.4 Potential impacts on aquatic fauna

Endangered fauna

One Endangered EPBC Act-listed aquatic fauna species has potential habitat within the study area: Loggerhead Turtle. The study area is not considered to be core habitat for the Loggerhead Turtle, and its potential occurrence is considered to be limited to incidental and transitory occurrences. Feeding resources provided by the aquatic habitats are not considered to be a limiting resource for this species. Breeding habitat is known to be limited to the northern range of the species and is not found in NSW. It is considered highly unlikely that the proposal would impact on the Loggerhead Turtle, and therefore a Significant Impact Criteria Assessment is not recommended for this species.

Vulnerable fauna

Three vulnerable EPBC Act-listed aquatic fauna species have potential habitat within the study area: the Green Turtle, Leatherback Turtle and Hawksbill Turtle. As with the Loggerhead Turtle, potential occurrences of these species in the study area are thought to be incidental and transitory only. Feeding resources provided by the aquatic habitats are not considered to be a limiting resource for these species. It is considered highly unlikely that the proposal would impact on any of these species, and therefore Significant Impact Criteria Assessments are not recommended.

Marine fauna

One EPBC Act ‘Marine Listed’ species has previously been recorded from the study area: Hairy Pipefish. Protection provided to Marine Listed species under Section 248 of the EPBC Act is restricted to Commonwealth waters (more than three nautical miles from the coast), and thus no Significant Impact Criteria Assessment is triggered here.

7.0 RECOMMENDATIONS

The proposal is considered unlikely to have a significant impact on threatened species, populations or ecological communities, provided the recommendations (and associated mitigation measures) specified in Golder Associates' *Homebush Bay Bridge Contamination Management Plan for Proposed Bridge Construction* (2011) are implemented including:

- Minimise dispersal of sediment and associated contaminants.
- Minimise leaching of soil contaminants to groundwater and the receiving environment.

Table 2 of Golder Associates (2011) provides specific mitigation measures, including the use of a sediment boom and curtains; appropriate storage of fuels; and, disposal of construction waste appropriately to a licenced facility. These mitigation measures must be implemented to reduce the risks to terrestrial and aquatic flora and fauna, and their habitats.

A number of additional recommendations have been made to ensure any potential impacts on the flora and fauna of the study area are minimised, including:

- All construction machinery and stockpiles be contained within the nominated temporary construction sites.
- Appropriate sediment fencing be erected around construction sites to protect Homebush Bay and associated drainages.
- Minimise the dispersal of construction dust into Homebush Bay and nearby drainages.
- In situ water quality should be measured both inside and outside the silt curtains during construction to monitor effectiveness of control measures. Specific monitoring measures will be defined within the Construction Environmental Management Plan (CEMP) and must ensure turbidity (NTU) within the silt curtains has reached acceptable limits prior to their removal.
- Large woody debris encountered within the subject site during construction should be relocated elsewhere within the study area as opposed to being removed.
- Retain planted native tree species on the western bank of the subject site where possible. Protect all areas of retained native vegetation including scattered trees during construction by means of temporary fencing. Fencing must be installed before construction work commences.

- Replace trees that are removed during construction with native species of local provenance.

- Implement a weed control program to ensure soil disturbance resulting from the construction of the bridge does not exacerbate weed invasion within the subject site and adjoining vegetation communities.

8.0 CONCLUSION

This report assesses the ecological significance of threatened plant and animal species, endangered populations and Endangered Ecological Communities that occur, or have the potential to occur, within the area affected by the proposal, in accordance with the EP&A Act, TSC Act, FM Act and the EPBC Act.

The TSC Act-listed EEC Coastal Saltmarsh is mapped as occurring within the study area and was recorded during field investigations. No threatened flora species were recorded during the field investigation however based on previous records adjacent to the study area and the habitat present, the TSC Act-listed threatened flora species Narrow-leafed Wilsonia is considered likely to occur within the study area.

The potential impacts from the construction of the bridge on Coastal Saltmarsh and Narrow-leafed Wilsonia is limited to contaminated sediment, dispersed during the construction of the bridge being deposited within foreshore vegetation. Part 3A Assessments of Significance conducted for the Coastal Saltmarsh EEC and Narrow-leafed Wilsonia concluded the proposal is unlikely to have a significant impact on this community or species.

No threatened terrestrial fauna species were recorded in the study area during the field investigation. However, potential habitat is considered to occur within the study area for 12 TSC Act-listed threatened fauna species and one endangered fauna population. Part 3A Assessments of Significance were conducted for Australasian Bittern (previously recorded in the study area), White-fronted Chat endangered population (previously recorded in the study area), and Terek Sandpiper (potential indirect impacts to limiting foraging habitat). These assessments concluded a significant impact by the proposal to be unlikely.

A Significant Impact Criteria Assessment was conducted for the Australasian Bittern (listed on both the EPBC and TSC Acts). The assessment concluded a significant impact by the proposal to be unlikely.

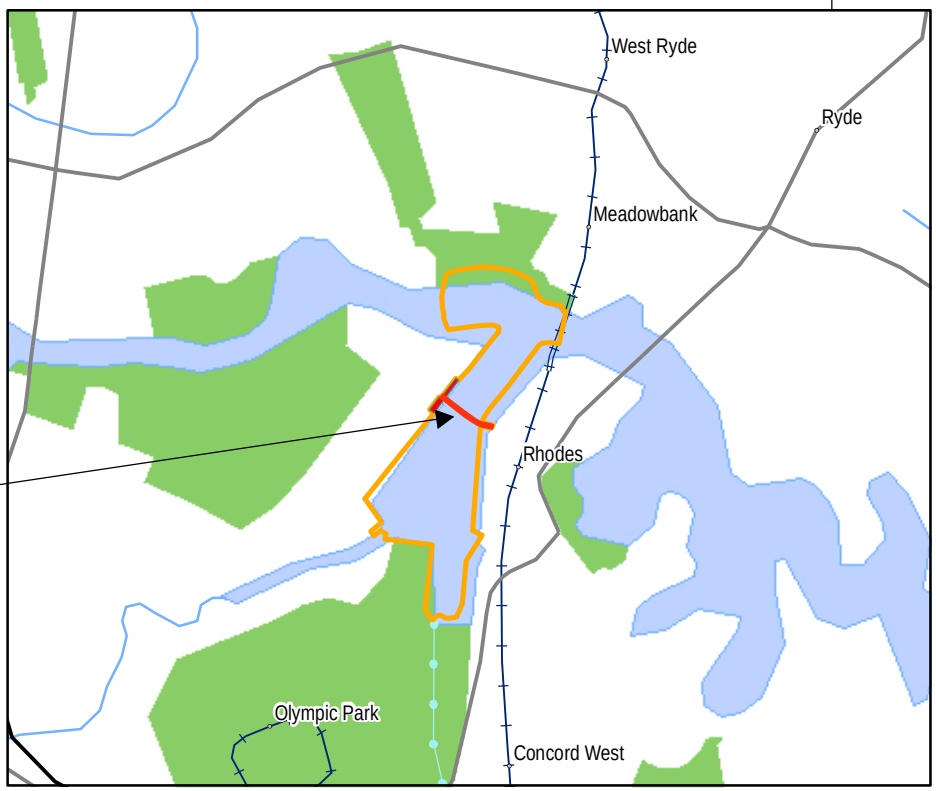
No migratory fauna species were recorded during the field survey however the study area is considered to support known and/or potential habitat for 37 migratory species. A Significant Impact Criteria Assessment was conducted for the migratory species and concluded a significant impact by the proposal to be unlikely.

A desktop survey of aquatic flora and fauna has been conducted within the study area. Four EPBC Act-listed turtles, three of which are also TSC Act-listed, were found to potentially occur in the study area. Such occurrences would be incidental and transient, as such no assessments are recommended for these species. The EPBC Act and FM Act-listed Hairy Pipefish has previously been

recorded in the study area, however no assessment requirements are triggered under this proposal.

A number of recommendations outlined in Section 7.0 of this report have been made to mitigate and/or minimise potential impacts to terrestrial and aquatic flora and fauna. Provided these recommendations, including mitigation measures specified by Golder Associates (2011), are implemented, the proposal is unlikely to significantly impact threatened terrestrial or aquatic biota.

FIGURES



Subject Site

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18-20 Mandible Street
Alexandria
NEW SOUTH WALES
2015

Figure 1: Location of the Study Area within a regional context

Date: 05 Aug 2011	Drawn By: JMS
File ID: 12926	Checked By: JC
Location: P:\12900s\12926\Mapping\12926_F1.mxd	

0 0.5 1 2

Kilometres

N

Figure 2: Overview of the Study Area

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2015

Date: 05 August 2011

Drawn by: JMS

Job number: 12926

Checked by: JC

Location: P:\12900s\12926\Mapping\12926_F2_Overview.mxd

Acknowledgements: Imagery provided by Arup

0 50100 200 300 400
Metres

Scale 1:10,980 at A3
Map Projection: GDA 1994 MGA Zone 56
Horizontal Datum: Geocentric Datum of Australia 1994

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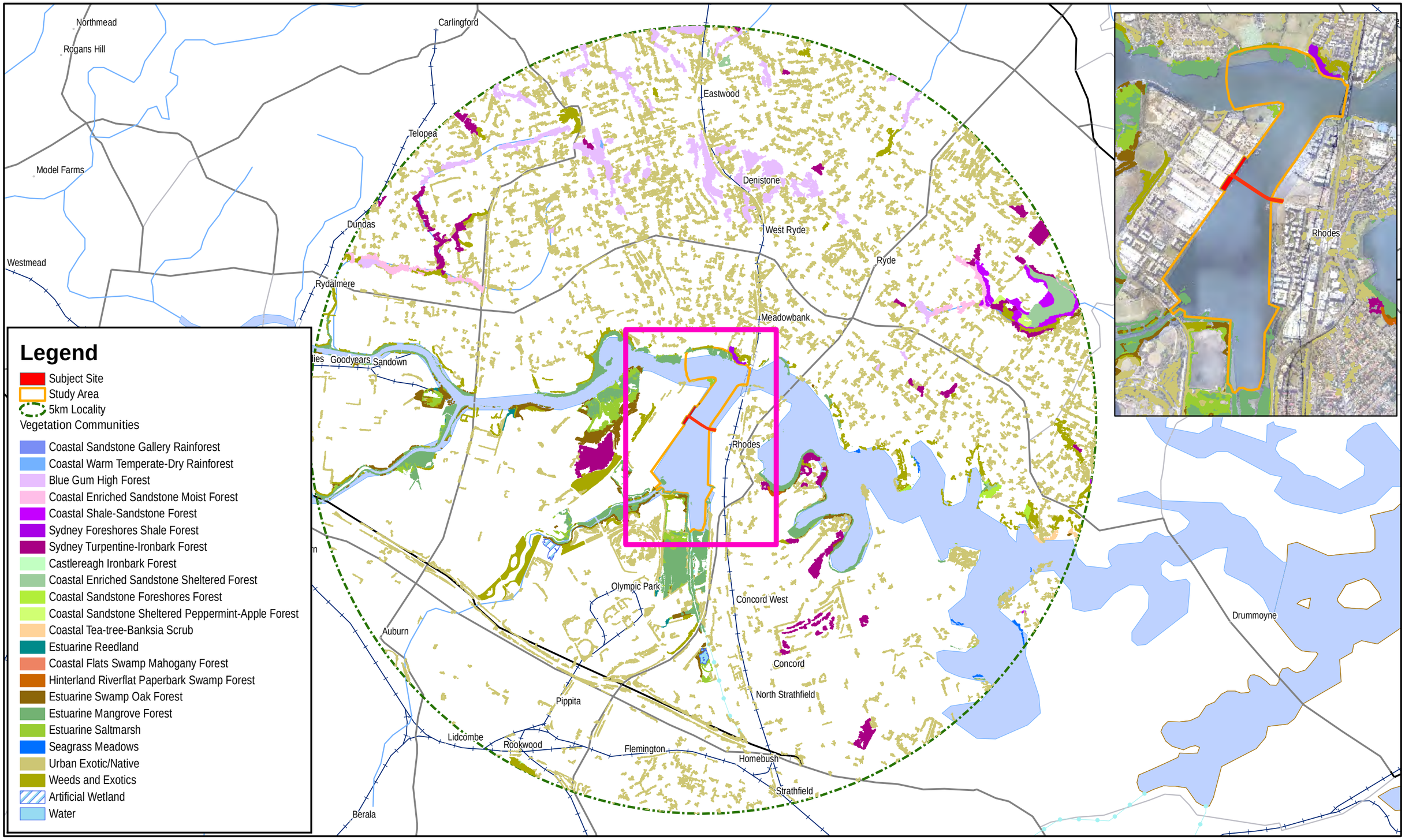

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2015

Figure 3: Vegetation Communities within the locality of the Study Area

Date: 09 August 2011	Drawn by: JMS
Job number: 12926	Checked by: JC
Location: P:\12900s\12926\Mapping\12926_F3_Vegetation.mxd	

Acknowledgements: DECCW (2009) The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area (Vol 1 & 2). Unpublished report funded by the Australian Government and the Sydney Metro Catchment Management Authority. Department of Environment, Climate Change & Water, Hurstville. Imagery provided by Arup

0 600 1,200 1,800 2,400
Metres

Scale 1:45,000 at A3
Map Projection: GDA 1994 MGA Zone 56
Horizontal Datum: Geocentric Datum of Australia 1994

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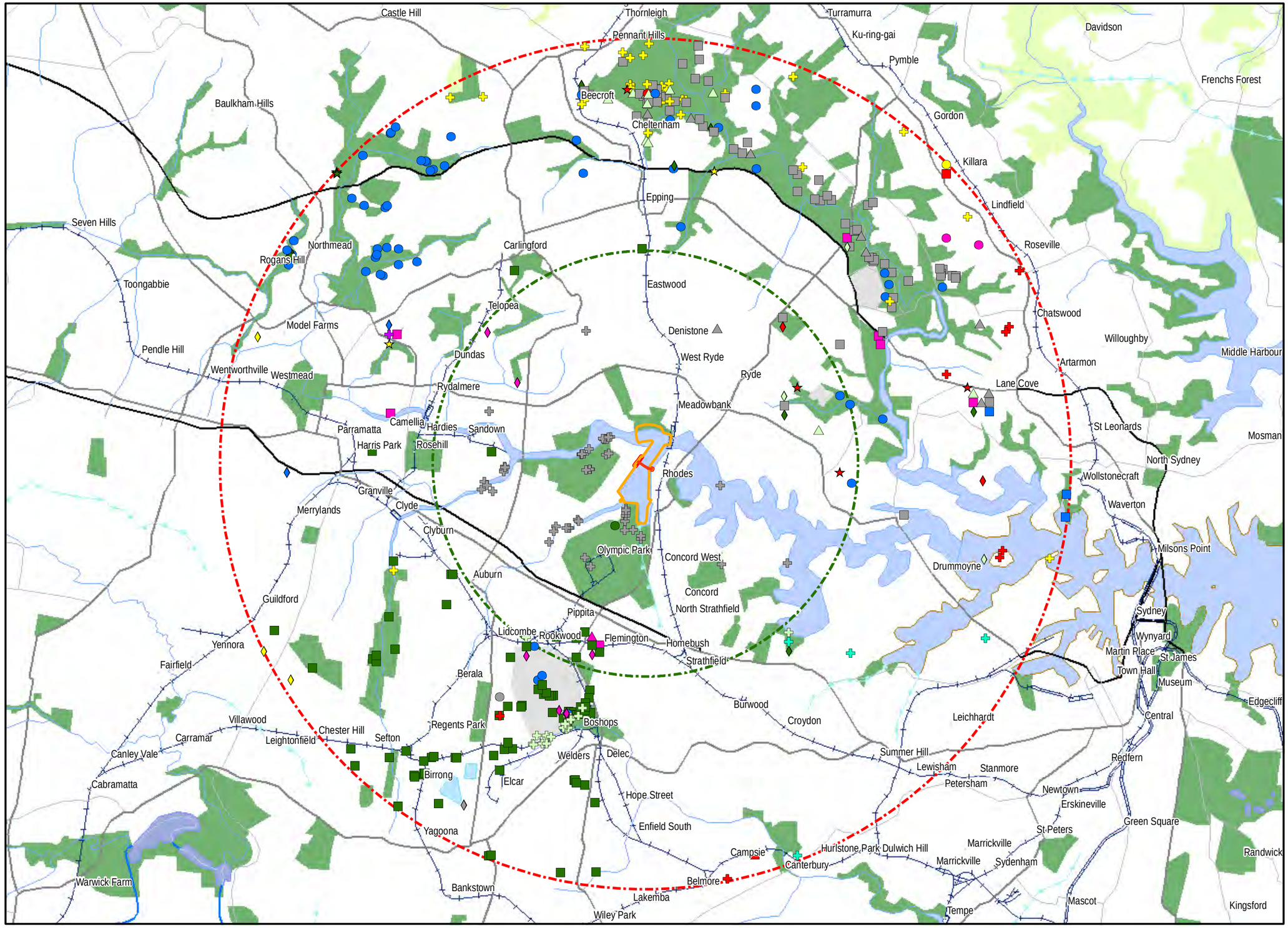

Legend

Threatened Flora

- Acacia bynoeana
- Acacia pubescens
- Acacia terminalis subsp. terminalis
- Callistemon linearifolius
- Darwinia biflora
- Darwinia peduncularis
- Deyeuxia appressa
- Dillwynia tenuifolia
- Epacris purpurascens var. purpurascens
- Eucalyptus camfieldii
- Eucalyptus scoparia
- Genoplesium baueri
- Grammitis stenophylla
- Hibbertia superans
- Hypsela sessiliflora
- Leptospermum deanei
- Melaleuca deanei
- Persoonia hirsuta
- Persoonia nutans
- Pimelea curviflora var. curviflora
- Pimelea spicata
- Pomaderris prunifolia
- Prostanthera marifolia
- Pultenaea pedunculata
- Syzygium paniculatum
- Tetratheca glandulosa
- Tetratheca juncea
- Triplarina imbricata
- Wahlenbergia multicaulis
- Wilsonia backhousei
- Study Area
- Subject Site
- 5km Locality
- 10km Search Area

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Figure 4: Threatened Flora within a 10km search radius of the Study Area

Date: 05 August 2011 | Drawn by: JMS

Job number: 12926 | Checked by: JC

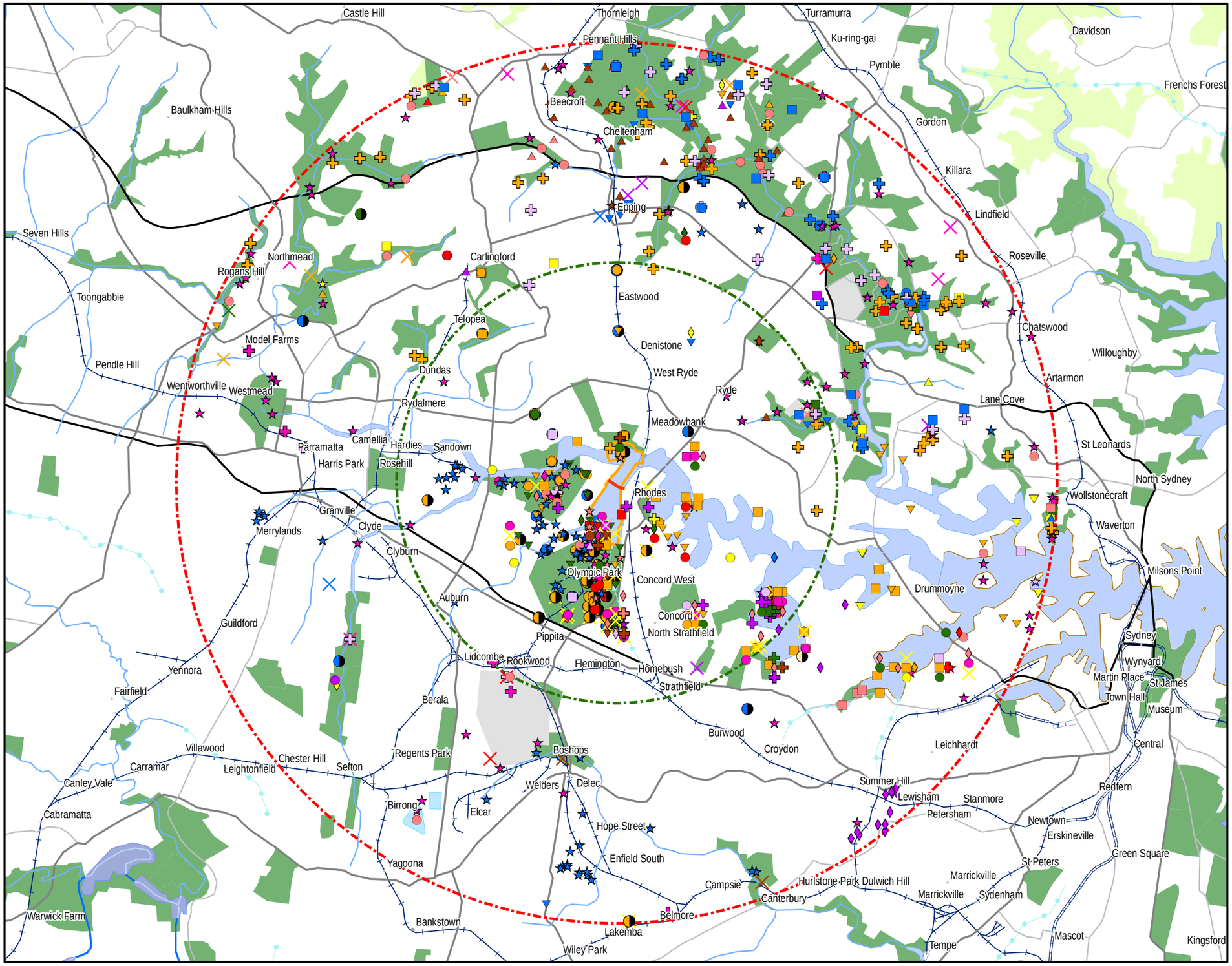
Location: P:\12900s\12926\Mapping\12926_Thr_Flora.mxd

0 0.75 1.5 3 4.5 6

Kilometers

Scale 1:90,000 at A3
Map Projection: GDA 1994 MGA Zone 56
Horizontal Datum: Geocentric Datum of Australia 1994

N



Legend

Threatened and Migratory Fauna

- Australasian Bittern
- Australian Painted Snipe
- Australian Reed-Warbler
- Bar-tailed Godwit
- Barking Owl
- Black Bittern
- Black-faced Monarch
- Black-necked Stork
- Black-tailed Godwit
- Broad-billed Sandpiper
- Bush Stone-curlew
- Caspian Tern
- Cattle Egret
- Comb-crested Jacana
- Common Greenshank
- Common Sandpiper
- Common Tern
- Cotton Pygmy-Goose
- Cumberland Plain Land Snail
- Curlew Sandpiper
- Double-banded Plover
- Eastern Bentwing-bat
- Eastern Curlew
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Pygmy-possum
- Eastern Reef Egret
- Fork-tailed Swift
- Freckled Duck
- Gang-gang Cockatoo
- Glossy Black-Cockatoo
- Glossy Ibis
- Grass Owl
- Great Egret
- Great Knot
- Greater Broad-nosed Bat
- Greater Sand-plover
- Green and Golden Bell Frog
- Grey Plover
- Grey-headed Flying-fox
- Latham's Snipe
- Lesser Sand-plover
- Little Bentwing-bat
- Little Curlew
- Little Eagle
- Little Lorikeet
- Little Tern
- Marsh Sandpiper
- Oriental Cuckoo
- Osprey
- Pacific Golden Plover
- Pectoral Sandpiper
- Pied Oystercatcher
- Powerful Owl
- Rainbow Bee-eater
- Red Knot
- Red-capped Plover
- Red-crowned Toadlet
- Red-necked Stint
- Regent Honeyeater
- Ruddy Turnstone
- Ruff
- Rufous Fantail
- Satin Flycatcher
- Scarlet Robin
- Sharp-tailed Sandpiper
- Southern Myotis
- Spectacled Monarch
- Spotted-tailed Quoll
- Superb Fruit-Dove
- Swift Parrot
- Terek Sandpiper
- Turquoise Parrot
- Varied Sittella
- Western Sandpiper
- Whimbrel
- White-bellied Sea-Eagle
- White-throated Needletail
- Wood Sandpiper
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

Endangered Populations

- Long-nosed Bandicoot
- Little Penguin
- White-fronted Chat

- Study Area
- Subject Site
- 5km Locality
- 10km Search Area

Figure 5: Threatened and Migratory Fauna within a 10km search radius of the Study Area

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2015

Date: 09 August 2011 | Drawn by: JMS

Job number: 12926 | Checked by: JC

Location: P:\12900s\12926\Mapping\12926_Thr_Fauna.mxd

0 0.75 1.5 3 4.5 6

Kilometers

Scale 1:90,000 at
Map Projection: GDA 1994 MGA Zone 56
Horizontal Datum: Geocentric Datum of Australia 1994

N

PLATES

Plate 1: The western foreshore of the subject site.

Plate 2: The eastern foreshore of the subject site.

Plate 3: Coastal Saltmarsh EEC occurring within the study area.

Plate 4: Vegetation occuring within the Coastal Saltmarsh.

Plate 5: Estuarine Mangrove vegetation occuring within the study area.

Plate 6: Remediation site on eastern (Rhodes) side of subject site.

Plate 7: View east across Homebush Bay within the subject site.

Plate 8: Rock retaining wall on eastern side of study area, south of subject site.

Plate 9: Shallow pools and limited mud flat on western side of study area, north of subject site.

Plate 10: White-faced Heron on western side of study area, south of subject site.

Plate 11: Mud flats associated with mangroves.

Plate 12: Little Black Cormorant swimming in the study area.

Plate 13: Emergent wooden structures – potential bird perch sites.

Plate 14: Shipwreck – potential fauna perch and shelter habitat.

Plate 15: Native vegetation south of study area along foreshore cycleway.

Plate 16: Waterbird refuge, saltmarsh wetland south of study area.

APPENDICES

APPENDIX 1

Flora Results

Plant species recorded in the study area:

Native Species			Observed				
Family Name	**Latin Name**	**Common Name**	**Subject Site: East Side of Bay**	**Subject Site: West Side of Bay**	**Mangrove**	**Saltmarsh**	**Planted**
Avicenniaceae	*Avicennia marina*				*		
Myrtaceae	*Callistemon rigidus*	Stiff Bottlebrush					*
Casuarinaceae	*Casuarina cunninghamia x glauca*			*			
Commelinaceae	*Commelina cyanea*	Native Wandering Jew					*
Phormiaceae	*Dianella caerulea*					*	
Chenopodiaceae	*Einadia trigonos*	Fishweed	*				
Myrtaceae	*Eucalyptus botryoides*	Bangalay					*
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark					*
Myrtaceae	*Eucalyptus sp.*			*			
Cyperaceae	*Fecinia nodosa*	Knobby Club-rush				*	
Juncaceae	*Juncus kraussii ssp. australiensis*	Sea Rush				*	
Myrtaceae	*Melaleuca nodosa*						*
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree					*
Poaceae	*Microlaena stipoides*						*
Myoporaceae	*Myoporum acuminatum*						*
Chenopodiaceae	*Sarcocornia quinqueflora*					*	
Poaceae	*Setaria sp.*					*	
Chenopodiaceae	*Suaeda australis*					*	
Aizoaceae	*Tetragonia tetragonioides*	New Zealand Spinach	*		*	*	
Poaceae	*Zoysia macrantha*	Prickly Couch				*	

Introduced Species

Family Name	Latin Name	Common Name	Subject Site: East Side of Bay	Subject Site: West Side of Bay	Mangrove	Saltmarsh	Planted
Chenopodiaceae	*Atriplex prostrata*					*	
Asteraceae	*Bidens pilosa*	Cobbler's Pegs		*			
Chenopodiaceae	*Chenopodium album*	Fat Hen		*			
Poaceae	*Chloris gayana*	Rhodes Grass	*				
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*	*			
Poaceae	*Cynodon dactylon*	Common Couch		*		*	
Poaceae	*Digitaria sanguinalis*	Crab Grass		*			
Asteraceae	*Lactuca serriola*	Prickly Lettuce	*				
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass		*			

APPENDIX 2

Fauna Results

Animal species recorded in the study area:

Latin Name	Common Name	EPBC Act	TSC Act	Observation Type
Birds				
Columba livia	Rock Dove		U	O
Acridotheres tristis	Common Myna		U	OH
Anas superciliosa	Pacific Black Duck			O
Chenonetta jubata	Australian Wood Duck			O
Egretta novaehollandiae	White-faced Heron			O
Grallina cyanoleuca	Magpie-lark			OH
Strepera graculina	Pied Currawong			H
Coracina novaehollandiae	Black-faced Cuckoo-shrike			OH
Vanellus miles	Masked Lapwing			OH
Ocyphaps lophotes	Crested Pigeon			O
Corvus coronoides	Australian Raven			OH
Rhipidura leucophrys	Willie Wagtail			O
Hirundo neoxena	Welcome Swallow			OH
Larus novaehollandiae	Silver Gull			OH
Malurus cyaneus	Superb Fairy-wren			OH
Lichenostomus chrysops	Yellow-faced Honeyeater			H
Manorina melanocephala	Noisy Miner			OH
Phylidonyris novaehollandiae	New Holland Honeyeater			O
Neochmia temporalis	Red-browed Finch			OH
Pelecanus conspicillatus	Australian Pelican			O
Phalacrocorax carbo	Great Cormorant			O
Phalacrocorax melanoleucos	Little Pied Cormorant			O
Phalacrocorax sulcirostris	Little Black Cormorant			O
Phalacrocorax varius	Pied Cormorant			O
Trichoglossus haematodus	Rainbow Lorikeet			H
Himantopus himantopus	Black-winged Stilt			O
Threskiornis molucca	Australian White Ibis			O
Zosterops lateralis	Silvereye			H

Key: O = observed;
H = heard; and,
U = unprotected.

APPENDIX 3

Previously Recorded Aquatic Fauna

Aquatic fauna surveyed from Homebush Bay (Smith *et al.* 1996):

Latin Name	Common Name	EPBC Act	FM Act	Introduced
Fish				
Urolophus sp.	Stingaree			
Herklotsichthys castelnaui	Southern herring			
Hyperlophus vittatus	Sandy sprat			
Engraulis australis	Anchovy			
Gambusia affinis	Mosquito fish			*
Pseudomugil signifer	Pacific blue-eye			
Urocampus carinirostris	Hairy pipefish	Ma	Ma	
Centropogon australis	Eastern fortesque			
Platycephulus fuscus	Dusky flathead			
Ambassis jacksoniensis	Port Jackson perchlet			
Sillago ciiata	Sand whiting			
Pomatomus salatrix	Tailor			
Pseudocaranx dentex	Silver trevally			
Trachurus novaezelandiae	Yellowtail scad			
Gerres subfasciatus	Silver biddy			
Acanthopagrus australis	Yellowfin bream			
Girella tricuspidata	Luderick			
Liza argentea	Flat-tail mullet			
Mugil cephalus	Sea mullet			
Acanthogobius flavimanus	Oriental goby			*
Acentrogobius bifrenatus	Bridled goby			
Favonigobius exquisitus	Exquisite goby			
Favonigobius lateralis	Long finned goby			
Favonigobius tamarensis	Tamar river goby			
Gobiopterus semivestitta	Transparent goby			
Mugilogobius stigmaticus	Goby			
Pseudogobius olorum	Swan river goby			
Redigobius macrostoma	Large mouth goby			
Philypnodon grandiceps	Flathead gudgeon			
Pseudorhombus arsius	Large-tooth flounder			
Pseudorhombus jenynsii	Small-tooth flounder			
Monacanthus chinensis	Fan belly leatherjacket			
Crustaceans				
Portuunus pelagicus	Stingaree			
Scylla serata	Southern herring			
Metapenaeus macleayi	Sandy sprat			
Metapenaeus endevouri	Endevour prawn			
Penaeus mondon	Tiger prawn			
Penaeus plebejus	Eastern king prawn			

APPENDIX 4

EP&A Act Assessments of Significance

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (referred to below as Coastal Saltmarsh) is an EEC listed under the TSC Act (NSW Scientific Committee 2004a). Coastal Saltmarsh occurs within the southern section of the study area as shown in Figure 3. The community occurs in a narrow strip edged by mangroves adjacent to a walking path leading out to the Shipwreck Viewing Platform. This is shown in Plate 3.

Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are intermittently inundated by salt water. Coastal Saltmarsh is often found on the inland side of mangrove stands. Coastal saltmarsh are typically treeless and include succulent herbs, and salt tolerant grasses and sedges and may include salt pans, tall reeds and some mangroves. Characteristic species as listed in the NSW Scientific Committee Final Determination for Coastal Saltmarsh (NSW Scientific Committee 2004a) dominate the community within the study area including: Samphire (*Sarcocornia quinqueflora*), Sea Rush (*Juncus kruassii*), Knobby Club Rush (*Fecinia nodosa*), Prickly Couch (*Zoysia macrantha*) and Seablite (*Sueda australis*).

The Coastal Saltmarsh in the study area is over 800 m to the south of the subject site (Figure 2). There is potential for the community to be impacted by contaminated sediment disturbed during the construction phase of the proposal and carried by tidal flows.

How is the proposal likely to affect the lifecycle of a Threatened Species and / or population?

Not applicable, Coastal Saltmarsh is not a species or population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal may affect the Coastal Saltmarsh through contaminated sediment, disturbed during the construction phase of the proposal being deposited into the community. Sediment may be transported by tidal flows. This affect would be restricted to areas at or below the high tide mark during construction. Sediment deposited within the Coastal Saltmarsh may affect the habitat by changing the soil surface conditions in affected areas. This could affect native plant germination, introduce excess nutrients or toxins, and potentially benefit exotic species. If sediment were to smother plants within the EEC, this could affect transpiration, respiration and photosynthesis.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area does not occur at or near the known limits of distribution for Coastal Saltmarsh.

How is the proposal likely to affect current disturbance regimes?

The area of Coastal Saltmarsh potentially impacted by the proposal is currently impacted by weed invasion as it is a narrow area with a high amount of edge vulnerable to weed invasion. Disturbance of the soil profile is evident in this area. Sediment deposited into the community as a result of the proposal could exacerbate weed invasion, however, this is considered unlikely.

The Contamination Management Plan Report (Golder Associates 2011) has considered this potential disturbance and assessed the predicted increase in turbidity to be minimal provided that the recommended sediment boom and curtain controls are implemented throughout the construction phase and remain in place until the settling of sediments has occurred. Provided these mitigation measures are undertaken the proposal is unlikely to antagonise the current disturbance regimes within the study area.

How is the proposal likely to affect habitat connectivity?
The area of Coastal Saltmarsh potentially affected by the proposal is a narrow strip that is isolated from a larger area of Coastal Saltmarsh to the south of the study area (Figure 3). Potential impacts of the proposal are therefore unlikely to significantly impact habitat connectivity for Coastal Saltmarsh on a local or regional scale.

How is the proposal likely to affect critical habitat?
Not applicable there is no listed critical habitat occurring within or adjacent to the Study Areas.

Key thresholds
In regard to Step 5 of the Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005; the four 'Key Thresholds' listed are included below and are addressed in relation to the potential impact of the proposal.

The development application needs to contain a justification of the preferred option based on:

- **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

The potential impact of the proposal to Coastal Saltmarsh is contamination from sediment, disturbed during the construction phase of the proposal.

A summary of recommendations by Golder Associates (2011), to avoid or mitigate this impact includes:

- No dredging or use of bored piles is proposed in areas subject to notices under the *Contaminated Land Management Act* 1997.
- Installation of a sediment boom and curtain around barge works sites for over-water pile installation.
- A sediment curtain used would be the full depth of the Bay.
- The sediment control device will be installed, as much as practicable, during high tide periods from a boat, thereby minimising any disturbance to the existing sediments.
- The sediment control device will be designed to rise and fall with the tide to prevent sediments disturbed during the remediation works dispersing in Homebush Bay.

The recommendations summarised above will significantly reduce the risk of contaminated sediment being deposited within the Coastal Saltmarsh. The Contamination Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided the recommendations of the report are implemented. These recommendations are considered adequate to avoid and/or mitigate potential impacts of the proposal and therefore maintain the biodiversity values of Coastal Saltmarsh.

- **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

Given the minor nature of the potential impacts on the habitat for Coastal Saltmarsh the proposal is considered unlikely to reduce the long-term viability of the community.

- **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

  Given the minor nature of the potential impacts on the habitat for Coastal Saltmarsh the proposal is considered unlikely to accelerate the extinction of Coastal Saltmarsh.

- **Whether or not the proposal will adversely affect critical habitat.**

Not applicable, there is no listed critical habitat occurring within or adjacent to the study area.

Conclusion

Based on the above assessment the proposed bridge construction is considered unlikely to have a significant impact on the Coastal Saltmarsh EEC.

Narrow-leaf Wilsonia ***Wilsonia backhousei***

The study area supports potential habitat for Narrow-leafed Wilsonia. This species is listed on the TSC Act as Vulnerable. Narrow-leafed Wilsonia is a perennial sprawling, matted shrub less than 15 cm tall which occurs on the edges of saltmarshes and lakes (DEC 2005).

Narrow-leaf Wilsonia has been recorded within the Coastal Saltmarsh community adjoining the study area. This species was not recorded during the field survey however based on the previous records and the habitat assessment the species is considered likely to occur within the study area.

The proposal may affect habitat for Narrow-leafed Wilsonia by depositing contaminated sediment, disturbed during the construction phase of the proposal. Sediment may be transported by tidal flows into vegetation communities along the foreshore within the study area.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Narrow-leaf Wilsonia occurs on the edges of salt marshes and lakes and flowers in spring and summer (DEC 2005). The proposal may cause sediment to be deposited within vegetation communities potentially supporting Narrow-leafed Wilsonia. This could impact the life cycle of Narrow-leafed Wilsonia by impeding germination, as well as smothering or otherwise compromising seedlings and mature plants.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Deposited sediment dispersed form the subject site may affect potential habitat for Narrow-leafed Wilsonia through altered soil surface conditions by affecting soil structure, drainage and nutrient levels as well as potentially introduce toxins.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Narrow-leafed Wilsonia is not at the limit of its distribution at Homebush Bay. This species occurs in all southern states of Australia and occurs on the east coast between Mimosa Rocks National Park and Wamberal north of Sydney (Harden 1992).

How is the proposal likely to affect the current disturbance regimes?

The main threats to Narrow-leafed Wilsonia include trampling by grazing stock, habitat loss due to coastal development, competition with weeds, and rubbish dumping. Of these disturbance regimes competition with weeds is relevant to the proposal. Vegetation communities potentially providing habitat for the species including Coastal Saltmarsh are subject to weed invasion. Sedimentation caused by the construction phase of the proposal is considered unlikely to exacerbate weed invasion in affected areas through increased nutrients and creating small deposits that could be colonised by exotic species.

The Contamination Management Plan Report (Golder Associates 2011) has considered this potential disturbance and assessed the predicted increase in turbidity to be minimal provided that the recommended sediment boom and curtain controls are implemented throughout the construction phase and remain in place until the settling of sediments has

occurred. Provided these mitigation measures are undertaken the proposal is unlikely to antagonise the current disturbance regimes within the study area.

How is the proposal likely to affect habitat connectivity?
The proposal will not involve the removal of any vegetation providing potential habitat for Narrow-leafed Wilsonia. Sedimentation of this habitat resulting from the proposal is considered to be unlikely. Therefore the proposed bridge construction will not disrupt habitat connectivity for Narrow-leafed Wilsonia.

How is the proposal likely to affect critical habitat?
Not applicable there is no listed critical habitat occurring within or adjacent to the study area.

Key thresholds

In regard to Step 5 of the Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005; the four 'Key Thresholds' listed are included below and are addressed in relation to the potential impact of the proposal.

The development application needs to contain a justification of the preferred option based on:

- **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

The potential impact of the proposal to Narrow-leafed Wilsonia is contamination from sediment, disturbed during the construction phase of the proposal.

A summary of recommendations by Golder Associates (2011), to avoid or mitigate this impact includes:

- No dredging or use of bored piles is proposed in areas subject to notices under the *Contaminated Land Management Act* 1997.
- Installation of a sediment boom and curtain around barge works sites for over-water pile installation.
- A sediment curtain used would be the full depth of the Bay.
- The sediment control device will be installed, as much as practicable, during high tide periods from a boat, thereby minimising any disturbance to the existing sediments.
- The sediment control device will be designed to rise and fall with the tide to prevent sediments disturbed during the remediation works dispersing in Homebush Bay.

The recommendations summarised above will significantly reduce the risk of contaminated sediment being deposited within potential habitat for Narrow-leafed Wilsonia. The Contamination Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided the recommendations of the report are implemented. These recommendations are considered adequate to avoid and/or mitigate potential impacts of the proposal and therefore maintain the biodiversity values of potential habitat for Narrow-leafed Wilsonia.

- **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

Given the minor nature of the potential impacts on Narrow-leafed Wilsonia the proposal is considered unlikely to reduce the long-term viability of the species.

- **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

Given the minor nature of the potential impacts on the habitat for Narrow-leafed Wilsonia the proposal is considered unlikely to accelerate the extinction of the species.

- **Whether or not the proposal will adversely affect critical habitat.**

Not applicable, there is no listed critical habitat occurring within or adjacent to the study area.

Conclusion

Based on the above assessment the proposed bridge construction is considered unlikely to have a significant impact on Narrow-leafed Wilsonia.

White-fronted Chat ***Epthianura albifrons***

The White-fronted Chat (*Epthianura albifrons*) is listed as an Endangered Population under Schedule 1 of the TSC Act.

Numerous records of individuals of the White-fronted Chat endangered population have been previously made within 10 km of the study area, including one record within the study area (OEH Atlas of NSW Wildlife). This species breeds and forages within saltmarsh and mangroves, both of which occur in the study area. Potential habitat for this species occurs as breeding and foraging habitat in saltmarsh and mangrove communities at the northern and southern ends of the study area. The most recent record of this species was made in 2008 to the west of the study area.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The White-fronted Chat prefers damp open habitats such as wetlands containing saltmarsh bordered by open grasslands or sparsely treed landscapes. Along the coast, White-fronted Chats are found in estuarine and saltmarsh habitats. This population is regularly sighted around Newington Nature Reserve adjacent to the study area.

This species is insectivorous foraging for flies and beetles on or close to the ground. Foraging generally takes place over bare or grassy ground adjacent to wetlands.

This population has also been recorded nesting within the mangroves adjacent to the study area. The breeding season extends from July to March with open nests built in low vegetation. Nesting has also been recorded within mangroves adjacent to the study area.

The proposed bridge is to be constructed over highly modified landscapes on the western and eastern banks of the Bay. There would be no habitat removed as part of the proposal. The bridge involves pillars to be constructed on the substrate of the Bay to support the 455 m length bridge. During the construction phase indirect impacts to White-fronted Chat habitat may occur through increased turbidity levels within the Bay extending to the mangroves and saltmarsh. The increased turbidity resulting from the proposal was assessed within the Contamination Management Plan Report (Golder Associates 2011) and it was determined that the predicted increase in turbidity is considered to be minimal provided that appropriate mitigation measures such as sediment booms and curtains are installed during the construction phase. As the increase in turbidity is assessed to be only minimal, is it considered highly unlikely that the saltmarsh and mangrove communities at the northern and southern ends of the study area would be negatively impacted as a result of the proposed bridge.

Given that the proposed bridge development is to be established over a highly modified landscape where no mangrove or saltmarsh vegetation will be directly impacted or removed, that the indirect impacts to the mangrove and saltmarsh communities is expected to be minimal, it is considered unlikely that the lifecycle of the White-fronted Chat endangered population will be negatively affected as a result of the proposal.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?
The study area support habitats for the White-fronted Chat endangered population in the form of a small area of saltmarsh at the southern end of the study area and mangrove communities at the northern and southern extremities of the study area. Within these vegetation communities the endangered population of White-fronted Chat may breed and forage for insects. This habitat occurs approximately 800 m south and 900 m north of the proposed bridge location. Consequently the proposal will not directly remove breeding or foraging habitat for the White-fronted Chat.

Potential indirect impacts to habitat of the White-fronted Chat may occur through increased turbidity resulting during the construction phase of the proposed bridge. Increased turbidity may indirectly impact foraging habitat as water quality is reduced through the increased sediments present within the water column. This is turn may impact on the mangrove communities along the foreshore of the Bay. The Contamination Management Plan Report (Golder Associates 2011) considers the expected increased turbidity as a consequence of the proposal will be minimal provided that appropriate mitigation measures, ie. sediment boom and curtains, be erected around piling areas during construction to contain resuspended materials and minimise suspension of sediments and associated contaminates in the Bay.

Given that the increase in sediments within the Bay are considered minimal, the indirect impacts to the mangrove communities and foraging resources for the White-fronted Chat are also expected to be minimal.

Does the proposal affect any threatened species that are at the limit of its known distribution?
The distribution of the White-fronted Chat extends across the southern half of Australia, from Queensland to Tasmania across to Western Australia. In NSW this species is generally found along the coast in the southern part of the state. Consequently the study area is not at or near the limit of distribution for this species. There are two disjunct sub-populations within the Sydney Metropolitan Catchment Area; one at Newington Nature reserve in proximity to the study area and one at Towra Point Nature Reserve near Botany Bay. Despite the proximity of the proposed bridge to the sub-population on the Parramatta River the proposal will not reduce the occupancy of this population.

How is the proposal likely to affect the current disturbance regimes?
The main threats to the White-fronted Chat include reduction in habitat size and quality, human disturbance, elevated nest predation levels, mangrove encroachment and sea-level rise associated with global warming impacting saltmarsh habitat, isolation of populations through urbanisation and increased predation particularly from feral cats, foxes and rodents (NSW Scientific Committee 2010a).

The proposal will not increase the prevalence of these disturbance regimes. The proposal will involve the installation of five piers within Homebush Bay to support the 455 m length bridge. During the construction of these piers on the substrate of the Bay, increased sedimentation is predicted to result during the installation process. Reduced water quality due to increased turbidity is considered a threat to the White-fronted Chat as these indirect impacts may reduce the quality of foraging habitat and resources available.

The Contamination Management Plan Report (Golder Associates 2011) has considered this potential disturbance and assessed the predicted increase in turbidity to be minimal provided that the recommended sediment boom and curtain controls are implemented throughout the construction phase and remain in place until the settling of sediments has occurred. Provided these mitigation measures are undertaken the proposal is unlikely to antagonise the current disturbance regimes within the study area.

How is the proposal likely to affect habitat connectivity?
The proposal will not involve the removal of any riparian vegetation along the banks of the Parramatta River or Homebush Bay. The current foreshore within the subject site is highly modified. Planted Casuarina trees and Eucalypts occur over mown lawn on the western bank. Sparsely scattered native and exotic weeds occur on the eastern bank. The current landscapes where the piers are proposed to be established offer no breeding or foraging habitat for the White-fronted Chat. Furthermore no habitat exists north or south of the bridge that would become fragmented as a result of the bridge installation. Consequently the establishment of the proposed bridge will not disrupt habitat connectivity for the White-fronted Chat.

How is the proposal likely to affect critical habitat?
Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date no critical habitat has been declared for the White-fronted Chat endangered population (DEWHA 2008c). Regular sightings of this population are made within the saltmarsh of Newington Nature Reserve adjacent to the study area however the proposal should not negatively affect this habitat, consequently the proposal will not affect critical habitat for this population.

Key thresholds

In regard to Step 5 of the Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005; the four 'Key Thresholds' listed are included below and are addressed in relation to the potential impact of the proposal.

The development application needs to contain a justification of the preferred option based on:

- **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

The potential impact of the proposal to the White-fronted Chat endangered population is contamination from sediment, disturbed during the construction phase of the proposal.

A summary of recommendations by Golder Associates (2011), to avoid or mitigate this impact includes:

- No dredging or use of bored piles is proposed in areas subject to notices under the *Contaminated Land Management Act* 1997.
- Installation of a sediment boom and curtain around barge works sites for over-water pile installation.
- A sediment curtain used would be the full depth of the Bay.

- The sediment control device will be installed, as much as practicable, during high tide periods from a boat, thereby minimising any disturbance to the existing sediments.
- The sediment control device will be designed to rise and fall with the tide to prevent sediments disturbed during the remediation works dispersing in Homebush Bay.

The recommendations summarised above will significantly reduce the risk of contaminated sediment being deposited within potential habitat for White-fronted Chat. The Contamination Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided the recommendations of the report are implemented. These recommendations are considered adequate to avoid and/or mitigate potential impacts of the proposal and therefore maintain the biodiversity values of potential habitat for White-fronted Chat.

- **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

Given the minor nature of the potential impacts on the endangered population of White-fronted Chat, the proposal is considered unlikely to reduce the long-term viability of the population.

- **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

Given the minor nature of the potential impacts on the habitat for White-fronted Chat, the proposal is considered unlikely to accelerate the extinction of the population.

- **Whether or not the proposal will adversely affect critical habitat.**

Not applicable, there is no listed critical habitat occurring within or adjacent to the study area.

Conclusion

Based on the above assessment the proposed bridge construction is considered unlikely to have a significant impact on the White-fronted Chat endangered population.

Australasian Bittern ***Botaurus poiciloptilus***

The Australasian Bittern (*Botaurus poiciloptilus*) is listed as Endangered under Schedule 1 of the TSC Act and Endangered under the EPBC Act.

The Australasian Bittern has been previously recorded three times within 10 km of the study area, including once within the study area and once just outside the study area (OEH Atlas of NSW Wildlife and Birds Australia Atlas). Potential habitat for this species occurs as foraging habitat in the cover of the mangroves at the northern and southern ends of the study area.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The species favours tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.) where it can hide during the day. The species feeds mainly at night on frogs, fish, yabbies, eels, spiders, insects and snails. Feeding occurs on shallow edges of pools or waterways, or feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Foraging is usually nocturnal or crepuscular while during the day this species remains hidden in dense vegetation (DECC 2005; Marchant and Higgins 1990). The Australasian Bittern breeds in summer from October to January; nests are built in secluded places in deep densely-vegetated wetlands and swamps on a platform of reeds (DECC 2005; Marchant and Higgins 1990).

The study area does not support dense riparian vegetation which constitutes breeding habitat for the Australasian Bittern. It is likely that the study area only supports foraging habitat for this species amongst the mangroves at the northern and southern ends of the study area. Given that the proposed bridge development is to be established over a highly modified landscape where no riparian vegetation will be directly impacted or removed, it is considered unlikely that the lifecycle of the Australasian Bittern will be negatively affected as a result of the proposal.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The study area does not support breeding resources (dense and emergent reeds) for the Australasian Bittern however this species may forage at the northern and southern ends of the study area in the cover of the mangroves for frogs, fish, yabbies, spiders, insects and snails (DEC 2005b). This foraging habitat occurs approximately 800 m south and 900 m north of the proposed bridge location. Consequently the proposal will not directly remove breeding or foraging habitat for the Australasian Bittern.

Potential indirect impacts to foraging habitat of the Australasian Bittern may occur through increased siltation and turbidity resulting during the construction phase of the proposed bridge. Increased turbidity may indirectly impact foraging habitat as water quality is reduced through the increased sediments present within the water column. This is turn may impact on the mangroves along the foreshore of the Bay. The Contamination Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided that appropriate mitigation measures, ie. sediment boom and curtains, be erected around piling areas during construction to contain resuspended materials and minimise suspension of sediments and associated contaminates in the Bay.

Given that the increase in sediments within the Bay are considered minimal, the indirect impacts to the mangrove communities and foraging resources for the Australasian Bittern are also expected to be minimal.

Does the proposal affect any threatened species that are at the limit of its known distribution?
Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW this species occurs in suitable habitats across most of the state except for the far north-west (DEC 2005b). The study area occurring within the Sydney area does not fall at or near the limit of distribution for the Australasian Bittern.

How is the proposal likely to affect the current disturbance regimes?
The main threats to the Australasian Bittern include drainage of wetlands and ponds, reduced water quality due to siltation, pollution and salinity, predation by foxes and cats, use of herbicides, pesticides and other chemicals near wetland areas and grazing and associated frequent burning of wetland areas (DECC 2005).

The proposal will not increase the prevalence of all but one of these disturbance regimes. The proposal will involve the installation of five piers within Homebush Bay to support the 455 m length bridge. During the construction of these piers on the substrate of the Bay, increased sedimentation is predicted to result during the installation process. Reduced water quality due to siltation and pollution are considered a threat to the Australasian Bittern as these indirect impacts may reduce the quality of foraging habitat and resources available.

The Contamination Management Plan Report (Golder Associates 2011) has considered this potential disturbance and assessed the predicted increase in turbidity to be minimal provided that the recommended sediment boom and curtain controls are implemented throughout the construction phase and remain in place until the settling of sediments has occurred.

How is the proposal likely to affect habitat connectivity?
The proposal will not involve the removal of any riparian vegetation along the banks of the Parramatta River or Homebush Bay. The current foreshore within the subject site is highly modified. Planted Casuarina trees and Eucalypts occur over mown lawn on the western bank. Sparsely scattered native and exotic weeds occur on the eastern bank. The current landscapes where the piers are proposed to be established offer no breeding or foraging habitat for the Australasian Bittern. Furthermore no habitat exists north or south of the bridge that would become fragmented as a result of the bridge installation. Consequently the establishment of the proposed bridge will not disrupt habitat connectivity for the Australasian Bittern.

How is the proposal likely to affect critical habitat?
Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Australasian Bittern, consequently the proposal will not affect critical habitat for this species.

Key thresholds

In regard to Step 5 of the Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005; the four 'Key Thresholds' listed are included below and are addressed in relation to the potential impact of the proposal.

The development application needs to contain a justification of the preferred option based on:

- **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

The potential impact of the proposal to Australasian Bittern is contamination from sediment, disturbed during the construction phase of the proposal.

A summary of recommendations by Golder Associates (2011), to avoid or mitigate this impact includes:

- No dredging or use of bored piles is proposed in areas subject to notices under the *Contaminated Land Management Act* 1997.
- Installation of a sediment boom and curtain around barge works sites for over-water pile installation.
- A sediment curtain used would be the full depth of the Bay.
- The sediment control device will be installed, as much as practicable, during high tide periods from a boat, thereby minimising any disturbance to the existing sediments.
- The sediment control device will be designed to rise and fall with the tide to prevent sediments disturbed during the remediation works dispersing in Homebush Bay.

The recommendations summarised above will significantly reduce the risk of contaminated sediment being deposited within potential habitat for Australasian Bittern. The Contamination Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided the recommendations of the report are implemented. These recommendations are considered adequate to avoid and/or mitigate potential impacts of the proposal and therefore maintain the biodiversity values of potential habitat for Australasian Bittern.

- **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

Given the minor nature of the potential impacts on Australasian Bittern the proposal is considered unlikely to reduce the long-term viability of the species.

- **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

Given the minor nature of the potential impacts on the habitat for Australasian Bittern the proposal is considered unlikely to accelerate the extinction of the species.

- **Whether or not the proposal will adversely affect critical habitat.**

Not applicable, there is no listed critical habitat occurring within or adjacent to the study area.

Conclusion

Based on the above assessment the proposed bridge construction is considered unlikely to have a significant impact on the Australasian Bittern.

Terek Sandpiper ***Xenus cinereus***

The Terek Sandpiper (*Xenus cinereus*) is listed as Vulnerable under Schedule 2 of the TSC Act.

The Terek Sandpiper has been previously recorded twice within 10 km of the study area, including once within the locality (OEH atlas of NSW Wildlife). This species was recorded as recently as 2010. Potential habitat for this species occurs as foraging habitat on the mudbanks in proximity to the mangroves at the northern and southern ends of the study area.

No breeding habitat occurs within the study area as this species breeds in the Northern Hemisphere. The Terek Sandpiper favours mudbanks and sandbanks located near mangroves for foraging and shelter. Although the proposal would result in no direct impacts and only minimal indirect impacts to the mangroves and associated mudflats, it may impact a limiting foraging resource for this species.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Terek Sandpiper prefers coastal mudflats, lagoons, creeks, rocky pools, reefs, brackish pools and estuaries. It particularly favours mudbanks and sandbanks near mangroves along the coast. The species will generally roost amongst mangroves and dead trees, often with other wader species. Feeding occurs on open intertidal mudflats for worms, crustaceans, shellfish, insects and larvae.

The Terek Sandpiper breeds mainly in Russia and Finland. Following the breeding season birds migrate to Africa, Australia, Malaysia or India from the months of August to April. The Terek Sandpiper is generally considered a rare migrant to Australian south-eastern shores. As this species does not breed in Australia, no breeding habitat will be impacted as a result of the proposal.

The study area only supports foraging and sheltering habitat for this species along the mudflats beneath the mangroves at the northern and southern ends of the study area. Given that the proposed bridge development is to be established over a highly modified landscape where no riparian vegetation will be directly impacted or removed, it is considered unlikely that the lifecycle of the Terek Sandpiper will be negatively affected as a result of the proposal.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The study area does not support breeding resources for the Terek Sandpiper however this species may forage towards at the northern and southern ends of the study area along the mudflats beneath mangroves for small invertebrates. This foraging habitat occurs approximately 800 m south and 900 m north of the proposed bridge location. Consequently the proposal will not directly remove breeding or foraging habitat for the Terek Sandpiper.

Potential indirect impacts to foraging habitat of the Terek Sandpiper may occur through increased turbidity resulting during the construction phase of the proposed bridge. Increased turbidity may indirectly impact foraging habitat as water quality is reduced through the increased sediments present within the water column. This is turn may impact on the mangrove communities along the foreshore of the Bay. The Contamination

Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided that appropriate mitigation measures, ie. sediment boom and curtains, be erected around piling areas during construction to contain resuspended materials and minimise suspension of sediments and associated contaminates in the Bay.

Given that the increase in sediments within the Bay are considered minimal, the indirect impacts to the mangrove communities and foraging resources for the Terek Sandpiper are also expected to be minimal.

Does the proposal affect any threatened species that are at the limit of its known distribution?
Terek Sandpiper's migrate to Australia during August to April. This species has been recorded across northern Australia and is less commonly found along the eastern and southern coasts of NSW. Although the Terek Sandpiper is less common within NSW this species will use suitable habitats along the north to south coasts of NSW. The study area occurring within the Sydney area does not fall at or near the limit of distribution for the Terek Sandpiper.

How is the proposal likely to affect the current disturbance regimes?
The main threats to the Terek Sandpiper include clearing of habitat, hydrological changes to waterbodies and estuaries and disturbance to foraging and roosting sites (NPWS 1999i).
The proposal will not increase the prevalence of these disturbance regimes. The proposal will involve the installation of five piers within Homebush Bay to support the 455 m length bridge. During the construction of these piers on the substrate of the Bay, increased sedimentation is predicted to result during the installation process. Reduced water quality due to increased turbidity is considered a threaten to the Terek Sandpiper as these indirect impacts may reduce the quality of foraging habitat and resources available.

The Contamination Management Plan Report (Golder Associates 2011) has considered this potential disturbance and assessed the predicted increase in turbidity to be minimal provided that the recommended sediment boom and curtain controls are implemented throughout the construction phase and remain in place until the settling of sediments has occurred. Provided these mitigation measures are undertaken the proposal is unlikely to antagonise the current disturbance regimes within the study area.

How is the proposal likely to affect habitat connectivity?
The proposal will not involve the removal of any riparian vegetation along the banks of the Parramatta River or Homebush. The current foreshore within the subject site is highly modified. Planted Casuarina trees and Eucalypts occur over mown lawn on the western bank. Sparsely scattered native and exotic weeds occur on the eastern bank. The current landscapes where the piers are proposed to be established offer no foraging habitat for the Terek Sandpiper. Furthermore no habitat exists north or south of the bridge that would become fragmented as a result of the bridge installation. Consequently the establishment of the proposed bridge will not disrupt habitat connectivity for the Terek Sandpiper.

How is the proposal likely to affect critical habitat?
Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. Important foraging areas have been identified within NSW at the Richmond River estuary and the Hunter River estuary, however these sites are

not in proximity to the study area, consequently the proposal will not affect critical habitat for this species.

Key thresholds

In regard to Step 5 of the Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005; the four 'Key Thresholds' listed are included below and are addressed in relation to the potential impact of the proposal.

The development application needs to contain a justification of the preferred option based on:

- **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

The potential impact of the proposal to Terek Sandpiper is contamination from sediment, disturbed during the construction phase of the proposal.

A summary of recommendations by Golder Associates (2011), to avoid or mitigate this impact includes:

- No dredging or use of bored piles is proposed in areas subject to notices under the *Contaminated Land Management Act* 1997.
- Installation of a sediment boom and curtain around barge works sites for over-water pile installation.
- A sediment curtain used would be the full depth of the Bay.
- The sediment control device will be installed, as much as practicable, during high tide periods from a boat, thereby minimising any disturbance to the existing sediments.
- The sediment control device will be designed to rise and fall with the tide to prevent sediments disturbed during the remediation works dispersing in Homebush Bay.

The recommendations summarised above will significantly reduce the risk of contaminated sediment being deposited within potential habitat for Terek Sandpiper. The Contamination Management Plan Report (Golder Associates 2011) considers the likely increased turbidity expected to result as a consequence of the proposal will be minimal provided the recommendations of the report are implemented. These recommendations are considered adequate to avoid and/or mitigate potential impacts of the proposal and therefore maintain the biodiversity values of potential habitat for Terek Sandpiper.

- **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

Given the minor nature of the potential impacts on Terek Sandpiper the proposal is considered unlikely to reduce the long-term viability of the species.

- **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

Given the minor nature of the potential impacts on the habitat for Terek Sandpiper the proposal is considered unlikely to accelerate the extinction of the species.

- **Whether or not the proposal will adversely affect critical habitat.**

Not applicable, there is no listed critical habitat occurring within or adjacent to the study area.

Conclusion

Based on the above assessment the proposed bridge construction is considered unlikely to have a significant impact on the Terek Sandpiper.

APPENDIX 5

EPBC Act Assessments of Significance

Australasian Bittern ***Botaurus poiciloptilus***

The Australasian Bittern (*Botaurus poiciloptilus*) is listed as Endangered under the EPBC Act and Endangered under Schedule 1 of the TSC Act.

The Australasian Bittern favours tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.) where it can hide during the day. The species feeds mainly at night on frogs, fish, yabbies, eels, spiders, insects and snails. Feeding occurs on shallow edges of pools or waterways, or feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Foraging is usually nocturnal or crepuscular while during the day this species remains hidden in dense vegetation (DECC 2005; Marchant and Higgins 1990). The Australasian Bittern breeds in summer from October to January; nests are built in secluded places in deep densely-vegetated wetlands and swamps on a platform of reeds (DECC 2005; Marchant and Higgins 1990).

Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of a population of the species?

The study area does not support breeding habitat for this species. Australasian Bitterns are likely to forage beneath the mangroves at the northern and southern ends of the Bay for invertebrates, small fish and frogs. No intact native vegetation will be removed in order to construct the proposed Homebush Bay Bridge. The current foreshore within the subject site is highly modified. Planted Casuarina trees and Eucalypts occur over mown lawn on the western bank. Sparsely scattered native and exotic weeds occur on the eastern bank. This vegetation does not provide habitat for the Australasian Bittern.

Consequently no breeding or foraging habitat will be directly impacted as a result of the proposal. During the construction of the bridge it is predicted that sediments will be disturbed from the Bay substrate and that there is the possibility for increased turbidity to occur as a result of the proposal. Increases to turbidity reduce water quality and in high densities may affect the mangrove communities and the foraging resources available for the Australasian Bittern. Golders Associates (2011) have investigated the potential sediment volumes to be disturbed during the works and have concluded that the increase of sediments dispersing through the Bay are considered minimal provided appropriate controls ie. sediment booms and curtains are installed during construction. Given that no breeding or foraging habitat will be directly impacted as a result of the proposal and that the indirect impacts will be minimal, it is considered unlikely that the proposal will lead to a long-term decrease in the size of an Australasian Bittern population.

Is there a real chance or a possibility that the action will reduce the area of occupancy of the species?

Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW this species occurs in suitable habitats across most of the state except for the far north-west (DEC 2005b). The study area occurring within the Sydney Metropolitan Area does not lie at or near the limit of the area of occupancy for the Australasian Bittern.

The proposal will not involve the removal of any breeding or foraging habitat for this species. Indirect impacts to foraging habitat through increased sedimentation are expected to be minimal. Given that no habitat will be directly impacted and indirect impacts will be minimal, the proposal is unlikely to reduce the area of occupancy of the Australasian Bittern.

Is there a real chance or a possibility that the action will fragment an existing population into two or more populations?
The Australasian Bittern has been previously recorded three times within 10 km of the study area, including once within the study area and once just outside the study area (OEH Atlas of NSW Wildlife and Birds Australia Atlas). Potential habitat for this species occurs as foraging habitat in the cover of the mangroves at the northern and southern ends of the study area. Given that no breeding or foraging habitat will be directly impacted as a result of the proposal the action is unlikely to fragment an existing population into two or more populations.

Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of the species?
Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. A Register of Critical Habitat is maintained by the Minister under the EPBC Act (DEWHA 2008b). To date, no critical habitat has been declared for the Australasian Bittern, consequently the proposal will not affect critical habitat for this species.

Is there a real chance or a possibility that the action will disrupt the breeding cycle of a population of the species?
The study area does not support dense riparian vegetation which constitutes breeding habitat for the Australasian Bittern. It is likely that the study area only supports foraging habitat for this species beneath the mangroves at the northern and southern extents of the study area. Given that the proposed bridge development is to be established over a highly modified landscape where no riparian vegetation will be directly impacted or removed, it is considered highly unlikely that the proposal will disrupt the breeding cycle of a population of the Australasian Bittern.

Is there a real chance or a possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?
The proposal has a small possibility of reducing the quality of foraging habitat for this species through increased turbidity and diminished water quality affecting the mangrove within the study area. Appropriate mitigation measures have been prescribed to minimise increases to turbidity resulting from the proposal and it has been determined that any resulting impacts are expected to be minor. Consequently this potential indirect impact is highly unlikely to reduce the quality of habitat to an extent that the Australasian Bittern is likely to decline.

Is there a real chance or a possibility that the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?
Invasive species which are considered a threat to the Australasian Bittern are the European Red Fox and Feral Cat. Predation by both these species are listed as Key Threatening Processes (KTPs) which affect the Australasian Bittern. Cats and foxes are likely to be already established on both sides of Homebush Bay and the construction of the proposed bridge should not result in new areas of habitat to be colonised by these invasive species. As a result the proposal is unlikely to result in Feral Cats and/or European Red Foxes becoming further established within Australasian Bittern habitat within the study area.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?
No diseases have been identified as threats to the Australasian Bittern by OEH or DSEWPaC. It is considered unlikely that the proposal would introduce any diseases that may cause the species to decline.

Is there a real chance or a possibility that the action will interfere with the recovery of the species?
The main threats to the Australasian Bittern include drainage of wetlands and ponds, reduced water quality due to siltation, pollution and salinity, predation by foxes and cats, use of herbicides, pesticides and other chemicals near wetland areas and grazing and associated frequent burning of wetland areas (DECC 2005).

Although there may be a temporary increase in turbidity associated with the construction of the bridge, this indirect impact which may reduce the quality of available foraging habitats should be minimal provided the recommended sediment booms and curtains are installed and maintained during the construction phase. The proposal should not increase the prevalence of any of the above mentioned threats for the Australasian Bittern.

The Australasian Bittern is threatened by the following Key Threatening Processes (KTPs) relevant to the proposal:

- Clearing of Native Vegetation (NSW Scientific Committee 2001a) - the proposal would not involve clearing of any native vegetation that is potential habitat for the Australasian Bittern.
- Predation by Feral Cats (NSW Scientific Committee 2007) - the proposal should not increase predation by feral cats as there will be no clearing, fragmentation or isolation of potential habitats for the Australasian Bittern.
- Predation by the European Red Fox (NSW Scientific Committee 2005) - the proposal should not increase predation by foxes as there will be no clearing, fragmentation or isolation of potential habitats for the Australasian Bittern.
- Alteration to the Natural Flow Regimes of Rivers, Streams, Floodplains and Wetlands (NSW Scientific Committee 2002a) – the proposal should not involve alteration of the natural flow regimes of the Bay or Parramatta River within the study area to an extent that is likely to interfere with the recovery of this species.

Consequently, the action is considered highly unlikely to interfere with the recovery of the Australasian Bittern.

Conclusion
Based on the above assessment the proposed bridge construction is considered unlikely to have a significant impact on the Australasian Bittern.

Migratory Fauna

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

- Substantially modify, destroy or isolate an area of important habitat for a migratory species.

- Result in an invasive species that is harmful to a migratory species becoming established in an area of important habitat for the migratory species.

- Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

An area of important habitat for a migratory species is defined in DEWHA (DEWHA 2009c) as:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or

- Habitat that is of critical importance to the species at particular lifecycle stages; and/or

- Habitat utilised by a migratory species which is at the limit of the species range; and/or

- Habitat within an area where the species is declining.

Further, the process for identifying important habitat specifically for 36 migratory shorebirds is detailed in DEWHA (2009b).

Forty-four migratory species or their habitat have been previously recorded within 10 km of the study area. Of these, 37 species are considered to have known and/or potential habitat within the study area. The following migratory species have been previously recorded within the study area: Common Tern *Sterna hirundo*, Bar-tailed Godwit *Limosa lapponica*, Great Egret, Latham's Snipe *Gallinago hardwickii*, Curlew Sandpiper *Calidris ferruginea*, Sharp-tailed Sandpiper *Calidris acuminata* and Black-faced Monarch *Monarcha melanopsis*.

Twenty-two of the 37 migratory species with known and/or potential habitat are included in the *Significant impact guidelines for 36 migratory shorebird species* (2009b). Following these guidelines, a site may be considered important habitat if it supports:

- At least 0.1 per cent of the 'flyway population' of a single species, or

- At least 2000 migratory shorebirds, or

- At least 15 shorebird species.

Only four migratory shorebird species (as listed in the guidelines: Bar-tailed Godwit, Latham's Snipe, Curlew Sandpiper and Sharp-tailed Sandpiper) have been previously

recorded within the study area. In the last 50 years at least 2500 individuals of these birds have been recorded within 10 km of the study area, with at least 76 individuals recorded in the study area; none of which have been recorded within the last five years. Therefore, the study area is not considered to support 2000 migratory shorebirds. Finally, the study area does not support at least 0.1 per cent of the 'flyway population' (0.1 per cent Bar-tailed Godwit = 325, only one individual recorded; 0.1 per cent Curlew Sandpiper = 180, 66 individuals recorded; 0.1 per cent Sharp-tailed Sandpiper = 160, only one individual recorded; 18 individuals required for Latham's Snipe, eight recorded).

Therefore, the study area is not considered important habitat for the 22 species listed within the *Significant impact guidelines for 36 migratory shorebird species* (2009b). The remaining 15 migratory birds with known and/or potential habitat in the study area are considered further below.

Of the remaining 15 migratory birds, only three have been previously recorded within the study area: Common Tern, Great Egret and Black-faced Monarch. The Common Tern has been recorded 4 times, all in 1985; the Great Egret has been recorded 6 times, all between 1998 and 2000; and, the Black-faced Monarch has been recorded once, in 1995. The study area is not considered to be important habitat for these three species or the remaining migratory birds.

As habitat within the study area has been ruled out as 'important habitat' according to DEWHA guidelines (DEWHA 2009c; 2009b), only the last Significant Impact Criterion needs to be addressed:

- Will the proposal seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

The study area is considered unlikely to support an ecologically significant proportion of the population of any of the 37 migratory species with known and/or potential habitat. Further, no direct impacts are anticipated on any of these species and any minor indirect impacts to mudbank, mangrove and/or saltmarsh habitat is considered as unlikely to result in serious lifecycle disruption for any of these species (including those species where individuals utilise surrounding habitat within Sydney Olympic Park wetlands, Bicentennial Park and Millennium Parklands).

The table below lists the 37 migratory species with known and/or potential habitat in the study area, whether or not they have been previously recorded within the study area, whether or not they are listed in the DEWHA (2009b) guidelines, and whether or not the study area provides important habitat.

Common Name	Recorded in Study Area?	Listed in DEWHA (2009b) Guidelines?	Does Study Area provide 'important habitat'?
White-bellied Sea-eagle	No	No	No
Osprey	No	No	No

Common Name	Recorded in Study Area?	Listed in DEWHA (2009b) Guidelines?	Does Study Area provide 'important habitat'?
Great Egret	**Yes**	No	No
Cattle Egret	No	No	No
Eastern Reef Egret	No	No	No
Double-banded Plover	No	**Yes**	No
Greater Sand Plover	No	**Yes**	No
Lesser Sand Plover	No	**Yes**	No
Pacific Golden Plover	No	**Yes**	No
Grey Plover	No	**Yes**	No
Black-faced Monarch	**Yes**	No	No
Satin Flycatcher	No	No	No
Rufous Fantail	No	No	No
Little Tern	No	No	No
Caspian Tern	No	No	No
Common Tern	**Yes**	No	No
Rainbow Bee-eater	No	No	No
Australian Reed-	No	No	No
Common Sandpiper	No	**Yes**	No
Sharp-tailed Sandpiper	**Yes**	**Yes**	No
Red Knot	No	**Yes**	No
Curlew Sandpiper	**Yes**	**Yes**	No
Western Sandpiper	No	No	No
Pectoral Sandpiper	No	**Yes**	No
Red-necked Stint	No	**Yes**	No
Latham's Snipe	**Yes**	**Yes**	No
Grey-tailed Tattler	No	**Yes**	No
Broad-billed Sandpiper	No	**Yes**	No
Bar-tailed Godwit	**Yes**	**Yes**	No
Black-tailed Godwit	No	**Yes**	No
Eastern Curlew	No	**Yes**	No
Whimbrel	No	**Yes**	No
Ruff	No	**Yes**	No

Common Name	Recorded in Study Area?	Listed in DEWHA (2009b) Guidelines?	Does Study Area provide 'important habitat'?
Wood Sandpiper	No	**Yes**	No
Marsh Sandpiper	No	**Yes**	No
Terek Sandpiper	No	**Yes**	No
Glossy Ibis	No	No	No

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