

Port Botany Post Construction Environmental Monitoring

Shorebird Off-Peak
Season Summary
Report

September 2017

EL1112046



Osprey, Penrhyn Estuary

Photo by Avifauna

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1 Introduction

1.1 Background

Penrhyn Estuary was the most important feeding and roosting site remaining on the northern side of Botany Bay for both migratory and non-migratory shorebirds. Penrhyn Estuary was a small waterway located to the north of Brotherson Dock, which was artificially created during the reclamation of the Botany foreshore between 1975 and 1978. The Estuary has since been rehabilitated as part of the Port Botany Expansion Project to enhance the existing intertidal habitat and to expand the Estuary of approximately 30 ha as a long-term habitat for migratory shorebirds. Habitat enhancement may result in the return of some birds that previously used the area but are no longer found in the Estuary, and in some cases no longer found in Botany Bay. The aim of the shorebird monitoring program is to monitor numbers of shorebirds feeding and roosting on site to determine the success of the habitat enhancement works.

Penrhyn Estuary was considered a significant feeding and roosting site in Botany Bay for seven 'key' species (NSW Wader Study Group Data). Six of these species were selected to measure the success of the Penrhyn Estuary Habitat Enhancement Plan (PEHEP) throughout the pre-construction, construction and post construction phases. These species are: Bar-tailed Godwit, Red-necked Stint, Double-banded Plover, Curlew Sandpiper, Red Knot and Pacific Golden Plover. The seventh key species, the Sharp-tailed Sandpiper, was unsuitable to include for monitoring because of its irregularity in numbers at coastal sites due to the variability of flooding of inland wetlands.

The abundance of the key species in Penrhyn Estuary, compared with counts at reference sites, will indicate the success of PEHEP works. No decline in numbers of any of the key species compared with baseline data would indicate that the habitat enhancement has had no negative impacts. Any increase in the numbers of each of these species would potentially be evidence of habitat enhancement.

1.2 Purpose of this report

This report outlines field procedures, provides details of the sites monitored and initial observations of raw data for the off-peak season shorebird monitoring done between April and August 2017. Apart from the Double-banded Plover, which is a trans-Tasman migrant that spends its non-breeding season in Australia between February-August, the other key species are northern hemisphere migrants and generally only return to their non-breeding grounds in the southern hemisphere during the 'peak' season (September to March). Hence, the best indication of the success of the PEHEP works in the post-construction phase is interpreted from analysis after the peak season shorebird monitoring, which is provided in the annual reporting of those data.

2 Monitoring Methodology

2.1 Sampling Design

Fortnightly surveys of shorebird abundance and diversity were carried out during low and high tides at the study site, Penrhyn Estuary, and at selected reference sites from April to August 2017. Where possible, local reference sites were chosen so that all sites could be surveyed on the same day by the same team of shorebird experts. However, as sites around Botany Bay did not support sufficient numbers of some species for analysis, some regional reference sites were selected outside of the Bay (**Table 1** and **Figures 1-3**).

Table 1 Habitats and key species monitored in Penrhyn Estuary and reference sites

Area	Sites	Habitats	Key species
Penrhyn Estuary	Transects 1 & 2	Tidal estuarine mudflats Tidal sand flats Sand spits Sandy beaches Stony substrate Sandy islands	Bar-tailed Godwit Red-necked Stint Pacific Golden Plover Red Knot Curlew Sandpiper Double-banded Plover
Southern Botany Bay	Quibray Bay	Tidal sand flats Sandy beaches Oyster lease structures	Bar-tailed Godwit
	Riverside Drive	Tidal estuarine mudflats Tidal sand flats Sand spit Sandy beaches	
	Woodlands Road	Tidal estuary mudflats Tidal sand flats Sandy beaches	
Boat Harbour		Tidal rock platform Tidal sand flats Sandy beaches	Red-necked Stint Double-banded Plover
Parramatta Estuary ¹	Hen and Chicken Bay	Tidal estuarine mudflats Tidal sand flats Sandy beaches Sand/rock spits Concrete jetty	Curlew Sandpiper
	Mason Park & Waterbird Refuge	Saltmarsh and lagoons	
Hunter River Estuary ^{1,2}		Tidal estuarine mudflats Tidal sand flats Sandy beaches Rocky shores	Pacific Golden Plover

¹Regional reference site

²Reference site only monitored during peak season

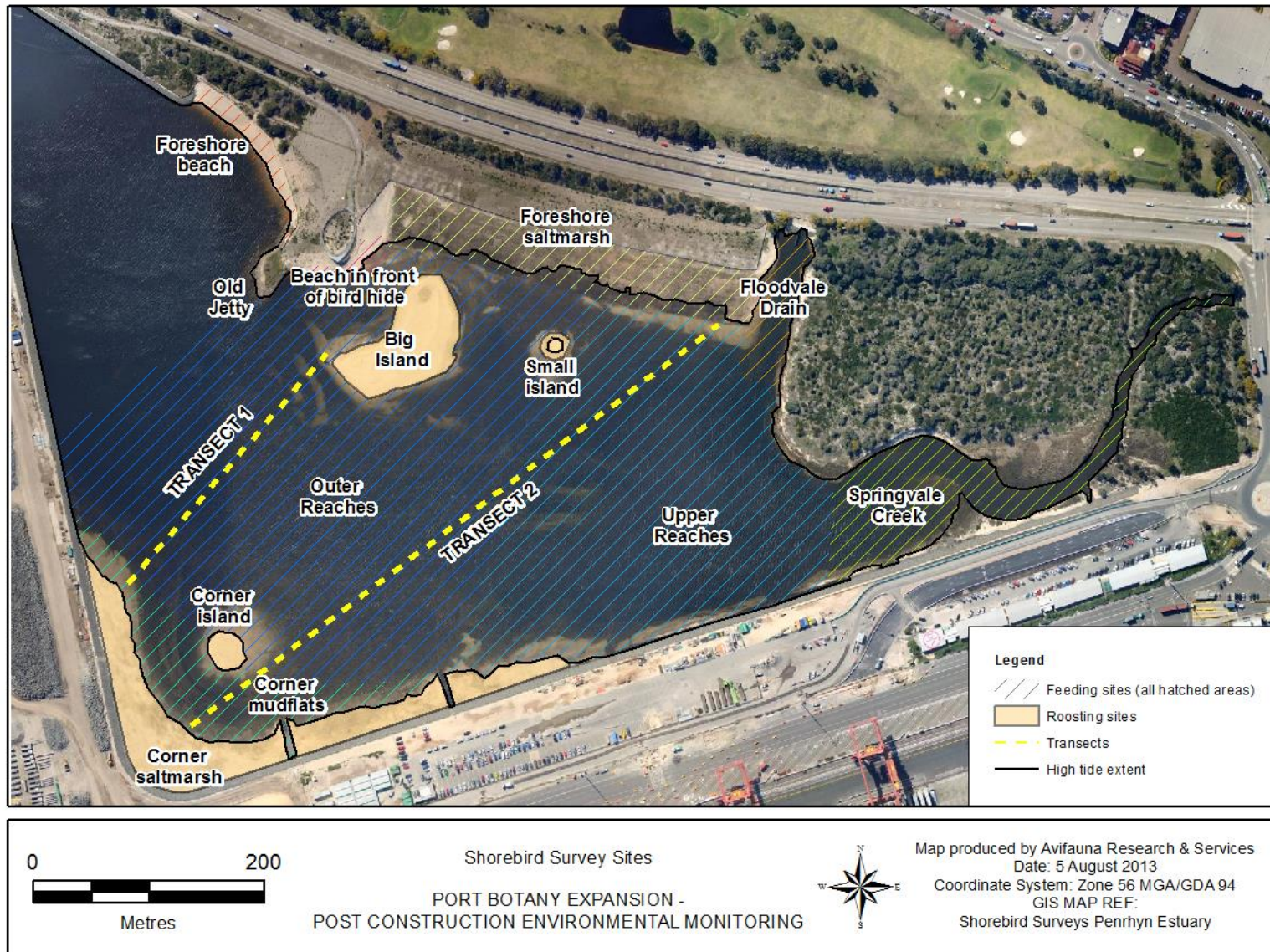


Figure 1 Penrhyn Estuary Shorebird Feeding and Roosting Sites

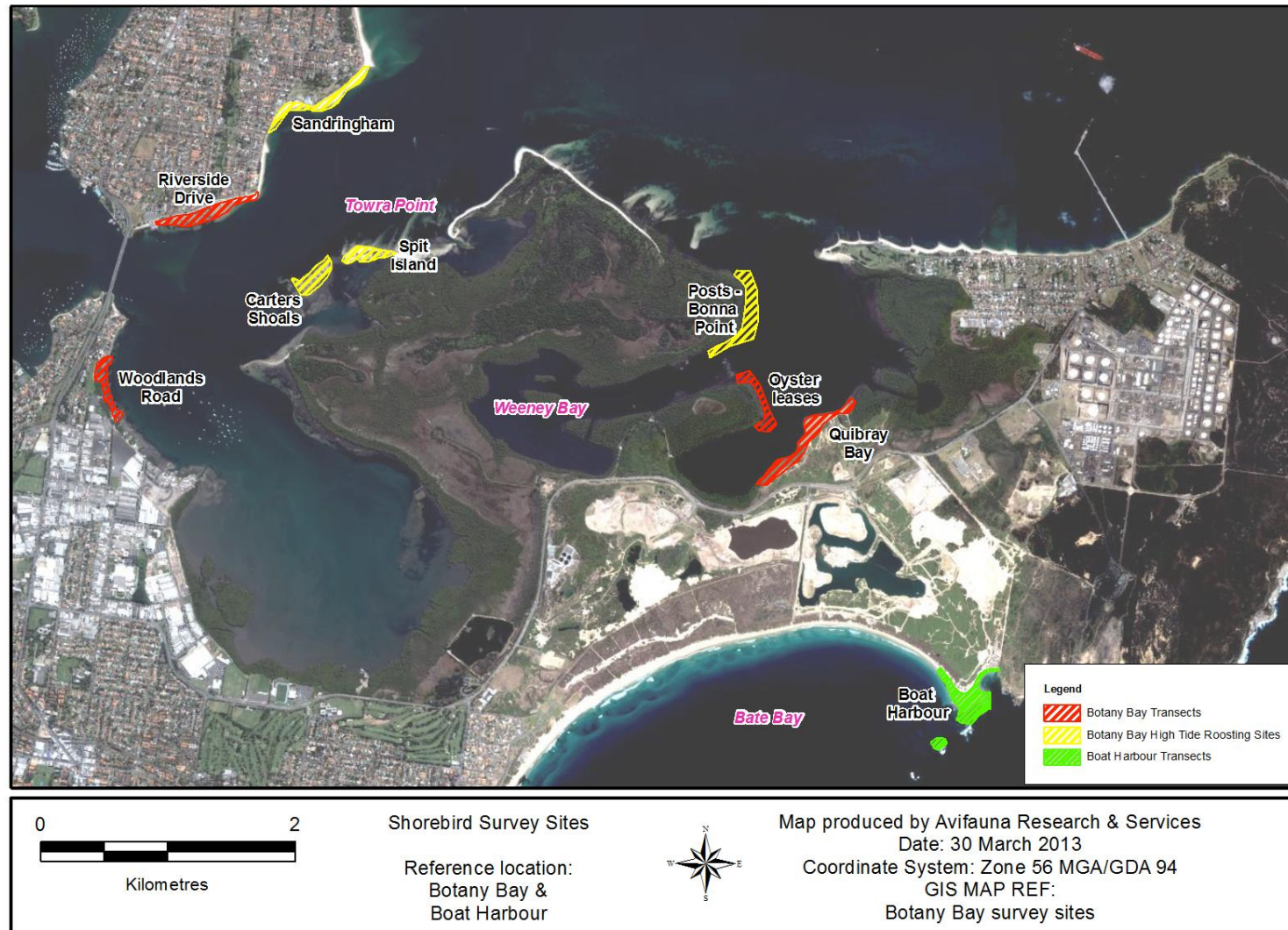


Figure 2 Shorebird Reference Sites: Southern Botany Bay and Boat Harbour Transects

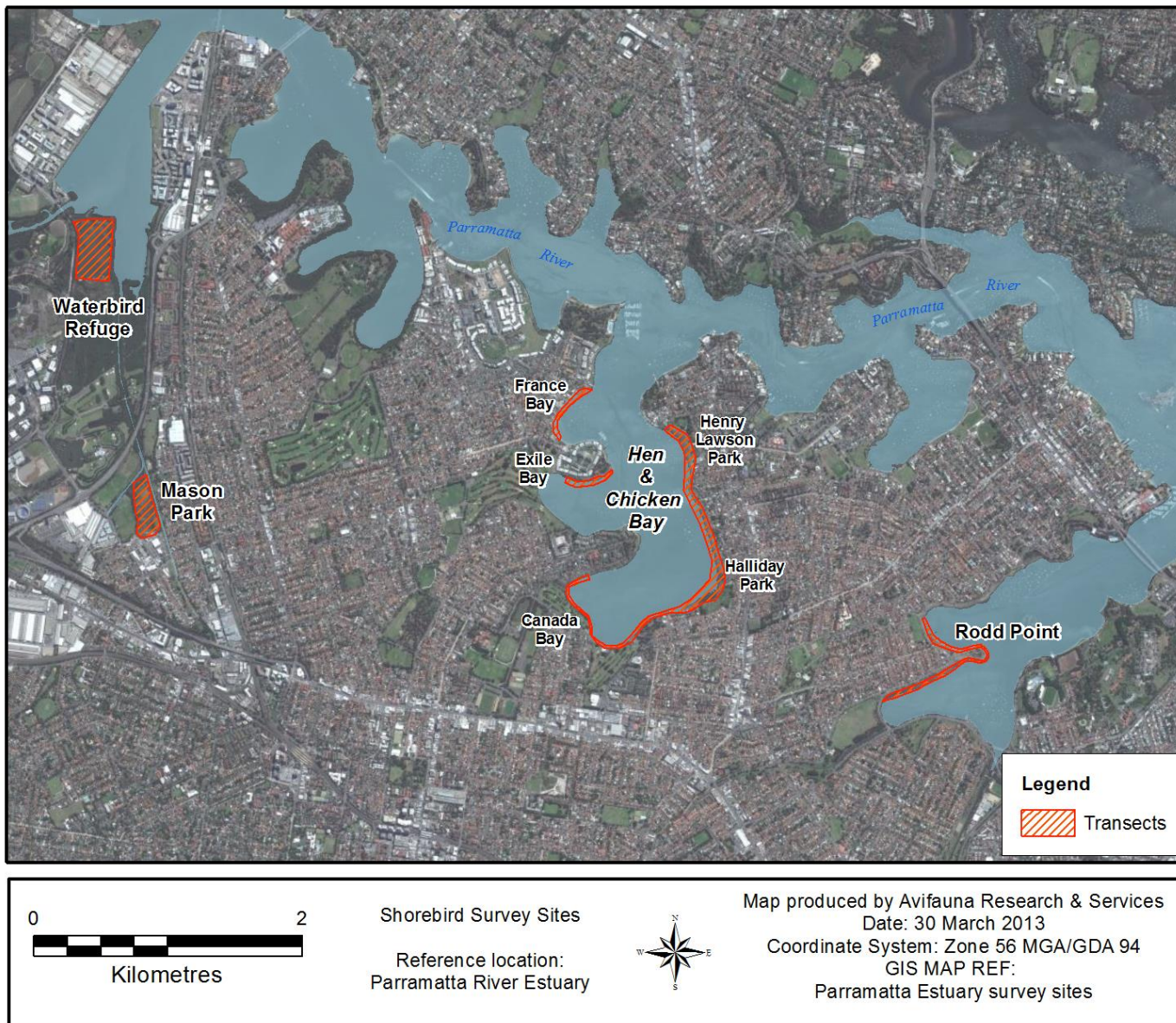


Figure 3 Shorebird Reference Sites: Parramatta River Estuary Transects

2.2 Field Procedures

Penrhyn Estuary

Shorebirds were observed for two hours at low and high tide, recording species present, abundance, behaviour and habitat usage. Weather conditions were also noted, as well as any disturbance or predation in the estuary.

At low tide, surveys were conducted on foot by walking along predetermined transects (**Figure 1**), with access via gates along the northern perimeter of Foreshore Road near the Bird Hide. High tide surveys required two observers to complete the survey by boat, with transects varying depending on the height of the tide. The boat was launched near the Bird Hide, with 4WD access via the gates on Foreshore Road. During neap tides, when it was too shallow to access the whole estuary by boat, surveys were conducted by walking through shallow water wearing chest waders.

Southern Botany Bay

Three reference sites in Southern Botany Bay were monitored by boat at high tide and on foot at low tide to measure the abundance of shorebirds against those counts obtained from Penrhyn Estuary, while additional high tide roost sites were also monitored to estimate the total population of Bar-tailed Godwits in Botany Bay (**Figure 2**).

Riverside Drive provides approximately 6 ha of tidal flats, with roosting areas confined to a beach and small sandspit at the outlet of a small creek at Scott Park. Previously, Bar-tailed Godwits regularly used the site at high tide. However, numbers have declined and only observed at this site on an irregular basis. This is most likely due to wind and water erosion of the sandspit.

Woodlands Road Reserve provides approximately 5 ha of mudflats, providing feeding habitat for small numbers of Bar-tailed Godwit. Small areas of exposed sand provide limited roosting space. Preferred roosting habitat is mostly available only during neap tides given there is insufficient suitable area available during spring high tides. In which case the birds roost elsewhere in Botany Bay. However, Bar-tailed Godwits can be present at this site in areas generally shunned (next to waterfront buildings adjacent to the reserve). This is because space is also limited at 'Spit Island' due to recent erosion and loss of habitat there.

Spit Island is the most important shorebird roosting habitat in Botany Bay for migratory shorebirds and is also nesting habitat for the endangered Little Tern but the severe erosion of the site has been listed as a major concern as part of the Towra Point Ramsar during a recent assessment by the Australian Government.

Quibray Bay supports a steady population of Bar-tailed Godwits with roosting sites including small beaches and nearby oyster lease posts. Given existing information show that shorebirds move to other locations in Botany Bay in adverse weather (e.g. birds will avoid the exposed oyster leases at times), additional roosting sites at Sandringham, Spit Island and Carters Shoals were also monitored (**Figure 2**).

Boat Harbour

Boat Harbour is a medium-sized sandstone reef (approximately 3 ha), located on the northeast of Bate Bay (**Figure 2**). The reference site provides shelter for migratory shorebirds such as the Red-necked Stint, Double-banded Plover, Pacific Golden Plover and Ruddy Turnstone, which use the area for feeding at low tide and as a roost site at high tide.

Parramatta Estuary

Reference sites around Parramatta River Estuary were chosen mostly to monitor the Curlew Sandpiper (**Figure 3**). The area, however, also provides habitat for large numbers of Bar-tailed Godwits. Hen and Chicken Bay provides feeding and roosting sites with several small beaches, rocky outcrops and jetties. Alternative habitat for the Curlew Sandpiper and other shorebirds has been available in tidal saltmarsh wetlands at Mason Park and the Waterbird Refuge at Homebush, although the former no longer provides suitable habitat due to mangrove incursion across saltmarsh and mudflats previously used by Curlew Sandpipers.

Further details of field procedures can be found in the Monitoring Services Management Plan (Cardno 2013).

2.3 Laboratory Procedures

Shorebirds were identified and recorded, noting the number of species present, behaviour, habitat usage and any disturbances. On occasions with two surveyors in the field, observations were recorded directly into a waterbird survey notebook, with one person observing while the other scribed. When a single observer was in the field, a digital voice recorder was used to note observations. Upon completion of field surveys, notebooks were returned to the office and data was entered immediately into the database. Voice recordings were uploaded onto the computer and notes then transferred into a waterbird survey notebook. Weather conditions were recorded from the Bureau of Meteorology online database (www.bom.gov.au), including temperature, wind speed and wind direction. Notebooks were stored once all information was entered, and the database was backed up onsite and to an offsite representative.

Significant disturbances or incidents that may have occurred while in the field were actioned after discussion with the director. Incidents requiring action may include, for example, pest control, unauthorised personnel within the estuary or reporting of pollution such as oil spills.

2.4 Quality Control Procedures

Shorebird identification was verified through photographic records where necessary. High quality digital photography was also used for count verification with large flocks of birds. Photography was also used to confirm the health condition of shorebirds.

Observers were responsible for entering their own field notes to minimise the handling of the data, reducing potential error. The director reviewed all observations and data before submitting into the database to ensure the accuracy of data collected.

3 Monitoring Works

Shorebird surveys were conducted at Penrhyn Estuary and associated reference sites as outlined below.

Table 2 Timing, location and frequency of shorebird monitoring

Where	When	What
Penrhyn Estuary	Fortnightly, April- August	<ul style="list-style-type: none"> > Shorebird abundance, diversity and behaviour > Disturbance and predation > Shorebird health
<i>Reference sites</i>		
Southern Botany Bay	Fortnightly, April- August	> Shorebird abundance, diversity and behaviour
Parramatta Estuary	Fortnightly, April- August	> Shorebird abundance, diversity and behaviour
Boat Harbour	Fortnightly, April- August	> Shorebird abundance, diversity and behaviour

4 Preliminary Findings

Two of the six key species (Bar-tailed Godwit and Pacific Golden Plover) were observed in Penrhyn Estuary during the off-peak season, April to August 2017 (**Table 3**). The Bar-tailed Godwit, Pacific Golden Plover, Red-necked Stint, Red Knot and Curlew Sandpiper are all northern hemisphere migrants, with only small numbers of Red-necked Stint and Bar-tailed Godwit remaining in their non-breeding grounds. The Double-banded Plover is a transTasman migrant, spending its non-breeding season in Australia between February-August, returning to breed in New Zealand between August-March.

Double-banded Plovers were not recorded at high or low tide at Penrhyn Estuary during the 2017 off-peak period whereas in contrast, they were recorded monthly between April and August at Boat Harbour (reference site) (**Figure 4a and b**). These results indicate that Boat Harbour appears to be a preferred site to Penrhyn Estuary for both feeding and roosting.

Numbers of Double-banded Plover in Penrhyn Estuary declined during the construction phase of the Port Botany Expansion (**Figure 5**). In the first three years of the post-construction phase there was a gradual increase in abundance of Double-banded Plover in Penrhyn Estuary in the low tide surveys, where peak counts approached pre-construction levels (**Figure 5a**). Peak counts at high tide, however, declined so that in 2013 they were about 10% of pre-construction levels (**Figure 5b**). In 2014 at low tide, a slight decline in peak counts was observed but there was an increase in counts at high tide (**Figure 5a and b**). Counts in 2015 were similar to 2014 for high and low tide but up to half of the (target) pre-construction levels. Low tide counts in 2016 were less than half of the target and none were observed at high tide. In 2017, low tide and high tide failed to register a single Double-banded Plover (**Figure 5a and b**). This preference to forage and roost outside of the Penrhyn Estuary area suggests that it remains uncertain whether or not pre-construction abundance levels will return to the site. This drop in peak abundance over the 'off-peak' season could be a reflection of the overall decrease in shorebird abundance being observed across the wider Botany Bay area, or presence at sites not covered during this study, for example Sydney Airport .

Three Pacific Golden Plovers were observed on high and low tide on 10 April just before migration, showing typical pre-breeding plumage and increased body mass. After this date, Pacific Golden Plover was absent from Penrhyn Estuary, whilst small numbers of one to three non-breeding birds persisted at the Boat Harbour reference site throughout the off-peak season. Red-necked stints were also absent from Penrhyn Estuary, however up to 16 remained at Boat Harbour throughout this period. A single Bar-tailed Godwit was observed feeding on one occasion in Penrhyn Estuary during the 'off-peak' season which is a further reduction of the low numbers observed on three separate occasions the previous year.

Statistical analyses after the peak season counts for 2017 - 2018 will provide an assessment of the success of the PEHEP works in the post-construction phase with the return of the key migratory species.

Table 3 Species observed in Penrhyn Estuary April – August 2017

	EPBC	TSC
Australasian Darter		
Australian Pelican		
Australian White Ibis		
Bar-tailed Godwit*	M	
Black-winged Stilt		
Caspian Tern		
Cattle Egret		
Chestnut Teal		
Crested Tern		
Eastern Great Egret		
Eastern Osprey	M	V
Great Cormorant		
Grey Teal		
Little Black Cormorant		
Little Egret		
Little Pied Cormorant		
Masked Lapwing		
Pacific Black Duck		
Pacific Golden Plover*	M	
Pied Cormorant		
Pied Oystercatcher		E
Red-capped Plover		
Royal Spoonbill		
Silver Gull		
Striated Heron		
Whimbrel		
White-faced Heron		

* Key species for Penrhyn Estuary

EPBC Species protected under the Environment Protection and Biodiversity Conservation Act 1999 (Migratory species)

TSC Species protected under the Threatened Species Conservation Act 1995 (Vulnerable, Endangered)

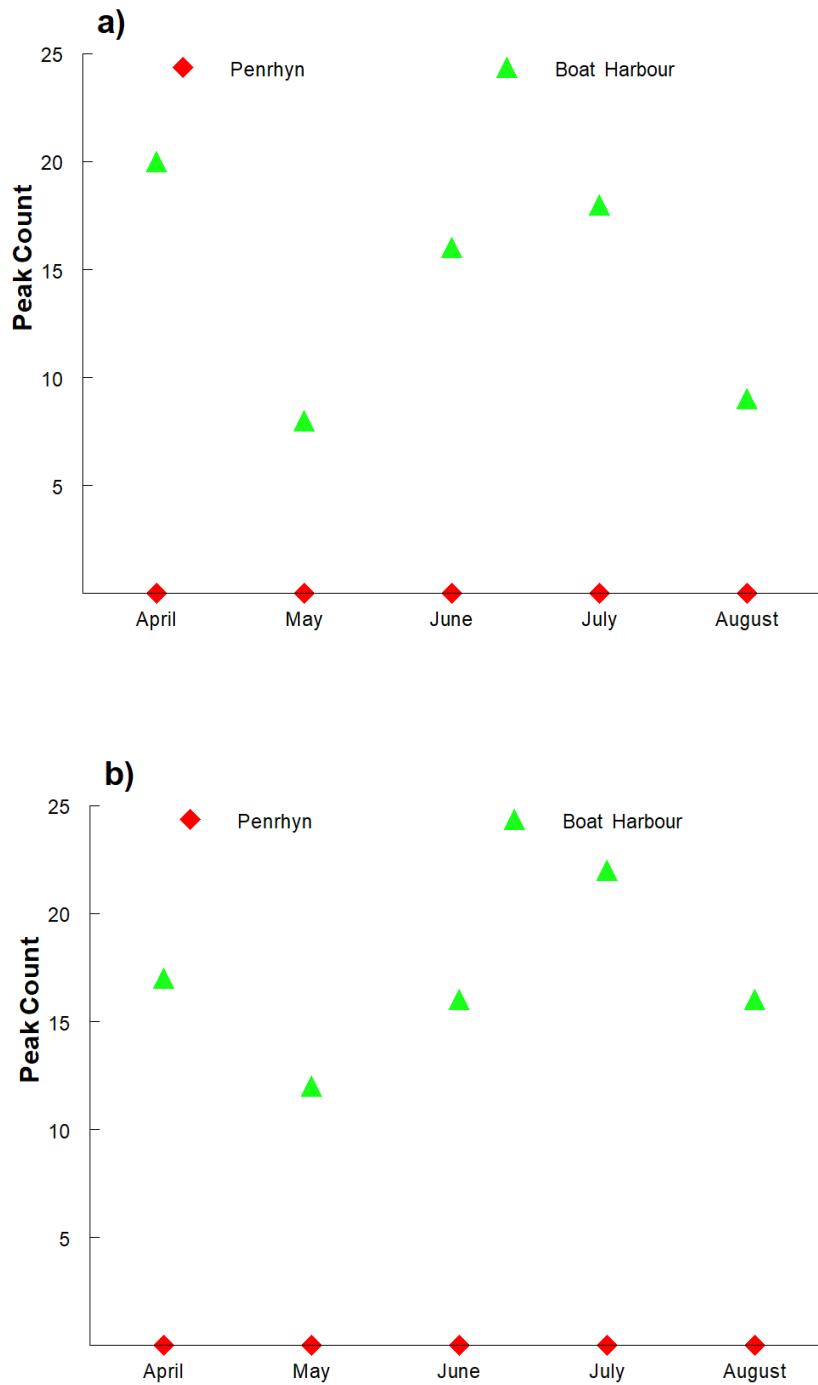


Figure 4 Peak Count of Double-banded Plover at a) Low Tide and b) High Tide between April and August in the 2017 off-peak season

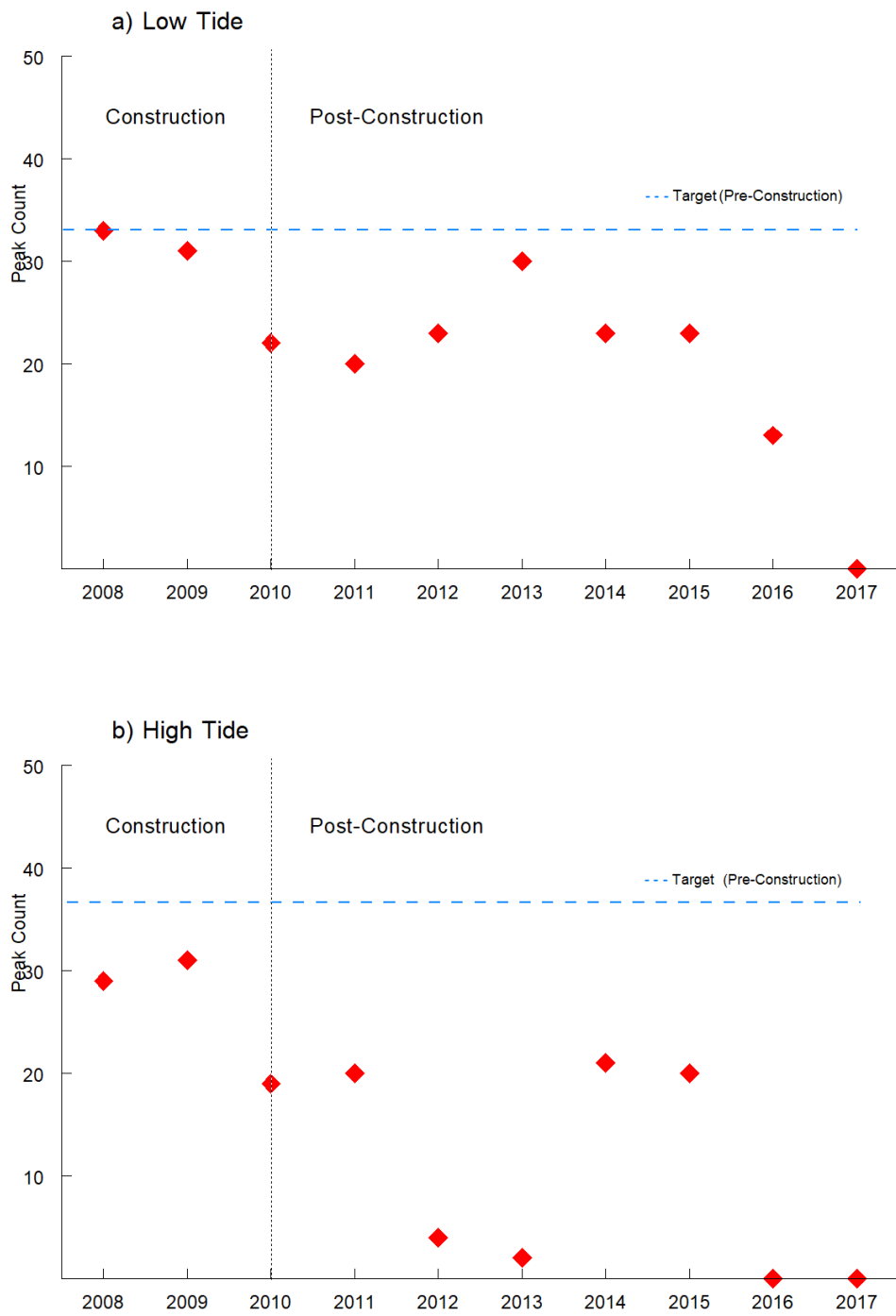


Figure 5 Peak Abundance of the Double-banded Plover in Penrhyn Estuary During a) Low Tide and b) High Tide in Construction and Post-construction phases

5 References

Avifauna Research & Services (2013). *Port Botany Post Construction Environmental Monitoring: Shorebirds Monitoring Off-Peak Summary Report*. EL1112046 Prepared for Sydney Ports Corporation. Period ending August 2013.

Cardno (2013). *Port Botany Expansion Environmental Enhancement Works – Post Construction Environmental Monitoring. Monitoring Services Management Plan*. EL1112046 Prepared for Sydney Ports Corporation. August 2013.

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APPENDIX A
SHOREBIRD
SUEVES:
PENRHYN
ESTUARY AND
REFERENCE SITES

Appendix A: Shorebird Surveys: Penrhyn Estuary and Reference Sites

A-1: Diurnal Shorebird Surveys: Penrhyn Estuary (Key Species)

Subsite	Common Name	Count	Behaviour	Habitat	Date	Tide
Upper Reaches	Curlew Sandpiper	1	Feeding	Exposed mud/sand	08/08/2017	Low
Outer Flushing Channel	Pacific Golden Plover	3	Roosting	Rocks	10/04/2017	High
Outer Flushing Channel	Pacific Golden Plover	3	Roosting	Rocks	10/04/2017	Low

A-2: Reference Site Monitoring: Botany Bay (Bar-tailed Godwit)

Subsite	Common Name	Count	Behaviour	Habitat	Date	Tide
Spit Island	Bar-tailed Godwit	27	Roosting	Sandspit	13/04/2017	High
Woodlands Rd	Bar-tailed Godwit	79	Roosting	Artificial structure	13/04/2017	High
Woodlands Rd	Bar-tailed Godwit	2	Feeding	Exposed mud/sand	13/04/2017	Low
Quibray Bay	Bar-tailed Godwit	10	Feeding	Exposed mud/sand	13/04/2017	Low
Spit Island	Bar-tailed Godwit	85	Roosting	Sandspit	26/04/2017	High
Riverside Drive	Bar-tailed Godwit	1	Feeding	Exposed mud/sand	26/04/2017	Low
Woodlands Rd	Bar-tailed Godwit	3	Feeding	Exposed mud/sand	26/04/2017	Low
Quibray Bay	Bar-tailed Godwit	8	Feeding	Exposed mud/sand	26/04/2017	Low
Sandringham	Bar-tailed Godwit	5	Roosting	Beach	13/05/2017	High
Spit Island	Bar-tailed Godwit	2	Roosting	Sandspit	13/05/2017	High
Woodlands Rd	Bar-tailed Godwit	54	Roosting	Beach	13/05/2017	High
Riverside Drive	Bar-tailed Godwit	12	Feeding	Exposed mud/sand	13/05/2017	Low
Woodlands Rd	Bar-tailed Godwit	1	Feeding	Exposed mud/sand	13/05/2017	Low
Riverside Drive	Bar-tailed Godwit	16	Roosting	Beach	26/05/2017	High
Riverside Drive	Bar-tailed Godwit	7	Feeding	Exposed mud/sand	26/05/2017	Low
Quibray Bay	Bar-tailed Godwit	7	Feeding	Exposed mud/sand	26/05/2017	Low
Riverside Drive	Bar-tailed Godwit	29	Roosting	Beach	10/06/2017	High
Woodlands Rd	Bar-tailed Godwit	26	Roosting	Exposed mud/sand	10/06/2017	High
Riverside Drive	Bar-tailed Godwit	13	Feeding	Exposed mud/sand	10/06/2017	Low
Woodlands Rd	Bar-tailed Godwit	22	Roosting	Beach	23/06/2017	High
Riverside Drive	Bar-tailed Godwit	49	Roosting	Beach	23/06/2017	High
Quibray Bay	Bar-tailed Godwit	5	Feeding	Exposed mud/sand	23/06/2017	Low
Riverside Drive	Bar-tailed Godwit	13	Feeding	Exposed mud/sand	23/06/2017	Low
Woodlands Rd	Bar-tailed Godwit	38	Roosting	Beach	25/07/2017	High
Woodlands Rd	Bar-tailed Godwit	12	Feeding	Exposed mud/sand	25/07/2017	Low
Riverside Drive	Bar-tailed Godwit	8	Feeding	Exposed mud/sand	25/07/2017	Low
Woodlands Rd	Bar-tailed Godwit	11	Feeding	Exposed mud/sand	07/08/2017	Low

Riverside Drive	Bar-tailed Godwit	9	Feeding	Exposed mud/sand	07/08/2017	Low
Sandringham	Bar-tailed Godwit	65	Roosting	Sandspit	22/08/2017	High
Riverside Drive	Bar-tailed Godwit	6	Feeding	Exposed mud/sand	22/08/2017	Low
Quibray Bay	Bar-tailed Godwit	1	Feeding	Exposed mud/sand	22/08/2017	Low

A-3: Reference Site Monitoring: Parramatta River (Curlew Sandpiper)

Not recorded

A-4: Reference Site Monitoring: Boat Harbour (Pacific Golden Plover)

Subsite	Common Name	Count	Behaviour	Habitat	Date	Tide
Boat Harbour	Pacific Golden Plover	2	Roosting	Rocks	15/04/2017	High
Boat Harbour	Pacific Golden Plover	2	Roosting	Rocks	25/05/2017	High
Boat Harbour	Pacific Golden Plover	2	Feeding	Rocks	25/05/2017	Low
Boat Harbour	Pacific Golden Plover	1	Feeding	Rocks	05/07/2017	Low
Boat Harbour	Pacific Golden Plover	2	Roosting	Rocks	05/07/2017	High
Boat Harbour	Pacific Golden Plover	3	Roosting	Rocks	24/07/2017	High
Boat Harbour	Pacific Golden Plover	2	Feeding	Rocks	24/07/2017	Low
Boat Harbour	Pacific Golden Plover	1	Roosting	Rocks	09/08/2017	High
Boat Harbour	Pacific Golden Plover	1	Feeding	Rocks	09/08/2017	Low
Boat Harbour	Pacific Golden Plover	2	Roosting	Rocks	23/08/2017	High
Boat Harbour	Pacific Golden Plover	1	Feeding	Rocks	23/08/2017	Low

A-5: Reference Site Monitoring: Boat Harbour (Double-banded Plover)

Subsite	Common Name	Count	Behaviour	Habitat	Date	Tide
Boat Harbour	Double-banded Plover	6	Roosting	Rocks	15/04/2017	High
Boat Harbour	Double-banded Plover	6	Feeding	Rocks	15/04/2017	Low
Boat Harbour	Double-banded Plover	8	Feeding	Rocks	28/04/2017	Low
Boat Harbour	Double-banded Plover	19	Roosting	Rocks	12/05/2017	High
Boat Harbour	Double-banded Plover	14	Feeding	Rocks	12/05/2017	Low
Boat Harbour	Double-banded Plover	18	Roosting	Rocks	25/05/2017	High
Boat Harbour	Double-banded Plover	15	Feeding	Rocks	25/05/2017	Low
Boat Harbour	Double-banded Plover	5	Feeding	Rocks	20/06/2017	Low
Boat Harbour	Double-banded Plover	8	Feeding	Rocks	20/06/2017	High
Boat Harbour	Double-banded Plover	5	Feeding	Rocks	05/07/2017	Low
Boat Harbour	Double-banded Plover	14	Roosting	Rocks	05/07/2017	High
Boat Harbour	Double-banded Plover	8	Roosting	Rocks	24/07/2017	High
Boat Harbour	Double-banded Plover	6	Feeding	Rocks	24/07/2017	Low
Boat Harbour	Double-banded Plover	6	Roosting	Rocks	09/08/2017	High

Boat Harbour	Double-banded Plover	9	Feeding	Rocks	09/08/2017	Low
Boat Harbour	Double-banded Plover	6	Roosting	Rocks	23/08/2017	High
Boat Harbour	Double-banded Plover	8	Feeding	Rocks	23/08/2017	Low

A-6: Reference Site Monitoring: Boat Harbour (Red-necked Stint)

Subsite	Common Name	Count	Behaviour	Habitat	Date	Tide
Boat Harbour	Red-necked Stint	16	Roosting	Rocks	15/04/2017	High
Boat Harbour	Red-necked Stint	5	Feeding	Rocks	15/04/2017	Low
Boat Harbour	Red-necked Stint	23	Feeding	Rocks	28/04/2017	Low
Boat Harbour	Red-necked Stint	6	Roosting	Rocks	12/05/2017	High
Boat Harbour	Red-necked Stint	2	Feeding	Rocks	12/05/2017	Low
Boat Harbour	Red-necked Stint	2	Roosting	Rocks	25/05/2017	High
Boat Harbour	Red-necked Stint	13	Feeding	Rocks	25/05/2017	Low
Boat Harbour	Red-necked Stint	7	Feeding	Rocks	08/06/2017	High
Boat Harbour	Red-necked Stint	12	Feeding	Beach	08/06/2017	Low
Boat Harbour	Red-necked Stint	14	Feeding	Rocks	20/06/2017	Low
Boat Harbour	Red-necked Stint	20	Feeding	Rocks	20/06/2017	High
Boat Harbour	Red-necked Stint	4	Roosting	Rocks	05/07/2017	High
Boat Harbour	Red-necked Stint	12	Roosting	Rocks	24/07/2017	High
Boat Harbour	Red-necked Stint	11	Feeding	Rocks	24/07/2017	Low
Boat Harbour	Red-necked Stint	9	Feeding	Rocks	09/08/2017	High
Boat Harbour	Red-necked Stint	17	Feeding	Rocks	09/08/2017	Low
Boat Harbour	Red-necked Stint	25	Roosting	Rocks	23/08/2017	High
Boat Harbour	Red-necked Stint	20	Feeding	Rocks	23/08/2017	Low