

**Report to:**

**URS**

**Botany Groundwater Cleanup Project**

**Bird Monitoring Program**

**October 2006**

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## 1.0 Introduction

The Botany Groundwater Cleanup Project undertaken by Orica will result in large volumes of groundwater being prevented from entering from an area from Penrhyn Estuary to the eastern end of Foreshore Beach. Penrhyn Estuary provides important feeding and roosting areas for waterbirds, especially migratory shorebirds, which are protected under international agreements and the EPBC Act. The effected area is the last habitat remaining on the north side of the Bay for these shorebirds and is important for their long-term survival in the Sydney area.

As part of the project Orica are committed to monitoring the effects of the groundwater removal on the environment, including the fauna and flora of Penrhyn Estuary and Foreshore Beach. URS have been commissioned to undertake the relevant studies and have contracted Avifauna Research and Services Pty Ltd to undertake the study of potential impact on waterbirds, including migratory shorebirds protected under international agreements and the EPBC Act, as well as threatened species listed under the TSC Act.

The removal of groundwater from the vicinity of Penrhyn Estuary may have an impact on invertebrates associated with the intertidal mudflats which are essential for the survival of migratory birds that feed on these animals. Changes to the groundwater flows are likely to change species composition and density of invertebrates over time and in turn have some impact on shorebirds. These changes can be measured with regular sampling of invertebrates at the study site once or twice each year. However the effect on the shorebirds may be more subtle needing an assessment of any changes to the population at the site and a measure of the health of the birds. Changes in the numbers and species composition of shorebirds at the sites can be made by counting the birds at the site during feeding and roosting on a regular basis. The health and condition of the shorebirds can either be carried out by catching the birds and measuring certain basic metabolic parameters (e.g. blood plasma triglyceride levels) to determine habitat quality (whether the birds are gaining or losing weight in the Estuary and/or using high resolution digital photography in the field to assess body mass. These techniques require a high level of expertise by the researcher and have been developed in recent years based on research in Botany Bay and other parts of the world, for example Egeler *et al* (2003), Williams *et al* (1999) and Wiersma and Piersma (1995).

Counting birds at the study site can be carried out relatively easily by a skilled observer who is able to identify all species of shorebirds and other waterbirds that are likely to occur at the site. Changes in numbers of each species at Penrhyn Estuary tend to change depending on the season as migratory species move through the area during migration. Counts should therefore be carried out at least weekly at low and high tide to measure the number shorebirds feeding at the site as well as numbers of birds roosting there. The difference in numbers will determine whether birds are moving into or out of the site during the various stages of the tide.

## 2.0 Methods

Shorebirds were monitored at Penrhyn Estuary from mid-September 2005 to mid-October 2006 once every week. Counts were carried out at high tide and low tide, usually on the same day except during the winter months if both tides did not occur during daylight hours. Counts at high tide were timed to enable counts of all shorebirds that were likely to be using the estuary as feeding habitat, on the assumption that shorebirds generally roost at the most convenient roost site to their foraging area. Counts were carried out at low tide to determine which parts of the estuary were used as feeding habitat and to determine whether these patterns changed over time. Low tide counts also confirmed whether all birds feeding at the estuary roosted there or moved elsewhere.

Birds were counted and identified using high quality optical 10x50 binoculars and/or 25x77 spotting scope. Data was collected in a field note book then entered onto an Excel spreadsheet for storage and analysis. The Estuary was divided into five sections for the purpose of assessing which parts of the estuary were used over time. These were: upper estuary (section 1) outer estuary (section 2) Port Spit (section 3), Port Beach (section 4) and the Old Government Jetty (as a roost site only) (section 5). Springvale Creek (Section 1a) was counted during low tide only by walking up the creek bed. Section 1b was included in the count of the upper estuary (section 5).

Of the 24 species of shorebirds observed at the Estuary during the study seven species were considered key species for monitoring (see Table 1). The numbers of each of these species at the Estuary represented a major proportion of the Botany Bay populations which rely on the Estuary as feeding as well as roosting habitat.

A baseline study was not carried out prior to this project due to the need for an immediate start of the monitoring. However data collected by the NSW Wader Study Group since 2001 includes monthly high tide counts of shorebirds at Penrhyn Estuary, as well as other sites in Botany Bay and at Boat Harbour (on the ocean side of the Kurnell Peninsula). These data were used to compare counts of shorebirds during this study through the year.

Count data was stored as Excel files and are included in the appendices of this report. Count and habitat usage were plotted on charts for several key species and are included in this report. Many digital photographs were taken and stored electronically. Two of those appear in this report.



Figure 1: Transects used to count shorebirds at Penrhyn Estuary. 1 = Upper Reaches, 1a = Springvale Creek, 1b = Floodvale Creek, 2 = Outer Reaches, 3 = Port Spit, 4 = Part Beach, 5 = Old Government Jetty and nearby beach (roosting site), 6 = Foreshore Beach

**Table 1:** Birds recorded at Penrhyn Estuary September 2005 – September 2006

| Scientific name                    | Common name                          | max count  | Resident/migratory | Listing |
|------------------------------------|--------------------------------------|------------|--------------------|---------|
| <i>Tringa nebularia</i>            | Common Greenshank                    | 1          | M                  | JC/EPBC |
| <i>Actitis hypoleucos</i>          | Common Sandpiper                     | 1          | M                  | JC/EPBC |
| <i>Arenaria interpres</i>          | Ruddy Turnstone                      | 1          | M                  | JC/EPBC |
| <b><i>Calidris acuminata</i></b>   | <b><i>Sharp-tailed Sandpiper</i></b> | <b>22</b>  | M                  | JC/EPBC |
| <i>Calidris alba</i>               | Sanderling                           | 3          | M/Th               | JC/EPBC |
| <b><i>Calidris canutus</i></b>     | <b><i>Red Knot</i></b>               | <b>18</b>  | M                  | JC/EPBC |
| <b><i>Calidris ferruginea</i></b>  | <b><i>Curlew Sandpiper</i></b>       | <b>16</b>  | M                  | JC/EPBC |
| <i>Calidris melanotos</i>          | Pectoral Sandpiper                   | 1          | M                  | JC/EPBC |
| <b><i>Calidris ruficollis</i></b>  | <b><i>Red-necked Stint</i></b>       | <b>45</b>  | M                  | JC/EPBC |
| <i>Calidris tenuirostris</i>       | Great Knot                           | 2          | M/Th               | JC/EPBC |
| <b><i>Charadrius bicinctus</i></b> | <b><i>Double-banded Plover</i></b>   | <b>54</b>  | M                  | EPBC    |
| <i>Charadrius ruficapillus</i>     | Red-capped Plover                    | 8          | R                  |         |
| <i>Elsayornis melanops</i>         | Black-fronted Dotterel               | 2          | R                  |         |
| <i>Haematopus fuliginosus</i>      | Sooty Oystercatcher                  | 1          | R/Th               |         |
| <i>Haematopus longirostris</i>     | Pied Oystercatcher                   | 2          | R/Th               |         |
| <i>Heteroscelus brevipes</i>       | Grey-tailed Tattler                  | 3          | M                  | JC/EPBC |
| <i>Himantopus himantopus</i>       | Black-winged Stilt                   | 12         | R                  |         |
| <b><i>Limosa lapponica</i></b>     | <b><i>Bar-tailed Godwit</i></b>      | <b>162</b> | M                  | JC/EPBC |
| <b><i>Pluvialis fulva</i></b>      | <b><i>Pacific Golden Plover</i></b>  | <b>17</b>  | M                  | JC/EPBC |
| <i>Pluvialis squatarola</i>        | Grey Plover                          | 1          | M                  | JC/EPBC |
| <i>Xenus terek</i>                 | Terek Sandpiper                      | 1          | M/Th               | JC/EPBC |
| <i>Numenius madagascariensis</i>   | Eastern Curlew                       | 1          | M                  | JC/EPBC |
| <i>Numenius phaeopus</i>           | Whimbrel                             | 1          | M                  | JC/EPBC |
| <i>Vanellus miles</i>              | Masked Lapwing                       | 2          | R                  |         |
| <b>Other waterbirds</b>            |                                      |            |                    |         |
| <i>Anas superciliosa</i>           | Pacific Black Duck                   | 2          | R                  |         |
| <i>Anas castanea</i>               | Chestnut Teal                        | 6          | R                  |         |
| <i>Anhinga melanogaster</i>        | Darter                               | 1          | R                  |         |
| <i>Ardea novaehollandiae</i>       | White-faced Heron                    | 1          | R                  |         |
| <i>Ardea ibis</i>                  | Cattle Egret                         | 4          | M                  | JC/EPBC |
| <i>Egretta alba</i>                | Great Egret                          | 2          | M                  | JC/EPBC |
| <i>Egretta garzetta</i>            | Little Egret                         | 1          | R                  |         |
| <i>Butorides striatus</i>          | Striated Heron                       | 1          | R                  |         |
| <i>Threskiornis molucca</i>        | Australian White Ibis                | 16         | R                  |         |
| <i>Pelecanus conspicillatus</i>    | Australian Pelican                   | 12         | R                  |         |
| <i>Phalacrocorax carbo</i>         | Great Cormorant                      | 2          | R                  |         |
| <i>Phalacrocorax melanoleucos</i>  | Little Pied Cormorant                | 4          | R                  |         |
| <i>Phalacrocorax sulcirostris</i>  | Little Black Cormorant               | 50         | R                  |         |
| <i>Phalacrocorax varius</i>        | Pied Cormorant                       | 3          | R                  |         |
| <i>Sterna nilotica</i>             | Gull-billed Tern                     | 2          | R                  |         |
| <i>Sterna albifrons</i>            | Little Tern                          | 7          | M/En               | JC/EPBC |
| <i>Sterna bergii</i>               | Crested Tern                         | 24         | R                  |         |
| <i>Sterna caspia</i>               | Caspian Tern                         | 2          | M                  | JC/EPBC |
| <i>Sterna hirundo</i>              | Common Tern                          | 130        | M                  | JC/EPBC |
| <i>Chlidonias leucopterus</i>      | White-winged Black Tern              | 1          | M                  | JC/EPBC |
| <i>Chlidonias hybridus</i>         | Whiskered Tern                       | 1          | R                  |         |
| <i>Larus dominicanus</i>           | Kelp Gull                            | 2          | R                  |         |
| <i>Larus novaehollandiae</i>       | Silver Gull                          | 410        | R                  |         |

En, Th = listed under the TSC Act as Endangered or Threatened

JC/EPBC = listed under JAMBA, CAMBA or EPBC Act as migratory species

M= migratory R= resident

### 3.0 Species accounts

#### 3.1 Bar-tailed Godwit

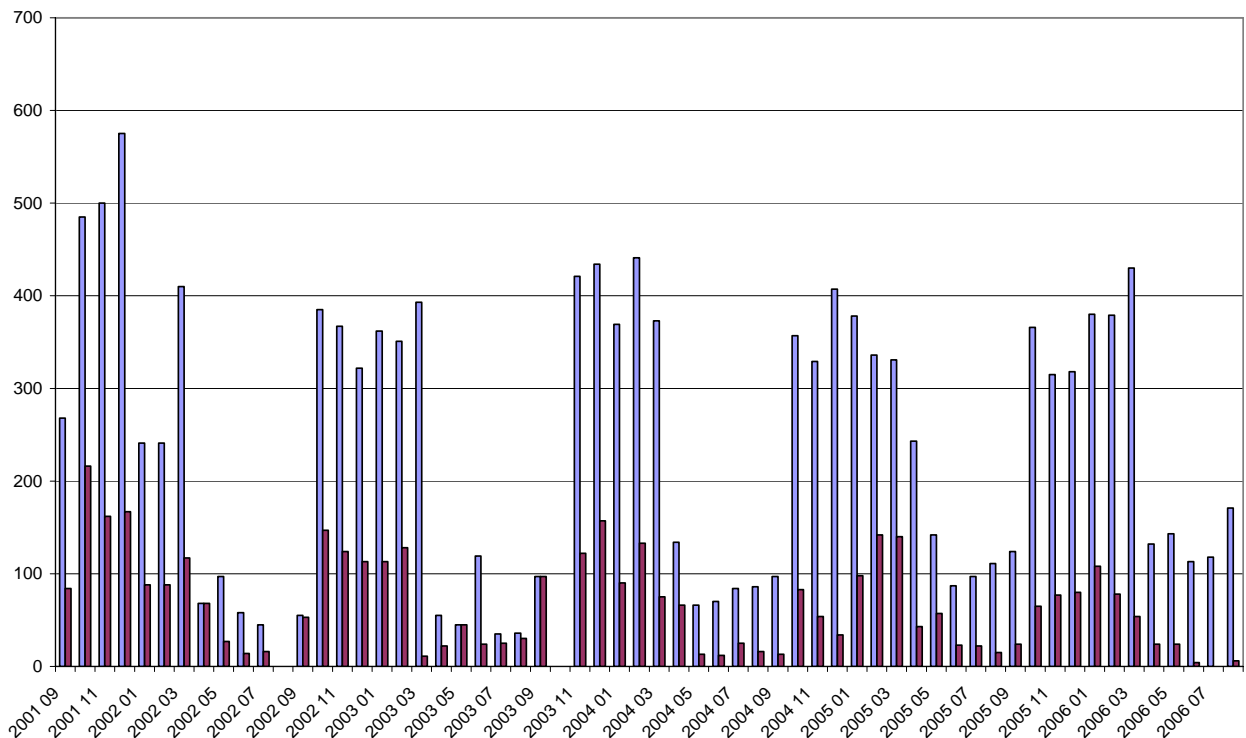
Since Penrhyn Estuary has been monitored as a sub-site of Botany Bay by researchers in 1992 the Bar-tailed Godwit has been recorded as the most numerous Arctic breeding migratory shorebird species at the Estuary throughout the year. It is therefore considered a key species for monitoring during this study. This species is found over much of Botany Bay and observations carried out over the past 20 years (pers. obs) shows that the Bar-tailed Godwit adapts to a wider range of habitats than any of the other migratory species found in Botany Bay. The Botany Bay population as a whole has remained relatively stable over the past five years with average maximum counts of 432 birds, although there appears to be a slow gradual decline at Penrhyn Estuary (Figure 2).

During this study numbers of Bar-tailed Godwits varied throughout the year reflecting the migratory nature of this species. Lowest numbers were during the winter months when all adults in breeding condition leave for their breeding grounds in Siberia and Alaska (Figure 2a). Peak counts of up to 160 birds were consistent with counts over the past five years.

Figure 2b shows the distribution of Bar-tailed Godwits in the estuary at low tide. Preferred habitat was the upper and outer reaches of the estuary during early part of the study but the outer reaches were preferred during the latter part of the study so far.

**Figure 2:**

Bar-tailed Godwit counts in Botany Bay as a whole (blue) and proportion of birds at Penrhyn Estuary (red) (gaps = no data collected)



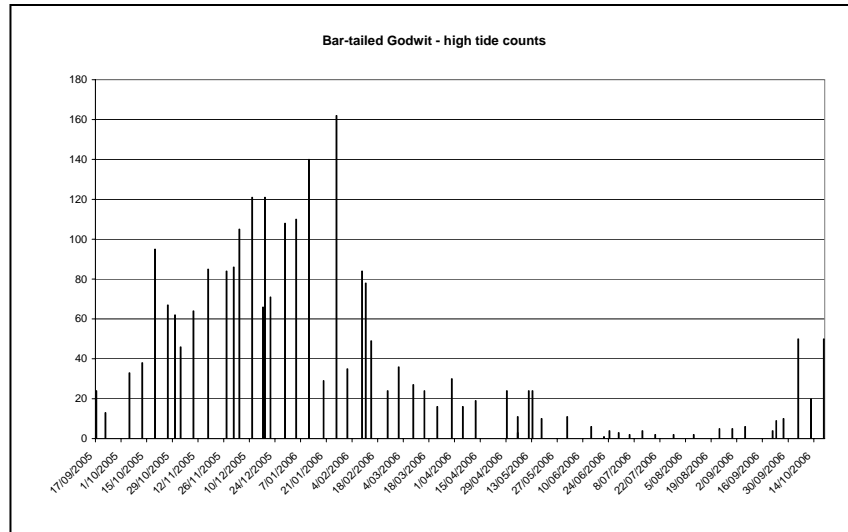


Figure 2a

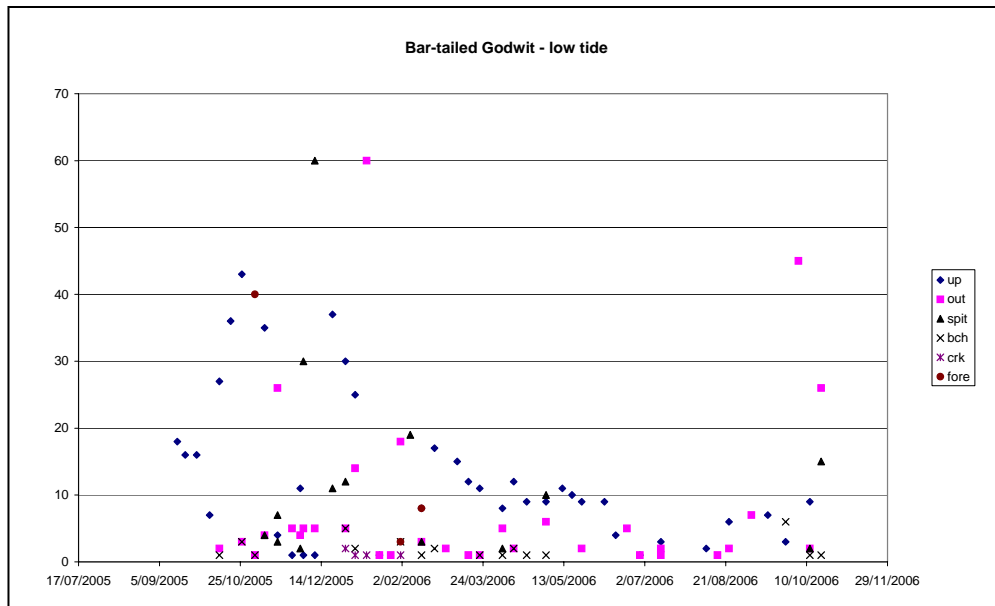


Figure 2b

### 3.2 Red-necked Stint

The Red-necked Stint occurs at Penrhyn Estuary in Botany Bay and at Boat Harbour (on the ocean side of the Kurnell Peninsula). From banding and colour flagging records it is known that that the same birds return to the sites year after year and that there is some interchange between Penrhyn Estuary and Boat Harbour. However it has also been revealed that some birds pass through the area on their migration to Victoria, and most likely Tasmania and South Australia.

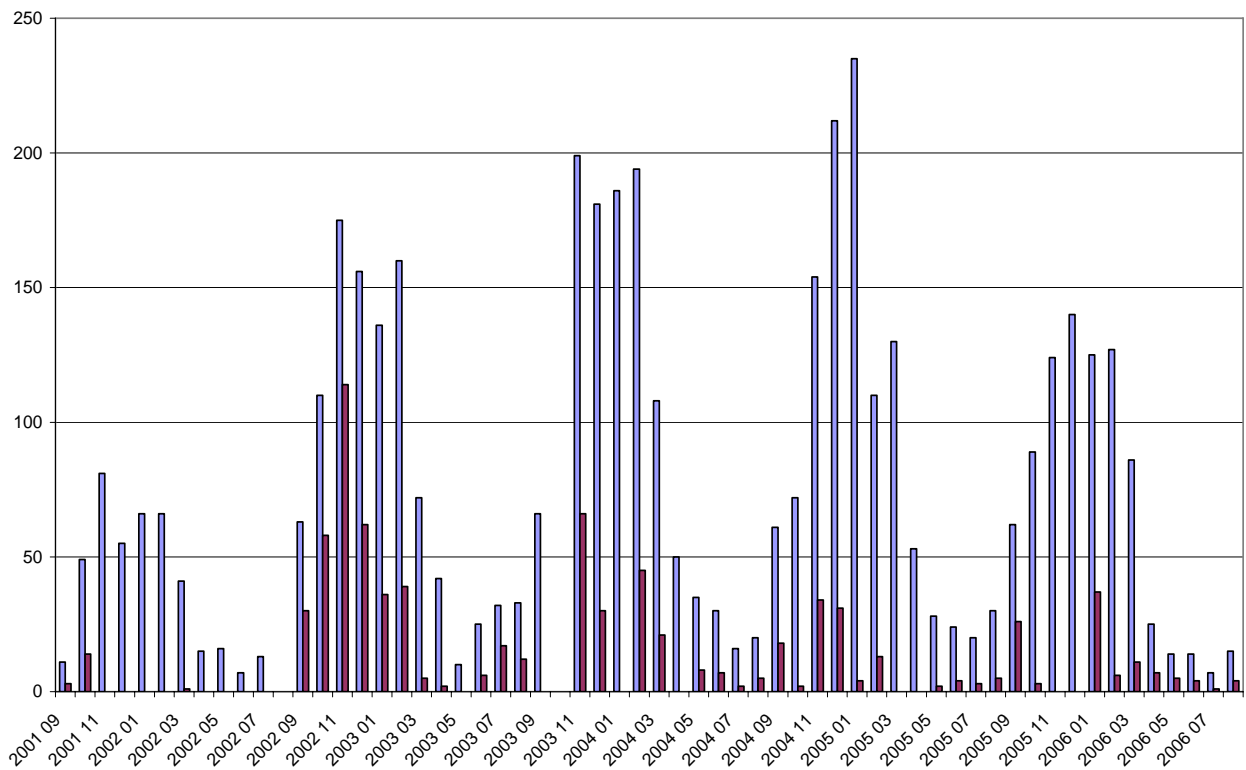
Data collected by the Australasian Wader Studies Group since 1977 indicates a decline in numbers in the Botany Bay region, although count data are sporadic, and no sub site counts are available. Counts since 2001

During this study numbers of Red-necked Stints varied throughout the year reflecting the migratory nature of this species. Lowest numbers were during the winter months when all adults in breeding condition leave for their breeding grounds in Siberia (Figure 3a). Peak counts of up to 45 birds at Penrhyn Estuary were consistent with mean counts over the past five years.

Preferred feeding areas appeared to be Port Beach and Port Spit followed by the upper reaches during the first season of this study (Figure 3b).

**Figure 3:**

Red-necked Stint counts in Botany Bay (including Boat Harbour) (blue) and number of birds at Penrhyn Estuary (red) between 2001 and 2006



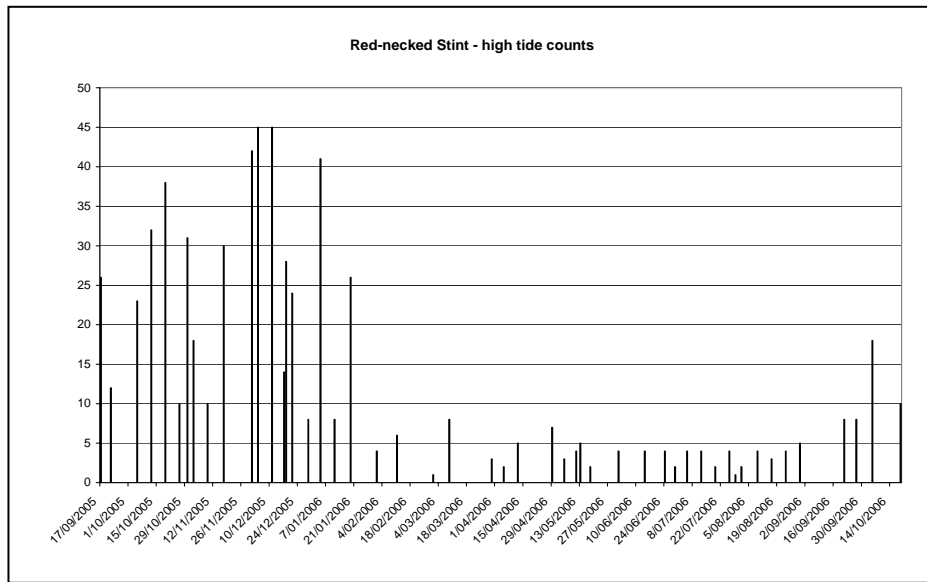


Figure 3a

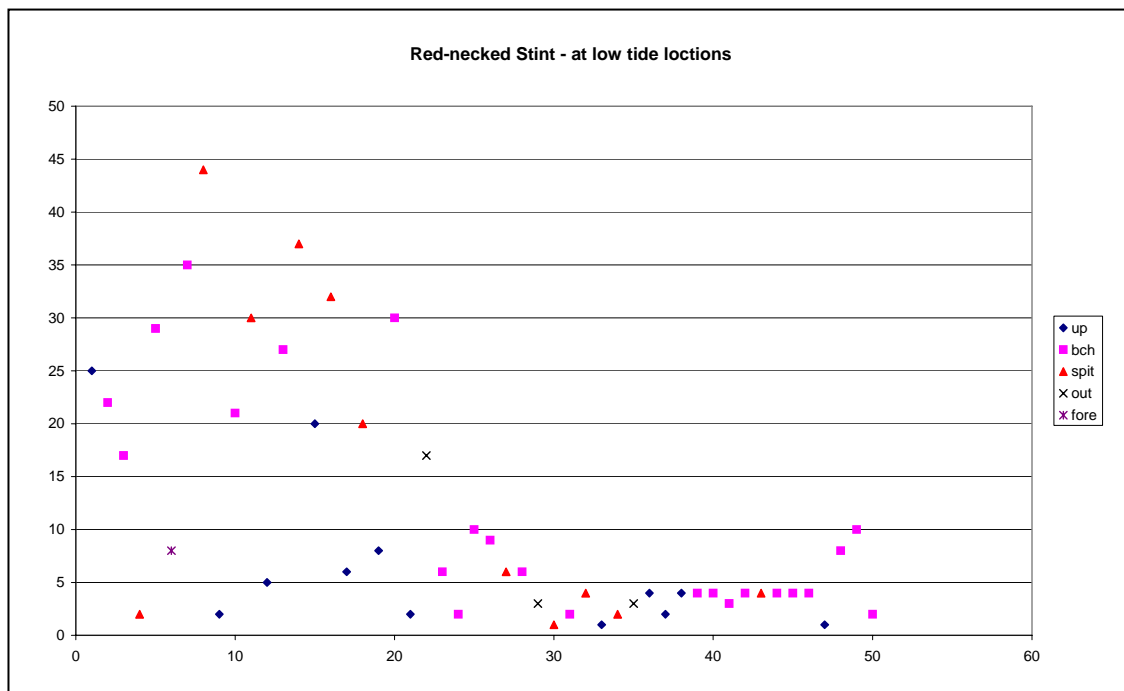


Figure 3b

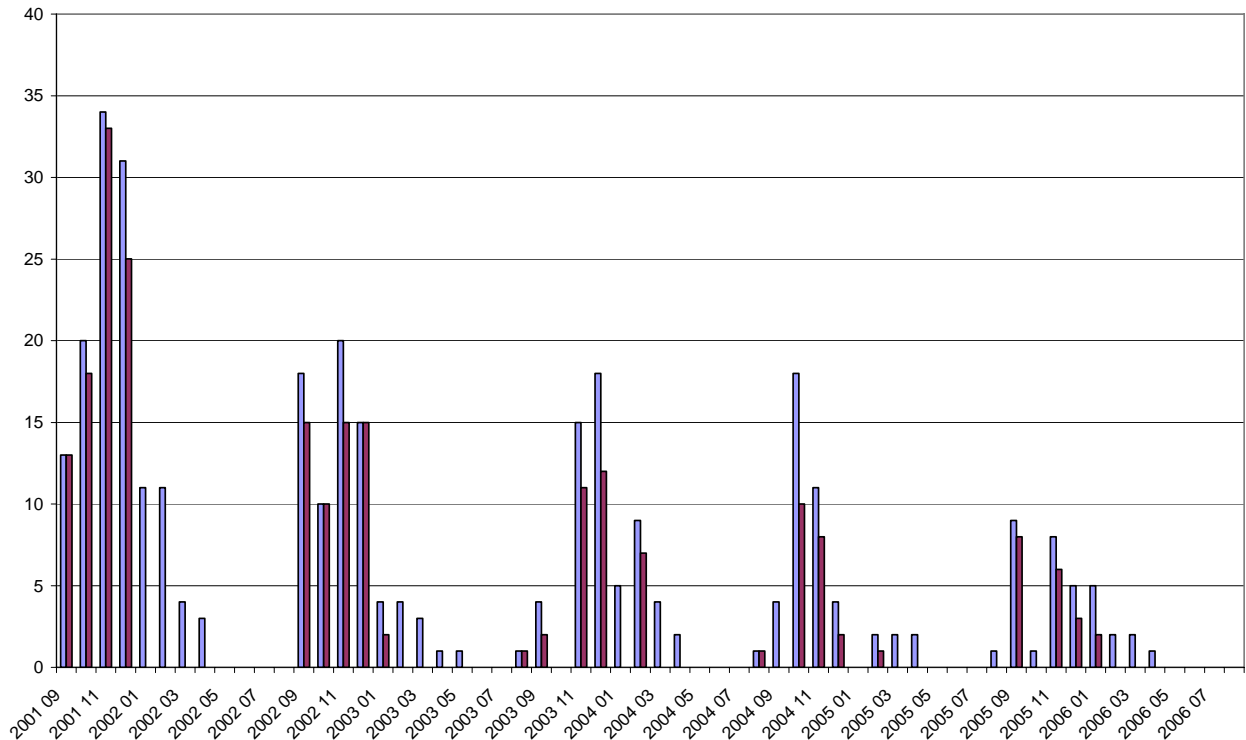
### 3.3 Curlew Sandpiper

Most of the Curlew Sandpipers associated with Botany Bay occur at Penrhyn Estuary, as shown in Figure 4. This species has declined more than any other species in Botany Bay, however this decline is also evident throughout south east Australia for reasons not fully understood, but are considered to represent a broad population level decline (Watkins 2004). Small numbers of this species also occur in the Parramatta River estuary. The Hunter River estuary is the nearest site where, despite substantial decline in numbers during recent years, they still occur in relatively large numbers (200+).

Counts during this study were similar to less than in previous years, following the trend of the past five years (Figure 4a). This species showed a strong preference for the upper reaches of the Estuary during the first part of the study, as shown in Figure 4b (data not yet available for the 2006/2007 season).

**Figure 4:**

The majority of Curlew Sandpiper occur at Penrhyn Estuary (blue) when compared with the whole of Botany Bay, including Boat Harbour (red).



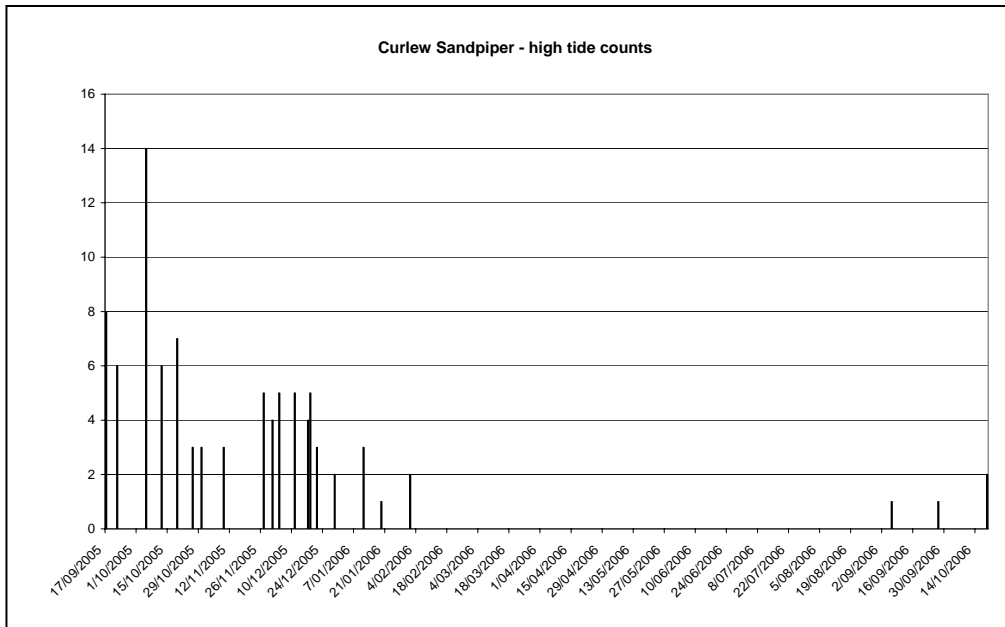


Figure 4a

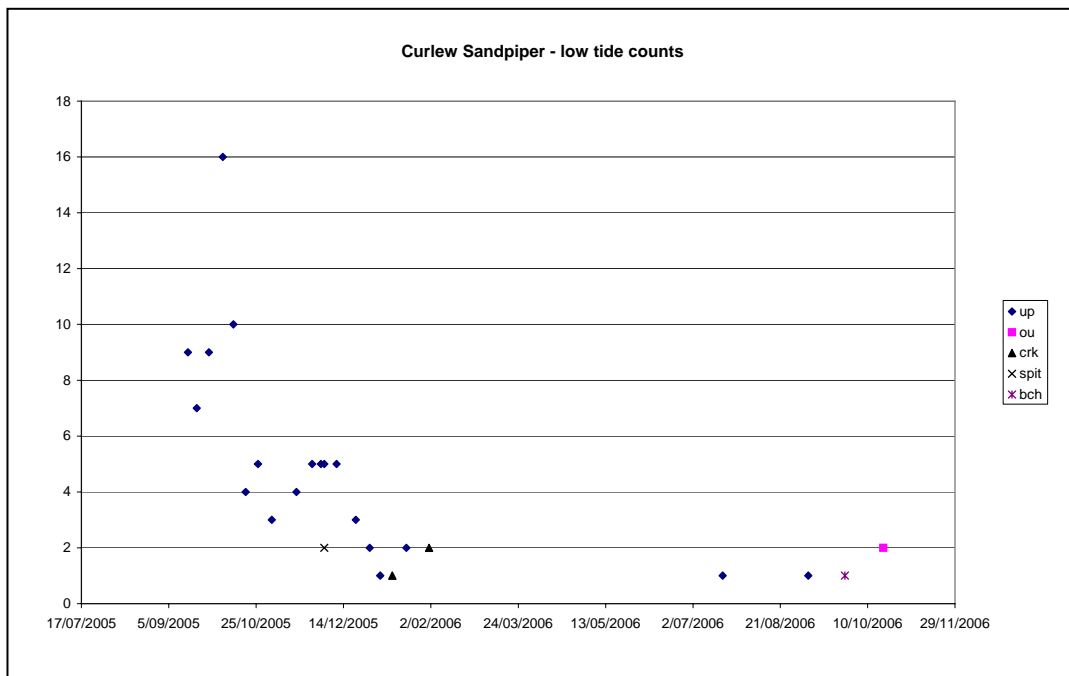


Figure 4b

### 3.4 Sharp-tailed Sandpiper

At Penrhyn Estuary most Sharp-tailed Sandpipers feed on the upper reaches of the Estuary and in the channel formed below the outlet of Springvale Drain, feeding on exposed mud and along the margins of saltmarsh. The removal of the mangroves is likely to create more favourable feeding habitat following the completion of the Penrhyn Estuary Habitat Enhancement works.

This species depends on slightly different habitat to other migratory shorebirds and may not reflect the condition of the open mudflats over most of the Estuary. Therefore it is not a species that provides a good indication of the effect of impacts in the estuary.

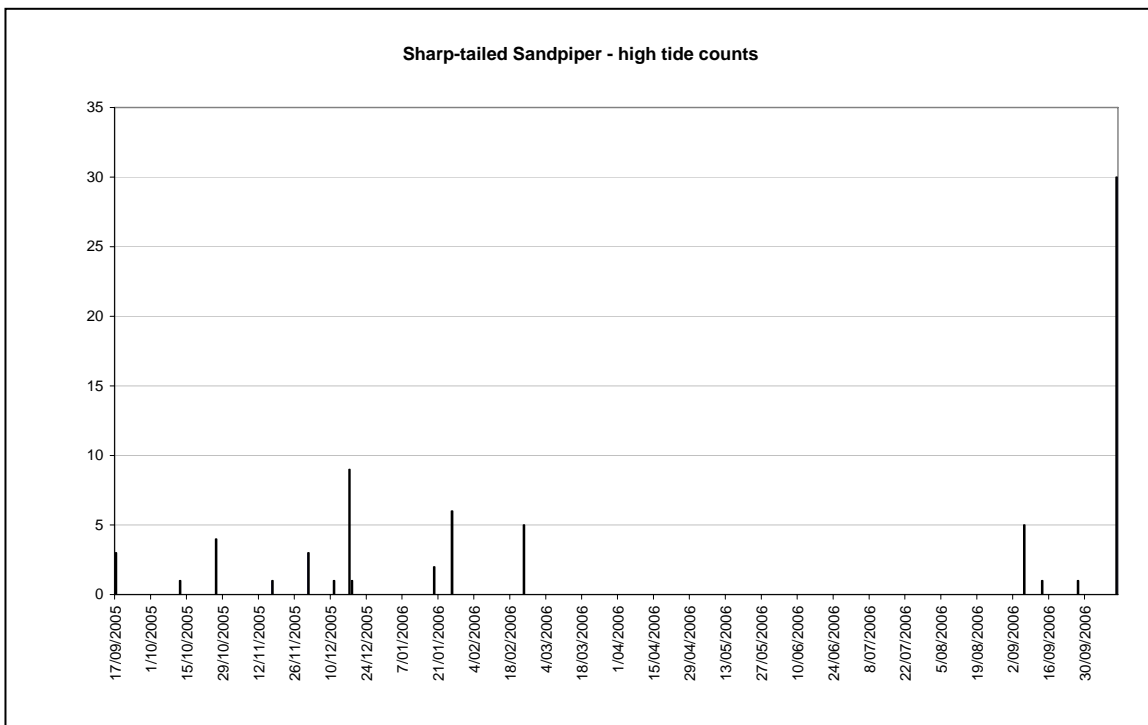


Figure 5a

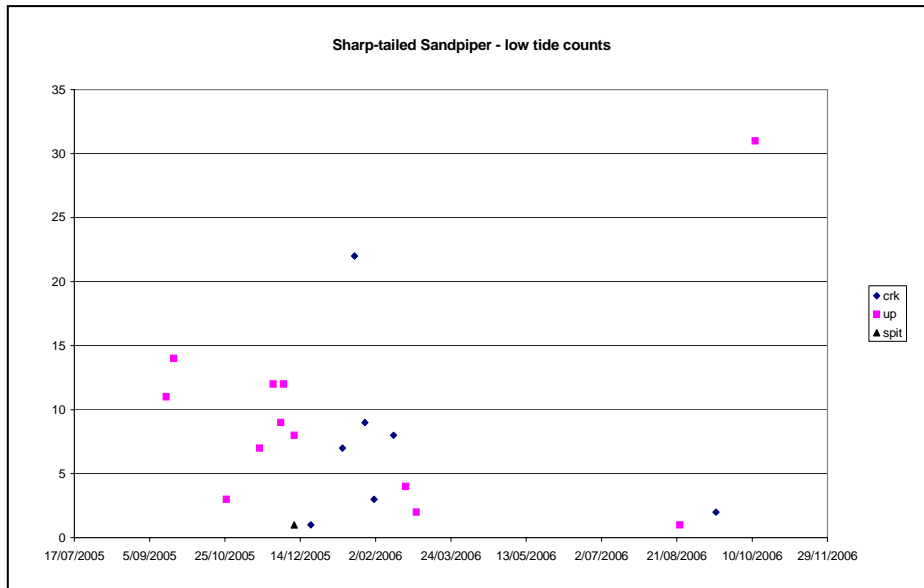


Figure 5b

### 3.5 Pacific Golden Plover

The Pacific Golden Plover has declined in numbers since the 1970s and 1980s when between 100 and 200 were observed in Botany Bay during the summer each year (Appendix A) compared with counts of 25 to 30 in recent years. This species has been associated with Penrhyn Estuary since the construction of the Parallel Runway resulted in the loss of the remaining habitat on the north side of the Botany Bay. This species feeds in the upper reaches of the Estuary during the day. No night time observations have been made to determine where this species feeds at night. The Pacific Golden Plovers found at Penrhyn Estuary, unlike other shorebirds, roost on the side of a very steep sand dune at the mouth of Springvale Creek or, if this site is unstable, join other shorebirds at sand spits in the Estuary.

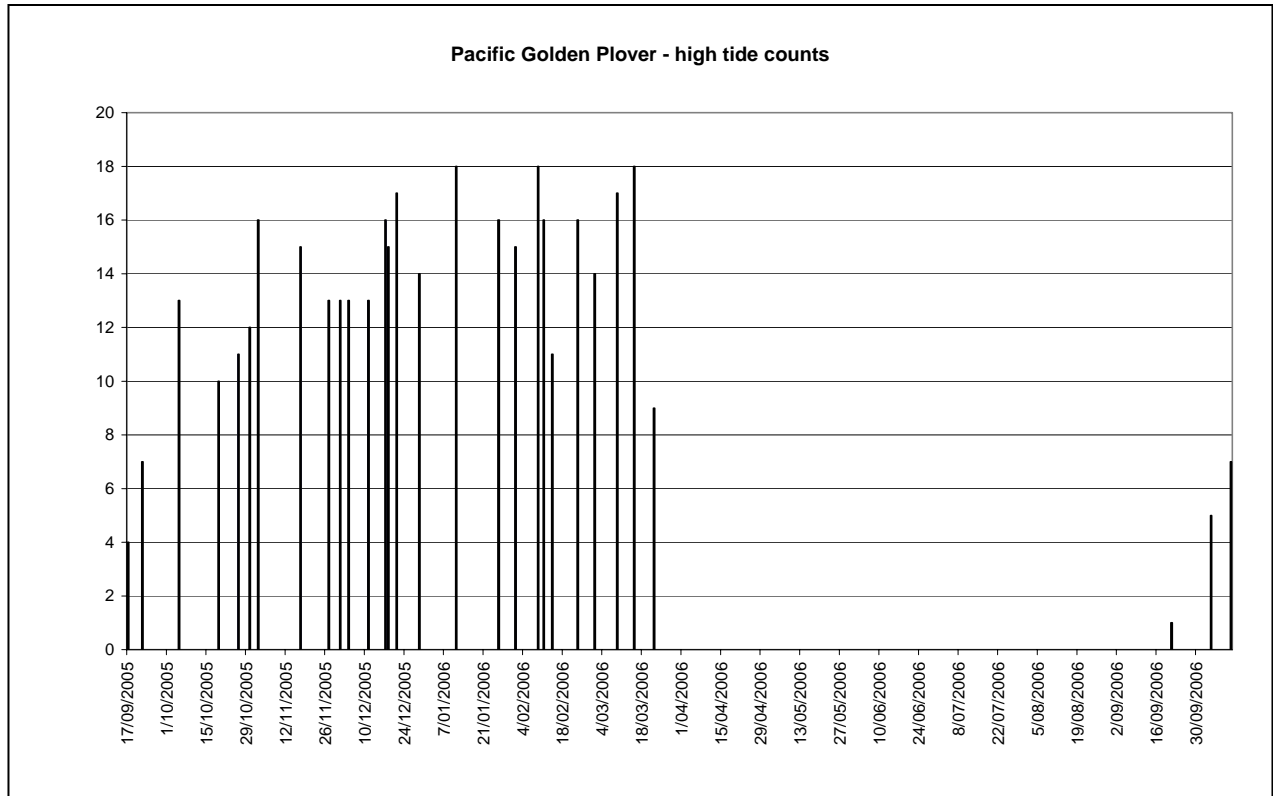


Figure 6

### 3.6 Red Knot

The Red Knot is an interesting passage migrant that generally stays only a few days at Penrhyn Estuary before moving on to Victoria and New Zealand. Once in New Zealand a large proportion of these birds return to their breeding grounds direct and from then on only fly between the Arctic and New Zealand. Botany Bay has long been an important staging area for this species although numbers have been in decline for some years. Penrhyn Estuary is the most important site in the Bay for this species.

Up to 18 Pacific Golden Plover were observed during the 2005/2006 season which is consistent with recent counts by the NSW Wader Study Group in the Estuary.

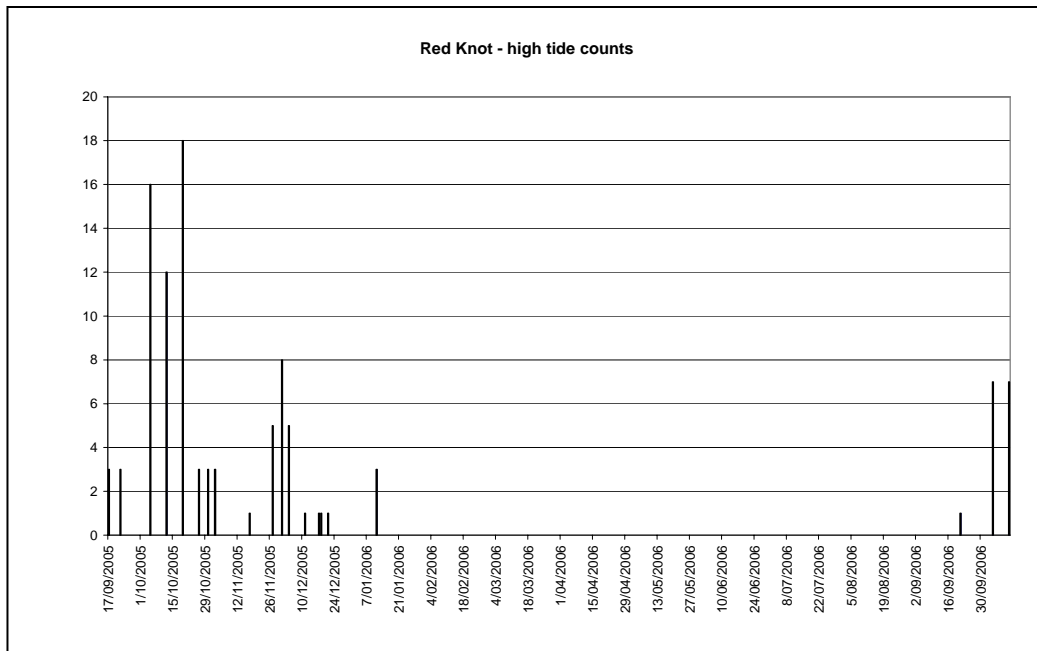


Figure 7

### 3.7 Double-banded Plover

Counts by the NSW Wader Study Group between 2001 and 2006 identified two sites as being used by the Double-banded Plover, Penrhyn Estuary and Boat Harbour (on the ocean side of the Kurnell peninsula). The majority of the population were found at Penrhyn Estuary with the balance being found at Boat Harbour, although the whole population was occasionally found at Boat Harbour soon after arrival from New Zealand, as shown in Figure 3. The Double-banded Plover population has been comparatively steady at Penrhyn Estuary in recent years with maximum counts of between 50 and 60 birds (Figure 3), although this is a decline of about 50% of counts regularly made of 120 birds or more between in the northern part of Botany Bay between 1977 and 1989 (Appendix A). During this study this species spent significant time feeding at the upper reaches of the Estuary or on oyster covered rocks at a beach between the Estuary and the Patricks terminal during the day (*P. Straw pers. obs.*). Although the study did not include control sites, Double Banded Plovers were recorded at Boat Harbour by the NSW Wader Study Group during that period.

**Figure 8:**

Double-banded Plover counts over whole of Botany Bay including Boat Harbour (blue) and proportion of birds found at Penrhyn Estuary (red).

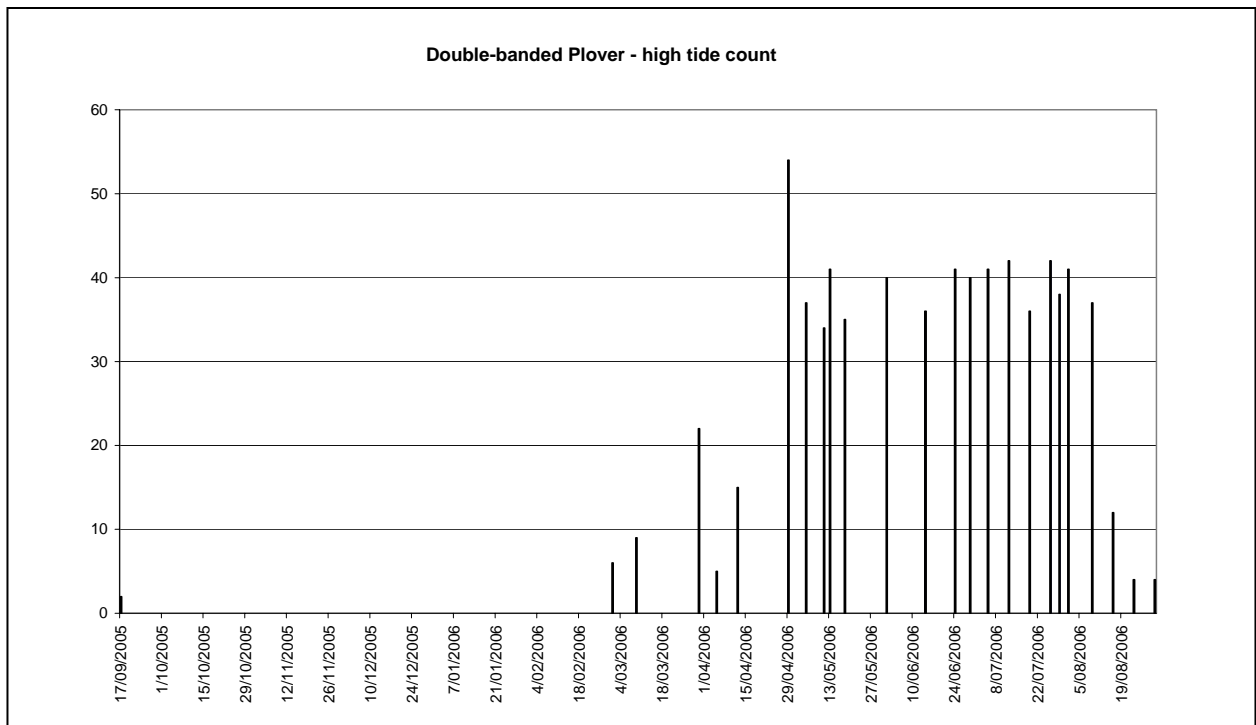
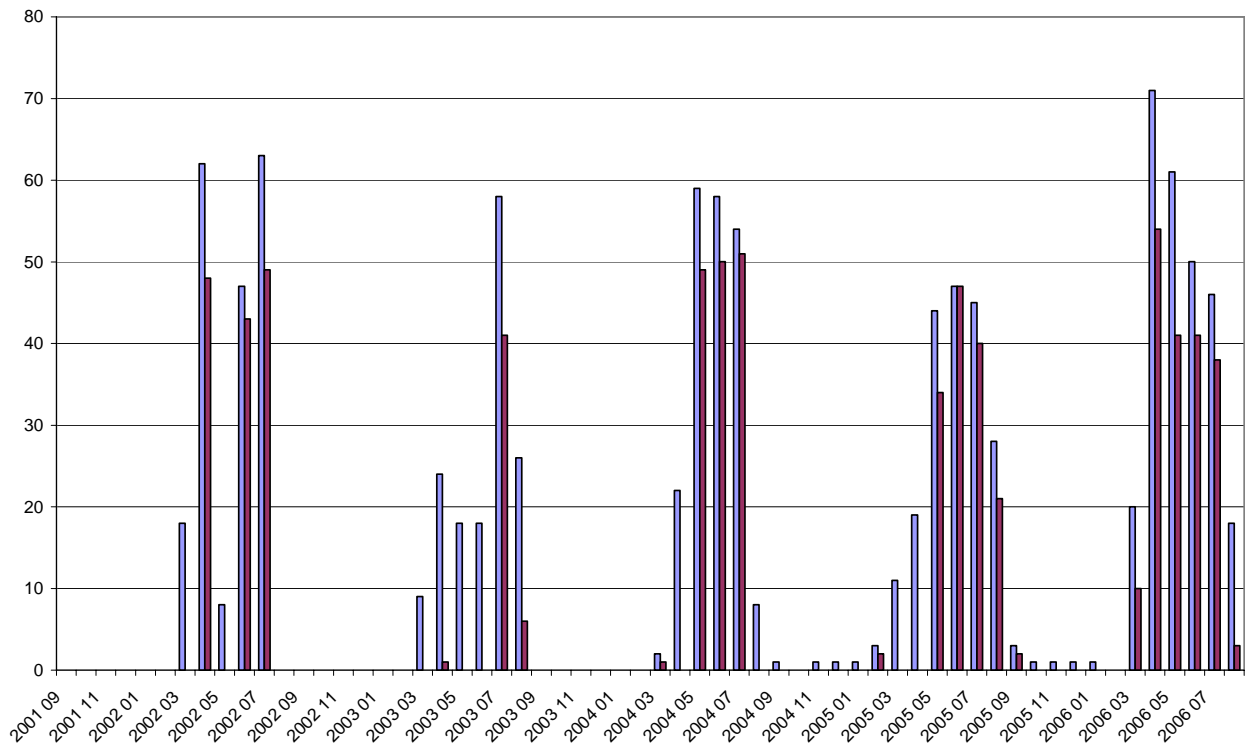


Figure 8a

## 4.0 Health of Birds

While the numbers and species diversity of shorebird species at the Penrhyn Estuary will provide an indicator of the availability of feeding and roosting habitat it is important to assess the quality of habitat through the general condition and health of the birds. For example large numbers of shorebird present, but unable to maintain peak physical condition may mean that birds are not able to build up fat reserves prior to an arduous migration or even maintain sufficient condition for predator avoidance and long term survival.

The Bar-tailed Godwit was used as an indicator species for this study due to the fact that birds were present throughout the year and, being the largest of the migratory species, was the easiest to measure body profiles.

During the study Bar-tailed Godwits maintained body profiles above the minimum score of 1, out of a range of 1 to 5, 1 being the estimated fat free weight of the bird and 5 being the maximum weight prior to migration (an increase of 50-60% of base body mass). No birds were observed to have a body profile of 5 which indicates that Botany Bay may not be a main launch site for migratory birds flying to the Yellow Sea.



**Figure 9:** May 2006. Male Bar-tailed Godwit in full breeding plumage but remaining at Penrhyn Estuary during the northern hemisphere breeding season.

This adult male Bar-tailed Godwit is in full breeding plumage. Although in good physical condition is not in a physical state to migrate to its breeding grounds in Alaska (body score 2 - 3). No Bar-tailed Godwits were observed to reach body score 5 (ready for a 6000 km flight to the Yellow Sea) which would indicate the Botany Bay is only a minor staging area for Bar-tailed Godwits.



**Figure 10:** Mixed flock of shorebirds at Penrhyn Estuary, October 2005.

Red Knot (medium sized birds) are still in partial breeding plumage (chestnut blotching) and are likely to be on their way to Victoria or New Zealand with a body score of 3 or 4, as are the Curlew Sandpiper (the smaller birds with down-curved bills). On the other hand the Bar-tailed Godwits are not preparing for further migration and will stay in Botany Bay to complete their moult of flight feathers before continuing or may stay in the Bay until it is time for their northern migration.

## 5 Conclusion

The shorebird monitoring program at Penrhyn Estuary indicates the numbers and species diversity of shorebirds in the Estuary are similar to previous population trends shown by the data collected by the NSW Wader Study Group over the past five to six years. While there has been marked declines in many of the shorebirds when compared with counts carried out by the Australasian Wader Studies Group in the 1970s and 1980s most species have been relatively stable over the past five years and maintained similar populations during the 2005/2006 season.

One species that continues to decline in numbers at Penrhyn Estuary is the Curlew Sandpiper (Figures 4 and 4a). However this is a species that is in decline throughout its range in Australia and not as a direct result of local impacts in Botany Bay.

While there was an apparent shift in habitats by the Bar-tailed Godwit in October 2006 it is too early to draw any conclusions about the change in habitat preference by the Bar-tailed Godwit away from the upper reaches of the Estuary.

## References

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Watkins, D. 2004. Review of the Potential Impacts of the Proposed Port Botany Expansion on Shorebirds. Report to Sydney Ports Corporation, NSW DEC, Commonwealth DEH and NSW DIPNR by Wetlands International – Oceania, Canberra

Wiersma, P. & Piersma, T. 1995. Scoring abdominal profiles to characterise migratory cohorts of shorebirds: an experiment with Red Knots. *Journal of Field Ornithology* 66: 88-98

Williams, T.D., Guglielmo, C.G., Egeler, O. & Martyniuk, C.J. 1999. Plasma lipid metabolites provide for information on mass change over several days in captive Western Sandpipers. *Auk* 116: 994-1000