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Migratory Wader Assessment Report

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Prepared for

API Management Pty Ltd

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1.0 Introduction

API Management Pty Ltd (API) proposes to develop the Anketell Point Port, a port facility to export iron ore product generated from its West Pilbara Iron Ore Project. Anketell Point is situated at the eastern end of Nickol Bay, immediately adjacent to the eastern end of Dixon Island in the Shire of Roebourne, Western Australia (**Figure 1**).

The proposed development is surrounded by extensive littoral habitats. Desktop analysis indicated that these habitats are likely to support migratory waders, seabirds and bush birds, some of which are listed for protection under various Acts and international agreements. Bush birds typically inhabit terrestrial environments but can be located along the mainland coast or on islands adjacent to the mainland. Terrestrial species have not been addressed in this report.

Twenty-six species of seabirds are known to occur in the Dampier Archipelago Region, spending the majority of their lives at sea, ranging over large distances to forage over the open ocean obtaining their primary food source from the pelagic waters (DEWHA, 2008). Some species of seabirds are known to nest on nearby coastal and offshore islands in the Dampier Archipelago (DEWHA, 2008; Dunlop *et al.*, 2002). These species may visit the survey area, but are unlikely to use the area as a significant foraging or nesting site (**Appendix A**).

Twenty-six species of migratory waders are known to pass through the Dampier Archipelago Region, spending the majority of their time foraging in littoral environments along the Pilbara coastline (Bamford *et al.*, 2008; DEWHA, 2008). These species of international significance are likely to utilise the project area during both the breeding and non-breeding seasons. An assessment of the habitats surrounding the survey area aimed to determine the potential impact of direct and indirect loss of habitat on the migratory wader populations.

Professional ornithologists from Western Wildlife and AECOM scientists conducted seasonal bird surveys, with a focus on migratory waders.

This report outlines:

- the migratory wader species that are likely to occur in the general study area (**Figure 1**) with standard and additional survey areas adopted to examine populations;
- their typical habitats, a summary of the observations made by Western Wildlife; and
- an assessment of the regional and flyway significance of the survey areas to migratory waders.

Potential direct and indirect impacts are also briefly discussed.

1.1 Objectives

The objectives of the migratory wader surveys were to:

- create a migratory wader species list for the survey areas;
- determine the habitation of the areas by migratory waders; and
- assess whether areas support migratory waders in excess of 1% of estimated flyway populations.

In order to achieve this, it was necessary to conduct surveys during the southward migration (October), the non-breeding season (December/January), the northward migration (March) and the breeding season (July). The non-breeding season survey was unable to be completed in 2009 due to weather constraints (Tropical Cyclone Dominic), however, subsequent data from southward (October 2008, October 2010) and northward (March 2009) migrations, and a non-breeding season (January 2011) were captured.

Figure 1
Migratory Wader Study Area

0 0.5 1 1.5
Kilometres

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Author: unknown J:\Client_Data\Australian_Premium_IronOre\60027030 - API Enviro PFS\Workspaces\Working\2009_09_14__Maps_for_Susannah\Figure 1 - Migratory Wader Study Area_MR_20110405.mxd

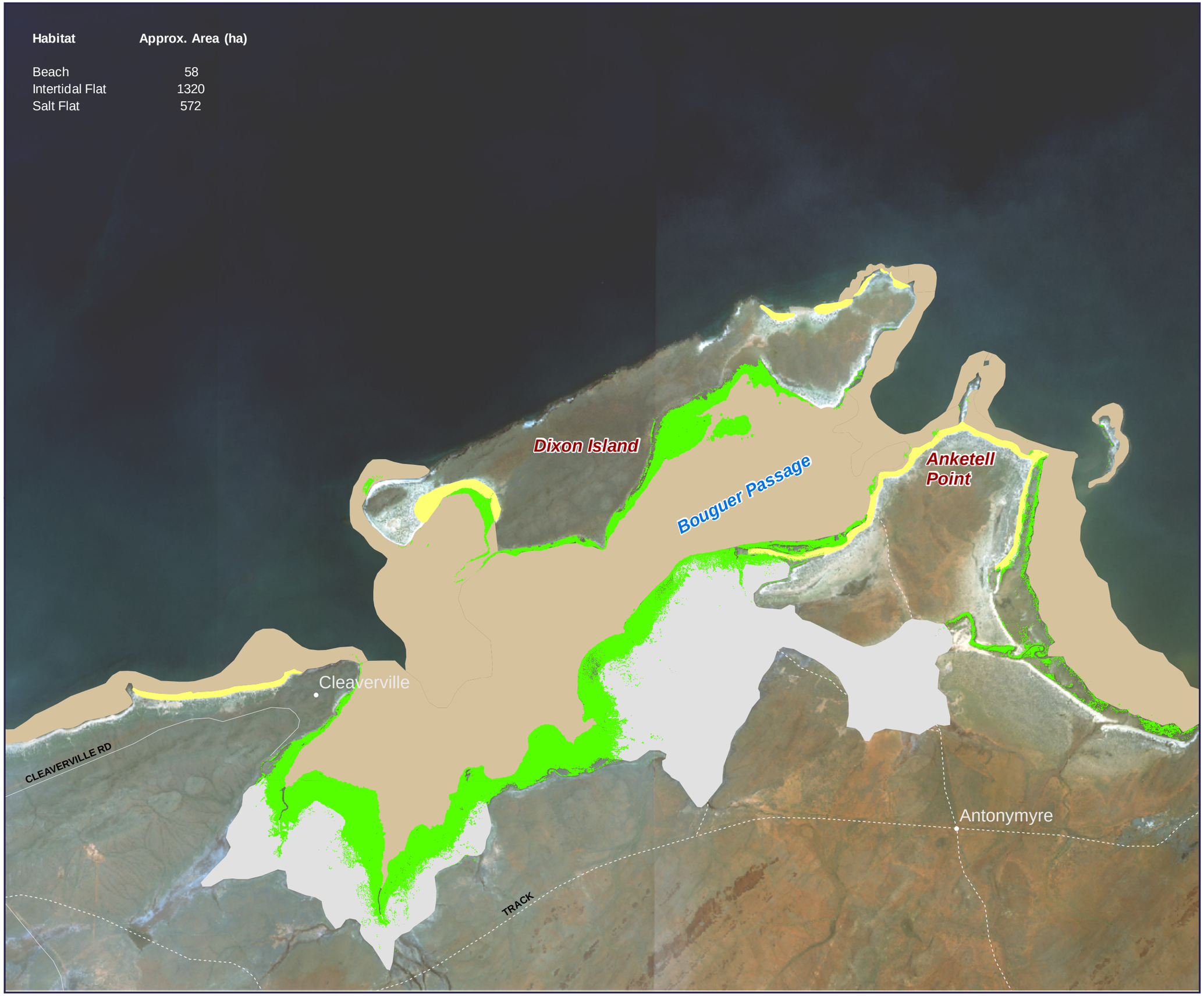
1.2 Dampier Archipelago Habitats

Approximately 4,000 km^2 of seabed, coral reefs and intertidal areas make up the Dampier Archipelago (Wells and Walker, 2003). Nickol Bay, an extensive (700 km^2), shallow, muddy marine embayment lies within the eastern portion of the Dampier Archipelago (Wells and Walker, 2003; Jones, 2004). Wide mudflats, with a rich mangrove zone that fringes the upper intertidal area characterises the southern and south-eastern shores of Nickol Bay, while rocky shores, limestone pavements and tidal flats are spread throughout (Wells and Walker, 2003; Jones, 2004).

Migratory waders use the archipelago's beaches and mudflats as feeding and resting sites during their long flights between Australia and their breeding grounds in Siberia and Alaska (Tingay and Tingay, 1978). Intertidal sand and mudflats often associated with mangroves support a diverse range of infauna including crustaceans (e.g. amphipods) and molluscs (gastropods and bivalves). These intertidal areas are key feeding zones for waders during low tide (CALM, 2000).

Two extensive mudflats are located in close proximity to the project area: Bouguer Passage, an intertidal flat between Dixon Island and the mainland, and a sub-coastal mud/salt flat south and west of Anketell Point (**Figure 2**). In other parts of the survey area, dense mangrove communities line the upper intertidal zone of the mainland, while sandy beaches are scattered along the coastal fringe and islands.

Habitat	Approx. Area (ha)
Beach	58
Intertidal Flat	1320
Salt Flat	572



Migratory Wader Potential Local Habitats

Figure 2

0 0.5 1 1.5 2

Kilometres

LEGEND

- Beach
- Intertidal Flat
- Salt/Mud Flats
- Mangroves

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1.3 Migratory Waders

Migratory waders undertake annual migrations of thousands of kilometres (some in excess of 20,000 km) between their breeding areas in the high Arctic, to non-breeding areas of Australasia, Africa and South America (Bamford *et al.*, 2008). Southward migration to non-breeding grounds in the southern hemisphere typically occurs from September to November. Waders spend summer in the non-breeding habitats (December to February), feeding intensively on invertebrates to build up stores of fat and protein in preparation for migration back to the Arctic (Bamford *et al.*, 2008; Priest *et al.*, 2002). Northward migration to the Arctic breeding grounds takes place between March and April, where waders capitalise on the abundant food supply during the Arctic summer (Bamford *et al.*, 2008).

Table 1 Migration Routes and Timing

Migration Direction & Breeding Period	Route/ Location	Timing
Southward/ Non-Breeding	Northern Hemisphere → Southern Hemisphere *(Siberia → Australia)*	September – November
Non-breeding	Southern Hemisphere *(Australia)*	December – January
Northward/ Non-Breeding	Southern Hemisphere → Northern Hemisphere *(Australia → Siberia)*	February – April
Breeding	Northern Hemisphere *(Siberia)*	May – August

1.4 Regulatory Framework

All migratory bird species are protected under a number of Acts, agreements and conventions. The *Convention on the Conservation of Migratory Species of Wild Animals* (CMS), the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the Western Australian *Wildlife Conservation Act 1950* (WC Act) protect bird species that are threatened and/or migratory.

In addition, a list of migratory bird species is also maintained under numerous international agreements: the *Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment 1974* (JAMBA), the *Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986* (CAMBA), the *Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds 2007* (ROKAMBA), and the *Partnership for the Conservation of Migratory Waterbirds and the Sustainable Use of their Habitats in the East Asian Australasian (EAA) Flyway* (Flyway Partnership). Under these agreements and conventions, Australia has an obligation to conserve the habitats and migration routes of migratory avifauna.

1.5 The East Asian Australasian (EAA) Flyway

The EAA Flyway (**Figure 3**), which stretches from Siberia and Alaska southwards to Australia and New Zealand, is a geographic region that supports populations of waders during their annual migrations (Bamford *et al.*, 2008; DEWHA, 2008). It is one of eight major flyways recognised around the world, and is used by about 8 million waders of 54 different species (Bamford *et al.*, 2008). Sites important to migratory waders are those that regularly support greater than or equal to one percent of the flyway population of a species, or are known to regularly support greater than 20,000 waders in total (Ramsar Convention, 2000). There are 400 such sites which have been identified in the EAA Flyway (Bamford *et al.*, 2008). In Australia, 118 sites of international importance have been listed, supporting significant populations of 28 migratory species (Bamford *et al.*, 2008). Eight of these species are present in Australia during the non-breeding season in numbers of greater than 75% of their Flyway population (Bamford *et al.*, 2008). These species are the: Bar-tailed Godwit, Little Curlew, Grey-tailed Tattler, Great Knot, Red-necked Stint, Sharp-tailed Sandpiper, Oriental Plover and the Australian Pratincole (Bamford *et al.*, 2008).

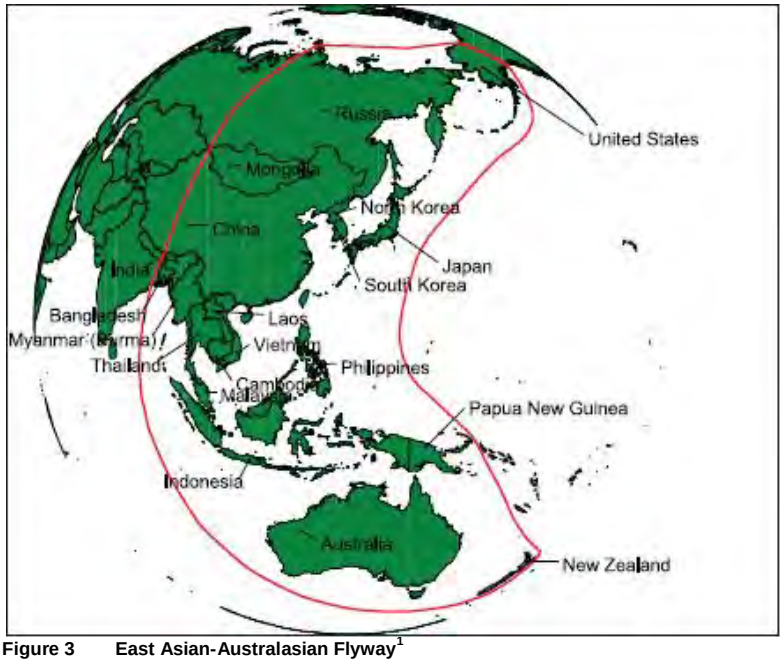

Figure 3 East Asian-Australasian Flyway[1]

1.6 Migration Patterns

Southward wader migrants from the northern hemisphere typically arrive in Australia during September to November, using offshore islands as stopover or staging sites before dispersing to intertidal flats on the mainland, coastal areas, or freshwater wetlands and grasslands. Waders typically spend the Australian summer in these habitats, building up stores of fat, and leave for the northward migration between February and April. Some individuals remain in Australia during the breeding season (May – August). Typically, these individuals are too old, too young or did not accumulate enough fat reserves to make the return migration. Population numbers of some waders are therefore more abundant during the non-breeding season (summer) rather than the breeding season (winter).

Bamford (2005) observed that the abundance of migratory waders on Barrow Island increased during the southward migration period, decreased slightly during the non-breeding season, and then increased again during the northward migration period. It was also concluded that the total wader abundance was lower during the breeding season (Bamford, 2005). Despite the peaks in abundance during the southward migration, population numbers remained high throughout the remainder of the summer period for many species. This indicated that many waders remained on the island for the entire non-breeding season, using it as more than just a "staging post" (Bamford, 2005).

1.7 Regional Distribution

Habitats in the North-West of Australia (**Figure 4**) are considered important foraging and roosting sites for migratory waders of the EAA Flyway (Bamford *et al.*, 2008; Watkins, 1993). Twenty-six species regularly migrate along the coastline, while six of these species are typically present in significant numbers: Grey-tailed Tattlers, Ruddy Turnstones, Red-necked Stints, Sanderlings, Greater Sand Plovers and Lesser Sand Plovers (Bamford *et al.*, 2008).

[1] (Bamford *et al*., 2008)

Roebuck Bay and Eighty Mile Beach are two of the most important sites for migratory waders (including the Grey-tailed Tattler) in Australia, supporting greater than 1% of the EAA Flyway populations for 18 and 16 species respectively (Bamford *et al.*, 2008). Annually, the areas have supported over 850,000 waders. Ashmore Reef and Cartier Island are recognised as important staging points for migratory waders, annually supporting >1% of the population for five species, while Barrow Island is ranked tenth for important Australian migratory bird sites, annually supporting >1% of the population for three species (DEWHA, 2008). Surveys conducted by Bamford in 2003 – 2004 on Barrow Island indicated that the island was regionally significant for Grey-tailed Tattlers (6.6%), Ruddy Turnstones (5.5%) and Red-necked Stints (2.4%) (Bamford, 2005). The Saltworks at Port Hedland supports >1% of the population for five species (DEWHA, 2008). Dampier Saltworks supports internationally important habitat for two migratory waders: Curlew Sandpiper (1.67%) and Oriental Plover (2.6%). Migratory wader surveys completed in the Exmouth Gulf for the Yannarie Solar Salt Field project ranked the Exmouth Gulf survey area as internationally important for five migratory species (Biota, 2005). The Rowley Shoals and Scott Reef may also be important sites for foraging, resting and staging posts (DEWHA, 2008).

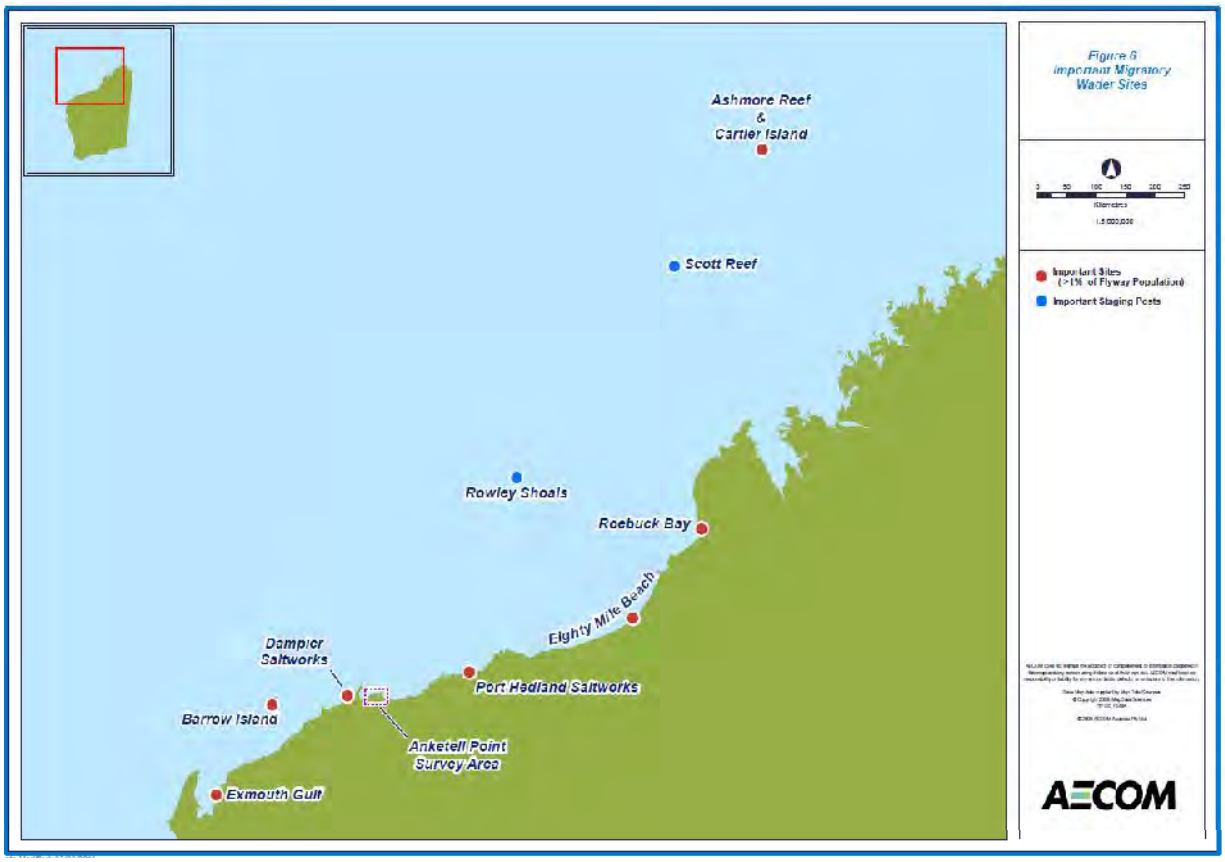

Figure 4 Important Migratory Wader Sites[2]

1.8 Migratory Wader Habitats

In Australia, waders typically forage in shallow waters along coastal intertidal mudflats, estuaries, shorelines, reefs and along the edges of inland wetlands (Geering, 2007; Watkins, 1993). During high tide, the waders are forced from the intertidal feeding grounds to roosting sites, which are critical to the survival of waders (Rogers *et al.*, 2006). Studies have found that for an area to provide suitable habitat for migratory waders, it must provide areas rich in food with nearby roosting sites that allow the birds to rest without losing substantial energy to disturbance or extended travel (DEWHA, 2009).

[2] (Bamford, 2005; Bamford *et al.*, 2008; Biota, 2005; DEWHA, 2008)

1.8.1 Roosting Sites

Specific types of roosting sites are preferred by the different species as they provide refuge and proximity to foraging grounds (Rogers *et al.*, 2006). Mangrove stands in the north-west of Australia are typically unsuitable as roosting sites for waders as they are usually too densely vegetated (Rogers *et al.*, 2006); however, some species (Grey-tailed Tattlers) do roost in mangroves (Biota, 2005). Roosting sites are typically near the high tide mark, on sandspits or open shores with clear visibility to avoid predation, free from disturbance, and within 5 – 10 km of foraging grounds (Finn *et al.*, 2002; Rogers *et al.*, 2006).

Optimal foraging areas may be of no use to waders if they are not associated with adequate roosting habitat, and therefore interference to or the loss of roosting sites may affect the carrying capacity of an area, with negative consequences for shorebird populations. Suitable roosting sites for migratory waders need to be safe from predation and involve low energy costs. Roosting sites therefore need to be close to foraging grounds, to minimise energy consumed flying from one to the other as there is a maximum distance each species is prepared to fly. This distance is largely influenced by body size, wing moult and fuel load. This examined in further detail in **Section 5.1**.

2.0 Surveys

Six avifauna surveys have been conducted by Western Wildlife in the survey area. Dates and locations of each survey are presented below and illustrated in **Figure 5** and **Figure 6**

- March 2008 – terrestrial and wader bird survey (northward migration/ non-breeding season)
    - Anketell Point
- October 2008 – wader bird survey (southward migration/ non-breeding season)
    - Anketell Point
- February 2009
    - *not completed due to flooding[3] and strong winds from Tropical Cyclone Dominic and a subsequent tropical low (non-breeding season)*
- March 2009 – wader bird survey (northward migration/ non-breeding season)
    - Anketell Point
- July 2009 – wader bird survey (breeding season)
    - Anketell Point, Dixon Island, Bouguer Passage and Cleaverville (Standard Survey Sites)
- October 2010 – wader bird survey (southward migration/ non-breeding season)
    - Anketell Point, Dixon Island, Bouguer Passage and Cleaverville (Standard Survey Sites)
- January 2011 – wader bird survey (non-breeding season)
    - Anketell Point, Dixon Island, Bouguer Passage and Cleaverville (Standard Survey Sites)
    - Lambert Bay, Cape Lambert, Point Samson, Cossack, Pemberton Island, Walcott Island, South-west Cleaverville, Mangrove Creek and West Cleaverville (Additional Survey Sites)

Due to the preliminary port design, migratory wader surveys initially focussed on Anketell Point (and not Dixon Island directly). From July 2009 onwards, surveys encompassed Dixon Island and Bouguer Passage as port design alterations at that time proposed Dixon Island in the development footprint.

During January 2011, Additional Survey Sites were added to the Standard Survey Areas (**Figure 7**). This addition aimed at identifying the presence of migratory wader roosting occurrence or habitat in the wider region. During previous surveys opportunistic observations have been made whilst in the area of the 'Mainland Mangroves' (Figure 7), however as no targeted counts were conducted until January 2011, the area is considered one of the Additional Survey Sites.

Western Wildlife Technical Reports contain detailed methodology and results for each survey (**Appendix A**).

[3] 198 mm rainfall recorded at Karratha Airport during January 2009, and 224 mm rainfall recorded during February 2009. www.bom.gov.au

Figure 5
Migratory Wader Survey Areas (high tide)

0 0.5 1 1.5
Kilometres

Survey Areas
July 09, October 10 & January 11
March 09 & October 08

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Author: MR J:\Client_Data\Australian_Premium_IronOre\60027030 - API Enviro PFS\Workspaces\Working\2009_09_14__Maps_for_Susannah\Figure 7 - Migratory Water Survey Areas - high tide_MR_20110405.mxd

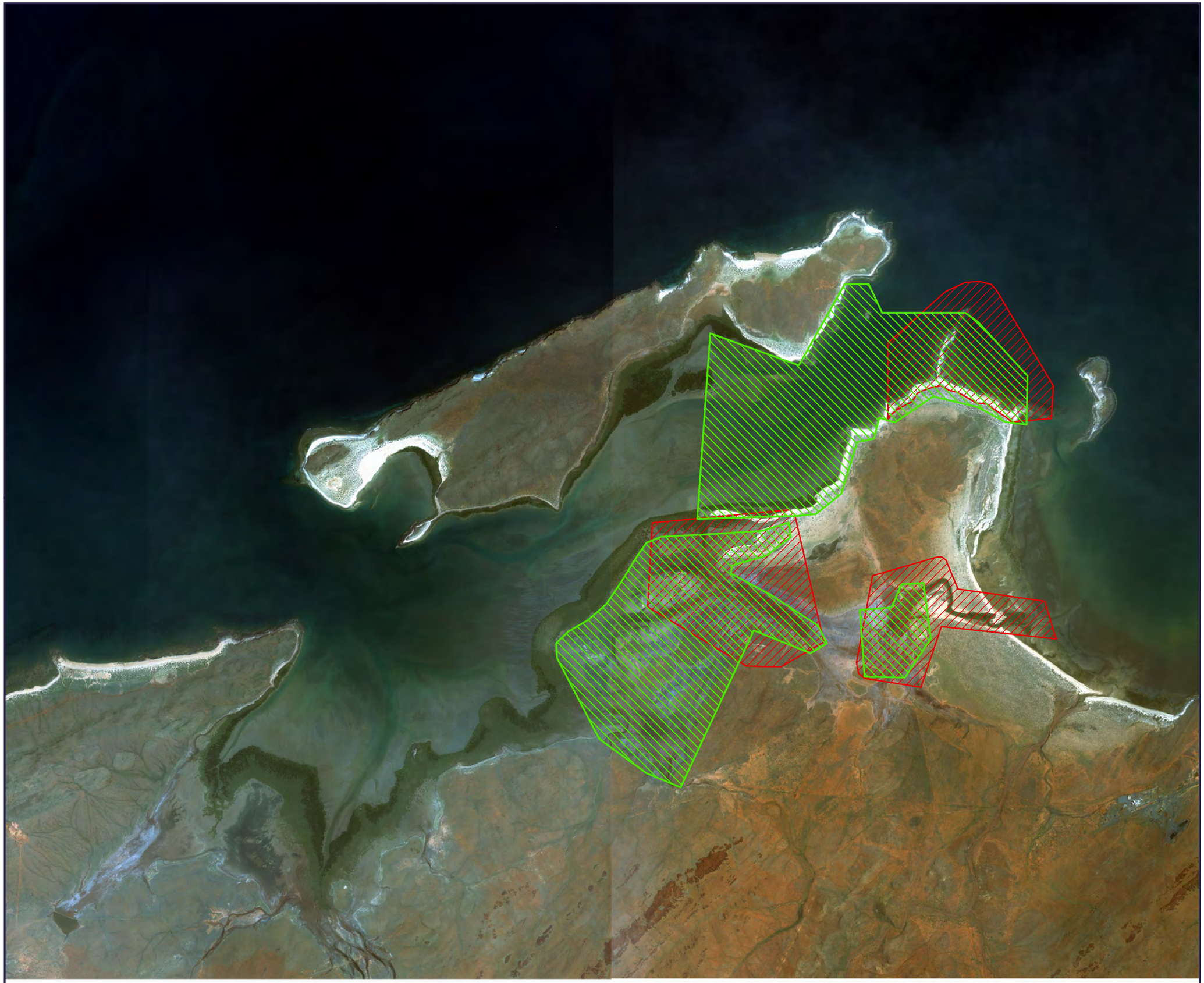


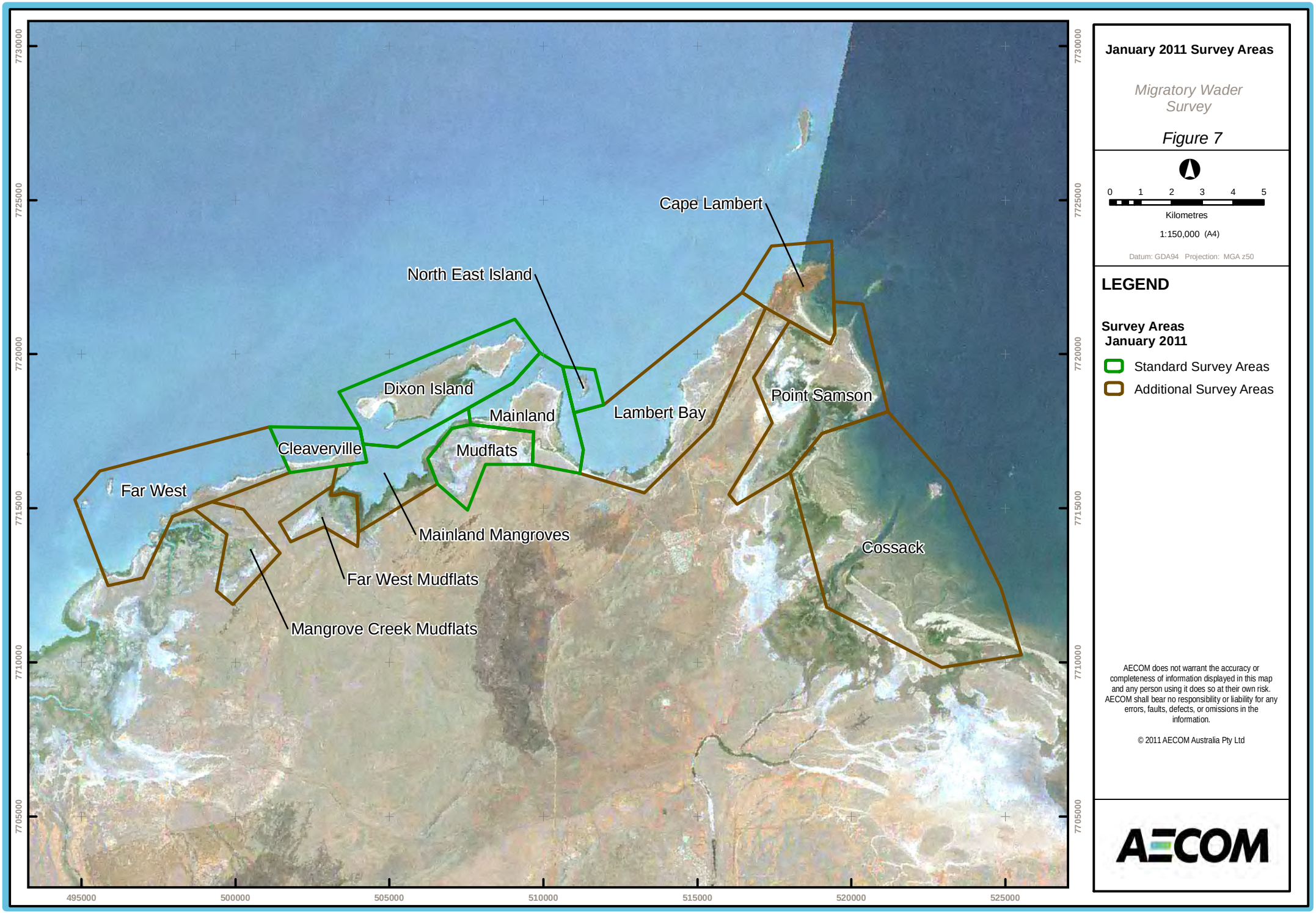
Figure 6
Migratory Wader Survey Areas (low tide)

0 0.5 1 1.5
Kilometres

Survey Areas
July 09, October 10 & January 11
March 09 & October 08

AECOM

Date Modified: 23/03/2011
Author: MR J:\Client_Data\Australian_Premium_IronOre\60027030 - API Enviro PFS\Workspaces\Working\2009_09_14__Maps_for_Susannah\Figure 8 - Migratory Water Survey Areas - low tide_MR_20110323.mxd



January 2011 Survey Areas

Migratory Wader Survey

Figure 7

0 1 2 3 4 5

Kilometres

1:150,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

Survey Areas January 2011

- Standard Survey Areas
- Additional Survey Areas

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Date Modified: 5/04/2011

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3.0 Results

Desktop surveys undertaken by Western Wildlife (2008) identified that up to 26 migratory wader species may occur in the project area. Field surveys conducted by Western Wildlife have recorded a total of 21 migratory wader species (Western Wildlife, 2008; 2009a; 2009b; 2009c; 2010; 2011).

3.1 Standard Survey Areas

3.1.1 Migratory Wader Diversity

Migratory wader diversity was greatest during the period comprising northward migration/ non-breeding season (March 2008 and 2009) and the non-breeding season (January 2011) with 19 of the 21 migratory wader species being observed (**Appendix A**). The diversity was lowest during the breeding season (July), with only 12 migratory wader species recorded (**Table 2**).

Table 2 Migratory wader species recorded in the survey area (NOTE ✓ means this species was observed to be present)

Common Name	Mar* 08	Oct^ 08	Mar* 09	Jul# 09	Oct^ 10	Jan@ 11
Ruddy Turnstone *Arenaria interpres*	✓	✓	✓	✓	✓	✓
Sanderling *Calidris alba*	✓	✓	✓		✓	✓
Red-necked Stint *Calidris ruficollis*	✓	✓	✓	✓	✓	✓
Curlew Sandpiper *Calidris ferruginea*		✓	✓		✓	
Great Knot *Calidris tenuirostris*	✓	✓	✓	✓	✓	✓
Red Knot *Calidris canutus*			✓		✓	✓
Greater Sand Plover *Charadrius leschenaultia*	✓	✓	✓	✓	✓	✓
Lesser Sand Plover *Charadrius mongolus*		✓	✓	✓	✓	✓
Oriental Plover *Charadrius veredus*		✓				✓
Oriental Pratincole *Glareola maldivarum*	✓					✓
Sharp-tailed Sandpiper *Calidris acuminata*						✓
Whimbrel *Numenius phaeopus*	✓	✓	✓	✓	✓	✓
Eastern Curlew *Numenius madagascariensis*	✓	✓	✓	✓	✓	✓
Grey Plover *Pluvialis squatarola*		✓	✓	✓	✓	✓
Pacific Golden Plover *Pluvialis fulva*	✓	✓	✓		✓	✓
Grey-tailed Tattler *Tringa brevipes*	✓	✓	✓	✓	✓	✓
Terek Sandpiper *Tringa cinerea*	✓	✓			✓	✓
Wood Sandpiper *Tringa glareola*	✓					
Common Sandpiper *Tringa hypoleucos*	✓	✓		✓	✓	✓
Common Greenshank *Tringa nebularia*	✓	✓	✓	✓	✓	✓
Bar-tailed Godwit *Limosa lapponica*	✓	✓	✓	✓	✓	✓

*Northward Migration/ Non-breeding

^Southward Migration/ Non-breeding

#Breeding Season

@Non-breeding Season

3.1.2 Migratory Wader Abundance

The five most abundant migratory wader species recorded during the surveys included:

- Great Knot 1,373 (0.36% population) January 2011
- Bar-tailed Godwit 1,203 (0.10% population) January 2011
- Grey-tailed Tattler 662 (1.32% population) October 2010
- Red-necked Stint 569 (0.18% population) January 2011
- Greater Sand Plover 509 (0.15% population) January 2011

Apart from the Grey-tailed Tattler, no other species exceeded or approached the 1% population threshold (**Table 3**). The abundances in 2011 were consistent with the relative abundance of species in preceding years of survey.

Table 3 Maximum Migratory Wader Population Counts

Common Name	1% of Estimated EAA Flyway Population*	Max % population recorded	Date of Highest Record
Ruddy Turnstone *Arenaria interpres*	7,000	0.01%	October 2010
Sanderling *Calidris alba*	7,000	<0.01%	January 2011
Red-necked Stint *Calidris ruficollis*	3,200	0.18%	January 2011
Curlew Sandpiper *Calidris ferruginea*	18,000	<0.01%	January 2011
Great Knot *Calidris tenuirostris*	3,800	0.36%	January 2011
Red Knot *Calidris canutus*	10,000	<0.01%	March 2009
Greater Sand Plover *Charadrius leschenaultia*	3,400	0.15%	January 2011
Lesser Sand Plover *Charadrius mongolus*	3,000	0.02%	October 2010
Oriental Plover *Charadrius veredus*	700	0.02%	October 2008
Oriental Pratincole *Glareola maldivarum*	29,000	0.01%	January 2011
Sharp-tailed Sandpiper *Calidris acuminata*	1,600	<0.01%	January 2011
Whimbrel *Numenius phaeopus*	20,000	<0.01%	January 2011
Eastern Curlew *Numenius madagascariensis*	380	0.08%	January 2011
Grey Plover *Pluvialis squatarola*	7,000	<0.01%	October 2010
Pacific Golden Plover *Pluvialis fulva*	2,000	<0.01%	January 2011
Grey-tailed Tattler *Tringa brevipes*	500^	1.32%	October 2010
Terek Sandpiper *Tringa cinerea*	10,000	<0.01%	January 2011
Wood Sandpiper *Tringa glareola*	30,000	<0.01%	March 2008
Common Sandpiper *Tringa hypoleucos*	40,000	<0.01%	October 2010
Common Greenshank *Tringa nebularia*	14,000	0.02%	October 2010
Bar-tailed Godwit *Limosa lapponica*	12,000	0.10%	January 2011

*after Bamford et al (2008) ^ Elsewhere, Bamford et al (2008) reported a population estimate of 60,000

3.1.3 Migratory Wader Distribution

The three most recent wader surveys (July 2009, October 2010 and January 2011) have all covered the “standard survey” areas (Figure 7). Data from these three surveys were broken down into seven main locations (as identified in Figure 5) to assess the distribution of migratory waders and other marine birds (**Figure 8**). Areas used by birds during high tide varied between seasons/surveys, with Southern Dixon Island supporting the greatest abundance of migratory waders during July 2009, and the South-west Mudflats supporting the greatest abundance during October 2010 and January 2011.

Cleaverville and North-east Island had lower abundances of migratory waders with less than 100 waders cumulatively recorded at these two sites over the three seasons. Sites with moderate abundances of migratory waders were: Mainland (with an average of 186 across the three seasons), Southern Dixon Island (337 average), Northern Dixon Island (164 average) and South-east Mudflats (299 average). The number of waders at these sites fluctuated between seasons with high numbers recorded at Southern and Northern Dixon Island during July 2009, high numbers recorded at the Mainland, Southern Dixon Island and the South-east Mudflats during October 2010, and high numbers at the Mainland and South-east Mudflats during January 2011.

The area of highest total counts was the South-west Mudflats, with in excess of 4,300 counts during January 2011 and an average of 2,254 counts recorded across the three seasons.

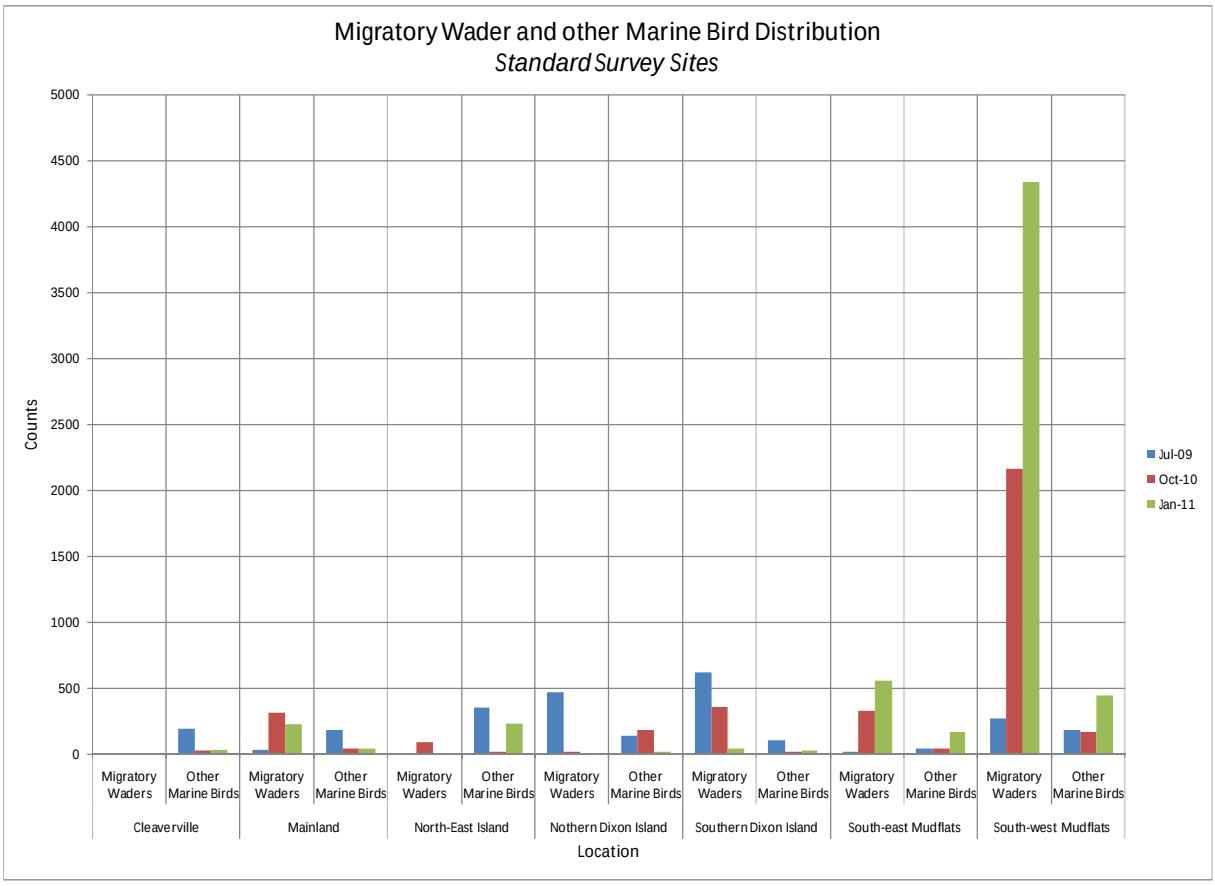


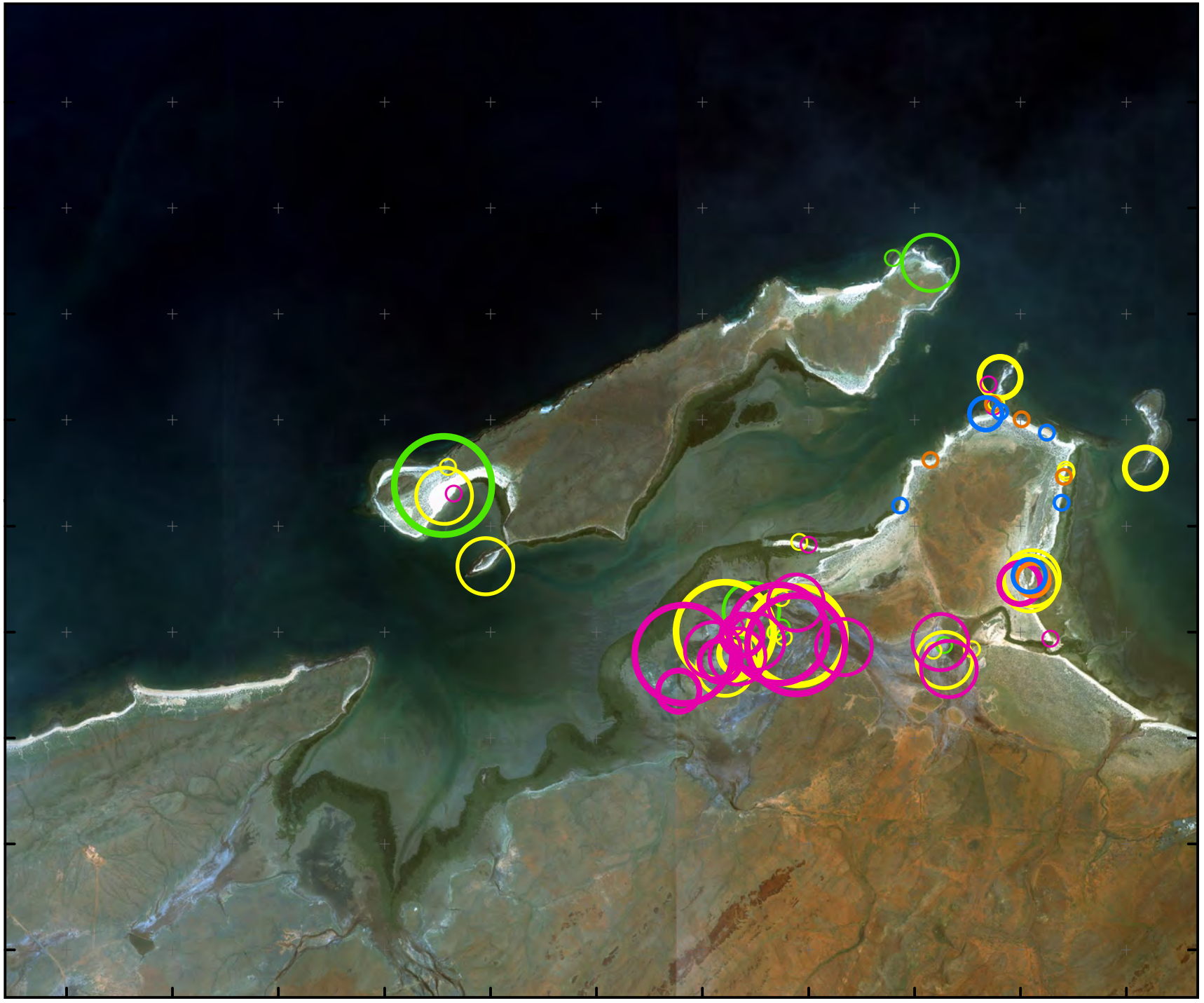
Figure 8 Migratory Wader and Other Marine Bird Distribution – Standard Survey Area

3.1.4 Roosting Sites

During the breeding season survey (July 2009), three roosting sites were found to support 96% of migratory waders recorded during the high tide survey: Southern Dixon Island (47%), Northern Dixon Island (33%) and the South-west Mudflats (16%) (**Figure 9**).

During the southward/ non-breeding survey (October 2010), the littoral zone supported approximately 76% of the total count of migratory waders in the standard survey area recorded at high tide, with the South-west Mudflats supporting 65% and the South-east Mudflats supporting 11% (**Figure 9**). The only other site to support large numbers of migratory waders at high tide was Dixon Island South-west (9%). These results were generally consistent with July 2009 and show that roosts tend to occur in the same places but may fluctuate with the tidal cycle (Western Wildlife, 2010).

During the non-breeding survey (January 2011), approximately 96% of migratory waders (recorded in the standard survey area) at high tide were found roosting in the littoral zone (**Figure 9**). Within the sub-coastal mudflats, the South-west Mudflats supported 84% of those waders, while the South-east Mudflats supported 12%. Dixon Island supported far fewer roosting birds in comparison to preceding years but the littoral zone as a roosting site appeared consistent with other years.



Migratory Wader Roosting Sites in Standard Survey Area

Migratory Wader Survey

Figure 9

0 0.5 1 1.5

Kilometres

1:50,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

Roosting Sites

- Jan 11
- Oct 10
- July 09
- March 09
- Oct 08

- 10 - 50
- 51 - 100
- 101 - 500
- > 500

AECOM

Date Modified: 5/04/2011

Author: MR G:\60101100 - API Enviro Phase 2\4 Tech work area\4.7 GIS\Working\2011_03_11_Bird_Survey_Mapping\Bird_Survey_Roosting_Sites_Map4_MR_20110405.mxd

3.1.5 Grey-tailed Tattlers

Western Wildlife (2009c) found that during the breeding season the standard survey areas supported less than 1% of the estimated population of any migratory wader species (**Appendix A**). However, during the southward/ non-breeding and non-breeding seasons, population numbers exceeded the 1% threshold level for the Grey-tailed Tattler (**Figure 10**). In the standard survey area during October 2010 (high tide), 662 Grey-tailed Tattlers (1.32%) were observed (Western Wildlife, 2010) and during January 2011 (high tide), 641 Grey-tailed Tattlers (1.28%) were observed (Western Wildlife, 2011) (**Table 4**).

Table 4 Numbers of Grey-tailed Tattlers in the Standard Survey Area

Survey Period	1% Flyway Population^	Mainland		Mainland & Dixon Island	
		Low Tide	High Tide	Low Tide	High Tide
March 08 (Northward/Non-breeding)	500	41 (0.08%)	12 (0.02%)	-	-
Oct 08 (Southward/Non-breeding)	500	278 (0.56%)	71 (0.14%)	-	-
March 09 (Northward/Non-breeding)	500	32 (0.06%)	33 (0.07%)	-	-
July 09 (Breeding Season)	500	1 (<0.01%)	1 (<0.01%)	35 (0.07%)	477 (0.95%)
October 10 (Southward/ Non-breeding)	500	501 (1.0%)	430 (0.86%)	501 (1.0%)	662 (1.32%)
January 11 (Non-breeding Season)	500	399 (0.8%)	604 (1.21%)	399 (0.8%)	641 (1.28%)

^ 1% threshold values for EAA Flyway estimated populations (Bamford *et al.*, 2008) for listed migratory wader species under the EPBC Act

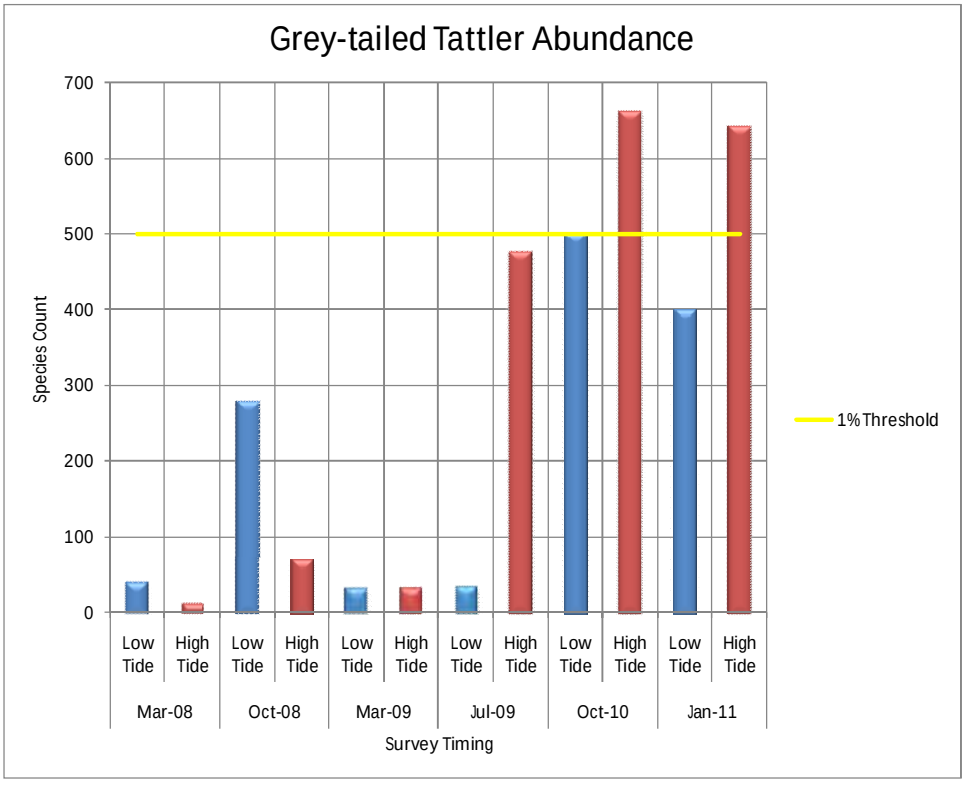


Figure 10 Grey-tailed Tattler abundance in the standard survey area[4]

[4] The complete standard survey area was not surveyed entirely during March 2008, October 2008 or March 2009 (i.e. Dixon Is observations were not made)

3.2 Additional Survey Areas

3.2.1 Migratory Wader Abundance

During January 2011, migratory wader counts were also undertaken at locations outside of the "standard survey" areas (**Figure 7**). It was found that the five most abundant migratory wader species recorded in the additional areas were the same five species recorded in high abundance in the standard survey area. The five species were, however, recorded in lower abundance at the additional survey areas. The presence of the same species indicates that the additional survey areas have similar habitat to the standard survey areas. These five species were:

- Greater Sand Plover 585 (0.17% population)
- Great Knot 522 (0.14% population)
- Bar-tailed Godwit 515 (0.04% population)
- Grey-tailed Tattler 349 (0.70% population)
- Red-necked Stint 169 (0.05% population)

Numbers approaching the significant threshold were recorded for Grey-tailed Tattlers which indicates that in addition to the Anketell Point standard survey area, the broader region is also used by the species.

3.2.2 Migratory Wader Distribution

The additional area surveyed during January 2011 was broken down into seven locations to assess the distribution and relative abundances of migratory waders and other marine birds (**Figure 11**).

'Far West Mudflats' and 'Cossack' supported high numbers of migratory waders, recording higher abundances than most sites in the standard survey area (**Figure 11**). The 'Far-West' and 'Cossack' sites also supported high numbers of other marine birds.

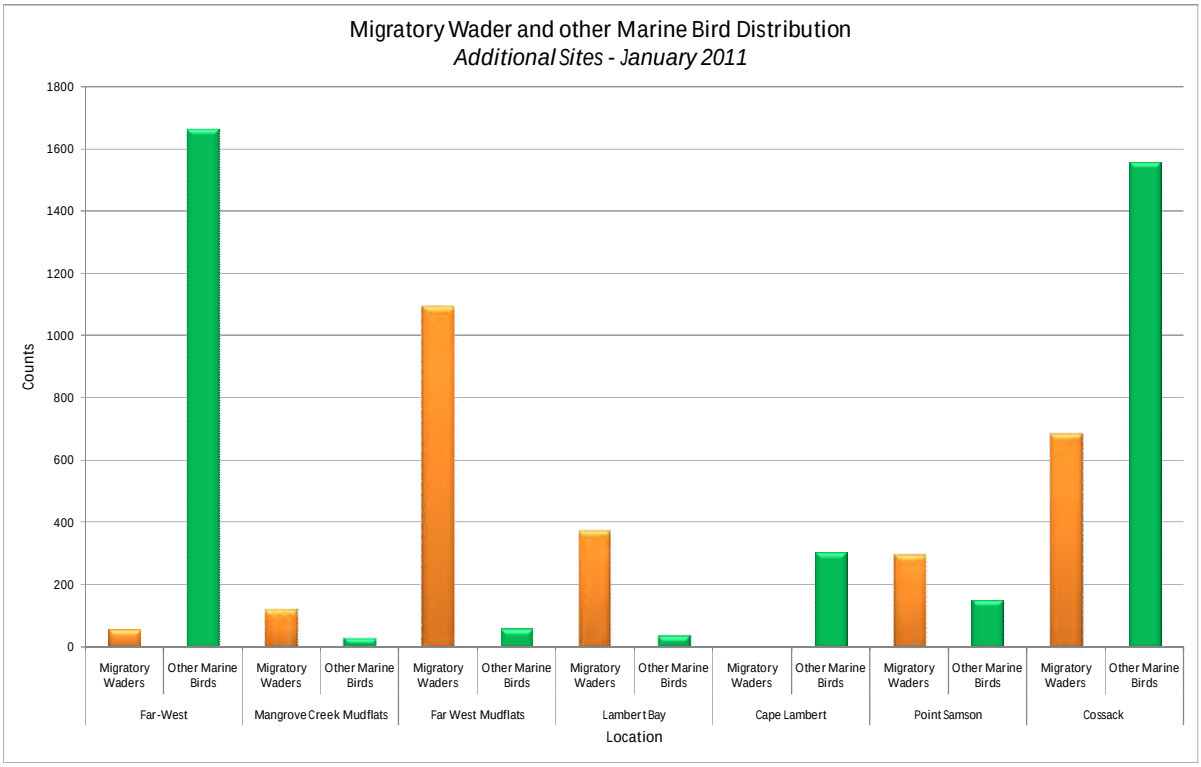


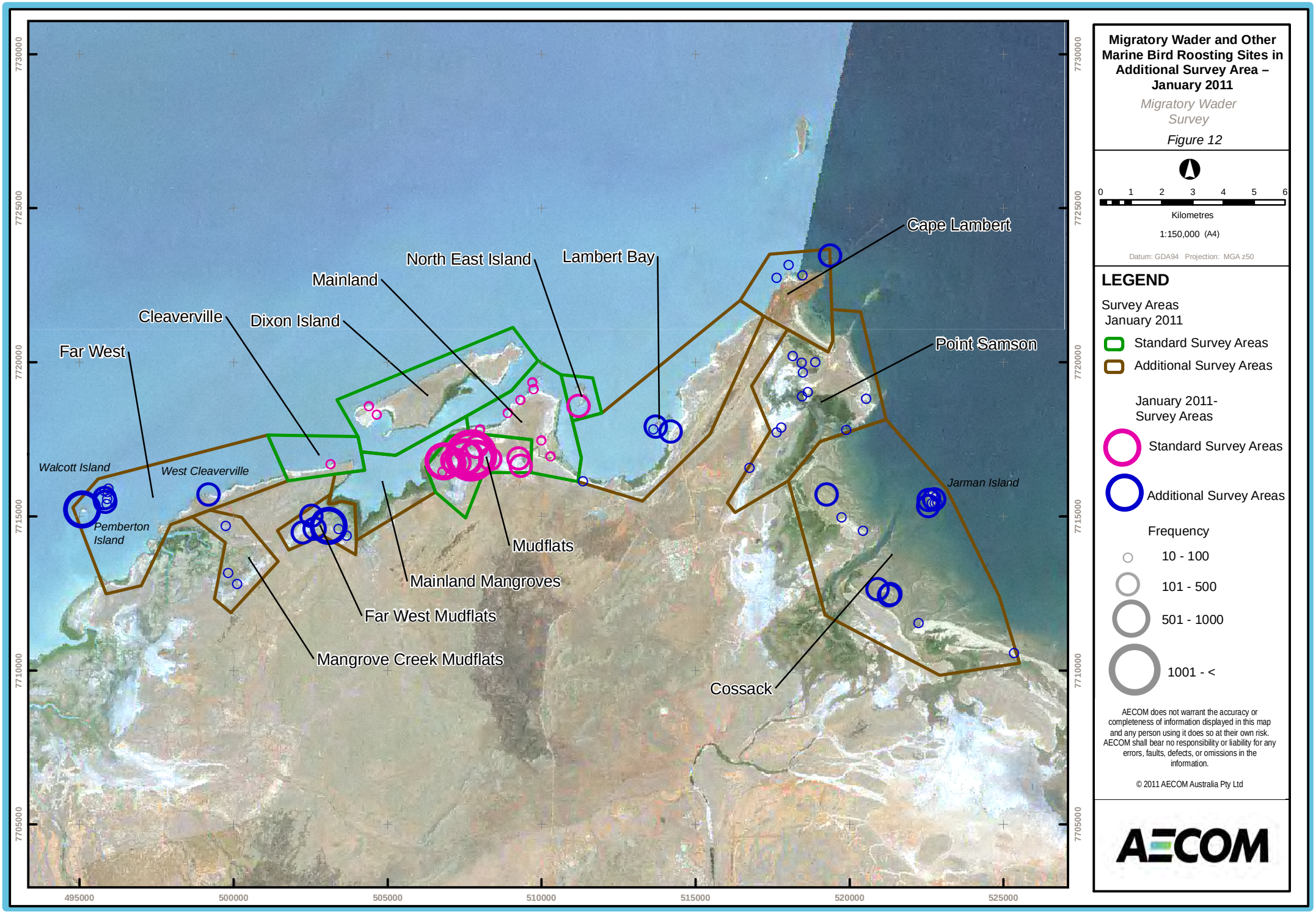
Figure 11 Migratory Wader and other Marine Birds (Shorebird and Seabird) distribution - Additional Survey Area - January 2011

3.2.3 Roosting Sites

During the January 2011 survey, it was found that roosting sites for migratory waders and other marine birds were widely distributed over the additional survey areas, with medium size roosting sites (101 – 500) located at: Walcott Island (123, 115), West Cleaverville (300), Lambert Bay East (159, 113), Cape Lambert (194), North Cossack (355), Central Cossack (282, 102, 298), Jarman Island (179, 122, 395), Far West Mudflats (147, 109, 103) (**Figure 12**). Two large roosting sites (>500) were observed at Pemberton Island (931) and the Far West Mudflats (709). However, many of these roosting sites, particularly the offshore islands, supported mainly shorebirds or seabirds and were not utilised by migratory waders.

Medium numbers of migratory wader roosts were found at: Lambert Bay East (159, 113), North Cossack (283), Central Cossack (297), and the Far West Mudflats (142, 109, 103) (**Figure 13**). One large roosting site was observed at the Far West Mudflats, which supported 681 migratory waders. Smaller roosting sites were observed scattered throughout the remainder of the additional survey sites, however approximately 85% of roosting waders were observed at the Far West Mudflats (44%), Cossack (26%) and Lambert Bay (15%).

These three roosting areas also supported approximately 82% of Grey-tailed Tattlers counted in the additional survey sites, with 44% at the Far West Mudflats, 14% at Cossack and 24% at Lambert Bay.



Migratory Wader and Other Marine Bird Roosting Sites in Additional Survey Area – January 2011

Migratory Wader Survey

Figure 12

0 1 2 3 4 5 6

Kilometres

1:150,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

Survey Areas
January 2011

- Standard Survey Areas
- Additional Survey Areas

January 2011-
Survey Areas

- Standard Survey Areas
- Additional Survey Areas

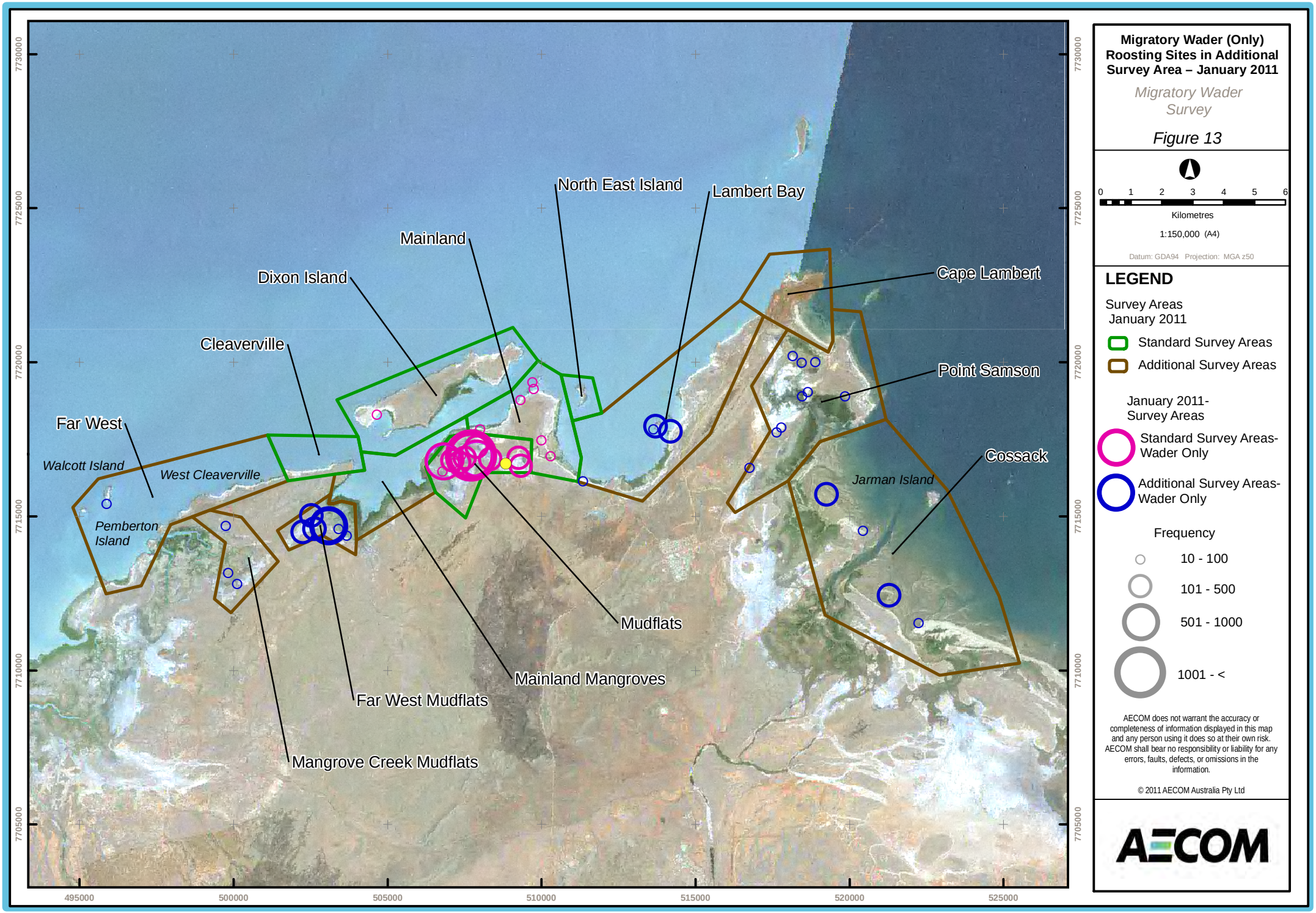
Frequency

- 10 - 100
- 101 - 500
- 501 - 1000
- 1001 - <

AECOM

Date Modified: 26/05/2011

Author: MR G:\60101100 - API Enviro Phase 2\4 Tech work area\4.7 GIS\Working\2011_03_11_Bird_Survey_Mapping\Bird_Survey_Roosting_Sites_Jan11_Map2_MR_20110405.mxd



Migratory Wader (Only) Roosting Sites in Additional Survey Area – January 2011

Migratory Wader Survey

Figure 13

0 1 2 3 4 5 6

Kilometres

1:150,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

Survey Areas January 2011

- Standard Survey Areas
- Additional Survey Areas

January 2011- Survey Areas

- Standard Survey Areas- Wader Only
- Additional Survey Areas- Wader Only

Frequency

- 10 - 100
- 101 - 500
- 501 - 1000
- 1001 - <

AECOM

Date Modified: 26/05/2011

Author: MR G:\60101100 - API Enviro Phase 2\4 Tech work area\4.7 GIS\Working\2011_03_11_Bird_Survey_Mapping\9_3\Bird_Survey_Roosting_Sites_Map3_KJ_201129041.mxd

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4.0 Results Summary

A total of 21 migratory wader species have been identified as occurring in the survey area, but population counts for species other than Grey-tailed Tattlers were low and much less than the 1% population threshold. It is unlikely that the Anketell Point area or broader Nickol Bay region supports significant populations of any other species.

Migratory wader surveys completed in the Exmouth Gulf for the Yannarie Solar Salt Field project ranked the Exmouth Gulf survey area as internationally important for five migratory species; the Grey-tailed Tattler, Bar-tailed Godwit, Ruddy Turnstone, Sanderling and the Greater Sand Plover (Biota, 2005). Of particular interest are the numbers recorded for the Grey-tailed Tattler. Species abundance at Exmouth Gulf increased from 484 during the breeding season, when numbers are usually low, to 3,184 during the non-breeding season. This follows the typical pattern of high wader counts during the non-breeding season (summer), and low counts during the breeding season (winter) when the majority of individuals of a species have returned to the northern hemisphere. Breeding season (winter) counts of Grey-tailed Tattler in Exmouth Gulf were comparable to those for the breeding survey at Anketell Point (477).

This pattern was also evident in migratory wader surveys conducted on Barrow Island where numbers peaked during the non-breeding season, and decreased during the breeding season (Bamford, 2005). Seasonal abundance for the Grey-tailed Tattler on Barrow Island were similar to those recorded in the Exmouth Gulf: counts of 428 during the breeding season (winter) and 2,634 during the non-breeding season (summer) (Bamford, 2005).

Notably, Eighty Mile Beach (on the WA coast to the north of Anketell Point and north of Port Hedland) is the most significant site known with a maximum count of 12,420 (Skeves, 2003) in southern migration 2002. It is apparent that the Grey-tailed Tattler migrates along the WA coast from sites such as Roebuck Bay, Eighty Mile Beach, Dampier and Barrow Island.

A maximum count of 477 Grey-tailed Tattlers was recorded during the breeding season in the standard survey area. Data collected during the southward/ non-breeding season (October 2010) and non-breeding season (January 2011) confirmed that population numbers of Grey-tailed Tattlers increased according to the trend elsewhere in the south Pilbara coast and exceeded the 1% threshold level (1.32% and 1.28% respectively). However, the non-breeding season abundance in the Anketell Point Area (641) remained well below the maximum values recorded from Exmouth Gulf (3,184) and Barrow Island (2,634). The data collected during the breeding and non-breeding seasons indicated that Bouguer Channel and the South-west Mudflats are foraging sites for migratory waders, in particular the Grey-tailed Tattler.

Based on survey data collected by Western Wildlife, the standard survey area provides migratory wader habitat supporting significant populations of the Grey-tailed Tattler (Western Wildlife, 2010; 2011). In addition to the southward migration season, the area supports significant numbers of Grey-tailed Tattlers during the non-breeding season.

Although the Additional Survey during January 2011 did not support significant populations of any migratory wader species, high numbers of Grey-tailed Tattlers were recorded at other regional sites across the broader survey area. This indicates that regional habitat features and alternative roosting sites are available for Grey-tailed Tattlers and other wader species.

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5.0 Impact Assessment

According to the "Significant impact guideline for 36 migratory shorebird species" (DEWHA 2009), 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 the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.

Given the Grey-tailed Tattler was the only species to exceed the one percent EAA population threshold (**Table 3**), it is unlikely that the proposed port development will have the potential for a significant impact on any other migratory wader species based on the above guidelines. The following impact assessment will therefore focus on potential impacts to the Grey-tailed Tattler population known from the survey area.

5.1 Direct Impacts

Grey-tailed Tattlers may be potentially impacted from the proposed port development through direct loss of habitat used for roosting and/or foraging. Surveys indicate the use of habitats in the region by shorebirds both while foraging at low tide and while roosting on the high tide. Direct impacts to roosting and foraging are considered separately.

5.1.1 Direct Loss of Foraging Habitat

During the low tide surveys in July 2009, October 2010 and January 2011 the majority of Grey-tailed Tattlers were recorded foraging in Bouguer Passage, and on the South-west Mudflats (Western Wildlife 2009c; 2010; 2011). Note that only during 2011 were intertidal habitats other than the Anketell Point standard survey areas examined.

Grey-tailed Tattlers have been observed foraging in Bouguer Passage adjacent to the proposed causeway location in East Channel and Far-east Channel survey areas (**Figure 14**). The Bouguer Passage tidal flats (west of the proposed causeway) have been found to support a significant number of foraging Grey-tailed Tattlers at certain times. However, installation of apertures within the temporary (construction phase) and permanent causeways will maintain tidal exchange through the causeway and ensure that no loss of foraging habitat adjacent to the causeway occurs as a result of the proposal.

Western Wildlife (2011; Appendix A) reported that Bouguer Passage mainland supports large numbers of foraging shorebirds. In 2011, the greatest numbers of birds were observed foraging in the Far West Channel (41%) and East Channel (38%) with fewer in the Far East Channel (12%). The pattern of foraging distribution was consistent with surveys conducted in earlier October 2010 and July 2009 surveys. Therefore, the areas of greatest foraging abundance were in the part of the Passage generally furthest from the proposed causeway.

The only direct loss of foraging habitat will be beneath the proposed causeway through the supratidal to the low intertidal zones in the survey area known as Far East Channel. Throughout the series of surveys, the Far East Channel survey area has supported a relatively low abundance of foraging birds (Western Wildlife 2011). The area in Far East Channel within the causeway corridor and above the Mean Low Water Spring elevation is 7.4 hectares. There is estimated to be in excess of one thousand hectares of foraging habitat associated with the Dixon Island - Bouguer Passage – Cleaverville – No Name Bay foreshore complex (depicted in **Figure 18** & **Figure 19**), so this direct loss of foraging habitat is a low proportion.

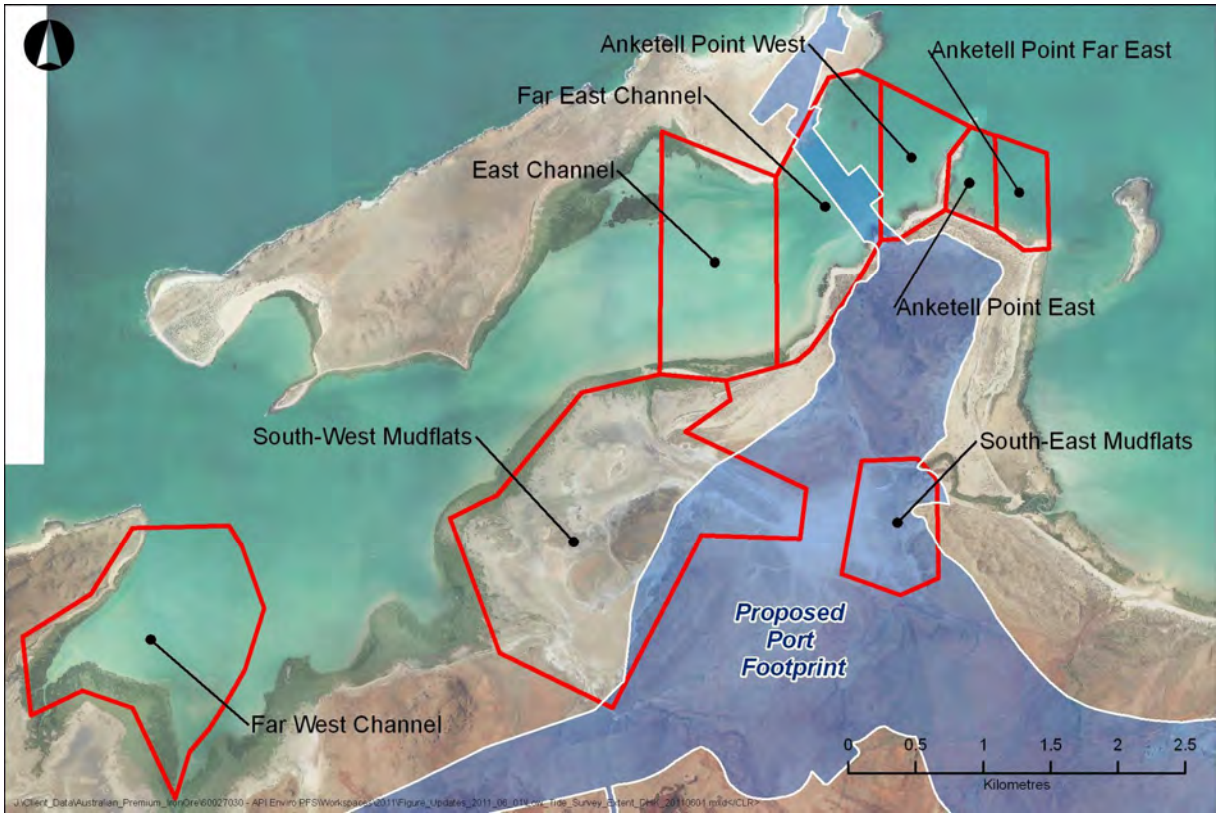


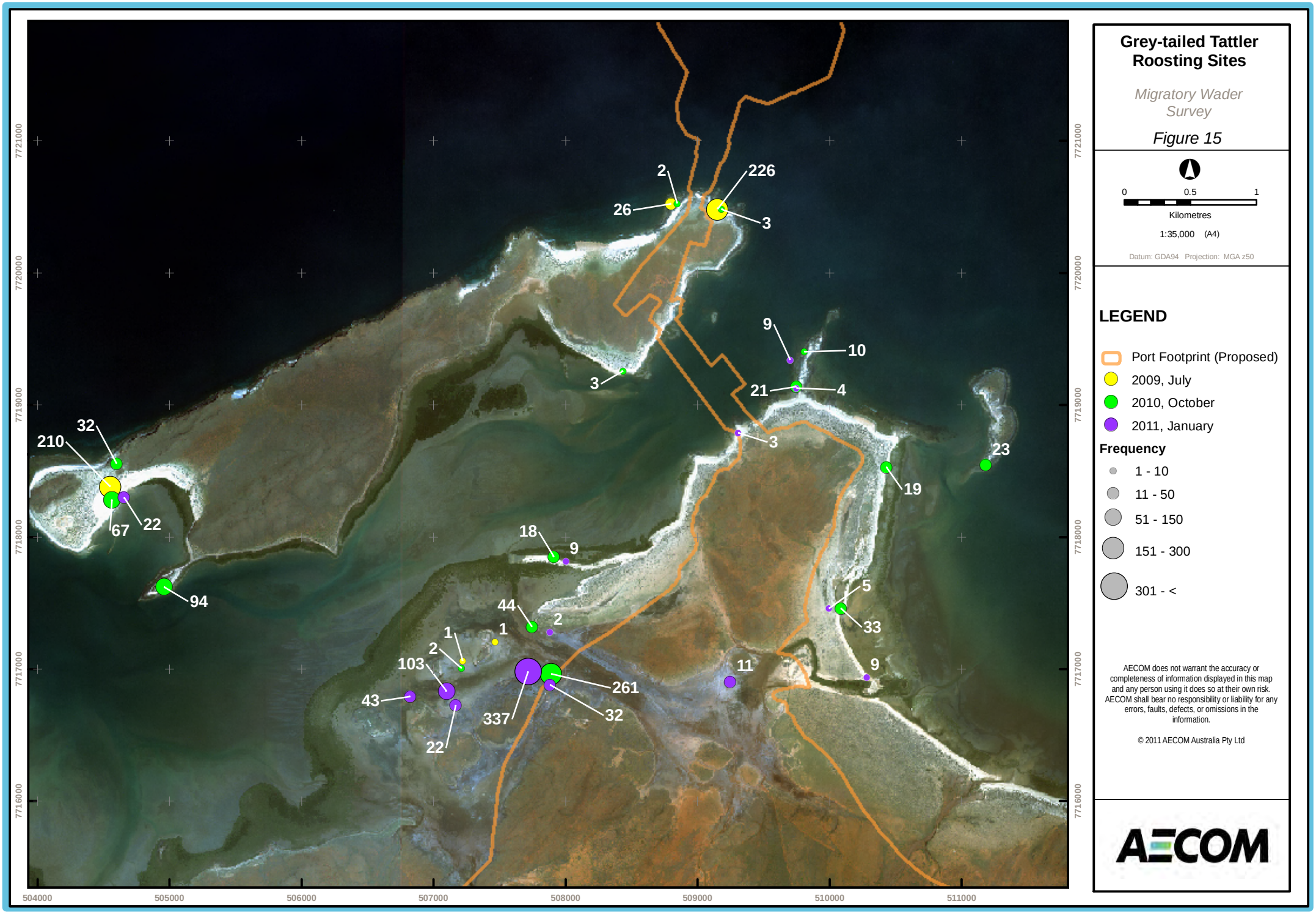
Figure 14 Low Tide Survey Extent of Foraging Areas during January 2011 showing proposed causeway

5.1.2 Direct Loss of Roosting Habitat

Figure 15 shows the proposed port envelope (in orange) against Grey-tailed Tattler roosting data (recorded during July 2009, October 2010 and January 2011). In 2011, three roosting sites were recorded within the area of direct disturbance (South-east Mudflats (11), South-west Mudflats (32) and Anketell Point (3)). Several larger roosting sites were located on the perimeter of the envelope, most notably on the South-west Mudflats, westward of the proposed port boundary.

The loss of a small number of roosting sites (used in non-breeding season January 2011) within the development envelope would not significantly impact Grey-tailed Tattler populations in the region as the vast majority of known roosting sites in the region are outside of the proposed development envelope. Also, suitable alternative roosting sites are known to be available within viable flying distances from the known foraging areas as examined in **Section 5.2**. Other more extensive and populous roosting sites may be subjected to indirect impacts from light and noise, which are addressed in more detail in **Section 5.3**.

In 2009, during the breeding season, a roosting site was located on the north east of Dixon Island (shown in Figure 9) but no usage of this site was recorded during the more recent 2010 (southward migration) and 2011 (non-breeding) surveys, when larger numbers of Grey-tailed Tattlers were observed roosting on coastal mudflats.



Grey-tailed Tattler Roosting Sites

Migratory Wader Survey

Figure 15

0 0.5 1

Kilometres

1:35,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

- Port Footprint (Proposed)
- 2009, July
- 2010, October
- 2011, January

Frequency

- 1 - 10
- 11 - 50
- 51 - 150
- 151 - 300
- 301 - <

AECOM

Date Modified: 1/06/2011

Author: MR G:\60101100 - API Enviro Phase 2\4 Tech work area\4.7 GIS\Working\2011_03_11_Bird_Survey_Mapping\Bird_Survey_Map_GTT_DHK_20110601.mxd

5.2 Indirect Impacts of Habitat Loss

The relationship between roosting and foraging habits can be examined to consider potential indirect impacts. Rogers *et al.* (2006) concluded that "feeding areas are only of use to migratory waders if they are associated with acceptable roosts". Alignment of foraging and roosting sites around Bouguer Passage is discussed below.

The Grey-tailed Tattler is a medium-sized bird and can be presumed to have similar travelling distance constraints as other migratory shorebirds when moving between roosts and foraging sites. Comparisons may be drawn with other Scolopacidae species, such as Great Knots and Red Knots, where there is a known relationship of movement between roosting and foraging areas. Note that Great Knots were also relatively abundant in the area recorded roosting in high numbers on the South-west Mudflats in January 2011, as well as in preceding years.

Studies have indicated that median one way flight distance between roosting and foraging sites for Great Knots and Red Knots were 1 – 3 km during the day and 6 – 8 km at night. A study on high tide roost choice of Great Knots (average length of 23 – 25 cm and a weight of 120 g) in Roebuck Bay found that median one-way flights between foraging and roosting sites were 1 – 3 km by day and 6 – 8 km at night (**Figure 16**) (Rogers, 2003).

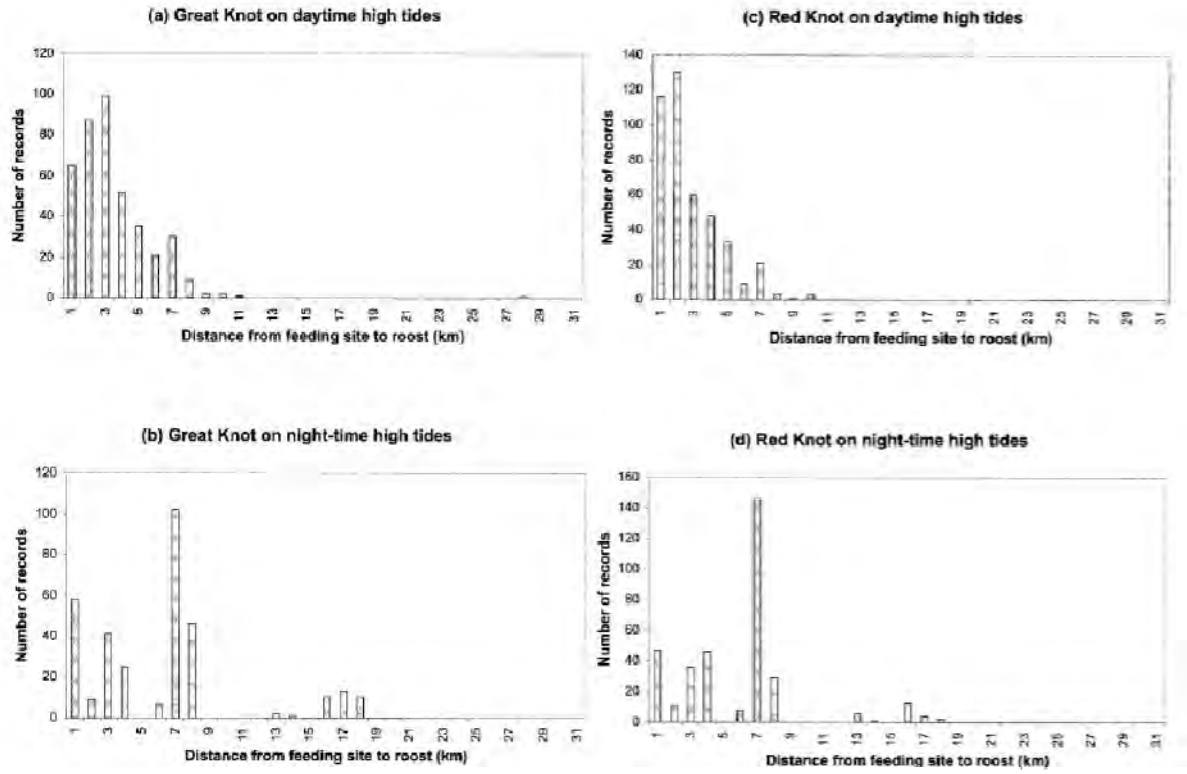


Figure 16 Distance between day and night feeding and high tide roost sites at Roebuck Bay, for 25 radio-tagged Great Knots (a & b) and 23 radio-tagged Red Knots (c & d) during March – April 2000 (excluding extreme neap tides) (Rogers, 2003)

Additionally, the Dunlin, another Scolopacidae species (in the northern hemisphere), is known to forage within 5 km of its roosts. A study on the distance to high-tide roosts of Dunlins (average length of 16 – 22 cm and a weight of 60 g) found that fewer than 20% of individuals foraged more than 5 km from roosting sites, with the density of Dunlins becoming very low on intertidal flats further than 5 km from the roost (Dias *et al.*, 2006) (**Figure 17**), yet the highest bird densities, while foraging, were found up to 3 to 4 kilometres away from roosting sites.

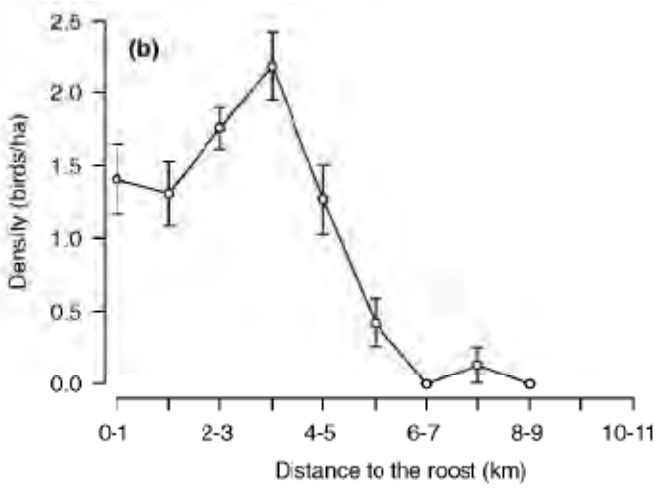
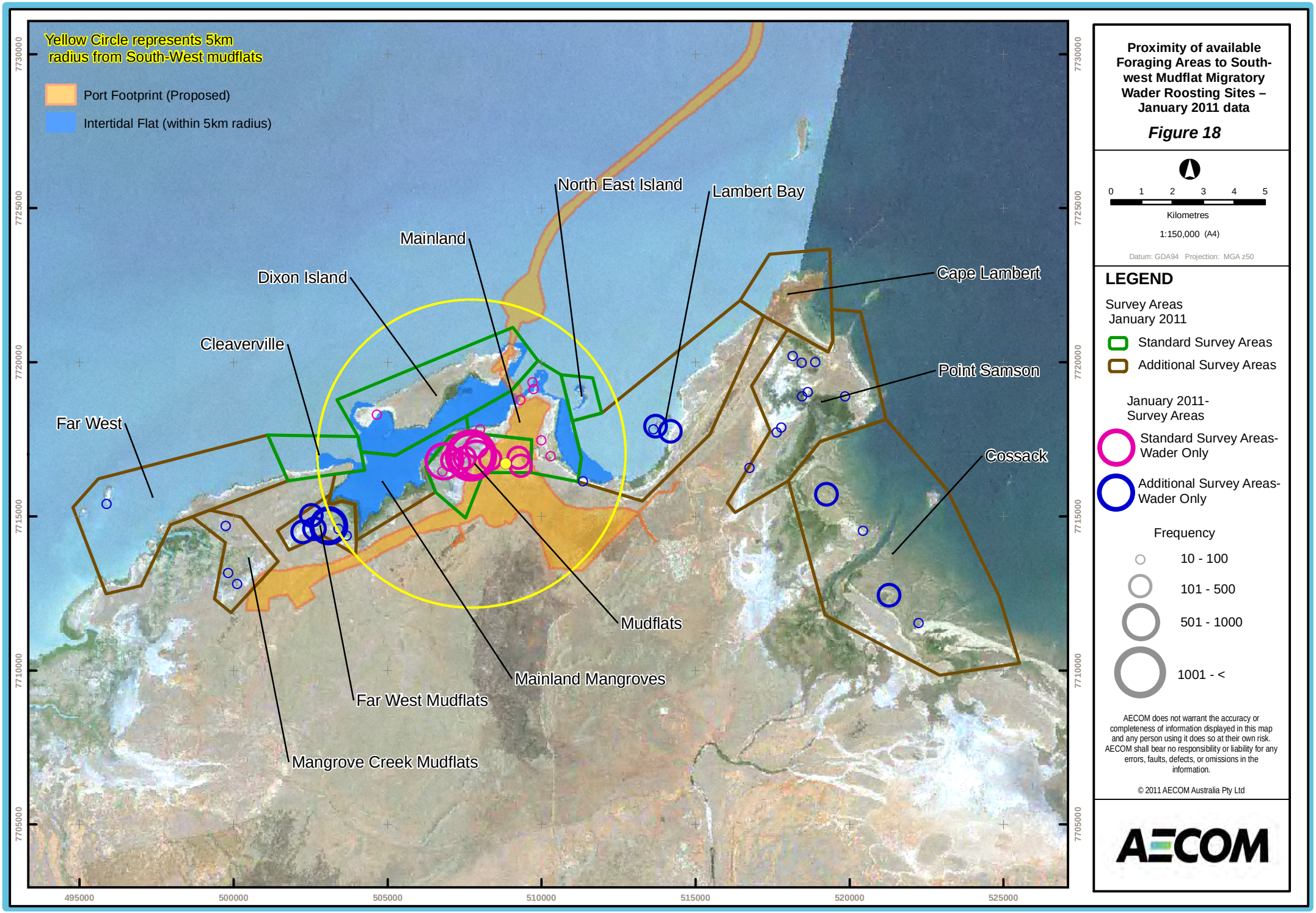


Figure 17 Relationship between the distance to the nearest roost and the overall density of Dunlins in their feeding areas (means ± SE) (Dias *et al.*, 2006)

Figure 18 presents the area of foraging habitat available to migratory shorebirds at low tide (shaded) in relation to observed roosting sites (purple and blue circles).

Of relevance to the proposed port development is the migratory bird habitat complex in and around the Bouguer Passage. Movement between the South-west Mudflats (roosting sites) and the intertidal flats between Dixon Island and the mainland (foraging) are not interrupted by the proposed location of the port development footprint (which is entirely to the east and south-east). Western Wildlife (2011) concluded that the Grey-tailed Tattlers that roosted in Mudflats were likely to forage within Bouguer Passage particularly between the Far West channel and East channel survey sites.

Roosting sites within a radius of 3 to 5 kilometres of the Bouguer Passage foraging areas are shown in **Figure 19**. Extensive roosting and foraging site combinations are also available between 5 and 10 km away from the Bouguer Passage area in places such as “Point Samson” and “Lambert Bay“. Grey-tailed Tattlers were observed roosting at each of these stated locations, with a large number of roosts also observed at “Far West Mudflats”. Overall, this indicates that suitable roosting habitat is available in the region for Grey-tailed Tattlers and other shorebirds, should they be dissuaded from habitation near the proposed port footprint.



Proximity of available Foraging Areas to South-west Mudflat Migratory Wader Roosting Sites – January 2011 data

Figure 18

0 1 2 3 4 5

Kilometres

1:150,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

Survey Areas January 2011

- Standard Survey Areas
- Additional Survey Areas

January 2011- Survey Areas

- Standard Survey Areas- Wader Only
- Additional Survey Areas- Wader Only

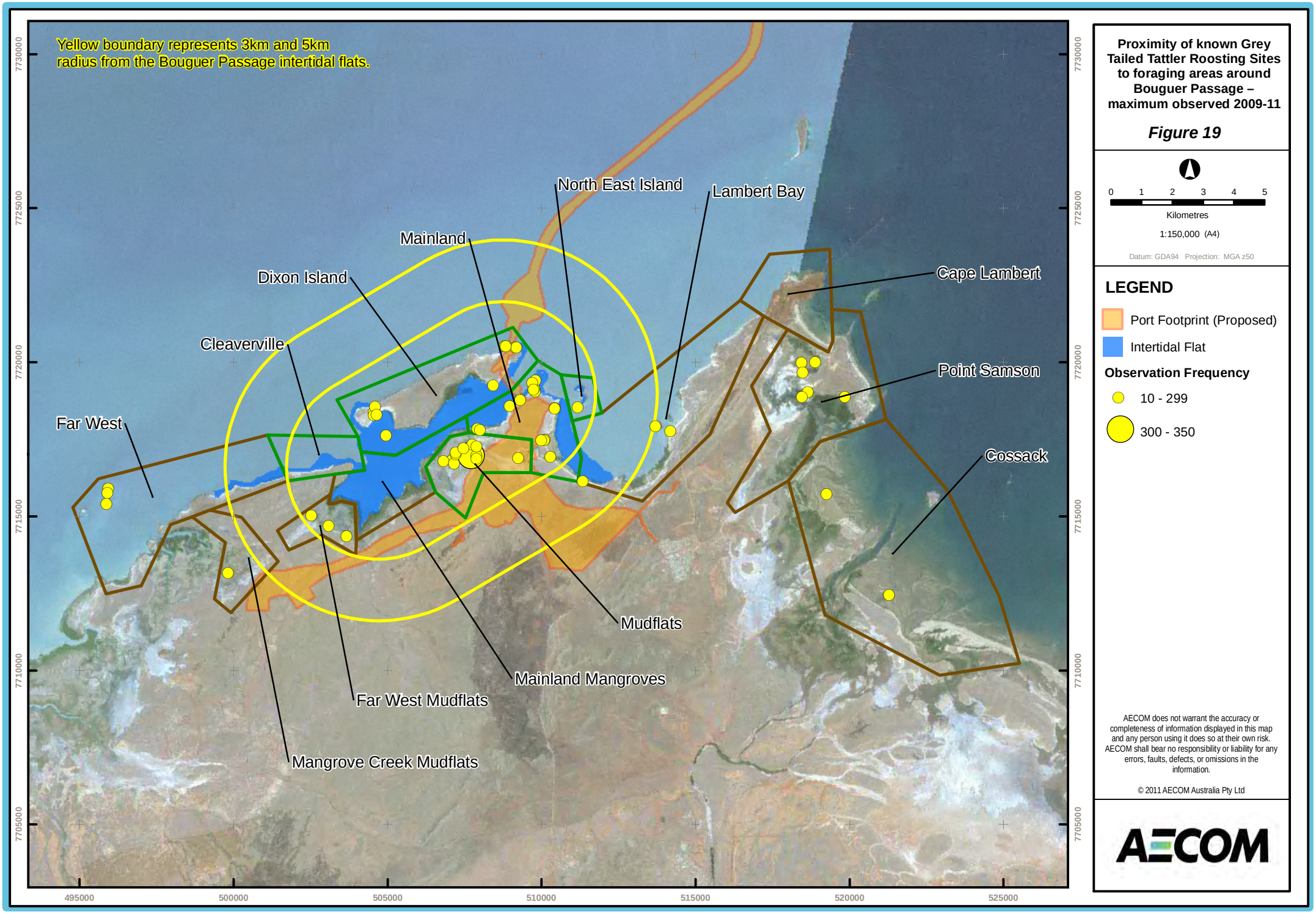
Frequency

- 10 - 100
- 101 - 500
- 501 - 1000
- 1001 - <

AECOM

Date Modified: 1/06/2011

Author: MR J:\Client_Data\Australian_Premium_IronOre\60027030 - API Enviro PFS\Workspaces\2011\Figure_Updates_2011_06_01\Proximity_of_Foraging_Areas_DHK_20110601mxd.mxd



Proximity of known Grey Tailed Tattler Roosting Sites to foraging areas around Bouguer Passage – maximum observed 2009-11

Figure 19

0 1 2 3 4 5

Kilometres

1:150,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

- Port Footprint (Proposed)
- Intertidal Flat

Observation Frequency

- 10 - 299
- 300 - 350

AECOM

Date Modified: 1/06/2011

Author: MR J:\Client_Data\Australian_Premium_IronOre\60027030 - API Enviro PFS\Workspaces\2011\Figure_Updates_2011_06_01\Proximity_Bouger_Passage_of_Foraging_Areas_DHK_20110601mxd.mxd

5.3 Other Indirect Impacts

Potential threats on the conservation of Grey-tailed Tattlers may include: loss of habitat (Milton, 2003) by threatening processes, introduced pests (DEWHA, 2008) and disturbance from light and noise emissions (Rogers *et al.*, 2006).

Grey-tailed Tattlers may be indirectly impacted from the proposed port development through disturbance by light and noise emissions. This risk is largely associated with light and noise emissions during roosting, as foraging tends to occur on more distant intertidal land further away from the proposed port.

Disturbance at key habitats may reduce Grey-tailed Tattler feeding and resting rates. The level and extent of disturbance will depend on final design, however, it is recommended that buffers be applied around areas of Grey-tailed Tattler habitation (DEWHA, 2009).

5.3.1 Noise Emissions

Potential effects of man-made noise on birds include:

- For very loud noises, hearing damage; permanent (125 – 140 dB(A)) and temporary threshold shifts (93 – 110 dB(A)) (PTS and TTS); and,
- For other noises, masking of vocal communication between individuals and other biologically important sounds; and other physiological and behavioural responses, such as avoiding an area.

The greatest risk of effect is associated with fugitive or impulsive noises scaring birds away from favoured roosting or feeding habitat. This effect is examined below.

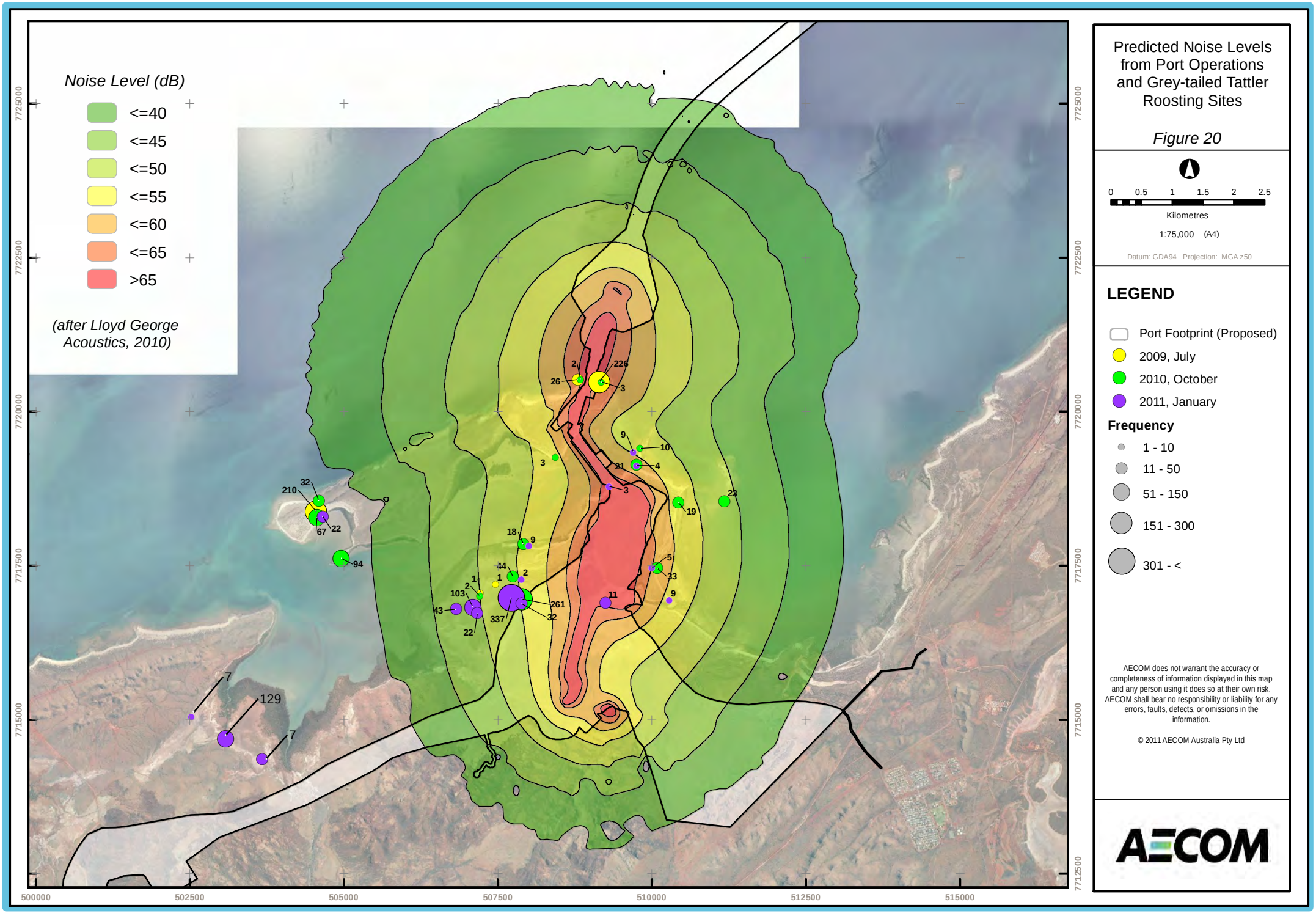
The hearing sensitivity of birds generally varies with frequency (Dooling *et al.,* 2000). A bird species is most sensitive to sounds at frequencies where its absolute hearing threshold is lowest, which is at frequencies between 1 and 5 kHz. Although hearing sensitivity varies among bird species, the variation is not great in comparison to other vertebrate groups (Dooling and Popper, 2007).

The masking effect of noise on migratory waders depends on the pre-existing level of ambient noise. Dooling *et al* (2007) concluded that, given an existing ambient noise environment of 50 to 55 dB(A), anthropogenic noise levels of 55 to 60 dB(A) can reasonably be assumed to begin to interfere with bird acoustic communication. This interference may lead to behavioural responses, potentially leading to abandonment of a roosting site.

Noise levels associated with the port operations at APP have been predicted assuming 115 Mtpa throughput and wind from all directions (Lloyd George Acoustics, 2010). **Figure 20** displays predicted port operations noise contours in relation to mapped Grey-tailed Tattler roosting sites. Based on predicted noise contours, port operations are unlikely to result in either TTS or PTS for migratory waders (noise levels exceeding 65dB are generally limited to within the proposed port footprint).

During previous surveys, four main roosting areas have been observed for Grey-tailed Tattlers (**Figure 20**): north-eastern end of Dixon Island, south-western end of Dixon Island, South-west Mudflats and Far West Mudflats. Small numbers of Grey-tailed Tattlers have been recorded elsewhere in the region. Roosts located on the north-eastern end of Dixon Island are situated outside of the direct footprint, yet fall within a zone of greater than 65 dB(A) in which indirect impacts may occur (after Dooling et al, 2007) and, therefore, birds utilizing this site are likely to experience behavioural and/or physiological disturbance. The majority of known Grey-tailed Tattler roosts on the South-west Mudflats are located in areas predicted to experience less than 50 dB(A), which is unlikely to cause behavioural and/or physiological disturbance. Other roosts at the south-western end of Dixon Island and the Far West Mudflats fall beyond the mapped ≤40 dB(A) contour, and therefore will not experience a substantial increase from ambient noise levels.

Although roosts located on the north-eastern end of Dixon Island will experience noise disturbance, the remainder of roost sites will either experience minimal disturbance or no significant change in noise environment. It is assumed that Grey-tailed Tattlers roosting on areas of indirect effects (such as the north-eastern end of Dixon Island) will utilise alternate roosting sites. This trend is supported by the lack of roosting Grey-tailed Tattlers at that site during the January 2011 survey (in contrast to findings from preceding years). Given the availability of alternative roosting sites, noise generated during port operations will not significantly impact regional habitation by the Grey-tailed Tattler population.



Predicted Noise Levels from Port Operations and Grey-tailed Tattler Roosting Sites

Figure 20

0 0.5 1 1.5 2 2.5

Kilometres

1:75,000 (A4)

Datum: GDA94 Projection: MGA z50

LEGEND

- Port Footprint (Proposed)
- 2009, July
- 2010, October
- 2011, January

Frequency

- 1 - 10
- 11 - 50
- 51 - 150
- 151 - 300
- 301 - <

AECOM

5.3.2 Emissions of Light

Migratory waders are adapted to natural changes associated with the day and night cycle as well as the night-time phase of the moon. Artificial lighting has the potential to create a constant level of light at night that can reverse these natural levels and cycles, thus affecting behaviour (Poot *et al.*, 2008, Wiese *et al.*, 2001). Migratory waders may also use lighting from natural sources to orient themselves during migration in a certain direction at night. In instances where an artificial light source is brighter than a natural source, the artificial light may act to override natural cues leading to disorientation (Poot *et al.*, 2008).

Lighting that is visible by a bird from the air is known to disorient nocturnally migrating birds and may cause bird mortalities. Little is known about how migratory waders are attracted to light at night, however, it has been suggested that when a bird flies into a lit area, it loses its visual cue to the horizon resulting in spatial disorientation as the bird then uses the artificial light as an orientation cue for migration (Verheijen 1985 and Herbert 1970 quoted in Rich and Longcore 2006). There may also be detrimental effects particularly if birds are disorientated to the point they are trapped within the lit area or if they subsequently collide with buildings or tall structures (Wiese *et al.*, 2001, Ogden 2002).

Migratory waders use a combination of mechanisms for orientation during their migration such as visual cues, celestial and magnetic orientation. Studies on the navigation of migratory birds have found the magnetic compass to be wavelength dependent and that migratory birds require blue-green light (shorter wavelength) part of the spectrum for magnetic compass orientation (Poot *et al.*, 2008). The study also found that red light (visible long-wavelength) has the reverse effect, disrupting magnetic orientation. Artificial lighting (its intensity and wavelengths) from sources spilling onto adjacent roosting sites should be considered during detailed design for infrastructure operating adjacent to areas such as the south-west mudflats.

Artificial light emissions have the potential to affect migratory waders through two broad mechanisms: behavioural disturbance and disorientation.

Artificial light may influence calling and foraging behaviours and also habitat selection. A study of roosting sites at Roebuck Bay in WA's south Kimberley coast found that migratory waders typically avoid roosting where exposed to sources of artificial lighting, as the light cues a response in waders that they may be detected by predators (Rogers *et al.*, 2006). Furthermore, it is suggested that lights may cause either disorientation or attraction, causing injury or mortality if they fly into structures (Bamford, 2005). Rogers *et al.* (2006) concluded that "feeding areas are only of use to waders if they are associated with acceptable roosts". For Bouguer Passage habitat management, the spatial alignment of the South-west Mudflats roosting sites with the intertidal flats for foraging between Dixon Island and the mainland are not directly interrupted by the proposed location of the port development footprint (which is to the east and south-east). It is therefore important to minimise disturbance on the mosaic of both foraging and roosting habitats, especially to the western and north-western faces of the mainland development.

In addition to migratory wader habitat directly impacted through loss of roosting habitat (**Section 5.1.2**), further roosting sites in the Mudflat (survey areas) may be affected by light emissions from the proposed port development. If roosting sites are disturbed, it is likely that waders will move to other suitable roosting sties in the region. However, this may increase pressure on alternative roosting sites used by migratory waders indirectly displaced.

Artificial lighting at the proposed port has the potential to dissuade migratory waders roosting on the north-eastern tip of Dixon Island and near Anketell Point. However, relatively low numbers of birds appear to roost at these sites. In addition, Pilbara coastal region industry lighting emissions are not known to result in the attraction of migratory birds towards existing facilities. WEL (2006) stated that "during operations, flaring activities at night have the potential to attract seabirds and shorebirds, although potential impacts are considered minor" (Pluto LNG Development PER). Additionally, the risk of light impacts on avifauna from similar proposals have not been considered significant (see the Cape Lambert Port B Development PER (SKM, 2009) or the Utah Point Berth Project, Port Hedland (SKM, 2008)). An assessment of light impacts on Barrow Island for the Gorgon project identified seabird nesting colonies being at risk, however, despite the area being recognised as an internationally important site for migratory waders (DEWHA, 2008; Bamford, 2005), impacts were not identified for these species (Chevron, 2008).

Proposed Mitigation Measures

Mitigation measures to be considered to limit the potential impact on migratory waders may include:

- Direct light spill of long wavelength (red) and high light intensity to be reduced as much as reasonably safely practicable,
- Careful placement and direction of lighting: all luminaires mounted as low in elevation as possible,
- Use of shrouded or timed lighting,
- Lighting along roadway and parking areas to use shielded low pressure sodium lighting, and/or
- Assessment of the light-reduction design aspects adjacent to mapped roosting areas subject to safety in design and safe operational practice.

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Appendix A

Western Wildlife Survey Reports

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Anketell Point:

Preliminary bird survey

Ms J.A. Wilcox and Dr R.A. Davis

Vegetation in the study area.

Prepared for: Maunsell
629 Newcastle St
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Prepared by: Western Wildlife
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13th June 2008

Introduction

Western Wildlife was asked by Maunsell to assess the value of the Anketell Point area to birds. The aim of the study was to provide a list of birds that have the potential to occur in the area and discuss the importance of the area to birds of conservation significance.

Methods

Anketell Point was visited on the 25th and 26th March 2008. All bird species encountered were recorded and notes were made on the habitats present on the site. Shorebirds and other waterbirds were counted at Anketell Point (between 50K 508854 E, 7718172 N and 50K 509777 E, 7718975 N) and at the tidal mudflats south of Anketell Point (at 50K 509047 E, 7717007 N).

Personnel

Ms Jenny Wilcox (*BSc.Biol./Env.Sci., Hons.Biol.*) of Western Wildlife and Ms Susannah Ford of Maunsell carried out the site inspection, and Ms Jenny Wilcox prepared this report. The report was reviewed by Dr Robert Davis (*BSc.Biol./Env.Sci., Hons.Biol., PhD. Zool.*) of Western Wildlife.

Sources of Information

The birds expected to occur in the study area were identified using information from a number of sources. These included publications that provide information on general patterns of distribution of birds (Barrett *et al*. 2003; Johnstone and Storr 1998; Johnstone and Storr 2004). In addition, the databases listed below in Table 1 were searched for observational and specimen records.

The birds included in Table 2 have the potential to occur, or be affected by changes to the study area. The lists exclude species that have been recorded in the general region only as vagrants, or for which suitable habitat is absent.

Table 1. Databases used in the preparation of this report.

Database	Type of records held on database	Area searched
Birds Australia Atlas Database	Records of bird observations in Australia, 1998-current.	20°34'S to 30°45'S and 116°50'E to 117°30'E
DEC's Threatened and Priority Fauna Database	Information and records on Threatened and Priority species in Western Australia	20°34'S to 30°45'S and 116°50'E to 117°30'E
EPBC Protected Matters Search Tool	Records on matters protected under the EPBC Act, including threatened species.	20°34'S to 30°45'S and 116°50'E to 117°30'E

Taxonomy and nomenclature for fauna species used in this report generally follow the WA Museum (2001) with alternative bird taxonomy from Christidis and Boles (1994) given in parentheses.

Assessment of conservation significance

Three levels of conservation significance are recognised in this report:

Conservation Significance 1:
- Species listed under State or Commonwealth Acts.

Conservation Significance 2:
- Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by DEC.

Conservation Significance 3:
- Species not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by DEC, but considered of local significance because of their pattern of distribution.

At the highest level of conservation significance (Conservation Significance 1) are those species that are protected under State or Commonwealth legislation.

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'matters of National Environmental Significance' that include threatened species and ecological communities and migratory species, among others. IUCN categories are used to categorise threatened species as 'extinct', 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' and 'conservation dependent', with all categories except 'extinct' and 'conservation dependent' listed as matters of National Environmental Significance. A list of migratory species is also maintained, containing mostly bird and marine species. The migratory species listed are those recognised under China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA) or species listed under the Bonn Convention for which Australia is a range state. Species listed in JAMBA are also protected under Schedule 3 of the *Western Australian Wildlife Conservation Act* 1950.

The *Western Australian Wildlife Conservation Act* 1950 (WA Wildlife Conservation Act) is State legislation for fauna protection administered by the Department of Environment and Conservation (DEC). The WA Wildlife Conservation Act lists species under a set of Schedules, where threatened species are listed as Schedule 1. Schedule 1 species are further categorised by DEC into the IUCN categories 'extinct', 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' and 'conservation dependent' species. The schedules and categories are further described in Appendix 1.

At the second-highest level of conservation significance (Conservation Significance 2) are species that are listed under publications on threatened species, or are listed as Priority species by DEC.

Reports on the conservation status of most vertebrate fauna species have been produced by the Department of the Environment and Heritage (DEH) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. An Action Plan has been prepared for birds (Garnett and Crowley 2000), as well as other taxonomic groups. These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

In Western Australia, DEC has also produced a list of Priority Fauna made up of species that are not considered Threatened under the *WA Wildlife Conservation Act*, but for which DEC feels there is cause for concern. Levels of Priority are described in Appendix 1.

At the third-highest level of conservation significance (Conservation Significance 3) are species that are not recognised under Federal or State legislation, listed in publications by DEH or listed as Priority species by DEC. These are species considered to be of local significance in the study area because they are at the limit of their distribution in the area, they have a very restricted range or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative or published recognition and is based on interpretation of information on the species patterns of distribution. The WA Department of Environmental Protection (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity.

Site description

Anketell Point is situated on the Pilbara coast between Karratha and Point Sampson, at 50K 509777 E, 7718975 N. Dixon Island is situated to the north of Anketell Point, and is separated from the point by an area of tidal mudflats.

The waterbird habitats in the study area consisted of areas of tidal mudflats, low mangroves and rocky shoreline (Plates 1, 2, 3 and front cover). The land bird habitat consisted of scattered low *Acacia* over Spinifex and grasses on flats and low stony hills (Plate 4). Most of this habitat was recently burnt.

Plate 1. Rocky shore and mudflats near Anketell Point.

Plate 2. Tidal mudflats between study area and Dixon Island.

Plate 3. Tidal mudflat to the south of the study area.

Plate 4. Recently burnt low Acacia over Spinifex and grasses on sandy flat.

Results and Discussion

There are 170 birds that have the potential to occur in the Anketell Point area, and during the March 2008 survey, 63 species were observed (Table 2). Counts of shorebirds were made on Anketell Point and on the tidal mudflats to the south of Anketell Point (Table 3).

As the study area lacks *Eucalyptus* and *Corymbia*, trees, species that forage on them, such as the Weebill, Red-browed Pardalote and Striated Pardalote, may be absent. In addition, species that nest in tree hollows, such as parrots and cockatoos, may forage in the area but not be present as breeding species. Areas of *Acacia* shrubs over Spinifex are likely to support a range of small insectivores, and the White-winged Fairy-wren, Singing Bush-Lark, Zebra Finch and Painted Firetail were recorded in the area during the site visit (Table 2).

The list of waterbirds in Table 2 is relatively extensive, but sea-birds that are only likely to overfly the area have been excluded. The number and diversity of waterbirds in the study area is likely to vary between seasons and between years, depending on regional weather conditions. In general, the number of larger waterbirds, such as ducks, cormorants, egrets, ibis, spoonbills, and gallinules, are likely to be relatively low. A relatively diverse range of shorebirds (such as sandpipers and plovers) was present, but numbers of these species were also quite low (Table 3).

There are 39 birds of conservation significance 1, three birds of conservation significance 2 and seven birds of conservation significance 3 that have the potential to occur in the study area. The majority of the conservation significance 1 species are shorebirds (such as plovers and sandpipers) and terns. Most of these species are listed as migratory species under the EPBC Act as they are listed under JAMBA, CAMBA or the Bonn Convention. Species listed under JAMBA are also listed under Schedule 3 of the WA Wildlife Conservation Act.

Conservation Significance 1

- **Peregrine Falcon** *Falco peregrinus*

This species is listed under Schedule 4 of the WA Wildlife Conservation Act.

The following 38 species are listed under the EPBC Act.

- **Great Egret** *Ardea alba*
- **Cattle Egret** *Ardea ibis*
- **Eastern Reef Egret** *Ardea sacra*
- **Eastern Osprey** *Pandion cristatus*
- **White-bellied Sea-Eagle** *Haliaeetus leucogaster*
- **Black-tailed Godwit** *Limosa limosa*
- **Bar-tailed Godwit** *Limosa lapponica*
- **Whimbrel** *Numenius phaeopus*
- **Eastern Curlew** *Numenius madagascariensis*

This Eastern Curlew is also listed as Priority 4 by DEC.

- **Marsh Sandpiper** *Tringa stagnatilis*
- **Common Greenshank** *Tringa nebularia*
- **Wood Sandpiper** *Tringa glareola*
- **Terek Sandpiper** *Tringa cinerea*
- **Common Sandpiper** *Tringa hypoleucos*
- **Grey-tailed Tattler** *Tringa brevipes*
- **Ruddy Turnstone** *Arenaria interpres*
- **Asian Dowitcher** *Limnodromus semipalmatus*
- **Red Knot** *Calidris canutus*
- **Great Knot** *Calidris tenuirostris*
- **Sanderling** *Calidris alba*
- **Red-necked Stint** *Calidris ruficollis*
- **Sharp-tailed Sandpiper** *Calidris acuminata*
- **Curlew Sandpiper** *Calidris ferruginea*
- **Broad-billed Sandpiper** *Limicola falcinellus*
- **Grey Plover** *Pluvialis squatarola*
- **Lesser Sand Plover** *Charadrius mongolus*
- **Greater Sand Plover** *Charadrius leschenaultii*
- **Oriental Plover** *Charadrius veredus*
- **Oriental Pratincole** *Glareola maldivarum*
- **Silver Gull** *Larus novaehollandiae*
- **Caspian Tern** *Sterna caspia*
- **Lesser Crested Tern** *Sterna bengalensis*
- **Crested Tern** *Sterna bergii*
- **Common Tern** *Sterna hirundo*
- **Little Tern** *Sterna albifrons*
- **Bridled Tern** *Sterna anaethetus*
- **Fork-tailed Swift** *Apus pacificus*
- **Rainbow Bee-eater** *Merops ornatus*

The Peregrine Falcon is a wide-ranging bird of prey that nests on cliffs and occasionally in tall trees (Johnstone and Storr 1998). This species has been recorded Burrup Peninsular in 2006 on DEC's Threatened and Priority Fauna Database (Appendix 3). Although unlikely to breed in the Anketell Point area, this species may use the area as part of a wider foraging range. Development of Anketell Point is unlikely to significantly impact this species.

Egrets are large wading birds that may forage in tidal mudflats. Of the three species listed above, only the Eastern Reef Egret was recorded during the site visit. The Eastern Reef Egret is likely to be relatively common on Dixon Island and the adjacent mainland coast, and is generally common along much of the Western Australian coastline. The Cattle Egret is an irregular visitor to areas south of the Kimberley (Johnstone and Storr 1998), and is often observed in associated with cattle or other livestock. The Great Egret is relatively common in the area and is likely to forage on the tidal mudflats on occasion, though it tends to favour freshwater habitats. The Anketell Point area is unlikely to be significant for the Cattle Egret or Great Egret.

The Eastern Osprey and White-bellied Sea-Eagle are both large birds of prey that forage in breed in coastal environments, though the White-bellied Sea-Eagle may range further inland. The Eastern Osprey was recorded in the study area, and both species are likely to forage in near-shore environments, and may nest on Dixon Island.

There are 25 species of shorebirds (godwits, whimbrels, sandpipers, greenshanks, tattlers, turnstones, dowitchers, knots, stints, plovers and pratincoles) listed above. Shorebirds that generally prefer freshwater habitats, or are only vagrants in the area, have been excluded from the list. Of the 25 species listed, 13 species were recorded on tidal mudflats in the study area.

All the shorebirds except the Oriental Plover would be inhabit areas of tidal mudflats, including areas under mangroves. The Oriental Plover may occur in small or large flocks in areas of open ground, including in recently burnt areas (Geering *et al*. 2007).

The Oriental Pratincole was the most numerous bird recorded on the tidal mudflats south of Anketell Point (Table 3). This species is a common non-breeding visitor to the Kimberley and Pilbara coast between October and May (Johnstone and Storr 1998). This species can sometimes occur in very large flocks of thousands or tens of thousands of birds that congregate in open areas (Johnstone and Storr 1998).

Development of Anketell Point may negatively impact shorebirds in the area, through some loss of habitat, changing the hydrology of tidal areas and increased human disturbance. However, the area is not known to be a site of international importance for shorebirds. Sites of international importance are those known to regularly support 1% or more of the flyway population of a species, or are known to regularly support over 20,000 shorebirds (Department of Environment and Heritage 2006). The 1% criteria for the shorebirds observed during the site visit are given in Table 3. Areas in the region known to be internationally important for some shorebird species include the Dampier Saltworks and Barrow Island to the east, and the Port Hedland Saltworks and Eighty Mile Beach to the north-west (Geering *et al*. 2007). Other than being an important destination for shorebirds, a site may also be important as a staging area that birds use while migrating. A staging area may still be important even if it supports less than 1% of the flyway population of a species.

There are seven gulls and terns listed above, of which three were recorded during the site visit. The Silver Gull, Caspian Tern and Crested Tern are common in the more southern parts of their range, but less common on the Pilbara coast. The Common Tern is a relatively uncommon winter visitor to the north-west coast, and the Bridled Tern is a summer visitor that may breed on islands in the area. Gulls and terns generally forage at sea and in near coastal areas, and may roost on beaches and tidal areas on Anketell Point. The area could be important for terns if they were breeding on Dixon Island.

The Fork-tailed Swift is a largely aerial species. Its ecology in Western Australia is not well known. This species is unlikely to be affected by changes in the Anketell Point area.

The Rainbow Bee-eater migrates southwards in summer to breed. It breeds in burrows dug into sandy banks or slopes. The Rainbow Bee-eater was recorded during the site visit (Table 2) and is likely to be present as a breeding seasonal visitor. As this species is common and widespread, development of Anketell Point is unlikely to affect the conservation status of this species.

Conservation Significance 2

- **Grey Falcon** *Falco hypoleucos*

This falcon is listed as Priority 4 by DEC.

- **Australian Bustard** *Ardeotis australis*

This bustard is listed as Priority 4 by DEC.

- **Bush Stone-Curlew** *Burhinus grallarius*

This Stone-Curlew is listed as Priority 4 by DEC.

The Grey Falcon is a very uncommon bird that inhabits lightly wooded areas in the northern part of Western Australia (Johnstone and Storr 1998). This species nests in eucalypts along rivers. Although it may occasionally be present in the Anketell Point area, it is not likely to be a breeding resident. Development of Anketell Point is unlikely to significantly impact this species.

The Australian Bustard inhabits grasslands and savannah grasslands, moving nomadically in response to the presence of food (Johnstone and Storr 1998). This species was recorded at Mount Anketell in 2007 (DEC's Threatened and Priority Fauna Database, Appendix 3) and near the study area during the site visit. This species is slow to take flight, so is vulnerable to being killed by vehicles on roads. Development of Anketell Point may also result in some habitat loss for this species.

The Bush Stone-Curlew inhabits lightly wooded plains, sheltering during the day in thickets of grass or under shrubs (Johnstone and Storr 1998). This species roosts and nests on the ground and is vulnerable to feral predators. This species was recorded on the Burrup Peninsular in 2006 (DEC's Threatened and Priority Fauna Database, Appendix 3) The Bush Stone-Curlew may occur in the Anketell Point area, and development of the area may result in some habitat loss for this species.

Conservation Significance 3	
• **Beach Stone-Curlew**	*Esacus neglectus*
• **Dusky Gerygone**	*Gerygone tenebrosa*
• **Mangrove Robin**	*Eopsaltria pulverulenta*
• **Mangrove Golden Whistler**	*Pachycephala melanura*
• **White-breasted Whistler**	*Pachycephala lanioides*
• **Mangrove Grey Fantail**	*Rhipidura phasiana*
• **Yellow White-eye**	*Zosterops lutea*

There are seven species of conservation significance 3 listed above. Except for the Beach Stone-Curlew, these are species that generally rely on mangrove habitats. Of these species, the White-breasted Whistler, Mangrove Grey Fantail and Yellow White-eye were recorded during the site visit (Table 2). Removal or fragmentation of mangrove habitats in or around the study area may isolate populations of these species.

The Beach Stone-Curlew is a large shorebird that is uncommon on the Pilbara coast (Johnstone and Storr 1998). This species was recorded during the site visit, and is likely to be sensitive to increased human activity in the area.

Summary and Conclusions

There are 170 species of bird with the potential to occur in the Anketell Point area, with 63 species recorded in the area during the site visit.

There are 39 species of conservation significance 1 that have the potential to occur in the area. Of these, the following 20 species were recorded in the area: Eastern Reef Egret, Eastern Osprey, Bar-tailed Godwit, Whimbrel, Eurasian Curlew, Common Greenshank, Wood Sandpiper, Terek Sandpiper, Common Sandpiper, Grey-tailed Tattler, Ruddy Turnstone, Great Knot, Sanderling, Red-necked Stint, Greater Sand Plover, Oriental Pratincole, Silver Gull, Caspian Tern, Crested Tern and Rainbow Bee-eater. Many of the conservation significance 1 species are migratory shorebirds, and small numbers of shorebirds were counted in the area.

There are three species of conservation significance 2 that have the potential to occur in the area. Of these, the Australian Bustard was recorded near the study area during the site visit.

There are seven birds of conservation significance 3 that have the potential to occur in the study area. Most of these are species that rely on mangrove habitats, and four were recorded during the site visit: the White-breasted Whistler, Mangrove Grey Fantail, Yellow White-eye and Beach Stone-Curlew.

The main impact of the development to land bird species in the Anketell Point area is the loss of some habitat. This is unlikely to significantly impact land birds of conservation significance in the area.

The main impacts of the development to waterbirds (including shorebirds) in the Anketell Point area are some habitat loss, potential fragmentation of mangrove habitats, changing the hydrology of tidal areas and increased human disturbance. The affect of these impacts will depend on the extent of the changes to the tidal habitats, but could significantly impact local populations of some species.

Further studies

In order to more accurately determine the importance of the Anketell Point area to migratory shorebirds, further bird surveys are recommended. Shorebird numbers at a particular site fluctuate throughout the year. If the area is an important destination for migratory birds, numbers will be high in summer. Sites that are important staging areas will support relatively high numbers of birds in spring, as birds move southwards, and in autumn, as birds return northwards. In addition, a site may be important for sedentary and over-wintering shorebirds.

Surveys of birds should be carried out at least quarterly, with their migration patterns taken into account. As shorebirds can be difficult to identify, surveys should be undertaken by an ornithologist who is experienced in shorebird identification.

Table 2. Birds that have the potential to occur in the study area.
+ = species recorded on the site during the 2008 site visit.
BA = species recorded in the area by Birds Australia (see Table 1).
DEC = species listed on DEC's Threatened and Priority Fauna Database (see Appendix 3).
Int = introduced species.

Species		Status	Records
Casuariidae (emu)			
Emu	*Dromaius novaehollandiae*		
Phasianidae (quails)			
Brown Quail	*Coturnix ypsilophora*		+ BA
Anatidae (ducks and swans)			
Plumed Whistling-Duck	*Dendrocygna eytoni*		
Grey Teal	*Anas gracilis*		BA
Pacific Black Duck	*Anas superciliosa*		BA
Anhingidae (darter)			
Darter	*Anhinga melanogaster*		BA
Phalacrocoracidae (cormorants)			
Great Cormorant	*Phalacrocorax carbo*		
Pied Cormorant	*Phalacrocorax varius*		BA
Little Black Cormorant	*Phalacrocorax sulcirostris*		BA
Little Pied Cormorant	*Phalacrocorax melanoleucos*		BA
Pelecanidae (pelican)			
Australian Pelican	*Pelecanus conspicillatus*		BA
Ardeidae (herons, egrets and bitterns)			
White-necked Heron	*Ardea pacifica*		
White-faced Heron	*Ardea (Egretta) novaehollandiae*		BA
Great Egret	*Ardea alba*	CS1	
Cattle Egret	*Ardea ibis*	CS1	
Little Egret	*Ardea (Egretta) garzetta*		+ BA
Eastern Reef Egret	*Ardea sacra*	CS1	+ BA
Striated Heron	*Butorides striatus*		BA
Nankeen Night-Heron	*Nycticorax caledonicus*		
Black Bittern	*Ixobrychus flavicollis*		BA
Threskionithidae (ibis and spoonbills)			
Australian White Ibis	*Threskiornis molucca*		+ BA
Yellow-billed Spoonbill	*Platalea flavipes*		
Accipitridae (osprey, hawks, eagles and harriers)			
Eastern Osprey	*Pandion cristatus*	CS1	+ BA
Black-shouldered Kite	*Elanus caeruleus (axillaris)*		BA
Square-tailed Kite	*Hamirostra (Lophoictinia) isura*		
Black-breasted Buzzard	*Hamirostra melanosternon*		
Black Kite	*Milvus migrans*		
Whistling Kite	*Haliastur sphenurus*		BA
Brahminy Kite	*Haliastur indus*		+ BA
Brown Goshawk	*Accipiter fasciatus*		+
Collared Sparrowhawk	*Accipiter cirrocephalus*		
Little Eagle	*Aquila (Hieraaetus) morphnoides*		BA
Wedge-tailed Eagle	*Aquila audax*		BA
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	CS1	BA
Spotted Harrier	*Circus assimilis*		+ BA
Swamp Harrier	*Circus approximans*		

Table 2. (cont.)

Species		Status	Records		
Falconidae (falcons)					
Brown Falcon	*Falco berigora*		+		
Nankeen Kestrel	*Falco cenchroides*		+	BA	
Australian Hobby	*Falco longipennis*			BA	
Grey Falcon	*Falco hypoleucos*	CS2			
Peregrine Falcon	*Falco peregrinus*	CS1		BA	DEC
Black Falcon	*Falco subniger*				
Otididae (bustard)					
Australian Bustard	*Ardeotis australis*	CS2	+		DEC
Turnicidae (button-quails)					
Little Button-Quail	*Turnix velox*		+		
Scolopacidae (snipe, godwit, curlews, sandpipers & stints)					
Black-tailed Godwit	*Limosa limosa*	CS1			
Bar-tailed Godwit	*Limosa lapponica*	CS1	+	BA	
Whimbrel	*Numenius phaeopus*	CS1	+	BA	
Eastern Curlew	*Numenius madagascariensis*	CS1	+	BA	DEC
Marsh Sandpiper	*Tringa stagnatilis*	CS1		BA	
Common Greenshank	*Tringa nebularia*	CS1	+	BA	
Wood Sandpiper	*Tringa glareola*	CS1	+	BA	
Terek Sandpiper	*Tringa cinerea (Xenus cinereus)*	CS1	+	BA	
Common Sandpiper	*Tringa (Actitis) hypoleucos*	CS1	+	BA	
Grey-tailed Tattler	*Tringa brevipes*	CS1	+	BA	
Ruddy Turnstone	*Arenaria interpres*	CS1	+	BA	
Asian Dowitcher	*Limnodromus semipalmatus*	CS1			
Red Knot	*Calidris canutus*	CS1		BA	
Great Knot	*Calidris tenuirostris*	CS1	+	BA	
Sanderling	*Calidris alba*	CS1	+	BA	
Red-necked Stint	*Calidris ruficollis*	CS1	+	BA	
Sharp-tailed Sandpiper	*Calidris acuminata*	CS1		BA	
Curlew Sandpiper	*Calidris ferruginea*	CS1		BA	
Broad-billed Sandpiper	*Limicola falcinellus*	CS1			
Burhinidae (stone-curlews)					
Bush Stone-Curlew	*Burhinus grallarius*	CS2			DEC
Beach Stone-Curlew	*Esacus neglectus*	CS3	+	BA	
Haematopodidae (oystercatchers)					
Pied Oystercatcher	*Haematopus longirostris*		+	BA	
Sooty Oystercatcher	*Haematopus fuliginosus*			BA	
Recurvirostridae (stilts and avocets)					
Black-winged Stilt	*Himantopus himantopus*			BA	
Banded Stilt	*Cladorhynchus leucocephalus*				
Red-necked Avocet	*Recurvirostra novaehollandiae*			BA	
Charadriidae (plovers, dotterels and lapwings)					
Grey Plover	*Pluvialis squatarola*	CS1			
Pacific Golden Plover	*Pluvialis fulva*		+	BA	
Red-capped Plover	*Charadrius ruficapillus*		+	BA	
Lesser Sand Plover	*Charadrius mongolus*	CS1		BA	
Greater Sand Plover	*Charadrius leschenaultii*	CS1	+	BA	
Black-fronted Dotterel	*Charadrius (Elseyornis) melanops*		+	BA	
Oriental Plover	*Charadrius veredus*	CS1			
Red-kneed Dotterel	*Erythrogonys cinctus*			BA	
Glareolidae (pratincoles)					
Australian Pratincole	*Stiltia isabella*				
Oriental Pratincole	*Glareola maldivarum*	CS1	+		

Table 2. (cont.)

Species		Status	Records	
Laridae (gulls, terns, skuas, jaegers and noddies)				
Silver Gull	*Larus novaehollandiae*	CS1	+	BA
Gull-billed Tern	*Sterna nilotica*		+	BA
Caspian Tern	*Sterna caspia*	CS1	+	BA
Lesser Crested Tern	*Sterna bengalensis*	CS1		BA
Crested Tern	*Sterna bergii*	CS1	+	BA
Roseate Tern	*Sterna dougallii*			
Common Tern	*Sterna hirundo*	CS1		BA
Little Tern	*Sterna albifrons*	CS1		
Fairy Tern	*Sterna nereis*			BA
Bridled Tern	*Sterna anaethetus*	CS1		
Whiskered Tern	*Sterna (Chlidonias) hybrida*		+	BA
Columbidae (pigeons and doves)				
Common Bronzewing	*Phaps chalcoptera*			
Crested Pigeon	*Ocyphaps lophotes*		+	BA
Spinifex Pigeon	*Geophaps plumifera*		+	BA
Diamond Dove	*Geopelia cuneata*			BA
Peaceful Dove	*Geopelia striata*		+	BA
Bar-shouldered Dove	*Geopelia humeralis*		+	BA
Cacatuidae (cockatoos and corellas)				
Galah	*Cacatua roseicapilla*		+	BA
Little Corella	*Cacatua sanguinea*			BA
Cockatiel	*Nymphicus hollandicus*			BA
Psittacidae (parrots, lorikeets and rosellas)				
Australian Ringneck	*Barnardius zonarius*			
Budgerigar	*Melopsittacus undulatus*		+	BA
Cuculidae (cuckoos)				
Pallid Cuckoo	*Cuculus pallidus*			BA
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*			BA
Centropodidae (pheasant coucals)				
Pheasant Coucal	*Centropus phasianinus*			
Strigidae (hawk owls)				
Barking Owl	*Ninox connivens*			
Southern Boobook	*Ninox novaeseelandiae*			
Tytonidae (barn owls)				
Barn Owl	*Tyto alba*			
Podargidae (frogmouths)				
Tawny Frogmouth	*Podargus strigoides*			
Caprimulgidae (nightjars)				
Spotted Nightjar	*Eurostopodus argus*			
Aegothelidae (owlet-nightjars)				
Australian Owlet-Nightjar	*Aegotheles cristatus*			
Apodidae (swifts)				
Fork-tailed Swift	*Apus pacificus*	CS1		
Alcedinidae (forest kingfishers)				
Azure Kingfisher	*Alcedo azurea*			
Halcyonidae (kingfishers)				
Blue-winged Kookaburra	*Dacelo leachii*			
Red-backed Kingfisher	*Todiramphus pyrrhopygia*			BA
Sacred Kingfisher	*Todiramphus sanctus*		+	BA
Collared Kingfisher	*Todiramphus chloris*			BA
Meropidae (bee-eaters)				
Rainbow Bee-eater	*Merops ornatus*	CS1	+	BA

Table 2. (cont.)

Species		Status	Records	
Maluridae (fairy-wrens, grasswrens and emu-wrens)				
Variegated Fairy-wren	*Malurus lamberti*			BA
White-winged Fairy-wren	*Malurus leucopterus*		+	BA
Rufous-crowned Emu-wren	*Stipiturus ruficeps*			
Striated Grasswren	*Amytornis striatus*			
Pardalotidae (pardalotes, thornbills, gerygones and allies)				
Red-browed Pardalote	*Pardalotus rubricatus*			
Striated Pardalote	*Pardalotus striatus*			
Weebill	*Smicrornis brevirostris*			
Dusky Gerygone	*Gerygone tenebrosa*	CS3		BA
Meliphagidae (honeyeaters and chats)				
Brown Honeyeater	*Lichmera indistincta*		+	BA
Singing Honeyeater	*Lichenostomus virescens*		+	BA
Grey-headed Honeyeater	*Lichenostomus keartlandi*			BA
White-plumed Honeyeater	*Lichenostomus penicillatus*			BA
Black-chinned Honeyeater	*Melithreptus gularis*			
Yellow-throated Miner	*Manorina flavigula*			BA
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*			
Orange Chat	*Epthianura aurifrons*			
Crimson Chat	*Epthianura tricolor*			
Petroicidae (robins)				
Mangrove Robin	*Eopsaltria pulverulenta*	CS3		BA
Pomatostomidae (babblers)				
Grey-crowned Babbler	*Pomatostomus temporalis*			
Pachycephalidae (shrike-tits, whistlers and allies)				
Crested Bellbird	*Oreoica gutturalis*			
Mangrove Golden Whistler	*Pachycephala melanura*	CS3		BA
Rufous Whistler	*Pachycephala rufiventris*			
White-breasted Whistler	*Pachycephala lanioides*	CS3	+	BA
Grey Shrike-thrush	*Colluricincla harmonica*			
Dicruridae (flycatchers, magpie-larks and fantails)				
Mangrove Grey Fantail	*Rhipidura phasiana*	CS3	+	BA
Grey Fantail	*Rhipidura fuliginosa*			BA
Willie Wagtail	*Rhipidura leucophrys*		+	BA
Magpie-Lark	*Grallina cyanoleuca*			BA
Campephagidae (cuckoo-shrikes and trillers)				
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*		+	BA
White-winged Triller	*Lalage tricolour (sueurii)*			BA
Artamidae (woodswallows, butcherbirds, magpies)				
White-breasted Woodswallow	*Artamus leucorynchus*		+	BA
Masked Woodswallow	*Artamus personatus*			
Black-faced Woodswallow	*Artamus cinereus*		+	BA
Little Woodswallow	*Artamus minor*			
Grey Butcherbird	*Cracticus torquatus*			BA
Pied Butcherbird	*Cracticus nigrogularis*		+	BA
Australian Magpie	*Cracticus (Gymnorhina) tibicen*			BA
Corvidae (ravens and crows)				
Torresian Crow	*Corvus orru*		+	BA
Little Crow	*Corvus bennetti*			BA
Ptilonorhynchidae (bowerbirds)				
Western Bowerbird	*Ptilonorhynchus maculatus*			
Alaudidae (larks)				
Singing Bushlark	*Mirafra javanica*		+	BA

Table 2. (cont.)

Species	Status	Records
Motacillidae (pipits and wagtails)		
Richard's Pipit *Anthus australis (novaeseelandiae)*		+ BA
Passeridae (grassfinches, sparrows and allies)		
Zebra Finch *Taeniopygia guttata*		+ BA
Painted Finch *Emblema pictum*		+ BA
Dicaeidae (flowerpeckers)		
Mistletoebird *Dicaeum hirundinaceum*		
Hirundinidae (swallows and martins)		
Welcome Swallow *Hirundo neoxena*		BA
Tree Martin *Hirundo nigricans*		+ BA
Fairy Martin *Hirundo ariel*		+ BA
Sylviidae (old world warblers)		
Spinifexbird *Eremiornis carteri*		
Rufous Songlark *Cincloramphus mathewsi*		+
Brown Songlark *Cincloramphus cruralis*		
Zosteropidae (white-eyes)		
Yellow White-eye *Zosterops luteus*	CS3	+ BA
Number of bird species expected (recorded on survey):		**170 (63)**

Table 3. Numbers of shorebirds and other waterbirds counted in the Anketell Point area.
M = EPBC Act listed migratory species.

Species	Migratory	1% of estimated flyway population*	Anketell Point	Anketell Point	Tidal Flats
			High tide 25/3/08	Low tide 26/3/08	Low tide 26/3/08
Ardeidae					
Little Egret				3	7
Eastern Reef Egret	M		2		
Threskionithidae					
Australian White Ibis				2	
Accipitridae					
Eastern Osprey	M			1	
Brahminy Kite				1	
Scolopacidae					
Bar-tailed Godwit	M	3,250		9	196
Whimbrel	M	1,000	1	3	
Eastern Curlew	M	380			1
Common Greenshank	M	600		2	3
Wood Sandpiper	M	1,000 – 10,000			3
Terek Sandpiper	M	600		1	2
Common Sandpiper	M	250 – 1,000	1		
Grey-tailed Tattler	M	500	12	10	31
Ruddy Turnstone	M	350	14		17
Great Knot	M	3,750			2
Sanderling	M	220			15
Red-necked Stint	M	3,250			2
Burhinidae					
Beach Stone-Curlew			1		
Haematopodidae					
Pied Oystercatcher				2	
Charadriidae					
Pacific Golden Plover	M	1,000 – 10,000	2		7
Red-capped Plover			1	5	27
Greater Sand Plover	M	1,100		2	17
Glareolidae					
Oriental Pratincole	M	28,800			71
Laridae					
Silver Gull				7	
Gull-billed Tern					1
Caspian Tern	M			1	4
Crested Tern	M		4	3	
Whiskered Tern			10		9

* (from Geering *et al*. 2007)

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Appendix 1. Categories used in the assessment of conservation status.

Environmental Protection and Biodiversity Conservation (EPBC) Act and the WA Wildlife Conservation Act

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the wild	Taxa known to survive only in captivity.
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable	Taxa facing a very high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not Threatened.

WA Department of Environment and Conservation Priority species (species not listed under the Conservation Act, but for which there is some concern).

Priority 1.	**Taxa with few, poorly known populations on threatened lands.** Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2.	**Taxa with few, poorly known populations on conservation lands.** Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3.	**Taxa with several, poorly known populations, some on conservation lands.** Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4.	**Taxa in need of monitoring.** Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5.	**Taxa in need of monitoring.** Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix 2. Species listed for the area 20°34'S to 20°45'S and 116°50'E to 117°30'E on the EPBC Protected Matters Search Tool.

Species	Status	Author's Comment
Southern Giant-Petrel *Macronectes giganteus*	Endangered & Migratory (marine)	This species may overfly the ocean in the study area.
Barn Swallow *Hirundo rustica*	Migratory (terrestrial)	This species may occur in the study area.
White-bellied Sea-Eagle *Haliaeetus leucogaster*	Migratory (terrestrial)	This species is likely to occur in the study area.
Rainbow Bee-eater *Merops ornatus*	Migratory (terrestrial) & Marine species	This species was recorded in the study area.
Great Egret *Ardea alba*	Migratory (wetland & marine)	This species is likely to occur in the study area.
Cattle Egret *Ardea ibis*	Migratory (wetland & marine)	This species is likely to occur in the study area.
Oriental Plover *Charadrius veredus*	Migratory (wetland)	This species may occur in the study area.
Oriental Pratincole *Glareola maldivarum*	Migratory (wetland)	This species was recorded in the study area.
Little Curlew *Numenius minutus*	Migratory (wetland)	This species is not likely to occur in the study area.
Fork-tailed Swift *Apus pacificus*	Migratory (marine) & Marine species	This species may overfly the study area.
Wedge-tailed Shearwater *Puffinus pacificus*	Migratory (marine)	This species may overfly the ocean in the study area.
Caspian Tern *Sterna caspia*	Migratory (marine)	This species was recorded in the study area.
Silver Gull *Larus novaehollandiae*	Marine species	This species was recorded in the study area.
Eastern Osprey *Pandion cristatus*	Marine species	This species was recorded in the study area.
Crested Tern *Sterna bergii*	Marine species	This species was recorded in the study area.

Appendix 3. Species listed for the area 20°34'S to 20°45'S and 116°50'E to 117°30'E on the DEC Threatened and Priority Fauna Database.

Species	Status	Author's Comments
Peregrine Falcon *Falco peregrinus*	Schedule 4	DEC record of 1 bird in 2006 at the Burrup. This species may occur in the study area.
Australian Bustard *Ardeotis australis*	Priority 4	DEC record of 2 birds in 2007 at Mount Anketell. This species may occur in the study area.
Bush Stone-Curlew *Burhinus grallarius*	Priority 4	DEC record of 1 bird in 2006 at the Burrup. This species may occur in the study area.
Eastern Curlew *Numenius madagascariensis*	Priority 4	DEC record of 1 bird in 1968 and 2 birds in 2002 at Nickol Bay. This species was recorded in the study area.
Flock Bronzewing *Phaps histrionica*	Priority 4	DEC record of 300 birds at Nickol River in 1968. This species is not likely to occur in the study area.

Anketell Point:

Spring shorebird survey

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12th January 2009

Introduction

Migratory waders are declining significantly in the East Asia-Pacific flyway, primarily due to the destruction of critical migration stop-over site along the eastern seaboard of Asia. However, the complexity of their migrations means that habitat must be preserved during both northward and southward migration, as well as during the breeding and non-breeding seasons, if populations are to be conserved. The loss of critical habitat in any of those four periods would be likely to impact on migratory waders. To assess any potential impact of development at Point Anketell on migratory waders during southward migration, a survey was conducted to assess the importance of the area for both roosting at high tide and for foraging at low tide. Other littoral zone birds and mangrove species are easily counted during surveys for migratory waders and these species were also recorded to determine potential impacts on Australian breeding waders, herons and terns.

Methods

The aim of the survey was to identify sites that were potentially important to migratory waders and other littoral birds during the southward migration period, which extends from September to October. To achieve this, a two-day survey was conducted on 17th and 18th October 2008 to survey birds at low tide and high tide. High tide surveys were conducted from 1000 to 1330 on 17th October to determine the location and size of roosting flocks on Anketell Point and the surrounding region. To do this, the study area was divided up into eight regions (Figure 1) and, within each of those regions, all littoral birds seen were recorded as either in a roost (>10 birds) or outside a roost. If a roost were observed then a GPS location of the roost site was recorded as well as the number of individuals of all species within that roost. Low tide counts were conducted on 17th October from 1330 to 1800 on mudflats in the south-west and south-east parts of the study area and on 18th October from 0600 to 1000 in the areas immediately surrounding Anketell Point. All birds recorded were assigned to one of the five areas demarcated for low tide counts (Figure 2). No systematic surveys were made for mangrove birds but they were recorded opportunistically during all high and low tide counts.

Personnel

The survey was conducted by Dr Mike Craig, as a sub-contracter to Western Wildlife, and Ms Susannah Ford from Maunsell. Mike has over 25 years experience in identifying and counting waders and waterbirds and has previously conducted wader survey for many proposed development, most notably proposal on Barrow Island and the east side of the Exmouth Gulf.

Results

Community Assemblage

We recorded a total of 36 species of mangrove and littoral birds of which 6 were mangrove specialists and 30 were littoral species. Of these littoral species, 20 are listed under at least one of JAMBA, CAMBA or ROKAMBA (typically all three). The most speciose families, all littoral birds, were Scolopacidae (12 species), Charadriidae (6 species) and Sternidae (4 species). The most abundant species during high tide counts were three scolopacids (Bar-tailed Godwit, Grey-tailed Tattler and Whimbrel), one charadriid (Red-capped Plover) and one larid (Silver Gull). The most abundant species during low tide counts were four scolopacids (Bar-tailed Godwit, Common Greenshank, Grey-tailed Tattler and Red-necked Stint) and one charadriid (Red-capped Plover).

Annotated List

Pied Cormorant (*Phalacrocorax varius*)
Uncommon. The only record is one individual roosting at high tide in the North region.

Little Black Cormorant (*Phalacrocorax sulcirostris*)
Uncommon. The only record is three individuals roosting at high tide in the North-west region.

Eastern Reef Egret (*Egretta sacra*)
Uncommon. The only record is one dark phase individual roosting at high tide on Anketell Point.

Little Egret (*Egretta garzetta*)
Uncommon. The only record is one individual foraging at low tide on the South-east mudflats.

Striated Heron (*Butorides striatus*)
Uncommon. The only records are one bird roosting at high tide in mangroves in the South-west region and one individual foraging on mudflats in Anketell Point West.

Brahminy Kite (*Haliastur indus*)
Frequent. One individual was recorded on rocks at high tide in the East region. Two birds were foraging at low tide over the South-west mudflats as was one bird over Anketell Point West.

Bar-tailed Godwit (*Limosa lapponica*)
Very common. More widespread at low tide when a total of 162 birds were recorded from the South-west and South-east mudflats and from Anketell Point West and East. More restricted at high tide where 177 birds were recorded roosting in the South-east region.

Whimbrel (*Numerius phaeopus*)
Common. A total of 19 birds recorded roosting at high tide in the South-east, East and South-west regions and a total of 8 birds foraging at low tide on South-west and South-east mudflats and Anketell Point West.

Eastern Curlew (*Numenius madagascarensis*)
Uncommon. A total of 8 birds were recorded foraging on the South-west and South-east mudflats but only a single bird was recorded roosting at high tide in the South-west region.

Common Greenshank (*Tringa nebularia*)
Common. Nine birds were recorded roosting at high tide in the South-east and North sections. More common at low tide when 8 birds were recorded foraging on Anketell Point West and the South-west and South-east mudflats.

Terek Sandpiper (*Xenus cinereus*)
Frequent. Nine birds were recorded foraging at low tide in the South-west mudflats.

Common Sandpiper (*Actitis hypoleucos*)
Frequent but widespread. Nine birds were recorded roosting at high tide in the South-east, East, Anketell Point, North and West regions. Four birds were recorded foraging at low tide on the South-east mudflats and Anketell Point West.

Grey-tailed Tattler (*Heteroscelus brevipes*)
Very common and widespread. A total of 71 birds were roosting at high tide in the South-east, East, Anketell Point, West and South-west and 278 birds were recorded foraging in all five areas surveyed at low tide.

Ruddy Turnstone (*Arenaria interpres*)
Common. Widespread at low tide when 27 birds were recorded on the South-west mudflats and Anketell Point West, East and Far-east. More restricted at high tide where the only record is two birds roosting on Anketell Point.

Great Knot (*Calidris tenuirostris*)
Frequent. A total 29 birds recorded foraging at low tide on South-west mudflats and Anketell Point West but only 8 birds recorded roosting at high tide in the South-east region.

Sanderling (*Calidris alba*)
Frequent. The only record is 25 birds on the South-west mudflats at low tide.

Red-necked Stint (*Calidris ruficollis*)
Very common but only recorded at low tide. A total of 486 birds were recorded foraging at low tide on the South-west mudflats and Anketell Point East and Far-east.

Curlew Sandpiper (*Calidris ferruginea*)
Uncommon. The only record is two birds foraging at low tide on the South-west mudflats.

Pied Oystercatcher (*Haematopus longirostris*)
Uncommon. One bird was recorded roosting at high in each of the North-east and North regions while three birds were recorded foraging at low tide on the South-west mudflats and Anketell Point West.

Grey Plover (*Pluvialis squatarola*)
Frequent. Four birds were recorded roosting at high tide in the South-east and North-east regions and eights were recorded foraging at low tide on the South-west mudflats and Anketell Point West and East.

Pacific Golden Plover (*Pluvialis fulva*)
Uncommon. Three birds were roosting at high tide in the North-east region and one bird was foraging at low tide on the South-west mudflats.

Red-capped Plover (*Charadrius ruficapillus*)
Very common. A total of 15 birds were recorded at high tide in the South-east, North-east, Anketell Point, North and North-west regions. A total of 113 birds were recorded foraging at low tide on the South-west mudflats and Anketell Point West, East and Far-east.

Lesser Sand Plover (*Charadrius mongolus*)
Uncommon. Five birds were foraging at low tide on the South-west mudflats.

Greater Sand Plover (*Charadrius leschanaultii*)
Common and widespread. Seven birds were roosting at high tide on Anketell Point and 67 birds were recorded foraging at low tide in all five areas surveyed at low tide.

Oriental Plover (*Charadrius veredus*)
Uncommon. The only record is a flock of 14 birds foraging at low tide on the South-east mudflats.

Silver Gull (*Larus novaehollandiae*)
Common and widespread. A total of 56 birds were recorded roosting at high tide in the Anketell Point, North and North-west regions. A total of 27 birds were foraging at low tide on the South-west mudflats and Anketell Point West, East and Far-east.

Gull-billed Tern (*Geliochelidon nilotica*)
Uncommon. Six birds were seen foraging at low tide over the South-west and South-east mudflats and Anketell Point West.

Caspian Tern (*Hydroprogne caspia*)
Frequent. Eleven birds were seen foraging at low tide over the South-west mudflats and Anketell Point West and East.

Little Tern (*Sternula albifrons*)
Uncommon. Six birds were seen foraging at low tide over the South-west mudflats and Anketell Point West.

Whiskered Tern (*Chlidonias hybridus*)
Uncommon. The only record is one bird at low tide on the South-west mudflats.

Collared Kingfisher (*Todiramphus chloris*)
Uncommon. A single bird was recorded in mangroves in the south-west part of the study area.

Dusky Gerygone (*Gerygone tenebrosa*)
Common. Two birds were seen in mangroves in the south-east part of the study area and six birds in mangroves in the south-west part of the study area.

Mangrove Robin (*Peneoenanthe pulverulenta)*
Uncommon. Two birds were recorded in mangroves in the south-west part of the study area.

White-breasted Whistler (*Pachycephala lanioides*)
Common. Two birds were seen in mangroves in the south-east part of the study area and five birds in mangroves in the south-west part of the study area.

Mangrove Grey Fantail (*Rhipidura phasiana*)
Common. Three birds were seen in mangroves in the south-east part of the study area and four birds in mangroves in the south-west part of the study area.

Yellow White-eye (*Zosterops luteus*)
Very common. Five birds were seen in mangroves in the south-east part of the study area and eight birds in mangroves in the south-west part of the study area.

Regional summaries

High tide roosting surveys
Most roosting birds were recorded in the South-east region, primarily in one large roost, with smaller numbers in other regions. The North-west region had the next highest number of roosting birds (primarily one roost of Silver Gulls) with smaller numbers in the East and Anketell Point regions. The area around Anketell Point (North-east and North regions) and in the south-west part of the study area (West and South-west regions) had low numbers of roosting birds.

Low tide foraging surveys
By far the greatest number of birds recorded at low tide with on the South-west mudflats, although within that area there were no particular concentrations of birds. Far lower numbers were recorded on the South-east mudflats. Around Anketell Point, the majority of birds were recorded in Anketell Point West, with lower numbers in Anketell Point East and relatively few in Anketell Point Far-east.

Mangrove surveys
All six mangrove specialists recorded were seen in mangroves in the south-west part of the study area while only four species were recorded in mangroves in the south-east part of the study area. All four species recorded in both areas of mangroves were recorded in higher numbers in the south-west mangroves.

Discussion

In a brief survey, such as was undertaken, we would not expect to record all species that occur regularly in the study area. There are a wide range of littoral birds, including several migratory waders, that would be expected to occur regularly in the study area, but that we did not record. These include, but are not restricted to, Eastern Great Egret (*Ardea modesta*), White-faced Heron (*Egretta novaehollandiae*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Eastern Osprey (*Pandion cristatus*), Black-tailed Godwit (*Limosa limosa*), Red Knot (*Calidris canutus*), Sharp-tailed Sandpiper (*Calidris acuminata*) and Crested Tern (*Thallaseus bergii*).

Despite the brief nature of the survey, 20 species were found that are listed under international agreements and are protected under the EPBC Act (1999).

Roosting sites

The area did not contain any significant roosts for littoral birds or migratory waders on southward migration. The totals for individual species throughout the study area were very small proportions of the global populations for each species (Table 1). The only species where > 0.1 % of the global population roosted in the study area was the Grey-tailed Tattler where it was estimated that about 0.18 % of the global population roosted in the area on southward migration. The only large (> 100 birds) roost in the study area was in the South-east region, relatively distant from Anketell Point. Given that it is the only large roost in the area, it would be prudent to avoid any disturbance or habitat modification in this area.

Foraging surveys

The area did not contain significant numbers of foraging birds on southward migration. The totals for individual species throughout the study area were small proportions of the global populations of each species (Table 1). There were only three species where > 0.1 % of the global populations foraged in the study area on southward migration. Between 0.12 and 0.15 % of the global population of Red-capped Plover and Red-necked Stint foraged in the study area on southward migration (Table 1), with the vast majority of foraging birds occurring on the South-west mudflats. About 0.70% of the world population of Grey-tailed Tattlers foraged in the study area on southward migration, again with the majority of birds occurring on the south-west mudflats.

The low tide surveys found that relatively few birds used the area around Anketell Point. More birds were found to the west of Anketell Point, rather than the east. This is unsurprising as the area east of the point is primarily intertidal reef platform, which typically supports relatively few species, while the area west of the point is a mixture of reef platform, sandy areas and mudflats. The presence of mudflats and the mixture of various habitats supports a greater variety of species and numbers of foraging birds.

Although surveys were not conducted on the extensive area of intertidal mudflats between Dixon Island and the mainland it is clear that this area, which includes the South-west mudflats support many thousands of birds. Given that the South-west mudflats forms only a small proportion of the mudflats available between Dixon Island and the mainland, yet they supported numbers of Grey-tailed Tattlers that were almost globally significant, it is likely that the area between Dixon Island and the mainland supports globally significant numbers of Grey-tailed Tattlers on southward migration. Therefore, minimising impacts on the mudflats in this region, by not altering water movement or sedimentation, should be a primary aim of the project. This would also help protect the numbers of Red-capped Plover and Red-necked Stint found in the study area.

Mangrove surveys

All mangrove species expected to occur in the study areas, except the Mangrove Golden Whistler (*Pachycephala melanura*), were recorded. Given the brief nature of the survey, and the fact that no systematic surveys of mangrove birds were conducted, it is likely that the Mangrove Golden Whistler also occurs in the study area, particularly as it has been recorded in the area by Johnstone (1990). The area contains extensive areas of mangroves and the project should aim to minimise impacts on them.

Regional Endemism and Restricted Taxa

Only one regionally endemic taxa was recorded from the study area. The Collared Kingfishers recorded belong to a subspecies endemic to the Pilbara coast (*pilbara*). This subspecies is confined to mangroves from the mouth of the Turner River near Port Hedland to Mangrove Bay on North-west Cape. The populations in the study area would form only a small proportion of the population of this taxa. All other species recorded are widespread throughout Australia, or more often, the world.

Conservation Significant Taxa

No conservation significant taxa were recorded in the study area although a total of 20 species are listed as migratory species under the EPBC Act (1999). However, none of the migratory species is considered rare or threatened, although the Eastern Curlew is listed as Priority Two. This species is far more abundant on the coastline between Port Hedland and Broome on passage and winters primarily in south-eastern Australia and, given the low numbers recorded in the study area, it is highly unlikely that the area is of critical importance to the species.

Conclusions and Recommendations

The survey found that, on southward migration, the study area did not contain significant global populations of any littoral birds, including those protected under the EPBC Act (1999). However, the area supported numbers of foraging Grey-tailed Tattlers that approached globally significant numbers, so it is important that the project minimises any possible impacts on the mudflats in the south-west of the study area, including those between Dixon Island and the mainland. As migratory waders have four distinct phases to their annual year, breeding, southward migration, non-breeding and northward migration, it is not possible to extrapolate findings from this survey to other phases of their annual year. Additional surveys will need to be conducted at breeding, non-breeding and northward migration times of the year to confirm that the area is not of critical importance to migratory waders at any time of the year. Given the complex and poorly understood movements of Australian breeding littoral birds, these additional surveys would also shed light on the importance of the study area year-round to these species as well.

Table 1. Totals numbers of the ten most abundant species in the study area on southward migration. The total numbers recorded both roosting at high tide and foraging at low tide are shown as well as the 1 % threshold for recognition of an area as globally significant. The numbers recorded at high and low tide as a proportion of the global population is also shown.

Species	High tide count	Low tide count	1% threshold	High tide count (%)	Low tide count (%)
Bar-tailed Godwit	177	162	12 000	0.01	0.01
Common Greenshank	9	81	14 000	< 0.01	< 0.01
Grey-tailed Tattler	71	278	400	0.18	0.70
Ruddy Turnstone	2	27	7 000	< 0.01	< 0.01
Great Knot	8	29	3 800	< 0.01	< 0.01
Sanderling	0	25	7 000	0	< 0.01
Red-necked Stint	0	486	3 200	0	0.15
Greater Sand Plover	7	67	3 400	< 0.01	0.02
Red-capped Plover	15	113	950	0.02	0.12
Silver Gull	56	27	20 000	< 0.01	< 0.01

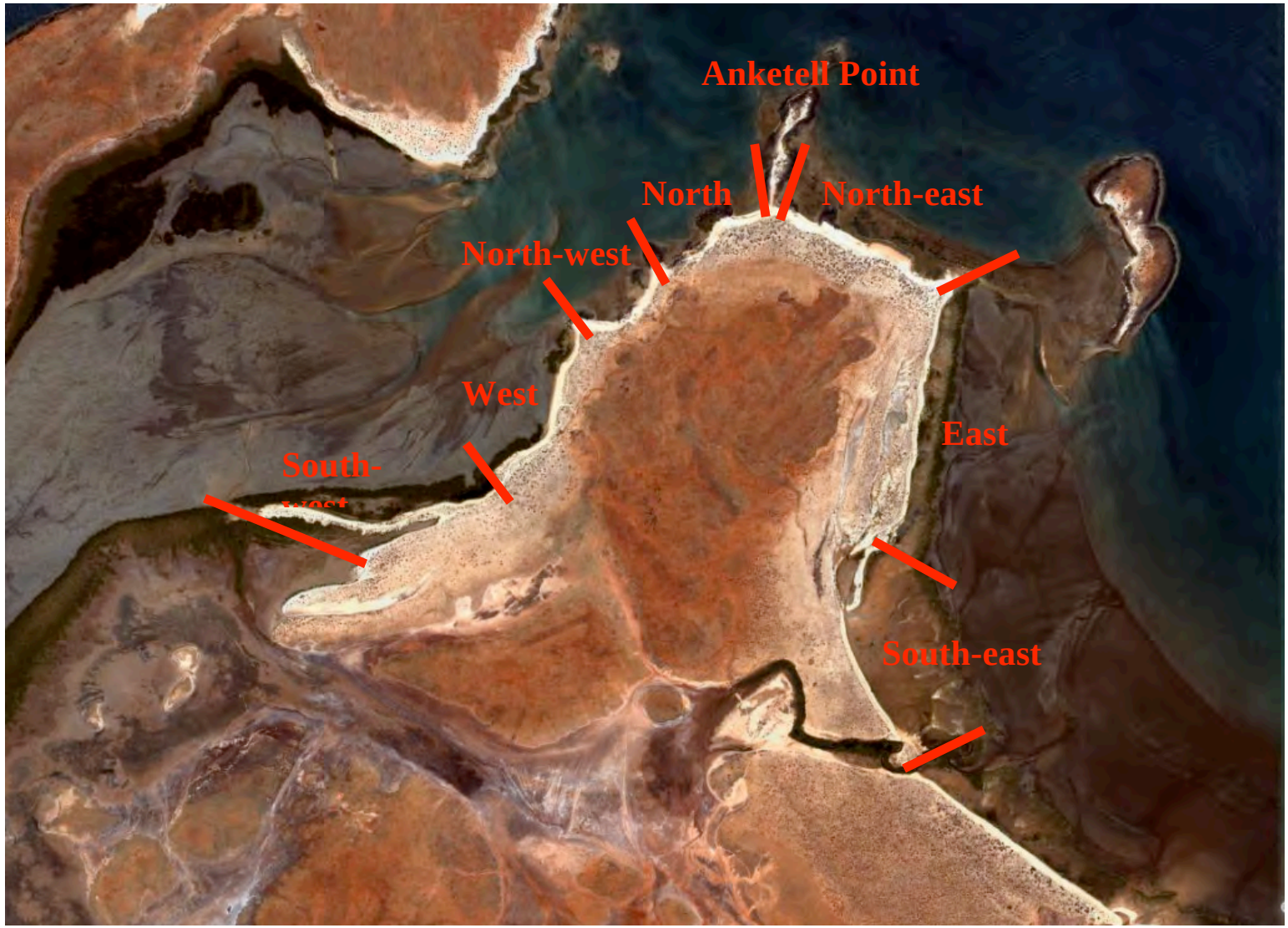

Figure 1. Map showing the eight regions within the study area that were surveyed for roosting birds at high tide.

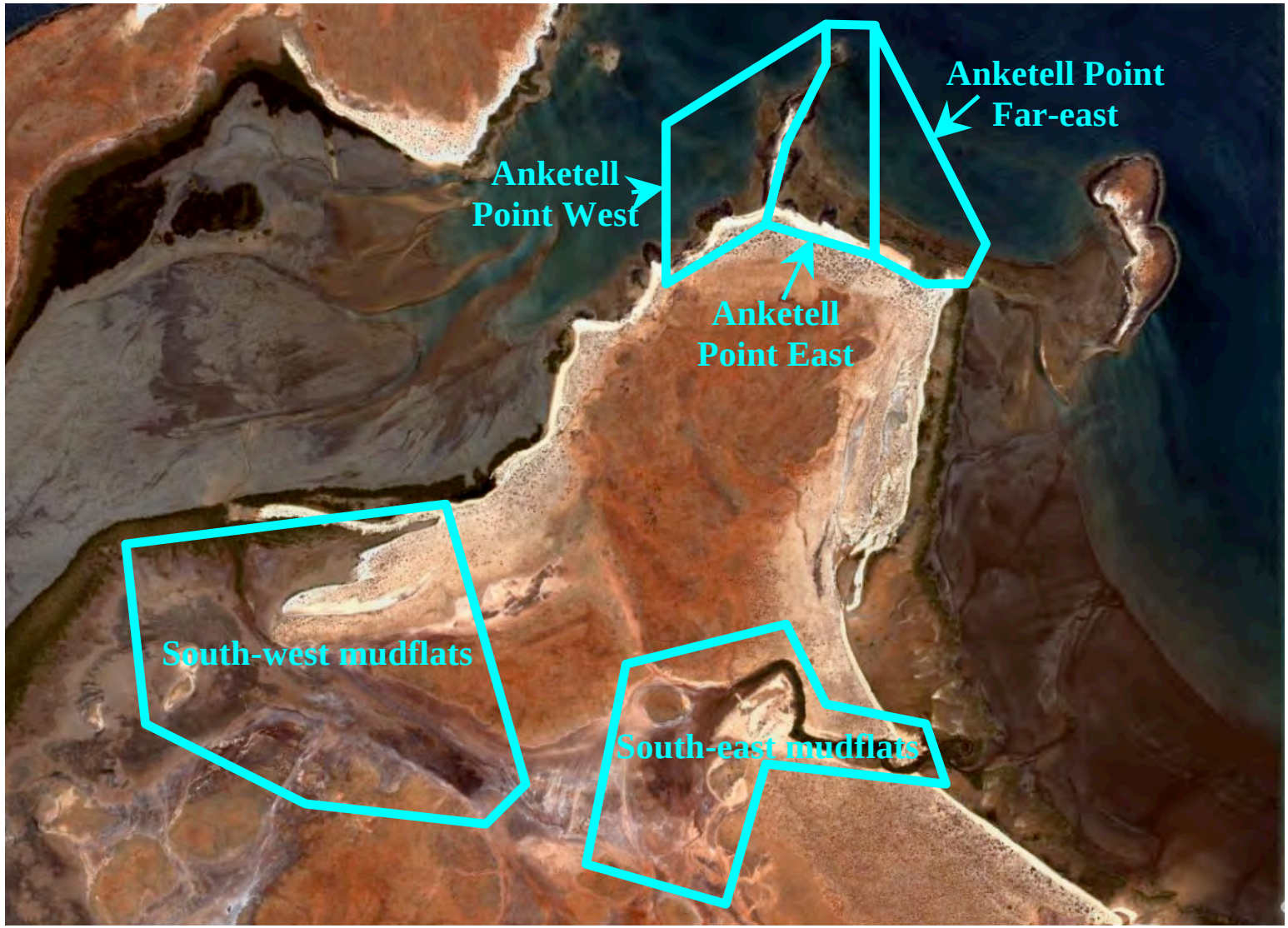

Figure 2. Map of the study area showing the boundaries of the five areas within the study area that were surveyed for foraging birds at low tide.

Figure 3. Map of the study area showing the location of the five roosts (> 10 birds) recorded in the study area during high tide counts. The four small circles represent small (10 to 50 birds) roosts and the large circle represents the large (> 50 birds) roost recorded.

Anketell Point:

Autumn shorebird survey

Dr M. Craig and Ms J.A. Wilcox

Prepared for: Maunsell
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13th April 2009

Introduction

Migratory waders are declining significantly in the East Asia-Pacific flyway, primarily due to the destruction of critical migration stop-over sites along the eastern seaboard of Asia. However, the complexity of their migrations means that habitat must be preserved during both northward and southward migration, as well as during the breeding and non-breeding seasons, if populations are to be conserved. The loss of critical habitat in any of those four periods would be likely to impact on migratory waders. To assess any potential impact of development at Point Anketell on migratory waders during northward migration, a survey was conducted to assess the importance of the area for both roosting at high tide and for foraging at low tide. Other littoral zone birds and mangrove species are easily counted during surveys for migratory waders and these species were also recorded to determine potential impacts on Australian breeding waders, herons and terns.

Methods

The aim of the survey was to identify sites that were potentially important to migratory waders and other littoral birds during the northward migration period, which extends through March. To achieve this, a two-day survey was conducted on 23rd and 24th March 2009 to survey birds at low tide and high tide. High tide surveys were conducted from 1100 to 1330 on 23rd March and 1020 to 1300 on 24th March, to determine the location and size of roosting flocks on Anketell Point and the surrounding region. To do this, the study area was divided up into eight regions (Figure 1) and, within each of those regions, all littoral birds seen were recorded as either in a roost (>10 birds) or outside a roost. If a roost were observed then a GPS location of the roost site was recorded as well as the number of individuals of all species within that roost. Low tide counts were conducted on 23rd March from 1430 to 1800 in the areas immediately surrounding Anketell Point. All birds recorded were assigned to one of the five areas demarcated for low tide counts (Figure 2). No systematic surveys were made for mangrove birds but they were recorded opportunistically during all high and low tide counts.

Personnel

Ms Jenny Wilcox (*BSc.Biol./Env.Sci., Hons.Biol.*) and Mr Richard King (*BSc.Env.Biol.*) of Western Wildlife carried out the survey and Ms Jenny Wilcox and Dr Mike Craig prepared the report.

Results

Community Assemblage

We recorded a total of 31 species of mangrove and littoral birds of which 2 were mangrove specialists and 29 were littoral species (Appendix 1). Of these littoral species, 20 are listed under at least one of JAMBA, CAMBA or ROKAMBA (typically all three). The most speciose families, all littoral birds, were Scolopacidae (11 species), Charadriidae (5 species) and Sternidae (3 species). The most abundant species during high tide counts were three scolopacids (Bar-tailed Godwit, Great Knot, Red Knot) and one charadriid (Greater Sand Plover). The most abundant species during low tide counts were three scolopacids (Red-necked Stint, Grey-tailed Tattler and Ruddy Turnstone) and two charadriids (Red-capped Plover and Greater Sand Plover).

Regional summaries

High tide roosting surveys

Most roosting birds were recorded in the North region and the South-east region, primarily in one large roost in each region, with smaller numbers in other regions.

Low tide foraging surveys
The greatest number of birds recorded at low tide were on the South-west mudflats, although within that area there were no particular concentrations of birds. Very low numbers were recorded on the South-east mudflats. Around Anketell Point, the majority of birds were recorded in Anketell Point East and Anketell Point Far East, with only a few birds in Anketell Point West.

Mangrove surveys
Only two mangrove specialists (Yellow White-eye *Zosterops luteus* and Mangrove Grey Fantail *Rhipidura phasiana*) were recorded during the March survey, both were seen in mangroves in the south-west part of the study area while only the Yellow White-eye was recorded in mangroves in the south-east part of the study area.

Discussion

In a brief survey, such as was undertaken, we would not expect to record all species that occur regularly in the study area. There are a wide range of littoral birds, including several migratory waders, that would be expected to occur regularly in the study area, but that we did not record. Despite the brief nature of the survey, 20 species were found that are listed under international agreements and are protected under the EPBC Act (1999).

Roosting sites

The area did not contain any significant roosts for littoral birds or migratory waders on northward migration. The totals for individual species throughout the study area were very small proportions of the global populations for each species (Table 1). The two large (> 100 birds) roosts in the study area were in the South-east region and the North region. The roost in the South-east region is relatively distant from Anketell Point. Given that it this is also where birds were recorded roosting during the southward migration survey, it would be prudent to avoid any disturbance or habitat modification in this area. The roost in the North region is very close to Anketell Point, and development of the point is likely to make this area unsuitable for roosting birds.

Foraging surveys

The area did not contain significant numbers of foraging birds on southward migration. The totals for individual species throughout the study area were small proportions of the global populations of each species (Table 1). There were only five species where > 0.1 % of the global populations foraged in the study area on northward migration. About 0.07 % and 0.13 % and 0.02 % respectively, of the global population of Red-capped Plover, Red-necked Stint and Greater Sand Plover foraged in the study area on northward migration (Table 1), with the vast majority of foraging birds occurring on the South-west mudflats. About 0.08% of the world population of Grey-tailed Tattlers foraged in the study area on southward migration, with the majority of birds occurring in the areas east of Anketell Point. About 0.01 % of the world population of Lesser Sand Plover foraged in the study area, with the few birds recorded showing no particular preference for site.

The low tide surveys found that relatively few birds used the area around Anketell Point as compared to the South-west mudflats. In this survey, more birds were found to the east of Anketell Point, rather than the west, as in the southward migration survey. This is surprising as the area east of the point is primarily intertidal reef platform, which typically supports relatively few species, while the area west of the point is a mixture of reef platform, sandy areas and mudflats. The presence of mudflats and the mixture of various habitats usually supports a greater variety of species and numbers of foraging birds.

Surveys were not conducted on the extensive area of intertidal mudflats between Dixon Island and the mainland, because at the time of survey the tidal amplitude was low, so the mudflats were not exposed at low tide. However, from the southward migration survey in spring 2008, it is clear that this area, which includes the South-west mudflats, support many thousands of birds. Minimising impacts on the mudflats in this region, by not altering water movement or sedimentation, should be a primary aim of the project.

Mangrove surveys

All mangrove species expected to occur in the study areas, except the Mangrove Golden Whistler (*Pachycephala melanura*), have been recorded, either in the southward migration survey (spring 2008) or the northward migration survey. Given the brief nature of the surveys, and the fact that no systematic surveys of mangrove birds were conducted, it is likely that the Mangrove Golden Whistler also occurs in the study area, particularly as it has been recorded in the area by Johnstone (1990). The area contains extensive areas of mangroves and the project should aim to minimise impacts on them.

Regional Endemism and Restricted Taxa

No regionally endemic taxa were recorded during the northward migration survey.

Conservation Significant Taxa

No conservation significant taxa were recorded in the study area although a total of 20 species are listed as migratory species under the EPBC Act (1999). However, none of the migratory species is considered rare or threatened, although the Eastern Curlew is listed as Priority 4. This species is far more abundant on the coastline between Port Hedland and Broome on passage and winters primarily in south-eastern Australia and, given the low numbers recorded in the study area, it is highly unlikely that the area is of critical importance to the species.

Conclusions and Recommendations

The survey found that, on southward migration, the study area did not contain significant global populations of any littoral birds, including those protected under the EPBC Act (1999). In the southward migration survey (spring 2008) the area supported numbers of foraging Grey-tailed Tattlers that approached globally significant numbers. During the northward migration survey, numbers of Grey-tailed Tattlers were lower and did not approach globally significant levels. As migratory waders have four distinct phases to their annual year, breeding, southward migration, non-breeding and northward migration, it is not possible to extrapolate findings from this survey to other phases of their annual year. An additional survey will need to be conducted at the breeding time of the year (winter) to confirm that the area is not of critical importance to migratory waders at that time. As the non-breeding survey (summer) was missed due to bad weather, it is recommended that this is also carried out. Given the complex and poorly understood movements of Australian breeding littoral birds, these additional surveys would also shed light on the importance of the study area year-round to these species as well.

Table 1. Totals numbers of the ten most abundant species in the study area on northward migration. The total numbers recorded both roosting at high tide and foraging at low tide are shown as well as the 1 % threshold for recognition of an area as globally significant. The numbers recorded at high and low tide as a proportion of the global population is also shown.

Species	High tide count	Low tide count	1% Threshold	High tide count (%)	Low tide count (%)
Bar-tailed Godwit	178	1	12 000	0.01	<0.01
Whimbrel	17	7	20 000	<0.01	<0.01
Grey-tailed Tattler	20	32	400	0.05	0.08
Ruddy Turnstone	33	29	7 000	<0.01	<0.01
Great Knot	125	0	3 800	0.03	0
Red Knot	69	0	10 000	0.01	0
Red-necked Stint	0	427	3 200	0	0.13
Lesser Sand Plover	36	21	3 000	0.01	0.01
Greater Sand Plover	73	76	3 400	0.02	0.02
Red-capped Plover	30	68	950	0.03	0.07

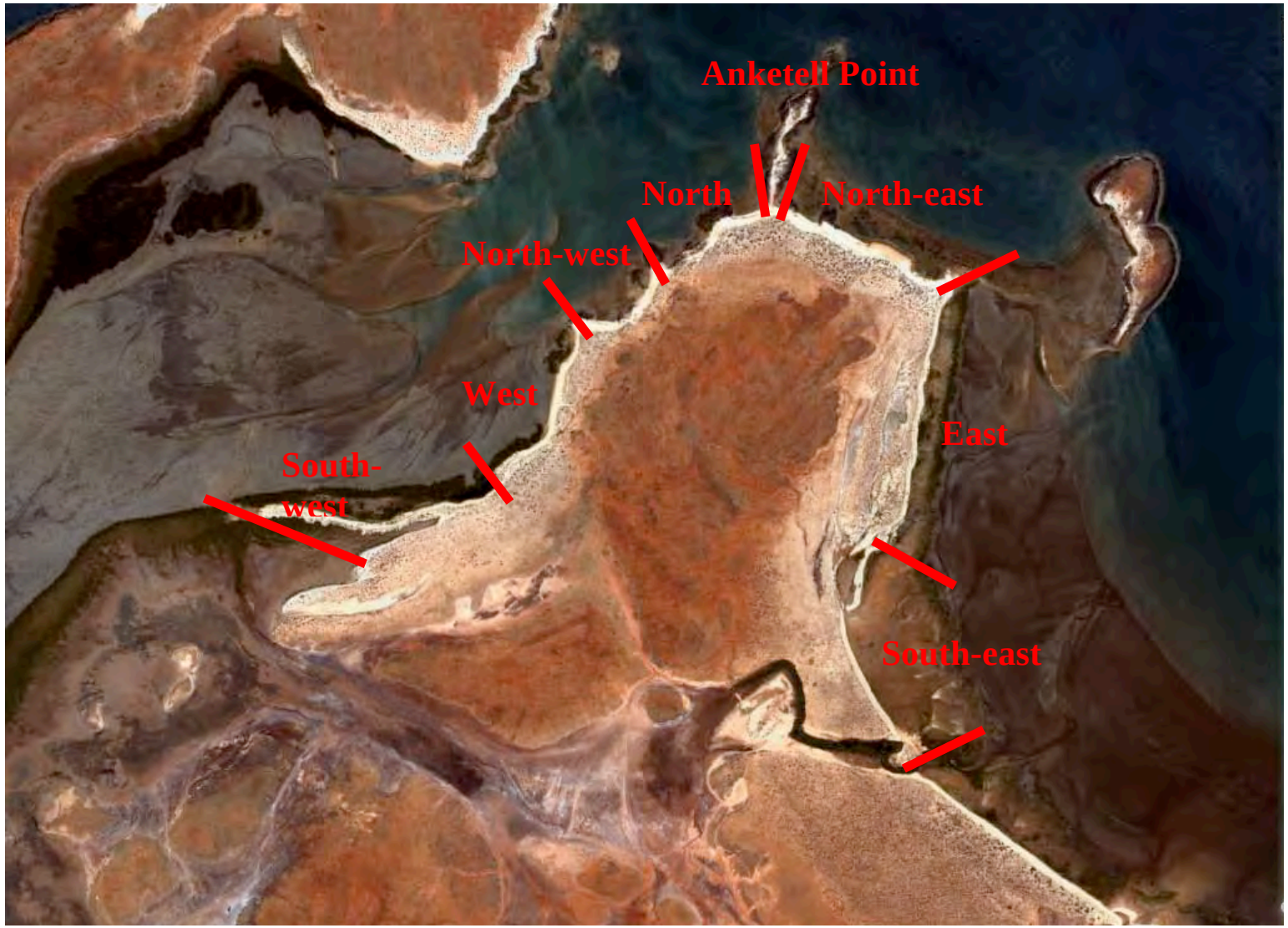

Figure 1. Map showing the eight regions within the study area that were surveyed for roosting birds at high tide.

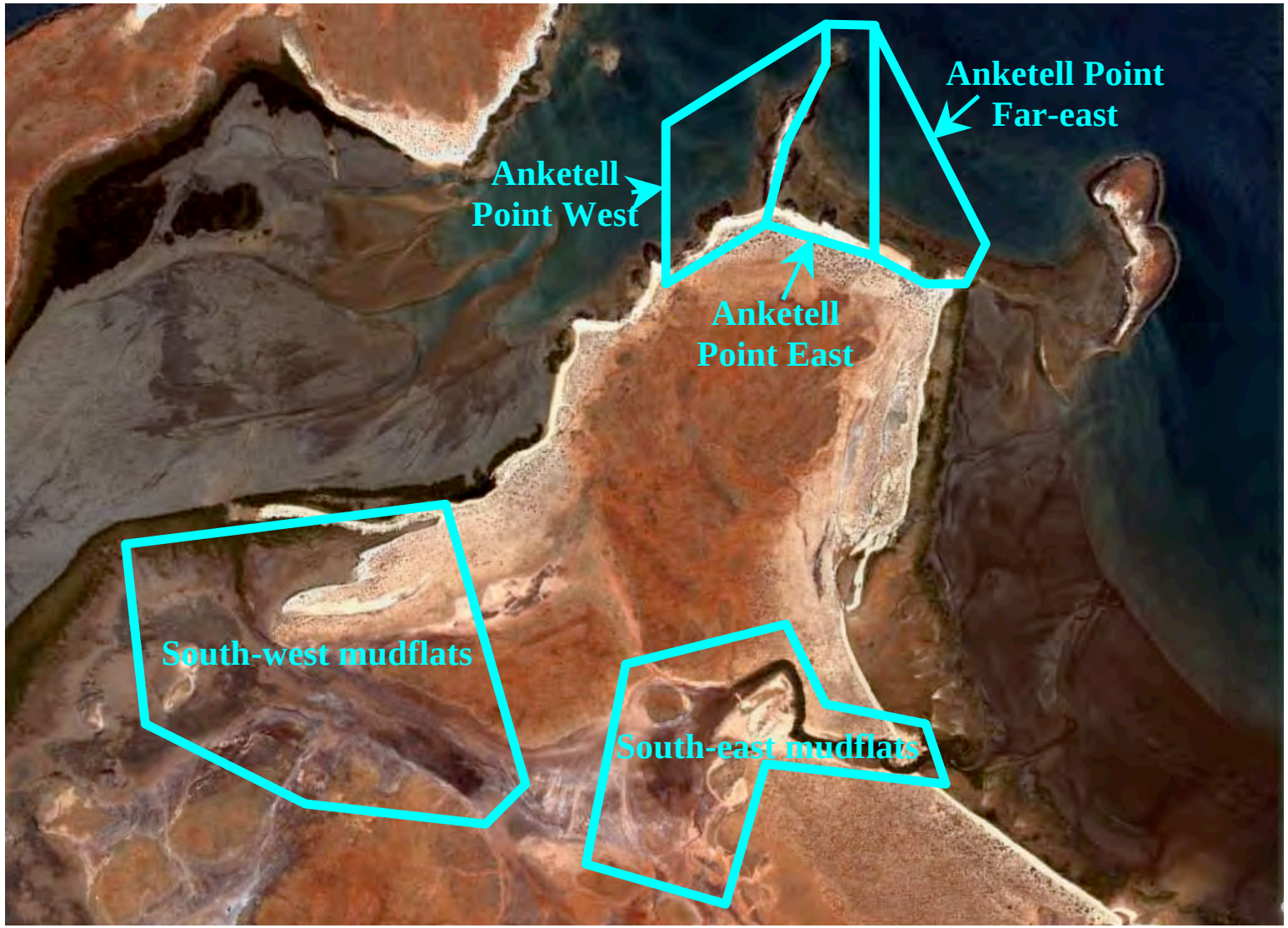

Figure 2. Map of the study area showing the boundaries of the five areas within the study area that were surveyed for foraging birds at low tide.

Figure 3. Map of the study area showing the location of the six roosts (> 10 birds) recorded in the study area during high tide counts. The four small circles represent small (10 to 50 birds) roosts and the large circle represents the large (> 50 birds) roosts recorded.

Appendix 1. Numbers of shorebirds and other waterbirds counted in the Anketell Point area during the northward migration survey. M = EPBC Act listed migratory species.

Species	Migratory	Anketell Point (High Tide)								Anketell Point (Low Tide)			Tidal Flats (High Tide)	
		SW	W	NW	N	AP	NE	E	SE	W	E	FE	SW	SE
Phalacrocoracidae														
Pied Cormorant										2				
Ardeidae														
Striated Heron											1			
Little Egret				2			2	1		1	1	1		2
Eastern Reef Egret	M										1	1		
Threskionithidae														
Australian White Ibis									2					
Accipitridae														
Osprey	M										1			
Brahminy Kite														
Scolopacidae														
Bar-tailed Godwit	M				170			8			1			
Whimbrel	M		9	1				5	2	1	3	3		
Eastern Curlew	M		2					1						
Common Greenshank	M			2							1			1
Curlew Sandpiper	M												17	
Grey-tailed Tattler	M		1	2	2	13			2	4	10	18		
Ruddy Turnstone	M		7		8	5	11		2	9	8	12		
Great Knot	M				55				70					
Red Knot	M				50				19					
Sanderling	M						1							
Red-necked Stint	M										6	1	406	14
Burhinidae														
Beach Stone-Curlew											1			
Haematopodidae														
Sooty Oystercatcher					1					1	1			
Pied Oystercatcher			18		1						1	3		
Charadriidae														
Grey Plover	M			1	4		1	2	5		1	3		
Pacific Golden Plover	M				1						1	2		
Red-capped Plover	M		3	3	4	3	4		13	2	3	1	55	7
Lesser Sand Plover	M				12		20		4	1	3	6	11	
Greater Sand Plover	M				41	1	26		5	2	5	7	62	
Laridae														
Silver Gull											3	4		
Caspian Tern	M													2
Crested Tern	M									1	1	1		

Anketell Point:

Winter (breeding season) shorebird survey

Dr M. Craig and Ms J.A. Wilcox

Anketell Point

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19th August 2009

INTRODUCTION

Migratory waders are declining significantly in the East Asia-Pacific flyway, primarily due to the destruction of critical migration stop-over sites along the eastern seaboard of Asia. However, the complexity of their migrations means that habitat must be preserved during both northward and southward migration, as well as during the breeding and non-breeding seasons, if populations are to be conserved. The loss of critical habitat in any of those four periods would be likely to impact on migratory waders.

To assess any potential impact of development at Point Anketell on migratory waders during the breeding season, a time when the number of migratory birds would be at its lowest, a survey was conducted to assess the importance of the area for both roosting at high tide and for foraging at low tide. Other littoral zone birds and mangrove species are easily counted during surveys for migratory waders and these species were also recorded to determine potential impacts on Australian breeding waders, herons and terns. This report summarises the results of this breeding season survey.

This report also summarises the results of all three surveys conducted in the area on southward migration (October 2008), northward migration (March 2009) and the breeding season (July 2009). No data are available for the 2008/2009 non-breeding season as bad weather made it impossible to access the site. This report includes recommendations on the most suitable areas to locate any potential development and, also, whether any additional surveys are required to determine the importance of the Anketell region for migratory waders and other littoral birds.

Legislative Protection for Shorebirds

At the Commonwealth level, migratory species are listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The species listed under the EPBC Act includes those listed under the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). Species listed under JAMBA are also protected under Schedule 3 of the *Western Australian Wildlife Conservation Act* 1950.

All migratory species listed under the EPBC Act are considered matters of national environmental significance. Therefore, if an action is likely to have a significant impact on a migratory species listed under the EPBC Act, the action will have to be referred to the Minister and undergo the environmental assessment and approval process.

Significant impacts on migratory shorebirds include the destruction, isolation or substantial modification of important areas of habitat, and/or the serious disruption of the lifecycle of an ecologically significant proportion of the population of a migratory species. Important habitat for a migratory species can include areas that are only used occasionally or periodically, but supports an ecologically significant proportion of the population. In the case of migratory shorebirds, this can include a site that is important during one or more of the breeding or non-breeding season, or as a staging area during northward or southward migration.

Important Bird Areas

Important Bird Areas (IBAs) are sites of global conservation significance to birds. An IBA must meet four criteria as defined by BirdLife International. The IBA criterion of most pertinence to migratory shorebirds is that the site supports >1% of the world population of a waterbird or seabird.

An IBA does not have any legislative protection, but the IBA process is a scientific method of identifying sites that are important for bird conservation. The IBA 1% criteria have been used in this report to determine whether the Anketell Point area supports a significant number of any shorebird species.

METHODS

Breeding season survey

The aim of the survey was to identify sites that were potentially important to migratory waders and other littoral birds during the breeding period, which extends from late April to early September, in the general region around Anketell Point. This region extended from Cleaverville in the west to a small creek to the east of Anketell Point and including two offshore islands, Dixon and North-east Island (Figs. 1 – 5).

To achieve this, a three-day survey was conducted from 23rd to 25th July 2009 to survey birds at high and low tide.

High tide surveys were conducted from 0930 to 1600 on 23rd July on Dixon and North-east Island and the mainland west from the Mainland Mangroves to Cleaverville, from 1000 to 1400 on 24th July to survey roosts from the small creek east of Anketell Point to the Mainland Mangroves and from 1200 to1400 on 25th July in the South-west and South-east Mudflats. To conduct high tide counts, the mainland was divided up into 11 regions, Cleaverville (Fig. 1), Mainland Mangroves (Fig. 1) and nine regions around Anketell Point (Fig. 2), while Dixon Island was divided up into seven regions (Fig. 3) and North-east Island was counted separately.

Within each of those regions, all littoral birds seen were recorded as either in a roost (>10 birds) or outside a roost. If a roost were observed then a GPS location of the roost site was recorded as well as the number of individuals of all species within that roost.

Low tide surveys of foraging birds were conducted from 0630 to 0900 on 24th July on the South-west and South-east Mudflats (Fig. 4) and Anketell Point East (the area from 509775 to 510200E) and Far East (the area from 510200 to 510600E) (Fig. 5) and from 0630 to 0900 on 25th July in Anketell Point West (the area from 509350 to 509775E) and the Far-east (the area from 508500 to 509350E) and East Channel (the area from 507700 to 508500E) (Fig. 5). All birds recorded were assigned to one of the seven areas demarcated for low tide counts (Figs. 4 & 5).

Figure 1. Map showing the location of the Cleaverville and Mainland Mangrove regions used to map the location of high tide roosts and individual birds in the south-west of the study area.

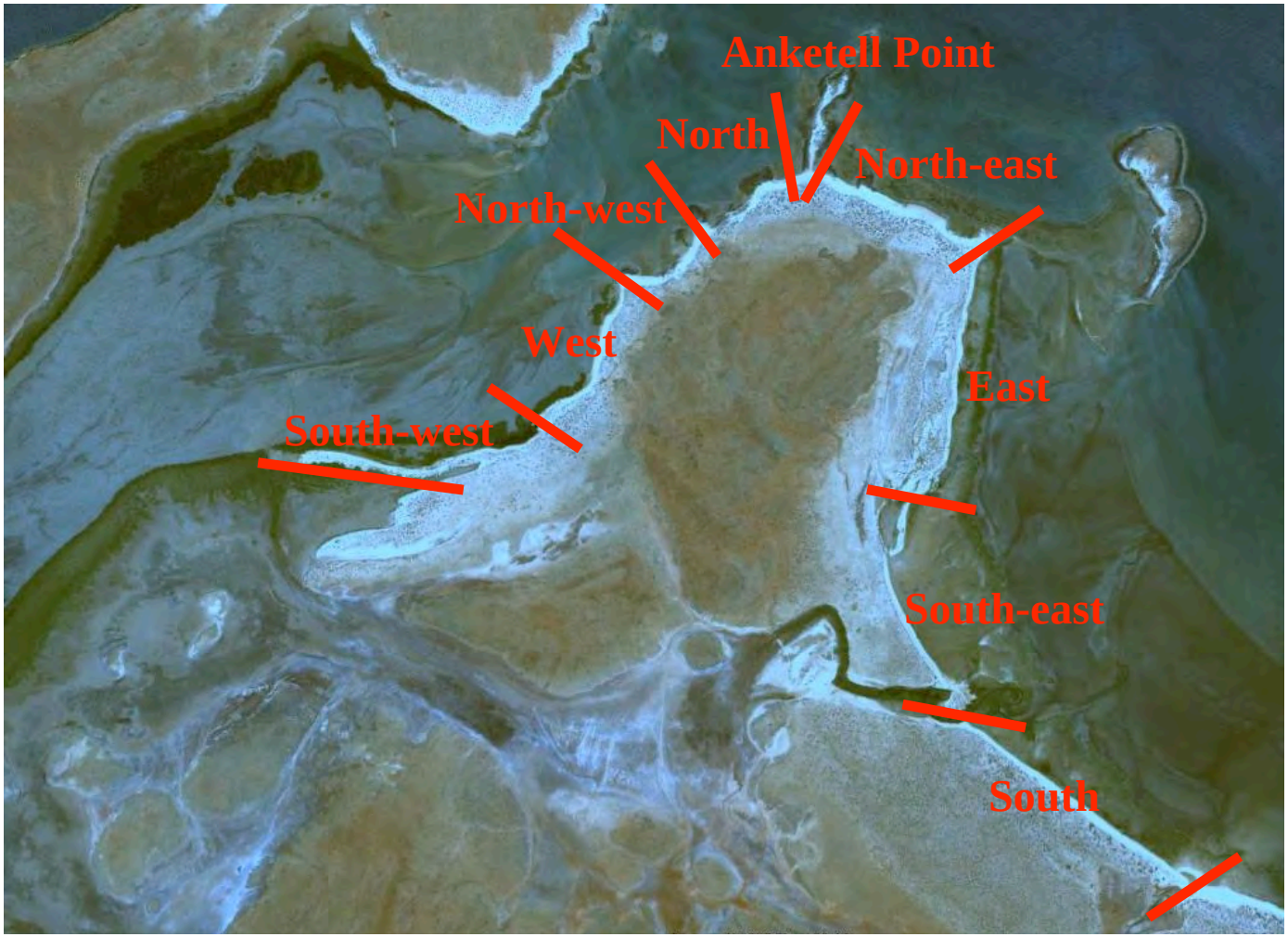

Figure 2. Map showing the location of the nine regions used to map the location of high tide roosts and individual birds along the mainland coast around Point Anketell.

Figure 3. Map showing the location of the seven regions used to map the location of high tide roosts and individual birds on Dixon Island.

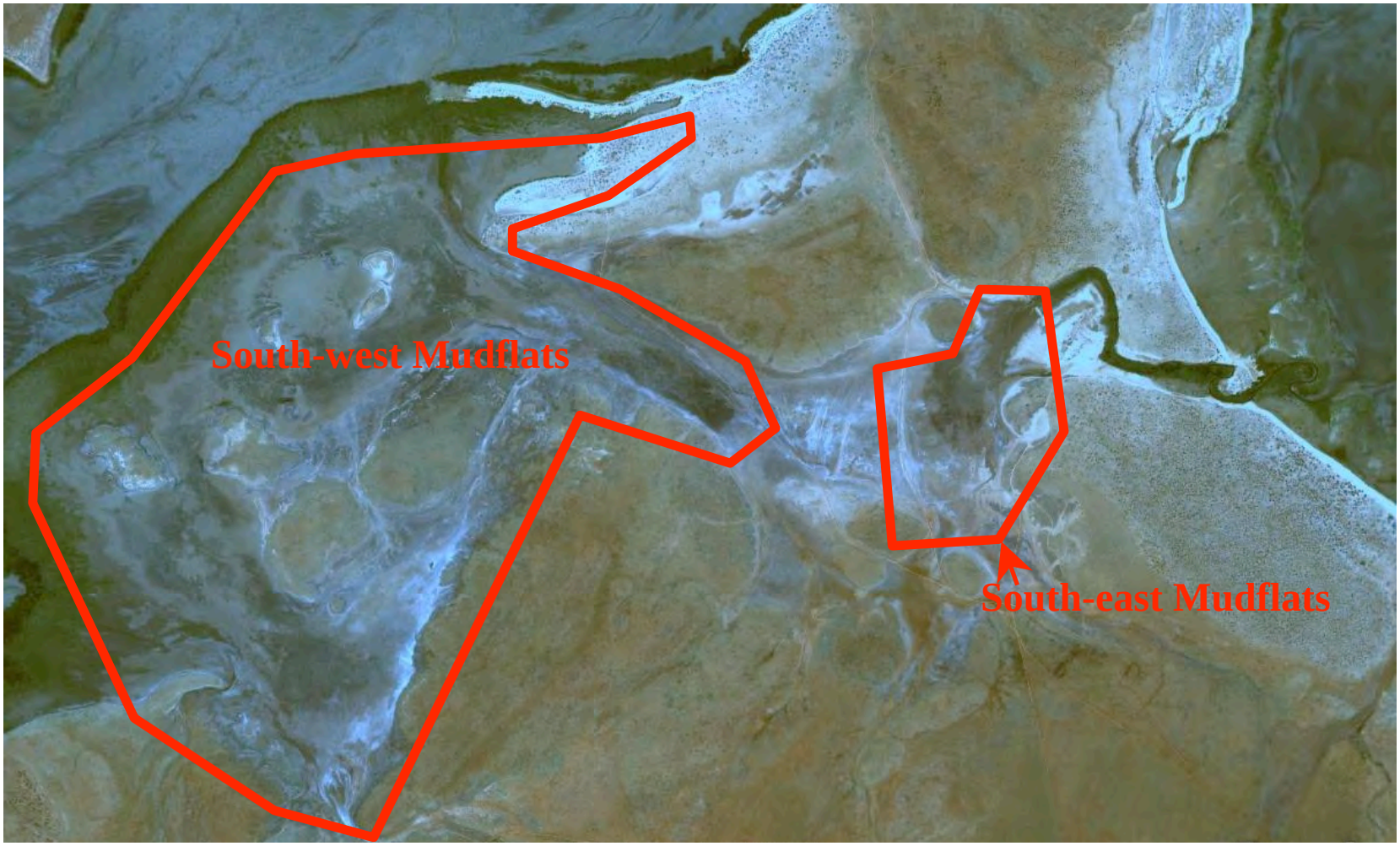

Figure 4. Map showing the location of the two sub-coastal mudflats that were surveyed both for roosting birds at high tide and for foraging birds at low tide.

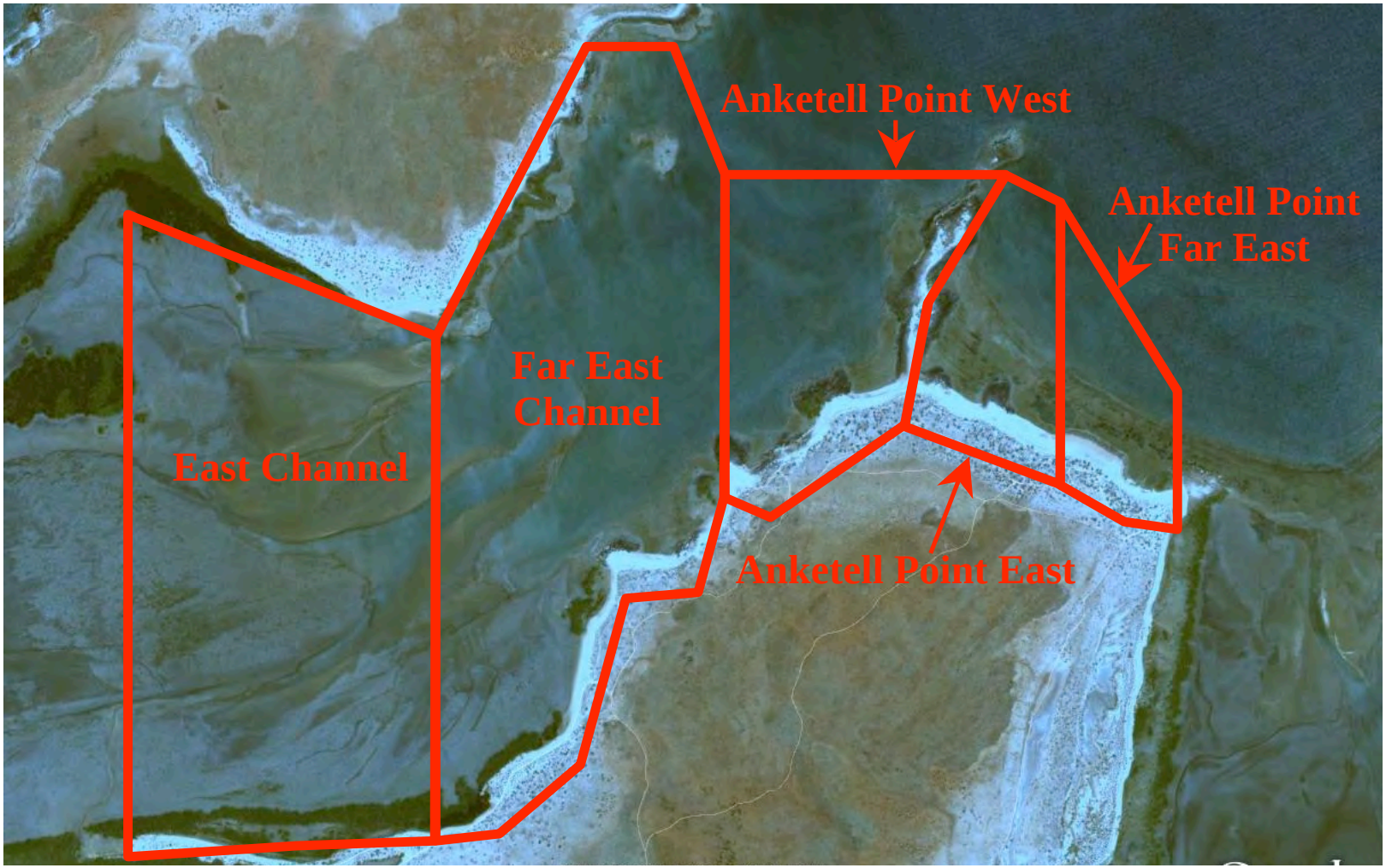

Figure 5. Map showing the location of the two channel sections and the three sections around Anketell Point that were surveyed for foraging birds at low tide.

All surveys

The methodology used in all three surveys was the same for both high tide and low tide counts. The difference being the area covered at each of low and high tide counts. In October 2008 and March 2009, high tide counts were only conducted in eight regions around Anketell Point. The South region, South-west and South-east Mudflats, Mainland Mangroves, Cleaverville and Dixon and North-east Islands were not counted at high tide. In October 2008 and March 2009 only the South-west and South-east Mudflats and Anketell Point West, East and Far East were counted at low tide. The East and Far East Channel were not surveyed for foraging birds at low tide during these visits.

Personnel

The breeding season (July 2009) survey was conducted by Dr Mike Craig, as a sub-contractor to Western Wildlife, and Ms Susannah Simon from Maunsell. Mike has over 25 years experience in identifying and counting waders and waterbirds and has previously conducted wader surveys for many proposed development, most notably proposals on Barrow Island and the east side of the Exmouth Gulf.

The southward migration (October 2008) survey was also conducted by Dr Mike Craig and Ms Susannah Simon. The northward migration (March 2009) survey was conducted by Ms Jenny Wilcox and Mr Richard King of Western Wildlife.

RESULTS

Breeding season survey

The following sections summarise the results of the July 2009 breeding season survey. All bird scientific names are presented in the annotated list.

Community Assemblage

A total of 34 littoral birds were recorded in July 2009, of which 17 were listed under JAMBA, CAMBA or ROKAMBA, with 12 listed under all three. The most speciose families were Scolopacidae (9 species), Laridae (6 species) and the Ardeidae and Charadriidae (4 species each). The most abundant species at high tide roosts were Crested Tern (606), Greater Sand Plover (504), Grey-tailed Tattler (477), Bar-tailed Godwit (216), Red-capped Plover (169) and Caspian Tern (141). The most abundant species at low tide were Greater Sand Plover (336), Red-necked Stint (180) and Red-capped Plover (158).

Annotated List

The birds recorded during the breeding season (July) survey are listed below in taxonomic order.

Black-necked Stork (*Ephippiorhynchus asiaticus*) – Scarce. The only record was one female seen on the South-east Mudflats at high tide.

Australian White Ibis (*Threskiornis molucca*) – Scarce. The only record was one bird roosting in the Mainland Mangroves at high tide.

Striated Heron (*Butorides striatus*) – Uncommon. The only records are one bird roosting on Anketell Point at high tide and another foraging on Anketell Point Far East at low tide.

White-faced Heron (*Egretta novaehollandiae*) – Uncommon. A total of four birds were recorded at high tide in the South, South-east and South-east Mudflats and a single bird was recorded in the latter location at low tide.

Little Egret (*Egretta garzetta*) – Common. A total of 56 birds were recorded in high tide roosts, with a single bird on North-east Island and the rest in Dixon Island South-west. Also a total of 17 birds recorded foraging at low tide in the East and Far East Channel and the South-east and South-west Mudflats.

Eastern Reef Egret (*Egretta sacra*) – Common. A total of 20 birds were recorded at high tide scattered across the North-east, North-east Island and Dixon Island West, North-west and North-east. Only three birds recorded at low tide with singles in Anketell Point East and the East and Far East Channel.

Australian Pelican (*Pelecanus conspicillatus*) – Uncommon. The only record was 22 birds in a high tide roost in Dixon Island South-west.

Little Pied Cormorant (*Phalacrocorax melanoleucos*) – Scarce. The only record was a single bird roosting in mangroves in Dixon Island South.

Osprey (*Pandion haliaetus*) – Frequent. A total of nine birds recorded at high tide with most (six) in Dixon Island West and North-west but with singles also over South-west Mudflats, North-east Island and Cleaverville.

Brahminy Kite (*Haliastur indus*) – Uncommon. Three birds were recorded at high tide over the Mainland Mangroves and Dixon Island South-west. Two birds were recorded at low tide over the South-west Mudflats and Far East Channel.

White-bellied Sea-Eagle (*Haliaeetus leucogaster*) – Scarce. The only record is a single bird over Dixon Island South-west at high tide.

Beach Stone-curlew (*Esacus magnirostris*) – Scarce. The only record is a single bird foraging at low tide on Anketell Point East.

Pied Oystercatcher (*Haematopus longirostris*) – Common, with 35 birds recorded at high tide and nine at low tide. Most birds at high tide were recorded in Cleaverville (24) with singles and pairs also scattered across Dixon Island South-west and East, North-east Island, Point Anketell and North-west. Birds at low tide were recorded in Anketell Point East and West and East and Far East Channel.

Sooty Oystercatcher (*Haematopus fuliginosus*) – Uncommon. A total of 15 birds were recorded at high tide in Cleaverville, Dixon Island West, North and North-east, North-east Island and Point Anketell.

Black-winged Stilt (*Himantopus himantopus*) – Uncommon. The only record was 16 birds in a high tide roost in Dixon Island South-west.

Grey Plover (*Pluvialis squatarola*) – Scarce. The only record was six birds in a high tide roost in Dixon Island South-west.

Red-capped Plover (*Charadrius ruficapillus*) – Very common. A total of 169 birds were recorded at high tide, mostly in the South-east (106) and South-west Mudflats (37) but with birds scattered in Dixon Island South-west and the South, North-east, Anketell Point and North. A total of 158 birds were recorded at low tide scattered across the South-west and South-east Mudflats, East and Far East Channel and Anketell Point West and East.

Lesser Sand Plover (*Charadrius mongolus*) – Uncommon. Four birds were recorded at high tide on the South-west Mudflats. At low tide four birds were seen in the same location and another 4 in the East Channel.

Greater Sand Plover (*Charadrius leschenaultii*) – Abundant, with 504 birds recorded at high tide roosts and 336 birds recorded at low tide. All birds at high tide were recorded in Dixon Island South-west (206) and North-east (87) and South-west Mudflats (211). At low tide birds were found mostly in the South-west Mudflats (291), with smaller numbers in the East Channel (37) and South-east Mudflats (8).

Bar-tailed Godwit (*Limosa lapponica*) – Common. A total of 216 birds were recorded at high tide with in Dixon Island South-west and a single bird was recorded at low tide in the East Channel.

Whimbrel (*Numenius phaeopus*) – Common. Forty-four birds were recorded a high tide, with almost all in a roost in Dixon Island South-west (43) and a single bird on the South-west Mudflats. Eight birds were recorded at low tide in the East and Far East Channel.

Eastern Curlew (*Numenius madagascarensis*) – Uncommon, with 10 recorded at high tide. Most were in Dixon Island South-west (9) and a single in the South-west.

Common Greenshank (*Tringa nebularia*) – Common, with 41 birds recorded in a high tide roost in Dixon Island South-west and eight birds recorded foraging at low tide in the East and Far East Channel.

Grey-tailed Tattler (*Heteroscelus brevipes*) – Abundant, with 477 birds recorded at high tide and 35 birds at low tide. Most birds in high tide roosts were recorded in Dixon Island North-east (259) and South-west (210) with eight birds also recorded on the South-west Mudflats. Most birds at low tide were foraging in the East and Far East Channel, with a single bird on the South-west Mudflats.

Common Sandpiper (*Actitis hypoleucos*) – Uncommon. A total of four birds recorded at high tide in the West and South-east.

Ruddy Turnstone (*Arenaria interpres*) – Uncommon. Four birds were recorded in high tide roosts in Dixon Island North and North-east and the South-west Mudflats, with a single bird recorded at low tide at the latter location.

Great Knot (*Calidris tenuirostris*) – Scarce. The only record is a group of six in a high tide roosts in Dixon Island South-west.

Red-necked Stint (*Calidris ruficollis*) – Very common with 56 birds recorded at high tide and 180 birds at low tide. Birds at high tide were found in the South-west and South-east Mudflats, while birds at low tide were found in those same two locations and the East Channel.

Silver Gull (*Larus novaehollandiae*) – Very common. A total of 79 birds were recorded at high tide in Cleaverville, Dixon Island South-west, North-west and North-east, North-east Island and Point Anketell. Most birds at low tide were found in the Far-east Channel (74) with further birds in Anketell Point West (3) and Far East (1).

Gull-billed Tern (*Geliochelidon nilotica*) –Uncommon. The only high tide record is a single bird in Dixon Island North-east, but four birds were seen foraging at low tide over the South-west Mudflats.

Caspian Tern (*Hydroprogne caspia*) – Very common. A total of 141 were recorded at high tide, with most in Cleaverville (67) and South-west Mudflats (71) and the remaining three on North-east Island. Most birds at low tide were in the Far East Channel (23) with a single bird in Anketell Point West.

Crested Tern (*Thalasseus bergii*) – Abundant, but recorded mostly at high tide. Birds at high tide were recorded in Cleaverville (11), Dixon Island North-east (112), North-east Island (316) and Anketell Point (167). Only two birds were recorded at low tide, in the Far East Channel.

Lesser Crested Tern (*Thalasseus bengalensis*) – Uncommon. The only record was four in a high tide roost in Cleaverville.

Whiskered Tern (*Chlidonias leucoptera*) – Uncommon. The only records are 12 in a high tide roost in Cleaverville and four birds in the South-west Mudflats, also at high tide.

High Tide Roosts

Most birds at high tide were roosting in Cleaverville, Dixon Island North-East, Dixon Island South-west, North-east Island, Anketell Point and the South-west Mudflats (Tables 1-3). All large roosts of more than 100 birds were confined to these areas (Fig. 6). The only sizeable roost outside these areas was one of 48 birds in the South-east Mudflats (Fig. 6). Numbers around the Mainland Coast were generally low. Apart from the large roost of, mostly, Crested Terns on Anketell Point, only scattered individuals were recorded around the Mainland Coast and no other roosts.

Low Tide Foraging

Almost all birds recorded at low tide were foraging in either the South-west or South-east Mudflats or the East or Far-east Channel (Table 4). Very few birds were recorded around Anketell Point with on a total of only 15 birds between Anketell Point West, East and Far East (Table 4).

Table 1. The number of individuals recorded roosting at high tide in Cleaverville, the seven regions of Dixon Island and North-east Island.

Species	Cleaverville	Dixon Island							North-east Island	Total
		South	South-west	West	North-west	North	North-east	East		
Black-necked Stork										
Australian White Ibis										
Striated Heron										
White-faced Heron										
Little Egret			55						1	**56**
Eastern Reef Egret				1	5		3		10	**19**
Australian Pelican			13						9	**22**
Little Pied Cormorant		1								**1**
Osprey	1			3	3				1	**8**
Brahminy Kite			1							**1**
White-bellied Sea-Eagle			1							**1**
Beach Stone-curlew										
Pied Oystercatcher	24		4					2	2	**32**
Sooty Oystercatcher	4			4		1	2		2	**13**
Black-winged Stilt			16							**16**
Grey Plover			6							**6**
Red-capped Plover			2							**2**
Lesser Sand Plover										
Greater Sand Plover			87				206			**293**
Bar-tailed Godwit			216							**216**
Whimbrel			43							**43**
Eastern Curlew			9							**9**
Common Greenshank			41							**41**
Grey-tailed Tattler			210				259			**469**
Common Sandpiper										
Ruddy Turnstone						1	2			**3**
Great Knot			6							**6**
Red-necked Stint										
Silver Gull	65		2		2		2		7	**78**
Gull-billed Tern							1			**1**
Caspian Tern	67								3	**70**
Crested Tern	11						112		316	**339**
Lesser Crested Tern	4									**4**
Whiskered Tern	12									**12**
Total	**188**	**1**	**712**	**8**	**10**	**2**	**587**	**2**	**351**	**1861**

Table 2. The number of individuals recorded roosting at high tide in the Mainland Mangroves and the nine regions of the mainland coast around Anketell Point.

Species	Mainland Mangroves	Mainland									Total
		South-west	West	North-west	North	Anketell Point	North-east	East	South-east	South	
Black-necked Stork											
Australian White Ibis	1										**1**
Striated Heron						1					**1**
White-faced Heron									1	1	**2**
Little Egret											
Eastern Reef Egret							1				**1**
Australian Pelican											
Little Pied Cormorant											
Osprey											
Brahminy Kite	2										**2**
White-bellied Sea-Eagle											
Beach Stone-curlew											
Pied Oystercatcher				1		2					**3**
Sooty Oystercatcher						2					**2**
Black-winged Stilt											
Grey Plover											
Red-capped Plover					5	5	12			2	**24**
Lesser Sand Plover											
Greater Sand Plover											
Bar-tailed Godwit											
Whimbrel											
Eastern Curlew		1									**1**
Common Greenshank											
Grey-tailed Tattler											
Common Sandpiper			2						2		**4**
Ruddy Turnstone											
Great Knot											
Red-necked Stint											
Silver Gull						1					**1**
Gull-billed Tern											
Caspian Tern											
Crested Tern						167					**167**
Lesser Crested Tern											
Whiskered Tern											
Total	**3**	**1**	**2**	**1**	**5**	**178**	**13**	**0**	**3**	**3**	**209**

Table 3. The number of individuals recorded roosting at high tide in the sub-coastal Mudflats.

Species	Mudflats		Total
	South-west	South-east	
Black-necked Stork		1	**1**
Australian White Ibis			
Striated Heron			
White-faced Heron		2	**2**
Little Egret			
Eastern Reef Egret			
Australian Pelican			
Little Pied Cormorant			
Osprey	1		**1**
Brahminy Kite			
White-bellied Sea-Eagle			
Beach Stone-curlew			
Pied Oystercatcher			
Sooty Oystercatcher			
Black-winged Stilt			
Grey Plover			
Red-capped Plover	106	37	**143**
Lesser Sand Plover	4		**4**
Greater Sand Plover	211		**211**
Bar-tailed Godwit			
Whimbrel	1		**1**
Eastern Curlew			
Common Greenshank			
Grey-tailed Tattler	8		**8**
Common Sandpiper			
Ruddy Turnstone	1		**1**
Great Knot			
Red-necked Stint	43	13	**56**
Silver Gull			
Gull-billed Tern			
Caspian Tern	71		**71**
Crested Tern			
Lesser Crested Tern			
Whiskered Tern	4		**4**
Total	**450**	**53**	**503**

Table 4. The number of individuals recorded foraging at low tide in the two sections of the inter-island channel, the three sections around Anketell Point and the two sub-coastal mudflats.

Species	Channel		Anketell Point			Mudflats		Total
	East	Far -east	West	East	Far East	South -west	South -east	
Black-necked Stork								
Australian White Ibis								
Striated Heron					1			**1**
White-faced Heron							1	**1**
Little Egret	5	3				8	1	**17**
Eastern Reef Egret		1		1				**2**
Australian Pelican								
Little Pied Cormorant								
Osprey								
Brahminy Kite		1				1		**2**
White-bellied Sea-Eagle								
Beach Stone-curlew				1				**1**
Pied Oystercatcher	1	2	4	2				**9**
Sooty Oystercatcher								
Black-winged Stilt								
Grey Plover								
Red-capped Plover	43	6	1	4		62	42	**158**
Lesser Sand Plover	4					4		**8**
Greater Sand Plover	37					291	8	**336**
Bar-tailed Godwit	1							**1**
Whimbrel	2	6						**8**
Eastern Curlew								
Common Greenshank	7	1						**8**
Grey-tailed Tattler	30	4				1		**35**
Common Sandpiper								
Ruddy Turnstone						1		**1**
Great Knot								
Red-necked Stint	43					94	59	**196**
Silver Gull		74	3		1			**78**
Gull-billed Tern						4		**4**
Caspian Tern		23	1					**24**
Crested Tern		2						**2**
Lesser Crested Tern								
Whiskered Tern								
Total	**158**	**123**	**9**	**8**	**2**	**466**	**111**	**877**

Figure 6. Map showing the location of high tide roosts (>10 birds) with the greater Anketell Point region. The smallest circles represent roosts of 10-50 birds, the second smallest represent roosts of 51-100 birds, the second largest roosts of 101-500 birds and the largest circle represents the roost of >500 birds.

All surveys

The following sections summarise the results of the southward migration (October 2008) survey, the northward migration (March 2009) and the breeding season (July 2009) survey.

Community Assemblage

Over the three surveys, a total of 42 littoral birds were recorded, of which 24 are listed under JAMBA, CAMBA or ROKAMBA (and therefore the EPBC Act), with 20 listed under JAMBA, 22 listed under CAMBA and 19 listed under ROKAMBA. A total of 18 species are listed under all three treaties. The most speciose families were Scolopacidae (13 species), Laridae (7 species), Charadriidae (6 species) and Ardeidae (4 species). The Red-necked Stint, Red-capped Plover, Grey-tailed Tattler and Bar-tailed Godwit were the most consistently abundant species across all three surveys.

High Tide Roosts

There were generally few birds roosting along the mainland around Point Anketell, however, there were large roosts (>100 birds) in each of the surveys. The only large roost that occurred on both southward and northward migration was in the South-east region and this roost held 246 bird on southward migration and 141 birds on northward migration. The other large roosts were 334 birds in the North region on northward migration and 168 birds on the tip of Anketell Point in the breeding season. The North-east and East regions contained no roosts larger than 28 birds in any of the three surveys.

In contrast, the sub-coastal Mudflats, North-east Island and Dixon Island held one, one and two large roosts in the breeding season, the only season when they were surveyed. As we would expect the number of individuals to be much lower in the breeding season than at other times of the year, it is highly likely that these three areas will support either much larger roosts, or many more large roosts on southward or northward migration or the non-breeding season.

The area did not support more than 1% of the population (according to IBA criteria) of any of the species recorded in high tide roosts on southward or northward migration or the breeding season (Table 5). However, in these seasons, only the area of the mainland around Anketell Point was surveyed (no survey was conducted in the non-breeding season), so the statement needs to be taken in that context. Given the lack of surveys in the non-breeding season, it is impossible to determine whether the area around Anketell Point is important for any littoral birds at that time of the year. As there are 65 sites in Australia that pass the 1% threshold for waders in the non-breeding season, but not at other times of the year, and 10 of those sites lie within the tropics, it is quite possible that area is important for waders in the non-breeding season. The data collected so far suggest that only the Grey-tailed Tattler would be likely to exceed the 1% threshold in the non-breeding season but a further survey would be desirable to determine this. From our surveys it is also not possible to determine whether the greater Anketell region is an important site for littoral birds on northward or southward migration or in the non-breeding season. If this was to be determined, surveys in each of these three seasons would be required. Again, based on the data, the Grey-tailed Tattler is the only species expected to exceed the 1% threshold in any of these seasons, although it is considered highly likely it would do so in all three seasons.

Although the '1% of global population' criterion has been used as the threshold, the conclusions would be essentially the same if the threshold was '1% of flyway population'. In this latter scenario, the threshold for Grey-tailed Tattler remains the same as the species is restricted to the East Asian – Australasian Flyway. The only difference would be that the Greater Sand Plover might qualify across the greater Anketell Region. A total of 504 birds were recorded in the greater region in the breeding season and the 1% of the flyway population is 1100 individuals, so it is quite possible that threshold would be exceeded in the greater Anketell area in one or all of southward and northward migration and the non-breeding season.

None of the other species were recorded in numbers even close to the flyway threshold so it is considered highly unlikely the flyway 1% threshold would be exceeded in the greater Anketell region for any other species.

Low Tide Foraging

No large concentrations of birds were recorded foraging in the area adjacent to Anketell Point in any of the three surveys conducted. While it is not certain that this is also the case in the non-breeding season, the foraging habitat to the east of Anketell Point is mostly rocky platform and the area immediately to the west in sandy flats, neither if which provides high quality foraging habitat.

Therefore, it is considered unlikely that the area immediately adjacent to Anketell Point supports large numbers of foraging birds in the non-breeding season. Due to the large numbers of Grey-tailed Tattlers foraging in the South-west Mudflats on southward migration (0.56% of global population), the same conclusion cannot be made about the sub-coastal mudflats (Table 6). Again, a survey in the non-breeding season is highly desirable as it is quite possible that this area would support a globally significant population of Grey-tailed Tattlers at low tide at this time of the year.

It is also not possible to comment on the importance of the eastern part of the channel between the mainland and Dixon Island for foraging at low tide. As this area was only surveyed in the breeding season, it is not possible to determine how many birds forage in this area at other times of the year. It is quite possible that many birds forage in this area on southward and northward migration and the non-breeding season although, again, it is only likely to support globally significant populations of Grey-tailed Tattlers.

Table 5. Minimum population counts from high tide roosts in each of the three seasons, with the proportion of the global population in brackets, for each species where more than 10 individuals were recorded in at least one survey. Data from all sites surveyed at high tide in all three surveys (the eight regions around Anketell Point) are shown as well as the data from the greater Anketell region obtained in the breeding season (July). The two counts that were >0.30% of the global population are shown in bold.

Species	1% Threshold	October	March	July (Mainland)	July (All sites)
Little Egret	20 000	0 (0%)	5 (<0.01%)	0 (0%)	56 (<0.01%)
Eastern Reef Egret	10 000	1 (<0.01%)	0 (0%)	1 (<0.01%)	20 (<0.01%)
Australian Pelican	10 000	0 (0%)	0 (0%)	0 (0%)	22 (<0.01%)
Pied Oystercatcher	*110*	*2 (0.02%)*	*19 (0.17%)*	*3 (0.03%)*	***35 (0.32%)***
Sooty Oystercatcher	115	0 (0%)	1 (<0.01%)	2 (0.02%)	15 (0.13%)
Black-winged Stilt	3 000	0 (0%)	0 (0%)	0 (0%)	16 (<0.01%)
Grey Plover	7 000	4 (<0.01%)	13 (<0.01%)	0 (0%)	6 (<0.01%)
Red-capped Plover	950	15 (0.02%)	32 (0.03%)	22 (0.02%)	169 (0.18%)
Lesser Sand Plover	3 000	0 (0%)	36 (0.01%)	0 (0%)	4 (0%)
Greater Sand Plover	3 400	7 (<0.01%)	73 (0.02%)	0 (0%)	504 (0.15%)
Bar-tailed Godwit	12 000	177 (0.01%)	220 (0.02%)	0 (0%)	216 (0.02%)
Whimbrel	20 000	18 (<0.01%)	19 (<0.01%)	0 (0%)	44 (<0.01%)
Eastern Curlew	380	1 (<0.01%)	3 (<0.01%)	1 (<0.01%)	10 (0.03%)
Common Greenshank	14 000	9 (<0.01%)	2 (<0.01%)	0 (0%)	41 (<0.01%)
Grey-tailed Tattler	*500*	*71 (0.14%)*	*33 (0.07%)*	*1 (<0.01%)*	***477 (0.95%)***
Ruddy Turnstone	7 000	2 (<0.01%)	38 (<0.01%)	0 (0%)	4 (<0.01%)
Great Knot	3 800	8 (<0.01%)	125 (0.03%)	0 (0%)	6 (<0.01%)
Red Knot	10 000	0 (0%)	69 (<0.01%)	0 (0%)	0 (0%)
Red-necked Stint	3 200	0 (0%)	0 (0%)	0 (0%)	56 (0.02%)
Silver Gull	20 000	56 (<0.01%)	0 (0%)	1 (<0.01%)	79 (<0.01%)
Caspian Tern	3 000	0 (0%)	0 (0%)	0 (0%)	141 (0.05%)
Crested Tern	6 000	0 (0%)	0 (0%)	167 (0.03%)	606 (0.10%)
Whiskered Tern	10 000	0 (0%)	0 (0%)	0 (0%)	16 (<0.01%)

Table 6. Minimum population counts from low tide surveys in each of the three seasons, with the proportion of the global population in brackets, for all species where at least 10 individuals were recorded in at least one survey. Data from all sites surveyed at low tide in all three surveys (the three regions around Anketell Point and the two mudflats) are shown as well as the data from the greater Anketell region obtained in the breeding season (July). The one count that was >0.30% of the global population is shown in bold.

Species	1% Threshold	October	March	July (Mainland)	July (All sites)
Little Egret	20 000	1 (<0.01%)	5 (<0.01%)	9 (<0.01%)	17 (<0.01%)
Red-capped Plover	950	113 (0.12%)	68 (0.07%)	109 (0.11%)	158 (0.17%)
Lesser Sand Plover	3 000	5 (<0.01%)	21 (<0.01%)	4 (<0.01%)	8 (<0.01%)
Greater Sand Plover	3 400	67 (0.02%)	76 (0.02%)	299 (0.09%)	336 (0.10%)
Oriental Plover	700	14 (0.02%)	0 (0%)	0 (0%)	0 (0%)
Bar-tailed Godwit	12 000	162 (0.01)	3 (<0.01%)	0 (0%)	1 (<0.01%)
Common Greenshank	14 000	81 (<0.01%)	1 (<0.01%)	0 (<0.01%)	8 (<0.01%)
Grey-tailed Tattler	*500*	***278 (0.56%)***	*32 (0.06%)*	*1 (<0.01%)*	*35 (0.07%)*
Ruddy Turnstone	7 000	27 (<0.01%)	29 (<0.01%)	1 (<0.01%)	1 (<0.01%)
Great Knot	3 800	29 (<0.01%)	0 (0%)	0 (0%)	0 (0%)
Sanderling	7 000	25 (<0.01%)	0 (0%)	0 (0%)	0 (0%)
Red-necked Stint	3 200	486 (0.15%)	427 (0.13%)	153 (0.05%)	180 (0.06%)
Curlew Sandpiper	18 000	2 (<0.01%)	17 (<0.01%)	0 (0%)	0 (0%)
Silver Gull	20 000	27 (<0.01%)	7 (<0.01%)	4 (<0.01%)	78 (<0.01%)
Caspian Tern	3 000	11 (<0.01%)	2 (<0.01%)	1 (<0.01%)	24 (<0.01%)

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are based on the northward and southward migration surveys around the immediate Anketell Point area, and the breeding season survey of the greater Anketell Point area.

1. The area immediately around Anketell Point is unlikely to be a significant site for shorebirds, except possibly for the Grey-tailed Tattler.

Based on surveys conducted, the area immediately around Anketell Point does not support globally significant populations of littoral birds and, with the exception of the Grey-tailed Tattler in the sub-coastal mudflats, is unlikely to do so in the non-breeding season when no survey was conducted.

2. The greater Anketell region is highly likely to be a significant site for the Grey-tailed Tattler and possibly the Greater Sand Plover.

The greater Anketell region is highly likely to support a globally significant population of Grey-tailed Tattler on southward and northward migration and the non-breeding season, with the main roosts for this species probably occurring on North-east and South-west Dixon Island. The greater Anketell region may possibly support a significant flyway population of the Greater Sand Plover, though only further surveys would determine this.

3. The sub-coastal mudflats are likely to be important for shorebirds.

Ecologically, the sub-coastal mudflats (Fig. 4) seem to be important for shorebirds and tidal water to the South-west and South-east mudflats enters along creeks from the north and east respectively. There appears to be little surface water exchange between these two mudflats and then only on very high spring tides. A survey in the non-breeding season is desirable to determine the number of Grey-tailed Tattler that use the South-west Mudflats.

4. Shorebird numbers are unlikely to be significant on the area of coast to the east of Anketell Point.

The area to the east of Anketell Point (the North-east region) did not contain significant numbers of birds at either high or low tide and, based on the roosting and foraging habitat observed would be unlikely to do so at any time of the year. A survey of this area in the non-breeding season is not critical, although any survey conducted at that time would also be able to assess this area.

5. The intertidal area between Dixon Island and the mainland is likely to be important for foraging shorebirds, including potentially a globally significant population of Grey-tailed Tattlers.

The inter-tidal area between the mainland and Dixon Island appears to be important foraging habitat for littoral birds. As this area was only surveyed in the breeding seasons, it is impossible to determine whether the area would support globally significant populations, although it is considered that it would potentially only do so for Grey-tailed Tattlers.

The main water-flow inputs for this intertidal area are from the west and from the east around Point Anketell. As water enters this intertidal area on the tide, it deposits its coarse sediments first and its fine sediments last. This means that the areas closest to Anketell Point and in the middle of the intertidal area provide relatively poorer sandy foraging habitat while, as one moves westwards along the channel and, also, north and south to the coastlines of the mainland and Dixon Island the intertidal area provides much richer, muddier foraging habitat. This implies that any impediment to the flow of water into this intertidal area would likely have negative impacts of the quality of foraging habitat in the entire eastern half of the intertidal area. It is not critical to survey this area in the remaining three seasons as it is already clear that it is important for foraging birds. However, any surveys at those times of the year would also be able to survey the same areas that were counted in the breeding season survey.

6. Dixon Island is likely to be a significant roosting site for shorebirds, including potentially a globally significant population of Grey-tailed Tattlers.

Surveys in the breeding season showed that Dixon Island contained several important roosts and was very close to supporting a globally significant population of Grey-tailed Tattler (0.94% of global population). The largest roost of this species on Dixon Island was in the North-east part of the island. Therefore, it is highly likely that Dixon Island supports a globally significant population of Grey-tailed Tattlers on southward and northward migration and in the non-breeding season.

Three additional surveys on the southward and northward migration and the non-breeding season is recommended to determine whether the island supports a globally significantly population of Grey-tailed Tattlers and where the important roost sites were for this species. Only then could recommendations be made on any measures to protect this species on Dixon Island.

Greater Anketell Point Area:

Spring (southward migration) shorebird survey 2010

Dr M. Craig and Ms J.A. Wilcox

Anketell Point

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8th November 2010

INTRODUCTION

Migratory waders are declining significantly in the East Asian-Australasian flyway, primarily due to the destruction of critical migration stop-over sites along the eastern seaboard of Asia. However, the complexity of their migrations means that habitat must be preserved during both northward and southward migration, as well as during the breeding and non-breeding seasons, if populations are to be conserved. The loss of critical habitat in any of those four periods would be likely to impact on migratory waders.

To assess any potential impact of development at Point Anketell and Dixon Island on migratory waders during southward migration, a survey was conducted in October 2010 to assess the importance of the area for both roosting at high tide and for foraging at low tide. Other littoral zone birds and mangrove species are easily counted during surveys for migratory waders and these species were also recorded to determine potential impacts on Australian breeding waders, herons and terns.

This report summarises the results of the southward migration survey undertaken in October 2010.

Legislative Protection for Shorebirds

At the Commonwealth level, migratory species are listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The species listed under the EPBC Act includes those listed under the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). Species listed under JAMBA are also protected under Schedule 3 of the *Western Australian Wildlife Conservation Act* 1950.

All migratory species listed under the EPBC Act are considered matters of national environmental significance. Therefore, if an action is likely to have a significant impact on a migratory species listed under the EPBC Act, the action will have to be referred to the Minister and undergo the environmental assessment and approval process.

Significant impacts on migratory shorebirds include the destruction, isolation or substantial modification of important areas of habitat, and/or the serious disruption of the lifecycle of an ecologically significant proportion of the population of a migratory species. Important habitat for a migratory species can include areas that are only used occasionally or periodically, but supports an ecologically significant proportion of the population. In the case of migratory shorebirds, this can include a site that is important during one or more of the breeding or non-breeding season, or as a staging area during northward or southward migration.

Important Bird Areas

Important Bird Areas (IBAs) are sites of global conservation significance to birds. An IBA must meet four criteria as defined by BirdLife International. The IBA criterion of most pertinence to migratory shorebirds is that the site supports >1% of the global population of a congregatory waterbird or seabird.

An IBA does not have any legislative protection, but the IBA process is a scientific method of identifying sites that are important for bird conservation. The IBA 1% global population criteria have been used in this report to determine whether the Anketell Point area supports a significant number of any shorebird species. These criteria are sourced from global waterbird numbers published in Delaney and Scott (2002).

Flyway Populations

The migratory shorebirds that visit Australia are from the East Asian – Australasian EAA) Flyway. The EAA Flyway includes Russia, Alaska, parts of south and east Asia, Australia and New Zealand. Some species occur only within this flyway, so the flyway and global population figures are the same. Other species occur in more than one flyway, so the population figures for the EAA Flyway are lower. Therefore, a species may not meet the 1% criterion for its global population, but it may meet or exceed the 1% criterion for the flyway population.

METHODS

The aim of the survey was to identify sites that were potentially important to migratory waders and other littoral birds in the greater region around Anketell Point during southward migration. Along the Pilbara coast, southward migration extends from about late September to mid-October. The region surveyed extended from Cleaverville in the west to a small creek to the east of Anketell Point and included two offshore islands, Dixon and North-east Island (Figs. 1 – 5).

To survey the greater Anketell region, a three-day survey was conducted from 8th to 10th October 2010 to count birds at low and high tide.

High tide surveys were conducted from 1000 to 1330 on 8th October from the small creek east of Anketell Point to the Mainland Mangroves, from 0900 to 1400 on 9th October on Dixon and North-east Island and the mainland west from the Mainland Mangroves to Cleaverville and from 1045 to 1330 on 10th October in the South-west and South-east Mudflats. To conduct high tide counts, the mainland was divided up into 11 regions, Cleaverville (Fig. 1), Mainland Mangroves (Fig. 1) and nine regions around Anketell Point (Fig. 2), while Dixon Island was divided up into seven regions (Fig. 3) and North-east Island was counted separately. Within each of those regions, all littoral birds seen were recorded as either in a roost (>10 birds) or outside a roost. If a roost were observed then a GPS location of the roost site was recorded as well as the number of individuals of all species within that roost.

Low tide surveys of foraging birds were conducted from 1400 to 1730 on 8th October on the South-west and South-east Mudflats (Fig. 4), from 0530 to 0730 on 9th October on Anketell Point East (the area from 509775 to 510200E) and Far East (the area from 510200 to 510600E) (Fig. 5) and from 0530 to 0900 on 10th October in Anketell Point West (the area from 509350 to 509775E) and the Far-east (the area from 508500 to 509350E) and East Channel (the area from 507700 to 508500E) (Fig. 5). All birds recorded were assigned to one of the seven areas demarcated for low tide counts (Figs. 4 & 5).

Personnel

The survey was conducted by Dr Mike Craig, as a sub-contractor to Western Wildlife, and Dr Christine Hass from AECOM. Mike has over 25 years experience in identifying and counting waders and waterbirds and has previously conducted wader surveys for many proposed developments, most notably proposals on Barrow Island and the east side of the Exmouth Gulf. The report was prepared by Dr Mike Craig and Ms Jenny Wilcox.

Figure 1. Map showing the location of the Cleaverville and Mainland Mangrove regions used to map the location of high tide roosts and individual birds in the south-west of the study area, as well as North-east Island in the north-east of the study area.

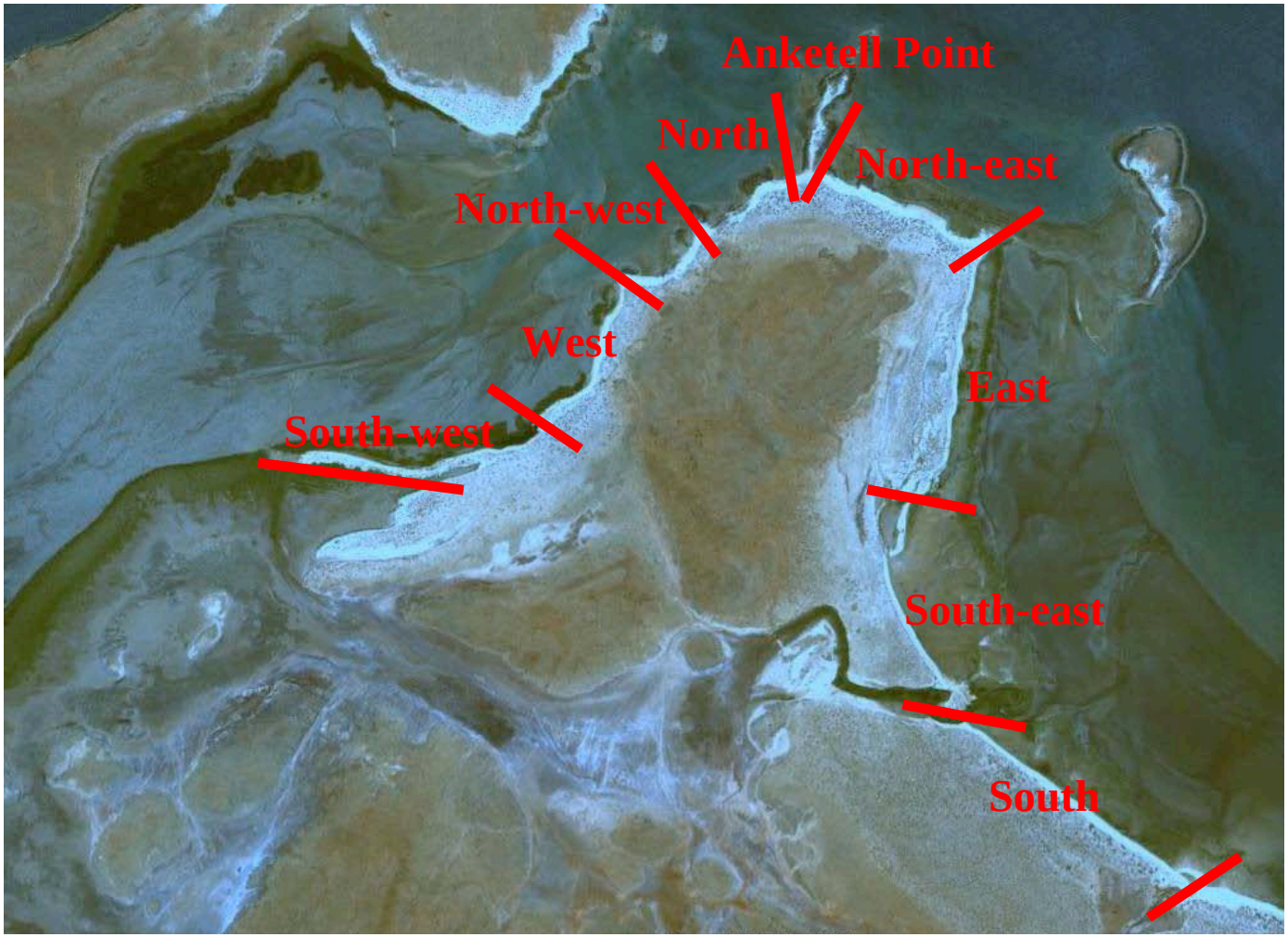

Figure 2. Map showing the location of the nine regions used to map the location of high tide roosts and individual birds along the mainland coast around Point Anketell.

Figure 3. Map showing the location of the seven regions used to map the location of high tide roosts and individual birds on Dixon Island.

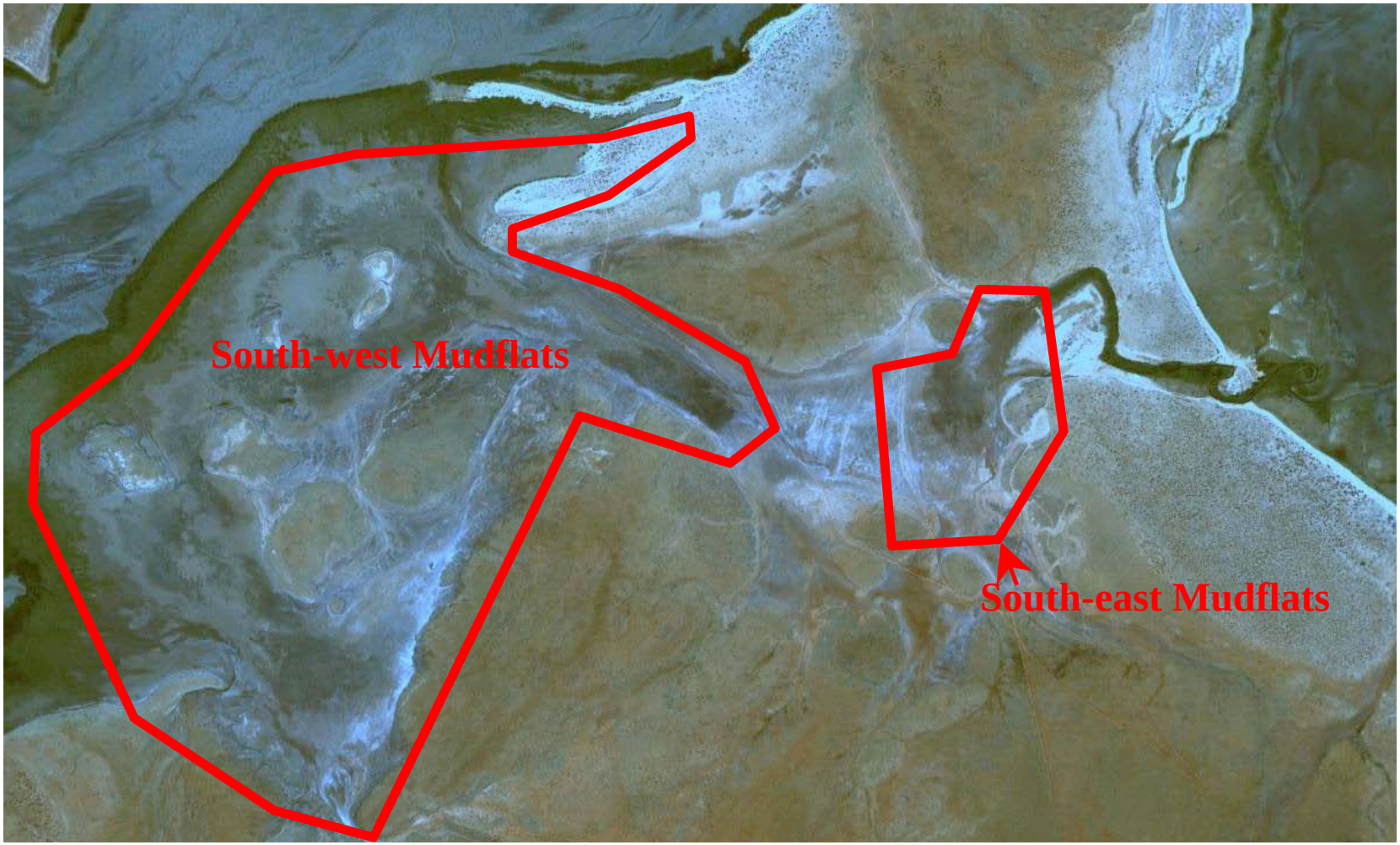

Figure 4. Map showing the location of the two sub-coastal mudflats that were surveyed both for roosting birds at high tide and for foraging birds at low tide.

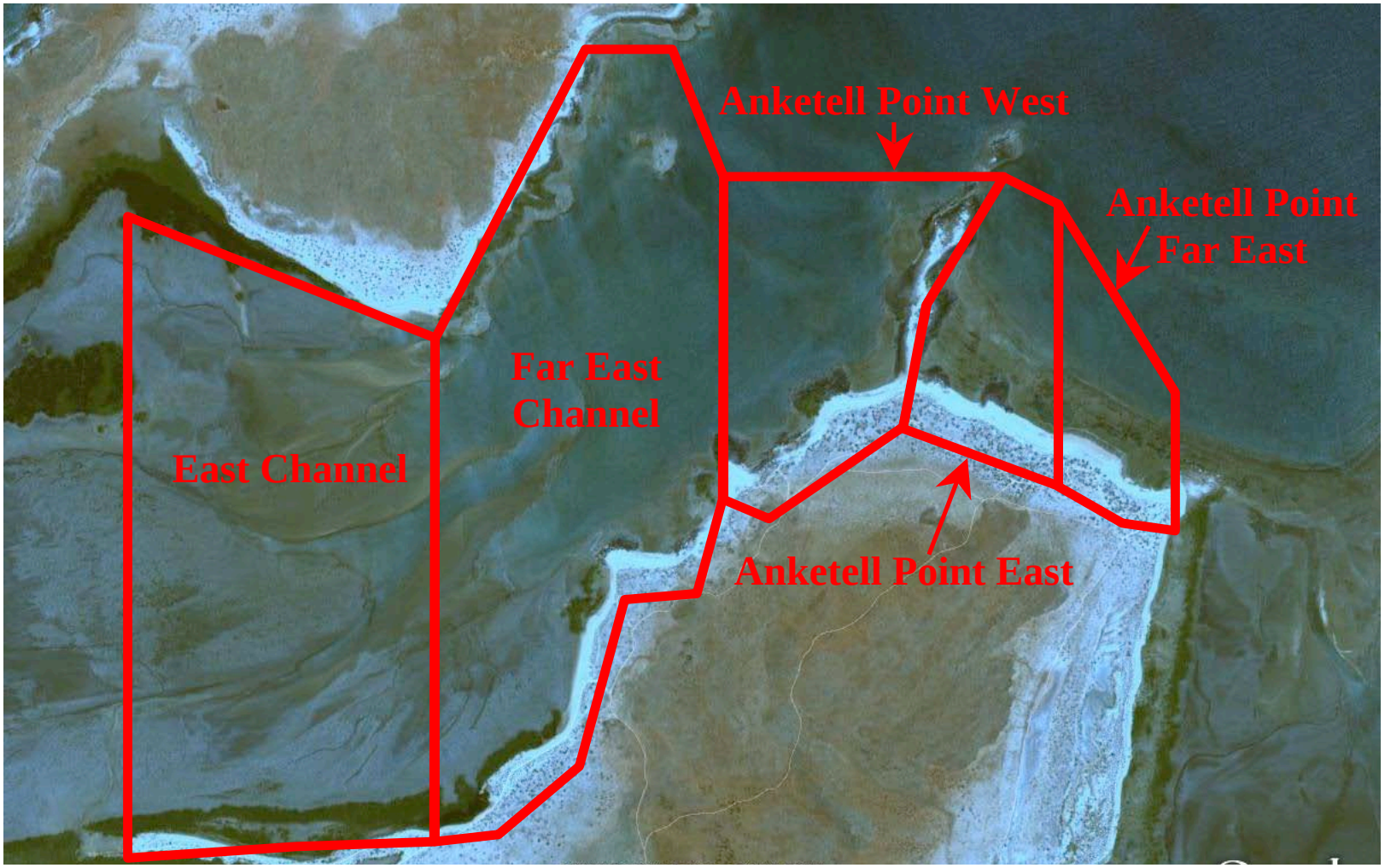

Figure 5. Map showing the location of the two channel sections and the three sections around Anketell Point that were surveyed for foraging birds at low tide.

RESULTS

Southward Migration Survey

The following section summarises the results of the October 2010 southward migration survey. All bird scientific names are presented in the annotated list.

Community Assemblage

A total of 38 littoral birds were recorded in October 2010, of which 23 were listed under one or more of CAMBA, JAMBA, or ROKAMBA. Twenty-two species were listed under CAMBA, 20 species under JAMBA and 18 under ROKAMBA, with 18 species listed under all three.

The most speciose families were Scolopacidae (13 species), Laridae (7 species), Charadriidae (5 species) and Ardeidae (4 species). The most abundant species at high tide roosts were Bar-tailed Godwit (683), Grey-tailed Tattler (662), Great Knot (524), Greater Sand Plover (456), Red-necked Stint (319), Common Greenshank (305) and Crested Tern (118). The most abundant species at low tide were Grey-tailed Tattler (501), Red-necked Stint (314), Bar-tailed Godwit (283), Greater Sand Plover (267), Red-capped Plover (158) and Great Knot (130).

Annotated List

The birds recorded during the spring southward migration (October 2010) survey are listed below in taxonomic order. The letter C, J and K at the end of each species' accounts indicate that the species is listed under CAMBA, JAMBA or ROKAMBA respectively.

Australian White Ibis (*Threskiornis molucca*) – Uncommon. The only records were 12 birds in one high tide roost and two other single individuals at high tide in the Mainland Mangroves.

Striated Heron (*Butorides striatus*) – Uncommon. A total of four birds were recorded at high tide from the South-east, Mainland Mangroves and Dixon Island East. A total of two birds were recorded at low tide, one each from Anketell Point Far-east and the East Channel.

Eastern Great Egret (*Ardea modesta*) – Scarce. The only record was a single bird perched in mangroves at low tide in the South-west Mudflats. **JC**

Little Egret (*Egretta garzetta*) – Common. A total of 20 birds were recorded in high tide roosts, with a single bird on the South-east Mudflats and the rest on the South-west Mudflats. Also a total of 23 birds recorded foraging at low tide in the East and Far East Channel and the South-east and South-west Mudflats.

Eastern Reef Egret (*Egretta sacra*) – Frequent. A total of 10 birds were recorded at high tide from Dixon Island North-west and North-east. Not recorded during low tide counts. **C**

Little Black Cormorant (*Phalacrocorax sulcirostris*) – Frequent. The only record was a flock of 27 at high tide in Dixon Island North-west.

Pied Cormorant (*Phalacrocorax varius*) – Scarce. The only record is a single bird at high tide in the Mainland Mangroves.

Australasian Darter (*Anhinga melanogaster*) – Scarce. The only record was one bird roosting in the Mainland Mangroves at high tide.

Eastern Osprey (*Pandion cristatus*) – Frequent. A total of six birds recorded at high tide with most (four) in Dixon Island North-west and singles in Dixon Island South-west and one on North-east Island. Also one bird at low tide over the South-west Mudflats.

Brahminy Kite (*Haliastur indus*) – Uncommon. Three birds were recorded at high tide over Dixon Island South-west, South-west and South-east. Singles birds were seen at low tide over Anketell Point Far-east, Anketell Point West and Far East Channel.

Pied Oystercatcher (*Haematopus longirostris*) – Common, with 39 birds recorded at high tide and seven at low tide. Most birds at high tide were recorded on the South-west Mudflats (26) with singles and pairs also scattered across Dixon Island South-west and East, Point Anketell and North-west and North-east regions. Birds at low tide were recorded in Anketell Point Far-east and West and the East Channel.

Sooty Oystercatcher (*Haematopus fuliginosus*) – Uncommon. A total of 15 birds were recorded at high tide in Cleaverville, Dixon Island North-east and North-west, North-east Island and Point Anketell.

Black-winged Stilt (*Himantopus himantopus*) – Uncommon. Three birds were recorded at high tide on the South-west Mudflats, a single bird at high tide in the Mainland Mangroves and a single bird at low tide on the South-west Mudflats.

Pacific Golden Plover (*Pluvialis fulva*) – Uncommon. Seven birds were recorded at high tide in Anketell Point and Dixon Island West and East. Only a single bird at low tide in Anketell Point East. **CJK**

Grey Plover (*Pluvialis squatarola*) – Common, with 20 birds recorded at high tide and 26 at low tide. Birds at high tide were in the South-east, East and North-east regions, South-west Mudflats, Anketell Point and Dixon Island South-west. Birds at low tide were recorded on the South-west Mudflats, Anketell Point East and West and the East Channel. **CJK**

Red-capped Plover (*Charadrius ruficapillus*) – Very common. A total of 100 birds were recorded at high tide, mostly in the South-east (40) and South-west Mudflats (49) but with birds scattered in Dixon Island South-west and South-west, Anketell Point and North. A total of 158 birds were recorded at low tide scattered across the South-west Mudflats, East and Far East Channel and Anketell Point West and East.

Lesser Sand Plover (*Charadrius mongolus*) – Common. A total of 15 birds were recorded at high tide and 56 at low tide. At high tide, individuals were scattered across Dixon Island South-west, North-east Island, Anketell Point and the South-east Mudflats. Most birds at low tide were on the South-west Mudflats (37), with other individuals widespread in Anketell Point Far-east, East and West and the Far East and East Channel. **CJK**

Greater Sand Plover (*Charadrius leschenaultii*) – Abundant, with 456 birds recorded at high tide roosts and 267 birds recorded at low tide. Birds at high tide were widespread in Dixon Island South-west and East, North-east Island, South-east and South-west Mudflats and Point Anketell. Birds were equally widespread at low tide across Anketell Point Far-east, East and West and the Far East and East Channel. **CJK**

Bar-tailed Godwit (*Limosa lapponica*) – Abundant. A total of 683 birds were recorded at high tide with most birds in the South-west (590) and South-east Mudflats (40), but with individuals scattered across Dixon Island South-west and East, North-east Island and South-east. At low tide, we recorded 283 birds on the South-west Mudflats, Anketell Point East and West and the Far East and East Channel. **CJK**

Whimbrel (*Numenius phaeopus*) – Very common. We recorded 106 birds at high tide, mostly in the South-west Mudflats (70), but some in the South-east Mudflats, Dixon Island South-west, North-east and East and the South, South-east, East, West and South-west. At low tide, 26 birds were recorded on the South-west and South-east Mudflats, Anketell Point West and the Far East and East Channel. **CJK**

Eastern Curlew (*Numenius madagascarensis*) – Frequent, with 10 birds recorded at high tide and 14 recorded at low tide. At high tide, birds were recorded in the South-west and South-east Mudflats. At low tide, birds were recorded on the South-west and South-east Mudflats and Far East and East Channel. **CJK**

Common Greenshank (*Tringa nebularia*) – Very common. We recorded 305 birds at high tide, mostly in the South-west Mudflats (277), but also in the South-east Mudflats, Dixon Island South-west and South and South-east. At low tide, we recorded 86 individuals in the South-west Mudflats, Anketell Point East and Far East and East Channel. **CJK**

Grey-tailed Tattler (*Heteroscelus brevipes*) – Abundant, with 662 birds recorded at high tide and 501 birds at low tide. Birds in high tide roosts were widespread in the South-west Mudflats, Dixon Island South-west, West, North-east, East and South, North-east Island and South, South-east, East, Anketell Point, West and South-west. At low tide, birds were equally widespread across the South-west and South-east Mudflats, Anketell Point Far-east, East and West and Far East and East Channel. **CJK**

Terek Sandpiper (*Xenus cinereus*) – Common, with 15 birds recorded at hight tide and 25 at low tide. Birds at high tide were recorded in South-west Mudflats and Dixon Island South-west. At low tide birds were foraging in South-west Mudlfats, Far East and East Channel. **CJK**

Common Sandpiper (*Actitis hypoleucos*) – Common. A total of 22 birds were recorded at high tide in Dixon Island South-west and North-east and the South, South-east, East, North-east, Anketell Point and South-west regions. Only two birds recorded at low tide, in the South-east Mudflats and Point Anketell East. **CJK**

Ruddy Turnstone (*Arenaria interpres*) – Very common, with 89 recorded at high tide and 12 at low tide. Birds in high roosts were widespread across Dixon Island South-west, West, East and North-east, North-east Island, South-west and South-east Mudflats, Anketell Point and South-east. At low tide, birds were recorded in Anketell Point Far-east and East, East Channel and South-west Mudflats. **CJK**

Great Knot (*Calidris tenuirostris*) – Abundant. A total of 524 birds were recorded at high tide, mostly in the South-west Mudflats (460), but also in the South-east Mudflats, Dixon Island South-west and the South-east and South-west regions. At low tide 130 birds were recorded in the South-west Mudflats, Anketell Point West and Far East and East Channel. **CJK**

Red Knot (*Calidris canutus*) – Scarce. The only record was a single bird in a high tide roost in the South-west Mudflats. **CJK**

Sanderling (*Calidris alba*) – Frequent. Nine birds were recorded at high tide in the South-west Mudflats and ten birds were recorded at low tide in Anketell Point East and the Far East and East Channel. **CJK**

Red-necked Stint (*Calidris ruficollis*) – Abundant with 319 birds recorded at high tide and 314 at low tide. Birds in high tide roosts were found in the South-west and South-east Mudflats amd Dixon Island South-west and Anketell Point. Birds foraging at low tide were recorded in Anketell Point Far-east and East and Far East and East Channel. **CJK**

Curlew Sandpiper (*Calidris ferruginea*) – Frequent. No birds were recorded at low tide but 12 birds were recorded in high tide roosts on the South-west Mudflats. **CJK**

Silver Gull (*Larus novaehollandiae*) – Very common. A total of 47 birds were recorded at high tide in Cleaverville, Mainland Mangroves, Dixon Island South-west, North-west, North-east and East, North-east Island and the North-west region. A total of 62 were recorded at low tide in Anketell Point East and West and the Far East Channel.

Gull-billed Tern (*Geliochelidon nilotica*) – Uncommon. The only record is two birds in a high tide roost on the South-west Mudflats.

Caspian Tern (*Hydroprogne caspia*) – Very common. A total of 42 were recorded at a high tide roost on the South-west Mudflats. At low tide, 73 birds were recorded on the South-west Mudflats, Anketell Point Far-east and West and the Far East and East Channel. **C**

Crested Tern (*Thalasseus bergii*) – Very common, but recorded mostly at high tide. Birds at high tide roosts were mostly in Dixon Island North-east (112) but with 5 birds on North-east Island and one bird in Dixon Island North-west. Only a single bird recorded at low tide, on Anketell Point West. **J**

Lesser Crested Tern (*Thalasseus bengalensis*) – Uncommon. Only recorded at high tide with 13 birds recorded in Dixon Island North-west and North-east and on North-east Island. **C**

Little Tern (*Sternula albifrons*) – Scarce. The only record is two birds foraging over Anketell Point East. **CJK**

Whiskered Tern (*Chlidonias leucoptera*) – Common. A total of 18 birds were recorded at high tide in the South-west Mudflats. Four birds were recorded at low tide in the South-west Mudflats and East Channel.

High Tide Roosts

A total of 3749 birds were recorded in high tide roosts in October 2010, on southward migration (Tables 1 – 3). Most birds at high tide were roosting in the sub-coastal mudflats with smaller number roosting in Dixon Island South-west, Dixon Island North-east, North-east Island, Anketell Point and South-east region (Fig. 6). The remaining regions either supported small roosts of less than 50 birds, or scattered individuals at high tide. Only Dixon Island North contained no birds at all.

The sub-coastal mudflats supported almost 72% of all birds recorded at high tide, with the South-west Mudflats supporting most of those (62%) with far fewer on the South-east Mudflats (10%). The other regions supporting large numbers of birds at high tide were, in order, Dixon Island South-west (8%), Dixon Island North-east and South-east region (both 4%) and Anketell Point and North-east Island (both 3%). Although only one other count across the same area has been conducted, the July 2009 breeding season survey (Western Wildlife 2009), these results are generally consistent and show that roosts tend to occur in the same regions.

The seven regions mentioned above appear to support most of the high tide roosts in the Greater Anketell region covered in this survey, at least in the breeding and southward migration seasons.

Low Tide Foraging

A total of 2091 birds were recorded foraging at low tide in October 2010, on southward migration (Table 4). Most birds were recorded foraging in the East and Far East Channel and South-west Mudflats with fewer in Anketell Point West, East and Far-east and the South-east Mudflats. By far the greatest numbers of birds were foraging in the East Channel (43%), followed by the South-west Mudflats (27%) and Far East Channel (17%). Anketell Point West supported more birds (6%) than either Anketell Point East (4%) or Far-east (2%) or the South-east Mudflats (<1%) but all supported relatively few birds.

Again, patterns were generally consistent with the survey in July 2009 (Western Wildlife 2009), with most birds foraging in the East and Far East Channel and South-west Mudflats. In addition, Anketell Point West generally supported more birds than Anketell Point East which, in turn, supported more birds than Anketell Point Far-east. However, in July 2009, almost 13% of birds at low tide were foraging on the South-east Mudflats indicating both that the importance of this area for foraging varies across seasons and that surveys need to be conducted across all shorebird seasons (breeding, southward migration, non-breeding and northward migration) as there is the potential for significant variation across seasons.

Differences between high and low tide counts

The population estimates for most species in the study area differed between high and low tides, which is not surprising at the former is designed to determine how many individuals use the study areas for roosting, while the latter is designed to determine how many individuals use specific parts of the study area for foraging. However, the reasons behind these differences vary between species and, as they will aid comprehension of the survey results, they are discussed briefly below.

Terns primarily forage at sea for fish and so their feeding cycles are governed more by currents than tide cycles, so many individuals could potentially be foraging at sea during high tides. Thus, differences between low and high tide counts for terns are unsurprising. The difference was least for gulls, which reflects the fact that gulls forage primarily in intertidal areas and do relatively little foraging at sea, at least compared to terns. Some species, like the Eastern Reef Egret and Sooty Oystercatcher were unrecorded at low tide because they forage primarily in rocky intertidal areas, such as those on North-east Island and the north coast of Dixon Island, which were not surveyed at low tide.

Most shorebirds had higher population estimates for high tide counts, compared to low tide counts. This most likely reflects the fact that only a proportion of the study area, close to the proposed development, was surveyed at low tide, whereas almost all of the study area was surveyed at high tide. The extra birds in high tide roosts probably foraged in the channel between Dixon Island and the mainland, but to the west of the areas surveyed. While counts were not conducted there, huge numbers of birds were seen in this part of the channel while counting bird in the East Channel and we suspect that numbers there are greater than in the East Channel. Some birds in roosts will also have foraged on mudflats off the east side of the Mainland (East, South-east and South regions) although the numbers would undoubtedly be very small compared to the numbers of birds in the channel, except for the Common Sandpiper which tends not to forage on extensive mudflats.

Among shorebirds, there were five exceptions to the above patterns. For three species, the Grey Plover, Terek Sandpiper and Red-necked Stints, very similar numbers of birds were recorded at high and low tide indicating that birds foraging in the low tide areas surveyed roosted in the study area, while birds foraging outside those areas probably roost outside the study area. Two species, the Red-capped Plover and Lesser Sand Plover, were recorded more frequently at low tide. This result is not surprising for the Red-capped Plover as this species frequently roosts on dry areas bereft of vegetation that are not favoured by other waders. Therefore, it is possible that many of the bird foraging at low tide roosted in dry sub-coastal areas behind the Mainland Mangroves that were not surveyed. The result for the Lesser Sand Plover is surprising as it normally roosts in areas favoured by other waders and, along the Pilbara coast, typically roosts in mixed flocks with Greater Sand Plovers (M. Craig, personal observation). Thus, the reasons for the lower numbers of birds in high tide roosts are unclear but it suggests some individuals may roost in sub-coastal areas behind the Mainland Mangroves. The most likely area would be the extensive sub-coastal mudflats in the south-western part of the study area.

Table 1. The number of individuals recorded roosting at high tide in Cleaverville, the seven regions of Dixon Island and North-east Island.

Note: see Figures 1 and 3 for the delineation of these areas.

Species	Cleaverville	Dixon Island							North-east Island	Total
		South	South-west	West	North-west	North	North-east	East		
Australian White Ibis										**0**
Striated Heron								1		**1**
Eastern Great Egret										**0**
Little Egret										**0**
Eastern Reef Egret					9		1			**10**
Little Black Cormorant					27					**27**
Pied Cormorant										**0**
Australasian Darter										**0**
Eastern Osprey			1		4				1	**6**
Brahminy Kite			1							**1**
Pied Oystercatcher			6					2		**8**
Sooty Oystercatcher	4				1		7		2	**14**
Black-winged Stilt										**0**
Pacific Golden Plover		1		2						**3**
Grey Plover			1							**1**
Red-capped Plover			3							**3**
Lesser Sand Plover			1						5	**6**
Greater Sand Plover		1	25						36	**62**
Bar-tailed Godwit		1	8						2	**11**
Whimbrel			2				3	1		**6**
Eastern Curlew										**0**
Common Greenshank			14							**14**
Grey-tailed Tattler		4	163	32			6	4	23	**232**
Terek Sandpiper			4							**4**
Common Sandpiper			4				2			**6**
Ruddy Turnstone			18	8			2	2	20	**50**
Great Knot			45							**45**
Red Knot										**0**
Sanderling										**0**
Red-necked Stint			20							**20**
Curlew Sandpiper										**0**
Silver Gull	18	8	1		4		4	1	4	**40**
Gull-billed Tern										**0**
Caspian Tern										**0**
Crested Tern					1		112		5	**118**
Lesser Crested Tern					8		4		1	**13**
Little Tern										**0**
Whiskered Tern										**0**
Total	**22**	**15**	**317**	**42**	**54**	**0**	**141**	**11**	**99**	**701**

Table 2. The number of individuals recorded roosting at high tide in the Mainland Mangroves and the nine regions of the mainland coast around Anketell Point.

Note: see Figures 1 and 2 for the delineation of these areas.

Species	Mainland Mangroves	Mainland									Total
		South-west	West	North-west	North	Anketell Point	North-east	East	South-east	South	
Australian White Ibis	14										**14**
Striated Heron	1								2		**3**
Eastern Great Egret											**0**
Little Egret											**0**
Eastern Reef Egret											**0**
Little Black Cormorant											**0**
Pied Cormorant	1										**1**
Australasian Darter	1										**1**
Eastern Osprey											**0**
Brahminy Kite		1							1		**2**
Pied Oystercatcher				1		2	2				**5**
Sooty Oystercatcher						1					**1**
Black-winged Stilt	1										**1**
Pacific Golden Plover						4					**4**
Grey Plover						1	1	1	6		**9**
Red-capped Plover		2			2	4					**8**
Lesser Sand Plover						8					**8**
Greater Sand Plover						30					**30**
Bar-tailed Godwit			1						41		**42**
Whimbrel		4	1					2	20	1	**28**
Eastern Curlew											**0**
Common Greenshank									8	1	**9**
Grey-tailed Tattler		24	5			31		21	40	2	**123**
Terek Sandpiper											**0**
Common Sandpiper		3				4	1	3	2	3	**16**
Ruddy Turnstone						19			5		**24**
Great Knot		1							6		**7**
Red Knot											**0**
Sanderling											**0**
Red-necked Stint						9					**9**
Curlew Sandpiper											**0**
Silver Gull	2			5							**7**
Gull-billed Tern											**0**
Caspian Tern											**0**
Crested Tern											**0**
Lesser Crested Tern											**0**
Little Tern											**0**
Whiskered Tern											**0**
Total	**20**	**35**	**7**	**6**	**2**	**113**	**4**	**27**	**131**	**7**	**352**

Table 3. The number of individuals recorded roosting at high tide in the sub-coastal Mudflats.

Note: see Figure 4 for the delineation of these areas.

Species	Mudflats		Total
	South-west	South-east	
Australian White Ibis			**0**
Striated Heron			**0**
Eastern Great Egret			**0**
Little Egret	19	1	**20**
Eastern Reef Egret			**0**
Little Black Cormorant			**0**
Pied Cormorant			**0**
Australasian Darter			**0**
Eastern Osprey			**0**
Brahminy Kite			**0**
Pied Oystercatcher	26		**26**
Sooty Oystercatcher			**0**
Black-winged Stilt	3		**3**
Pacific Golden Plover			**0**
Grey Plover	10		**10**
Red-capped Plover	49	40	**89**
Lesser Sand Plover		1	**1**
Greater Sand Plover	216	148	**364**
Bar-tailed Godwit	590	40	**630**
Whimbrel	70	2	**72**
Eastern Curlew	9	1	**10**
Common Greenshank	277	5	**282**
Grey-tailed Tattler	307		**307**
Terek Sandpiper	11		**11**
Common Sandpiper			**0**
Ruddy Turnstone	13	2	**15**
Great Knot	460	12	**472**
Red Knot	1		**1**
Sanderling	9		**9**
Red-necked Stint	175	115	**290**
Curlew Sandpiper	12		**12**
Silver Gull			**0**
Gull-billed Tern	2		**2**
Caspian Tern	42		**42**
Crested Tern			**0**
Lesser Crested Tern			**0**
Little Tern			**0**
Whiskered Tern	28		**28**
Total	**2329**	**367**	**2696**

Table 4. The number of individuals recorded foraging at low tide in the two sections of the inter-island channel, the three sections around Anketell Point and the two sub-coastal mudflats.

Species	Channel		Anketell Point			Mudflats		Total
	East	Far-east	West	East	Far East	South-west	South-east	
Australian White Ibis								**0**
Striated Heron	1				1			**2**
Eastern Great Egret						1		**1**
Little Egret	2	7				13	1	**23**
Eastern Reef Egret								**0**
Little Black Cormorant								**0**
Pied Cormorant								**0**
Australasian Darter								**0**
Eastern Osprey						1		**1**
Brahminy Kite		1	1		1			**3**
Pied Oystercatcher	4		2		1			**7**
Sooty Oystercatcher								**0**
Black-winged Stilt						1		**1**
Pacific Golden Plover				1				**1**
Grey Plover	7		1	5		13		**26**
Red-capped Plover	88	18	3	6		43		**158**
Lesser Sand Plover	3	2	1	8	5	37		**56**
Greater Sand Plover	140	41	5	16	8	56	1	**267**
Bar-tailed Godwit	112	33	7	3		128		**283**
Whimbrel	3	2	3			15	3	**26**
Eastern Curlew	1	1				10	2	**14**
Common Greenshank	45	10		1		30		**86**
Grey-tailed Tattler	203	39	16	23	19	200	1	**501**
Terek Sandpiper	19	2				4		**25**
Common Sandpiper				1			1	**2**
Ruddy Turnstone	5			3	1	3		**12**
Great Knot	81	17	25			7		**130**
Red Knot								**0**
Sanderling	4	4		2				**8**
Red-necked Stint	174	117		21	2			**314**
Curlew Sandpiper								**0**
Silver Gull		24	37	1				**62**
Gull-billed Tern								**0**
Caspian Tern	2	34	26		1	10		**73**
Crested Tern			1					**1**
Lesser Crested Tern								**0**
Little Tern				2				**2**
Whiskered Tern	2					2		**4**
Total	**896**	**352**	**128**	**93**	**39**	**574**	**9**	**2091**

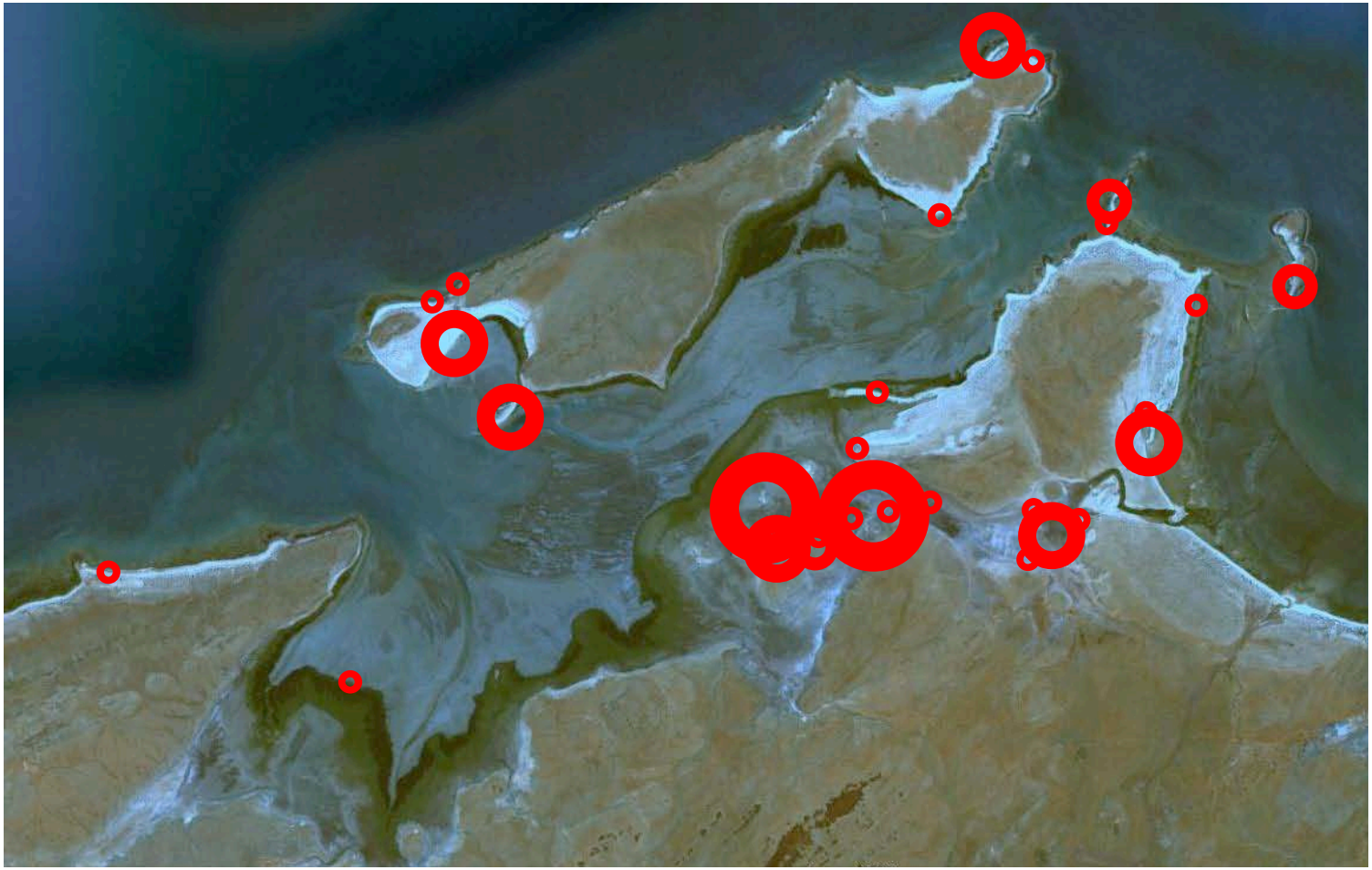

Figure 6. Map showing the location of high tide roosts (>10 birds) within the greater Anketell Point region in October 2010. The smallest circles represent roosts of 10-50 birds, the second smallest represent roosts of 51-100 birds, the second largest roosts of 101-500 birds and the largest circle represents roosts of >500 birds.

Global Populations

In October 2010, the Greater Anketell region supported globally significant populations of one species, the Grey-tailed Tattler (Table 5). A total of 662 birds were recorded roosting at high tide with most in the South-west Mudflats (46%) and Dixon Island South-west (25%). Smaller numbers were roosting in the South-east (6%), Dixon Island West and Anketell Point (both 5%), South-west (4%) and North-east Island and East (both 3%). The remaining 21 birds were scattered through the remaining regions.

A total of 501 birds were recorded at low tide, with the majority in the East Channel (41%) and South-west Mudflats (40%) and lower number in the Far East Channel (8%), Anketell Point East (5%), Far-east (4%) and West (3%) and the South-east Mudflats (<1%). As the Grey-tailed Tattler is migratory, breeding in eastern Siberia, it is possible that the study area holds greater numbers of birds during either the non-breeding season or northward migration, or both. Unfortunately, we lack data from the Greater Anketell Region during both those seasons.

No other species came close to the 1% global population criterion. The closest species was the Pied Oystercatcher with 0.35% of the global population in the study area at high tide (Table 5). This was very similar to the 0.32 % recorded in July 2009 (Western Wildlife 2009) and, as the species is resident, it is likely that the numbers recorded provide a reasonably good estimate of the year round population.

The only other resident species where the study area supported ≥0.10% of the global population, were the Red-capped Plover (0.17%; we have used low tide counts for this species for the reasons discussed above) and the Sooty Oystercatcher (0.13%). These estimates are very close to those recorded in July 2009 (0.18% for Red-capped Plover and 0.13% for Sooty Oystercatcher), which is unsurprising considering the species are considered resident. Given their resident status, we can confidently assume that counts for all three species will not exceed the 1% threshold in any season, although we lack counts for the non-breeding and northward migration seasons.

Among migratory species, the only other species (apart from the Grey-tailed Tattler) where the study area supported ≥0.10% of the global population were the Great Knot (0.14%), Greater Sand Plover (0.13%) and Red-necked Stint (0.10%). Although we lack data for these species for the non-breeding and northward migration seasons, it is unlikely that the study area would hold >1% of the global population of these species in either of those seasons. To achieve this would require the study area to support 7 times more Great Knot, 8 times more Greater Sand Plovers and 10 times more Red-necked Stints then were recorded during the southward migration. Such increases above southward migration counts are unrecorded for any sites along the Pilbara or Kimberley coast so we can reasonably assume the study area does not support global significant populations of these species during the non-breeding and northward migration seasons.

Flyway Populations

As the flyway population estimate for the Grey-tailed Tattler is the same as the global population estimate (Table 5), the number of Grey-tailed Tattlers is also significant within the EAA flyway.

No other species came close to the 1% flyway population criterion. The closest species were the Common Greenshank (0.51%) and Greater Sand Plover (0.41%), both with high counts at high tide (Table 5). It is possible, although unlikely, that the study area supports >1% of the flyway population of these species in either the non-breeding or northward migration seasons, or both.

Among the remaining migratory species, the only other species where the study area supported ≥0.10% of the flyway population were the Great Knot (0.14%), Whimbrel (0.11%), Bar-tailed Godwit (0.21%), Ruddy Turnstone (0.25%) and Red-necked Stint (0.10%). Although we lack data for these species for the non-breeding and northward migration seasons, it is unlikely that the study area would hold >1% of the flyway population of these species in either of those seasons.

Table 5. Minimum population counts from high tide roost counts and low tide counts, with the proportion of the global and EAA flyway populations.

Note: the two counts that were ≥ 1% of the global population are shown in bold.

Species	1% Criterion (Global Pop[n])	1% Criterion (Flyway Pop[n])	Minimum Counts in October 2010					
			High Tide			Low Tide		
			Count	% Global Pop[n]	% Flyway Pop[n]	Count	% Global Pop[n]	% Flyway Pop[n]
Australian White Ibis	10 000	-	14	<0.01	-	0	-	-
Striated Heron	N/A*	-	4	-	-	2	-	-
Eastern Great Egret	20 000	-	0	-	-	1	<0.01	-
Little Egret	20 000	-	20	<0.01	-	23	<0.01	-
Eastern Reef Egret	10 000	-	10	<0.01	-	0	-	-
Little Black Cormorant	10 000	-	27	<0.01	-	0	-	-
Pied Cormorant	5 000	-	1	<0.01	-	0	-	-
Australasian Darter	1 000	-	1	<0.01	-	0	-	-
Eastern Osprey	N/A	-	6	-	-	1	-	-
Brahminy Kite	N/A	-	3	-	-	3	-	-
Pied Oystercatcher	110	-	39	0.35	-	7	0.06	-
Sooty Oystercatcher	115	-	15	0.13	-	0	-	-
Black-winged Stilt	3 000	-	4	<0.01	-	1	<0.01	-
Pacific Golden Plover	2 000	1 000	7	<0.01	<0.01	1	<0.01	<0.01
Grey Plover	7 000	1 250	20	<0.01	0.02	26	<0.01	0.02
Red-capped Plover	950	-	100	0.11	-	158	0.17	-
Lesser Sand Plover	3 000	1 400	15	<0.01	0.01	56	0.02	0.04
Greater Sand Plover	3 400	1 100	456	0.13	0.41	267	0.08	0.24
Bar-tailed Godwit	12 000	3 250	683	0.06	0.21	283	0.02	0.09
Whimbrel	20 000	1 000	106	<0.01	0.11	26	<0.01	0.03
Eastern Curlew	380	380	10	0.03	0.03	14	0.04	0.04
Common Greenshank	14 000	600	305	0.02	0.51	86	<0.01	0.14
Grey-tailed Tattler	500	500	**662**	**1.32**	**1.32**	**501**	**1.00**	**1.00**
Terek Sandpiper	10 000	600	15	<0.01	0.02	25	<0.01	0.04
Common Sandpiper	40 000	250	22	<0.01	0.09	2	<0.01	<0.01
Ruddy Turnstone	7 000	350	89	0.01	0.25	12	<0.01	0.03
Great Knot	3 800	3 750	524	0.14	0.14	130	0.03	0.03
Red Knot	10 000	2 200	1	<0.01	<0.01	0	-	-
Sanderling	7 000	220	9	<0.01	0.04	10	<0.01	0.04
Red-necked Stint	3 200	3 250	319	0.10	0.10	314	0.10	0.10
Curlew Sandpiper	18 000	1 800	12	<0.01	<0.01	0	-	-
Silver Gull	20 000	-	47	<0.01	-	62	<0.01	-
Gull-billed Tern	3 400	-	2	<0.01	-	0	-	-
Caspian Tern	3 000	-	42	0.01	-	73	0.02	-
Crested Tern	12 000	-	118	<0.01	-	1	<0.01	-
Lesser Crested Tern	1 600	-	13	<0.01	-	0	-	-
Little Tern	2 800	-	0	-	-	2	<0.01	-
Whiskered Tern	10 000	-	28	<0.01	-	4	<0.01	-

*N/A = non-congregatory so thresholds can not be determined

CONCLUSIONS AND RECOMMENDATIONS

1. The greater Anketell region is highly likely to be a significant site for the Grey-tailed Tattler and possibly the Greater Sand Plover.

Based on the survey conducted in October 2010, the Greater Anketell region supports globally significant populations of Grey-tailed Tattler on southward migration. Most of the roosts in October 2010 were located in the South-west Mudflats and Dixon Island South-west while most of the low tide foraging was done in the East Channel and South-west Mudflats, although reasonable numbers were recorded in most areas surveyed at low tide.

Data from the non-breeding (summer) and northward migration (autumn) seasons are lacking for the greater Anketell area. Therefore, it is not possible to speculate about how many individuals occur in the study area, nor where they roost and forage, at these times.

The October 2010 results and the survey results reported in Western Wildlife (2009) indicate that it is unlikely that the study area supports globally significant populations of any other species. However, it is possible that counts of Greater Sand Plovers in the non-breeding and northward migration seasons may exceed 1% of the East Asian-Australasian Flyway population of this species.

2. The sub-coastal mudflats are likely to be important for shorebirds.

The surveys conducted so far indicate that the sub-coastal mudflats are very important at both high and low tide for both all birds and Grey-tailed Tattlers in particular. Tidal water to the South-west and South-east mudflats enters along creeks from the north and east respectively. The only surface water exchange between these two mudflats occurs on very high spring tides. Therefore, any development should aim to cross this area of mudflats at the highest point, between the two areas where the large roosts are located. Ideally, impacts could be minimised through infrastructure that allowed waterflow between these two mudflats.

3. The channel between Dixon Island and the mainland is likely to be important for foraging shorebirds, including potentially a globally significant population of Grey-tailed Tattlers.

The channel between Dixon Island and mainland supports large numbers of foraging birds of both all species and Grey-tailed Tattlers in particular. The main waterflow inputs for this intertidal area are from the west and from the east around Point Anketell. As water enters this intertidal area on the tide, it deposits its coarse sediments first and its fine sediments last. This means that the areas closest to Anketell Point and in the middle of the intertidal area provide relatively poorer sandy foraging habitat while, as one moves westwards along the channel and, also, north and south to the coastlines of the mainland and Dixon Island, the intertidal area is likely to provide a much richer, muddier foraging habitat. This implies that any impediment to the flow of water into this intertidal area would likely have negative impacts of the quality of foraging habitat in the entire eastern half of the intertidal area.

4. Most high tide roosts were located on the sub-coastal mudflats, Dixon Island, North-east Island, Anketell Point and the south-east region on the mainland.

Most high tide roosts were located in the sub-coastal mudflats, with the majority of birds in the South-west Mudflats. Other important high tide roosts were located on Dixon Island South-west, Dixon Island North-east, North-east Island, Anketell Point and the South-east region. Unless surveys are conducted in the non-breeding and northward migration seasons, it is not possible to confidently identify which region support the most important roosts year round.

5. The area to the east of Anketell Point may support fewer birds.

It is difficult to identify areas that contain low numbers of birds year round as roost sites in the non-breeding or northward migration seasons may differ in location from those in the breeding and southward migration seasons. At low tide, the most important areas were the channel between Dixon Island and the Mainland and the sub-coastal mudflats, with areas to the east of Anketell Point supporting relatively fewer birds. While it is likely that this pattern is consistent throughout the year, it would be desirable to collect information in the non-breeding and northward migration seasons to confirm this.

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Greater Anketell Point Area:

Summer (non-breeding season) shorebird survey 2011

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INTRODUCTION

Migratory shorebirds are declining significantly in the East Asian-Australasian flyway, primarily due to the destruction of critical migration stop-over sites in the Yellow Sea area of north-eastern China and the Korean Peninsula. However, the complexity of their migrations means that habitat must be preserved during both northward and southward migration, as well as during the breeding and non-breeding seasons, if populations are to be conserved. The loss of critical habitat in any of those four periods (or "shorebird seasons") would be likely to impact on migratory shorebirds.

Previous bird surveys in the Anketell Point area were carried out in the following seasons:

- March 2008 (northward migration) – preliminary bird survey of immediate Anketell Point area with opportunistic counts of shorebirds only.
- October 2008 (southward migration) – shorebird survey of immediate Anketell Point area.
- March 2009 (northward migration) – shorebird survey of immediate Anketell Point area.
- July 2009 (breeding season) – shorebird survey of greater Anketell Point area.
- October 2010 (southward migration) – shorebird survey of greater Anketell Point area.

In the surveys of the greater Anketell Point region, significant numbers of the Grey-tailed Tattler (*Heteroscelus brevipes*) were recorded.

To assess any potential impact of development at Point Anketell and Dixon Island on migratory shorebirds during the non-breeding season, a survey was conducted in January 2011 to assess the importance of the area for both roosting at high tide and for foraging at low tide. This was to complement earlier surveys conducted in the greater Anketell Area in the breeding season (July 2009) and southward migration (October 2010).

Unlike previous surveys, this survey also covered a wider area in order to determine the importance of any surrounding areas for migratory shorebirds and put populations in the Anketell Point area into a regional perspective. Other littoral zone birds and mangrove species are easily counted during surveys for migratory shorebirds and these species were also recorded to determine potential impacts on Australian breeding shorebirds, herons and terns.

This report summarises the results of the non-breeding season survey undertaken in January 2011.

Legislative Protection for Shorebirds

At the Commonwealth level, migratory species are listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The species listed under the EPBC Act includes those listed under the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). Species listed under JAMBA are also protected under Schedule 3 of the *Western Australian Wildlife Conservation Act* 1950.

All migratory species listed under the EPBC Act are considered matters of national environmental significance. Therefore, if an action is likely to have a significant impact on a migratory species listed under the EPBC Act, the action will have to be referred to the Minister and undergo the environmental assessment and approval process.

Significant impacts on migratory shorebirds include the destruction, isolation or substantial modification of important areas of habitat, and/or the serious disruption of the lifecycle of an ecologically significant proportion of the population of a migratory species (DEWHA 2009). Important habitat for a migratory species can include areas that are only used occasionally or periodically, but supports an ecologically significant proportion of the population. In the case of migratory shorebirds, this can include a site that is important during one or more of the breeding or non-breeding season, or as a staging area during northward or southward migration (Bamford *et al*. 2008, DEWHA 2009).

Important Bird Areas

Important Bird Areas (IBAs) are sites of global conservation significance to birds. An IBA must meet four criteria as defined by BirdLife International. The IBA criterion of most pertinence to migratory shorebirds is that the site supports >1% of the estimated global population of a congregatory waterbird or seabird.

An IBA does not have any legislative protection, but the IBA process is a scientific method of identifying sites that are important for bird conservation. The IBA 1% global population criteria have been used in this report to determine whether the Anketell Point area supports a significant number of any shorebird species. These criteria are sourced from global waterbird numbers published in Delaney and Scott (2002).

Flyway Populations

The migratory shorebirds that visit Australia are from the East Asian – Australasian EAA) Flyway. The EAA Flyway includes Russia, Alaska, parts of south and east Asia, Australia and New Zealand. Some species occur only within this flyway, so the flyway and global population figures are the same. Other species occur in more than one flyway, so the population figures for the EAA Flyway are lower. Therefore, a species may not meet the 1% criterion for its global population, but it may meet or exceed the 1% criterion for the flyway population.

METHODS

The aim of the January 2011 survey was to identify sites that were potentially important to migratory shorebirds and other littoral birds in the region around Anketell Point during the non-breeding season. An additional aim was to identify significant roost sites for the Grey-tailed Tattler, a species recorded in high numbers on previous surveys.

Along the Pilbara coast, the non-breeding season extends from early November to early March. The region surveyed extended from Pemberton Island and a sandy spit approximately 12km ENE of Karratha (495465E, 7712996N) in the west, to a small inlet approximately 6.3km ESE of Cossack (525413E, 7710540N) in the east. The survey also included five offshore islands which, from west to east, were Pemberton, Walcott, Dixon, North-east and Jarman Island (Figs. 1 – 5).

To survey this region, a six-day survey was conducted from 21st to 26th January 2011 to count birds at low and high tide.

High tide surveys were conducted from 1000 to 1445 on 21st January from the South-west Mainland to the first rocky headland to the east of Anketell Point, from 1000 to 1500 on 22nd January from the sandy spit 12km ENE of Karratha to Cape Lambert Beach to the east of Cape Lambert, from 1015 to 1545 on 23rd January from Cape Lambert Beach, east of Cape Lambert, to the inlet 6.3km ESE of Cossack and the Cossack and South Samson Mudflats, from 1145 to 1600 on 24th January on the South-west and South-east Mudflats and the North Samson Mangroves and from 1230 to 1600 on 25th January on the Far West Mudflats and the Mangrove Creek Mudflats.

Planned counts around Karratha on the 26th January had to be cancelled due to unsafe weather conditions caused by the presence of Tropical Cyclone Bianca with Karratha being under Yellow Alert during the time that high tide counts could have been conducted.

To conduct high tide counts, the region was divided up into 13 survey regions, Nickol Bay, Mangrove Creek Mudflats, Cleaverville, Far West Mudflats, Dixon Island, Mainland Mangroves, Mainland, Mudflats, North-east Island, Lambert Bay, Cape Lambert, Point Samson and Cossack (Fig. 1).

Of these regions, all except Mangrove Creek Mudflats, Cleaverville, Far West Mudflats, Mainland Mangroves and North-east Island were further divided into smaller sections to facilitate an understanding of the spatial distribution of shorebirds in the broader region (Figs. 2-7). Within each of these regions and sections, all littoral birds seen were recorded as either in a roost (>10 birds) or outside a roost. If a roost were observed then a GPS location of the roost site was recorded as well as the number of individuals of all species within that roost.

Low tide surveys of foraging birds were conducted on 22nd January from 0545 to 0800 on Anketell Point Far-east (the area from 510200 to 510600E), Anketell Point East (the area from 509775 to 510200E) and Anketell Point West (the area from 509350 to 509775E), on 23rd January from 0545 to 0910 in the Far East Channel (the area from 508500 to 509350E) and East Channel (the area from 507700 to 508500E), on 24th January from 0545 to 0900 on the South-west and South-east Mudflats (Fig. 4) and on 25th January from 0715 to 1015 on the Far West Channel (north to the rocky point and east to the mangrove channel). The area between the Far West Channel and Anketell Point West was not surveyed due to safety reasons, as this area of mudflat is separated from the coast by mangroves that would be difficult to traverse in the case of a rising tide. See Figure 8 for the location of all eight areas surveyed at low tide. All birds recorded were assigned to one of the eight areas demarcated for low tide counts.

Personnel

The survey was conducted by Dr Mike Craig, as a sub-contractor to Western Wildlife, and Mr Brendan Metcalf, also a sub-contractor to Western Wildlife. Mike has over 25 years experience in identifying and counting shorebirds and waterbirds and has previously conducted shorebird surveys for many proposed development, most notably proposals on Barrow Island and the east side of the Exmouth Gulf. The report was prepared by Dr Mike Craig and Ms Jenny Wilcox of Western Wildlife.

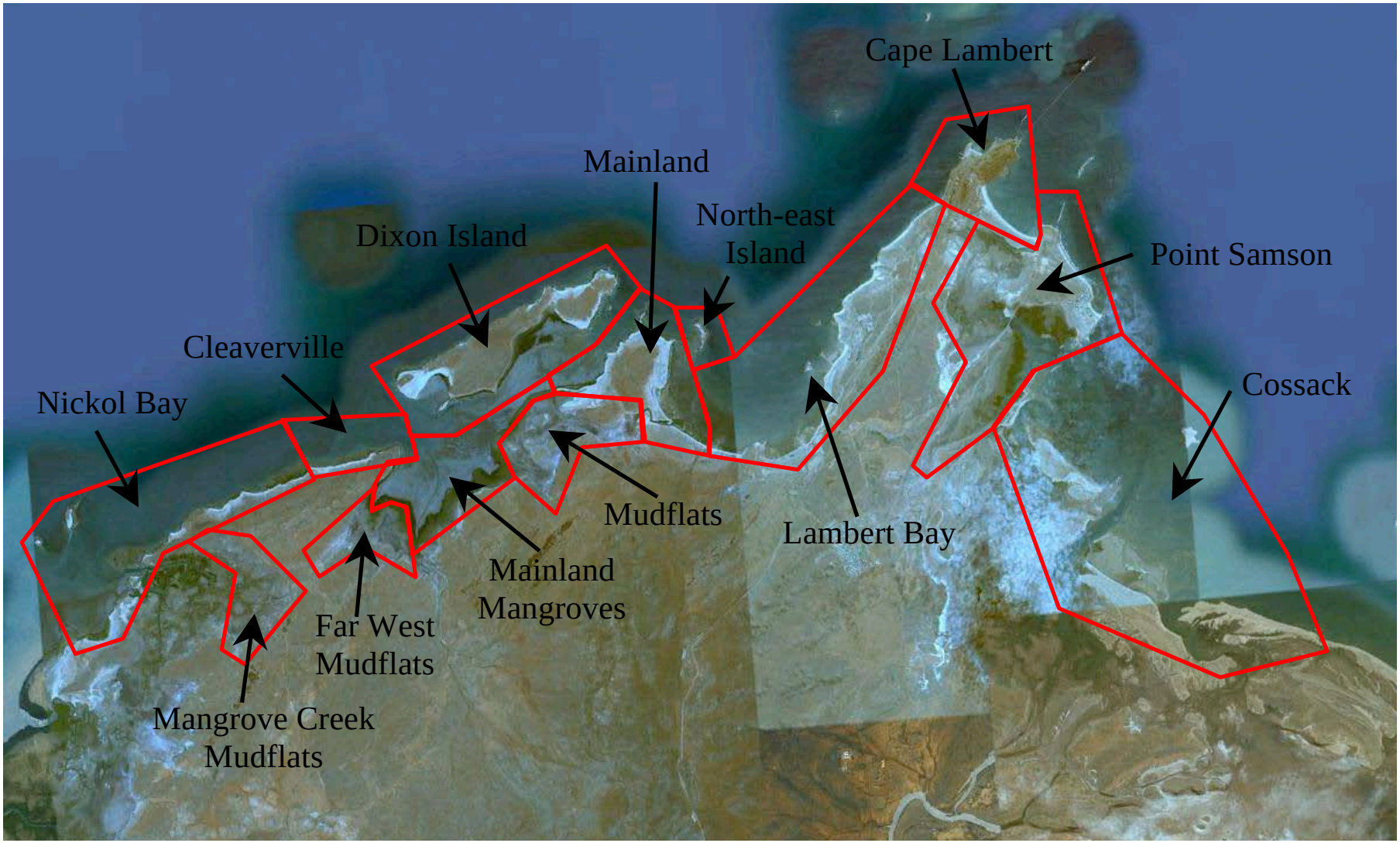

Figure 1. Map showing the location of the thirteen main regions surveyed for shorebirds (both individuals and roosts) at high tide.

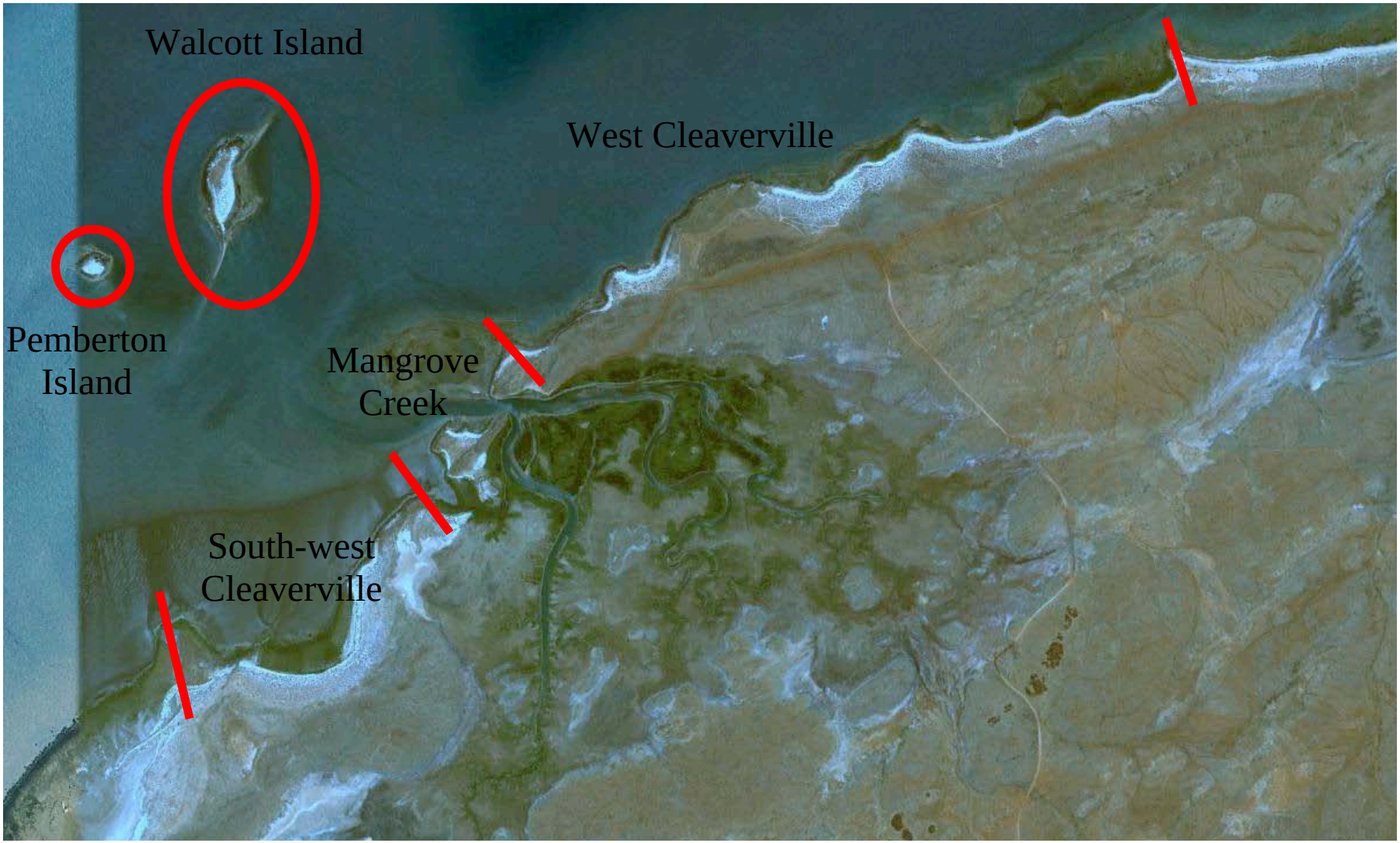

Figure 2. Map showing the location of the five sections used to map the location of high tide roosts and individual birds in the Nickol Bay region.

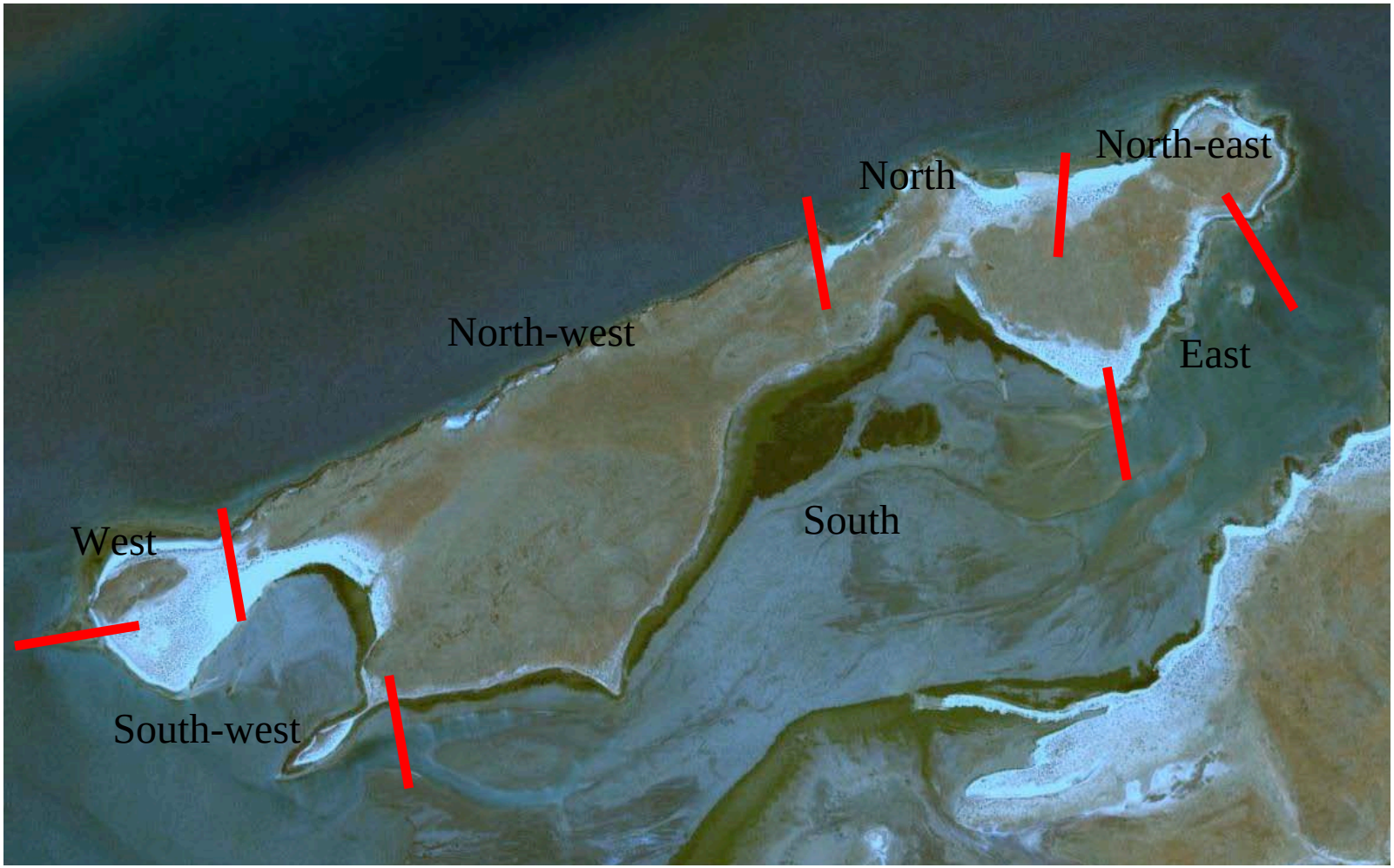

Figure 3. Map showing the location of the seven sections used to map the location of high tide roosts and individual birds on Dixon Island.

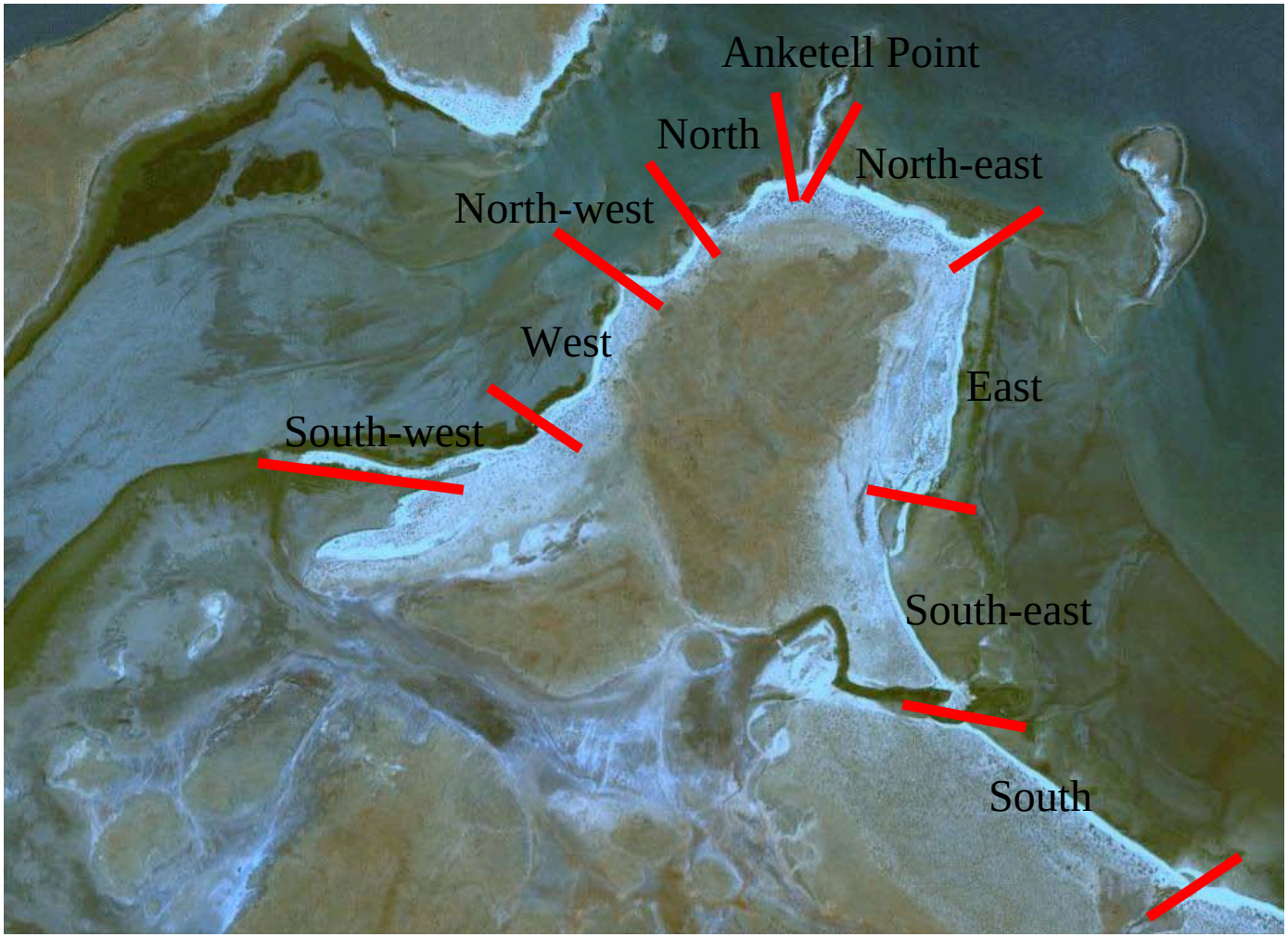

Figure 4. Map showing the location of the nine sections used to map the location of high tide roosts and individual birds in the Mainland region.

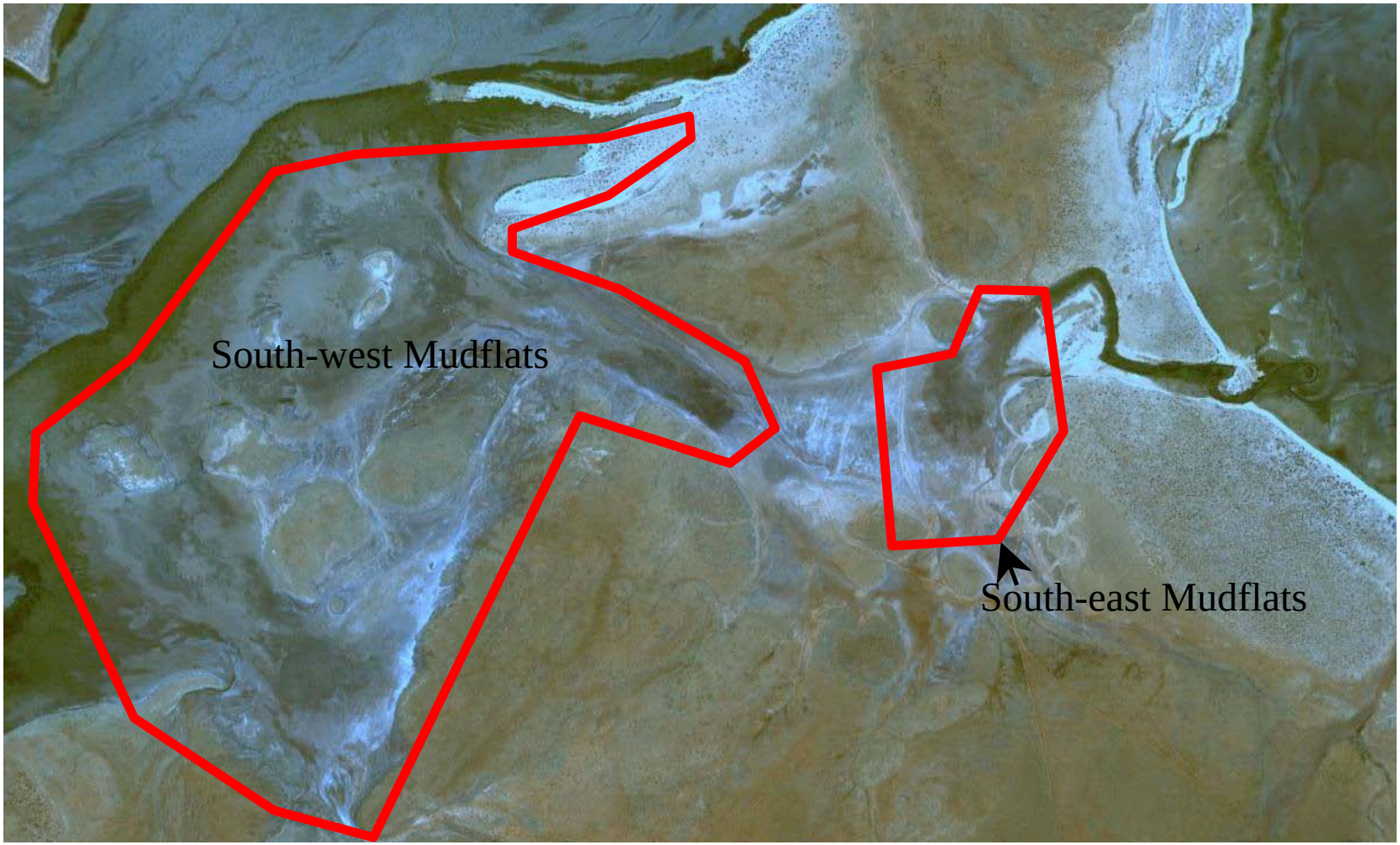

Figure 5. Map showing the location of the two sub-coastal mudflats that were surveyed both for roosting birds at high tide and for foraging birds at low tide.

Figure 6. Map showing the location of the ten sections used to map the location of high tide roosts and individual birds in the Lambert Bay, Cape Lambert and Point Samson regions.

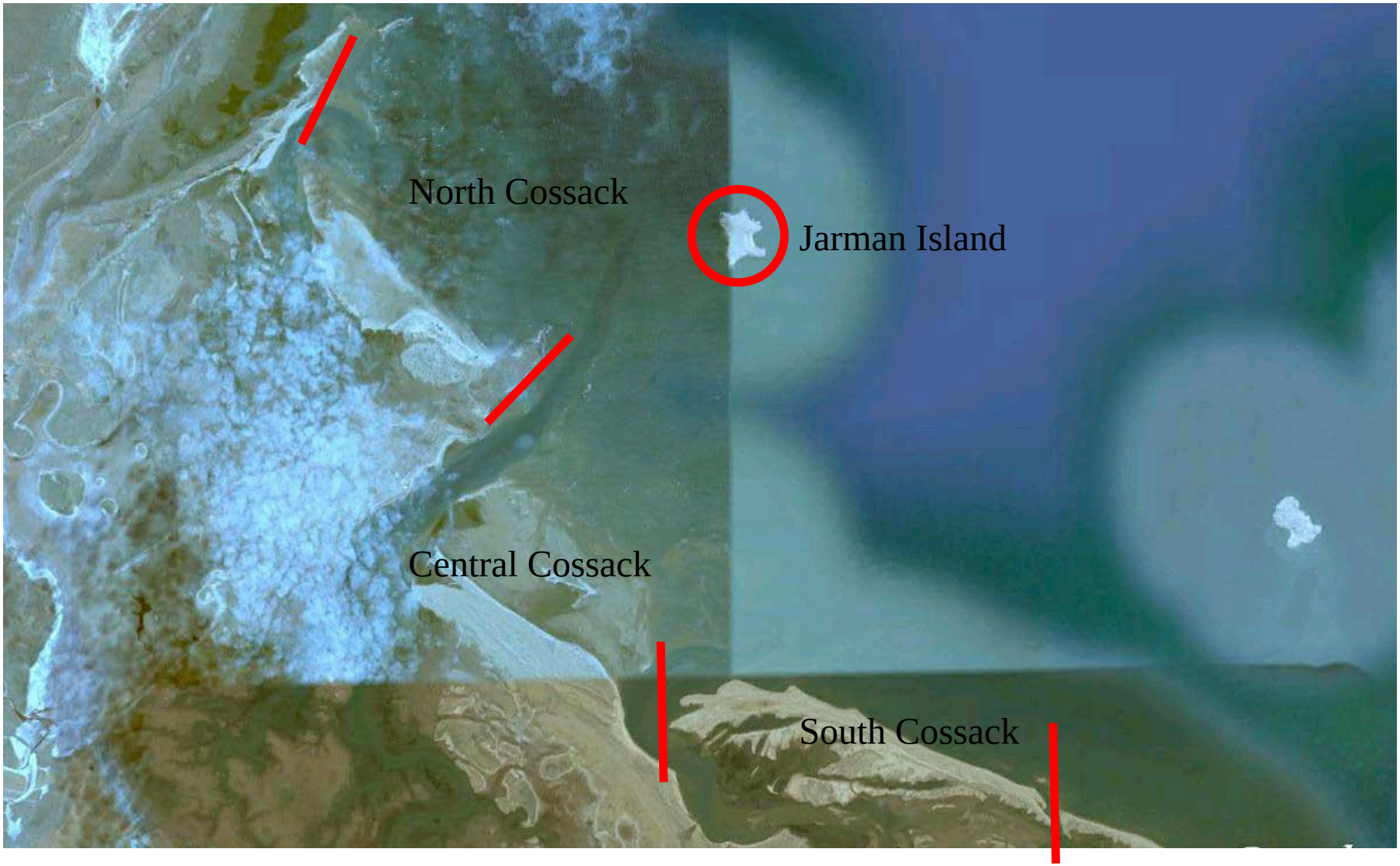

Figure 7. Map showing the location of the four sections used to map the location of high tide roosts and individual birds in the Cossack region.

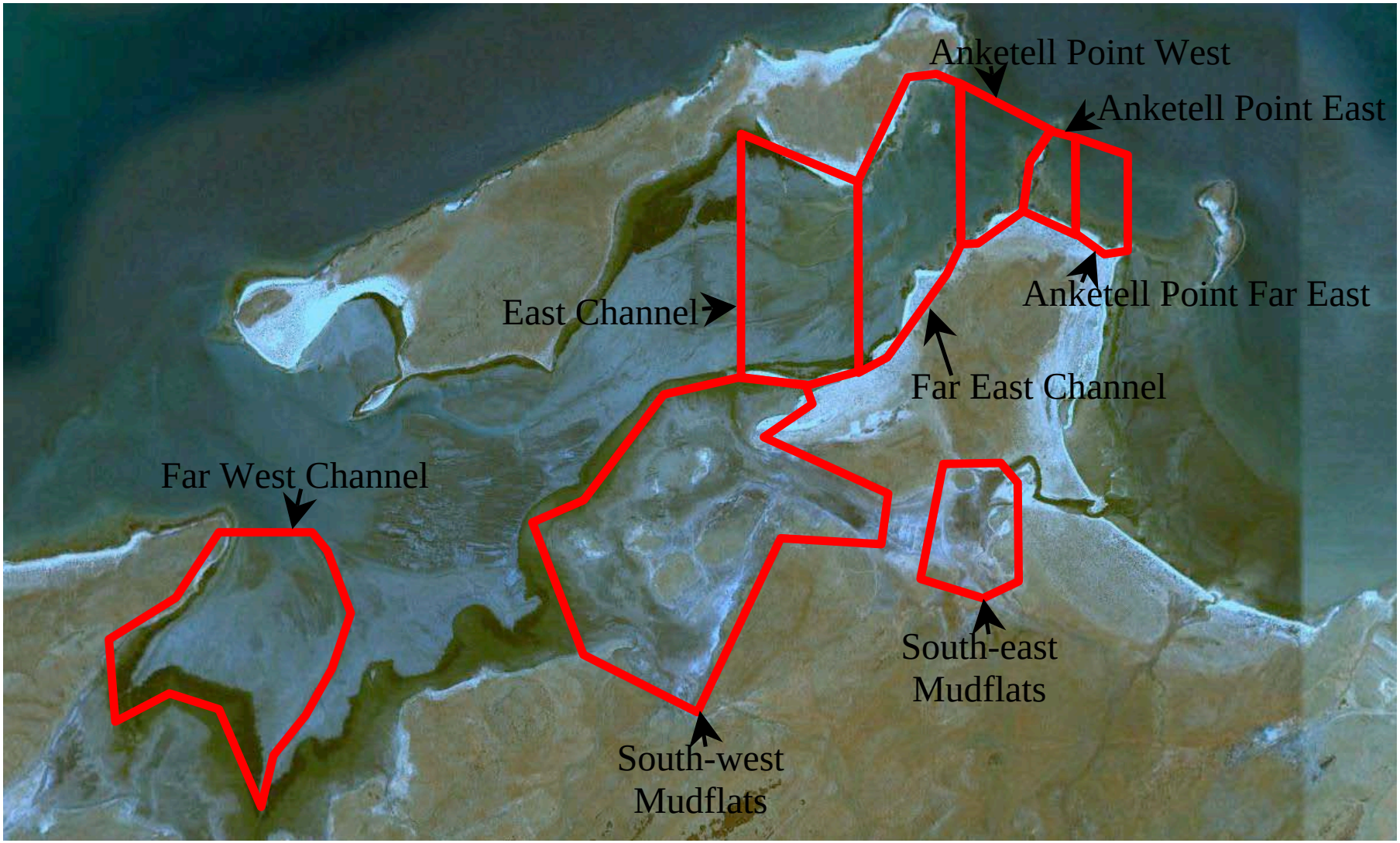

Figure 8. Map showing the location of the eight areas surveyed for foraging birds at low tide.

RESULTS

Community Assemblage

We recorded a total of 45 littoral birds in January 2011 (Table 1), of which 28 were listed under either CAMBA, JAMBA or ROKAMBA. Twenty-seven species were listed under CAMBA, 24 species under JAMBA and 22 under ROKAMBA, with 22 species listed under all three.

The most speciose families were Scolopacidae (14 species), Laridae (9 species) and Charadriidae (6 species). The most abundant species in high tide roosts were Great Knot (1895), Bar-tailed Godwit (1718), Crested Tern (1679), Silver Gull (1234), Greater Sand Plover (1094), Grey-tailed Tattler (990) and Red-necked Stint (738) (Tables 1 and 2). The most abundant species at low tide were Grey-tailed Tattler (722), Bar-tailed Godwit (361), Greater Sand Plover (356), Red-necked Stint (205), Great Knot (169) and Common Greenshank (143) (Table 3).

Annotated List

The birds recorded during the summer non-breeding season (January 2011) survey are listed below in taxonomic order. The letter C, J and K at the end of each species' accounts indicate that the species is listed under CAMBA, JAMBA or ROKAMBA respectively.

Australian Pelican (*Pelecanus conspicillatus*) – Uncommon. A total of 19 birds were recorded at high tide, with 12 birds on Pemberton Island, four birds in Lambert Bay East, two birds in Central Cossack and a single bird in Lambert Bay North (Table 2). The only record at low tide was one bird in the Far East Channel (Table 3).

Australian White Ibis (*Threskiornis molucca*) – Uncommon. A total of 10 widely scattered individuals were recorded at high tide in the Mainland Mangroves, South-west Mudflats, South-west, West and South Mainland and the North Samson Mudflats (Table 2). Seven individuals were recorded at low tide in the Far West, East and Far East Channel and Anketell Point West (Table 3).

Striated Heron (*Butorides striatus*) – Uncommon. The only record at high tide was one bird in the Point Samson Mangroves (Table 2). At low tide a total of six birds were recorded from the Far West, East and Far East Channel and the South-west Mudflats (Table 3).

Little Egret (*Egretta garzetta*) – Frequent, with a total of 20 birds recorded at high tide and 12 birds at low tide. Birds at high tide were recorded primarily from the South-west and South-east Mudflats but with records also from the Far West Mudflats, East Mainland, North Samson Mudflats, Central and South Cossack (Table 2). A low tide, birds were recorded in the Far West and East Channel (Table 3).

Eastern Reef Egret (*Egretta sacra*) – Frequent. A total of 24 birds were recorded at high tide, mostly from Walcott Island, West Cleaverville and Cape Lambert, but also from the North-west Mainland and Lambert Bay South (Table 2). The only bird recorded at low tide was in Anketell Point East (Table 3). **C**

Little Pied Cormorant (*Phalacrocorax melanoleucos*) – Scarce. The only record is a single bird at high tide in the Mainland Mangroves (Table 1).

Little Black Cormorant (*Phalacrocorax sulcirostris*) – Frequent. The only record was a flock of 300 at high tide in West Cleaverville (Table 2).

Pied Cormorant (*Phalacrocorax varius*) – Common, with 163 birds recorded at high tide, but only a single bird at low tide. At high tide, most birds were on Pemberton Island and Cape Lambert, but also singles in Dixon Island West and Lambert Bay East (Table 2). The single bird at low tide was in the Far West Channel (Table 3).

Eastern Osprey (*Pandion cristatus*) – Frequent. A total of 19 birds were recorded at high tide from across the region with birds on Walcott Island, Mangrove Creek, West Cleaverville, Dixon Island North-west, South-east Mainland, Cape Lambert, Cape Lambert Beach, South Samson Mudflats, Point Samson Mangroves, North and South Cossack and Jarman Island (Table 2). At low tide, single birds were recorded over the East Channel and Anketell Point West (Table 3).

White-bellied Sea-Eagle (*Haliaeetus leucogaster*) – Uncommon. Single birds were recorded at high tide over the Mangrove Creek Mudflats, Point Samson Mangroves and Central Cossack (Table 2). **C**

Brahminy Kite (*Haliastur indus*) – Uncommon. Two birds were recorded at high tide over the East and South Mainland (Table 2). Singles birds were seen at low tide over Anketell Point Far-east and the South-west Mudflats (Table 3).

Beach Stone-curlew (*Burhinus magnirostris*) – Uncommon. Single birds were recorded at high tide on Walcott Island, West Mainland and North-east Island (Table 2). Not recorded at low tide.

Pied Oystercatcher (*Haematopus longirostris*) – Common, with 123 birds recorded at high tide and 19 at low tide. Most birds at high tide were recorded on the South-west Mudflats (83), Cleaverville (15) and North Cossack (8) but it was also recorded on Walcott Island, West Mainland, Point Anketell, Lambert Bay East, Cape Lambert, Point Samson, North, Central and South Cossack and Jarman Island (Table 2). At low tide, birds were recorded in the Far West, East and Far East Channel and Anketell Point West (Table 3).

Sooty Oystercatcher (*Haematopus fuliginosus*) – Common. A total of 50 birds were recorded at high tide from across the region. Birds were recorded on Pemberton and Walcott Islands, West Cleaverville, Cleaverville, Dixon Island East and North-east, North-east Island, Lambert Bay North, Point Samson, Point Samson Mangroves, Central and South Cossack and Jarman Island (Table 2). Not recorded at low tide.

Black-winged Stilt (*Himantopus himantopus*) – Uncommon. Three birds were recorded at high tide on the Far West and South-west Mudflats (Table 2), and two birds were recorded at low tide in the Far West Channel (Table 3).

Pacific Golden Plover (*Pluvialis fulva*) – Frequent. A total of 16 birds were recorded at high tide on the South-east Mudflats, East Mainland and North Samson Mangroves (Table 2). Not recorded at low tide. **CJK**

Grey Plover (*Pluvialis squatarola*) – Common, with 33 birds recorded at high tide and 21 at low tide. Birds at high tide were widespread in the Far West, South-east and South-west Mudflats, East Mainland, Lambert Bay South and East, South Samson Mudflats and Central and South Cossack (Table 2). Birds at low tide were recorded in the Far West, East and Far East Channel and Anketell Point West (Table 3). **CJK**

Red-capped Plover (*Charadrius ruficapillus*) – Very common. A total of 253 birds were recorded at high tide, mostly in the South-west (93), South-east (48), Mangrove Creek (29) and Far West Mudflats (23), but with birds scattered in Anketell Point, West, North-east, East, South and South-east Mainland, Lambert Bay South and East, Cossack, South Samson and North Samson Mudflats and Central and South Cossack (Table 2). A total of 96 birds were recorded at low tide scattered across the Far West, East and Far East Channel, South-west Mudflats, and Anketell Point East (Table 3).

Lesser Sand Plover (*Charadrius mongolus*) – Common. A total of 38 birds were recorded at high tide and 41 at low tide. At high tide, individuals were scattered across Mangrove Creek , Far West and South-east Mudflats, Anketell Point, North-east Mainland, Lambert Bay South and East and North Samson Mudflats (Table 2). Birds were widespread at low tide in the Far West, East and Far East Channel, Anketell Point West, East and Far-east and the South-east Mudflats (Table 3). **CJK**

Greater Sand Plover (*Charadrius leschenaultii*) – Abundant, with 1094 birds recorded at high tide roosts and 356 birds recorded at low tide. Birds at high tide were mostly in the Mangrove Creek, Far West, South-west, South-east and South and North Samson Mudflats and Lambert Bay East, but there were also birds widely scattered in the South-west, West, North-west and North-east Mainland, Anketell Point, Lambert Bay South, Cossack Mudflats and North and South Cossack (Table 2). Birds were equally widespread at low tide across Far West, East and Far East Channel, Anketell Point West, East and Far-east and the South-east Mudflats (Table 3). **CJK**

Oriental Plover (*Charadrius veredus*) – Uncommon. Seven birds were roosting at high tide in the Mangrove Creek Mudflats (Table 2) and two birds were recorded on the South-west Mudflats at low tide (Table 3). **CJK**

Bar-tailed Godwit (*Limosa lapponica*) – Abundant. A total of 1718 birds were recorded at high tide with most birds in the South-west Mudflats (982), but with birds also present in the Far West and South-east Mudflats, West, East and South-east Mainland, Lambert Bay South and East, Cossack and North Samson Mudflats and North, Central and South Cossack (Table 2). At low tide, we recorded 361 birds in the Far West, East and Far East Channel and Anketell Point West, East and Far-east (Table 3). **CJK**

Whimbrel (*Numenius phaeopus*) – Very common. We recorded 260 birds at high tide, mostly in the South-west Mudflats (119), but with some individuals in the Mangrove Creek, Far West and South-east Mudflats, Dixon Island South, South-west, West and East and the South-west, West, East, South-east and South Mainland, Anketell Point, North-east Island, Lambert Bay South and East, Cossack and North Samson Mudflats, North, Central and South Cossack and Jarman Island (Table 2). At low tide, 29 birds were recorded in the Far West, East and Far East Channel, Anketell Point West and East and the South-west and South-east Mudflats (Table 3). **CJK**

Eastern Curlew (*Numenius madagascarensis*) – Common, with 64 birds recorded at high tide and 21 at low tide. At high tide, birds were recorded in the Mangrove Creek, Far West, South-west, South-east, Cossack and South and North Samson Mudflats and North Cossack (Table 2). At low tide, birds were recorded in the Far West and Far East Channel and the South-west and South-east Mudflats (Table 3). **CJK**

Common Greenshank (*Tringa nebularia*) – Very common. We recorded 196 birds at high tide, mostly in the Far West Mudflats (78), but also in the Mangrove Creek, South-west and South-east Mudflats, South-west, West and East Mainland, Lambert Bay South and East, Cossack and North Samson Mudflats and Central Cossack (Table 2). At low tide, 143 individuals were recorded in the Far West, East and Far East Channel (Table 3). **CJK**

Grey-tailed Tattler (*Heteroscelus brevipes*) – Abundant, with 990 birds recorded at high tide and 722 birds at low tide. Birds in high tide roosts were primarily in the South-west Mudflats (539), but with reasonable numbers in the Far West Mudflats (151), Lambert Bay East (83), Central Cossack (47) and Dixon Island South-west (31). The remaining individuals were widespread across Walcott Island, West Cleaverville, Mangrove Creek Mudflats, Mainland Mangroves, Dixon Island, South, South-west and East, Anketell Point, South-west, West, North-west, North-east, East, South-east and South Mainland, South-east Mudflats, North-east Island, Lambert Bay South and East, North Samson Mudflats, Point Samson, Point Samson Mangroves and North and Central Cossack (Table 2). At low tide, birds were equally widespread across the Far West, East and Far East Channel, Anketell Point West, East and Far-east and the South-west Mudflats (Table 3). **CJK**

Terek Sandpiper (*Xenus cinereus*) – Common, with 97 birds recorded at high tide and 68 at low tide. Birds at high tide were only recorded in the Far West (21) and South-west (76) Mudflats (Table 2). At low tide birds were foraging in the Far West, East and Far East Channel (Table 3). **CJK**

Common Sandpiper (*Actitis hypoleucos*) – Frequent. A total of 17 birds were recorded at high tide scattered across Dixon Island North-east and East, Anketell Point, South-west, West, North-west, North-east, East and South Mainland, Lambert Bay South and East and the North Samson Mudflats (Table 2). Only three birds recorded at low tide, in the East and Far East Channel (Table 3). **CJK**

Ruddy Turnstone (*Arenaria interpres*) – Very common, with 198 recorded at high tide and 50 at low tide. Birds in high roosts were widespread across Walcott Island, Cleaverville, Mangrove Creek, Far West, South-west and South-east Mudflats, Anketell Point, West, North-west, East and South-east Mainland, Lambert Bay South and East, North Samson Mudflats and Central Cossack (Table 2). At low tide, birds were recorded in the East and Far East Channel and Anketell Point West, East and Far-east (Table 3). **CJK**

Great Knot (*Calidris tenuirostris*) – Abundant. A total of 1895 birds were recorded at high tide, mostly in the South-west Mudflats (1356), but also in the Far West and South-east Mudflats, Lambert Bay East and North and Central Cossack (Table 2). At low tide 169 birds were recorded in the Far West, East and Far East Channel (Table 3). **CJK**

Red Knot (*Calidris canutus*) – Scarce. The only record was two birds foraging at low tide in the Far West Channel (Table 3). **CJK**

Sanderling (*Calidris alba*) – Frequent. A total of 29 birds were recorded at high tide, mostly in the South-west Mudflats (26) but with two birds in Lambert Bay East and a single bird in the South-east Mudflats (Table 2). Ten birds were recorded at low tide in the East Channel and Anketell Point East (Table 3). **CJK**

Red-necked Stint (*Calidris ruficollis*) – Abundant with 738 birds recorded at high tide and 205 at low tide. Birds in high tide roosts were mostly found in the Far West (148) and South-west (523) Mudflats, but with individuals also found in the Mangrove Creek, South-east, Cossack, South Samson and North Samson Mudflats and Lambert Bay East (Table 2). Birds foraging at low tide were recorded in the Far West, East and Far East Channel and Anketell Point East and Far-east (Table 3). **CJK**

Sharp-tailed Sandpiper (*Calidris acuminata*) – Scarce. The only record is two birds roosting at high tide in the Far West Mudflats (Table 1). **CJK**

Curlew Sandpiper (*Calidris ferruginea*) – Frequent. No birds were recorded at low tide but 32 birds were recorded in high tide roosts on the Far West (2) and South-west (30) Mudflats (Table 2). **CJK**

Oriental Pratincole (*Glareola maldivarum*) – Common. Not recorded at low tide but 358 birds were recorded at high tide, mostly in the South-west Mudflats (357) but with a single bird on the South-east Mudflats (Table 2). **CJK**

Silver Gull (*Larus novaehollandiae*) – Abundant. A total of 1234 birds were recorded at high tide. They were most abundant on Walcott (380) and Jarman Islands (541), but they were also widespread across South-west Cleaverville, Mangrove Creek, West Cleaverville, Cleaverville, Far West Mudflats, Mainland Mangroves, Dixon Island, North-west, North and North-east, West and East Mainland, South-west and South-east Mudflats, North-east Island, Lambert Bay East and North, Cape Lambert and Cape Lambert Beach, North Samson Mudflats, Point Samson, Point Samson Mangroves and North, Central and South Cossack (Table 2). A total of 86 were recorded at low tide in the Far West, East and Far East Channel and Anketell Point West and East (Table 3).

Gull-billed Tern (*Geliochelidon nilotica*) – Frequent. We recorded a total of 16 birds at high tide in the Far West and South-west Mudflats and a single bird at low tide over the Far West Channel (Tables 2 and 3).

Caspian Tern (*Hydroprogne caspia*) – Common. A total of 53 were recorded at high tide roosts on the Far West, South-west and South-east Mudflats, Lambert Bay South and North, Central and South Cossack (Table 2). At low tide, 37 birds were recorded in the Far West, East and Far East Channel, Anketell Point West and East and South-east Mudflats (Table 3). **C**

Crested Tern (*Thalasseus bergii*) – Abundant, but only recorded at high tide. Birds at high tide roosts were mostly on Pemberton Island (750), Central Cossack (316), Jarman Island (230) and North-east Island (219), but with other individuals on Dixon Island West, South-west Mudflats, Cape Lambert, Point Samson and North and South Cossack (Table 2). **J**

Lesser Crested Tern (*Thalasseus bengalensis*) – Common. Only recorded at high tide with 47 individuals recorded across Pemberton Island, North-east Island, Central Cossack and Jarman Island (Table 2). **C**

Common Tern (*Sterna hirundo*) – Very common, but only recorded at high tide when 242 individuals were found across the South-west and South-east Mudflats, Cape Lambert, North and South Cossack and Jarman Island (Table 2). **CJK**

Bridled Tern (*Onychoprion anaethetus*) – Very common, but only recorded at high tide from offshore islands. A total of 142 were counted on Jarman Island (140) and Walcott Island (2) (Table 2).

Little Tern (*Sternula albifrons*) – Very common, but recorded primarily at high tide. A total of 343 birds were counted at high tide from the Far West Mudflats, South-west and South-east Mudflats, Dixon Island East, Cape Lambert, Cape Lambert Beach, North Samson Mudflats, Point Samson, Point Samson Mangroves and North Cossack (Table 2). Only eight birds were recorded at low tide, foraging over the Far West, East and Far East Channel (Table 3). **CJK**

Whiskered Tern (*Chlidonias leucoptera*) – Uncommon. The only records are two birds at high tide on the South-east Mudflats and one bird foraging at low tide over the Far West Channel (Tables 2 and 3).

High Tide Roosts

Surveys of rooting birds at high tide were carried out in the areas indicated in Figures 1 – 7.

A total of 12,534 birds were recorded in high tide roosts in January 2011, in the non-breeding season (Tables 1 and 2). Most birds at high tide were roosting in the sub-coastal mudflats and the offshore islands (Figure 9), but roosts on the offshore islands comprised mostly gulls, terns and cormorants, whereas roosts on the sub-coastal mudflats comprised mostly shorebirds.

Smaller numbers of roosting birds were recorded in Lambert Bay East, Cape Lambert, North Samson Mudflats and North and Central Cossack, but no other regions or sections supported more than 200 birds, except West Cleaverville whose count was most up almost entirely by a flock of 300 Little Black Cormorants. The sub-coastal mudflats supported approximately 53% of all birds counted and most of these birds were on the South-west Mudflats (38%), with the Far West Mudflats (9%) and South-east Mudflats (6%) supporting far fewer birds. The offshore islands supported 19% of the birds counted with birds being more even distributed across Jarman Island (8%), Pemberton Island (7%) and Walcott Island (4%).

The offshore islands were not counted during the other surveys but the importance of the South-west and South-east Mudflats has been consistent across all three surveys conducted so far in January 2011 (non-breeding), October 2010 (southward migration) and July 2009 (breeding). The Far West Mudflats were first counted during this survey so the importance of this mudflat in the other seasons is unknown, although it is likely to be important during the other shorebird seasons as well.

Table 1. High tide counts: the number of individuals recorded roosting at high tide in each region.

Note: see Figure 1 for the delineation of these regions.

Species	Number of individuals in each region													Totals
	Nickol Bay	Mangrove Creek Mudflats	Far West Mudflats	Cleaverville	Mainland Mangroves	Dixon Island	North-east Island	Mainland	Mudflats	Lambert Bay	Cape Lambert	Point Sampson	Cossack	
Australian Pelican	12									5			2	**19**
Australian White Ibis					2			6	1			1		**10**
Striated Heron												1		**1**
Little Egret			2					1	12			2	3	**20**
Eastern Reef Egret	18					1				1	4			**24**
Little Pied Cormorant					1									**1**
Little Black Cormorant	300													**300**
Pied Cormorant	135					1				1	26			**163**
Eastern Osprey	3					3		1			5	3	4	**19**
White-bellied Sea-Eagle		1										1	1	**3**
Brahminy Kite								2						**2**
Beach Stone-curlew	1					1	1							**3**
Pied Oystercatcher	2			15				2	83	2	3	2	14	**123**
Sooty Oystercatcher	18			3		7	2			3		9	8	**50**
Black-winged Stilt			1						2					**3**
Pacific Golden Plover								5	3			8		**16**
Grey Plover			5					4	15	5		1	3	**33**
Red-capped Plover		29	23					10	141	18		30	2	**253**
Lesser Sand Plover		12	12					2	5	4		3		**38**
Greater Sand Plover		42	189					11	498	162		166	26	**1094**
Oriental Plover		7												**7**
Bar-tailed Godwit			182					47	1156	47		3	283	**1718**
Whimbrel		37	20			5	1	45	128	7		11	5	**259**
Eastern Curlew		8	20			1			28			7	1	**65**
Common Greenshank		2	78					12	48	3		22	31	**196**
Grey-tailed Tattler	12	2	151		1	37	2	51	550	88		48	48	**990**
Terek Sandpiper			21						76					**97**
Common Sandpiper						2		12		2		1		**17**
Ruddy Turnstone	43	4	15	1				32	30	32		10	31	**198**
Great Knot			248						1373	16			258	**1895**
Red Knot														**0**
Sanderling									27	2				**29**
Red-necked Stint		4	148						569	3		14		**738**
Sharp-tailed Sandpiper			2											**2**
Curlew Sandpiper			2						30					**32**
Oriental Pratincole									358					**358**
Silver Gull	389		11	16	1	4	1	18	17	3	54	79	641	**1234**
Gull-billed Tern			9						7					**16**
Caspian Tern			4						42	1			6	**53**
Crested Tern	750					25	219		3		81	1	600	**1679**

Table 1. (cont.)

Species	Number of individuals in each region													Totals
	Nickol Bay	Mangrove Creek Mudflats	Far West Mudflats	Cleaverville	Mainland Mangroves	Dixon Island	North-east Island	Mainland	Mudflats	Lambert Bay	Cape Lambert	Point Sampson	Cossack	
Lesser Crested Tern	32						4						11	**47**
Common Tern									4		124		114	**242**
Bridled Tern	2												140	**142**
Little Tern			7			2			299		4	19	12	**343**
Whiskered Tern									2					**2**
Totals:	**1717**	**148**	**1150**	**35**	**5**	**89**	**230**	**261**	**5507**	**405**	**301**	**442**	**2244**	**12534**

Table 2. High tide counts: the number of individuals recorded roosting at high tide in each region and section.

Note: see Figures 1 - 7 for the delineation of these regions and sections.

Species	Nickol Bay					Mangrove Creek Mudflats	Far West Mudflats	Cleaverville	Mainland Mangroves	Dixon Island							North-east Island	Mainland									Mudflats		Lambert Bay			Cape Lambert		Point Samson					Cossack				Total
	Pemberton Island	Walcott Island	South-west Cleaverville	Mangrove Creek	West Cleaverville					South	South-west	West	North-west	North	North-east	East		South-west	West	North-west	North	Anketell Point	North-east	East	South-east	South	South-west	South-east	South	East	North	Cape Lambert	Cape Lambert Beach	Cossack Mudflats	South Samson Mudflats	North Samson Mudflats	Point Samson	Point Samson Mangroves	North Cossack	Central Cossack	South Cossack	Jarman Island	
Australian Pelican	12																												4	1									2			**19**
Australian White Ibis									2									1	1							4	1								1							**10**
Striated Heron																																				1					**1**
Little Egret							2																	1			8	4							2				1	2		**20**
Eastern Reef Egret		14			4								1																1			4										**24**
Little Pied Cormorant									1																																	**1**
Little Black Cormorant					300																																					**300**
Pied Cormorant	135											1																		1		26										**163**
Eastern Osprey		1		1	1								3												1						3	2		2		1	1		2	1	**19**
White-bellied Sea-Eagle						1																														1		1				**3**
Brahminy Kite																								1		1																**2**
Beach Stone-curlew		1										1					1																										**3**
Pied Oystercatcher		2						15											1			1					83			2			3			2		8	2	2	2	**123**
Sooty Oystercatcher	2	11			5			3							6	1	2													3					7	2		2	1	5	**50**
Black-winged Stilt							1																				2															**3**
Pacific Golden Plover																								5				3							8							**16**

Table 2. (cont.)

Species	Nickol Bay					Mangrove Creek Mudflats	Far West Mudflats	Cleaverville	Mainland Mangroves	Dixon Island							North-east Island	Mainland								Mudflats		Lambert Bay			Cape Lambert		Point Samson					Cossack				Total
	Pemberton Island	Walcott Island	South-west Cleaverville	Mangrove Creek	West Cleaverville					South	South-west	West	North-west	North	North-east	East		South-west	West	North-west	North	Anketell Point	North-east	East	South-east	South	South-west	South-east	South	East	North	Cape Lambert	Cape Lambert Beach	Cossack Mudflats	South Samson Mudflats	North Samson Mudflats	Point Samson	Point Samson Mangroves	North Cossack	Central Cossack	South Cossack	Jarman Island	
Grey Plover							5																4			9	6	1	4					1					2	1		**33**
Red-capped Plover						29	23												1			2	4	1	1	1	48	93	8	10				16	6	8				1	1		**253**
Lesser Sand Plover						12	12															1	1				5	1	3					2	1						**38**
Greater Sand Plover						42	189											1	1	1		6	2				233	265	8	154				9	55	102			20		6		**1094**
Oriental Plover						7																																				**7**
Bar-tailed Godwit							182												2					34	11		982	174	1	46				1		2			127	86	70		**1718**
Whimbrel						37	20			2	1	2					1	7	2			1		18	13	4	119	9	3	4				1		10			1	1	2	1	**259**
Eastern Curlew						8	20									1											27	1						2	2	3			1				**65**
Common Greenshank						2	78											2	1					9			39	9	1	2				1		21				31			**196**
Grey-tailed Tattler		10			2	2	151		1	3	31					3	2	11	3	1		13	1	6	13	3	539	11	5	83						44	1	3	1	47			**990**
Terek Sandpiper							21																				76															**97**
Common Sandpiper															1	1		1	3	1		2	3	1		1			1	1						1							**17**
Ruddy Turnstone		43				4	15	1											8	1		18		4	1		20	10	1	31						10				31			**198**
Great Knot							248																				1356	17		16									154	104			**1895**
Red Knot																																											**0**
Sanderling																											26	1		2													**29**
Red-necked Stint						4	148																				523	46		3				4	7	3							**738**
Sharp-tailed Sandpiper							2																																			**2**

Table 2. (cont.)

Species	Nickol Bay					Mangrove Creek Mudflats	Far West Mudflats	Cleaverville	Mainland Mangroves	Dixon Island							North-east Island	Mainland									Mudflats		Lambert Bay			Cape Lambert		Point Samson					Cossack				Total
	Pemberton Island	Walcott Island	South-west Cleaverville	Mangrove Creek	West Cleaverville					South	South-west	West	North-west	North	North-east	East		South-west	West	North-west	North	Anketell Point	North-east	East	South-east	South	South-west	South-east	South	East	North	Cape Lambert	Cape Lambert Beach	Cossack Mudflats	South Samson Mudflats	North Samson Mudflats	Point Samson	Point Samson Mangroves	North Cossack	Central Cossack	South Cossack	Jarman Island	
Curlew Sandpiper							2																				30															**32**
Oriental Pratincole																											357	1														**358**
Silver Gull		380	1	2	6		11	16	1				2	1	1		1		11					7			13	4		1	2	51	3			10	25	44	23	60	17	541	**1234**
Gull-billed Tern							9																				7															**16**
Caspian Tern							4																				41	1	1											1	4	1		**53**
Crested Tern	750											25					219										3					81					1		15	316	39	230	**1679**
Lesser Crested Tern	32																4																								3		8	**47**
Common Tern																											3	1				124							34		3	77	**242**
Bridled Tern		2																																								140	**142**
Little Tern							7									2											235	64				2	2			16	1	2	12				**343**
Whiskered Tern																												2															**2**
Total:	**931**	**464**	**1**	**3**	**318**	**148**	**1150**	**35**	**5**	**5**	**32**	**29**	**6**	**1**	**8**	**8**	**230**	**23**	**34**	**4**	**0**	**44**	**11**	**91**	**40**	**14**	**4780**	**727**	**32**	**367**	**6**	**291**	**10**	**34**	**75**	**242**	**37**	**54**	**398**	**694**	**147**	**1005**	**12534**

Figure 9. Map showing the location of high tide roosts (>10 birds) within the survey area. The smallest circles represent roosts of 10-50 birds, the second smallest represent roosts of 51-100 birds, the second largest roosts of 101-500 birds and the largest circle represents roosts of >500 birds.

Low Tide Foraging

Surveys of foraging birds at low tide were carried out in the areas indicated in Figure 8, including the channel between Dixon Island and the Mainland, as well as the mudflats exposed to the east and west of Anketell Point and the sub-coastal mudflats.

A total of 2,485 birds were recorded foraging at low tide in January 2011, in the non-breeding season (Table 3). Most birds were recorded foraging in the Far West Channel, East Channel and Far East Channel, with far fewer in Anketell Point West, Anketell Point East and Anketell Point Far-east, the South-west Mudflats and South-east Mudflats (Table 3, Figure 8).

The greatest numbers of birds were foraging in the Far West Channel (41%) and East Channel (38%) with fewer in the Far East Channel (12%). There was little difference in the numbers of birds between Anketell Point West, Anketell Point East, Anketell Point Far-east, the South-west Mudflats (all 2% each) or the South-east Mudflats (1%), but all supported relatively few birds. The Far West Channel was first surveyed in January 2011 but the large numbers of birds in the East and Far East Channel were consistent with the surveys in October 2010 and July 2009. The pattern of far fewer birds in Anketell Point West, East and Far-east were also consistent with surveys conducted in October 2010 and July 2009.

However, this survey differed from the two previous surveys in that it found far fewer birds foraging on the South-west and South-east Mudflats at low tide (Table 3). This difference may be related to the time in the tide cycle when the low tide counts were conducted. Due to the longer duration of this survey, counts during this survey were actually conducted around low tide times, whereas early surveys had been conducted on a falling tide when the sub-coastal mudflats became exposed but water still covered the channel between Dixon Island and the Mainland. This contrast provides insight into how birds forage across the tide cycle. The patterns observed suggest that, as the tide falls, birds leave their high tide roosts and forage on the sub-coastal mudflats (South-west Mudflats and South-east Mudflats, probably also Far West Mudflats, but no low tide counts have been conducted there) as they become exposed. As the tide falls further and the channel between Dixon Island and the Mainland becomes exposed, almost all birds leave the sub-coastal mudflats and move into the channel (and small numbers to other areas) to forage (Figure 8).

While this pattern suggests that the channel between Dixon Island and the Mainland is the most important foraging area, the sub-coastal mudflats may also be important as many birds will also forage there for a few hours on each tide cycle. The food ingested during these few hours may be energetically very important for birds, although this is not known with certainty due to lack of supporting data.

Table 3. Low tide counts: the number of individuals recorded foraging at low tide in the three sections of the inter-island channel, the three sections around Anketell Point and the two sub-coastal mudflats.

Note: see Figure 8 for the delineation of these regions and sections.

Species	Channel			Anketell Point			Mudflats		Total
	Far West	East	Far-east	West	East	Far East	South-west	South-east	
Australian Pelican			1						**1**
Australian White Ibis	2	2	1	2					**7**
Striated Heron	2	2	1				1		**6**
Little Egret	6	6							**12**
Eastern Reef Egret					1				**1**
Little Pied Cormorant									**0**
Little Black Cormorant									**0**
Pied Cormorant	1								**1**
Eastern Osprey		1		1					**2**
White-bellied Sea-Eagle									**0**
Brahminy Kite						1	1		**2**
Beach Stone-curlew									**0**
Pied Oystercatcher	4	10	4	1					**19**
Sooty Oystercatcher									**0**
Black-winged Stilt	2								**2**
Pacific Golden Plover									**0**
Grey Plover	9	8	3	1					**21**
Red-capped Plover	39	32	13		3		9		**96**
Lesser Sand Plover	14	12	1	2	2	9		1	**41**
Greater Sand Plover	146	152	33	4	10	9		2	**356**
Oriental Plover							2		**2**
Bar-tailed Godwit	190	121	26	14	9	1			**361**
Whimbrel	6	4	3	2	1		12	1	**29**
Eastern Curlew	2		1				17	1	**21**
Common Greenshank	68	69	6						**143**
Grey-tailed Tattler	323	314	45	11	11	17	1		**722**
Terek Sandpiper	28	37	3						**68**
Common Sandpiper		1	2						**3**
Ruddy Turnstone		18	27	1	1	3			**50**
Great Knot	92	59	18						**169**
Red Knot	2								**2**
Sanderling		8			2				**10**
Red-necked Stint	70	81	44		5	5			**205**
Sharp-tailed Sandpiper									**0**
Curlew Sandpiper									**0**
Oriental Pratincole									**0**
Silver Gull	15	5	52	13	1				**86**
Gull-billed Tern	1								**1**
Caspian Tern	1	1	19	2	1			13	**36**
Crested Tern									**0**
Lesser Crested Tern									**0**
Common Tern									**0**
Bridled Tern									**0**
Little Tern	3	2	3						**8**
Whiskered Tern	1								**1**
Total	**1150**	**945**	**306**	**54**	**47**	**45**	**43**	**18**	**2,484**

Differences between high and low tide counts

The population estimates for most species in the study area differed between high and low tides, which is not surprising as the former is designed to determine how many individuals use the study areas for roosting, while the latter is designed to determine how many individuals use specific parts of the study area for foraging. However, the reasons behind these differences vary between species and, as they will aid comprehension of the survey results, they are discussed briefly below.

Terns, gulls and cormorants primarily forage at sea for fish and so their feeding cycles are more governed by currents, rather than tide cycles, so many individuals could potentially be at sea, foraging, during high tides. Additionally, their foraging areas typically do not include the mudflats and intertidal platforms surveyed at low tide in this survey so, relatively, very few were recorded during low tide. Furthermore, most terns, gulls and cormorants at high tide were counted on offshore islands and are likely to forage in the ocean adjacent to these islands, rarely visiting the mainland during either high or low tides. Thus, differences between low and high tide counts are unsurprising.

Some species, like the Eastern Reef Egret and Sooty Oystercatcher, were rarely recorded or unrecorded at low tide because they forage primarily in rocky intertidal areas. Rocky intertidal areas may include those on North-east Island and the north coast of Dixon Island, which were not surveyed at low tide.

Most shorebirds had higher population estimates for high tide counts, compared to low tide counts. This most likely reflects the fact that only a proportion of the channel between Dixon Island and the Mainland was surveyed at low tide, whereas almost all of the study area was surveyed at high tide. The extra birds in high tide roosts probably foraged in the channel, but between the Far West Channel and East Channel sections surveyed (Figure 8). Indeed, while counts were not conducted there, large numbers of birds were seen in this part of the channel while counting birds in the Far West Channel and East Channel and we suspect that numbers there are equivalent to, or slightly greater than, the numbers of birds counted in the Far West and East Channel.

The Grey-tailed Tattler, with a high tide count of 990 and a low tide count of 722 likely fits into the scenario described above.

Some shorebirds in roosts will also have foraged on mudflats off the east side of the Mainland (East, South-east and South sections) although the numbers would be expected to be very small compared to the numbers of birds in the channel, except for the Common Sandpiper which tends not to forage on extensive mudflats.

Among shorebirds, there was only one exception to the pattern described above. The Lesser Sand Plover was recorded more frequently at low tide. This result is surprising as it normally roosts in areas favoured by other shorebirds and, along the Pilbara coast, typically roosts in mixed flocks with Greater Sand Plovers. The reasons for the lower numbers of birds in high tide roosts are unclear, but this pattern has been consistent across this survey and surveys in October 2010 and July 2009 (Western Wildlife 2009 and 2010). This suggests that some high tide roosting areas for this species are not covered during our surveys, although where those areas might be is not apparent from aerial photography.

Global populations

The survey area supported globally significant populations of two species, the Grey-tailed Tattler and the Pied Oystercatcher (Table 4).

For Grey-tailed Tattlers, a total of 990 birds were recorded roosting at high tide within the survey area, almost 2% of the global population, so the region is clearly of international significance for this species (Table 2, Figure 10). Most Grey-tailed Tattlers at high tide were recorded on the South-west Mudflats (539 birds: 54%) and this single mudflat alone supported more than 1% of the global population and is internationally significant (Table 2). Other areas that were important for the species at high tide were the Far West Mudflats (151 birds: 15%), Lambert Bay East (83 birds: 8%), Central Cossack (47 birds: 5%), North Samson Mudflats (44 birds: 4%) and South-west Mainland (31 birds: 3%). No other region or section of the survey area supported more than 15 birds (Table 2).

We recorded 722 Grey-tailed Tattlers at low tide with the majority in the Far West Channel (323 birds: 45%) and East Channel (314 birds: 43%) (Table 3). Far fewer were in Anketell Point Far-east (17: 2%), Anketell Point East (11: 2%) and Anketell Point West (11: 2%). Almost none were found foraging at low tide on the South-west (1: <1%) and South-east (0: 0%) Mudflats (Table 3).

These results suggest that the number of Grey-tailed Tattlers is fairly consistent between the southward migration and non-breeding season, with 662 birds (1.32% of global population) recorded during southward migration (Western Wildlife 2010) compared to 641 birds (1.28% of global population) recorded over the same sites (i.e. excluding Nickol Bay, Mangrove Creek, Far West Mudflats, Lambert Bay, Cape Lambert, Point Samson and Cossack regions: see Figure 1) in January 2011, during the non-breeding season. The numbers of birds present in the study area are likely to be similar during northward migration, although we lack data for this season. What was different during this survey was the concentration of birds on the South-west Mudflats (Table 2). During southward migration, the number of birds present on this single mudflat in October 2010 was only 307 birds (0.61% of global population), compared to 539 in the non-breeding season (1.08% of global population). Thus this survey has served to emphasise the importance of the South-west Mudflats to this species. It also suggests that a survey during northward migration would be prudent as the spatial distribution of shorebirds varies between seasons.

The other species that exceeded the 1% threshold was the Pied Oystercatcher, a species not listed under the EPBC Act (Table 4, Figure 11). Again, most individuals of this species were recorded in the South-west Mudflats (83 birds: 67%), with most of the rest in Cleaverville (15 birds: 12%) and North Cossack (8 birds: 7%). No other region or section supported more than three birds (Table 2).

Despite the 1% threshold being exceeded for the Pied Oystercatcher, we do not believe that this represents a major issue for the proposed development. The threshold was only exceeded because a much wider area was covered during this survey and this threshold would not have been exceeded if only the sites surveyed in October 2010 and July 2009 had been covered. If only these sites had been surveyed (i.e. excluding Nickol Bay, Mangrove Creek, Far West Mudflats, Lambert Bay, Cape Lambert, Point Samson and Cossack regions: see Figure 1), then the total counts would have been 100 birds, which would not have exceeded the threshold. In those same sites, 39 birds were recorded in October 2010 and 35 birds in July 2009. What caused this greater concentration of birds within these regions in January 2011 is unclear. Even if this concentration was due to the higher spring tides in January 2011, compared to October 2010 and July 2009, and suggests that the South-west Mudflats are approaching global significance for this species, this makes little difference to the overall project. This is because the mudflat in question is already of global significance for the Grey-tailed Tattler and, therefore, any development needs to avoid, or minimise, any impact or disturbance on this mudflat.

It is very unlikely that even this broad survey area supports more than 1% of the global population of any other species. The next closest migratory species was the Great Knot, where the survey area supported 0.50% of the global population, and the next closest resident species was the Sooty Oystercatcher, where the survey area supported 0.44% of the global population (Table 4).

Flyway Populations

As the flyway population estimate for the Grey-tailed Tattler is the same as the global population estimate (Table 4), the number of Grey-tailed Tattlers in the study area is also significant within the EAA flyway. As the Pied Oystercatcher is not migratory, there is no flyway estimate for this species.

No other species met or exceeded the 1% flyway population criterion. However, the Greater Sand Plover came very close with a high tide count of 1094 birds or 0.99% of the flyway population (Table 4). In the previous survey, the high tide count was 456 birds or 0.41% of the flyway population (Western Wildlife 2010). However, over a third of the birds counted in January 2011 were in the Mangrove Creek, Lambert Bay, Point Samson and Cossack regions and would, therefore, be outside the project area (Table 1).

Among the remaining migratory species, the only other species where the study area supported ≥0.10% of the flyway population were the Ruddy Turnstone (0.56%), Bar-tailed Godwit (0.53%), Great Knot (0.51%), Common Greenshank (0.32%), Whimbrel (0.26%) and Eastern Curlew (0.17%) (Table 4). Although we lack data for these species for the northward migration season, based on this survey and previous surveys (Western Wildlife 2009 and 2010) it is unlikely that the study area would hold >1% of the flyway population of these species in that season.

Table 4. Minimum population counts from high tide roosts and low tide counts, with the proportion of the global and EAA flyway populations.

Note: the counts that were ≥ 1% of the global or flyway population are shown in bold.

Species	1% Criterion (Global Pop[n])	1% Criterion (Flyway Pop[n])	Minimum Counts in January 2011					
			High Tide			Low Tide		
			Count	% Global Pop[n]	% Flyway Pop[n]	Count	% Global Pop[n]	% Flyway Pop[n]
Australian Pelican	10 000	-	19	<0.01	-	1	<0.01	-
Australian White Ibis	10 000	-	10	<0.01	-	7	<0.01	-
Striated Heron	N/A*	-	1	-	-	6	-	-
Little Egret	20 000	-	20	<0.01	-	12	<0.01	-
Eastern Reef Egret	10 000	-	24	<0.01	-	1	<0.01	-
Little Pied Cormorant	5 000	-	0	-	-	1	<0.01	-
Little Black Cormorant	10 000	-	300	0.03	-	0	-	-
Pied Cormorant	5 000	-	163	0.03	-	1	<0.01	-
Eastern Osprey	N/A	-	19	-	-	2	-	-
White-bellied Sea-Eagle	N/A	-	3	-	-	0	-	-
Brahminy Kite	N/A	-	2	-	-	2	-	-
Beach Stone-curlew	N/A	-	3	-	-	0	-	-
Pied Oystercatcher	110	-	**123**	**1.12**	**-**	19	0.17	-
Sooty Oystercatcher	115	-	50	0.44	-	0	-	-
Black-winged Stilt	3 000	-	4	<0.01	-	2	<0.01	-
Pacific Golden Plover	2 000	1 000	16	<0.01	<0.01	0	-	-
Grey Plover	7 000	1 250	33	<0.01	<0.01	21	<0.01	0.02
Red-capped Plover	950	-	253	0.27	-	96	0.10	-
Lesser Sand Plover	3 000	1 400	38	0.01	0.03	41	0.01	0.03
Greater Sand Plover	3 400	1 100	1094	0.32	0.99	356	0.10	0.32
Oriental Plover	700	700	7	0.01	0.01	2	<0.01	<0.01
Bar-tailed Godwit	12 000	3 250	1718	0.14	0.53	361	0.03	0.11
Whimbrel	20 000	1 000	260	0.01	0.26	29	<0.01	<0.01
Eastern Curlew	380	380	64	0.17	0.17	21	0.06	0.06
Common Greenshank	14 000	600	196	0.01	0.32	143	0.01	0.24
Grey-tailed Tattler	500	500	**990**	**1.98**	**1.98**	**722**	**1.44**	**1.44**
Terek Sandpiper	10 000	600	97	<0.01	0.16	68	<0.01	<0.01
Common Sandpiper	40 000	250	17	<0.01	0.07	3	<0.01	<0.01
Ruddy Turnstone	7 000	350	198	0.03	0.56	50	<0.01	<0.01
Great Knot	3 800	3 750	1895	0.50	0.51	169	0.04	0.04
Red Knot	10 000	2 200	0	-	-	2	<0.01	<0.01
Sanderling	7 000	220	29	<0.01	<0.01	10	<0.01	<0.01
Red-necked Stint	3 200	3 250	738	0.23	0.23	205	0.06	0.06
Sharp-tailed Sandpiper	1 600	1 600	2	0.01	0.01	0	-	-
Curlew Sandpiper	18 000	1 800	32	<0.01	<0.01	0	-	-
Oriental Pratincole	29 000	20 000	358	0.01		0	-	-
Silver Gull	20 000	-	1234	0.06	-	86	<0.01	-
Gull-billed Tern	3 400	-	16	<0.01	-	1	<0.01	-
Caspian Tern	3 000	-	53	0.02	-	37	0.01	-
Crested Tern	12 000	-	1679	0.14	-	0	-	-
Lesser Crested Tern	1 600	-	47	0.03	-	0	-	-
Common Tern	26 000	-	242	<0.01	-	0	-	-
Bridled Tern	4 000	-	142	0.04	-	0	-	-
Little Tern	2 800	-	343	0.12	-	8	<0.01	-
Whiskered Tern	10 000	-	2	<0.01	-	1	<0.01	-

*N/A = non-congregatory so thresholds can not be determined

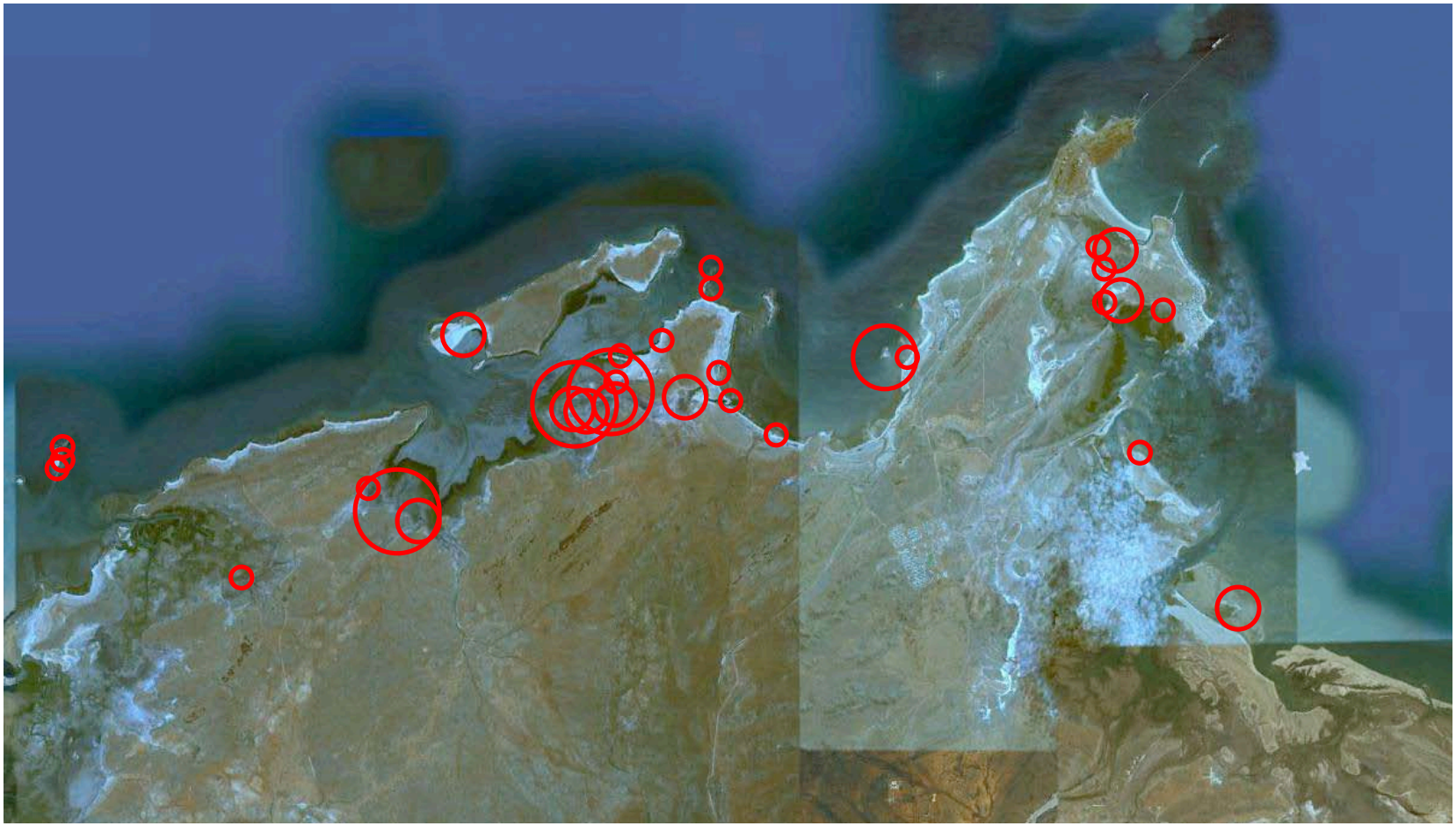

Figure 10. Map showing the location of high tide roosts of Grey-tailed Tattlers within the survey area. The smallest circles represent roosts of 1-10 birds, the second smallest represent roosts of 11-50 birds, the second largest roosts of 51-100 birds and the largest circle represents roosts of >100 birds.

Figure 11. Map showing the location of high tide roosts of Pied Oystercatchers within the survey area. The smallest circles represent roosts of 1-5 birds, the second smallest represent roosts of 6-10 birds, the second largest roosts of 11-50 birds and the largest circle represents roosts of >50 birds.

Limitations of the survey

We are confident that our survey provided reasonably accurate estimates of the populations of species within the study area, as defined by Figure 1. However, this was the first survey to cover such a broad area so, in order to better interpret the results, it is important to understand the inevitable limitations of the survey.

The first limitation was primarily due to the size of the area surveyed. As this area was so large there was an inevitable compromise between the thoroughness of surveying each area and the time taken to survey each area. Close to the proposed impact area (particularly the Mainland region) we chose to be very thorough, and walk all areas on foot. As we moved further away from the proposed impact area we opted for a compromise between time and thoroughness. Thus, the Mangrove Creek, Cossack, South Samson and North Samson Mudflats were surveyed primarily by driving to certain vantage points, then scanning for shorebirds using the spotting scope. To more thoroughly survey these areas at high tide would take a week or more. This survey method is likely to have resulted in odd individuals being missed, particularly for species that roost singly or in pairs away from other shorebirds, such as the Red-capped Plover and Common Sandpiper. However, we are confident that we did not miss any large roosts and we consider it unlikely we missed many, if any, small roosts (<30 birds) in these areas.

The second limitation pertains to the limitation of conducting surveys from a boat, which means that we inevitably missed birds roosting on the beach where that beach had mangroves on its seaward side. We probably did not detect many of the birds in these stretches of coastline and the number of birds present on those stretches is likely to be proportional to the distance between the beach and the mangroves, with more birds present the further from the beach the mangroves are. Lambert Bay South was walked on foot on 21st January, when we recorded 32 birds, and then surveyed from the boat the following day when we recorded three birds. This difference is likely to be the maximum number of birds missed, as these mangroves are relatively far from the beach in this section. Other areas where we likely missed birds are the southern parts of Lambert Bay East, Dixon Island South and the Mainland Mangroves, but we consider it unlikely we would have missed more than a few dozen birds in Lambert Bay East and Dixon Island South. We could have, potentially, missed more birds on the landward side, or in, the Mainland Mangroves.

The third limitation is largely due to the inaccessible nature of the survey area and relates primarily to the Mangrove Creek Mudflats and the Cossack region. In these areas, there are sub-coastal areas that could potentially support roosting birds but the lack of road access means that it is not possible to survey them using a combination of a vehicle and walking. The number of birds are present in these areas is unknown, although our counts from the northern and eastern parts of the Mangrove Creek Mudflats suggested that the southern and western parts of that mudflats probably does not support more than few hundred birds. However, this does not really affect the recommendations for the proposed development because these areas are a reasonably distant from the proposed impact area. Areas close to the proposed impact area were thoroughly covered on foot, so we have an accurate estimate of the numbers of birds likely to impacted by the development.

Conclusions

Locations of important areas for shorebirds

- ***The sub-coastal mudflats are likely to be important for shorebirds.***

  The surveys conducted so far indicate that the sub-coastal mudflats are very important at both high and low tide for all shorebirds. Tidal water to the South-west and South-east mudflats enters along creeks from the north and east respectively. The only surface water exchange between these two mudflats occurs on very high spring tides. Therefore, any development should aim to cross this area of mudflats at the highest point, between the two areas where the large roosts are located. Ideally, impacts could be minimised through infrastructure that allowed waterflow between these two mudflats.

- ***The channel between Dixon Island and the mainland is likely to be important for foraging shorebirds.***

  The channel between Dixon Island and mainland supports large numbers of foraging shorebirds. The main waterflow inputs for this intertidal area are from the west and from the east around Point Anketell. As water enters this intertidal area on the tide, it deposits its coarse sediments first and its fine sediments last. This means that the areas closest to Anketell Point provide relatively poorer sandy foraging habitat while, as one moves westwards along the channel, the intertidal area provides much richer, muddier foraging habitat. This implies that any construction that impedes the flow of water into this channel would likely have negative impacts of the quality of foraging habitat in the entire eastern half of the intertidal area.

- ***Most high tide roosts were located on the sub-coastal mudflats and off-shore islands.***

  In January 2011, most high tide roosts were located in the sub-coastal mudflats, with the majority of birds in the South-west Mudflats. Other important high tide roosts were located on offshore islands. It is likely that these areas are important roosts year round. Other areas (e.g. the Anketell Point and South-east sections on the Mainland) have had significant roosts in previous surveys.

Shorebird species that have significant numbers in the survey area

- ***The greater Anketell region is highly likely to be a significant site for the Grey-tailed Tattler.***

  Based on the survey conducted in January 2011, the survey area supports globally significant populations of Grey-tailed Tattler during the non-breeding season. These birds are concentrated on the South-west Mudflats, which alone supported a globally significant population. Low tide counts confirmed that the channel between Dixon Island and the mainland is the most important area for foraging birds. We counted 682 birds spread over the three sections of this channel during this survey, which considering part of this channel was not counted at low tide, suggests that the study area could potentially support even more Grey-tailed Tattlers, perhaps roosting in, or on the landward side of, the Mainland Mangroves.

  We lack data from the greater Anketell area for the northward migration season, but the data available from previous surveys suggest it is highly likely that the survey area supports a globally significant population of Grey-tailed Tattlers during all seasons.

- ***The greater Anketell region may be a locally significant site for the Pied Oystercatcher.***

  The other species recorded at more than 1% of the global population in the survey area was the Pied Oystercatcher. However, the 1% threshold was only exceeded because areas that would be negligibly impacted by the proposed development were included in the survey. In addition, the Pied Oystercatcher is not listed under the EPBC Act.

- **T*he greater Anketell region may be a significant site for the Greater Sand Plover.***

  Based on the survey conducted in January 2011, the survey area supports almost 1% of the flyway population of the Greater Sand Plover. However, the 1% threshold was only approached because areas that would be negligibly impacted by the proposed development were included in the survey.

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