MIGRATORY SHOREBIRD ASSESSMENT

TOONDAH HARBOUR AND WEINAM CREEK PRIORITY DEVELOPMENT AREAS

Prepared for
frc environmental on behalf of Walker Corporation

Biodiversity Assessment and Management Pty Ltd
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November 2014

BAAM
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Project Author/s: Dr Penn Lloyd

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Biodiversity Assessment and Management Pty Ltd

Date: 20/11/2014

Managing Director

MIGRATORY SHOREBIRD ASSESSMENT

TOONDAH HARBOUR AND WEINAM CREEK PRIORITY DEVELOPMENT AREAS

Table of Contents

Table of Figures

Table of Terms and Abbreviations

BAAM	Biodiversity Assessment and Management Pty Ltd
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (now DoE)
DoE	Commonwealth Department of the Environment
ED Act	Queensland *Economic Development Act 2012*
EDQ	Economic Development Queensland

EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
NC Act	Queensland *Nature Conservation Act 1992*
PDA	Priority Development Area
Ramsar Convention	*Convention on Wetlands of International Importance 1971*
RCC	Redland City Council

EXECUTIVE SUMMARY

Purpose of the report

Biodiversity Assessment and Management (BAAM) has prepared this report for frc environmental on behalf of Walker Corporation to detail the results of a survey and assessment of migratory shorebird species abundances and habitat use within the Toondah Harbour (Cleveland) and Weinam Creek (Redland Bay) Priority Development Areas (PDAs), South East Queensland.

Study approach

This assessment is based on the results of two field surveys spaced several days apart, together with a review and assessment of survey data sourced from the Queensland Wader Study Group (QWSG). The field surveys documented the total numbers of each species of migratory shorebird using intertidal mudflats at low tide and coastal roost sites at high tide within each PDA study area, and were conducted in accordance with Commonwealth survey guidelines for migratory shorebirds.

Toondah Harbour PDA

Migratory shorebird habitat within the Toondah Harbour PDA comprises intertidal mudflat foraging habitat used by up to 144 migratory shorebirds of five species for foraging at low tide. Two migratory shorebird roost sites located immediately adjoining the PDA have been used by ten migratory shorebird species. A claypan to the south was used by typically up to 500 to 1,500 migratory shorebirds over the period 1995/6-2013/14 and 0-19 migratory shorebirds in October/November 2014. An offshore area of mangroves to the east of the PDA was used by 417 migratory shorebirds during a survey in November 2014. These habitats comprise a small portion of the Moreton Bay Ramsar site of international importance for migratory shorebirds, and are identified as 'important habitat' for migratory shorebirds under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Weinam Creek PDA

Migratory shorebird habitat within the Weinam Creek PDA comprises a limited area of intertidal foraging habitat used by 0-1 migratory shorebirds of one species for foraging at low tide over two surveys, and is therefore not considered to be important habitat for migratory shorebirds. Intertidal mudflat habitat along the northern boundary, but outside of the PDA is used by larger numbers of migratory shorebirds, with 3 and 36 migratory shorebirds of four different species recorded over two low tide surveys; this latter habitat comprises a small portion of the Moreton Bay Ramsar site and is identified as 'important habitat' for migratory shorebirds under the EPBC Act. No migratory shorebirds were recorded roosting within or adjoining the PDA and no important high tide roost sites for migratory shorebirds are located within or adjoining the PDA.

Recommendations

The proposed development of the Toondah Harbour PDA is likely to have both direct and indirect impacts on important intertidal foraging habitat and important roost sites for migratory shorebirds within the Moreton Bay Ramsar site. Therefore, referral of the proposed project to the Commonwealth is recommended. Indirect impacts from disturbance may be mitigated through implementation of a setback, the construction of barrier fences to prevent access to sensitive migratory shorebird habitats and establishment of screening vegetation to screen migratory shorebirds in sensitive habitat areas from sources of visual disturbance. The proposed development of the Weinam Creek PDA is likely to have a minor direct impact on marginal intertidal foraging habitat for migratory shorebirds within the PDA and a minor indirect

impact on important foraging habitat for migratory shorebirds adjoining the PDA. While these impacts are unlikely to be considered significant, referral of the proposed project to the Commonwealth is recommended for legal certainty as these habitats are located within the Moreton Bay Ramsar site.

1.0 INTRODUCTION

This report has been prepared by Biodiversity Assessment and Management Pty Ltd (BAAM) for frc environmental on behalf of Walker Corporation to detail the results of a survey and assessment of migratory shorebird species abundances and habitat use within the Toondah Harbour (Cleveland) and Weinam Creek (Redland Bay) Priority Development Areas, South East Queensland.

1.1 BACKGROUND

Toondah Harbour and Weinam Creek were declared as Priority Development Areas (PDAs) in Redland City by the State Government under the *Economic Development Act 2012* (ED Act) on 21 June 2013. Redland City Council (RCC) has identified the potential for these PDAs to deliver long-term, sustainable economic growth for Redland City in a number of ways, including but not limited to:

- the generation of employment in a range of sectors across the economy;
- providing much needed infrastructure that will generate economic activity and improved public amenity both for the mainland and the islands; and
- working towards Council's goal of employment containment within the City through the generation of increased economic activity and industry growth.

Economic Development Queensland (EDQ) undertook the lead role as plan maker for the PDAs, while RCC has responsibility for undertaking development assessment. Following a process of specialist inputs and community engagement, a draft development scheme for each PDA was presented to the EDQ Board on 25 November 2013 and released for public comment on 10 January 2014. In response to community and commercial feedback, Redland City Council voted on a number of recommended changes to the draft plans on 19 March 2014 and the Queensland Government approved the final development schemes for the two PDAs on 29 May 2014. A call for expressions of interest to develop the two sites was open from 19 June to 28 July 2014, with the Queensland Government and RCC announcing on 18 September 2014 that Walker Group had been selected from eight expressions of interest as the preferred partner to develop Toondah Harbour and Weinam Creek. The next step of the process is for a detailed design to be developed that matches the final development scheme.

The preliminary ecological studies undertaken to inform the preparation of the structure plans and development schemes for the Toondah Harbour and Weinam Creek Priority Development Areas (PDAs) identified habitat areas likely to be used by migratory shorebirds within each PDA, and their likely importance as part of the Moreton Bay Ramsar site of international importance for migratory shorebirds (BAAM 2014). However, no surveys were undertaken to establish the numbers of migratory shorebirds using the PDA sites because the preliminary ecological studies were undertaken at a time of year when most migratory shorebirds are absent from Australia.

1.2 STUDY SCOPE

The scope of this migratory shorebird assessment is to:

- Describe the shorebird species and their numbers that utilise the foraging areas and adjoining roost sites within each of the Toondah Harbour and Weinam Creek Priority Development Areas (PDAs).
- Describe the habitat requirements of these species and their sensitivity to changes in habitat, including ongoing activities associated with the use of the PDA sites post development.
- Describe the methodology used for shorebird surveys.

2.0 ASSESSMENT APPROACH

This migratory shorebird assessment was required to be undertaken within a 2-week timeframe. This timeframe restricted the number of surveys that could be undertaken in accordance with Commonwealth survey guidelines for migratory shorebirds, which recommends conducting surveys in different months of the year to describe migratory shorebird use of an area (DEWHA 2009). This assessment therefore combined two field surveys spaced several days apart with a review and assessment of survey data sourced from the Queensland Wader Study Group (QWSG). The QWSG is a special interest group within Birds Queensland that monitors shorebird populations

in Queensland and conducts regular shorebird surveys of different parts of the Queensland coast that have large shorebird populations. A desktop review of published information was also undertaken to review migratory shorebird habitat requirements and sensitivity to habitat change and disturbance.

2.1 FIELD SURVEY

The field survey was conducted in accordance with the survey guidelines outlined in the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) *Policy Statement 3.21: Significant Impact Guidelines for 36 Migratory Shorebird Species* (DEWHA 2009). Specifically:

- The surveys for foraging shorebirds were conducted as close to the time of low tide as practicable and at a maximum of no more than two hours either side of low tide;
- The surveys for roosting shorebirds were conducted as close to the time of high tide as practicable and at a maximum of no more than two hours either side of high tide;
- The surveys were not undertaken during periods of high rainfall or strong winds, or when activities that cause disturbance to the birds were taking place;
- The surveys determined the total number of individuals of each species present, to enable assessment of site and habitat importance; and
- The surveys collected spatial data of the area used by shorebirds for roosting and feeding to facilitate mapping of roosting and foraging habitat.

During the low tide surveys, shorebirds feeding on intertidal mudflats were surveyed using a high-powered Swarovski spotting telescope mounted on a sturdy tripod. Habitat areas were surveyed from suitable vantage points that provided an unobstructed view of the entire area, without causing disturbance to the shorebirds.

A known migratory shorebird roost site in an offshore area of mangroves located immediately east of Toondah Harbour was surveyed from a boat driven slowly around the perimeter of the mangroves. Birds roosting in the mangrove trees were counted using Leica 10x42 binoculars; this count was facilitated by the fortuitous overflight of a White-bellied Sea-eagle during the survey that caused most migratory shorebirds to take flight and circle the roost site before settling again.

3.0 RESULTS AND DISCUSSION

3.1 MIGRATORY SHOREBIRD HABITAT REQUIREMENTS

A shorebird is a bird species in the order Charadriiformes (Colwell 2010). Most shorebirds live on or near the coast, on beaches, reefs and tidal mudflats, though some also frequent, or are largely confined to, freshwater habitats (Colwell 2010). Most coastal species feed on flat, tidal shores with extensive muddy or sandy intertidal areas.

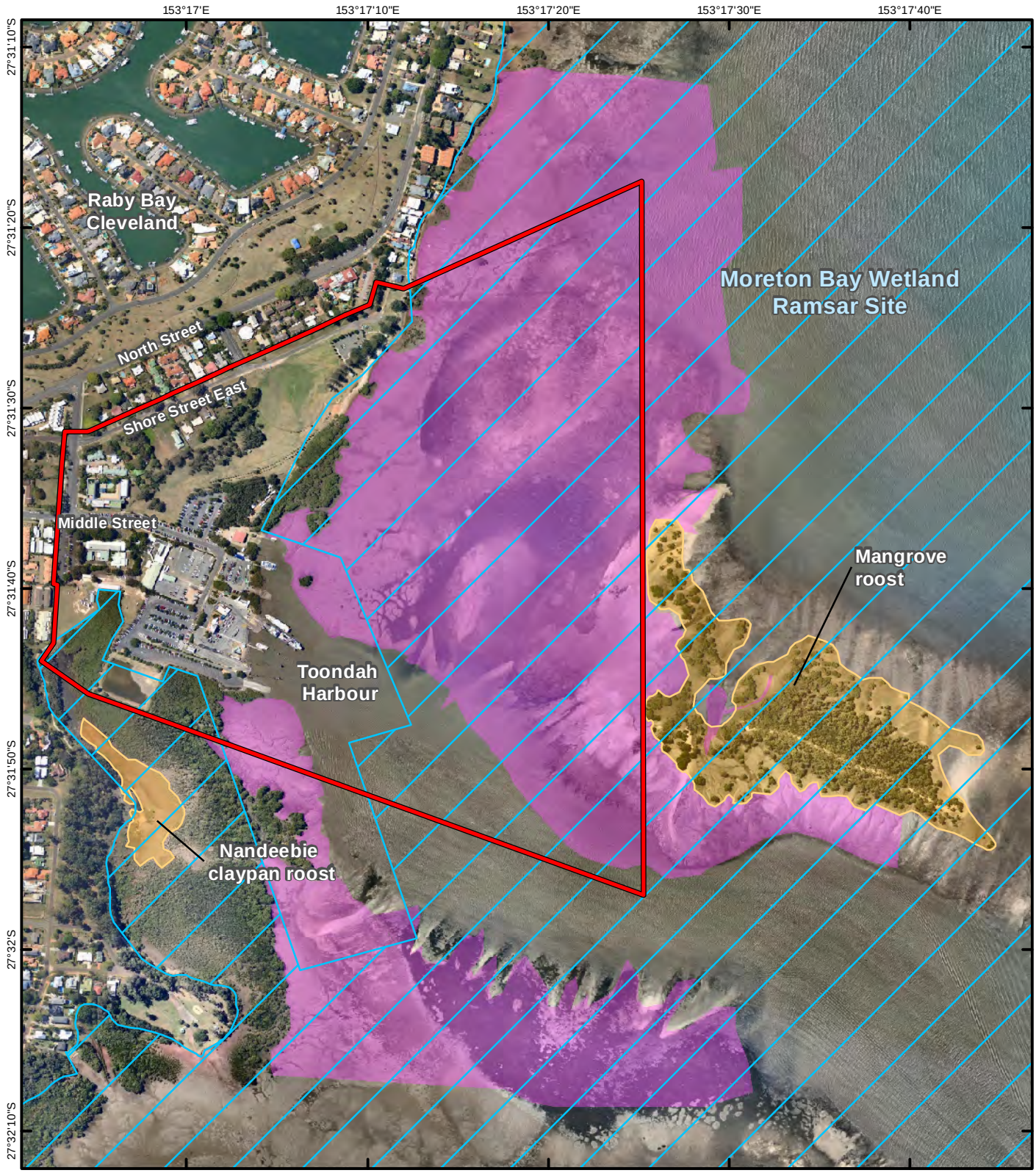
A large proportion of Australia's shorebird species are migratory, spending their non-breeding season (the Austral summer) in Australia and migrating up to 13,000 km north along the East Asian–Australasian Flyway to breeding grounds in eastern Siberia and western Alaska (most species, Bamford *et al*. 2006) or south to New Zealand (Double-banded Plover (*Charadrius bicinctus*), Pierce 1999).

On their over-wintering grounds in Australia, migratory shorebirds have a daily activity pattern driven largely by the tidal cycle, roosting in flocks at sites above the high water mark at high tide and moving to intertidal sandflat and mudflat feeding areas as the tide recedes (Colwell 2010). Shorebirds feed on a wide variety of benthic invertebrates, including crustaceans, molluscs and polychaete worms that are taken either on the surface of intertidal areas or extracted from soft muddy or sandy sediments by probing with their often elongated bills. They are dependent on nearby roosting areas that allow them to rest (during times when their feeding habitat is inundated at high tide) without losing too much energy to disturbance (Colwell 2010).

3.2 TOONDAH HARBOUR PDA

3.2.1 Low Tide Foraging Habitats

The preliminary ecological studies mapped the intertidal foraging habitats for migratory shorebirds, which comprised areas of mudflat and sandflat, some with extensive seagrass and areas of surface coral rubble (**Figure 3.1**).



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LEGEND

- Migratory shorebird foraging habitat
- Shorebird roost sites
- Ramsar Wetland area
- Priority Development Area boundary

Drawn By: MG Reviewed by: AC Date: 20/11/2014

Figure: **3-1**

Title: Migratory shorebird habitats within and adjoining the Toondah Harbour PDA

Project: **Migratory Shorebird Assessment, Toondah Harbour and Weinam Creek Priority Development Areas.**

Client: **FRC Environmental on behalf of Walker Corporation**

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Document Location: D:\GIS\Jobs\0223-006 Migratory Shorebird Assessment RCC PDAs\GIS\MXDs\ReportMaps\Figure 3-1 Migratory shorebird habitats - Toondah PDA UPdated 17ov2014 with spoil area.mxdDate: 18/11/2014 9:32:07 AM

The two low tide surveys conducted on 31st October and 6th November 2014 recorded a total of 137 and 21 migratory shorebirds respectively of five different species within the Toondah Harbour PDA (**Table 3.1**). Migratory shorebirds were observed foraging throughout the mapped distribution of intertidal foraging habitat within the PDA (see **Figure 3.1**).

The QWSG conducted a total of 17 low tide surveys within the PDA over the months June to October 2014. These surveys recorded the same five species of migratory shorebird as the BAAM surveys; only Grey-tailed Tattler was present during the winter months, but the number and abundance of migratory shorebird species increased from September as migratory shorebirds migrated into the area for the austral summer (**Table 3.2**).

3.2.2 High Tide Roost Sites

The preliminary ecological studies identified two high tide roost sites for migratory shorebirds that are situated outside of, but closely adjoin, the Toondah Harbour PDA (**Figure 3.1**). The one site comprises an offshore patch of mangroves immediately east of the PDA and north of the harbour entrance channel; some migratory shorebird species roost in these trees at high tide. The second site comprises a claypan and associated low, sparse saltmarsh vegetation located next to Nandeebie Park, to the south of the PDA.

Table 3.1. Total numbers of migratory shorebird species foraging within Toondah Harbour PDA during the BAAM low tide surveys in 2014.

	Date			31 Oct	6 Nov
	Low tide height (m)			0.6	0.4
Species	**Common name**	**EPBC[1]**	**NCA[2]**		
Limosa limosa	Bar-tailed Godwit	M		32	6
Numenius phaeopus	Whimbrel	M		6	13
Numenius madagascariensis	Eastern Curlew	M	NT	4	2
Tringa brevipes	Grey-tailed Tattler	M		88	
Xenus cinereus	Terek Sandpiper	M		7	
Total				**137**	**21**

[1] Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: M = migratory.
[2] Status under the Queensland *Nature Conservation Act 1992*: NT = near threatened.

Table 3.2. Average (and maximum) numbers of migratory shorebird species foraging within Toondah Harbour PDA each month during QWSG low tide surveys in 2014.

	Month in 2014			Jun	Jul	Aug	Sep	Oct
	Number of surveys			3	4	2	3	5
Species	**Common name**	**EPBC[1]**	**NCA[2]**					
Limosa limosa	Bar-tailed Godwit	M		0	0	0	0	27.6 (36)
Numenius phaeopus	Whimbrel	M		0	0	0	9.0 (17)	12.0 (18)
Numenius madagascariensis	Eastern Curlew	M	NT	0	0	2.0 (3)	4.0 (5)	5.4 (6)
Tringa brevipes	Grey-tailed Tattler	M		9.0 (27)	20.0 (52)	14.0 (20)	26.7 (43)	52.8 (92)
Xenus cinereus	Terek Sandpiper	M		0	0	0	0	4.0 (11)
Total				**9.0 (27)**	**20.0 (52)**	**16.0 (23)**	**39.7 (53)**	**101.8 (144)**

[1] Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: M = migratory.
[2] Status under the Queensland *Nature Conservation Act 1992*: NT = near threatened.

Offshore mangroves

The single high tide survey on 6 November recorded a total of 417 migratory shorebirds of 4 different species roosting in the offshore mangrove trees (**Table 3.3**). Most birds were roosting in the more scattered mangroves along the western portion of the mangrove patch that is closest to the eastern boundary of the PDA.

Nandeebie claypan

Four surveys of the Nandeebie claypan roost site (conducted at both neap and spring tides) recorded between 0 and 19 migratory shorebirds of two species roosting on the pan (**Table 3.3**).

Table 3.3. Total numbers of migratory shorebird species roosting at high tide during the BAAM high tide surveys at each of the Nandeebie claypan and offshore mangrove roost sites adjoining the Toondah Harbour PDA.

	Roost site			Pan	Pan	Pan	Pan	Mangrove
	Tide height (m)			2.2	2.2	2.3	2.4	2.4
	Date			30 Oct	31 Oct	5 Nov	6 Nov	6 Nov
Species	**Common name**	**EPBC**	**NCA**					
Numenius phaeopus	Whimbrel	M		5			1	184
Numenius madagascariensis	Eastern Curlew	M	NT	14	6		1	
Tringa brevipes	Grey-tailed Tattler	M						215
Arenaria interpres	Ruddy Turnstone	M						10
Xenus cinereus	Terek Sandpiper	M						8
Total migratory shorebirds				**19**	**6**	**0**	**2**	**417**

[1] Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: M = migratory.
[2] Status under the Queensland *Nature Conservation Act 1992*: NT = near threatened.

Photo 1. Extensive intertidal mudflat in the Toondah Harbour PDA, foraging habitat for migratory shorebirds.

Photo 2. Proximity of a public walkway (foreground) to the Nandeebie claypan migratory shorebird roost site (background).

Photo 3. Offshore mangroves adjoining the eastern boundary of Toondah Harbour PDA, an important roost site for migratory shorebirds.

Photo 4. Whimbrel roosting in mangrove tree adjoining the eastern boundary of the Toonhah Harbour PDA.

The QWSG conducted a total of 148 high tide surveys of the Nandeebie claypan roost site between March 1995 and May 2014, with a gap in surveys in the summers of 2004/5 to 2006/7. The maximum roost counts each summer are shown in **Figure 3.2** and the average roost count each year for surveys in the months of October to March inclusive are shown in **Figure 3.3**. The maximum roost count each year has typically ranged between 500 and 1,500 migratory shorebirds, with a maximum count of 2,562 migratory shorebirds in February 1996. Species specific data are summarised in **Table 3.4**.

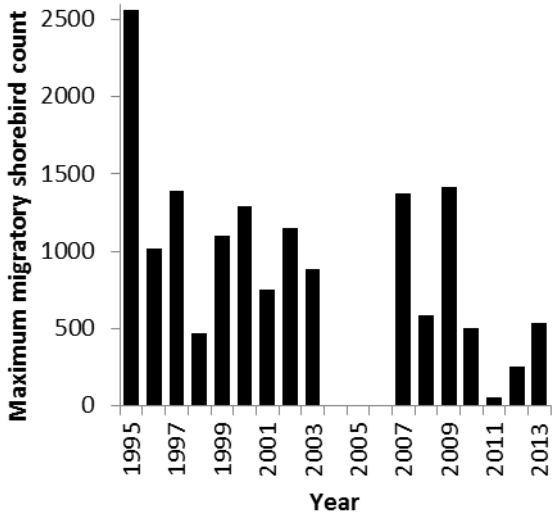


Figure 3.2. Maximum count of migratory shorebirds roosting at Nandeebie claypan each season of 1995/6 to 2003/4 and 2007/8 to 2013/14.

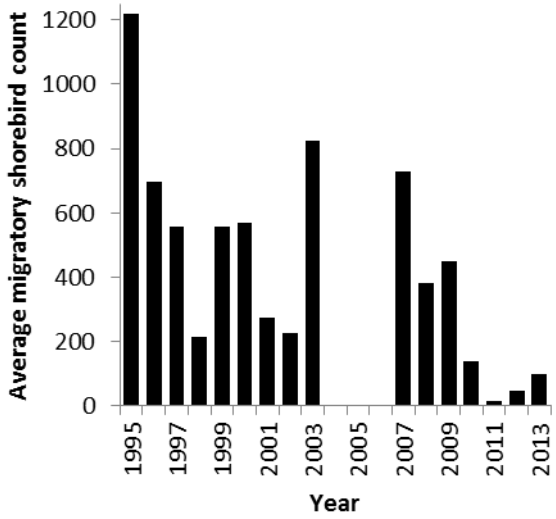


Figure 3.3. Average count of migratory shorebirds roosting at Nandeebie claypan over the months October to March each season of 1995/6 to 2003/4 and 2007/8 to 2013/14.

Table 3.4. Migratory shorebird species recorded roosting at the Nandeebie claypan by QWSG during 148 surveys over the period 1995/6 to 2013/14, the number (N) and percentage (%) of surveys in which the species was recorded, the average count of the species when present, and the maximum count over the survey period.

Species	Common name	EPBC	NCA	N	% of surveys	Average count	Maximum count
Calidris ferruginea	Curlew Sandpiper	M		2	1.4	1.5	2
Calidris tenuirostris	Great Knot	M		15	10.1	30.9	90
Limosa lapponica	Bar-tailed Godwit	M		70	47.3	530.8	2,300
Limosa limosa	Black-tailed Godwit	M		1	0.7	2.0	2
Numenius madagascariensis	Eastern Curlew	M	NT	76	51.4	27.4	180
Numenius phaeopus	Whimbrel	M		66	44.6	58.5	508
Pluvialis fulva	Pacific Golden Plover	M		1	0.7	1.0	1
Tringa brevipes	Grey-tailed Tattler	M		2	1.4	29.5	56

There appears to have been a reduction in migratory shorebird use of the Nandeebie claypan for roosting since the 2009/10 season, and the reasons for this may be twofold. First, there has been a gradual encroachment of mangroves colonising what was originally a larger and more open claypan, reducing the suitability of the site for migratory shorebirds, which prefer roost sites less enclosed by taller vegetation, as more open sites provide less cover for approaching predators (Rogers 2003; Rogers *et al*. 2006a). Second, a concrete walkway was constructed along the shoreline in 2004. This walkway is not screened from the roost site (see **Photo 2**) and facilitates the movement walkers, cyclists, dogs etc. to within 30-50 m of the edge of the area occupied by roosting birds, which is closer than the average distance at which many shorebird species may take flight due to visual disturbance (see **Section 3.4.2**). The construction of the walkway and the increasing population of Cleveland has likely increased disturbance to roosting shorebirds over the monitoring period.

3.2.3 Importance for Migratory Shorebirds

The Toondah Harbour PDA is identified as occurring within the bounds of the Moreton Bay Wetland of International Importance, listed under the *Convention on Wetlands of International Importance 1971* (Ramsar Convention) (**Figure 3.1**). The existing channel of the harbour and some intertidal areas immediately adjoining the channel are mapped as being outside of the Ramsar area (**Figure 3.1**).

The Moreton Bay Ramsar site is nationally and internationally significant as habitat for migratory shorebirds. The Moreton Bay shorebird area, which stretches 130 km from Caloundra in the north to Southport in the south, has been reported to support over 40,000 migratory shorebirds during the summer months (Driscoll 1993; Watkins 1993) and over 3,500 resident shorebirds (Driscoll 1997). However, the total populations of at least 11 migratory shorebird species have undergone significant declines in Moreton Bay over the 15 year period 1992-2008, declining an average 62% over this period, largely as a consequence of the loss of feeding habitat at critical migration stopover sites in the Yellow Sea (Wilson *et al*. 2011; Yang *et al*. 2011). Consequently, Moreton Bay currently supports an estimated total of around 30,000 migratory shorebirds during summer (David Milton, QWSG, personal communication).

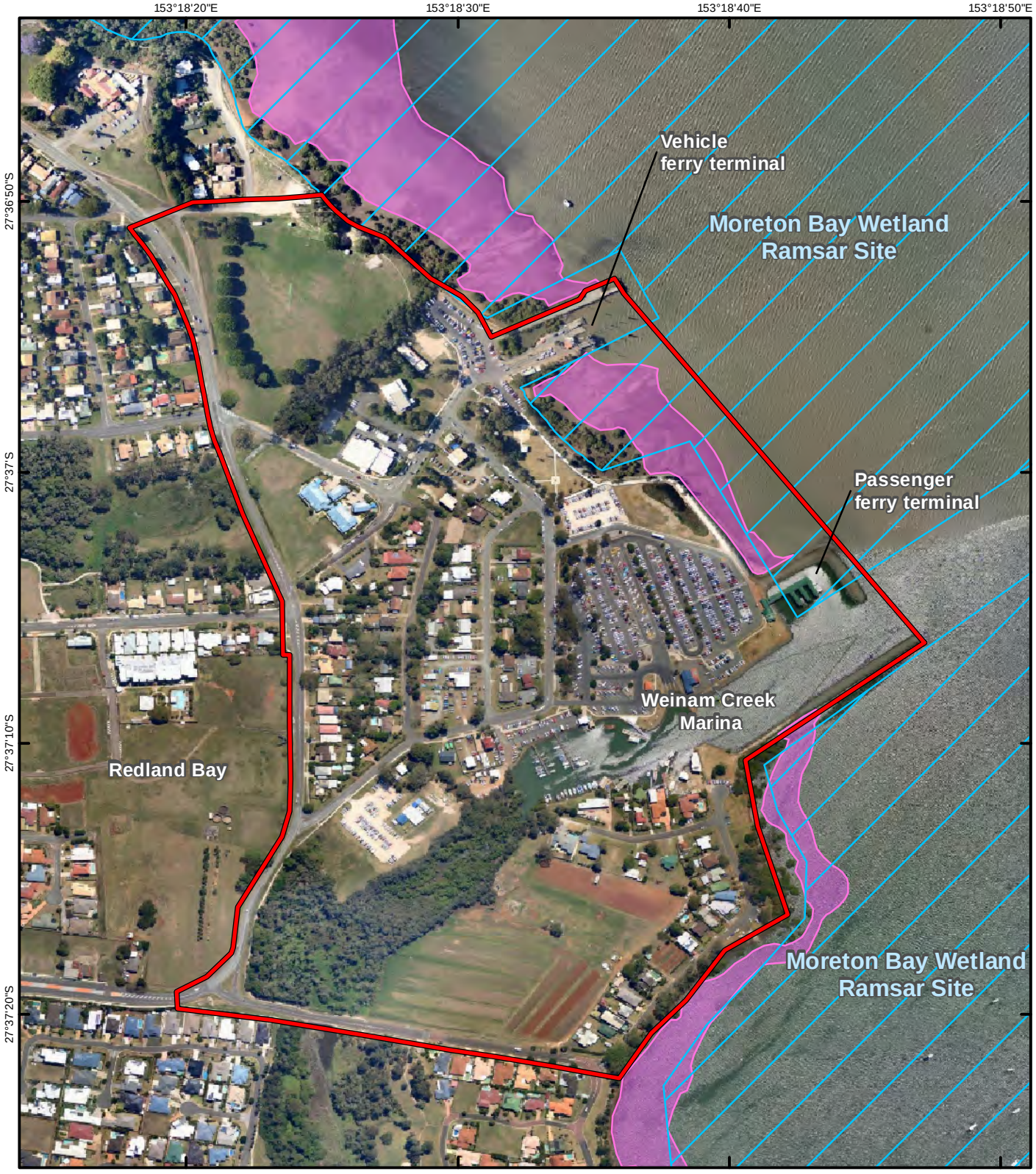
The number of migratory shorebird species utilising intertidal mudflats within the Toondah Harbour PDA is smaller than that recorded at nearby mudflats; however the density of foraging shorebirds within the PDA is roughly equivalent to many other mudflat areas within the Moreton Bay shorebird area. As the intertidal mudflats within the PDA comprise a small portion of the Moreton Bay shorebird area, the maximum count of 144 migratory shorebirds recorded foraging within the PDA comprises 0.5% of the estimated total of 30,000 migratory shorebirds that utilise the whole of the Moreton Bay shorebird area during summer.

Due to its recognition as an internationally important migratory shorebird area, habitats utilised by migratory shorebirds for foraging or roosting in Moreton Bay, including foraging habitat within the Toondah Harbour PDA and roosting sites adjoining the PDA are characterised as 'important habitat' for migratory shorebirds under the EPBC Act (DEWHA 2009b).

3.3 WEINAM CREEK PDA

3.3.1 Low Tide Foraging Habitats

Intertidal foreshore areas within the Weinam Creek PDA are relatively narrow and consist largely of coral rubble and sand. The most suitable intertidal habitat area for migratory shorebirds, which includes areas of mudflat and seagrass is located immediately north of the current vehicle ferry sea wall (**Figure 3.4**). Intertidal feeding habitat within the PDA is of marginal value to migratory shorebirds due to the nature of the substrate and proximity to existing disturbance. Therefore, the intertidal habitats within the PDA are likely to be used only infrequently by very few migratory shorebirds, whereas the intertidal area to the north of the vehicle ferry terminal is likely to be more frequently used. This was borne out by the results of the two low tide surveys, which recorded a total of 1 and 0 migratory shorebirds feeding within the PDA, but 36 and 3 migratory shorebirds feeding on the mudflat adjoining the northern boundary of the PDA, north of the vehicle ferry terminal (**Table 3.5**).



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LEGEND

- Migratory shorebird foraging habitat
- Ramsar Wetland area
- Priority Development Area boundary

Figure: **3-4**

Title: Migratory shorebird habitats within and adjoining the Weinam Creek PDA

Project: **Migratory Shorebird Assessment, Toondah Harbour and Weinam Creek Priority Development Areas.**

Client: **FRC Environmental on behalf of Walker Corporation**

BAAM ECOLOGICAL CONSULTANTS

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Table 3.5. Total numbers of migratory shorebird species foraging within or adjoining the Weinam Creek PDA boundary to the north and south during the BAAM low tide surveys in 2014.

				Within PDA		Northern boundary		Southern boundary	
	Date			31 Oct	6 Nov	31 Oct	6 Nov	31 Oct	6 Nov
	Low tide height (m)			0.6	0.4	0.6	0.6	0.4	0.6
Species	**Common name**	**EPBC**[1]	**NCA**[2]						
Limosa limosa	Bar-tailed Godwit	M				1			
Numenius phaeopus	Whimbrel	M		1		1	1		
Numenius madagascariensis	Eastern Curlew	M	NT			1	1		
Tringa brevipes	Grey-tailed Tattler	M				33	1		
Total				**1**	**0**	**36**	**3**	**0**	**0**

[1] Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: M = migratory.
[2] Status under the Queensland *Nature Conservation Act 1992*: NT = near threatened.

Photo 5. Narrow intertidal fringe between ferry terminals in the Weinam Creek PDA.

Photo 6. Rock sea wall used as a roost site by small numbers of resident shorebirds at Weinam Creek.

3.3.2 High Tide Roost Sites

There are no known high tide roost sites used by migratory shorebirds within or immediately adjoining the Weinam Creek PDA. The rock sea-walls bordering the passenger ferry terminal provide a potentially suitable roost site for several migratory shorebird species; however, because the seawalls are accessible to the public and located close to the busy ferry terminal, they are unlikely to be used by migratory shorebirds because of the likely high frequency of disturbance. While resident shorebirds such as Black-winged Stilt and Australian Pied Oystercatcher were recorded roosting on the northern seawall of the passenger ferry terminal during a high tide survey (see **Photo 6**), no migratory shorebirds were present.

3.3.3 Importance for Migratory Shorebirds

Intertidal habitat within the Weinam Creek PDA and adjoining the northern and southern boundaries of the PDA is mapped as located within the Moreton Bay Ramsar site, which is a site of international significance for migratory shorebirds. However, the intertidal habitat within the PDA between the vehicle and passenger ferry terminals is of marginal value and is likely to be used by only 1 or 2 migratory shorebirds for foraging at any point in time. Consequently, intertidal habitat within and along the southern boundary of the PDA is not identified as a component of the Moreton Bay important shorebird area (Clemens *et al*. 2008; Birds Australia 2009).

The intertidal mudflat along the northern boundary of the PDA to the north of the vehicle ferry terminal is identified as a component of the Moreton Bay important shorebird area and is utilised by migratory shorebirds at a density equivalent to that across Moreton Bay as a whole; consequently this foraging habitat can be characterised as 'important habitat' for migratory shorebirds under the EPBC Act (DEWHA 2009b).

There are no important roost sites for migratory shorebirds within or immediately adjoining the Weinam Creek PDA.

3.4 MIGRATORY SHOREBIRD SENSITIVITY TO HABITAT CHANGE AND DISTURBANCE

3.4.1 Sensitivity to Habitat Change

Migratory shorebirds share a similar basic ecology. They are highly dependent on a relatively small number of key feeding grounds at stop-over sites on their migration routes and on the non-breeding grounds in order to replenish their fat reserves for migration (Ma *et al*. 2013). Migratory shorebirds must feed voraciously on their over-wintering sites before undertaking long migrations of up to tens of thousands of kilometres. If their feeding rates are reduced and they do not manage to lay down sufficient reserves of fat, their subsequent survival on migration is severely compromised (Baker *et al*. 2004). They are also dependent on nearby roosting areas that allow them to rest (during times when their feeding habitat is inundated at high tide) without losing too much energy to disturbance (Colwell 2010). Many of these key sites are coastal wetlands that are increasingly threatened by development for aquaculture, industry and housing (Wetlands International 2006; Yang *et al*. 2011). This makes them particularly susceptible to habitat loss, disturbance and environmental change (Gill *et al*. 2001; Piersma & Baker 2000; Baker *et al*. 2004; Wilson *et al*. 2011). Consequently, shorebirds, and particularly migratory shorebirds are in decline around the world (Donaldson *et al*. 2000; Baker *et al*. 2004; Thomas *et al*. 2006; Wetlands International 2006), including in Australia (Close and Newman 1984; Nebel *et al*. 2008; Wilson *et al*. 2011). While migratory shorebird use of freshwater wetlands in inland Australia has declined as a result of habitat loss at inland wetlands (Nebel *et al*. 2008), recent dramatic population declines of migratory shorebirds in coastal areas of Australia appear to be more as a consequence of the ongoing loss of intertidal feeding habitat at key migration stopover sites in the Yellow Sea in south-east Asia than habitat loss in Australia (Wilson *et al*. 2011).

3.4.2 Sensitivity to Disturbance

During the approach of a disturbance agent, foraging shorebirds reduce their foraging activity to become more vigilant and will typically begin to walk away from the approach. If the approach continues, the birds will eventually take flight to a new location. Disturbance causes birds to spend energy flying away and to lose feeding time while relocating to different feeding areas, where the increased bird densities may intensify competition from interference and, if of sufficient duration, from prey depletion (Goss-Custard *et al*. 2006). There is little published information on critical thresholds of disturbance. In France, modelling shows that foraging oystercatcher *Haematopus ostralegus* experience reduced survival and breeding success if they are put to flight more than 1.0-1.5 times per hour in winters with good feeding conditions, or more than 0.2-0.5 times per hour when feeding conditions are poor (Goss-Custard *et al*. 2006). At Roebuck Bay in Western Australia, Great Knot spent an average of 30 minutes per high tide in alarm flights from disturbance by raptors and humans at the most disturbed roost site, yet still preferred to use this site than an alternative site 25 km away (Rogers *et al*. 2006c). At the most disturbed roost site in Moreton Bay, Brisbane, up to 400 shorebirds continued to use the roost during spring high tides despite a median number of flights per hour of 0.7, with a total time in flight of less than 5 min (Milton *et al*. 2011).

Birds taking flight are the most obvious result of disturbance, and different shorebird species have different sensitivities, taking flight at different distances from disturbance agents. Flight initiation distances in response to a variety of disturbance agents are summarised in **Table 3.6**. Larger species such as Eastern Curlew, Whimbrel and Bar-tailed Godwit tend to be more 'flighty', meaning they are more sensitive to disturbance and tend to take flight at greater distances from disturbance agents than most other shorebirds (Smit and Visser 1993; Glover *et al*. 2011). Joggers and walkers with a leashed dog are more disturbing than a walker alone (Lafferty 2001; Glover *et al*. 2011), and unleashed dogs are substantially more disturbing (Pfister and Harrington 1992; Kyne 2010).

Other more disturbing sources of disturbance are helicopters and other aircraft (Smit and

Visser 1993; Komenda-Zehnder *et al*. 2003; Rogers *et al*. 2006b), and watercraft, particularly jet-skis and jet boats (Smit and Visser 1993; Collins *et al*. 2000; Rodgers and Schwikert 2003). Jet-skis and jet boats are more disturbing that most other watercraft because of their generally faster travelling speeds and sharp turning abilities. At an important shorebird stopover and winter refuge in the southern United States, Red Knot *Calidris canutus* avoided roosts that had high average recreational boat activity within 1,000 m and dowitcher *Limnodromus griseus* and *L. scolopaceus* avoided prospective roosts when boat activity within 100 m was high, but disturbance did not appear to be a factor in roost site selection for other species (Peters and Otis 2006).

Table 3.6. Average flight initiation distance (FID) (and minimum-maximum range) of a variety of migratory shorebird species in response to various disturbance agents, summarised from studies in Australia and elsewhere in the world.

Species	Agent	Bird activity	FID avg (m)	FID range (m)	Ref.*
Australian studies					
Eastern Curlew *Numenius madagascariensis*	Walker	Mixed	126	81-196	1
Whimbrel *N. phaeopus*	Walker	Mixed	90		1
Pacific Golden Plover *Pluvialis dominica*	Walker	Mixed	49	40-60	1
Grey Plover *P. squatarola*	Walker	Mixed	44		1
Latham's Snipe *Gallinago harwickii*	Walker	Mixed	19	9-45	1
Black-tailed Godwit *Limosa limosa*	Walker	Mixed	31	27-35	1
Bar-tailed Godwit *L. lapponica*	Walker	Mixed	60	45-69	1
	Walker	Foraging		18-38	2
Common Sandpiper *Tringa hypoleucos*	Walker	Mixed	43		1
Grey-tailed Tattler *T. brevipes*	Walker	Mixed	23		1
Common Greenshank *T. nebularia*	Walker	Mixed	55	25-145	1
Marsh Sandpiper *T. stagnatilis*	Walker	Mixed	44	20-99	1
Ruddy Turnstone *Arenaria interpres*	Walker	Mixed	30	17-54	1
Sanderling *Caldris alba*	Walker	Mixed	32	22-39	1
Red-necked Stint *C. ruficollis*	Walker	Mixed	19	9-41	1
Pectoral Sandpiper C. melanotos	Walker	Mixed	23	16-30	1
Sharp-tailed Sandpiper *C. acuminata*	Walker	Mixed	20	4-44	1
Curlew Sandpiper *C. ferruginea*	Walker	Mixed	25	14-35	1
Shorebirds and terns	Plane	Roosting	170		8
	Boat	Roosting	75		8
	Walker	Roosting	25		8
	Dog	Roosting	30		8
Studies elsewhere					
Eurasian Curlew *N. arquata*	Walker	Foraging		102-196	3
	Walker	Foraging	211	124-299	4
	Walker	Foraging	339	225-550	5
	Walker	Foraging	102-196		3
	Walker	Roosting	213		6
	Helicopter	Roosting	200		6
	Car	Roosting	188		6
	Kayak	Roosting	230		7
	Wind surfer	Roosting	400		7
Bar-tailed Godwit *L. lapponica*	Walker	Foraging	107	88-127	4
	Walker	Foraging	219	150-225	5
	Walker	Foraging	101-138		3
	Kayak	Roosting	210		7
	Wind surfer	Roosting	240		7
Grey Plover *P. squatarola*	Walker	Foraging	124	106-142	4
Ruddy Turnstone *Arenaria interpres*	Walker	Foraging	47	31-53	4

* References: (1) Glover *et al*. 2011; (2) Blumstein *et al*. 2003; (3) Glimmerveen and Went 1984 in Smit and Visser 1993; (4) van der Meer in Smit and Visser 1993; (5) Wolff *et al*. 1982 in Smit and Visser 1993; (6) Blankestijn *et al*. 1986 in Smit and Visser 1993; (7) Koepff and Dietrich 1986 in Smit and Visser 1993; (8) Milton *et al*. 2011.

Individuals in larger flocks tend to be more sensitive to disturbance, particularly when they are in large, mixed species flocks, such as occurs at shorebird roosting sites (Rogers *et al*. 2006b; Glover *et al*. 2011). The relationship between flock size and disturbance does not appear to be linear; rather, disturbance levels climbed abruptly if bird numbers exceeded 50-100 (Rogers *et al*. 2006b). Therefore, flight initiation distances for individual species may be larger than those reported in **Table 4.1** when these species are roosting in large, mixed-species flocks.

Shorebirds living in environments that are heavily used by humans and exposed to repetitive, non-lethal disturbance stimuli experience energetic costs associated with their responses to disturbance (West *et al*. 2002; Goss-Custard *et al*. 2006). To reduce these costs, shorebirds are expected to habituate to repetitive stimuli that do not present a direct mortality risk (Deniz *et al*. 2003). Many studies have demonstrated the ability of many shorebird species to habituate to many forms of repetitive disturbance (Smit and Visser 1993; West *et al*. 2002; Baudains and Lloyd 2007), although the process of habituation may require lengthy exposure to repetitive disturbance stimuli (Komenda-Zehnder *et al*. 2003).

4.0 RECOMMENDATIONS

4.1 TOONDAH HARBOUR PDA

The proposed development of the Toondah Harbour PDA (see **Figure 4.1**) is likely to have both direct and indirect impacts on migratory shorebirds. The direct impact will involve the clearing of all intertidal foraging habitat for migratory shorebirds within the PDA through dredging for the marina and land reclamation, together with some foraging habitat adjoining the PDA. The project may have indirect impacts on adjoining intertidal foraging habitat, through disturbance to foraging shorebirds during construction and operation and possibly reduced water quality during dredging and reclamation works, and on adjoining roost sites through habitat change and increased disturbance, particularly if the proposed footprint extends to the edge of or into the offshore mangrove roosting habitat along the eastern boundary of the PDA.

Disturbance impacts may be mitigated through the construction of barrier fences to prevent access to sensitive migratory shorebird habitats and establishment of screening vegetation to screen migratory shorebirds in sensitive habitat areas from sources of visual disturbance. For example, while the existing mangroves adjoining the proposed carpark in the ferry services area will likely provide an effective screen to the Nandeebie claypan roost site, a barrier fence and vegetation screening along the boundary of the public walkway adjoining the Nandeebie claypan would reduce disturbance to migratory shorebirds using the claypan roost site. The impact of disturbance on the mangrove roost site on the eastern boundary of the PDA can be mitigated through the implementation to the extent possible of a minimum 30 m setback between the outer edge of mangroves in the mangrove roost site and the reclamation area boundary and/or effective fence barriers and vegetation screening.

As the foraging and roosting habitats that are likely to be directly and indirectly impacted by the project are identified as 'important habitat' for migratory shorebirds within the Moreton Bay Ramsar site, referral of the proposed project to the Commonwealth is recommended.

An action may have a significant impact on migratory shorebirds should it lead to any of:

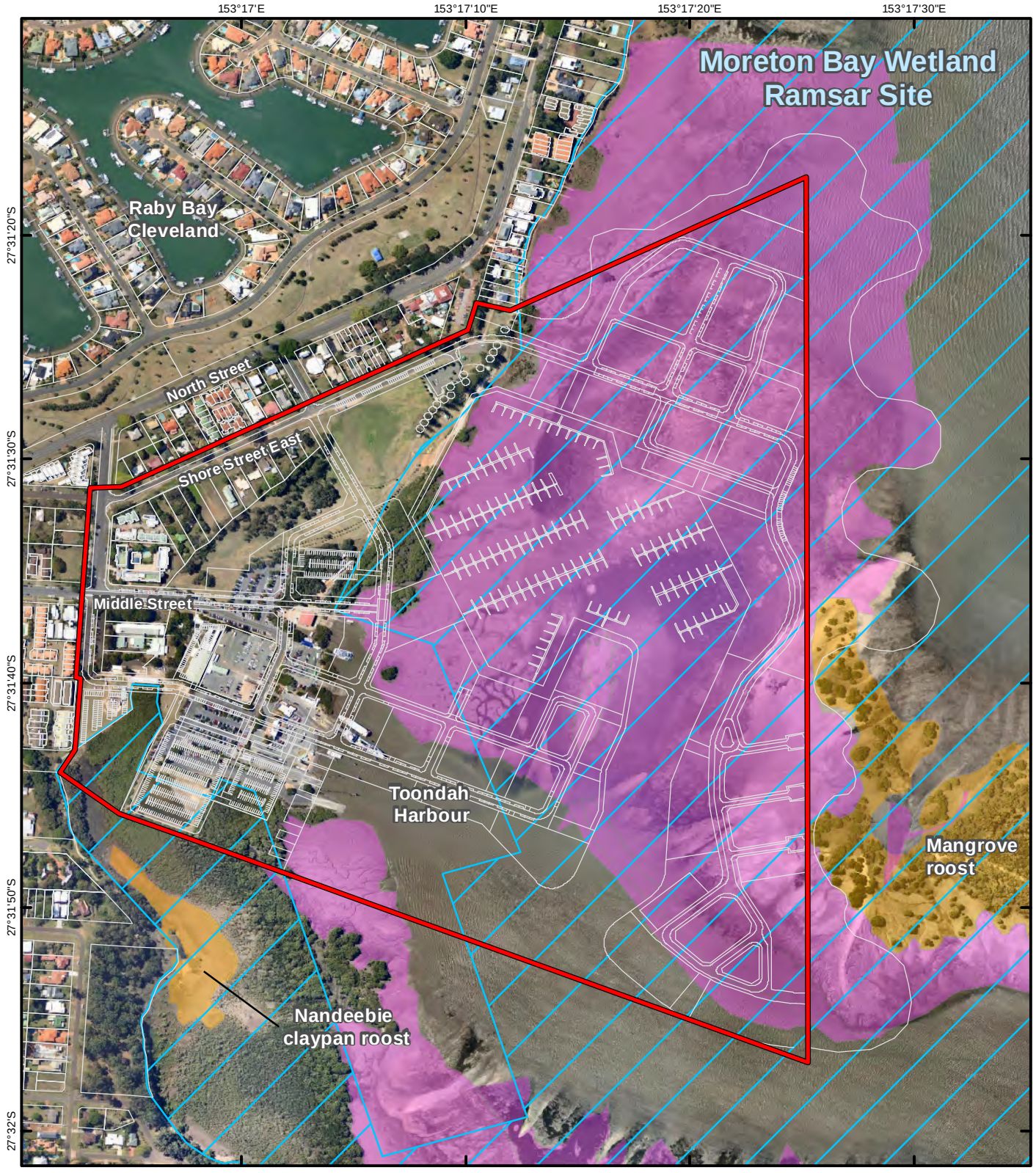
- loss of important habitat;
- degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site;
- increased disturbance leading to a substantial reduction in migratory shorebirds using important habitat; or
- direct mortality of birds leading to a substantial reduction in migratory shorebirds using important habitat (DEWHA 2009b).

4.2 WEINAM CREEK PDA

The proposed development of the Weinam Creek PDA is likely to have a very minor direct impact but potentially some indirect impacts on migratory shorebirds. The minor direct impact will involve the clearing of a small area of marginal intertidal foraging habitat for migratory shorebirds within the PDA through dredging for the marina and land reclamation. There is potential for a minor indirect impact during project construction through increased disturbance to migratory shorebirds foraging on intertidal mudflat habitat adjoining the PDA along its northern boundary; however mitigation

measures could be implemented to minimise indirect impacts.

While the minor direct and indirect impacts on migratory shorebirds are unlikely to be considered significant with the implementation of effective mitigation measures, referral of the proposed project to the Commonwealth is recommended for legal certainty as these habitats are located within the Moreton Bay Ramsar site.



Notes: Image sourced from Nearmaps (c) 2014

Coordinate System: GCS GDA 1994
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LEGEND

- Migratory shorebird foraging habitat
- Shorebird roost sites
- Ramsar Wetland area
- Proposed Site Layout
- Priority Development Area boundary

Figure: **4-1**

Title: Proposed Landuse Plan and Migratory shorebird habitats within and adjoining the Toondah Harbour PDA

Project: **Migratory Shorebird Assessment, Toondah Harbour and Weinam Creek Priority Development Areas.**

Client: **FRC Environmental on behalf of Walker Corporation**

BAAM ECOLOGICAL CONSULTANTS

Drawn By: MG Reviewed by: AC Date: 20/11/2014

Document Location: D:\GIS\Jobs\0223-006 Migratory Shorebird Assessment RCC PDAs\GIS\MXDs\ReportMaps\Figure 4-1 Landuse Plan - Toondah PDA UPdated 17ov2014 with spoil area.mxdDate: 20/11/2014 9:25:03 AM

5.0 REFERENCES

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