WEST PILBARA IRON ORE PROJECT

West Pilbara Iron Ore Project Stage 1

Anketell Point Port Development Proposal

Blasting Management Plan - Terrestrial

September 2014

West Pilbara Iron Ore Project Stage 1
Anketell Point Port Development Proposal

API Management Pty Ltd

Blasting Management Plan - Terrestrial

September 2014

Prepared by API Management Pty Ltd

Revision	Description	Prepared by	Reviewed by	Distribution	Date
A	Draft	S. Shute	P. Goodman	Internal	17/06/2014
0	Final	S. Shute	P. Goodman	DoE	17/07/2014
1	Final	S. Shute	P. Goodman	DoE	17/09/2014

Front cover image: NE tip of Dixon Island (lower right hand side) and tip of Anketell Point (top, centre), looking south west (image taken during autumn equinox high tide, March 2011, source API)

Inside cover image: View from high ground at Anketell Point looking east-northeast to Poverty Island (Cape Lambert Port B visible on the horizon) (September 2012, source API)

Contents

Figures

Tables

1 Introduction

1.1 Project description

API Management Pty Ltd (API) proposes to develop the West Pilbara Iron Ore Project (WPIOP), an iron ore mining and export operation based on a number of resources located on the western fringe of the Hamersley Ranges, south of Pannawonica in the Pilbara region of Western Australia. The project involves the development of a series of open cut mines, a railway and port facilities at Anketell Point.

Anketell Point is east of Nickol Bay, in the Shire of Roebourne, approximately 25 km north east of Karratha, 18 km north west of Roebourne and 12 km west of the Cape Lambert port facility.

Major marine components of the proposed Anketell Port include an approach jetty, causeway, boat harbour, dredged shipping channel, turning basin and berthing pockets. Major onshore components include a desalination plant, power station, rail loop, car dumper, stockpiles and export conveyor, ore stackers and reclaimers, offices and workshops.

1.2 Summary of environmental approvals process

The Public Environmental Review/draft Public Environment Report (PER/draft PER) document for the Anketell Port Development Proposal (API 2010), including draft environmental management plans, was published for public review on 20 December 2010. As a result of submissions received on the PER/draft PER, and the release of the draft Anketell Port Master Plan (DPA 2011), API amended the proposal to avoid the use of Dixon Island. A 'Section 43a EP Act 1986 Amendment to Proposal and Response to Submissions/Final PER' (API 2011) was subsequently published under the *Environmental Protection Act 1986* (EP Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) in November 2011. This document detailed the environmental impact assessment for the amended proposal and provided API responses to stakeholder submissions on the PER/draft PER and on the draft management plans. The Proposal was approved under the EP Act on 30 January 2013 (State Ministerial Statement 930 (MS930)) and under the EPBC Act in May 2013 (EPBC 2009/5120).

1.3 Document scope

The Blasting Management Plan-Terrestrial (BMP) (this document) has been prepared to protect listed threatened and migratory species from any impacts associated with blasting activities, as required under Condition 29 of the EPBC Act approval (EPBC 2009/5120) as set out in Table 1.3. As no marine blasting is proposed, the BMP is limited to the management of potential impacts from terrestrial blasting. Should marine blasting become necessary, for example if any material to be dredged is found to be significantly harder than the extensive geotechnical programme indicated, the BMP will be revised accordingly, or a separate Blasting Management Plan-Marine prepared, and submitted to the Minister for the Environment for approval prior to the commencement of marine blasting.

API sought clarification of the scope and interpretation of the BMP in it's review of the draft EPBC Act approval (submitted to the former Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), now the Department of Environment (DoE) on 22 April 2013). API requested that the condition be revised such that the requirements applicable to marine and terrestrial blasting were expressed separately. API also noted that:

- The risks, and relevant management actions, relating to marine and terrestrial blasting are significantly different;
- Marine blasting is not currently proposed;
- Terrestrial blasting as proposed at Anketell Point poses zero risk to in-water fauna including whales and turtles;
- The modelling of vibration pressures in water (water over-pressure) and air (air over-pressure) adjacent to terrestrial blasting is not well developed and would not allow for the meaningful delineation of exclusion zones (G. Boucher Consulting, pers. comm.), even in the event of accurate fauna sensitivity data;
- Empirical data suggests that blasting immediately adjacent to water courses does not cause fish mortality (G. Boucher Consulting, pers. comm.), thus listed threatened marine species and listed migratory marine species are considered to be at negligible risk;
- The major migratory bird roosting and foraging sites are located greater than 1000 m from the proposed terrestrial blasting locations, and as such migratory birds are considered to be at negligible risk of impact; and
- Many of the migratory bird species present at Anketell Point are relatively cryptic and as such the monitoring of exclusion zones (which might include rocky shore, mangrove and saltmarsh habitat) for single animals would be problematic.

DSEWPaC responded that there would be no change to the structure or wording of the condition was proposed, but that API could omit marine blasting from the BMP if not proposed as part of the proposal (D. Snowdon, pers comm., 2013).

1.4 Description of proposed blasting operations

Blasting will be required within the construction area during bulk earthwork operations to prepare a stable foundation and level surface for development. The potential extent and duration of these operations is indicated in Table 1.1. Prominent hard rock areas that exceed the 'design plate level' require blasting prior to excavation. These areas are predominantly confined to elevated land on the Anketell Point 'promontory' between the intertidal mudflat area and the northern extent of Anketell Point (see 'Drill & Blast' areas in Table 1.1). The excavated material will be used to fill low-lying areas or will be used in causeway construction. There is also a potential requirement for minor blasting to create the excavation for rail car dumper construction which may extend to around 20 m below 'design plate level'. Further geotechnical investigations are required to confirm the final port design and hence the detail of blasting requirements.

Blasting at the proposed quarry location will also be required to provide rock material to support the construction of the causeway. The potential extent and duration of the quarry blasting operations is also indicated in Table 1.1. The proposed quarry is located in Mount Roe Basalt (massive, vesicular, and glomeroporphyritic basalt) (AECOM 2011a) within the vegetation communities 'AThg2' (open shrubland of *Acacia pyrifolia* var. *pyrifolia* over Hummock Grassland of *Triodia wiseana* on rocky hill slopes) and 'MAT' (mixed shrubland of *Acacia* spp. over Hummock Grassland of *Triodia* spp. on orange-brown sandy soil) (API 2011), and is adjacent to Rio Tinto's active quarry (refer Figure 3.1).

The type of excavation and hence the blast designs required to provide a uniform ground level for the terrestrial infrastructure (through 'cut and fill') across the Anketell Port development footprint will differ from blasting required at the proposed quarry to produce rock armour and other rock products required for the causeway.

The 'construction' blasting within the development footprint will involve small (~5 m) benches (the height of material to be removed by a blast) with blasts fired as "paddock blasts" (i.e. with many rows). In contrast, the blasting at the quarry will be conducted on much larger benches (~15 m), fired to free faces and with only a few rows per blast (to enhance armour rock yields). Preliminary blast designs based on the above characteristics (Table 1.2) were derived as part of an 'Assessment of Terrestrial Blast-Induced Ground Vibration at the Anketell Port/Quarry Site and Adjacent Turtle Nest Sites' (George Boucher Consulting 2012).

Table 1.1 Indicative onshore construction sequence diagrams indicating the approximate area and duration of proposed blasting operations (AECOM 2012)

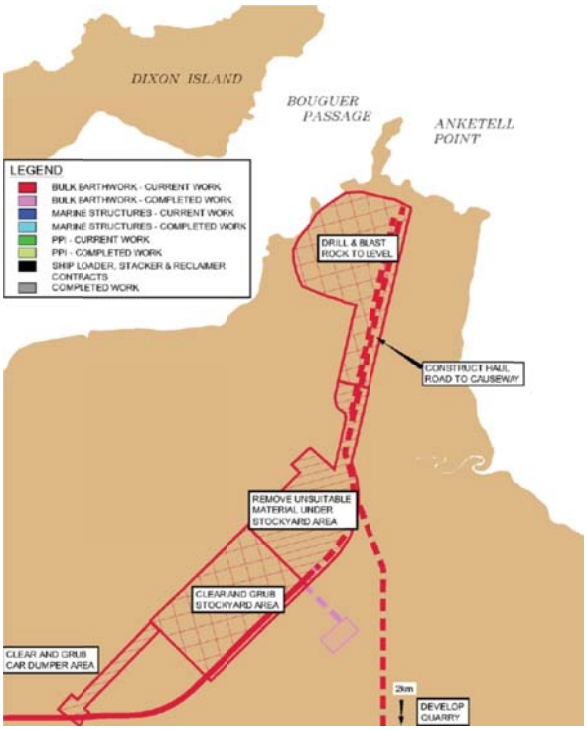
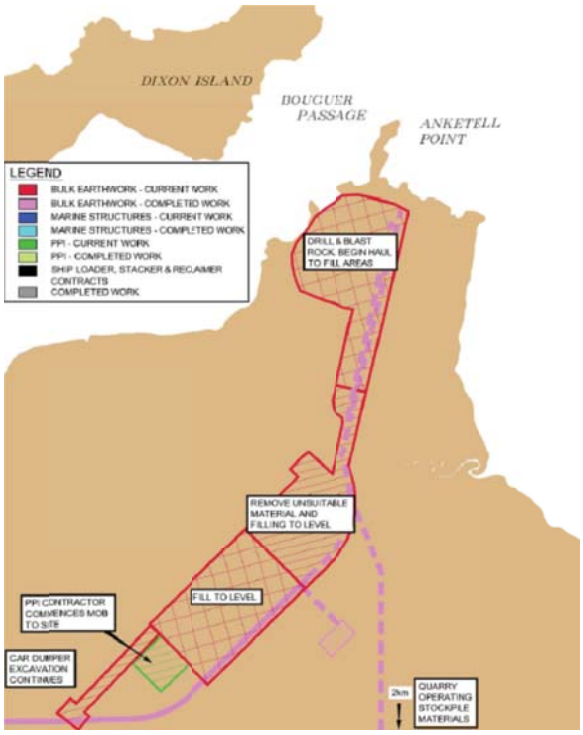
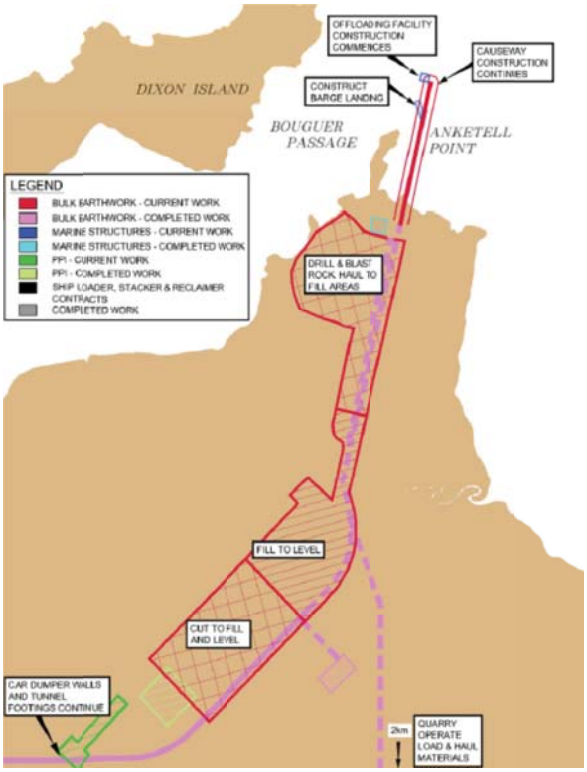
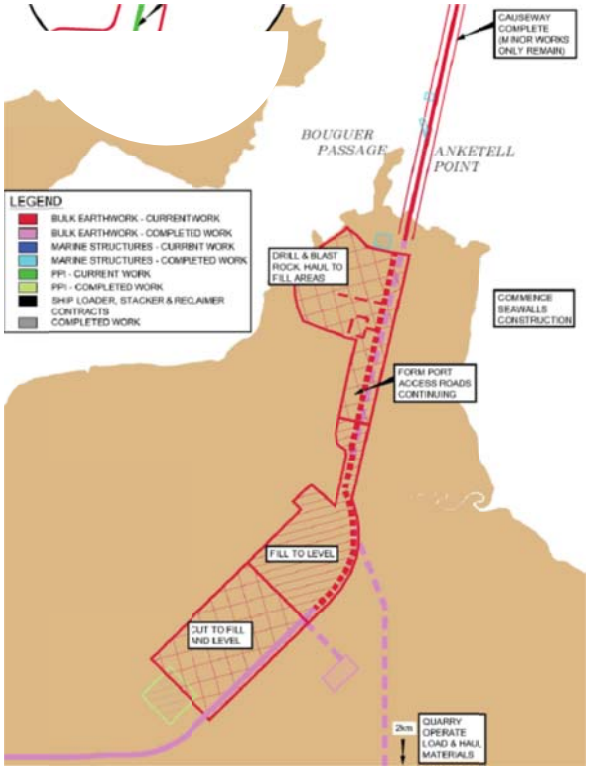
<table>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td>Construction blasting ('drill & blast') commences at Anketell Point ~6 months into onshore construction programme</td>
<td>Construction blasting continues and quarry blasting commences ~8 months into onshore construction programme</td>
</tr>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td>Construction blasting and quarry blasting continues (~12 months into onshore construction programme)</td>
<td>Final stages of construction blasting and quarry blasting ~20 months into onshore construction programme</td>
</tr>
</table>

Table 1.2 Preliminary blast designs for the development footprint and quarry

Location & Type	Bench Height (m)[1]	Hole Diameter (mm)[2]	Powder Factor (kg/bcm)[3]	Spacing (m)[4]	Burden (m)[5]	Subdrill (m)[6]	Charge Mass per Hole (kg)	
							ANFO Mass[7]	Pump Emuls Mass[8]
Construction (dry)	5	102	0.49	3.5	3.0	0.8	25	0
Construction (wet)	5	102	0.72	3.5	3.0	0.8	0	37
Quarry (dry)	15	115	0.55	4.0	3.5	0.9	116	0
Quarry (wet)	15	115	0.68	4.4	3.8	0.9	0	170

Notes: 1. Vertical height of material to be removed by blasting; 2. Diameter of hole drilled into rock into which explosive is inserted; 3. The mass of explosive (kg) needed to blast a particular volume of rock (bank cubic metres, bcm); 4. Spacing between holes (parallel to face); 5. Spacing between holes (perpendicular to face); 6. Distance between the bottom of the hole and the bottom of the material to be removed; 7. Mass of ammonium nitrate/fuel oil (widely used bulk industrial explosive mixture) per hole; and 8. Mass of pump introduced emulsion explosives (used where a high level of water resistance is required).

Relatively, the proposed 'construction' blasting poses the most (though minimal) risk to listed threatened and migratory species given that the blasting footprint is closer to turtle nesting beaches and listed migratory bird roosts.

Table 1.3 Environmental approval conditions (EPBC 2009/5120) relating to the BMP (this document)

Condition		Relevant section of document	Comments
29.	*To protect listed threatened and migratory species, the person taking the action must develop and submit to the Minister for approval a Blasting Management Plan[1] (BMP), should blasting be required. The BMP must include management measures to be undertaken for any blasting activities. These must include but not be limited to the following:*		
	a. A description of the blast methodology;	Section 1.4	The blasting designs provided in Section 1.4 are preliminary, but are based on standard industry practice in the Pilbara.
	b. Management measures to enable an avoidance response by listed threatened species and listed migratory species, prior to blasting;	Section 6.3	An audible warning (siren) will be sounded adjacent to the blasting location immediately prior to the detonation of an explosive charge (or charges), to alert all site personnel. This warning is likely to cause any nearby birds to 'take flight'. The use of a dedicated bird scaring device is not proposed as (1) the risk of physical injury to migratory birds at roosts adjacent to the proposed blasting locations is considered negligible, and (2) the use of such a device would likely cause greater displacement of birds than the proposed construction activities and compromise the management targets set within the Marine Fauna Management Plan.
	c. The use of appropriately sized zones, based on site specific modelling, that exclude listed threatened species and listed migratory species;	NA	Considered relevant to marine blasting only. The adoption and enforcement of exclusion zones is not relevant to terrestrial blasting given the limited risk of harm. It is not practicable to implement or monitor exclusion zones for migratory bird species (including numerous small and/or cryptic species and species in the habit of roosting within mangrove foliage).

[1] *Note: If a condition of another approval held by the proponent requires submission of a plan that meets the requirements of condition 29, the proponent may simultaneously meet the relevant requirements of both conditions by submitting a single plan.*

Condition		Relevant section of document	Comments
d.	*Visual monitoring for the presence of listed threatened and migratory species;*	Section 6.2	Considered relevant to marine blasting only. As discussed above (29c) visual monitoring of migratory birds is not considered practicable or effective. Monitoring of turtle nesting at Anketell Point beach is proposed (Section 6.2).
e.	*Management measures which include complete cessation of blasting if listed threatened and/or migratory species are observed in zone(s) required by Condition 29c. Blasting activities must not recommence until any listed threatened and/or migratory species that were observed in the zone(s) required by Condition 29c, are observed to move outside the zone(s) required by Condition 29c or until at least 30 minutes after the last sighting within the zone(s) required by Condition 29c;*	NA	Considered relevant to marine blasting only (wording is modelled on marine piling condition (Condition 20)). The adoption and enforcement of exclusion zones is not practicable or effective for terrestrial blasting within the approved disturbance footprint.
f.	*Post blast inspection procedures for injured listed threatened and/or migratory species including management of injured fauna;*	Section 6.2 Section 6.4	Considered relevant to marine blasting only. Notwithstanding, API has committed to undertaking several 'migratory bird health surveys' aiming to identify any individuals impacted by terrestrial blasting operations. The routine monitoring of construction activities will also facilitate the detection of any blasting-related impacts. Turtle nesting success surveys will allow any impacts to the development or survival of turtle eggs or embryos from terrestrial blasting to be quantified.
g.	*Reporting within one business day to the Minister when injury to, or mortality of, an listed threatened and/or migratory species occurs;*	Section 7.2	
h.	*Contingency measures should blasting result in injury to or mortality of fauna;*	Section 6	
i.	*Measures that prohibit night time blasting during the peak nesting/hatching seasons for marine turtles, the peak southern and northern migration of listed migratory birds, and the northern and southern migration of mother and calf humpback whales, as determined in consultation with the Western Australian Department of Environment and Conservation or successor agency: and*	Section 6.1	Night time blasting will be prohibited during the peak nesting/hatching season for marine turtles (1 November to 28 February). Given the negligible level of risk, the suspension of night time blasting during the peak southern and northern migration of listed migratory birds, and the northern and southern migration of mother and calf humpback whales, is not proposed.
j.	*Vibration monitoring of turtle nests at Anketell Point, Dixon Island and Bell's Beach.*	Section 6.1	

Condition		Relevant section of document	Comments
30.	*The BMP must be submitted for approval by the Minister at least three months prior to the commencement of blasting activities, unless otherwise approved by the Minister.*	Section 8	
31.	*Blasting activities must not commence until the BMP has been approved. The approved BMP must be implemented.*	Section 8	

1.5 Structure of plan

This plan is structured as follows:

- Description of the existing environment (Section 2);
- Description of the range of potential environmental impacts relevant to listed threatened and migratory species (Section 3);
- Outline of roles and responsibilities to enable API and its contractors to monitor, assess and mitigate impacts from construction activities (Section 4);
- Overview of the management framework to be adopted during the construction phase (Section 5);
- Details of monitoring procedures and management actions to be implemented during the construction phase (Sections 6); and
- Outline of the reporting, audit and review procedures (Sections 7 and 8).

1.6 Related documents/projects

A number of separate though related documents prepared to fulfil other conditions of the EPBC Act approval (EPBC 2009/52120) provide detailed information on monitoring programmes proposed during the construction of Anketell Port not specifically covered within this plan. Details, including survey sites and methods, are described in the following documents:

- Ecosystem Research and Monitoring Programme (ERMP) (monitoring and management of potential impacts to coastal processes, the condition and behaviour of listed threatened and migratory species, water quality and benthic habitats);
- Migratory bird survey program (survey of the usage of the coastline within a 100 km radius of Anketell Point by migratory birds);
- Migratory Birds Offsets Management Plan (MBOMP) (identification and management of 275 ha of habitat of significance to listed migratory birds);
- Marine Fauna Management Plan (MFMP) (monitoring and management of potential impacts to marine fauna and avifauna); and
- Dredge Environmental Management Plan (DEMP) (water quality and habitat health monitoring during the dredge programme and management actions to ensure that the Environmental Protection Outcomes (EPOs) are met).

A number of the documents required under the EP Act approval (MS930) also provide detailed information on additional monitoring programmes proposed during the construction of Anketell Port, including:

- Scope of State of the Marine Environment Surveys (habitat mapping, habitat health, coastal processes, hydrodynamics);
- Coastal Habitat Management Plan (CHMP) (monitoring of mangrove health and coastal processes, management actions to minimise impacts); and
- Light Management Plan (LMP) (monitoring and management of artificial light spill and potential associated impacts to marine turtles).

2 Existing Environment

2.1 Regional overview

Anketell Point is located east of Nickol Bay, adjacent to the east end of Dixon Island, within the Pilbara region of Western Australia. The region is characterised by high temperatures, low rainfall and cyclonic activity, and high evaporation rates. Hot summers occur between October and April, and dry winters from May to September.

Limestone reefs and small islands are located throughout the region and are common throughout the Dampier Archipelago. Most of the continental shelf exhibits a gentle, even slope, and a steep slope around the archipelago represents former shoreline and separates Nickol Bay from the oceanic waters of the North West Shelf (Jones 2004). Dixon Island and Anketell Point are separated by a relatively shallow tidal area called Bouguer Passage.

2.2 Turtle nesting in the Anketell Point area

Marine turtle beach usage surveys were undertaken in February 2008, January, March and October 2009, October 2010, January 2011 and February 2012 on mainland beaches, nearby islands and the beaches of the Dampier Archipelago. These data are compared to data from other major nesting sites in the broader region. Regionally significant nesting beaches are found at Barrow Island and Mundabullangana Beach south of Port Hedland.

Delambre, Legendre and Huay Islands are significant at a local level (Pendoley Environmental 2010, Biota 2012). These rookeries are not considered regionally significant when compared with the other island rookeries in the area (Pendoley Environmental 2010, Biota 2012). A map of nesting beaches across the Anketell Point region is provided in Figure 2.1. Nesting activity at Anketell Point, Bells Beach and Dixon and Delambre islands is discussed in more detail below.

2.2.1 Anketell Point

One set of flatback tracks was observed in January 2009 (Pendoley Environmental 2010). No evidence of recent turtle nesting was observed in late October 2009 (at the end of expected peak nesting period for hawksbill turtles). No historic or recent nesting activity was recorded at Anketell Point in October 2010 or January 2011 (Pendoley Environmental 2011). A single emerged nest was recorded in February 2012 and a single track and nest was recorded in October 2012 (Oceanica 2012, S.Shute pers. obs. 2012). Although flatback turtles occasionally nest at Anketell Point, the usage of these beaches, approximately 100 to 200 m from the construction blasting location, is extremely minor compared to other beaches in the region.

2.2.2 Bells Beach

Bell's Beach is long and wide, located over 4 km from the construction and quarry blasting locations and is backed by sand dunes. Although it is a mainland beach, and therefore easily accessed, the 4WD track to the beach has been closed. Nesting activity has been recorded during all previous surveys of this beach (Pendoley Environmental 2010, 2011). In February 2012 there was evidence of nesting activity by flatback turtles along the length of the beach (Oceanica 2012).

2.2.3 Dixon Island

The main nesting beach at Dixon Island is long and wide, with a distinct change in slope between the beach face and berm and some evidence of scarping. The beach is bordered by rock outcrops at both ends, however there was considerable geomorphic variation between the eastern and western ends, which is likely to affect the suitability of the entire length of beach for turtle nesting. The studies completed to date concluded that the level of nesting activity at Dixon Island was low compared to other important rookeries in the region (Biota 2012) and is dominated by flatback turtles (with low numbers of hawksbill turtles). The nesting beaches are located approximately 1.85 km from the construction blasting location.

2.2.4 Bezout Island

The nesting beach at Bezout Island is small and narrow, and is located between adjacent rock platforms. In February 2012 there was evidence of tracks and several unsuccessful nesting attempts across this area (Oceanica 2012). Available information suggests the level of use is likely lower than that of Dixon Island and may be limited to hawksbill turtles only. Bezout Island is located over 11 km from the construction blasting location.

2.2.5 Delambre Island

Over five nights during the main nesting season in January 2011 an average of 140 flatback turtles, equally distributed between the northeast, southeast and southwest beaches, and 29 hawksbill turtles, were recorded each

night (Pendoley Environmental 2011). An average of less than one green turtle per night was recorded along the east coast beaches. This site is located over 18 km from the construction blasting location.

2.3 Migratory birds

The area surrounding Anketell Point was surveyed intensively between October 2008 and February 2012, with surveys during the breeding season (April to August/early September), southern migration (August-November), northern migration (March/April) and non-breeding season (early November to early March) allowing the stages of key use of the area to be determined. The abundance of the most common species (Grey-tailed Tattler, Greater Sand Plover, Bar-tailed Godwit and Great Knot) was greatest during the southern migration (October 2010) and the non-breeding season (January 2011, February 2012). This follows the pattern in Grey-tailed Tattler abundance recorded during migratory wader surveys conducted on Barrow Island where numbers peaked during the non-breeding season, and decreased during the breeding season (Bamford 2005). The Grey-tailed Tattler was abundant within the Anketell Point area (>1% of global population) and was considered a key species during the impact assessment (Figure 2.2) (API 2010, 2011). The Greater Sand Plover is considered another key species due to the relatively high numbers (1094 (Summer 2011), 692 (Summer 2012)) recorded across the region during the majority of surveys, which approached 1% of the flyway population (Figure 2.3).

Numbers of the Grey-tailed Tattler recorded from the Proposal area and surrounds exceeded the threshold of 1% of the flyway population during surveys conducted in October 2010 (low tide count 501 birds, high tide count 662 birds), January 2011 (low tide count 399 birds, high tide count 641 birds) and February 2012 (low tide count 770, high tide count 1004) (AECOM 2011b, Western Wildlife 2012). A number of Grey-tailed Tattler were recorded roosting within the proposal envelope (261 birds in October 2010, 380 birds in January 2011, 319 birds in February 2012). Survey of the wider area in January 2011 and February 2012 revealed that sites beyond the project envelope also support significant numbers of Grey-tailed Tattler.

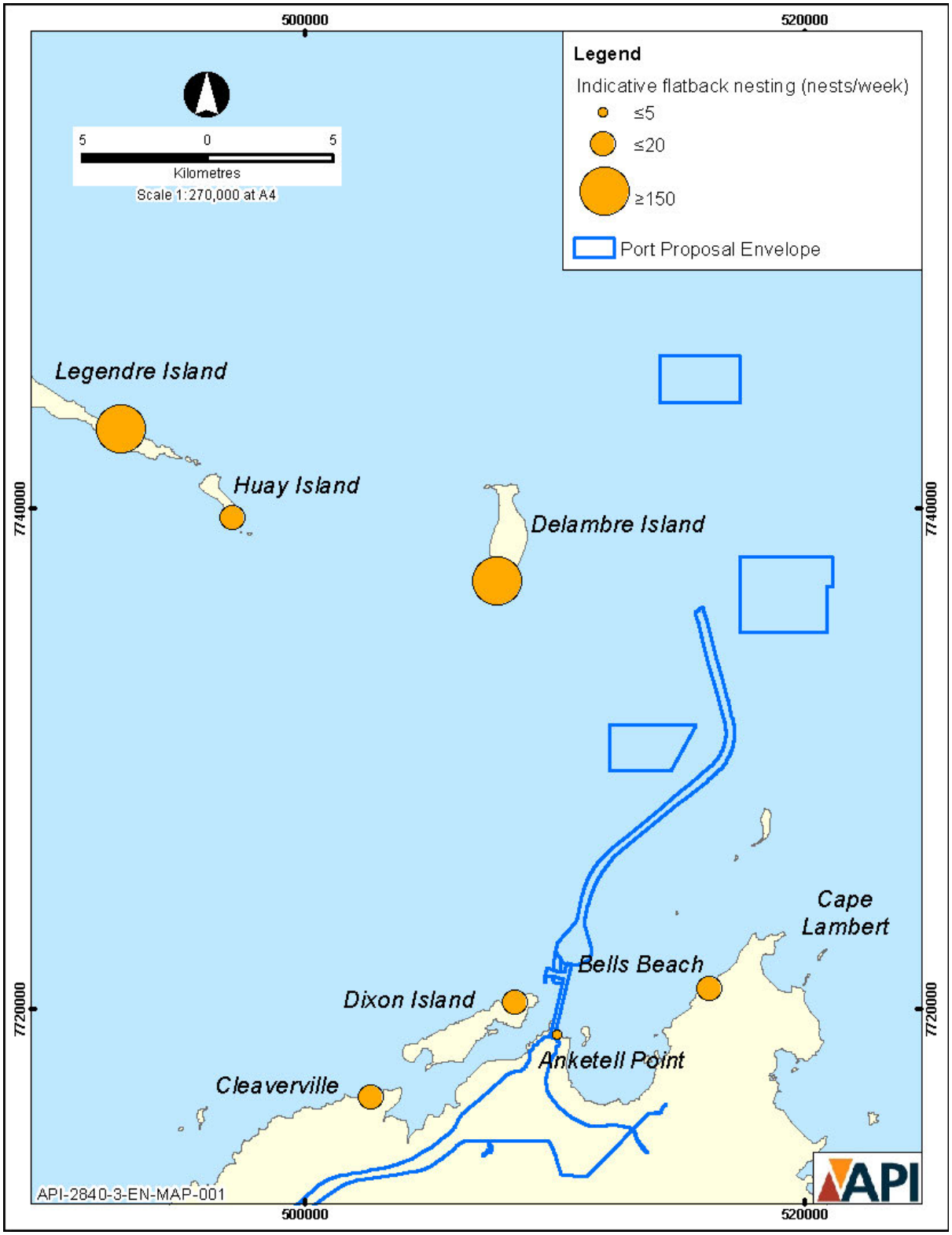


Figure 2.1 Location of turtle nesting sites across the Anketell Point region

Figure 2.2 Abundance of Grey-tailed Tattler recorded at high tide roosts between 2008 and 2012

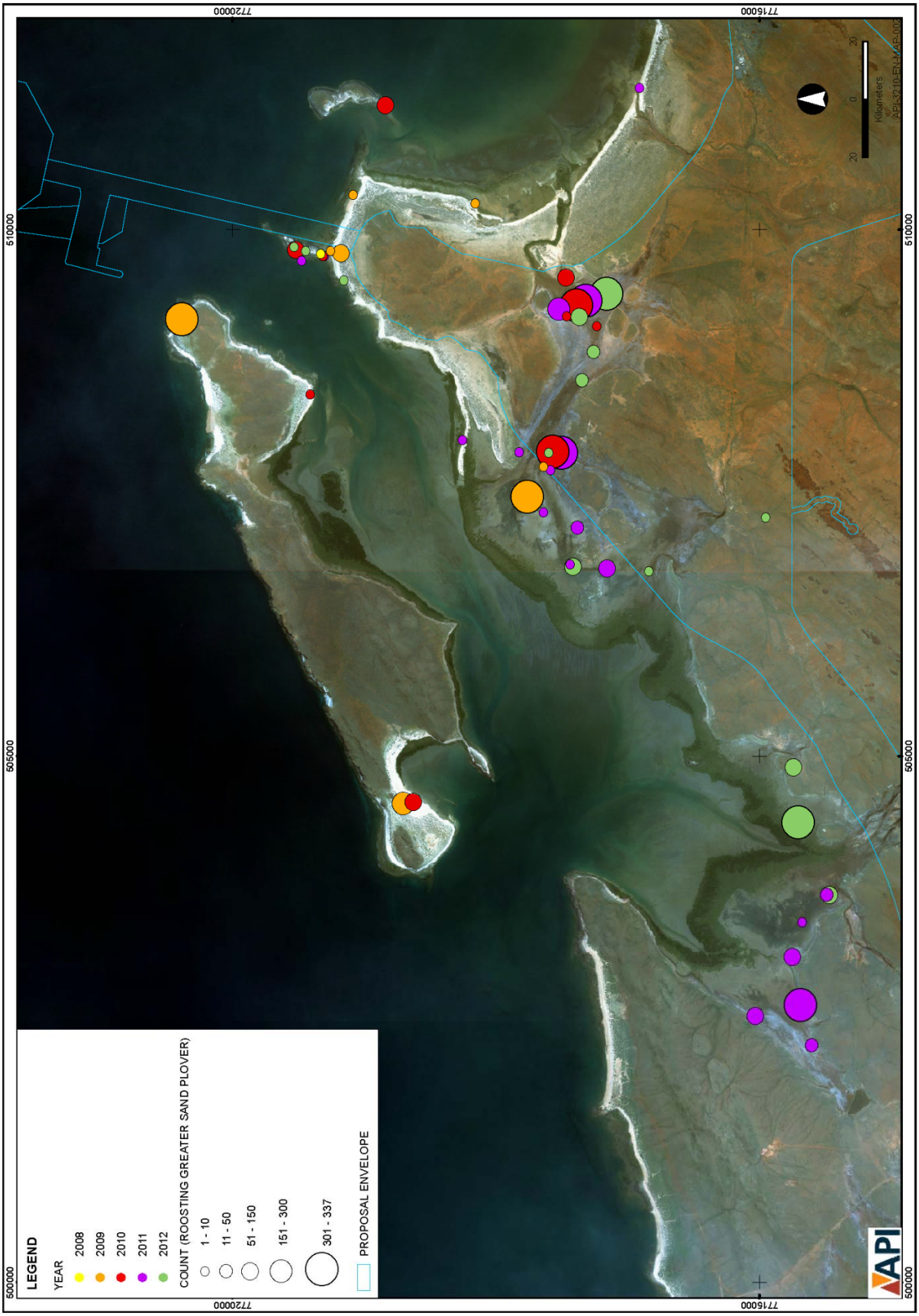


Figure 2.3 Abundance of Greater Sand Plover recorded at high tide roosts between 2008 and 2012

3 Potential terrestrial blasting-related impacts

3.1 Injury to or mortality of marine turtles (and other marine migratory or listed species)

The risk of injury to or mortality of marine turtles is considered negligible given the poor transmission of ground vibrations (caused by blasting) into adjacent fluid (i.e the ocean) or gaseous media (i.e. the atmosphere) (AS2187.2). Thus individuals in waters surrounding Anketell Point or on adjacent beaches are unlikely to be at any risk. Personnel evacuation distances in the Pilbara range from 500 m for a small diameter blast hole to 1000 m for a large blast hole (used exclusively in mines) but these distances are based almost entirely on the control of risk posed by flyrock rather than air or ground vibration (G. Boucher pers comm., 2014).

3.2 Ground vibration impacts to turtle eggs or embryos

A literature search identified no reports or papers discussing the impacts of blasting vibrations on turtle rookeries, although it is commonly referenced as a potential impact. Personal correspondence with the author of an honours thesis (M. Ripcke, pers comm. 2012), and subsequent presentations (Ripcke et al. 2014), reporting the results of simulated pile driving vibrations on flatback hatching also failed to identify any sources of information on blasting vibration impacts on turtle rookeries. Although the work by Ripcke et al. (2014) did determine that the lethal vibration $(LV_{50})^2$ for flatback turtle embryos was suspected to lie between 1.67 m/s^2 and 3.7 m/s^2 vertical acceleration (at 440 Hz), it is difficult to relate such pile-driver induced data (reported as vertical acceleration) to blasting-induced vibration (generally measured as velocity) (G. Boucher pers comm., 2012).

Given the lack of available data on the risk posed by terrestrial blasting to turtle rookeries, API commissioned a specialist blasting engineer to model the likely magnitude of ground vibrations from the proposed construction and quarry blasting operations reaching nesting beaches at Anketell Point, Bells Beach, Cleaverville and on Dixon and Delambre islands (Figure 3.1).

This modelling predicted that ground vibrations:

- at Anketell Point beach would exceed the levels designated for the prevention of human disturbance (5 mm/second) and could pose a risk to turtle nesting;
- at the Dixon Island nesting beaches would fall below 2 mm/second and would most likely not be of concern (i.e. not pose a risk to turtle nesting); and
- at all other nesting sites would fall below 0.5 mm/second and would most likely be less than the measurement limitations of vibration measuring instruments, and would not be of concern (i.e. not pose a risk to turtle nesting) (George Boucher Consulting 2012).

[2] Dose that causes the death of half the members of a tested population after a specified test duration.

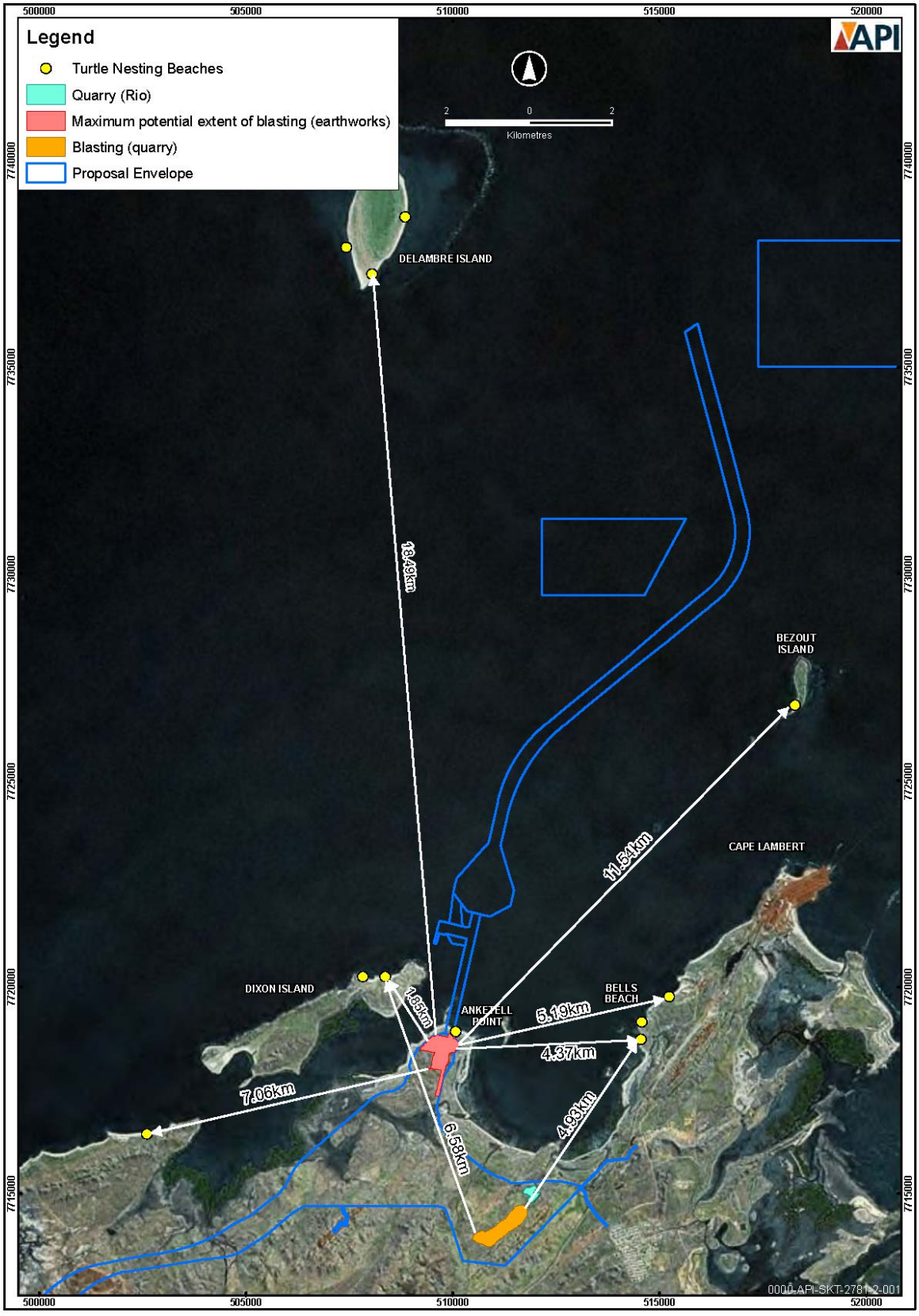


Figure 3.1 Indicative blasting areas (indicative construction footprint and quarry) in relation to regional turtle nesting beaches

3.3 Displacement of migratory birds due to noise disturbance

Potential short-term displacement of individuals from mainland roosting sites could occur during the construction phase, though evidence from the Port of Brisbane suggests that migratory birds may readily acclimatise to ongoing noise disturbance (W. Young, pers. comm.).

Two major (> 150 birds) Grey-tailed Tattler roosts were recorded within the development envelope during the February 2012 survey, one was recorded during the January 2011 survey and one was recorded during the October 2010 survey (in the same location as the northern most major roost identified in 2012) (Figure 2.2).

Numerous alternative roosts, including major roosts, were recorded outside of the development envelope including the 'Far West mudflats' (south east of Cleaverville) and on Dixon Island (AECOM 2011b, Western Wildlife 2012) allowing any displaced birds to relocate to a suitable area without a long flight.

3.4 Injury to or mortality of migratory birds due to increased air pressure

The risk of injury to or mortality of migratory species is considered negligible given the poor transmission of ground vibrations (caused by blasting) into adjacent gaseous media (i.e. the atmosphere) (AS2187.2). Thus individuals beyond the immediate vicinity of blasting operations are unlikely to be at risk. No Grey-tailed Tattler roosts are present within 100 m of the proposed blasting area and no major roosts (>150 birds) are present within 1,500 m of the proposed blasting area (Figure 3.2). No Greater Sand Plover roosts are present within 100 m of the proposed blasting area and no major roosts (>150 birds) are present within 600 m of the proposed blasting area (Figure 3.2).

To ensure that personnel are safely clear of the blasting area prior to each blast it is standard practice for the shotfirer/blast controller to sound an audible warning (siren) adjacent to the blasting location. This warning may displace any birds in the immediate vicinity of the blasting operation.

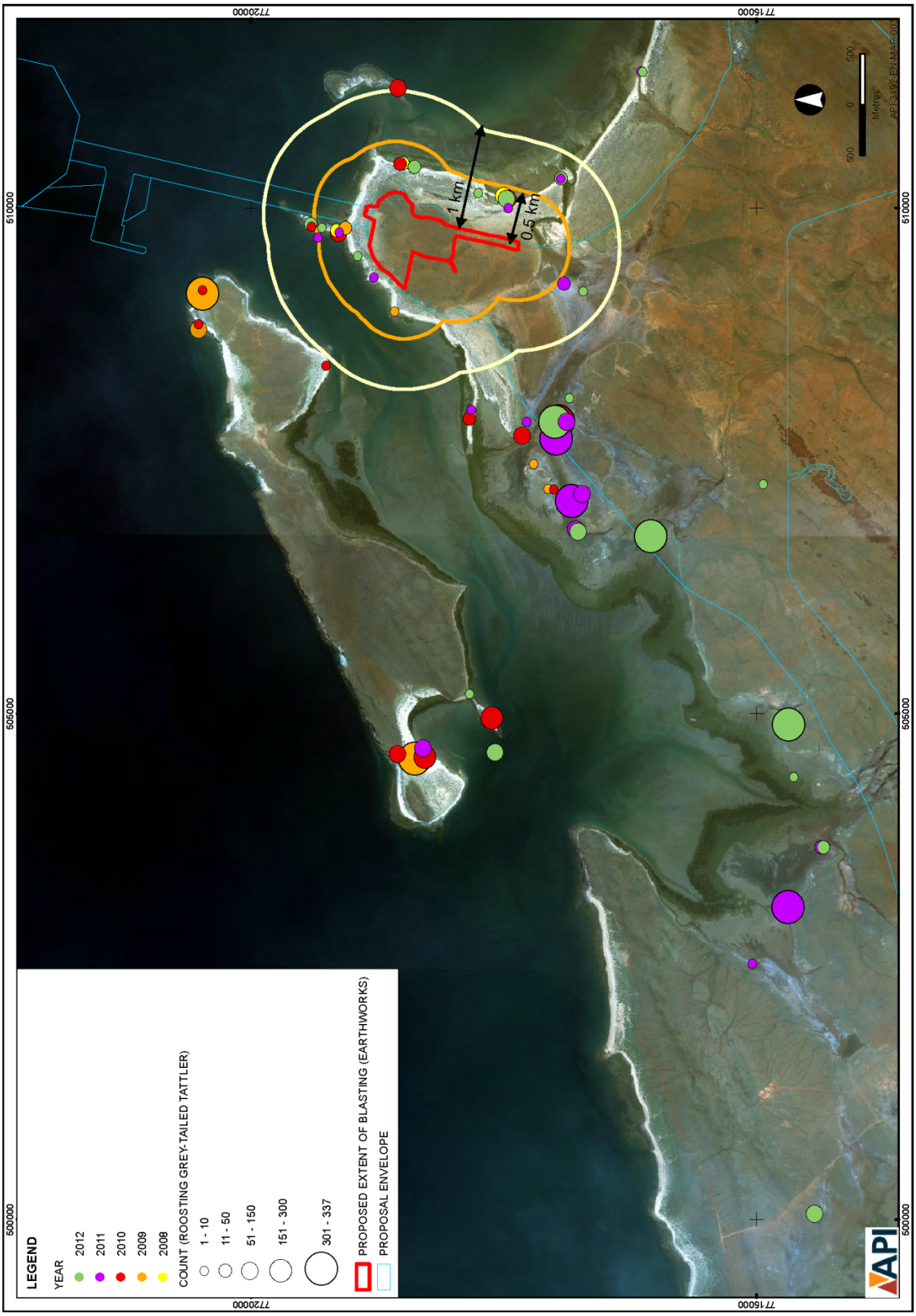


Figure 3.2 Indicative 'construction' blasting area in relation to Grey-tailed Tattler roosts

4 Roles and Responsibilities

Table 4.1 outlines the provisional roles and responsibilities of personnel responsible for implementation of this plan.

Table 4.1 Roles and Responsibilities

Role	Responsibility
Project Director (API)	Overall responsibility for project implementation and compliance against statutory legislation and project legal obligations
Port Manager (API)	• Responsibility to construct Anketell Port in a safe and environmentally responsible manner compliant with all State and Commonwealth statutory obligations; • Ensure the requirements of this plan are integrated into construction and operational planning and on-ground activities; and • Ensure API conditions, commitments and policies are followed.
Manager Environment and Community (API)	• Provide technical advice and guidance and assist senior management to coordinate the implementation of this management plan and coordinate the review and audit of this plan; • Coordinate the statutory reporting and assessment of compliance against the plan in relation to statutory legal obligations; and • Implement the management systems necessary to ensure all employees and contractors are aware of and perform in accord with API policies and standards, regulatory requirements and approval conditions.
Contractors	Contractors will develop their environmental procedures to be consistent and compliant with API environmental policies and standards.
Site Environmental Superintendent (API)	• Monitor construction activities and be available to provide environmental advice as needed; and • Conduct audits of the contractors.
All personnel, contractors and visitors	• Comply with requirements of this plan; • Attend inductions relating to environmental management; and • Report environmental incidents.

5 Management objectives and performance indicators

The intent of this plan is to ensure that risks to listed threatened and migratory species arising from terrestrial blasting operations are identified, avoided, or where this is not practicable, mitigated. While some minor impacts such as the displacement of fauna from within and adjacent to the approved development footprint due to construction activities (including blasting) may occur, and have been predicted, this plan aims to ensure that no significant impact[3] to species of conservation significance occurs as a result of blasting.

The objectives, targets and performance indicators for the protection of listed threatened and migratory species during blasting operations at Anketell Port are provided in Table 5.1.

Table 5.1 Objectives, targets and performance indicators for the protection of listed threatened and migratory species from blasting-related impacts

Objectives	Environmental Management Targets	Performance Indicators
Minimise impact to turtle nesting due to ground vibration associated with the construction of Anketell Port.	No impact to turtle nesting success due to blasting-related ground vibration.	Ground vibration monitoring, and nesting success monitoring.
Minimise disturbance/displacement of migratory birds at roosts beyond construction footprint.	No long-term displacement of migratory birds from significant roosts (>100 birds previously recorded) beyond the proposal envelope.	Results of migratory bird surveys.
Minimise impacts to listed migratory birds as a result of terrestrial blasting activities.	No mortality of, or injury to, listed migratory birds as a result of terrestrial blasting activities.	Results of migratory bird surveys and routine monitoring of construction activities.

The key monitoring procedures and management actions relevant to these objectives are discussed in Section 6.

[3] As defined in DEWHA (2009).

6 Monitoring procedures and management actions

6.1 Ground vibration

The monitoring to be completed to track ground vibration and enable the protection of marine turtles during terrestrial blasting operations is outlined in Table 6.1.

Table 6.1 Monitoring of ground vibration

Monitoring of construction impacts	
Activity	Onshore construction blasting
Environmental Value(s)	Turtle nesting success
Potential Environmental Impact(s)	Ground vibration
Impact Pathway	Impacts to embryo development
Management Triggers	Ground vibration greater than maximum baseline levels at turtle nesting sites (Bells Beach, Dixon Island)
Monitoring Programme Summary	
When blasting commences at Anketell Point (construction area), blast vibration monitoring will be used to derive sufficient data to confirm the rate of transmission of ground vibration and validate the modelled levels reaching adjacent turtle nesting beaches. If nesting occurs at Anketell Point concurrently with blasting API may, in consultation with the Department of Parks and Wildlife (DPaW) and the DoE, seek to excavate and relocate eggs to Bells Beach prior to the commencement or continuation of blasting.	
Timing • Baseline monitoring prior to the commencement of construction; • Initial monitoring of ground vibration during terrestrial blasting to validate model predictions; and • Ongoing monitoring during the nesting season(s) for the duration of blasting activities.	
Location Baseline monitoring of ground vibration and monitoring during initial stages of terrestrial blasting operations to validate predictions at: • Anketell Point; • Dixon Island; and • Bells Beach. Ongoing monitoring during blasting at: • Anketell Point (if nesting occurs and nest(s) are not relocated) to collect data on the gross effects of blasting-induced ground vibration on turtle embryo and hatchling development. Note that the low incidence of nesting at this site is expected to limit the dataset to the emergence success of 1-2 nests/season.	
Method Monitoring of ground vibration levels adjacent to nesting areas (measurements made as close to mean chamber depth (0.5 m) as possible). Blast-induced ground vibrations are typically measured as peak particle velocity (PPV), measured simultaneously in three orthogonal directions (vertical, longitudinal and transverse). The instruments used to measure blast-induced ground vibration are standardised around the world (complying to International Society of Explosives Engineers standards). Ground vibration instrumentation and measurement practice are also described within AS2187.2 (2006). Ground vibration monitors are "set" to monitor by arming the instrument to detect any ground vibration which exceeds an assigned "trigger" level. Once a trigger event is detected, the instrument will record all ground vibration activity for a set period of time (typically 5-10 seconds). Following determination of baseline ground vibration levels, this trigger value can be set to exclude instrument trigger from non-blast related vibration sources (for example wind upon ground or trees, ocean waves upon shore/rocks or vehicle traffic). Typically the minimum practical trigger level, to avoid the recording of non-blast related vibration sources, is about 0.5 mm/sec (George Boucher Consulting 2012).	

Management Strategies

To ensure that the risks of impacts to turtle nesting success from terrestrial blasting are minimised, the following constraints will be applied:

A. Construction Area

i. Maximum bench height = 5m
ii. Maximum blast hole diameter = 102mm
iii. Maximum charge per hole = 37kg
iv. Maximum number of charges/8ms window = 3.

B. Quarry

i. Maximum bench height = 15m
ii. Maximum blast hole diameter = 115mm
iii. Maximum charge per hole = 170kg
iv. Maximum number of charges/8ms window = 3

C. Overall

Night time blasting will be prohibited during the peak nesting/hatching season for marine turtles (1 November to 28 February).

Contingency management

If monitoring indicates a risk of impact at turtle nesting beaches beyond Anketell Point, blast intensity (i.e. charge per hole and/or number of charges) will be reduced to minimise the risk of impact.

6.2 Turtle nesting success

The monitoring to be completed to confirm achievement of the management objective for marine turtles during/following terrestrial blasting operations is outlined in Table 6.2.

Table 6.2 Monitoring of turtle nesting success

Monitoring of construction impacts	
Activity	Onshore construction and quarry blasting
Environmental Value(s)	Turtle nesting success
Potential Environmental Impact(s)	Ground vibration
Impact Pathway	Impacts to embryo development
Management Triggers	Reduction in nesting success (compared to baseline data and reference sites)
Monitoring Programme Summary	
Timing • In the event that monitoring of ground vibration during the initial stages of terrestrial blasting operations indicates an exceedance of baseline levels at a turtle nesting site, monitoring of hatching success at that site at the end of each turtle nesting season (February/March).	
Location At any of the following site(s) exhibiting ground vibration levels exceeding baseline: • Anketell Point (if nesting occurs and nest(s) are not relocated); • Dixon Island; • Bells Beach; and • A reference site (one of the above if not exposed to ground vibration levels above baseline levels, or a suitable separate site (e.g. Delambre Island)).	
Method Excavation of nests (minimum of four per site if practicable) following emergence to determine the number of hatched eggs (empty eggshells which were more than 50% intact), live hatchlings, dead hatchlings, eggs with no discernable embryo, eggs with partially developed embryo and eggs with fully developed embryo.	
Management Strategies	
Contingency management	
In the event of a reduction in nesting success (compared to baseline data and reference sites): • Investigate cause; • Notify the Commonwealth Minister for the Environment and DPaW within 1 business day if determined to be a result of the proposal; • Implement measures and strategies to mitigate impact (i.e. additional management of ground vibration); and • Review the effectiveness of the management measures and revise as necessary.	

Nest relocation protocols

In the event that it is agreed with DPaW and the DoE that a turtle nest should be relocated from Anketell Point beach, the following protocols (from Eckert et al. 1999) will be adopted, with a member of the API Environment and Community Team present at all times:

- Eggs will be excavated and handled with care (and a record made of the number of eggs and the entire relocation process);
- When transported by vehicle/vessel they will be cushioned from vibrations (special care is needed when handling eggs that are more than 2 hours old, for example when translocating eggs the following morning as the delicate embryonic membranes of older eggs are easily torn if the eggs are rotated or jarred);
- No eggs will remain unburied for periods exceeding 5 hours;
- The top of each egg will be marked with a soft grease pencil prior to transferring it to a bucket or other inflexible container (not a sack) to ensure that they are not rotated either during transport or during reburial;
- An 'artificial' nest will be excavated at Bells Beach or on Dixon Island in the vicinity of natural nests;
- Nests will be excavated to the same depth as natural nests (refer Pendoley Environmental 2011) and constructed in the shape of a flask or urn, with a rounded bottom and a straight narrow opening leading from the egg chamber to the surface;
- If nest excavation is hampered by cave-ins during periods of very dry weather, a bucket of fresh water will be poured into the unfinished nest, and the nest excavation continued; and
- Eggs will be placed into the 'artificial' nest one at a time (under no circumstances will eggs be "poured") and the damp sand removed during excavation of the nest will be used to cover the eggs;
- Damp sand will be firmly tamped in place in layers of 8-12 cm; and
- Each nest will be marked and associated with a standard data record form.

6.3 Migratory bird distribution and abundance

The monitoring to be completed to track the displacement of migratory birds due to blasting activities is outlined in Table 6.3.

Table 6.3 Monitoring of migratory bird distribution and abundance

Monitoring of construction and operational impacts	
Impacting Activity	Noise during terrestrial blasting
Environmental Value(s)	Fauna abundance
Potential Environmental Impact(s)	Noise disturbance
Impact Pathway	Displacement from foraging or roosting habitats
Management Trigger	NA
Monitoring Programme	
Timing Listed migratory bird counts bi-annually during October (southward migration) and January (non-breeding season) during construction. Observations of listed migratory bird behaviour prior to, during, and following blasting operations: opportunistically during initial stages of terrestrial blasting operations, or as soon as significant numbers of listed migratory birds are present at Anketell Point.	
Location Major roosting areas adjacent to project footprint.	
Method Measurement of populations of migratory waders via targeted counts within the vicinity of the Proposal area. Counts will be timed to coincide with the expected maximum annual abundance of the dominant migratory species (October and January), and will cover the same areas previously surveyed as part of the baseline studies. Opportunistic observations of listed migratory bird behaviour at roosts at varying distances from blasting operations, to determine the extent of a 'take flight' response and the duration of displacement of these individuals from roosts. Video footage may be captured during these observations to facilitate species identification and capture of the detailed response of displaced birds.	
Management Strategies	
The risk of displacement of migratory birds from roosts adjacent to the development footprint was taken into account during the development of the required environmental offsets. Monitoring will be completed to confirm the extent of any impact. No specific management measures relevant to the displacement of migratory birds are proposed.	

6.4 Migratory bird health

The monitoring to be completed to track the health of migratory birds following blasting operations is outlined in Table 6.4.

Table 6.4 Monitoring of migratory bird health

Monitoring of construction and operational impacts	
Impacting Activity	Increased air pressure during terrestrial blasting
Environmental Value(s)	Fauna abundance
Potential Environmental Impact(s)	Injury or mortality
Impact Pathway	Increased air pressure
Management Trigger	Recorded injury to, or mortality of, listed migratory birds as a result of blasting activities
Monitoring Programme	
Timing Surveys within eight hours following the completion of a 'construction' blasting event[4] during the period of peak utilization of the area by migratory birds (1 October to 28 February): • Following each blast or series of blasts during the first week of terrestrial 'construction' blasting; and • Monthly surveys (± 1 week) for the duration of terrestrial 'construction' blasting. One-off surveys (counts) during October (southward migration) and January (non-breeding season).	
Location Previously identified major roosting sites (Grey-tailed Tattler and/or Greater Sand Plover) within 1 km of the location of the preceding blast(s).	
Method Surveys of major roosting sites to confirm no injured or dead listed migratory birds as a result of terrestrial blasting activities. In addition to the surveys described above, the routine monitoring of construction activities (opportunistic but ongoing during the construction phase) is likely to aid in the identification of any mortality events[5].	
Management Strategies	
Sounding of an audible warning (siren) adjacent to the blasting location no more than five minutes prior to the detonation of an explosive charge (or charges).	
Contingency management	
In the event of any injury to, or mortality of, a listed threatened and/or migratory species due to blasting activities, the following actions will be implemented: • Notify the Commonwealth Minister for the Environment within 1 business day; • Investigate cause; • Implement measures and strategies in response to the injury or mortality; and • Review the effectiveness of the management measures and revise as necessary.	

[4] To facilitate the identification of injured or recently deceased birds.

[5] Involving groups of individuals at documented roosts.

7 Reporting

7.1 Community liaison

A Community Environmental Forum will be established prior to the commencement of port construction. Attendance is envisaged to include local community representatives (including members of the Point Samson Community Association (PSCA) and Wickham community), Shire of Roebourne, DPaW and the Pilbara Ports Authority. Meetings of this group will be scheduled to provide project updates and receive feedback on any environmental matters and concerns.

7.2 Formal reporting requirements

Any injury to, or mortality of, an EPBC Act listed threatened and/or migratory species will be reported to the Commonwealth Minister for Environment within one business day, together with evidence related to the cause of this injury or mortality.

8 Audit and review

A summary of the key audit procedures is presented in Table 8.1.

Table 8.1 Summary of audit procedure

Key Action	Evidence	Reporting
Submit BMP for approval by the Commonwealth Minister for Environment at least three months prior to the commencement of blasting activities	Correspondence register	NA
Blasting activities must not commence until the BMP has been approved.	Approval of BMP (correspondence register)	NA
Implement approved BMP	Records of monitoring and management measures undertaken in accordance with BMP within document management system/correspondence register	NA
Submit Marine Fauna Incident Report to the Commonwealth Minister for Environment within one business day	In the event of any natural or proposal attributable injury or mortality of an EPBC Act listed threatened and/or migratory species	Within one business day of the observation

The approved BMP will be reviewed, and amended as required, at a minimum every twelve months following the commencement of blasting operations.

The plan may be reviewed within this time as appropriate to maintain currency with, for example, possible operational/design/capacity changes, changing standards, or on the basis of ground vibration, turtle hatching or migratory bird abundance monitoring results.

9 References

AECOM. 2011a. Port Development-Onshore Geotechnical Site Walkover. Report prepared by AECOM Australia Pty Ltd for API Management Pty Ltd, Como, Western Australia. June 2011.

AECOM. 2011b. Migratory Wader Assessment Report. Report prepared by AECOM Australia Pty Ltd for API Management Pty Ltd, Como, Western Australia.

AECOM. 2012. Basis of Schedule-Anketell Port. Report prepared by AECOM Australia Pty Ltd for API Management Pty Ltd, Como, Western Australia.. May 2012.

API 2010. West Pilbara Iron Ore Project (WPIOP) Stage 1 – Anketell Point Port Public Environmental Review. August 2010.

API 2011. West Pilbara Iron Ore Project (WPIOP) Stage 1 – Anketell Point Port 43a/Response to Submissions and Final Public Environment Report. June 2011.

Australian Standard 2187.2-2006. Explosives - Storage and use. Published by Standards Australia.

Biota. 2012. West Pilbara Iron Ore Project: Anketell Port Marine Turtle Desktop Review. Prepared by Biota Environmental Sciences for API Management Pty Ltd, Como, Western Australia. April 2012.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009. Matters of National EnvironmentalSignificance. Significant impact guidelines 1.1. *Environment Protection and Biodiversity Conservation Act 1999*.

DPA. 2011. Anketell Port Land Use and Infrastructure Master Plan 2011 – 2041.

Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and Donnelly, M. (Editors). 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

George Boucher Consulting. 2012. Assessment of Terrestrial Blast-induced Ground Vibration at the Anketell Port/Quarry Site and adjacent Turtle Nest Sites. Prepared for API Management Pty Ltd. April 2012.

Jones, D. S. 2004. The Burrup Peninsula and Dampier Archipelago, Western Australia: an introduction to the history of its discovery and study, marine habitats and their flora and fauna. Records of the Western Australian Museum Supplement No. 66: 27–49.

Oceanica. 2012. West Pilbara Iron Ore Project: Regional Survey of Turtle Nesting Beaches (February 2012). Report prepared by Oceanica Consulting Pty Ltd for API Management Pty Ltd, Como, Western Australia. April 2012.

Pendoley Environmental. 2010. *API Project Anketell Point Marine Turtle Surveys*. Prepared for AECOM by Pendoley Environmental Pty Ltd. January 2010.

Pendoley Environmental 2011. Turtle Surveys Anketell Point 2010/2011. Report prepared by Pendoley Environmental Pty Ltd for API Management Pty Ltd, Como, Western Australia. May 2011.

Ripcke, M., Guinea, M. and McGuinness, K. 2014. Preliminary results of the effects of simulated pile driving vibrations on sea turtle embryogenesis. Abstract of poster presented at the 34th Annual Symposium on Sea Turtle Biology and Conservation, New Orleans, Louisiana, USA, 10-17 April 2014.

Western Wildlife 2012. Greater Anketell Point Area: Summer (non-breeding season) shorebird survey 2012. Report prepared by Western Wildlife for API Management Pty Ltd, Como, Western Australia.

Personal correspondence

Boucher, G. George Boucher Consulting. Telephone conversation, 11 April 2012.

Boucher, G. George Boucher Consulting. E-mail correspondence. 28 May 2014.

Ripcke, M. Undergraduate, Charles Darwin University. E-mail correspondence. March 2012.

Shute, S. Senior Environmental Scientist-Port, API Management. Personal observation. October 2012.

Snowdon, D. Assistant Director, North West Section, North, West & Offshore Assessment Branch, Department of Sustainability, Environment, Water, Population and Communities. Telephone conversation. 30 April 2013.

Young, W. Environment and Heritage Manager Dampier Port Authority. E-mail correspondence. November 2012.