RTA Weipa Pty Ltd

Feral Pig Management Offset Strategy

8 July 2016

RioTinto

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1 PURPOSE

This Feral Pig Management Offset Strategy has been prepared to address Conditions 43 to 47 of the South of Embley Project (SoE Project) approval (EPBC 2010/5642) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Strategy has been designed to reduce the annual level of feral pig predation on the nests of the following listed turtle species:

- Green Turtle (*Chelonia mydas),*
- Hawksbill Turtle (*Eretmochelys imbricate);*
- Flatback Turtle *(Natator depressus);*
- Loggerhead Turtle *(Caretta caretta);*
- Olive Ridley Turtle *(Lepidochelys olivacea); and*
- Leatherback Turtle (*Dermochelys coriacea)*.

2 BACKGROUND

A detailed environmental impact assessment of Matters of National Environmental Significance under the EPBC Act, including community consultation, has been undertaken and is presented in the *South of Embley Project Environmental Impact Statement* (RTA 2013).

The Environmental Impact Statement (EIS) identified that lighting at the proposed Boyd Port could have an adverse impact on marine turtle hatchlings (RTA 2013). Altered above-water night-time light regimes can have an effect on hatchlings' attempts to find water. Lights at a nesting beach may result in marine turtle hatchlings heading inland rather than into the ocean, with subsequent mortality. Lights adjacent to nesting beaches can result in hatchlings entering the ocean safely, only to re-emerge closer to the light source. Offshore lighting may result in hatchlings aggregating under the light, effectively becoming a focus for predatory fish.

While the design of lighting will seek to minimise adverse impacts on hatchlings, a compensatory measure was proposed in the EIS to enhance overall hatchling survivorship by reducing the predation of turtle nests by feral pigs (RTA 2013). This Feral Pig Management Offset Strategy expands on that feral pig control proposal.

2.1. Regulatory requirements

The then Minister for Sustainability, Environment, Water, Population and Communities approved the SoE Project (EPBC 2010/5642) with conditions on 14 May 2013 (and varied on 3 June 2014). The approval requires a Feral Pig Management Offset Strategy be prepared and approved by the Minister prior to the commencement of the action. The approved Strategy must be implemented. The conditions relating to the Strategy, and where they are addressed in this document, are outlined in **Table 1**.

Table 1: Feral Pig Management Offset Strategy EPBC Act Approval Conditions

Condition	Addressed in this plan
43. The approval holder must implement an adaptive Feral Pig Management Offset Strategy to reduce the annual level of feral predation on **listed turtle species** nests for the period of this approval.	**Section 1**
44. The Feral Pig Management Offset Strategy must be implemented at a minimum, in the project area as described in Figure 7-23 of the **Final Environmental Impact Statement.**	**Section 5 and Appendix B**
45. The Feral Pig Management Offset Strategy must include surveying to develop significantly robust baseline data for **listed turtle species** nesting in the project area and desired outcomes, benchmarks, readily measureable performance indicators and goals, timeframes for reporting and implementation, corrective actions and contingency measures, and, specify the person/s roles with responsibility for implementing actions. The Feral Pig Management Offset Strategy must provide information detailing Traditional Owner employment opportunities, and mechanisms for reporting the number of local indigenous person/s actually employed in the implementation of this Strategy (consistent with condition 42).	**Sections 6.1 and 9**
46. The Feral Pig Management Offset Strategy must adhere to the **department's** *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs*, or its most current version. The Feral Pig Management Offset Strategy must also adhere to the *Humane Pest Animal Control: Code of Practice and Standard Operating Procedures* (that is currently being updated), or its most current version.	**Section 5 and Appendix C**
47. The findings from the Feral Pig Management Offset Strategy must be used to inform the Marine and Shipping Management Plan at condition 5 on an ongoing basis.	**Section 8**
48. The Feral Pig Management Offset Strategy must be submitted to the **Minister** for approval at least 6 months prior to the **commencement of the action**. The **commencement of the action** must not occur until the Feral Pig Management Offset Strategy has been approved by the **Minister**.	The requirement does not relate to the content of this strategy.

2.2. SoE Project Summary

The SoE Project involves the construction and operation of a bauxite mine and associated processing and Port facilities for shipping of bauxite to either Gladstone or international markets. The SoE Project involves a staged increase in production up to 50 million dry product tonnes per annum (Mdptpa) of bauxite. The initial production is likely to be approximately 22.5Mdptpa. Actual production rates and the timing and size of capacity expansions will depend on market conditions. The anticipated mine life is approximately 40 years, depending on production rates.

The SoE Project is located near Boyd Point on the western side of Cape York Peninsula. The main components of SoE Project are illustrated in **Figure 1** and summarised below. Detailed information on the SoE Project is presented in the Commonwealth EIS (RTA, 2013).

- **bauxite mining** – involving the clearing, salvage of topsoil, stripping of overburden, extraction of up to 50Mdptpa of bauxite, replacement of topsoil and revegetation. Mined areas will be progressively rehabilitated;
- **bauxite processing** – crude bauxite will be transported using a network of internal haul roads to one of two beneficiation plants (Boyd beneficiation plant, followed by a second plant near Norman Creek). A beneficiation plant separates the bauxite and waste materials through sizing, screening, washing and dewatering. Chemicals are not used in the process, only water. Fine waste materials will be discharged to tailings storage facilities;
- **product bauxite stockpiles** – beneficiated product stockpiles, built by a stacker for subsequent reclaiming, will be established adjacent to Boyd Port;
- **ancillary infrastructure** – involving the construction and operation of a diesel-fuelled power station, workshops, warehouse, administration facilities, package sewage treatment plant, temporary waste storage prior to disposal off-site and diesel storage facilities;
- **barge, ferry and tug facilities** – involving the construction and operation of a new ferry and tug terminal at Hornibrook Point, a roll on/roll off barge facility at Humbug Wharf, and a new barge and ferry terminal on the western bank of the Hey River;
- **on-site camp** – involving the construction of a camp facility. Additional accommodation may be constructed in Weipa if required.
- **water infrastructure** – involving the construction of a water supply dam on a freshwater tributary of Norman Creek (Dam C), plus pipelines, water treatment plants (for potable water) and artesian bores;
- **Port and ship-loading facilities** – involving the construction and operation of the Boyd Port, shiploading and tug mooring facilities between Boyd Point and Pera Head. Works will include a jetty, bulk carrier vessel wharf and berthing structures, tug and line boat moorings, ship-loader and dredging of berth pockets and departure areas.

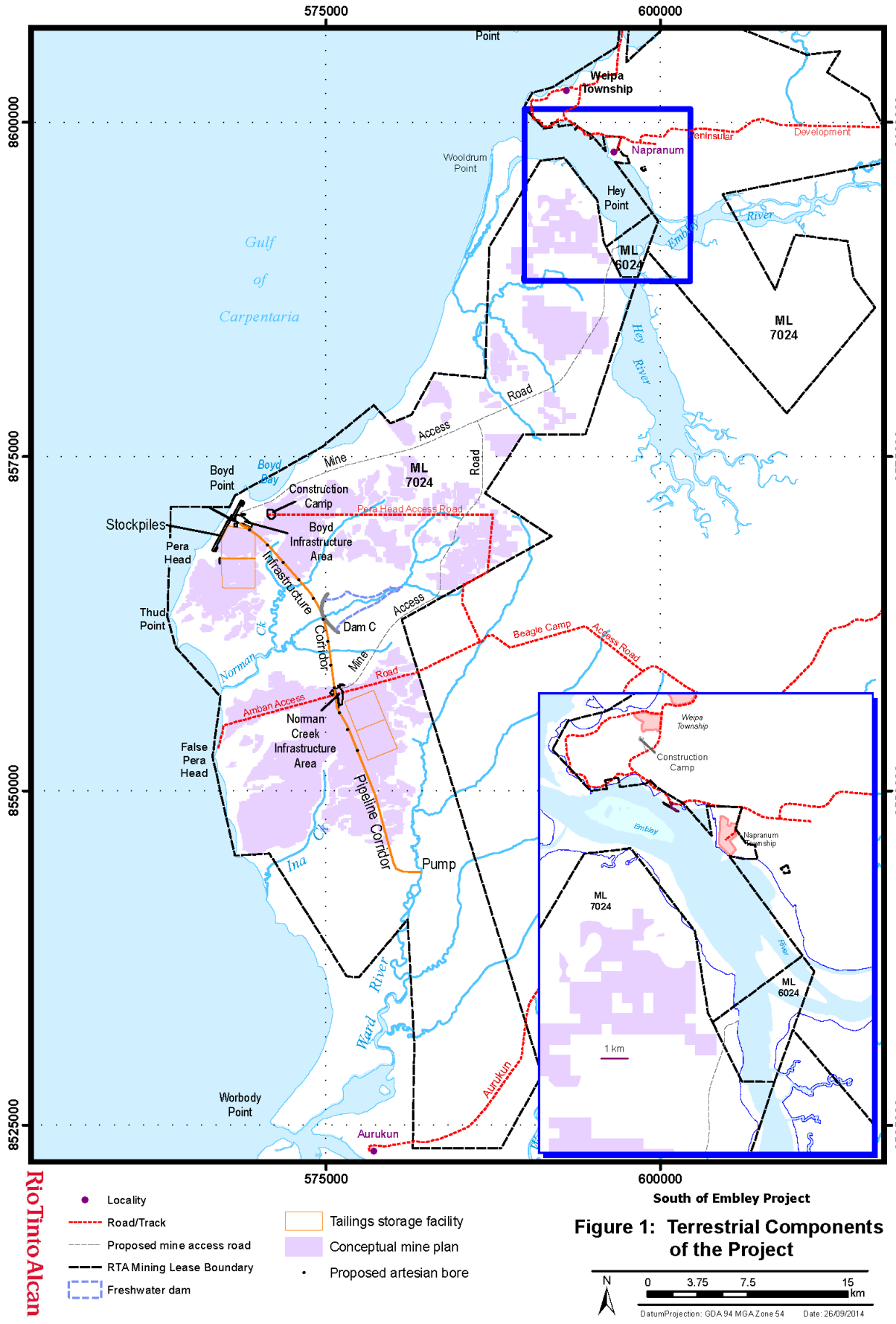

Figure 1: Components of the SoE Project

Figure 1: Terrestrial Components of the Project

The initial construction phase of the SoE Project is expected to take approximately 3 years. The actual timing will depend on the timing of the wet season in relation to commencement of construction and the staging of the project.

The Port of Weipa will continue to receive deliveries of fuel, cargo, and equipment for the SoE Project at the Humbug, Evans Landing, and Lorim Point wharves from domestic (mostly the Port of Cairns) and international ports. Materials will then be transferred either to vehicles or smaller barges as required for transport to the SoE Project area.

3 MARINE TURTLE NEST PREDATION

3.1. NEST SURVEYS

The known locations of high density Flatback Turtle nesting for the Torres Strait/Gulf of Carpentaria management unit are Crab Island, Deliverance Island, Kerr Island and Wellesley Islands where the nesting densities of females is measured in the thousands (Limpus 2007). On Crab Island, Leis (2008) found an average of 30 nesting tracks per kilometre per day of beach surveyed during May 2008.

Surveys of nesting activity in the vicinity of the SoE Project, summarised in **Table 2**, show far lower densities of nesting turtles.

Table 2: Summary of marine turtle nests surveys

Location	Timing	Nests/km/night	Reference
Boyd Point to False Pera Head (38 km)	August to September 2003	0.3	(Bell 2004)
Boyd Point to Pera Head (10km)	May to July 2007	0.6	(GHD 2007)
5km north of Boyd Point to Norman Creek (27km)	April 2008	0.1	RTA (2013)
Winda Winda Creek to Ina Creek (60km)	February to October 2013	Various, see Table 3.	Guinea (2014)
	Boyd Point to Pera Head, 22 August - 2 September 2013	0.292	

The most comprehensive surveys were baseline surveys conducted in 2013 by RTAW and are presented in **Appendix A** (*Sea Turtle Monitoring South of Embley 2013* (Guinea (2014)). Rapid assessment of the numbers of marine turtles nesting on 60 km of coastline commenced with a two-day survey in February 2013 and continued with surveys lasting three days each over most months until August and October, at which time the surveys expanded to 10 days each. The August-September survey was the most intense (see **Table 3**) with a team of eight persons conducting at least three surveys of each beach of the 60 km coastline. The beach from Boyd Point to Pera Head, the vicinity of the proposed Boyd Port, became the focal beach and was surveyed nightly for sea turtle nesting and predation of existing nests by feral pigs and native predators.

The beach sections surveyed in 2013 are shown in **Figure 2**.

Of the identifiable nests found in the 2007 and 2008 surveys, 85% were Flatback nests (RTA 2013). Of the nests found between Boyd Point and Pera Head in August 2013, 62% were Flatbacks, 32% Olive Ridley, and 7% Hawksbill, Green and unidentified turtles (Guinea 2014).

The 2013 surveys from February to October found that the peak of nesting occurred in the last week of August and the first week of September.

Table 3: Marine turtle nests laid during August-September 2013 survey

Section	Number of Nests	Number of nights	Length of Beach (km)	Nests/km/night
Northern	27	8	14.5	0.233
Boyd Bay	1	6	9.2	0.018
Boyd - Pera	19	10	6.5	0.292
Pera -Thud	9	8	6.0	0.188
Thud - Norman	29	8	7.3	0.500
Amban	10	4	9.5	0.263
Southern	24	4	5.1	1.172

Figure 2: Beach sections surveyed in 2013

Loggerhead sea turtles have not been recorded as nesting on the beaches of the Gulf of Carpentaria (Limpus (2008)). This species for the most part nests on beaches in the region of the Tropic of Capricorn in eastern and Western Australia. Sporadic low density nesting in WA has been recorded as far north as Ashmore Reef. At more southern latitudes it nests during the summer months. There has been no nesting in winter months reported for this species to date. Previous studies at Crab Island and along the coast north of Weipa and of the beaches in the South of Embley lease have failed to record Loggerheads nesting.

Leatherback turtles likewise are not reported as nesting in the Gulf of Carpentaria (Limpus (2009)). In Australia, Leatherbacks are recorded nesting in southern Queensland and northern New South Wales from the mid-1970s to the mid-1990s but have not been reported nesting since 1996. In that region they nested in the summer months. The other known nesting area for Leatherbacks is in Arnhem Land and Coburg Peninsula where the species still nests but in the winter months.

Both Loggerheads and Leatherbacks occur in the Gulf of Carpentaria as foraging species but have not been reported ashore.

3.2. FERAL PIG PREDATION

There are two major anthropogenic threats to nesting marine turtles along the beaches of western Cape York, (a) predation by feral pigs, and (b) entanglement in discarded fishing nets (ghost nets). Predation by feral pigs is currently considered the most significant of these threats. Predation has been identified as a key threat to marine turtles under the EPBC Act in the 'Recovery Plan for Marine Turtles in Australia' (Environment Australia 2003) and the *Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs* (DEH 2005). Doherty (2005) and Limpus and Chatto (2004) identify one of the greatest threats to marine turtle populations on the west coast of Cape York is the loss of eggs from predation by feral pigs. Doherty (2005) reported 70% of nests surveyed in 2003-2004 between Pennefather River and Duyfken Point were destroyed by feral pig predation, with a 100% predation rate early in the nesting season. The Cape York Sustainable Futures (CYSF) Sea Turtle Project (CYSF 2011) reported that aerial culling near coastal ecosystems on western Cape York can reduce feral pig predation on marine turtle nests by up to 70% in key breeding areas.

The 2013 marine turtle nest survey found 68% of nests were predated by feral pigs, with additional predation evident from goannas and dingoes (Guinea 2014). This is consistent with the 2007-2008 surveys which showed that 70% of nests were predated (RTA 2013). Feral pig activity within the field survey area was particularly prevalent in areas with direct access to the beach from adjacent bushland. Where cliffs extended to the water's edge, feral pig activity was considerably less.

4 FERAL PIG CONTROL OPTIONS

The aim of the Feral Pig Management Offset Strategy is to reduce the level of feral pig predation on the nests of listed marine turtle species on beaches between Winda Winda Creek and Ina Creek.

It has been generally assumed that many individual pigs are responsible for depredation events, that depredation occurs randomly across available nests and that depredation rates are directly proportional to the number of pigs in an area (Doherty 2005). However, recent research has identified mature male pigs (boars) that live on the beachfronts are usually the major egg predators (Fuentes *et al* 2014, Whytlaw *et al* 2013, Mitchell 2006; Mitchell 2010).

Whytlaw *et al* (2013) found that despite the uniform availability of nests along the length of a western Cape York beach (Pennefarther beach), depredation was significantly clustered in a

small number of locations and virtually all nests available (independent of age) were consumed within these areas. This clustering and intensity of predation was maintained throughout the study period. These findings suggest the presence of isolated, discrete feeding areas of approximately equivalent size, supporting the hypothesis of individual pigs foraging within specific feeding zones. These centres of high depredation were located almost directly in front of freshwater swamps which are a limiting resource during the dry-season. Their findings suggest concentrated use of these feeding zones by individual pigs in the dry months which coincide with the main nesting season.

The *South of Embley Project Environmental Impact Statement* (RTA 2013) contemplated extending feral pig control from beaches to certain riparian hinterland areas (refer to map in **Appendix B**) based on the assumption that feral pigs would travel large distances from inland to the nesting beaches. The findings of Fuentes *et al* 2014, Whytlaw *et al* 2013, Mitchell 2006 and Mitchell 2010 indicate that targeting control efforts along the beaches is a more effective use of available resources. It is therefore proposed to concentrate controls on the coastal zone.

Six control options designed to minimise feral pig predation on marine turtle nests have been identified:

- Aerial shooting from helicopter along the coastal zone;
- Aerial baiting (1080) from helicopter or fixed wing aircraft along the coastal zone;
- Night shooting along beaches by marksmen with night vision scopes (to target those boars that are understood to do the vast majority of the predation);
- Fixed bait (1080) feeding stations that can only be accessed by feral pigs (and not by other fauna) positioned along beaches (see **Figure 3** for example of The HogHopperTM);
- Nest exclusion devices; and
- Trapping.

Figure 3: Example of a fixed bait station (The HogHopper™)

There are many factors to be considered when selecting which approach, or combination of approaches, is best suited to the SoE Project situation. These include:

- Likely effectiveness;
- Whether different approaches are needed for different beaches;
- Timing in relation to peak nesting season;
- RTAW safety requirements regarding use of firearms and use of aircraft;
- Practicality, beach access, logistics and cost;
- Possible stakeholder aversion to baiting;
- Opportunities for involvement of Traditional Owners;
- Need for RTAW to coordinate with other entities undertaking feral pig control works to the north and south on the SoE Project area.

The Australian and Queensland Governments are jointly funding the Nest to Ocean Turtle Protection Program aimed at reducing the threat of feral predation on marine turtle nests. This program will also aim to develop collaborative partnerships across government and the community to enhance the incubation success of turtle eggs in Queensland.

Applications to the Queensland Department of National Parks, Recreation, Sport and Racing for the first round of funding closed in October 2013. The funding will be targeted so that activities under the Nest to Ocean Turtle Protection Program do not overlap with RTAW's Feral Pig

Management Offset Strategy. However, it will be necessary for RTAW to co-ordinate its activities with those of neighbouring entities which have been successful in gaining funding.

Lessons from other feral pig control programs on Cape York (e.g. Cape York Natural Resource Management, APN Cape York, Balkanu) shall be used to optimize the effectiveness of controls for the South of Embley coastal area.

5 IMPLEMENTATION PLAN DEVELOPMENT

Given the many factors to be considered before selecting which feral pig control approach, or combination of approaches, is best suited to the SoE Project situation, a staged approach to the development and implementation of the Feral Pig Management Offset Strategy has been adopted.

The following actions have been undertaken in developing the implementation plan:

- Field inspection of each beach section (**Figure 2**) and beach access by feral pig control expert;
- Workshops involving RTAW, Traditional Owners and a feral pig control expert to discuss the merits and practicality of control options;
- Liaison and coordination with the organisers of other Cape York feral pig control programs, especially those receiving funding under the Nest to Ocean Turtle Protection Program;
- Preparation of requirements to be implemented regarding animal welfare and public awareness of relevant control practices; and
- Finalise feral pig monitoring plan.

The following actions shall be undertaken before each feral pig control campaign:

- RTAW safety risk assessment of use of firearms on the mining lease;
- RTAW safety risk assessment of use of helicopter and/or fixed wing aircraft and an evaluation of availability of aircraft which are suitably certified to Rio Tinto aviation standards;
- Confirmation of availability of suitably experienced individuals and resources to implement the Program; and
- Liaison and coordination with the organisers of other Cape York feral pig control programs, especially those receiving funding under the Nest to Ocean Turtle Protection Program;
- Ensure the program adheres's to the NSW Model Code of Practice (*NSW PIGCOP*) Humane control of feral pigs (NSW Department of Primary Industries, 2014) and Standard Operating Procedures Aerial shooting of feral pigs (*NSW PIG002*) (NSW Department of Primary Industries, 2015a), Ground shooting of feral pigs (*NSW PIG003*) (NSW Department of Primary Industries, 2015b) and Poisoning of feral pigs using PIGOUT 1080 baits (*PIG006*) (NSW Department of Primary Industries, 2015c), or their latest version.

- Note the *Model Code of Practice and Standard Operating Procedures* replaced the *Humane Pest Animal Control: Code of Practice and Standard Operating Procedures* (NSW Department of Primary Industries, 2005).

The objective is to complete the above actions in time to allow the feral pig control campaign to commence before the peak turtle nesting season (approximately August) each year. The initial goal of control measures shall be to achieve up to a 70% reduction in the rate of feral pig predation of nests, to be achieved within 3 years of commencement of controls. This goal shall be subject to revision as new information comes to hand.

The implementation plan (Appendix D) details the activities to be implemented for the duration of the EPBC Act approval while recognising that, as is envisaged by Condition 43 of the EPBC Act approval, the Strategy is meant to be adaptive and will necessarily evolve as the effectiveness of controls is evaluated over time.

Condition 46 of the EPBC Act approval requires that the Strategy adheres to the *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs* (Department of the Environment and Heritage, 2005). The consistency of the Strategy with the Threat Abatement Plan is shown in Appendix C. The Strategy is also consistent with *Queensland Feral Pig Management Strategy* (Department of Natural Resources, Mines and Energy, 2004).

6 MONITORING

Monitoring information shall be used to contribute to adaptive management. Monitoring options include the following, implementation of these options is addressed in the Implementation Plan (Appendix D):

- Beach monitoring using ground surveys of turtle and feral pig around the peak turtle nesting season;
- Camera traps set up at nesting sites to identify and help to quantify predating animals and high predation zones;
- If helicopter shooting is used, high pig activity areas can be identified by firstly mapping the location of shot or sighted animals and secondly using photographic analysis of the extent and location of diggings;
- Permanent free feeding stations with associated cameras can be used to quantify the feral pig population over time and identify higher population areas;

These monitoring tools can generate data suitable for GIS analysis and able to be used in adaptive planning to target control measures for maximum effectiveness.

The outcomes of the controls as measured by the monitoring program shall be published annually in accordance with Condition 57 of the EPBC Act approval and reported to the Department of Environment in accordance with Condition 56 of the EPBC Act approval (see Section 7).

6.1. TURTLE NEST MONITORING

Monitoring of all nesting beaches between Winda Winda Creek and Ina Creek (**Figure 2**) will be undertaken, coinciding with the peak nesting season (August-September). The monitoring

surveys will be undertaken for approximately 10 to 12 days and generally follow the approach in Guinea (2014), viz.:

- Accessible beach sections shall be traversed at night by all-terrain vehicles (such as Rhino's), commencing two hours before night time high tide and finishing approximately two hours after high tide;
- Beach sections not accessible by all-terrain vehicles (e.g. due to cliffs of intertidal rock) shall be traversed on foot in the cool of the morning;
- A drag mark will be made so that fresh crawls made before the next survey traverse will be identifiable;
- Tracks left by nesting sea turtles will be identified to species where possible. The data collected shall include track morphology, track width, location on the beach of the nest;
- GPS recordings of the track and nest (if present) shall be made;
- The number of predated nests and unpredated nests will be recorded;
- Predators and potential predators will be identified if possible by tracks and traces left in the sand at the nest site. Feral pig activity is indicated by rooting holes, footprints and scats.

The objective of monitoring is to obtain sufficient data to detect long-term trends in nest predation rates by feral pigs. Nesting activity shall be standardised in terms of nest/km/night for each beach section. All nesting beaches between Winda Winda Creek and Ina Creek will be monitored regardless of whether various feral pig control measures may be concentrated in discrete zones. An annual monitoring campaign is proposed initially, commencing in the year of the first feral pig control campaign (in the first peak turtle nesting season following the commencement of the action). Based on the results of the monitoring and the experience gained in implementing the monitoring, the survey approach may be adapted over time to improve efficiency and effectiveness.

6.2. FERAL PIG MONITORING

Camera traps will be selectively used to record feral pig predation on nests. This will give an indication of the proportion of predation due to feral pigs. Other predators (such a goannas) may be incidentally, but not reliably, captured by camera traps. If bait stations are employed, camera traps will be used at selected stations to record feral pig visitation rates.

Depending on the control approach taken and availability of suitable aircraft, consideration will be given to the utility of obtaining an estimate of population size reduction due to the control measures by aerial survey. It may be possible to use the method of Eberhardt (1982) to estimate population size from index data collected before and after removal of a known number of individuals. The key focus will remain, however, on the monitoring of changes in nest predation rates by feral pigs.

7 REPORTING

All reports and related analysis of survey data required by this Strategy will be published annually on the RTA website in accordance with Condition 57 of the EPBC Act approval. Relevant survey data will also be provided to the Department on request in accordance with Condition 56. The Strategy and any subsequent revisions will be published on the RTA website in accordance with Condition 59 of the EPBC Act approval. The RTA website address is:

http://www.riotinto.com/australia/reports-and-publications-16120.aspx

8 RELATIONSHIP WITH OTHER PLANS

In accordance with Condition 47 of the EPBC Act approval, the findings from the Feral Pig Management Offset Strategy shall be used to inform the Marine and Shipping Management Plan required under Condition 5 of the EPBC Act approval on an ongoing basis.

9 TRADITIONAL OWNER EMPLOYMENT OPPORTUNITIES

RTA has committed to working collaboratively with Traditional Owners, through the relevant Western Cape Communities Co-existence Agreement (WCCCA) Sub-Committees and the WCCCA Coordinating Committee to further increase representation of local Aboriginal people, and in particular, the Wik & Wik Waya Traditional Owners across the workforce. For this reason, focussed work, in collaboration with Traditional Owners and the Members of the WCCCA South of Embley Sub-Committee will be undertaken, to understand the current challenges, the outcomes achieved to date and the development of strategies specific to the needs of this community.

In addition, RTA Weipa, as a signatory to the Western Cape Regional Partnership Agreement (RPA), is actively working with the RPA working group on employment and training to identify opportunities where industry, Governments and local Aboriginal people can strategically partner to develop relevant skills and employment pathways prior to and during the construction phase of the SoE Project.

Traditional Owner employment opportunities associated with land management will be available in the Land and Sea Management Programmes, which are part of the Communities, Heritage and Environmental Management Plan (SoE Communities, Heritage and Environment Working Group, 2014). The opportunities include, but are not limited to:

- Feral Pig Control Program;
- Weed Management Program;
- Fire Management Program; and
- Seed collection associated with rehabilitation.

In addition, through the existing Indigenous Land Use Agreement, opportunities for employment of Traditional Owners are identified through an employment and training plan. This plan identifies work opportunities and roles within these work opportunities that may be filled by Traditional Owners. Traditional Owners that may be capable of filling these roles are then identified with RTAW supporting identified candidates to become appropriately skilled to fill the identified roles.

RTAW supports the employment of Traditional Owners in all areas of the business if they are appropriately skilled and qualified.

As a part of the reporting obligations under the Indigenous Land Use Agreement, quarterly review reports are provided to the WCCCA Coordinating Committee on RTAW's Traditional Owner employment and training obligations, including numbers engaged in Land and Sea Management Programmes. Direct employment or contracting opportunities shall exist during the implementation of the Feral Pig Management Offset Strategy, particularly with turtle nest monitoring. The extent of opportunities in feral pig control shall depend on the final control techniques adopted.

10 TRADITIONAL OWNER CONSULTATION

Traditional Owners were consulted in accordance with the process under the Indigenous Land Use Agreement during the preparation of this Strategy. This consultation involved the following:

- the Strategy was lodged with the Western Cape Communities Coexistence Agreement (WCCCA) Coordinating Committee in November 2014;
- the Strategy was subsequently presented to a meeting of the Communities, Heritage and Environment Management Plan (CHEMP) Working Group. No queries about the Plan were raised at the meeting. Members of the CHEMP Working Group were asked to provide any comments on the Plan within a few weeks. No comments were received;
- the presentation to the Working Group was then lodged with the WCCCA Coordinating Committee and which formally noted that the management plans had been presented to the Working Group.

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12 GLOSSARY

Commencement of the action / commenced the action – any works that are required to be undertaken for **construction** (except exploration, site investigation and **preliminary works)**.

Construction – any works that are required to be undertaken for the project including the beneficiation plant (including tailings storage facility); Boyd Port facility, and Hey and Embley River facilitates; dam construction; clearing of vegetation; and infrastructure facilities (including power station, roads, and fuels storage). Excludes **preliminary works**.

Final Environmental Impact Statement – comprises the South of Embley Project Final Environmental Impact Statement (March 2013).

Impacts/impacted – as defined in section 527E of the EPBC Act.

Listed turtle species – listed threatened species and/or Listed migratory species under the EPBC Act, specifically Green Turtle (*Chelonia mydas),* Hawksbill Turtle (*Eretmochelys imbricate);* Flatback Turtle *(Natator depressus);* Loggerhead Turtle *(Caretta caretta);* Olive Ridley Turtle *(Lepidochelys olivacea);* and Leatherback Turtle (*Dermochelys coriacea)*;

Matter of national environmental significance – those matters protected under the EPBC Act: World Heritage properties, National Heritage places, wetlands of international importance (Ramsar wetlands), listed threatened species and communities, listed migratory species, Commonwealth marine areas, Great Barrier Reef Marine Park, the environment where nuclear actions are involved (including uranium mines).

Minister – the **Minister** administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the **Minister**.

Preliminary works – includes activities associated with the upgrade of Beagle Camp and Pera Head Access Roads; establishment of exploration drill and seismic lines; vegetation clearing and construction of the mine access road (between Hey River terminal and Boyd mine infrastructure area); terrestrial vegetation clearing associated with temporary barge landing area near Pera Head; construction and operation of barge landing area located on Hey River; preparation of laydown areas at Humbug and Hornibrook terminals (existing disturbed areas); construction (including vegetation clearing of up to 30 hectares) and operation of a temporary accommodation camp (up to 200 persons) in the project area; installation and operation of ancillary infrastructure (including diesel fuelled power generation, laydown areas, package sewage treatment plants, waste storage and disposal facilities, fuel storage, offices and cribs, and access roads); construction and operation of an artesian bore including associated storage and treatment facilities and pipelines; and, installation of communications infrastructure.

Project Area – the construction and operational area associated with the South of Embley Project works at Boyd Point on the western side of Cape York Peninsula

RTAW – RTA Weipa Pty Ltd

SoE Project – South of Embley Project

Appendix A

SEA TURTLE MONITORING

SOUTH OF EMBLEY 2013

Report

October 2014

Prepared by

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Charles Darwin University

Darwin 0909

Northern Territory

1 Executive Summary

Rio Tinto Alcan gained approval to expand the existing bauxite mine at Weipa to its lease area south of the Embley River. The approval required a Feral Pig Offset Strategy that needed robust baseline data on the sea turtle species nesting on the beaches of the lease. Rapid assessment of the numbers of sea turtles nesting on the beaches commenced with a two-day survey in February 2013 and continued with surveys lasting three days over most months until August and October when the surveys expanded to 10 days each. The August-September survey was the most intense with a team of eight persons conducting at least three surveys of each beach of the 60 km coastline. The beach from Boyd Point to Pera Head, the vicinity of the proposed wharf, became the focal beach and was surveyed nightly for sea turtle nesting and predation of existing nests by feral pigs and native predators.

All-Terrain vehicles were used on beaches and where access was blocked by boulders or creeks, the surveys continued on foot to cover every beach on the coast. All tracks, fresh and depredated sea turtle nests were identified to species where possible and recorded with GPS locations. Infrared camera traps were placed on 10 nests to record predators in action. Any evidence of hatched sea turtle nests was recorded with the same detail.

In the nine months of survey 502 nests belonging to four species of sea turtle were recorded. Flatback turtles accounted for 54% of the nests and Olive Ridley Turtles represented another 27%. Hawksbill, Green Turtles and unidentified nests comprised the remainder. At the time of the surveys 68% of these nests had been depredated by feral pigs. Only 11 hatched nests were recorded in the entire nine month survey. Of the 308 nests recorded since the end of the August-September survey only 7 had hatched within the nine weeks to the October survey.

Camera traps recorded feral pigs and dingoes at the nests but only the pigs dug into the nests and consumed the eggs. Goannas were the main predator of nests along the isolated beaches from Pera Head to Thud Point. On the other beaches the goannas and dingoes investigated the nests after the pigs had finished. Feral pigs were the most prevalent and pernicious predator of sea turtle eggs on the coastline of the lease.

The survey revealed sea turtles nest from February to October and possibly later. No surveys were conducted outside this time frame. Track widths revealed a species with a narrow track nesting in the early months of the year and a species with a large track nesting in the October survey. Uncertainty about the species responsible suggest Hawksbill and Olive Ridley turtles may peak in nesting activity prior to August and Green turtles in October and thereafter. Flatback Turtles nested throughout the survey period with increased nesting from July to October with a possible peak between the end of August and early September. Only Flatback, Hawksbill and Olive Ridley nesting adults were tagged in the August survey.

The survey provides a preliminary baseline for the numbers of turtle nests and tracks on the various beaches and the level of pig predation. Ongoing monitoring of the anticipated decrease in pig predation along with the increase in hatching success of turtle nests is important to document the efficacy of actions emanating from the Feral Pig Management Plan. Partnerships with communities and government could be a worthwhile and cost effective path to reduce the impact of feral pigs on sea turtle nests.

2 Contents

3 Introduction

Rio Tinto Alcan (RTA) has received State and Commonwealth approvals for Environmental Impact Statements for the South of Embley (SoE) Project that expands operations at Weipa to the lease area south of the Embley River that flows into the Gulf of Carpentaria. In May 2013, Commonwealth approval was given with conditions to mitigate against impacting on matters of National Environmental Significance. Included in the approval is the following requirement: “The Feral Pig Management Offset Strategy must include surveying to develop significantly robust baseline data for listed turtle species nesting in the project area and desired outcomes, benchmarks, readily measureable performance indicators and goals, timeframes for reporting and implementation, corrective actions and contingency measures, and, specify the persons/ roles with responsibility for implementing actions” (DoE 2013). This report goes, some way, in providing a preliminary baseline of information on the species and numbers of sea turtles nesting in the project area.

The Gulf of Carpentaria supports populations of all six species of sea turtles found in Australian waters (Limpus 2009). The Loggerhead and the Leatherback sea turtles are known as feeding and migratory species. The remaining four species nest on the shores and islands of the Gulf of Carpentaria as well as feed in the gulf waters and the seas to the north (Anon 2003). All six species are threatened under State, Northern Territory and Commonwealth legislation (Table 1). Each of the four species Green, Flatback, Hawksbill and Olive Ridley sea turtles form a Regional Management Unit (RMU) endemic to the Gulf of Carpentaria (Limpus 2009). Each management unit breeds in the Gulf of Carpentaria with limited present day exchange with populations of the same species from waters outside the gulf. The populations are genetically isolated and external recruitment is minimal (Wallace et al. 2010).

Beaches of the Gulf of Carpentaria and the islands have received little attention due, in part, to its remoteness and the small human population scattered in small communities. Mining provides the impetus for the establishment of larger communities. The earlier sea turtle surveys were journeys of discovery by museums (Cogger 1968, Cogger and Lindner 1969, Gow 1981, Cameron and Cogger 1992) with early authorative accounts provided by Bustard (1972). The significance and large size of Flatback nesting populations became apparent after visits to Crab Island (Limpus et al. 1983, Limpus, et al. 1993, Sutherland and Sutherland 2003, Leis 2009).

In his unpublished thesis, Doherty (2005) reported the seasonality of turtle nesting by Olive Ridley and Flatback turtles along the Gulf of Carpentaria coast from Duyfkin Point to the Pennefather River from 2003 to 2004. Feral pig predation resulted in the loss of 70% of the nests. In places and at times this loss was greater. Most sea turtle nesting occurred in the dry cooler months with high predation early in the season (Doherty 2005). Further surveys revealed similar high predation by pigs on turtle nests in the coastal areas south of Weipa (Bell 2003, Bell 2004). A combination of boat and foot surveys from Boyd Point to Pera Head in the months of May and July 2007 recorded 15 nesting events mostly in the vicinity of Boyd Point (RTA 2011). Surveys by foot along 27 km of coast line in April 2008 recorded seven Flatback, one hawksbill and two unidentified sea turtle nests (RTA 2011).

Table 1 Conservation Status of sea turtles under Queensland, Northern Territory, Commonwealth EPBC Act 1999 and the IUCN Red Listing

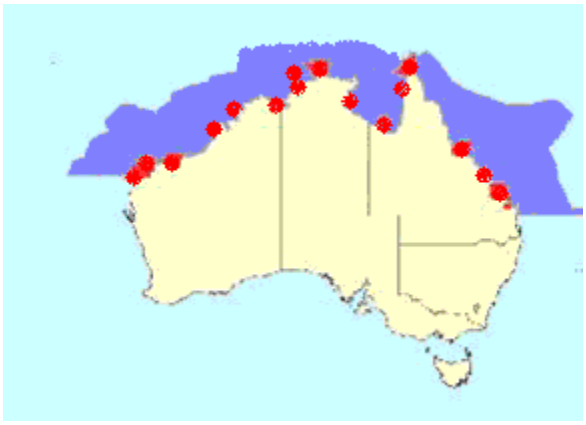
Common Name	Scientific Name	Queensland	Northern Territory	EPBC Act Status	IUCN Red List
Loggerhead Turtle	*Caretta caretta*	Endangered	Endangered	Endangered; Marine; Migratory	Endangered
Leatherback Turtle, Luth	*Dermochelys coriacea*	Endangered	Vulnerable	Endangered; Marine; Migratory	Critically Endangered
Olive Ridley Turtle, Pacific Ridley Turtle	*Lepidochelys olivacea*	Endangered	Not threatened in NT	Endangered; Marine; Migratory	Vulnerable
Green Turtle	*Chelonia mydas*	Vulnerable	Not threatened in NT	Vulnerable; Marine; Migratory	Endangered
Hawksbill Turtle	*Eretmochelys imbricata*	Vulnerable	Not threatened in NT	Vulnerable; Marine; Migratory	Critically Endangered
Flatback Turtle	*Natator depressus*	Vulnerable	Not threatened in NT	Vulnerable; Marine; Migratory	Data Deficient

In 2002, feral pigs became a Key Threatening Process under section 168 of the EPBC Act (1999). The impact by predators, habitat degradation, competition, and disease transmission precipitated their nomination. The Commonwealth Government released the Threat Abatement Plan seeking support and collaboration by stakeholders in feral pig control (DEH 2005). This was followed by a Threat Abatement Advice (DoE 2013) following several eradication programs including a Cape York Sustainable Futures Sea Turtle Project that removed 30,000 feral pigs from western Cape York. This program in 2009 and 2011 reduced feral pig predation on sea turtle nests by up to 70% (RTA 2011).

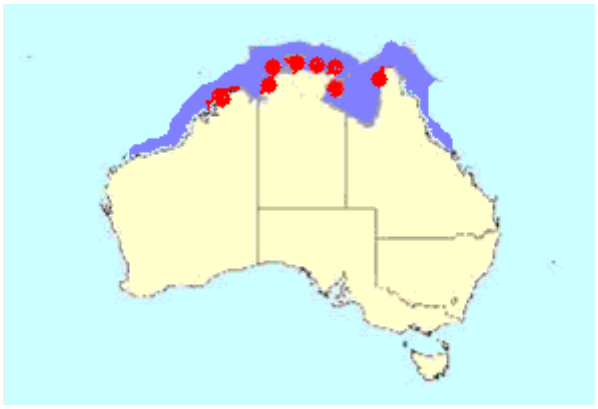
Given the fragmentary nature of previous surveys of sea turtle nesting and the impact of feral pig predation along the coast of the SoE proposed development lease, surveys in 2013 aimed to:

- establish the seasonality of nesting by the various species of sea turtle,
- record the spatial distribution of sea turtle nesting, and
- assess the level of predation by native and feral species.

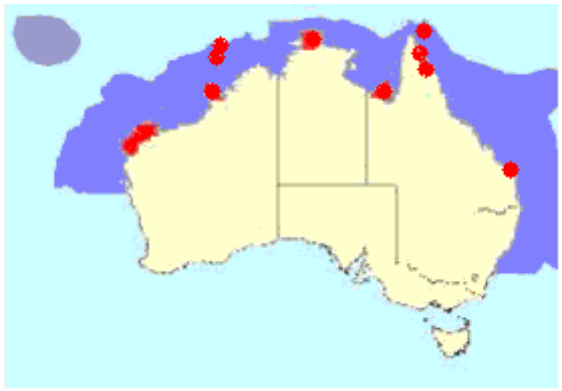
Figure 1: Major nesting areas for the six species of sea turtles in Australia form Regional Management Units



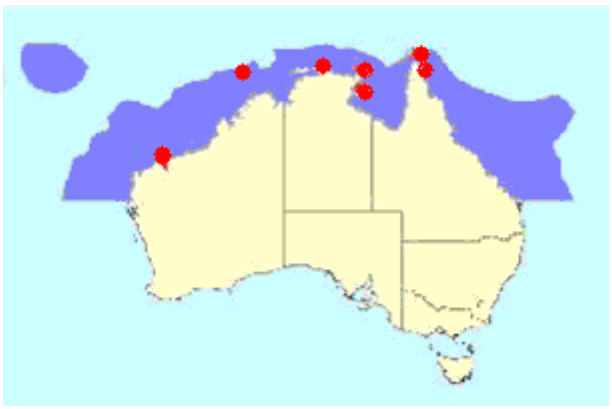
Flatback



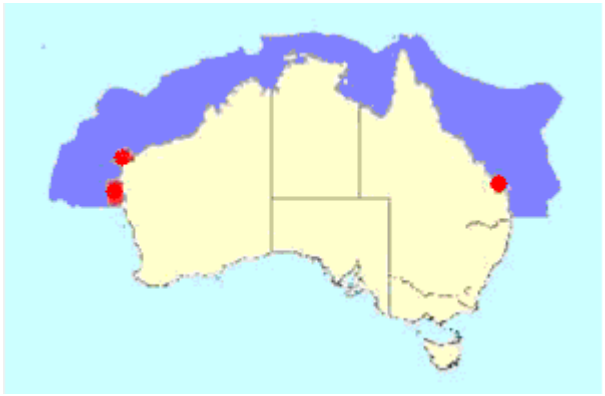
Olive Ridley



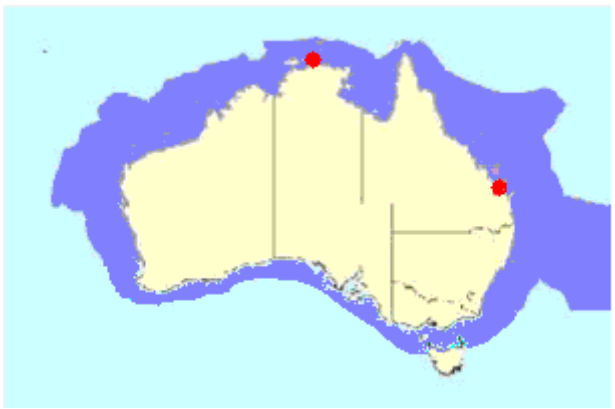
Green



Hawksbill



Loggerhead



Leatherback

4 Survey area and Methods

4.1 SURVEY AREA

The 2013 surveys were of the entire shoreline of the South of Embley Lease a distance of approximately 60 km (Figure 2). Surveys were land based and comprised sections conducted by foot with other sections assessed by vehicles where beach access permitted. The survey of the shoreline covered seven unequal sections based on access points and barriers to vehicle movement along the beach. The seven sections were: Northern Section, Boyd Bay Section, Boyd Point to Pera Head Section, Pera Head to Thud Point Section, Thud Point to Norman Creek Section, Amban Section and Southern Section to Ina Creek. The survey covered all sandy beaches of the SoE lease.

4.1.1 The Northern Section

The Northern Section extended from approximately 8 km south of Urquhart Point for a distance of 14.5 km. The only vehicle access was by a short track at the end of a drill line (Figure 2 track 1). The beach narrowed in the southern portion with cliffs of bauxite but widened to the north with sandy dunes with some sandstone outcrops. Trees and grasses grew along the dunes. The sand was coarse and firm in texture and light in colour with red (bauxite-stained) areas near the cliffs. Vehicle access was limited to low tide.

4.1.2 The Boyd Bay Section

Cliffs in the intertidal zone split this section into northern and southern portions. The northern portion was about 9.2 km in length and extended from the next suitable beach south of the Northern Section to the bauxite cliffs. The beach was wide and backed by low dunes with thick tree cover. Vehicular access was by a track along the top of the cliffs at the Boyd Bay Camp (Figure 2 track 2).

4.1.3 The Boyd Point to Pera Head Section

This section extended from the southern side of the cliffs at Boyd Bay Camp site to Pera Head. This portion was approximately 6.5 km in length. The beach was wide with low dunes covered with grasses and trees. Bauxite cliffs limited its width towards the south. The sand was light coloured with soft texture. The section terminated at a rock outcrop adjacent to a low swamp and a tidal creek near Pera Head. This section was the focal beach that was patrolled nightly for nesting sea turtles. Vehicular access was by a track extending from the Boyd Bay Camp to Boyd Point (Figure 2 track 2).

4.1.4 Pera head to Thud Point Section

The steep cliffs at Pera Head and boulders at Thud Point prevented vehicular access. This 6 km portion consisted of narrow beaches backed by vertical cliffs of bauxite. Access to the beach was by foot only. A rough track from the end of a drill line (Figure 2 track 3) provided vehicular access through the thick vine forest to the beach at Thud Point.

4.1.5 The Thud Point to Norman Creek Section

This section extended for approximately 7.3km along the coast from Thud Point to the mouth of Norman Creek. Vehicles accessed the beach by the same track as the Pera Head to Thud Point

Section (Figure 2 track 3). The sand was white and soft with dunes covered in grasses and casuarina trees.

4.1.6 Amban Section

Access to the sections south of Norman Creek require longer drives using existing tracks away from the coast. The Amban Access Road (Figure 2 track 4) provided vehicular access to the beach of the Amban Section. The sandy beach stretched for 9.5 km. The soft white sand beach with low dunes covered with coastal vegetation was backed by a tidal creek. Low tide enabled access to the entire length of the beach.

4.1.7 The Southern Section

The Southern Section ran for approximately 5.1 km south of Amban to the mouth of Ina Creek. Entry to the southern portion required a longer drive along the access tracks to the south where a narrow rough track (Figure 2 track 5) provided access to the beach. The white sand beach with low dunes and thick coastal vegetation ran along the length of the Southern Section. Surveys were conducted at low tide to allow access to the full length of the beach.

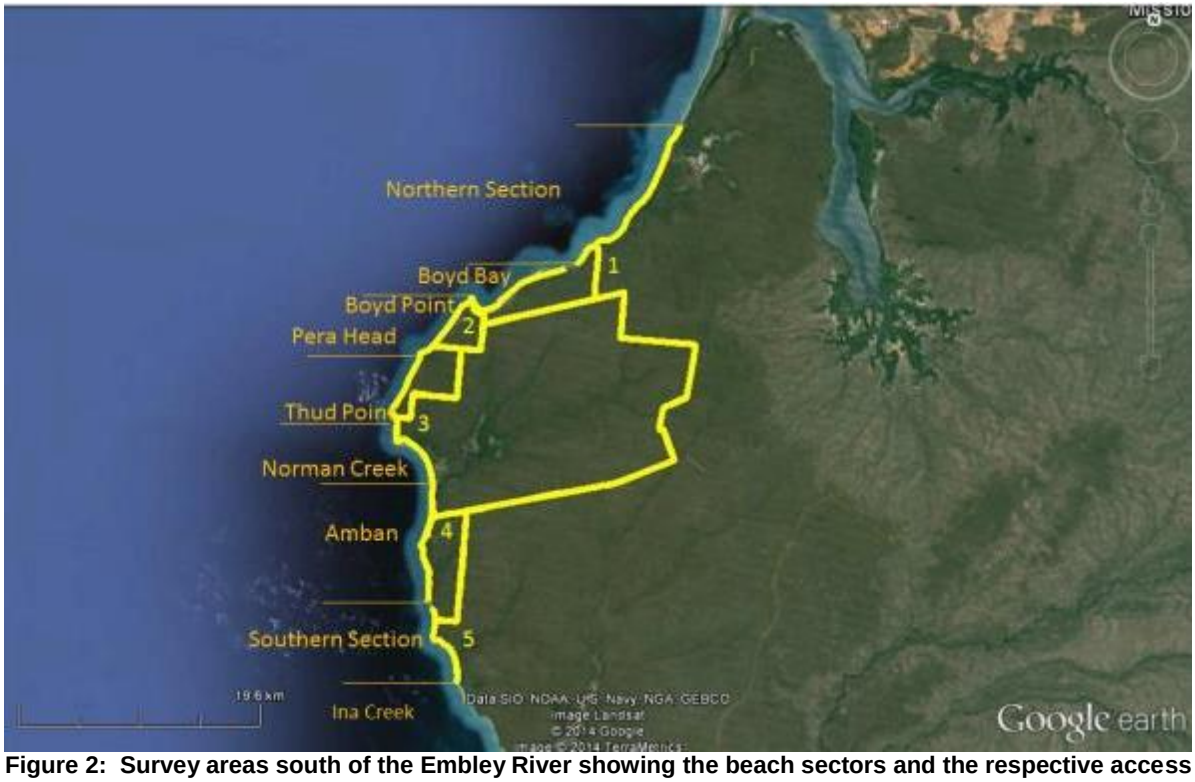


Figure 2: Survey areas south of the Embley River showing the beach sectors and the respective access points described in the text

4.2 SURVEY METHODS

The survey covered all months, except March, from February to October 2013. In August and October, the surveys intensified to provide multiple surveys over a period of 10 days of the entire shoreline using All-Terrain Vehicles and foot surveys. Yamaha Rhino side-by side-four-wheel-drive vehicles provided transport to the beaches along existing tracks and survey drill lines on the lease. The vehicles with headlights partially covered provided access to the focal, Boyd Point to Pera Head, beach at night without disturbing nesting sea turtles. Certified drivers maintained a safe speed and a distance apart to prevent rear-end collisions (Figure 3).

Surveys by foot in the cool of the morning covered the 6 km-section of beach from Pera Head to Thud Point where cliffs and intertidal boulders prevented vehicle access. A drag mark left by a garden rake separated existing nests from fresh nests on each day of the survey. Similarly, footprints or vehicle ruts over turtle tracks indicated a previously recorded from new nesting events thereby prevented duplication of records. The section of beach from Boyd Point to Pera Head (6.5 km) formed the focus of nightly surveillance for nesting turtles.

Shielded headlights of the Rhino for beach driving.

Safe driving distance between rhinos during survey

Fresh hawksbill sea turtle track over wheel ruts

Marking the survey line with a garden rake

Figure 3: Survey methods for SoE shoreline for sea turtle nesting activity

Tracks left by nesting sea turtles were identified to species where possible. The data set included track morphology, track width, location on the beach of the nest, GPS recordings of the track and nest, if present, and any evidence of depredation of the eggs and the species responsible.

Sea turtle species were identified by a decision matrix (Table 2) based on the gait, the width the position on the beach. Sections of straight tracks with an opposite gait formed by front and hind flipper pushing in unison could belong to either Flatback or Green turtles. The longer front flippers of the Green, compared to those of the Flatback turtle, extend well beyond the imprints of the plastron and the hind flippers (Limpus 2007 a, b). Olive Ridley and Hawksbill sea turtles use an

alternating (quadrapedal) gait when moving on land (Limpus 2008, Limpus 2009). The tracks of these two species are difficult to separate because of their alternating gait and similar narrow width (Chatto and Baker 2008). Green turtle tracks exceed 105 cm. Flatback tracks exceed 83 cm. Track widths and gait were useful but not always recognizable and seldom the sole diagnostic of species responsible for the track or the nest. Turtles of different RMUs differ in average size and therefore average track width which limits the utility of measurements from turtle populations outside of the Gulf of Carpentaria such as Hope and Smit (1998) and Chatto and Baker (2008). Often tracks were blown out by winds or obliterated by predators. Preference for nest sites higher or lower on the beach can provide another clue as to the turtle species responsible. Flatbacks, Greens and Hawksbills prefer nesting higher on the beach while Olive Ridleys often nest in the mid beach area just above the high water mark (Guinea 1990, Whiting 1997).

Species identification from depredated nests consisted of estimating the depth of the nest and the estimated size of eggs judged by the fragments of eggshell scattered about the nest. Flatback and Green turtles construct nests to depth usually exceeding 50 cm (Guinea et al. 2005, Schauble et al. 2006, Koch et al. 2007, Limpus 2007, Pendoley et al. 2014). Olive Ridley and hawksbill turtles have shallower nests usually in the 20 to 30 cm depth range (Whiting 1997, Whiting et al. 2007). The eggs of Flatbacks are much larger in size but fewer in number than those of the other species. Flatback clutches have on average about 50 eggs, each 50 mm in diameter (Limpus 2007, Pendoley et al. 2014). Clutches of Olive Ridley and Hawksbill often exceed 100 eggs about 35 mm in diameter (Limpus 2009). Again, each RMU varies in the average size of the eggs (Pendoley et al. 2014). Green turtles also have clutches that exceed 100 eggs that are slightly larger than those of Hawksbills and Olive Ridleys at about 45 mm in diameter. Typically, Green turtles excavate a larger volume of sand during nesting than do the other three species (Guinea et al. 2005).

4.3 PREDATION

Predators and potential predators were identified by tracks and traces left in the sand at the nest site. Feral pig activity such as rooting holes, footprints along with tracks and scats of them and other potential predators including goannas, and dingoes, ants and ghost crabs indicated the interest of a number of animals in sea turtle nests. Camera traps using infrared motion sensitive cameras placed at recently laid nests recorded which predators located the nests and the order of their arrival. Actual laying by the turtles in these nests was not observed but presumed to have occurred by the shape of the disturbance in the sand.

4.3.1 Beach Surveys

Tracks and scats of predators of turtle eggs and hatchlings indicated several predators were present at the nest. Fresh nests succumbed to predation shortly after laying. Tracks of predators superimposed over each other obscured the prints of the initial predator to the nest. Consequently, all predators at the nest were recorded. Diggings in different parts of the beach where turtle nests did not occur indicated predators sought other food items, such as crabs, as well.

Table 2: Nest and track characteristics of four species of sea turtle that nest on the beaches of SoE (Limpus 2009)

Characteristic	Green	Flatback	Olive Ridley	Hawksbill
Gait	Opposite = symmetrical	Opposite = symmetrical	Alternate = asymmetrical	Alternate = asymmetrical
Track width	105+ cm	83+ cm	55-83 cm	55 -83 cm
Front Flipper marks	Extend well beyond body	Extends beyond body with tips protruding	Barely extending beyond the body	Barely extending beyond the body
Hind Flipper marks	Small parallel, symmetrical	Large crescent, symmetrical	Small alternating	Small alternating
Approximate Nest Depth	<80 cm	~50 cm	35 cm	35- 45 cm
Nest Position on Beach	High	Low to High	Low	High
Clutch Size	70-150+	40 - 60	100+	100+
Egg dimension	45 mm	50 mm	35 mm	35 mm
Sand Disturbance	maximum	moderate	minimal	moderate

4.3.2 Camera Traps

Nine Reconyx PC900 Professional Game Cameras recorded predation on sea turtle eggs. Cameras, mounted on wooden stakes, were positioned within 5 metres of recently laid nests. Differences in the track morphology before and after the disturbance in the sand indicated the likelihood of a successful nest. Changes in topography of the disturbed sand indicated the location of the nest. The camera focused on the likely position of the nest without tree branches and grass being in the field of view that could prematurely trigger the camera. Movement near the nest triggered the cameras that recorded a fresh image every second. Cameras used natural light during daylight hours and Infrared radiation at night. Data included the time, temperature and moon phase.

4.4 ADULT TURTLES

A single vehicle patrol of the 6.5 km section of beach between Boyd Point and Pera Head lasted approximately 1 hour. Patrols involved at least two vehicles and started after dark and two hours

before the nighttime high tide. Patrols lasted until approximately two hours after the time of high tide. Nesting sea turtles were identified, but were approached only when they were either laying or returning to the water. One Titanium flipper tag was attached to the axial scale (closest to the body) of each of the front flippers (Limpus 1971, Limpus et al. 1983). Curved carapace length (CCL) and curved carapace width (CCW) were measured (+/- 1.0 mm) with a flexible fiberglass tape. All data were recorded to comply with Queensland Turtle Conservation Project (Limpus 2013). A sample of 10 eggs from each clutch was weighed (+/- 0.5 g) and the diameters measured (+/- 0.1 mm).

1. 4.4.1 Tracks

Track widths of nesting turtle were measured with a fiberglass tape. Frequency histograms in track width produced a polymodal distribution and investigated using probability paper (Cassie 1954) to identify the number of species, the average with of their tracks and therefore the seasonality of their presence on the beach. Tracks that did not result in a nest were recorded as non-nesting events to identify the nesting success of the sea turtles at each beach.

2. 4.4.2 Nests

A sea turtle lays between three and ten clutches per nesting season at 10 to 21 days interval, depending on the species and other environmental factors such as water temperature (Limpus 2009). Having laid, the turtle will not return to the beach for the interesting interval. Nests provide a more stable measure of turtle numbers than do tracks for which there could be several attempts before the nest is deposited. The numbers of nests laid in a season follows a normal distribution (Whiting et al 2013) which provides a description of the rate at which nests are laid, the start and end of the season as well as the mid-season peak of nesting (Guinea 2012, 2014). The cumulative number of nests follows a Gaussian or Logistic curve and in itself is a test for normality (Zar 1974). The nests recorded in each survey from February to October when added provide the basis of the logistic curve. The rate at which nests were deposited on the focal beach (Boyd-Pera Section) during the August-September survey and the October survey revealed the respective gradients and thereby the shape of the nesting season curve.

4.5 HATCHLING TURTLES

Nests that had hatched were located by following the hatchling tracks to the depression from which they emerged. Hatched nests were excavated during daylight following the hatching. Fully formed hatchlings at the neck of the nest were collected and held in moist cool conditions during the day for release the following night. A sample of 10 hatchlings were weighed (+/- 0.5 g) and the straight carapace length and straight carapace width measured with digital calipers (+/- (0.1 mm). A count of the body scales was recorded for positive identification to species (Limpus 1971).

5 Results

Sea turtles nested on the beaches throughout the SoE lease. Surveys conducted in February indicated low levels of nesting which increased during the dry season months. By the final survey in October 2013, 502 nests were recorded from 666 tracks by four species of sea turtle.

5.1 AUGUST –SEPTEMBER 2013 SURVEY

Surveys in February and April identified the Boyd Pera Section of coast as the likely focal beach with the most convenient vehicle access and with nesting numbers representative of sea turtle activity at more distant beaches. This focal beach was patrolled nightly. The remaining sections were patrolled so the initial survey was followed some days later to identify the numbers of turtles that had nested since the previous survey as well as the nesting activity within the present survey. All sections were surveyed at least three times during the period (Table 3). The initial survey occupied the most time as personnel were inducted and trained in the identification of species and track morphology and other marks in the sand including tracks of predators and identification of the eggshells to a particular species of sea turtle. The initial survey also recorded the nest from the intervening period since the July survey. Tracks from previous surveys that were crossed by either footprints or vehicle ruts were not included in the August-September survey.

During the August-September survey, 119 fresh sea turtle nests were recorded from the beaches between the initial and final surveys of the trip. The focal beach (Boyd-Pera) received 13 Flatback and 6 Olive Ridley nests in 10 nights of patrolling (Figure 4). The greatest nesting intensity during the survey and the preceding month was in the Boyd-Pera section that received 43 Flatback nests and 29 Olive Ridley nests and a single Hawksbill nest (Figure 5). Comparisons of the length of the beach, the numbers of fresh nests, and the number of nights of the survey for each beach revealed the Southern Section with 1.172 nests/km/night had the highest density (Table 4). The Pera-Thud Section and the Boyd Bay Section had the lowest nesting density with 0.188 and 0.018 nests/km/night respectively. The Boyd-Pera Section had medium nesting density of 0.292 nests/km/night which was similar to that received at the Northern and Amban Sections.

Nesting on the focal beach of Boyd-Pera reached a peak when the evening high tides occurred between 2000 and 2200 hr. around the third quarter of the moon on 27 August 2013. This moon phase coincided with the highest tide (2.3 m) and the smallest daily amplitude (0.7 m) for the portion of the lunar cycle during the survey (Figure 4).

Table 3: Survey schedule showing the dates and months in 2013 for the sections of the shoreline of the SoE Lease

Month	Northern	Boyd Bay	Boyd-Pera	Section Pera-Thud	Thud-Norman	Amban	Southern
February	18	18, 19	18,19		19		
April	10	8	8	9	9	9	9
May	9	7	7	7	7	8	8
June	19	18	18	18	20	19	19
July	19	18	22	22	22	22	22
August	26, 28, 30	26, 30	22-31	24,27,31	25,27,	30	30
September	2	11	1,2			1	1
October	11, 12, 19		11-13, 16, 21	16,19,22	16, 19	13	14, 17, 20

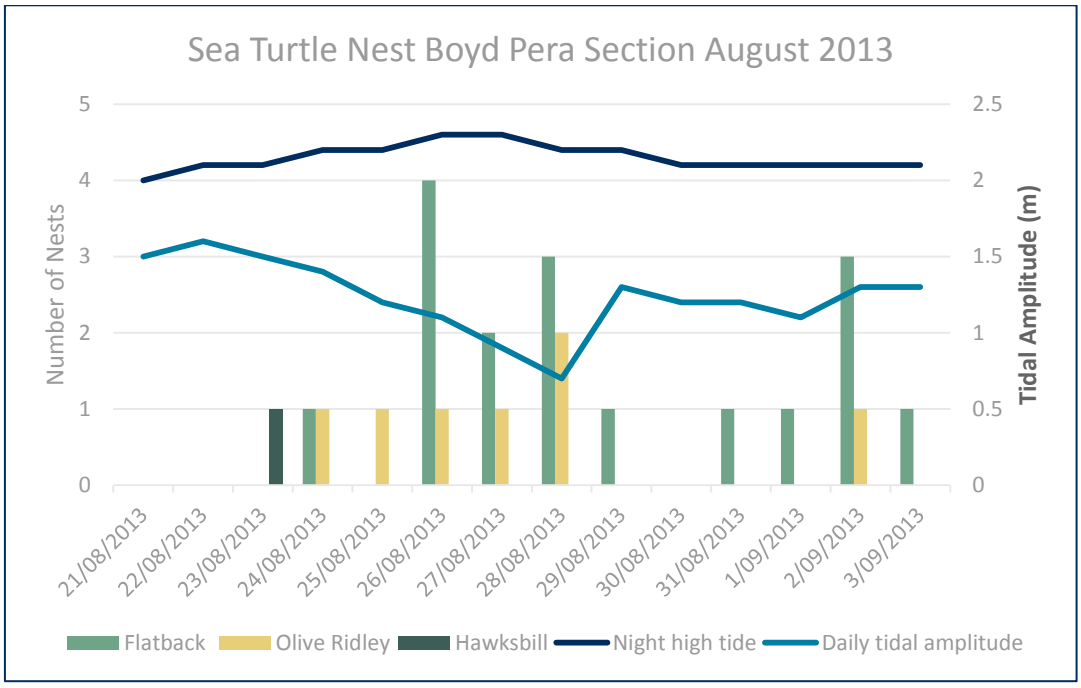


Figure 4: Sea turtle nests by species recorded in Boyd Pera focal beach in the August survey. The height of the night-time tide is shown along with the daily amplitude of the tide. Full moon occurred on 21 August

Table 4: Comparison of the number of sea turtle nests laid in each section during the August- September survey

Section	Number of Nests	Number of nights	Length of Beach (km)	Nests/km/night
Northern Section	27	8	14.5	0.233
Boyd Bay Section	1	6	9.2	0.018
Boyd-Pera Section	19	10	6.5	0.292
Pera-Thud Section	9	8	6.0	0.188
Thud-Norman Section	29	8	7.3	0.500
Amban Section	10	4	9.5	0.263
Southern Section	24	4	5.1	1.172

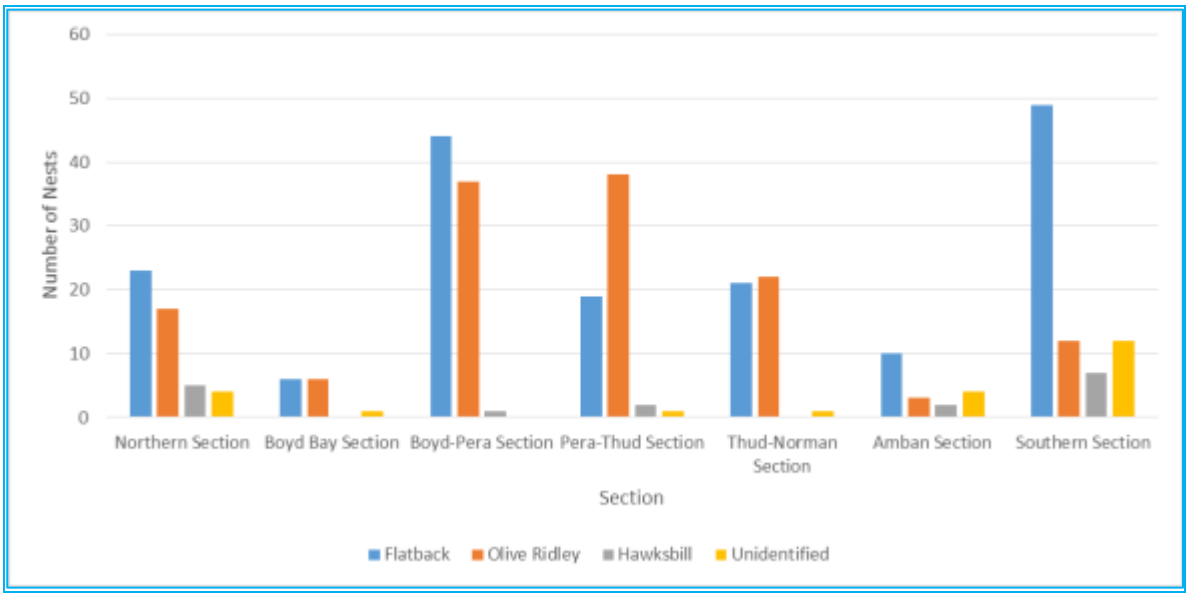


Figure 5: Numbers of sea turtle nests recorded in Sections on the SoE shoreline in the month prior to and within the August-September 2013 survey. The Boyd-Pera Section was the focal beach with nightly surveys of nesting sea turtles

Nesting data for the focal beach during the August-September and the October surveys revealed two different rates of nest accumulation. August-September had 19 nests laid in 10 nights while October had just 2 nests in the same time period (Figure 6). The peak of nesting (a week either side of the 50 percentile) corresponded with a cumulative total of 60 nests which occurred in the last week of August and the first week of September which coincided with the August-September survey in 2013.

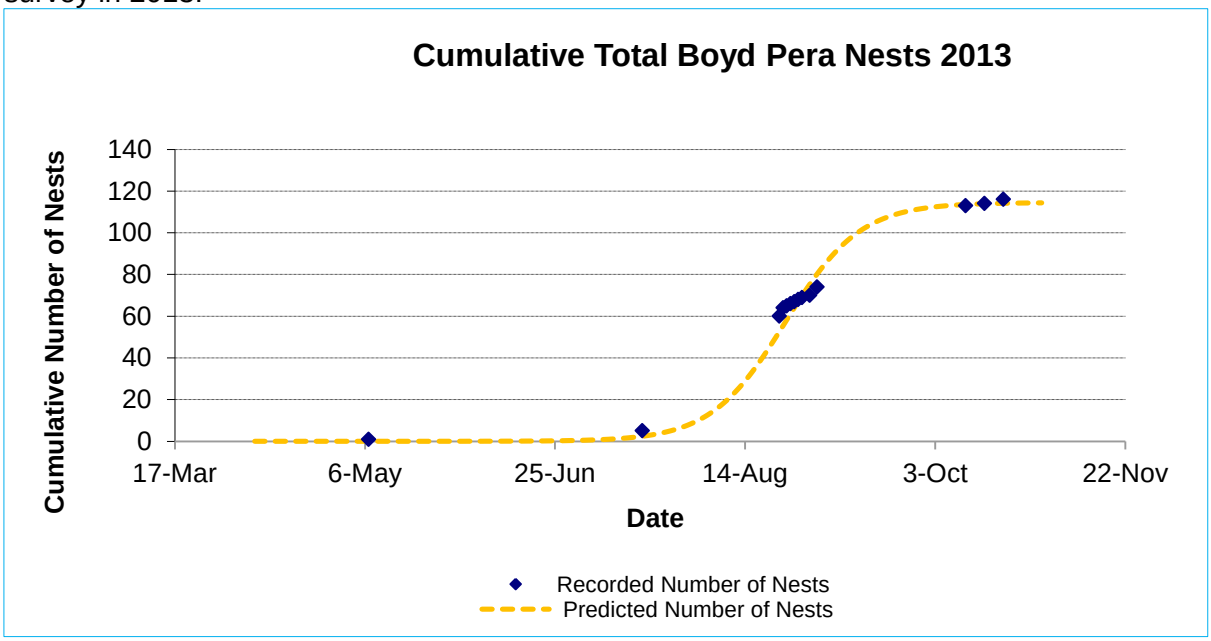


Figure 6: Cumulative number of sea turtle nests in the Boyd-Para Section in 2013 follow the logistic curve indicating the nesting season has a normal distribution. As such the predicted peak of the nests (50%) occurred in the last week of August and the first week of September 2013.

5.2 2013 SURVEY

The 2013 sea turtle survey was the longest and most thorough survey of sea turtles, their nests, and the fate of the nests conducted to date in the SoE lease (Figure 7). It provided a benchmark of numbers of sea turtle nests laid on the beaches, the species responsible, and the level of predation on the nests by feral and native predators. It involved rapid assessments of nest

numbers and predation throughout the year as well as intensive surveys at the peak of the nesting season and later. Data are presented on nesting adults and hatchlings over the entire SoE lease.

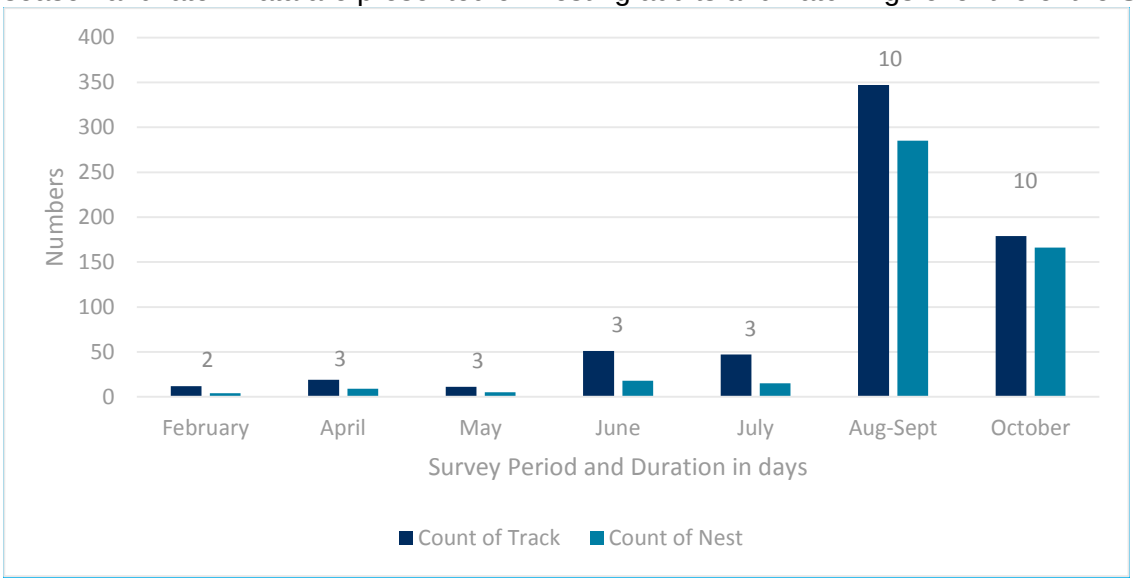


Figure 7: Numbers of tracks and nests recorded in each of the survey periods with the duration of each survey in days

5.3 ADULT SEA TURTLES

Surveys of nesting activities by sea turtles on the coastline of the SoE lease commenced in February 2013 with a time-limited rapid survey of the beaches. In these initial assessments, turtle nests were located in most cases by the scattering of eggshells being evidence of predation on the eggs. Track widths of the nesting turtles were measured with notes on nest position, nest depth and estimated size of the eggs and GPS location taken. By the end of the October Survey 666 tracks from 4 species of sea turtle had been recorded from the seven sections of the SoE lease (Figure 8) these tracks 502 resulted in nests (Table 5).

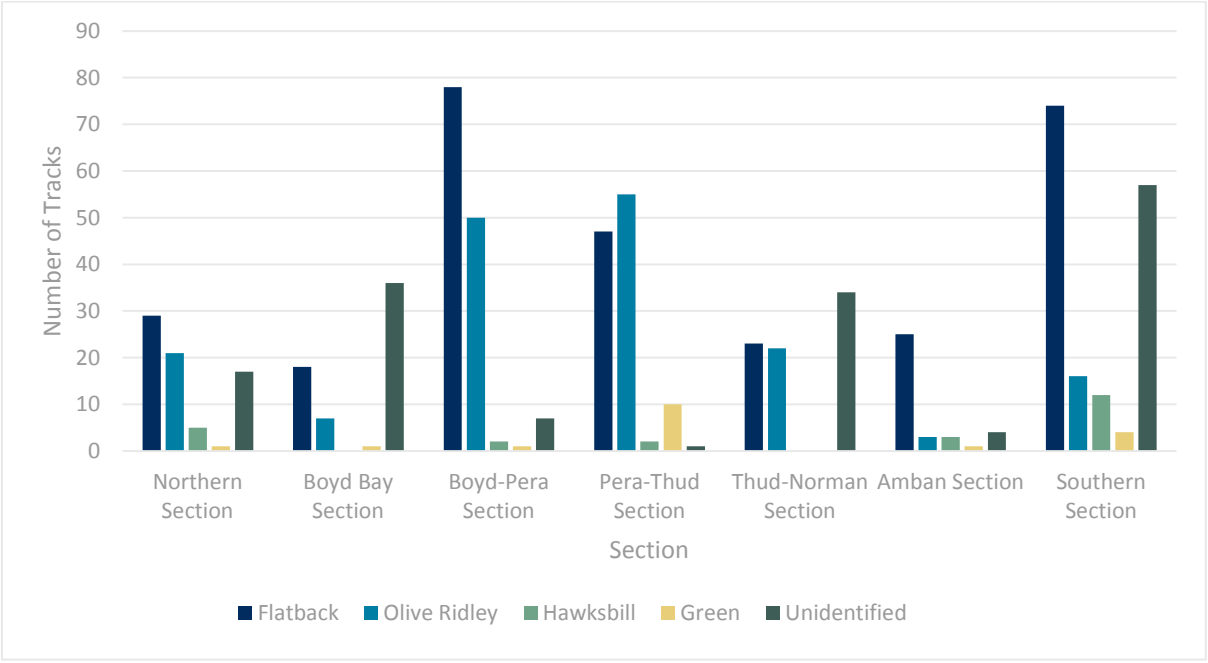
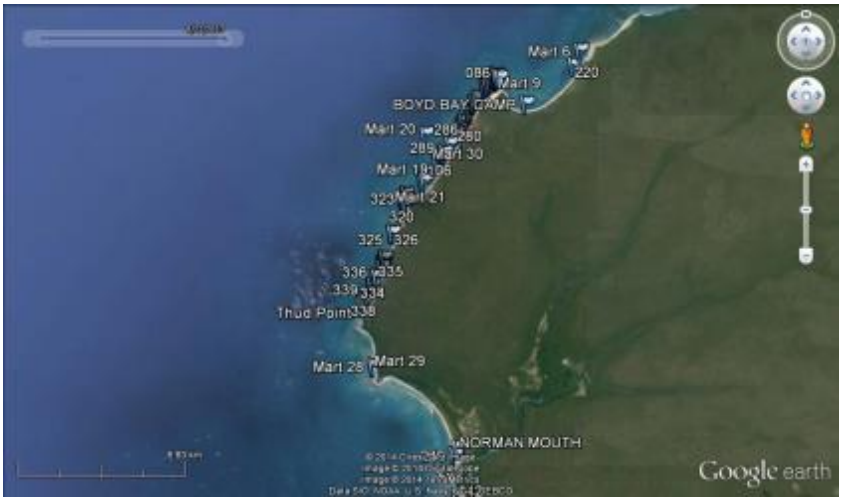


Figure 8: Numbers of tracks of species of sea turtle on the beaches of the SoE lease in 2013

Table 5: Numbers of tracks and nests of each species of sea turtle recorded in the coastal sections in the 2013 SoE survey

Section of SoE	Flatback		Olive Ridley		Hawksbill		Green		Unidentified	
	Tracks	Nests	Tracks	Nests	Tracks	Nests	Tracks	Nests	Tracks	Nests
Northern Section	29	26	21	12	5	5	1	1	17	8
Boyd Bay Section	18	17	7	7	-	-	1	1	36	16
Boyd-Pera Section	78	76	50	40	2	1	1	1	7	4
Pera-Thud Section	47	37	55	41	2	2	10	9	1	1
Thud-Norman Section	23	22	22	22	-	-	-	-	34	8
Amban Section	25	23	3	1	3	3	1	1	4	1
Southern Section	74	71	16	14	12	8	4	4	57	19
Grand Total	**294**	**272**	**174**	**137**	**24**	**19**	**18**	**17**	**156**	**57**

The Northern Section showing sea turtle nests



Boyd Bay to Norman Creek mouth showing sea turtle nests

The Southern Section showing sea turtle nests

Figure 9: Google Earth images of sea turtle nests recorded during the August 2013 Survey

5.3.1 Track Widths of Nesting Turtles

The width of the track of nesting turtles provided an indication of the species using the beaches (Figure 10). The small numbers of encounters with nesting turtles prevented an overall validation of species present according to track width alone. Initially the narrow alternating tracks were recorded as belonging to Olive Ridley Turtles. The initial identification was validated after encountering Olive Ridley Turtles nesting and observing their stop – start progression while on the beach and the frequent attempted body pits that produced in some, a “daisy chain“ of up to 20 attempted body pits. However, the presence of another species with narrow alternating tracks nesting higher on the beach initiated suspicion of Hawksbill Turtles being present as well. Hawksbill tracks were distinctive and often contained a deep groove that shifted sand to the margins of the track. Hawksbill Turtles often ploughed their heads into the sand while ascending the beach to produce a conspicuous furrow in the track.

Flatbacks were the most consistent in making their tracks. Of the three species, team members consistently identified correctly the tracks of nesting Flatback turtles. Hawksbill and Olive Ridley adults were difficult to distinguish because of their similar size and gait and had considerable overlap in track widths. Frequency distribution of track widths (Figure 11) indicated the presence of four species of sea turtle nesting on the beaches of the SoE lease. No photographs were taken of the track of the fourth species and it was not encountered during the intensive field survey in the August-September survey in 2013. Although Green Turtles and Flatback Turtles have a similar gait, the greater width of the Green Turtle track helps to distinguish the species. The tracks of Flatbacks and Olive Ridleys (which could include Hawksbills in earlier surveys) were the most common and occurred on all beaches in the survey (Figure 8, Table 5).

The frequency distribution of the tracks produced a polymodal curve when smoothed with a moving average trend-line (Figure 8). The curve indicated four species were represented in the frequencies of track widths. One species had an alternating gait with an average track width of 69.0 cm (sd = 6.2 cm). Another species also with an alternating gait had an average track width of 84.6 cm (sd= 8.6 cm). A third species with a simultaneous gait had an average track width of 94.0 cm (sd = 8.9.cm). A fourth species had a similar simultaneous gait with a track width greater than 110 cm.

The frequency of species with different track widths changed throughout 2013 suggesting a seasonality. In February, two species appear to comprise the nesting population. One species had a track width close to 60 cm and the other with a track width just above 90 cm (Figure 12). By June track widths extended from about 60 cm to 100 cm. By October track widths extended from about 70 cm to 120 cm. Flatback sea turtles were present on the nesting beaches throughout the survey and Olive Ridleys and Greens appear to be present in the early (February) and later (October) surveys in 2013. They was no nesting by Green Turtles recorded in the August-September Survey.

There was no seasonal variation in the success of nesting. The nesting success of Flatback Turtles ranged from 78 to 96%. Nesting success of Olive Ridley Turtles ranged from 33 to 100%. When all sections of the survey are compared for all of the surveys in 2013, the nesting success of all of the species is very close to 89% (Figure 13) indicating favourable beach conditions for nesting.

A Flatback Turtle track with extremities indicated.

Measuring the extremities of a Flatback tack.

The daisy-chain pattern left by an Olive Ridley Turtle low on the beach..

A track of an Olive Ridley Turtle

Track of a Hawksbill Turtle

Flatback Track from a nest high on the beach.

Figure 10: Sea turtle tracks and positions on the beach

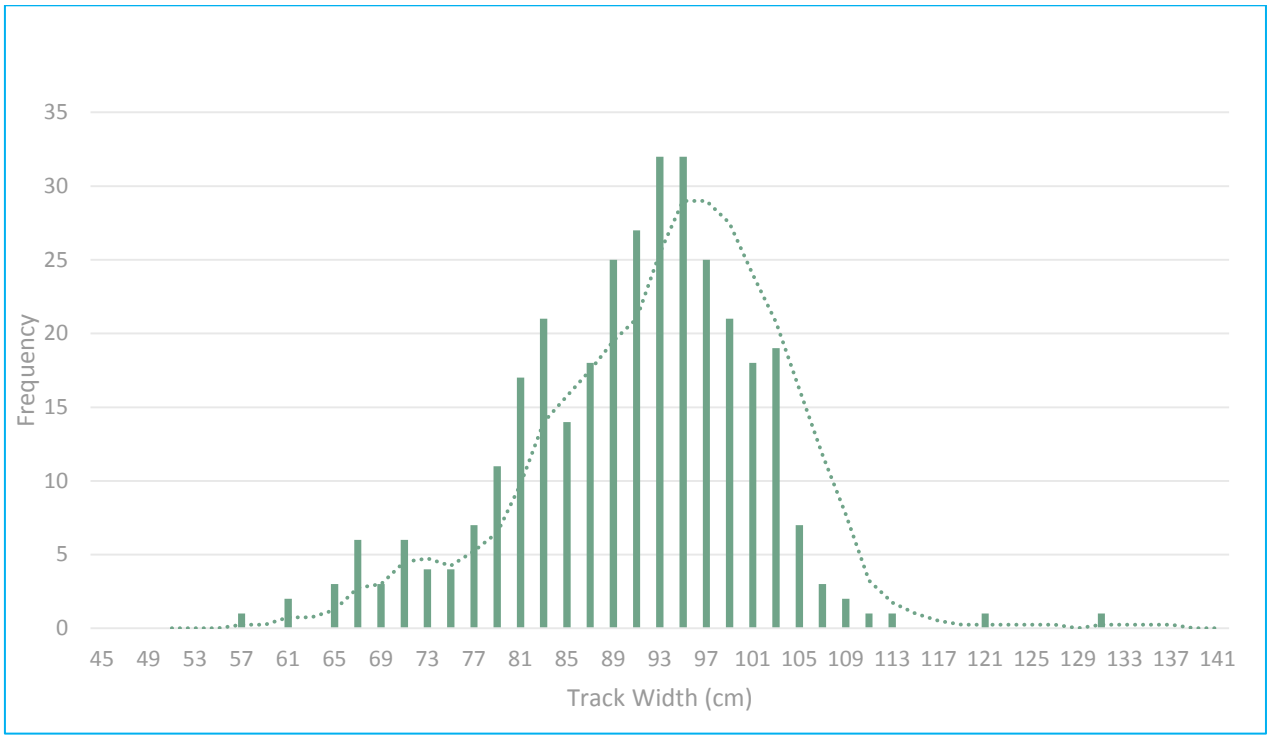


Figure 11: Frequency distribution of turtle tracks widths with a smoothing 4th order moving average

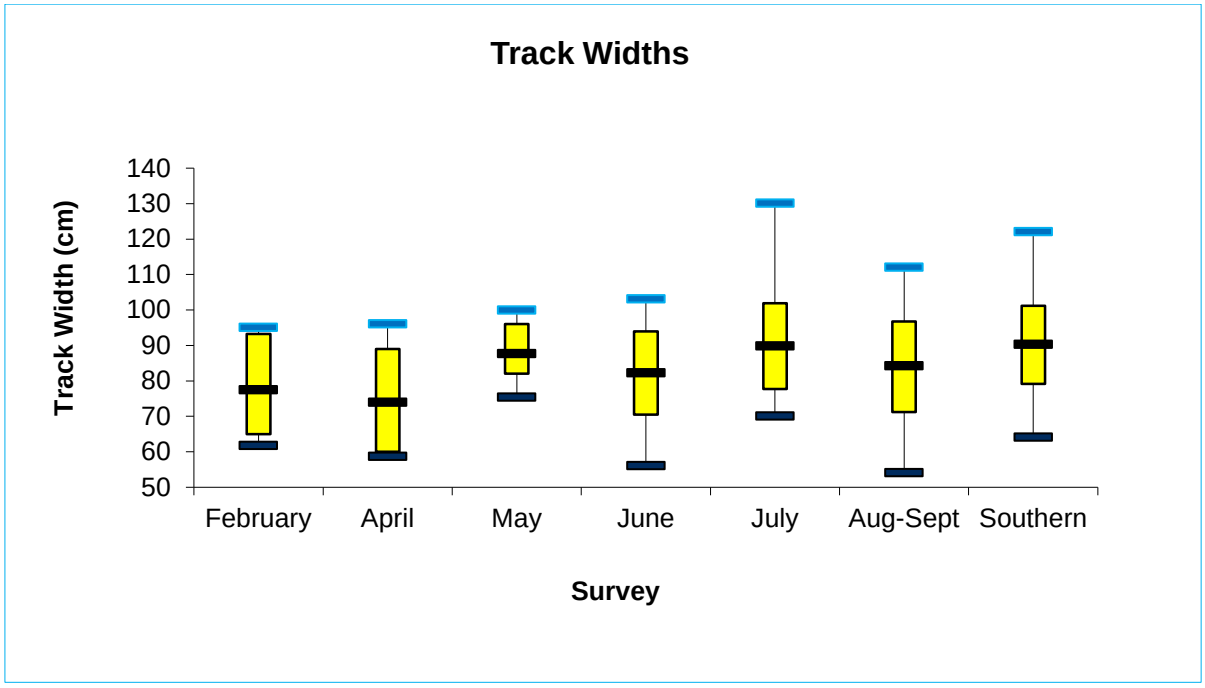


Figure 12: Possible change in width of turtle tacks with time in 2013 for al sections of the SoE lease. Presented are the average track width +/- standard deviation (yellow) and minimum and maximum widths (light and dark blue)

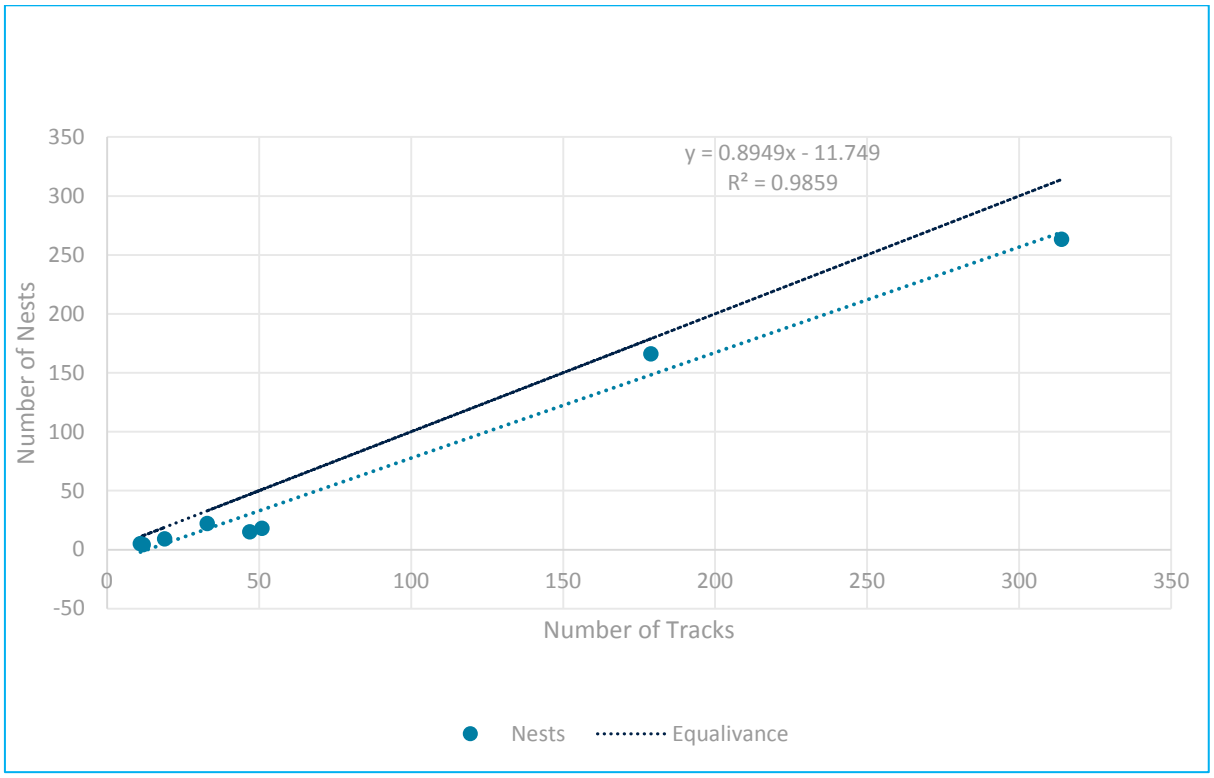


Figure 13: Nesting success, as the track to nest ratio, was below equivalence at 89% throughout the 2013 survey

5.3.2 Nesting Turtles Encounters

Seven sea turtles were encountered while either nesting or returning to the water (Figure 14). Three were Flatback Turtles; three were Olive Ridley Turtles with a single Hawksbill Turtle (Table 6). The curved carapace lengths (CCL) of the Flatback Turtles ranged from 83.8 to 85.7 cm (average = 84.7, sd = 0.95 cm) (Table 6). The curved carapace widths (CCW) of this group varied from 69.4 to 71.2cm (average = 70.1, sd = 0.99 cm). The curved carapace lengths of the Olive Ridley Turtles ranged from 65.4 to 72.1 cm (average = 68.6, sd = 3.36 cm) (Table 6). Their curved carapace widths varied from 62.5 to 67.3 cm (average = 64.8, sd = 2.4 cm). The length (CCL) and width (CCW) of the Hawksbill Turtle was 75.2 cm and 67.2 cm respectively.

Flatback Turtles and Olive Ridley Turtles were the most numerous nesting species recorded in 2013. The Boyd-Pera Section and the Southern Section received the most nests (Figure 15). Many of the nests were without tracks, so the position on the beach, depth of the raided nests and the estimated size of the depredated eggs provided the characters for identification. Most of the nests in the focal region of Boyd-Pera occurred on the high tide when early in the evening after a small tidal variation during the day (Figure 4). This pattern of nesting occurred at other beaches in the survey.

Flatback turtle nesting

Hawksbill turtle ashore but did not nest

Olive Ridley turtle nesting

Egg laying by Olive Ridley

Figure 14: Nesting activity by three species of sea turtle on the Boyd-Pera Section of SoE Lease

Table 6 Tag numbers and carapace dimensions of sea turtles encountered in the August 2013 SoE sea turtle survey

Date	Species	Primary Tag	Secondary Tag	CCL (cm)	CCW (cm)
2/9/2013	Flatback	QA34901	QA34911	85.7	69.6
2/9/2013	Flatback	QA34912	QA34913	83.8	71.2
29/8/2013	Flatback	QA34909	QA34910	84.6	69.4
28/8/2013	Hawksbill	QA34903	QA34905	75.2	67.2
2/9/2013	Olive Ridley	QA34914	QA34915	65.4	62.5
28/8/2013	Olive Ridley	QA34906	QA34907	72.1	67.3
28/8/2013	Olive Ridley	QA34902	QA34904	68.3	64.7

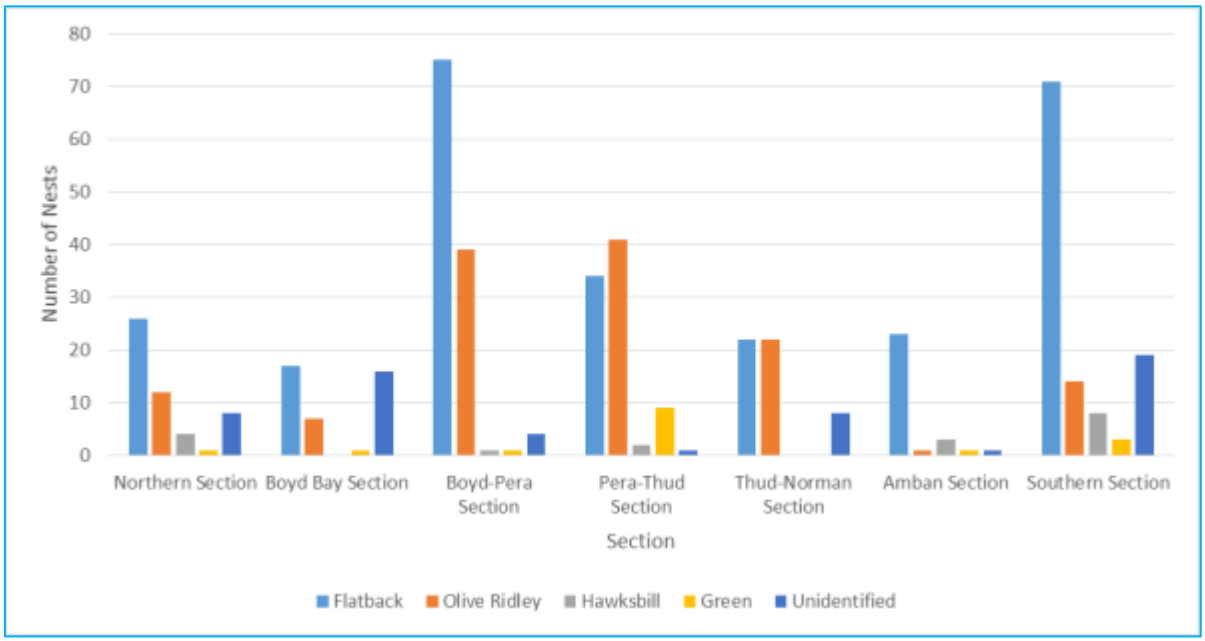


Figure 15: Numbers of nests of each species of sea turtle in the SoE lease in 2013

5.4 HATCHLING SEA TURTLES

A sample of 10 eggs from a Flatback nest was measured and weighed within an hour of laying (Figure 16). The eggs ranged from 49 mm to 50.5 mm in diameter (average = 49.7 mm, sd =0.59) Mass of each ranged from 66 to 70 g (average = 67.7, sd = 1.42). Similarly a sample of ten eggs from Olive Ridley nest ranged from 35 to 36.5 mm (average = 36.0, sd = 0.67) with their mass varying from 25.0 to 27.0 g (average 26.3, sd = 0.82).

On 1 September 2013, an Olive Ridley nest emerged in the Southern Section. The clutch consisted of 84 eggs of which 77 empty eggshells remained in the nest with 46 live hatchlings. One hatchling was dead and one egg contained a dead embryo. Another six eggs contained embryos in advanced stage of development that were kept in moist sand until ready for release the following night. The nest had a hatching success of 91.7% and an emergence success, before excavation, of 35.7%. An unbiased sample of 10 hatchlings were measured and weighed. The average Straight Carapace Length (SCL) was 42.1 mm and average Straight Carapace Width (SCW) was 32.8 mm with an average mass of 15.08 g (Table 7).

The scale counts of the hatchlings were typical of Olive Ridley Turtles (Limpus 2008). All ten hatchlings had a single nuchal scale, two post central scales, 12 marginal scales on either side of the carapace, four scales between the carapace and the plastron, 2 prefrontal scales, 3 post ocular scales on either side of the head. The central scales were 5 (10%), 6 (60%), or 7 (30%). The costal scales were either symmetrical with 6 (30%) or 7 (60%) or 6 and 7 (10%) on either side of the carapace. The post parietal scales were either regular with 2 (40%) or 3 (20%) scales or irregular with 2 (30%) or 3 (10%) scales.

Fresh Olive Ridley eggs (inner) and Flatback eggs (outer)

Olive Ridley hatchling

Figure 16: Eggs of Olive Ridley and Flatback turtles and an Olive Ridley hatchling from SoE

Table 7 Morphometric characters recorded from Olive Ridley hatchlings

Character	mean	sd	n
Mass (g)	15.08	0.15	10
SCL (mm)	42.1	0.57	10
SCW (mm)	32.8	0.92	10

5.5 PREDATION

Evidence of feral pig activity such as rooting holes and footprints occurred on every section of beach and in the dunes and wetlands behind the beach. A pig visited the Boyd Bay camp nightly and moved amongst the tents and around the dining area. It was in the open expanse of beach that the rooting was most evident. Other predators included goannas, and dingoes. Ants and ghost crabs also visited nests opened by other predators.

5.5.1 Beach Survey

Of the 39 nests recorded on Boyd-Pera Section in the October 2013 survey, 46% had been raided by pigs and goannas. During the survey from February to October 2013, 502 sea turtle nests were identified of which 68% had been destroyed by feral pigs and goannas (Figure 17). Most of the predation occurred on Boyd-Pera Section and the Southern Section with Flatbacks being the most common species depredated (Figure 18). Predation by pigs occurred some hours after the eggs were laid (Figure 19). Some nests survived for several days before being raided. Other nests were raided at the time of hatching. Of the 11 hatched nests recorded in the nine-month survey, four of the nests were depredated at the time of hatching.

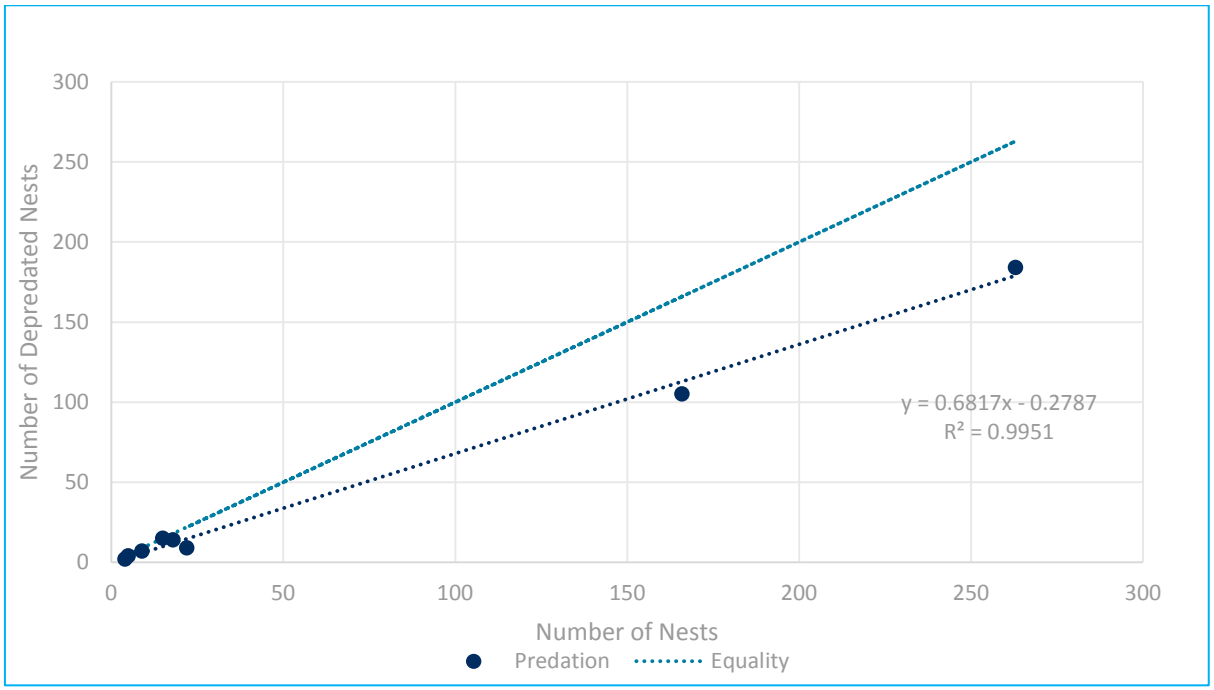


Figure 17: Rates of depredation of sea turtle nests over all surveys an all sections in the 2013 survey of the SoE lease averaged at about 68% the time of each survey

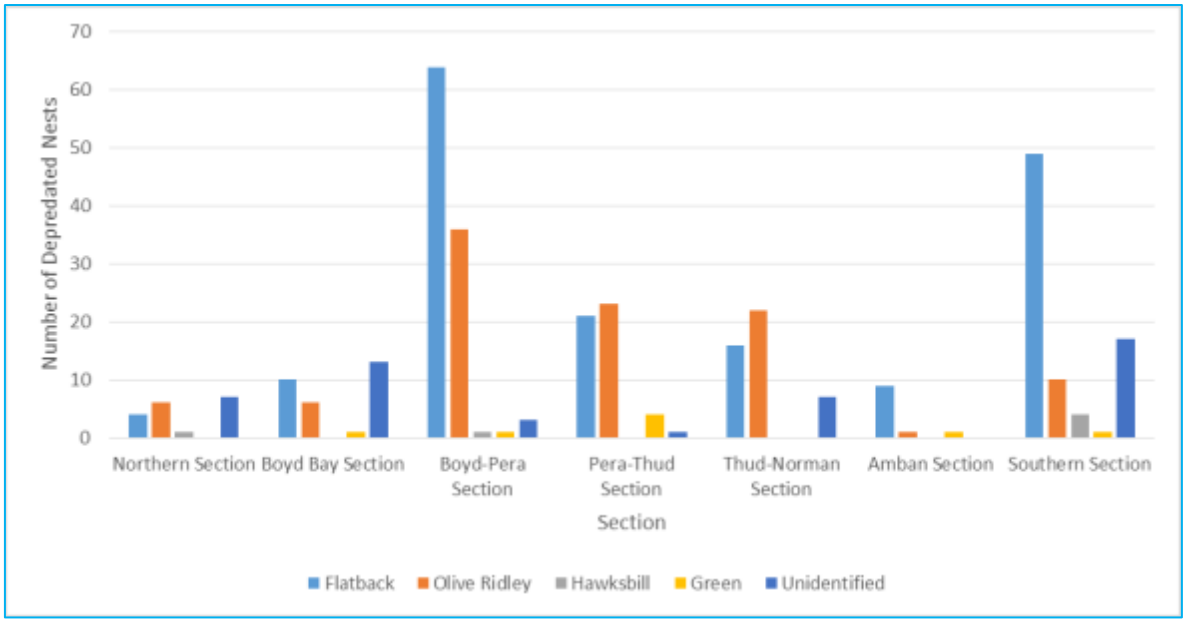


Figure 18: Number of nests of each species of sea turtle in the section of the survey that were raided by pigs and goannas

5.5.2 Camera Traps

Motion sensitive game cameras were positioned at fresh nests for one to nine days at four of the beaches in the survey area (Table 8). Predation did not occur at all nests during the period of camera deployment. Feral pigs and dingoes were the only predators recorded. Dingoes did investigate both the cameras and the activities of the pigs. Dingoes were the only predator photographed during the day but they were also active throughout the night foraging singly before and after pigs (Figure 20).

The cameras recorded two complete depredation events. Camera 5 recorded a pig approaching a Flatback nest in the Boyd-Pera section. At 2144 on the night of 23 August 2013, the pig started excavating the nest (Figure 21). Eggs were located after 10 minutes of digging. For the next 30 minutes, the pig remained almost motionless feeding on the eggs. It emerged from the excavated pit at 2224 and left the predated nest. An hour later a dingo visited the nest but did not dig and appeared not to feed.

Camera 10 recorded no activity around the Flatback nest on Boyd-Pera Section for the first three nights. At 0032 on the morning 27 August 2013 a pig approached the nest along the turtles return track and dug for 16 minutes before unearthing the first egg shell. Intermittent digging and eating continued until 0119 when it left the excavated and predated nest (Figure 22). A dingo visited the nest some hours later but did not excavate further.

Intertidal pig rooting Boyd Bay

Sea turtle nest raided by pigs

Olive Ridley sea turtle nest raided by goannas

Lacerations on eggshell by goanna depredation

Figure 19 Evidence of feral pig and goanna activity on the beaches of the SoE lease

Dingo on Pera-Thud section in daylight.

Dingo investigates the camera and dislodges it and the mount.

Figure 20 Images from Camera 2 showed the dingo interaction with the camera

Dingo investigating the nest on Boyd – Pera

Pig digs into the nest on Boyd – Pera.

Figure 21 Images from Camera 5 with a dingo inspecting the nest that was raided by the pig later that night on 29 August 2013

Pig approaching the nest along the turtle's exit track

Pig digging into the nest

Pig leaving the nest with eggshells visible

Dingo investigates the excavation but does not feed.

Figure 22: Images from Camera 10 showed the pig locating the nest along the turtle track, raiding of the eggs and a follow up visit by a dingo

Table 8 Location and duration of motion sensitive cameras and results

Section	Camera #	Nest GPS	Eastings	Northings	Date								
					8/23/2013	8/24/2013	8/25/2013	8/26/2013	8/27/2013	8/28/2013	8/29/2013	8/30/2013	8/31/2013
Boyd-Pera	5	388	568725	8572425	setup	predated - pigs							
Boyd-Pera	3	459	566187	8568706	setup	intact	intact	intact			intact		intact
Boyd-Pera	10	463	566405	8569035		setup	intact	intact	predated - pigs and dingo				
Pera-Thud	9	478	565052	8567217			setup					predated - pigs and dingo	
Boyd Bay	6		573763	8374902				setup	intact				intact
Thud-Norman	2		567041	8558198					setup and predated - pigs				
Boyd-Pera	5		568213	8547166					setup and predated - dingo then pigs				
Pera-Thud	4		563597	8563749						setup			intact
Northern	7		583859	858259								setup	intact
Northern	8		583598	8585222								setup	intact

6 Discussion

The full extent of sea turtle nesting on the beaches of the SoE lease was undetermined until the 2013 survey. For the first time the entire coastline was surveyed over a short period of time. Being a near simultaneous survey of approximately 60 km of sandy beach enabled the cumulative number of nests to be compiled for a year. A total of 502 nests belonging to four species of sea turtle were recorded and quantified. At the conclusion of the survey, only 11 nests produced hatchlings. The level of predation by feral pigs on turtle eggs over the whole SoE lease remained high throughout the year. The intensive 10-day survey in August-September enabled the rates of nesting to be established and positively identified three species by photographs, measurements, tagging, with egg dimensions recorded for two species as well as scale counts of Olive Ridley hatchlings. The 10 day survey in October recorded hatched Flatback nests and more fresh nests including those of Green turtles. Feral pigs were the major predator of sea turtle nests and destroyed 68% of the nests at the time of recording.

The number of nests recorded in the 2013 survey exceed those of previous surveys which indicated low numbers of sea turtle nesting on the beaches of the SoE lease. Previous surveys were conducted at time of the year when nesting was in low numbers such as in April, May and July (Bell 2003, 2004, RTA 2011). Sea turtles nesting in the SoE lease followed a seasonal pattern with very little nesting in the year until June after which nesting peaked in August and September and continued at a slower rate after October. Doherty (2005) found a similar trend in Flatback turtle nesting on the beaches north of Weipa. There the turtles started nesting in early May and continued through to mid-December and displayed two peaks of nesting. The first was in early August and the other in early October (Doherty 2005). Sampling in the 2003 survey was at monthly intervals in late July, late August and late October. The presence of two peaks of nesting may have been missed in the 2013 survey but the midpoint of the season in this and in Doherty's 2003 survey occurred in the last week of August and the first week of October.

Flatback turtles usually prefer to nest at spring tides that are associated with the new and full phases of the moon (Limpus 1971, 2007, Pendoley et al 2014) although nesting occurs at all tides including neap tides. This species also nests in lower numbers during the day (Limpus 2007). In the August-September survey in 2013, the peak of nesting occurred at a time of neap tides. This departure from the peak nesting expected at the times of full moon (21 August) is probably a feature of the mixed tidal idiosyncrasy of the Gulf of Carpentaria waters.

6.1 SPECIES PRESENT

Having recorded 502 sea turtle nests throughout the nine months of the survey, a higher number could be expected for the entire year as the summer months were not sampled. A number of between 500 to 1000 nests per year would seem likely, given the coastline of the lease and the moderate density of sea turtle nesting. The Boyd- Pera Section received 122 nests during the season. Flatback nests comprised 62% of the nests and Olive Ridley nests comprised 32% with Hawksbill and unidentified nests making the remainder. Flatback and Olive Ridley Turtles were the most common species in the surveys with smaller numbers of Hawksbills and Green Turtles. The numbers of individual nesting turtles remains uncertain as the number of tracks on the beach exceeds the number of nests due to multiple nesting attempts. The number of nests exceeds the

number of individuals due to multiple clutches being laid by individuals in a season. To quantify the number of individuals of each species, a saturation tagging campaign would need to be established for some years. The estimated duration of such a tagging program is three times the re-nesting interval, which could be in excess of 10 years for Flatbacks and longer for Green Turtles (C Limpus, personal communication). In view of the exhaustive logistical requirements of such a tagging campaign, the most appropriate measure of nesting activity is the number of nests.

6.2 NESTING DENSITY

In the August-September 2013 surveys the nesting density varied from 0.018 to 1.172 nests per km per night with the Boyd-Pera Section receiving 0.292 nests per km per night. These values are similar to estimated nesting densities afforded to track counts for varying sections of beach at different times of the year. The RTA Environmental Impact Statement documents the previous surveys in which Bell (2004) recorded 0.3 tracks per km per day for the section extending from False Pera Head to Boyd Bay. GHD in 2007 recorded 0.6 tracks per km per day for a similar area. RTA survey in 2008 recorded 0.1 track per km per day for the 27 km of beach from Norman Creek to north of Boyd Point (RTA 2011). The present survey identifies nests and their level of predation which provides a more stable metric of nesting activity. During the 2013 survey the nesting success was 89% regardless of species and locality which provided an approximate means of correlating tracks with nests for the period of the survey.

The combined surveys in 2013 indicated a low to moderate level of turtle nesting. Given approximately 55 % of the nests belonged to the vulnerable Flatback Turtle RMU and the remainder mostly to the endangered Olive Ridley Turtle RMU, the low to moderate level of nesting gains significance when compared with the high level of predation. Survival rates indicated very few hatchlings leave the beach to replenish the population.

6.3 PREDATION

Predation of turtle eggs was evident throughout the survey area. Pig predation was low in the Pera Head to Thud Point where goanna predation was more evident. Pig tracks were present on the beach only near the heavily vegetated Thud Point. Their presence on the rest of the beach may be deterred by the limited access afforded by vertical cliffs backing the beach, the exposed beach lacking shade and cover as well as a low density of nesting turtles. These however did not deter goannas and dingoes from patrolling the shoreline.

Although 68% of the nests were raided by feral pigs, it should be remembered predation of the nests occurred at any stage on incubation up to and including hatching. More disturbing was that only 11 nests hatched in the entire survey. Two belonged to Olive Ridley Turtles and the other eight were Flatbacks. Given 308 turtle nests had been recorded by the end of the August survey, only 7 hatched Flatback nests were recorded nine weeks later in the October survey. The predation rate may be far higher than the initial raided nest counts indicate.

6.4 SUITABILITY OF THE LAND BASED SURVEYS

This survey of nesting sea turtles by vehicles and foot patrols provided the most thorough method of identifying the species of sea turtles nesting on the SoE lease. The monthly rapid assessments gave a time scale to the nesting events that was lacking in previous surveys. It provided accurate GPS locations of nests and tracks. The fate of nests could be determined and duplicate records

checked not only by GPS coordinates but also by the marks and crosses placed on nests and tracks as they were recorded. The intensive survey in August-September was highly beneficial in providing an indication of the rate at which nests were laid so that a seasonal trend could be developed incorporating the results from the monthly surveys. The focal beach between Boyd Point and Pera Head, where major development is expected, provides the means to interact with sea turtles while ashore to positively identify turtles with their tracks and to tag individuals. Motion sensitive cameras positioned at the time of nesting enabled the recording of the timing and procedures of predators. The survey techniques developed in 2013 provided the robustness in spatial dimensions, temporal scope and effort to detect the results of various management options.

The only failing of this survey was the lack in the initial stages, of a thorough descriptive key to the species of turtle by their tracks and nest positions. As the sea turtles in the Eastern Gulf of Carpentaria form their own gene pools (RMUs), measurement of track widths and nest depths from other Australian localities required verification before they provided the certainty of identification that was required.

6.5 POSSIBLE FUTURE ACTIONS

The aims of the 2013 survey of the beaches of the SoE lease were to establish the seasonality and spatial distribution of turtle nesting and to assess the level of predation of turtle nests by feral pigs and other predators. The data set has established that sea turtle nest on every sandy beach in the lease. Nesting occurred in all months of the survey and possibly beyond the time frame allocated. Most nesting by three species at least, occurs between July and October. At any time of the year approximately 70% of the nests are depredated by feral pigs. The beaches provide good nesting habitat with almost 90% of the tracks resulting in a successful nest being laid but very few nests, less than 2%, survive to produce hatchlings onto the beach. The few hatchlings that were examined were normal in their size, weight and scale counts. Essentially the feral pig problem that is wide spread over Cape York Peninsula remains unaddressed on the SoE lease to the detriment of sea turtles.

Many options exist to assist to protect sea turtle nests from predation. These range from physical barriers and screens over nests to eradication of the predators by any of a number of ways. Studies at Mapoon, further north on Cape York Peninsula than the SoE lease, listed 23 mitigation measures to protect sea turtle eggs from predation and eight measures to reduce indigenous harvest of sea turtle eggs (Fuentes, et al. 2014). Prioritizing of management action could provide a useful and cost efficient approach to addressing feral pig predation on sea turtle nests at the SoE lease. The Mapoon study did not provide a timeframe during which the efficacy of the management action could be assessed. As has been shown in other feral pest eradication programs the removal of feral predators such as foxes enables other native predators such as goannas to have a similar impact on sea turtle nests as did the feral predators (McLachlan and McLachlan 2014).

Reducing the numbers of feral pigs and thereby increasing the numbers of hatchlings leaving the beaches of the SoE should be a priority. The timeframe for total eradication of the feral pigs could take some decades. However, much can be achieved in a shorter timeframe. This includes ensuring the numbers of hatchlings leaving the beach increases to a sustainable level. Sustainable hatchling production requires 70% of the sea turtle nests to produce hatchlings with a least 80 % hatching success and at least 70% of the hatchlings are female (Limpus 1993).

Progress towards this goal requires monitoring of not only the level of predation but also the success of nests that escaped predation.

Partnerships between government, communities and industry to address a matter of national environmental significance such as pig predation holds promise in mitigating the impacts on the environment. A recent initiative the Nest to Ocean Turtle Protection Program (Government 2014) provides just such an opportunity. The most appropriate time to implement such control measures is at the start of the nesting season in the SoE lease. It is unlikely as in the Mapoon study (Fuentes, et al. 2014) a single solution will prove adequate to satisfy all stakeholders. However, direct control of the predators will enhance sea turtle survivorship in the Gulf of Carpentaria. To this end the efficacy of the actions should be monitored not only by the reduction of pig numbers and depredated nests but also by increased survivorship of sea turtle hatchlings immediately following the feral pig control measures.

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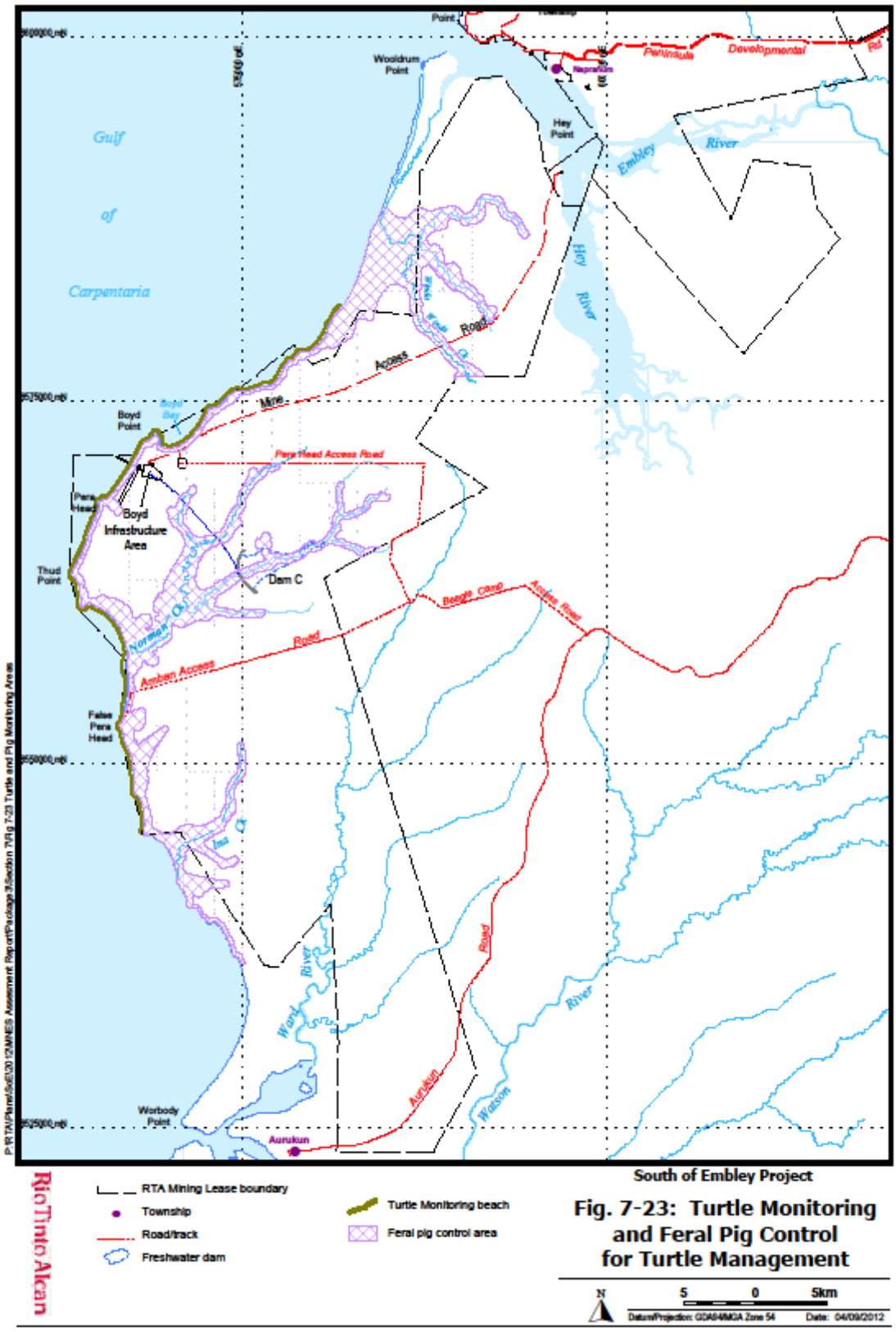
Appendix B Environmental Impact Statement Figure 7-23



Appendix C Consistency with Threat Abatement Plan

Consistency of the Feral Pig Management Offset Strategy with the *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs*

Objective	**Action**	**Consistency of the Strategy with the Threat Abatement Plan**
Prevent feral pigs from establishing in areas where they currently do not occur or are in low eradicable numbers, and where they are likely to pose a threat on biodiversity; especially where they would impact on nationally listed threatened species and ecological communities	• Identify those areas currently free from feral pigs or in low eradicable numbers and where these areas overlay priority areas for nationally listed threatened species and ecological communities, and which are feasible to maintain free of feral pigs. • Relevant agencies to verify as far as practicable, the presence or absence of feral pigs in priority areas. • Relevant agencies to develop and implement strategies including surveillance monitoring and contingency plans to remove and pigs found in these priority areas. Where practicable, monitoring should be integrated into other programs where they exist. • Awareness programs to be developed and implemented for key target groups (recreational hunters, bush walkers and land managers) to ensure that they understand the risk should feral pigs establish in these priority areas. • Review the adequacy and effectiveness of existing legislation and its implementation that aims to control the release, transport and keeping of feral pigs. Relevant jurisdictions to make appropriate amendments to develop best practice strategies to implement it where the review identifies inadequacies.	Not applicable: • Feral pigs are already established in the Project area, however the proposed feral pig control program aims to reduce feral pig numbers along the coastal zone where marine turtles are known to nest.
Integrate feral pig management plans and their implementation into natural resource planning and investment at a regional, state and territory and national level through consultation and liaison with key stakeholders	The Department and relevant state and territory agencies to: • Set out key concerns and issues to be included in Natural Resource Management planning/programs; and, • Establish protocols and use funding and other relevant mechanisms to improve the consistency and coordination of actions across tenures and jurisdictions. — —	Consistent: • A feral pig control program is proposed for the Project.
Increase the awareness and understanding of land managers and the general community about the damage that feral pig cause and management options.	• Relevant government agencies to assess the adequacy of available information and needs of key groups concerned about feral pigs and their management. • Government agencies to arrange the preparation, packaging and dissemination of appropriate material to target groups to awareness and	Consistent: • Through the feral pig control program that is proposed for the Project.

Objective	Action	Consistency of the Strategy with the Threat Abatement Plan
	understanding of feral pig damage and how best to manage it. • Support the dissemination and adoption of the pest management component of the Conservation and Land Management Training Package being developed by the National Training Authority.	
Quantify the impacts feral pigs have on biodiversity (especially nationally listed threatened species and communities) and determine the relationship between feral pig density and level of damage.	• Relevant government agencies to identify priority areas where nationally listed threatened species or ecological communities are known or perceived to be under threat from feral pigs. • Develop and implement appropriate studies that aim to determine the impact of feral pigs on national listed threatened species and the level of feral pig control required to reduce the impact to an acceptable level. This is best undertaken through and adaptive experimental approach to management.	Consistent: • Potential impacts from feral pigs on nesting marine turtle have been identified.
Improve the effectiveness, efficiency and humaneness of techniques and strategies used for managing the environmental damage due to feral pigs.	• In collaboration with private and government stakeholders, investigate and collate a list of current options for managing feral pigs, and assess the need for the development of effective and humane techniques and strategies with special emphasis on managing feral pigs in priority areas for the protection of nationally listed threatened species and ecological communities. • Relevant government agencies to assess techniques and strategies of feral pig control using these new approaches through an analysis of costs and benefits, safety, potential impact on no-target species and any other practical considerations, and formulate a regional best practice approach.	Consistent: • The proposed feral pig control program will use recognised methods for managing feral pigs within the Project area. • Controls will be coordinated with others undertaking controls to the north and south of the Project area • The Strategy will be approved by the Commonwealth department of Environment.

Appendix D Implementation Plan

1 Introduction

Consistent with the Feral Pig Management Offset Strategy, the Implementation Plan has been designed to reduce the annual level of feral pig predation on the nests of the following listed marine turtle species:

- Green Turtle (*Chelonia mydas*),
- Hawksbill Turtle (*Eretmochelys imbricate*);
- Flatback Turtle (*Natator depressus*);
- Loggerhead Turtle (*Caretta caretta*);
- Olive Ridley Turtle (*Lepidochelys olivacea*); and
- Leatherback Turtle (*Dermochelys coriacea*).

Within the beaches of the Project area only the Green, Hawksbill, Flatback and Olive Ridley turtles have been recorded nesting, however the control activities do not vary between the species.

Four management options are available for feral animal management; local eradication, strategic sustained or one-off management, commercial management and crisis management (Braysher 1993). The only management option considered to be viable in this offset strategy is “strategic sustained management”, where pig numbers are reduced and maintained at a low threshold level to achieve the desired performance indicator. The initial goal of control measures shall be to achieve a 70% reduction in the rate of feral pig predation of nests, to be achieved within 3 years of commencement of controls. This goal shall be subject to revision as new information comes to hand. The baseline survey conducted in 2013 identified feral pigs were the major predator of marine turtle nests, destroying 68% of nests. The level of pig threshold density required to achieve this performance indicator is unknown as no density dependant relationships on the effects of management on pig predation or turtle nesting success has been qualified.

Therefore an adaptive management approach will be implemented involving:

- A combination of observed high pig activity areas with freshwater and/or suitable shelter habitat availability and areas known to have higher turtle nesting activity will be used to identify high priority areas or “pig control zones”.
- The primary control method will be an initial knockdown effort (aerial or ground shooting) aimed at eradication of the pig population within these designated pig control zones and reducing to low levels in lower priority areas. Ground shooting is an alternative to aerial shooting in the event that aerial shooting is not able to be implemented for any reason. The management effort will consist of “sustained targeting” of a specific section of the pig population, specifically the individuals (mature males) causing the majority of the predation.
- Feeding stations to be deployed within the pig control zones as a monitoring tool and as bait stations for control effort (toxic baiting and shooting). Feeding stations will be a secondary control method.
- Monitoring using field cameras at feeding stations and turtle nests will be used to quantify and map (using GIS tools) pig and turtle nesting activity, as well as quantify the performance of the management effort and identify areas where predation is ongoing.
- The range of monitoring tools utilised will quantify overall pig predation level trends and to identify areas of new or continuous predation.
- Adaptive management effort will be sustained on an annual basis. Management effort will seek to maximise impact reduction by using proven control techniques targeting the predating animals within high predation areas and targeting at the turtle nesting seasons.

The number of feral pigs inhabiting the beaches within the Project area is unknown. Research data have documented pig populations for marine plains and associated coastal swamp habitats on Cape York which are the considered more preferred habitat for feral pigs than the beach frontage of the Project area:

- 40/km² - south of Aurukun. Dexter, N. (1990). Population density and management of feral pigs at Aurukan north Queensland. Canberra, Bureau of Rural Resources.
- 9/km² Rutland Plains. Cape York Weeds and Feral Animal Program. Internal report
- 4/km² and 3/km² at Lilyvale and Lakefield NP. Mitchell, J. (1998). The effectiveness of aerial baiting for control of feral pigs in north Queensland. *Wildlife Research*. 25 (3) 297.

Assuming a reasonable estimate for the 64km beach frontage of the Project area of 4 / km² then approximately 510 pigs may inhabit the 2km wide x 64km long coastal strip targeted. Adult boar population

densities are a low proportion of this total population and expected to be less than 1 /km² or approximately 100 boars.

2 The Plan

Fuentes *et al* (2014) suggested that the most effective control option scenarios to mitigate marine turtle egg predation were those that used a combination of control strategies to reduce pig numbers, to target specific pigs causing most impacts, to target specific areas where the majority of predation occurs and/or to physically protect nests. The control options to be utilised are aerial shooting or ground shooting and feeding stations implemented by Traditional Owners through the Land and Sea Management Program.

Aerial shooting is regarded as the most effective method for the Project area to achieve a rapid population knockdown in a short time period. Aerial shooting is especially useful in the inaccessible areas of the Project area. Ground shooting may be implemented in the event that aerial shooting is not able to be implemented for any reason (such as safety risk, or unavailability of suitable aircraft). Ground shooting is appropriate where individuals or small groups of pigs are causing intensive localised impacts and is also suited for eradicating small isolated populations. Feeding stations can be implemented as a monitoring tool and to support shooting programs and increase their effectiveness. Feeding stations also provide opportunity for target specific toxin control programs, as a supplementary control to the shooting programs. An action plan identifying the actions, triggers and timeframes for the implementation of feral pig controls and monitoring activities is provided in **Table 1**.

Trapping and nest exclusion devices have been considered as alternative methods, however these generally have more limitations than the preferred methods. Trapping will be very labour intensive in this area compared to other techniques and is not a rapid method of population reduction. Natural increases due to immigration and breeding would out-produce an ineffective trapping program. Sustained control of the population in inaccessible areas may be impossible to maintain by trapping alone. Nest exclusion devices are also labour intensive as typically fresh nests would have to be found and protected within 24 hours of laying. Both methods cannot be implemented in inaccessible areas of the Project area.

The Judas pig technique is considered ineffective at targeting mature male boars, and less effective at wider population control than the proposed shooting and baiting methods. The Judas pig technique requires animals to be captured, fitted with radio collars and released. The Plan has no trapping component so capturing pigs will require using other techniques such as dogging or tranquiliser darting from helicopters to capture pigs for collaring. The shooter and/or pilot will require experience in radio telemetry to locate the collared animals. Only sows could be utilised as they are gregarious whereas mature boars are not. Thus the Judas technique would locate predominantly females groups, which are not the target animals. Collaring boars would not result in additional boars being located. In addition, the success or otherwise of this method has not been researched extensively.

Aerial baiting was considered, despite being highly efficient method to deploy baits, it was not a preferred option as it can be less target specific than the currently chosen methods.

Notifications and signage will be implemented in accordance with Queensland regulations for 1080 baiting (*Health (Drugs and Poisons) Regulation 1996*). Notifications will include providing at least 72 hours notification to all neighbours whose property boundary falls within 2 km of the bait site and any property having frontage to the holding where baits are to be laid. Warning signs must be placed at all entrances to the property and at the extremities of the property boundaries fronting a public thoroughfare. Warning signs must be erected immediately before baiting and left in place for one month after the baits have been laid. The notifications and warning signs will also advise of forthcoming shooting operations.

Table 1: Action Plan for Feral Pig Controls and Monitoring

Actions	Triggers	Timeframes	Implementation Plan section
Feral pig control activities			
Aerial shooting	Coinciding with the peak turtle nesting activity. Predicted by tidal cycle (highest tide (2.3 m) and the smallest daily amplitude (0.7 m)).	2 to 4 days. As required to achieve eradication of adult male boars within 2km of beach frontage in the 3 high priority control zones. Shooters will utilise cameras and pig activity observed during overview survey and record pig kills on daily basis to measure eradication.	Section 2.1
Ground shooting	Implemented If aerial shooting cannot be implemented. Trigger remains the same as aerial shooting.	Approximately 2 weeks As required to achieve eradication of adult male boars (as determined from shooter observations) within 2km of beach frontage in the 3 high priority control zones. Shooters will utilise cameras and pig activity observed during overview survey and record pig kills on daily basis to measure eradication.	Section 2.1
Free feed stations	Commencing at the start peak turtle nesting season (August).	During peak turtle nesting season (August – September) until pigs are feeding continuously and toxin feeder introduced.	Section 2.3
Toxin feeders	Implemented once pigs are feeding continuously at free feeding stations.	Toxin baits introduced once pigs feeding from toxin feeder continuously for 3 days. Toxin baits deployed for 3 days, and then remaining baits and feeder station removed from site.	Section 2.3
Monitoring			
Helicopter overview survey	One day prior to aerial shooting.	As long as required to observe pig activity on beach frontage and waterholes (typically 2 to 4 hours).	Section 2.1 and Section 3
Shooter observations	During aerial or ground shooting.	Ongoing throughout aerial or ground shooting.	Section 2.1, Section 2.2 and Section 3
Feed station cameras	Commencing at the start peak turtle nesting season (August).	Deployed in conjunction with free feeders and toxin feeders, until toxin feeder removed.	Section 2.3 and Section 3
Turtle nest cameras	Deployed upon observation of fresh /unpredated turtle nests.	10 to 12 days in conjunction with marine turtle nest monitoring (Section 6.1 of FPMOS).	Section 3
Raked track plots (at feed stations)	Commencing at the start peak turtle nesting season (August).	Deployed in conjunction with free feeders and toxin feeders, until toxin feeder removed.	Section 3
Scavenger / predator activity	Following shooting program	6 to 10 days	Section 3

2.1 Aerial Shooting

Aerial shooting provides a high control effectiveness and cost efficiency and will be implemented as the primary control method. Aerial shooting is an impact reduction technique targeting the primary cause of turtle nest predation; specifically mature males (boars).

High priority areas will be characterised as having a combination of the densest turtle nesting and most availability of fresh water. Aerial shooting will initially concentrate within a 500m buffer zone from the beach front. Anecdotal evidence suggests mature boars shift their home ranges to converge on the beach frontage during the nesting season. This is assumed to be a learned behaviour gained from experience, and may be "taught" to younger generations. The aim is to achieve eradication of adult males in the control zone each year which will reduce the number of "teachers" so the number of boars who have learned this nest predating behaviour will be reduced over time. There is no evidence that aerial shooting has been conducted in this area and it is not expected that pigs would become habituated to the danger of helicopter noise and associated aerial shooting quickly.

Dependant on water availability and feral pig dispersal, the shooting zone may also be extended to fresh water locations up to 2 km inland from the beach frontage zone. An active low level and low speed search, harass and destroy strategy will target the mature boars and to flush these animals from cover.

Where

The aerial shooting program will be conducted on beaches between Winda Winda Creek and Ina Creek (**Figure 1**). However, to maximise control effectiveness and predation abatement, shooting will be concentrated within high priority pig control zones which have been identified by assessing the combination of turtle nesting density and availability of fresh water and suitable shelter habitat. The length and area of the beach sections are shown in **Table 2**. Whytlaw *et a*l (2013) found that despite the uniform availability of nests along the length of the beach, depredation was significantly clustered in a small number of locations and virtually all nests available (independent of age) were consumed within these areas. These findings suggest the presence of isolated, discrete feeding areas of approximately equivalent size, supporting the hypothesis of individual pigs foraging within specific feeding zones. These centres of high depredation were located almost directly in front of freshwater swamps which are a limiting resource during the dry-season. The findings suggest concentrated use of these feeding zones by individual pigs in the dry months which coincide with the main nesting season. Thus pig control zones are selected as sections of the beach frontage that have a combination of:

- densest turtle nesting; and
- availability of fresh water adjacent to the beach frontage; or
- availability of fresh water a suitable distance inland for pigs to forage from and suitable shelter habitat (e.g. riparian vegetation) adjacent to the beach frontage.

The primary unit used for turtle nesting density is the total number of nests observed per kilometre of beach frontage assessed per observation night (**Table 2**).

Table 2: Ranking of the seven sections from highest priority to lowest priority

Section	Beach frontage length (km)	Feral pig control area (including up to 2km from beach) (ha)	Turtle nesting density* (Nests/km/night)
Southern Section	**7.4**	**1,961**	**1.172**
Thud-Norman Section	**7.1**	**1,996**	**0.500**
Boyd-Pera Section	**6.4**	**1,472**	**0.292**
Amban Section	10.4	2,695	0.263
Northern Section	15.2	3,417	0.233
Pera-Thud Section	6.3	1,594	0.188
Boyd Bay Section	10.8	2,419	0.018
Total	63.6		

* Taken from Guinea (2014). Note length of beach monitored in Guinea (2014) is less than the total beach frontage due to inaccessible portions of section (e.g. rocky outcrops)

The three densest turtle nesting sections reported by Guinea (2014) are the Southern section, the Thud Point – Norman Creek section and the Boyd Point to Pera Head section. These sections also have fresh water or suitable habitat available (Norman Creek, Waterfall Creek and Ina Creek, Pera Head Swamp and a number of other freshwater waterholes/swamps locations). Aerial surveys and GIS information have been used to identify actual and potential sources of fresh water occurring within suitable pig foraging distance of the beach frontage (**Figure 1**). The location of these water points have been recorded on GIS systems. These water sources will be inspected before aerial shooting commences to assess water availability and to determine if any new sources of fresh water exist (as described below).

Based on a combination of turtle nesting density and fresh water or suitable shelter habitat availability, three high priority pig control zones for the aerial shooting program have been selected.

1. Pera Head to Boyd Point (avoiding construction and operational areas)
2. Thud Point to Norman Creek
3. Southern Section

Pig control zones will be targeted first before moving to lower priority sections. Construction and operational work areas are located close to the coast line between Pera Head and Boyd Point. Aerial shooting activities will be excluded from these work areas to the extent determined necessary through annual safety risk assessments to ensure safety of the Project workforce.

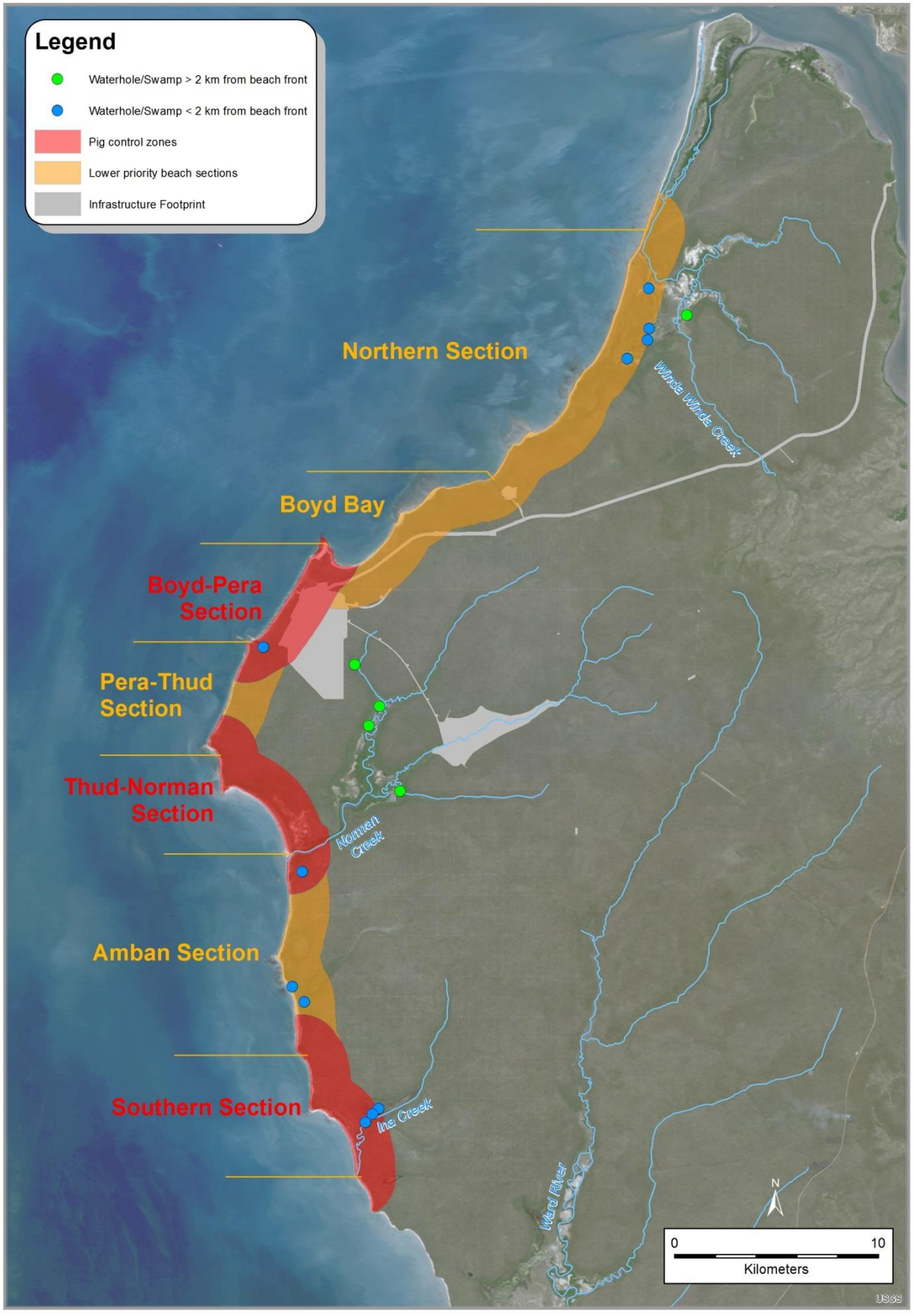


Figure 1: Feral Pig Control Areas

When

Surveys of the cumulative total number of turtle nests (see **Figure 2**) show the start of the main turtle nesting season occurs in mid-August through to early-October (Guinea 2014). The peak of nesting (a week either side of the 50 percentile) occurred in the last week of August and the first week of September. Nesting on the focal beach of Boyd-Pera reached a peak when the evening high tides occurred between 2000 and 2200 hours, around the third quarter of the moon on 27 August 2013. This moon phase coincided with the highest tide (2.3 m) and the smallest daily amplitude (0.7 m) for the portion of the lunar cycle during the survey.

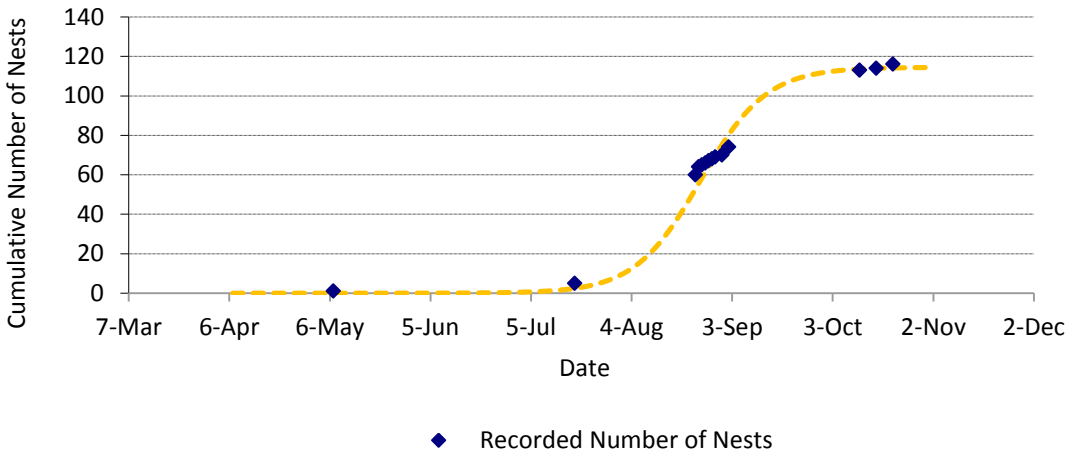


Figure 2: Cumulative Total of Turtle Nests (Boyd Point to Pera Head, 2013)

Based on aerial shooting programs in the Jardine River area, Mitchell (2006) suggested that pig numbers increased substantially on the beach frontage sometime after the nesting season had commenced. A pig index of 3.9 tracks / night / km was observed in early August which increased substantially to 21.0 tracks / night / km in early October. A shooting success index of 5.3 pigs / km (early August; pre turtle nesting season) and 17.6 pigs / km (early October; peak of turtle nesting season) was achieved. The Jardine River area has substantial fresh water availability behind the beach frontage and higher pig population than in the SoE Project area (pers. comm. Mitchell 2016). The vast majority of tracks were mature males. The observations suggested the time lag in predation was due to a shift in the boar's home range. Prior to the turtle nesting season the beach frontage only encompasses a part of their normal home range. Once a reliable food source from turtle nests is detected then the boars shift their home range centre to the beach frontage. This takes time for the boars to learn a reliable food source is available, hence the time lag.

The initial aerial shooting will commence from late-August, after the start of the nesting season to give time for the boars to become more concentrated on the beach frontage. Predicted tidal cycles will be assessed to assist in prediction of the peak turtle nesting period. Timing will be reviewed annually based on results from field camera and beach monitoring in previous years to maximise control effectiveness at times when the majority of predating boars will be operating on the beaches and minimise impacts of predation of turtle nests by other animals.

Who

SoE Project Environmental Specialist will be responsible for implementing the aerial shooting program. An assessment team consisting of the SoE Project Environmental Specialist, Land and Sea Management Program (Traditional Owner) representatives, aerial shooter, pilot and feral pig expert, will be formed to oversee the control program. The assessment team will meet prior to the program and as necessary during the program as monitoring data is obtained and assessed.

How

- Initial overview survey of beach frontage, to record available water/ feeding points and fresh pig activity signs and sightings. These coordinates will be communicated to the pilot prior to the shooting operation.
- Shooting operation will be conducted over 2 to 4 days. The length of shooting operation will be dependent on the level of pig control achieved, as observed on a daily basis.

- The high priority areas (identified previously and in combination with results of the overview survey) will be targeted first. A concentrated effort will be made to eradicate all pigs found within these high priority areas before moving on to the lower priority areas.
- The helicopter searching strategy will consist of low level (tree top) and low speed procedure. The aim is to hover on top of pigs to flush them from cover into open spaces (not into open beach). The flushing method has been successful in control programs on Cape York, including Lakefield National Park (J. Mitchell *pers. comm.*).
- Searching to initially concentrate within 500 m of beach frontage. This will be extended inland to water / feeding areas that are located within 2 km of the beach frontage (position marked from initial surveys).

A Standard Operating Procedure (*NSW DPI Aerial Shooting of Feral Pigs* (*PIG002*) (NSW DPI 2015a)) is available and will be adhered to by the operators. Shooting of feral pigs will be performed by competent, trained personnel who have been accredited and who hold the appropriate licences (Advanced Firearms course; Qld Biosecurity Aerial Platform Marksmanship Course). Helicopter pilots will hold the appropriate permits and be skilled and experienced in aerial shooting operations. Helicopter operators are approved by the Civil Aviation Safety Authority to undertake aerial shooting operations. Aerial shooting will comply with all relevant federal and state/territory legislation, policy and guidelines. Storage, use and transportation of firearms and ammunition will comply with relevant legislative requirements. The use of firearms and the use of aircraft on the mine lease will be subject to approval of the Site Senior Executive in compliance with the *Mining and Quarrying Safety and Health Act 1999* (Qld).

2.2 Ground Shooting

Ground shooting may be implemented in the event that aerial shooting is not able to be implemented for any reason (such as safety risk, or unavailability of suitable aircraft). Before each annual control campaign a safety risk assessment will be conducted and the program will be reviewed in accordance with humane pest animal management practices. The safety risk assessment will assess if the aerial shooting practices can be conducted safely in proximity to construction and mining activities and if available marksman and helicopter operators meet relevant regulatory requirements.

Like aerial shooting, ground shooting is an effective impact reduction technique targeting the primary cause of turtle nest predation; specifically mature males (boars). If adopted, ground shooting will be implemented at the same locations (**Figure 1**) and same timeframes as aerial shooting.

Who

Amrun Environmental Specialist will be responsible for implementing the ground shooting program. An assessment team consisting of the Amrun Environmental Specialist, Land and Sea Management Program (Traditional Owner) representatives, marksman and feral pig expert will be formed to oversee the control program. The assessment team will meet prior to the program and will meet as necessary during the program as monitoring data is obtained and assessed.

How

- Ground shooting operation will be conducted over approximately 2 weeks. The length of shooting operation will be dependent on the level of pig control achieved, as observed on a daily basis.
- The high priority areas (identified from camera monitoring of feeding stations and turtle nests) will be targeted first. A concentrated effort will be made to eradicate all pigs found within these high priority areas before moving on to the lower priority areas.
- Ground shooting will be implemented overnight to target peak pig activity at dawn and dusk. Marksmen will use night vision scopes attached to high powered rifles to target specific predating pigs.
- Competent marksmen with the relevant experience and training would be dispersed along the beaches (by vehicle or boat) at safe distances (at least 3 km apart). Shooters will be positioned in established hides to target predating pigs as they search for turtle nests. Night vision scopes and thermal cameras can be used to identify the predating animals.

A Standard Operating Procedure (*NSW DPI Ground Shooting of Feral Pigs* (*PIG003*) (NSW DPI 2015b)) is available and will be adhered to by the operators. Shooting of feral pigs will be performed by competent, trained personnel who have been accredited and who hold the appropriate licences. Storage, use and transportation of firearms and ammunition will comply with relevant legislative requirements. The use of

firearms on the mine lease will be subject to approval of the Site Senior Executive in compliance with the *Mining and Quarrying Safety and Health Act 1999* (Qld).

2.3 Feeding Stations

Feeding stations will be implemented as a secondary control method by Traditional Owners through the Land and Sea Management Program, which is part of the Communities, Heritage and Environmental Management Plan (SoE Communities, Heritage and Environment Working Group, 2014).

Feeding stations supply a continuous food source to attract large groups of pigs to the stations where control option(s) can then be utilised (poison or shooting). Field cameras can be used to monitor pig populations at feeding stations. Feed stations are target specific and can control entire breeding groups.

Where

Feeding stations will initially be established on the three priority pig control zones identified from the 2013 turtle survey i.e; Southern section; Thud Point to Norman Creek and the Boyd Bay to Pera Head section (**Figure 1**). Dependent on the level of pig control achieved, feed stations may also be established on the remaining lower priority sections. Logistically some of these lower priority areas are more remote and may be difficult to service. Monitoring by field cameras established on all feeding stations and nesting sites will also be used to adjust feeding station locations.

When

Feeding stations will be established at the start of the turtle nesting season (early to mid-August).

Who

The Amrun Community Specialist will be responsible for implementing the feeding stations. Feeding stations will be implemented by Traditional Owners through the Land and Sea Management Program in conjunction with the Amrun Community Specialist, an expert with suitable experience in feral pig control techniques and Amrun Environmental Specialist. Traditional Owners from the Land and Sea Management Program will assess the monitoring data as obtained and adapt the feeding station program as required.

How

- Feeding stations will be positioned behind the sand dune zone in shaded, high visitation areas principally near water sources, subject to site selection principals within the Standard Operating Procedure *Poisoning of feral pigs using PIGOUT 1080 baits* (*PIG006*) (NSW DPI 2015c).
- The number of feeding stations will be dependent on the length of beach frontage within each priority beach section. A minimum of 10 feeding stations will be established in total, spread over the 3 pig control zones. Feeding stations will be no more than 1 km apart.. The feral pig expert will help determine the location of the feeding stations.
- The feeding stations will be used as bait stations for toxin control with 1080.
- Two types of feeding stations will be utilised; initially free feeders followed up by toxin feeders.
    - Monitoring of the free feeders will initially be every 3 to 4 days.
    - When pig feeding commences then refilling the feeding station will be on a daily basis.
    - When pigs are constantly feeding at a free feeding site then a toxin feeder will be introduced.
    - Feeding pigs will be encouraged to feed on the non-toxic food material from the toxin feeder over a period of at least three days, after which toxic material will be added.
    - The toxin feeder will be monitored on a daily basis and after three days of toxic material being available, all remaining bait material will be collected and buried.
- The general operation of the feed stations will be checked at the same time as feed stations are monitored.
- The use of field cameras at feeding stations and nesting sites will allow the locations and numbers of shooting survivors to be identified. This will allow additional feeding stations to be deployed or established feeding stations with no pig activity to be moved to these beach sections where pig activity has been observed.
- If the feeding stations are active during the shooting program they can be used to support the shooting program. Attracting pigs to feeding stations can be used to concentrate pigs around known locations which can then be targeted during the shooting program.

1. Free feeders

Free feeders will be used to attract pigs or groups to the feeding sites and to introduce the food material to pigs so they recognise the novel material as a food source. Free feeders consist of an inexpensive mechanical device that holds a large volume of food material. By restricting the release of this food material (pigs can only access a limited amount at a time) pigs will be encouraged to remain around the site. The slow release also reduces the need to refill the devices constantly so reducing the labour component.

The feed station is made from joining together two large plastic garden pots (**Figure 3**). A hole is cut at the bottom to allow grain to trickle out. Star pickets are used to hold the feed station in place and prevent the stations from being knocked over.

Figure 3: Example of a free feeder

The free feeder is not target specific and species other than pigs can access the food material, however no toxic material will be used in the free feeder. The food material will consist of a mixture of dry mixed grain or cracked corn and unpoisoned commercially available "PIGOUT" baits. These will be added to allow the pigs to familiarize themselves with this PIGOUT bait material that will be used in the toxic feeders. Fermented grain, which is highly palatable to pigs, and if required non-de-odourised Blood and Bone™ fetrtiliser or caramelised sugar syrup will be deposited on or near the free feeders to initially attract pigs to the site. Fermented grain will encourage pigs to feed on the novel dry grain and PIGOUT material. Grain will be fermented under water in drums for 5 days.

2. Toxin feeders

Toxin feeders are mechanical devices where the animal has to operate a lid or covering to access the food material contained inside. Specifically designed toxin feeders will be deployed which will only be able to be lifted by pigs. Other species in the Project area are not powerful enough or lack a lifting ability. Toxin feeders are therefore target specific allowing toxic material to be used to destroy feeding pigs without allowing access to non-target species. Star pickets are used to hold the feed station in place and prevent the stations from being knocked over. The toxin feeders will have a sealed base to prevent animals digging under the feeder.

Examples of toxin feeders included the HogHopper™ and the FeralFix Box Feeder as shown below (**Figure 4**).

FeralFix Box Feeder

HogHopper ™.

Figure 4: Examples of Toxin feeders

The toxin will be administrated by utilising commercially available PIGOUT baits, or similar suitable replacement if PIGOUT baits are not available. PIGOUT baits are factory-prepared, shelf-stable bait that

can be purchased from the factory and delivered on site (**Figure 5**). PIGOUT baits provide an efficient poison application for the remote Project site, where is it is not feasible for registered 1080 users to be present for the duration of the baiting program The bait is made with a fish-flavoured cereal matrix, specially flavoured and dyed to maximise uptake by pigs and minimise uptake by birds and other non-target species. The bait is strengthened by an edible bio-degradable cellulose skin designed to reduce non-target uptake and to ensure ease of handling. Each bait contains 72 mg of '1080' contained in a patented toxin delivery system that is incorporated into the centre of each bait. The bait core is designed to minimise migration of poison into the surrounding bait matrix thereby further reducing non-target uptake.

Figure 5: PIGOUT baits

The use of 1080 in vertebrate pest control has been extensively researched in Australia and New Zealand and has been found to be target specific, humane, efficacious, cost effective with no environmental persistence or long-term effects on non-target populations (see Seawright and Eason 1994; Twigg and King 1991; Twigg and Parker 2010). A range of microorganisms also readily degrade 1080 into harmless by-products (Seawright and Eason 1994; Twigg and Socha 2001).

Standard Operating Procedures from NSW DPI, *Poisoning of feral pigs using PIGOUT 1080 baits* (*PIG006*) (NSW DPI 2015c) and the PIGOUT manufacturer, *Using PIGOUT® Feral Pig Bait* are available and will be adhered to by the operators. Additionally the use of 1080 products will be in accordance with the label directions for these products in Queensland. Baiting activities will be performed by competent, trained personnel. Use of poisons will comply with relevant regulatory requirements.

3 Monitoring Techniques

Monitoring information shall be used to contribute to an adaptive management approach. During the shooting programs and establishment and maintenance of feeding stations monitoring by field cameras and/or inspections will establish a pig visitation index and a pig predation index. These monitoring techniques will supplement the annual turtle nest monitoring.

The following monitoring programs will be implemented in conjunction with feeding station implementation, by Traditional Owners through the Land and Sea Management Program. These monitoring techniques will also allow for monitoring the effectiveness of both aerial and ground shooting activities. These monitoring techniques will also assist to select and prioritise the location of shooting activities.

- Field cameras will be established on recent nesting sites to continuously identify and quantify predating animals. The proportion of nests predated by pigs and other animals prior to and after the shooting program(s) will be the primary data measured and used as the criteria of shooting success.
- Field cameras will be established at each feeding station to quantify an index of the feral pig population over time. Changes in the visitation rate obtained (e.g. pigs seen / night) prior to and after the shooting program can also be used as an index of shooting success. Data on the visitation rate will also assist in identification of high pig population areas.
- Field camera's allow for biological monitoring to be conducted specifically sex and age class of the feral pigs as well as presence of other animals.
- Raked track plots can be used to support the camera monitoring at feed stations.
- Beach monitoring of turtle and feral pig activity within the beach sections during the turtle nesting season will contribute to the overall pig and turtle activity distribution and to the GIS knowledge base.

The following monitoring will be implemented in conjunction with the aerial or ground shooting programs:

- High pig activity areas will be identified by mapping the location of shot or seen animals.

- The number of pigs shot can be compared to numbers from camera monitoring prior to the shooting activity.
- Prior to the aerial shooting program an overview flight will be conducted to monitor waterholes. The overview flight will also be used to obtain photographic data of the extent of pig diggings. This data will assist in identifying changes in diggings due to changes in the pig population. The locations of observed pigs will also be collected.
    - Observation on the distribution of turtle tracks and pig sign on the beach sections can also be collected during the overview flight.
    - Depending on the availability of suitable aircraft, consideration will be given to the utility of obtaining an estimate of population size reduction due to culling by aerial survey. It may be possible to use the method of Eberhardt (1982) to estimate population size from index data collected before and after removal of a known number of individuals. The key focus will remain, however, on the monitoring of changes in nest predation rates by feral pigs.
- Following the shooting program monitoring of the level of predation of carcasses and/or turtle nests and hatchlings by scavengers or predators attracted to the carcasses will be conducted by traditional owners through the Land and Sea Management Program. The monitoring will assist in optimising timing of control activities to minimise impacts of turtle nest predation by other animals.

Data collected from monitoring programs will contribute to the GIS data base and allow for analysis of pig and turtle nest distribution. This analysis will allow for adaptive planning to target control measures for maximum effectiveness.

4 References

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NSW Department of Primary Industries (2015b) NSW Standard Operating Procedure (NSW PIG003) Ground shooting of feral pigs

NSW Department of Primary Industries (2015c) NSW Standard Operating Procedure (NSW PIG006) Poisoning of feral pigs using PIGOUT 1080 baits

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Appendix E Department of Environment Approval Notices

Australian Government
Department of the Environment

Our Reference: EPBC 2010/5642

Mr Paul Dewar
General Manager-Health, Safety and Environment
Rio Tinto Alcan Weipa
123 Albert St
BRISBANE QLD 4000

Dear Mr Dewar,

EPBC 2010-5642 – South of Embley Bauxite mine and port development
Approval of Feral Pig Management Offset Strategy – conditions 43-48

I refer to the updated Feral Pig Management Offset Strategy, 24 April 2015 (Strategy) submitted pursuant to the requirements of conditions 43-48 of the EPBC 2010/5642 approval granted to RTA Weipa Pty Ltd on 14 May 2013.

The Strategy has been reviewed by officers of the Department and has been found to meet the requirements of the relevant conditions. On this basis, and as delegate of the Minister for the Environment, I have decided to approve the Strategy.

As detailed in section 5 of the approved Strategy you must submit an implementation plan for approval to the Department prior to commencement of the first control program. The control program must not commence until the implementation plan is approved.

The Department has an active monitoring program which includes monitoring inspections, desk top document reviews and audits. As part of this program we will be undertaking a review of our records to ascertain the present status of this project in relation to its conditions of approval. We will contact you again if we require further information.

Please ensure that you maintain accurate records of all activities associated with, or relevant to the conditions of approval, so that they can be made available to the Department on request. Such documents may be subject to audit and used to verify compliance. Summaries of results of audits may be published by the Department. Information about the monitoring and audit program can be found on the Department's website at www.environment.gov.au/epbc/compliance/auditing.html.

We would appreciate if you could advise us of any changes to the project e.g. contact officer, company address, commencement date etc.

You should note that any transfer of this approval to another person must have the consent of the Minister under section 145B of the EPBC Act.

If you have any enquiries please contact Manel Samarakoon on 02 6274 1080.

Yours sincerely

Shane Gaddes
Assistant Secretary
Compliance and Enforcement Branch

25/8/2015

Australian Government
Department of the Environment

Mr Glenn Woodrow
Senior Advisor - Environment
Rio Tinto
414 George Street
Brisbane, Queensland 4000

Dear Mr Woodrow

South of Embley Bauxite Mine and Port Development (EPBC 2010/5642) – Feral Pig Management Offset Strategy (dated 27 June 2016)

Thank you for your letter dated 16 May 2016 to the Department, seeking approval of the *Feral Pig Management Offset Strategy (dated 27 June 2016),* in accordance with conditions 43 to 48 of the approval decision dated 14 May 2013.

Officers of this Department have considered the plan and are satisfied that it meets the requirements of conditions 43 to 48 of EPBC Act approval 2010/5642. On this basis, and as a delegate of the Minister for the Environment, I have decided to approve the plan in accordance with condition 72 of that approval. This plan must now be implemented in accordance with condition 48.

Should you require any further information please contact Christopher Kerin, Project Officer, on (02) 6274 2406 or by email: post.approvals@environment.gov.au.

Yours sincerely

S. Gaddes

Shane Gaddes
Assistant Secretary
Compliance & Enforcement Branch
Environment Standards Division

8 July 2016