Rio Tinto Alcan

Section 6

Threatened Species and Ecological Communities - Terrestrial Fauna

6 Threatened Species and Ecological Communities - Terrestrial Fauna

6.1 Introduction

6.1.1 General Structure of Section

This section documents the results of the detailed profiling and impact assessment work undertaken for the four terrestrial fauna species that were assessed in detail because they are known, likely or could possibly occur based on the results of the review of matters of NES and the assessment methodology documented in **Section 4.4**.

The species are:

- Red Goshawk (*Erythrotriorchis radiatus*) – possibly occurs within the Project area (listed as vulnerable under the EPBC Act);
- Masked Owl (*Tyto novaehollandiae kimberli*) – possibly occurs within parts of the Project area (listed as vulnerable under the EPBC Act);
- Northern Quoll (*Dasyurus hallucatus*) - possibly occurs within parts of the Project area (listed as endangered under the EPBC Act); and,
- Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*) – data deficient, actual presence or distribution of this species on western Cape York is not known (listed as critically endangered under the EPBC Act).

Figure 6-1 illustrates the known locations of records of these threatened fauna species on Cape York Peninsula based on a review of relevant secondary source databases.

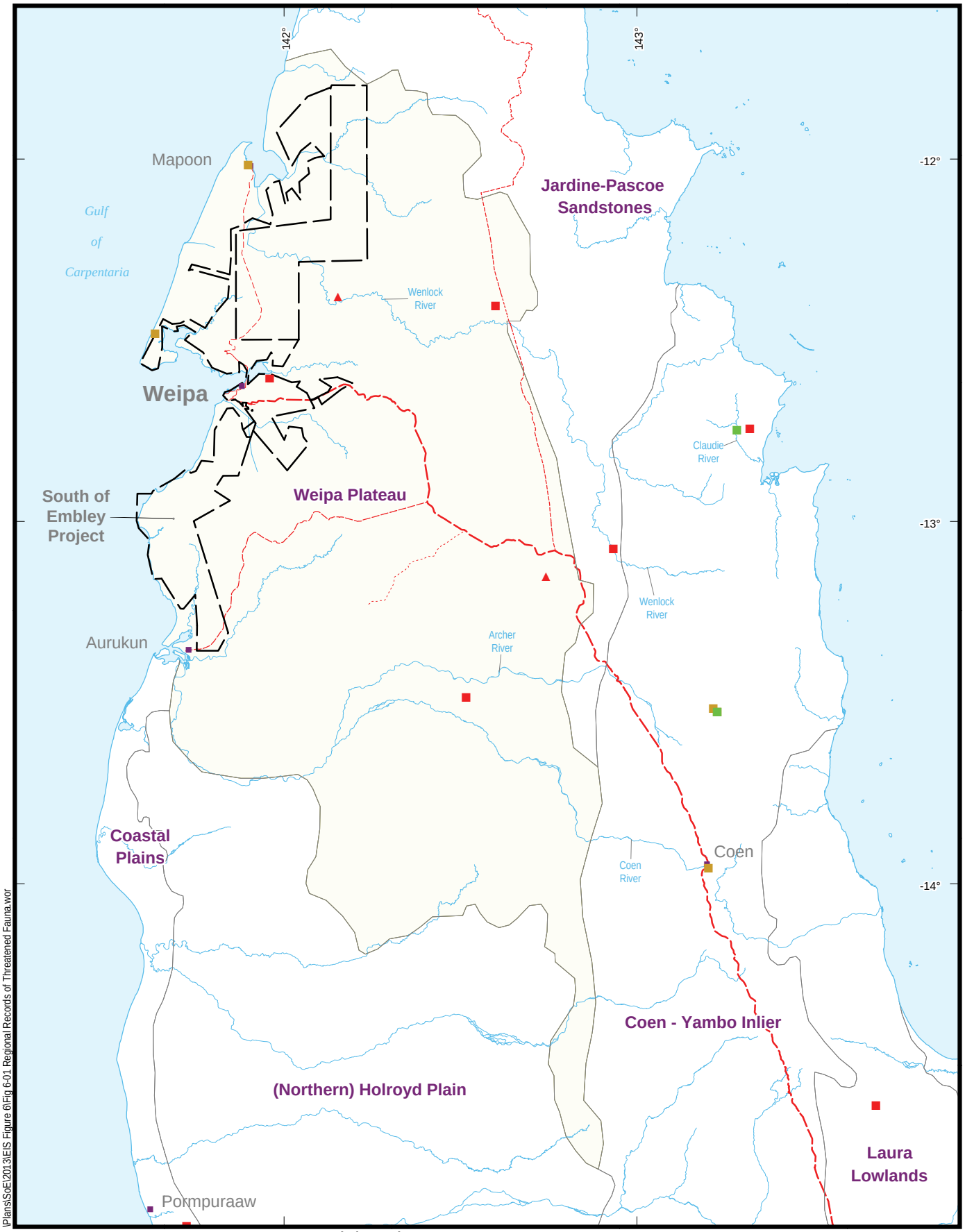
The data collection efforts to assess these species in detail were designed to address the information requirements outlined in the Tailored EIS Guidelines.

In general, the Tailored EIS Guidelines require the following information to be provided about the listed species and communities that are considered likely or known to occur in the Project area:

- broader distribution, ecology and habitat preferences of each species on a regional perspective;
- distribution, ecology and habitat preference of each species in the Project area;
- information to explain the survey methodology used and any limitations;
- relevant impacts;
- proposed avoidance, mitigation and monitoring measures;
- residual impacts and their significance; and,
- proposed offset measures.

This section is structured to document the results of this assessment and present the information in a logical progression for each species and is structured as follows.

- **Section 6.2** provides an overview of the general approach to survey for all species. This has been presented as a separate subsection to minimise repetition and duplication. Additional details on the species-specific efforts are documented in the relevant species-specific sections.
- **Sections 6.3** to **6.6** document the results of the data collection and impact assessment for each species.



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RTA Mining Lease boundary
Locality
River / Creek
Road / track

Recorded Location

Northern Quoll *(Dasyurus hallucatus)* ^
Bare-rumped Sheathtail Bat *(Saccolaimus saccolaimus nudicluniatus)* ^
Red Goshawk *(Erythrotriorchis radiatus)* # ^

Indicative Location

Red Goshawk *(Erythrotriorchis radiatus)**

^ Recorded location: From coordinates (References: Qld Museum 2012; Murphy 2002; F.Venter pers.com.)
# Recorded location: From map (Reference: Czechura*et al* 2010)
* Indicative location: Described in relation to local geographic features (References: Blandford and Associates 1994; Winter and Atherton 1985)

South of Embley Project

Fig. 6-1: Regional Records of Threatened Fauna

N
25 0 25km
Datum/Projection: GDA94/Lat-Long
Date: 05/02/2013

In order to present the information required in the Tailored EIS Guidelines, each species-specific section includes the following subsections:

- **Subsection 1 – Species Profiles** (**6.3.1**, **6.4.1**, **6.5.1** and **6.6.1**)
  - describes the secondary source profiling work undertaken to better understand each species, outlines regional preferences and focuses of survey effort.
- **Subsection 2 – Survey and Results** (**6.3.2**, **6.4.2**, **6.5.2** and **6.6.2**)
  - describes the specific survey efforts and the results that describe Project area habitat preferences.
- **Subsection 3 – Relevant Impacts** (**6.3.3, 6.4.3, 6.5.3** and **6.6.4**)
  - describes the relevant direct and indirect impacts of the Project.
- **Subsection 4 – Avoidance, Mitigation Enhancement Measures and Residual Effects** (**6.3.4**, **6.4.4** and **6.5.4**)
  - describes the measures proposed to reduce the relevant impacts of the Project.
- **Subsection 5 – Offset Measures** (**6.3.5**, **6.4.5** and **6.5.5**)
  - describes the measures proposed to offset any significant impacts of the Project, where required.

Cumulative and consequential impacts on these species are documented in **Section 18**. The cumulative and consequential impact assessment was undertaken at a higher/more strategic level of detail when compared to the Project-specific impact assessment because it is based on the potential activities that may or may not occur as a result of other projects.

6.1.2 General Approach to Profiling and Determining Habitat Preferences

Profiles include maps of potential habitat for each species within the Project area and Subregion (defined as the Weipa Plateau Subregion (Sattler and Williams 1999)). These maps have been developed by identifying the Regional Ecosystems (REs) that best align with the known habitat of each species, using Version 6 of the EHP RE mapping to construct the maps[1]. The EHP mapping for the REs within and adjacent to the Project area has been adjusted based on the results of ground-surveys of vegetation (refer **Figure 4-1**). Additional details of the approach to defining and mapping the REs is included in Section 7.5.2 of the Project's EIS (RTA 2011) and SEIS (RTA 2012) prepared for the Queensland Government.

For the Red Goshawk, Northern Quoll, and Masked Owl, an attempt has been made to differentiate habitat suitability for each species based on current known habitat requirements and location records. Delineation of suitable habitat for the Masked Owl within the Subregion is hindered by a lack of data on the availability of small mammal populations (a key resource for the species) but delineation of habitat suitability within the Project area is supported by results of field surveys of small mammals.

[1] Habitat suitability categories are based on RE types. The RE mapping outside the Project area often shows multiple RE's in a single mapping unit. For mapping display purposes, a conservative convention was adopted of assigning a high suitability to mapping units with more than 10% of any individual RE which had high habitat suitability. Calculations of areas of particular habitat suitability categories are not affected since mixed RE mapping units have percentage cover of each RE type within the unit and areas can be proportioned accordingly.

A general lack of data on the Bare-rumped Sheathtail Bat throughout its range and on Cape York also constrained definitive identification of habitat suitability, although targeted surveys for the species in a number of habitat types within the Project area conducted in June and October 2012 did not detect the species (refer **Section 6.6.1**).

Habitat suitability categories are defined as follows:

High suitability - Habitat providing vegetation and/or habitat features or structures that have the potential to be utilised significantly for nesting, breeding, rearing young, roosting/denning/shelter, or as a focus of foraging activity.

Moderate suitability - Includes habitat areas often in the vicinity of high suitability habitat that have the potential to be less intensively utilised for roosting/denning/shelter, foraging, or transit; and less likely to be utilised for nesting, breeding or rearing young.

Low/No suitability - Habitat that may be utilised for occasional foraging and/or transit between high and moderate suitability habitats; is not likely to be used for breeding/nesting; or may not be utilised at all.

6.1.3 General Approach to Impact Assessment

The Tailored EIS Guidelines require detailed impact assessments for each species identified as either known or likely to occur within the Project area. A conservative approach was taken and species that could possibly occur were also selected for more detailed assessment. **Section 4.4** describes how the likelihood of occurrence was identified. The detailed impact assessment includes a focus on potential impacts on key habitat for each species associated with the construction and operational phases of the Project.

In general, the impact assessment process for each species focussed on the following key steps:

1. determination of the potential environmental impacts of the Project on species;
2. identification of avoidance, mitigation and enhancement measures to avoid and/or mitigate potential adverse impacts; and,
3. determination of the significance any residual impacts.

To document the results of the impact assessment process, the various subsections have been structured to provide an overview of the potential construction impacts and operational / maintenance impacts for each species. The impact assessment process considered both potential direct and indirect impacts associated with the Project (refer **Table 6-1**).

Table 6-1 Potential Direct and Indirect Impacts Considered

Potential Direct Impacts	Potential Indirect Impacts
Clearing and loss of habitat	Noise
Edge effects	Water quality
Fragmentation of habitat	Altered hydrological regime
Effects on movement/breeding/feeding patterns	Air quality
Road kill	Introduction of weeds and pests
Altered light regime	Altered fire regime

The magnitude of potential impacts on each species assessed (both unmitigated and residual), are rated as either:

- None/negligible - unlikely to be any effect of consequence to the species.
- Minor impact - impact would occur in low/no suitability habitat, or over an area of moderate or high suitability habitat much less than the home range of the species. Individuals of the species would be affected and may need to alter utilisation of the impact area but are unlikely to be permanently displaced. Important populations would not be affected.
- Moderate impact - impact would occur over an area of moderate or high suitability habitat comprising the majority of a home range of the species and individuals may be displaced. Important populations may experience some affect.
- High impact - impact would occur over a large area of moderate or high suitability habitat compared to home range with multiple individuals affected and important populations permanently affected.

High and moderate residual impacts are considered to be significant, and none/negligible and minor residual impacts are not considered to be significant. **Table 6-2** summarises the habitat and potential occurrence within the Project area of the threatened terrestrial fauna species assessed in this section.

Table 6-2 Threatened Terrestrial Fauna Listed under the EPBC Act

Species **Common Name**	**EPBC Status**	**Habitat**	**Occurrence within Project Area**
Birds			
Erythrotriorchis radiatus Red Goshawk	V	Favours coastal and sub-coastal areas. Prefers a mix of vegetation types including tall open forest, woodland, lightly treed savannah and the edge of rainforest and riparian forests.	**Possible**
Tyto novaehollandiae kimberli Masked Owl	V	Prefers tall eucalypt forest and woodlands where small mammal prey is available.	**Possible**
Mammals			
Dasyurus hallucatus Northern Quoll	E	Rocky escarpments in eucalypt forests and woodlands within coastal regions.	**Possible**
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheathtail Bat	CE	Known habitats on eastern Cape York include riparian forest, vine forest and rainforests and adjacent woodland.	**Data Deficient**

Key to EPBC Status:
CE Critically Endangered
E Endangered
V Vulnerable

6.2 General Approach to Surveys

The following outlines the general approach to survey for fauna species. Specific survey efforts and results for each species are outlined in **Sections 6.3.2**, **6.4.2**, **6.5.2** and **6.6.2**.

The main objectives of the fauna survey program were to identify the potential presence of the species and to characterise their potential habitat within the Project area.

Field surveys conducted for the Project between July 2006 and May 2009 were undertaken prior to the release of the DSEWPaC *Survey Guidelines for Australia's Threatened Birds, Bats and Mammals* (DEWHA 2010a and 2010b, and DSEWPaC 2011c respectively). The original *Terms of Reference for an Environmental Impact Statement for the Project* (released in 2009 by the Queensland Government in consultation with DSEWPaC under the (then) Bilateral Agreement process) did not specify a survey methodology for fauna, however the Terms of Reference required surveys to be conducted at the appropriate time of the year when species were known to be present, and data was to be provided in a format compatible with the Queensland EHP WildNet database. These requirements were met. Surveys undertaken in June 2012 were conducted in accordance with the current relevant DSEWPaC survey guidelines for each species. The October 2012 surveys were undertaken in accordance with the guidelines and following discussion with DSEWPaC.

Even though the DSEWPaC survey guidelines were developed after most of the Project surveys were conducted, the survey approach for the 2006-2009 surveys (i.e. prior to the survey guidelines release) was consistent with the six step planning and design process outlined in the DSEWPaC guidelines. The survey guidelines provide recommended survey effort for small sites (less than 50ha) and acknowledge that comprehensive surveys at the same intensity are not feasible for large sites. In these situations, the guidelines recommend that an appropriate sampling approach be developed to focus the survey effort, and the approach be discussed with DSEWPaC. The general approach is to profile the species to identify habitat preferences, then focus survey efforts on favourable habitats in order to maximise the likelihood of detecting the species. The targeted approach undertaken between 2006 and 2009 was consistent with this recommendation. The survey approach during the 2012 surveys was also consistent with the targeted approach and survey effort recommended in the survey guidelines.

The aims of the survey programs developed for the Project were to characterise the fauna community in the main habitats present and also to identify the potential presence of threatened or migratory species listed under the EPBC Act. No threatened ecological communities were identified in the Project area. Of particular significance for the selected survey program was the potential presence of numerous highly mobile threatened fauna species that could, in low densities, occur over an extensive area of habitat. An intensive site-based comprehensive survey approach is generally not suitable given the highly mobile and low density nature of these species; rather a more extensive survey targeting many sites within potential likely habitat for each species is required to provide an appropriate opportunity of detecting individuals. The inadequacy of general stratified fauna surveys for uncommon or low density species and the need for targeted survey in likely habitats is supported by numerous authors (Philippi 2005, Guisan *et al.* 2006) and within the DSEWPaC survey guidelines.

Consequently, the survey program employed for the Project included extensive traverses and site inspections of likely habitat for threatened species. The bias of survey site locations towards non-Darwin Stringybark habitats was to focus the survey effort into areas of high/moderate suitability habitat in order to have the greatest chance of detecting these species.

Selection of the survey techniques was based on an assessment of the techniques practically available for the fauna community and habitats evident within the Project area, and experience with the

success or otherwise of these techniques during previous studies in similar habitats in the Weipa region. In addition, there were also logistical and safety issues associated with working in a remote tropical area where vehicular access and seasonal conditions affected the ability to conduct certain types of survey at different times of year. The result was the application of survey techniques specifically suited to the species and habitats likely to be present, recognising the prevailing logistical constraints, and providing an optimal balance of intensive site based data and more extensive data on threatened and migratory species.

Surveys

The surveys were undertaken by experienced ecologists who have worked in Northern Australia since 1991 and on Cape York since 2006.

Fauna surveys focussed initially on Darwin Stringybark dominated communities on the bauxite plateau which occur within the proposed mining areas. Following this initial survey, non-Darwin Stringybark dominated communities became the focus of survey effort to adequately describe their fauna community and concentrate the search effort within habitat that is favoured by the targeted threatened fauna in order to determine presence of the species. This approach is consistent with the approach recommended by the DSEWPaC *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a) and *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011c) for large areas with a variety of distinct habitat types. This included comprehensive surveys, supplementary surveys and targeted surveys. Comprehensive surveys were conducted determine the fauna community within the Project area. Survey sites were representative of the main habitats present within the Project area. The supplementary surveys comprised locations selected for a particular survey activity based on apparent habitat features, for example, favourable sites for harp traps, sites with high bird activity, sites with potential for supporting arboreal mammals; or, where comprehensive surveys were not completed due to fire or access issues. The targeted surveys focused on riparian forest, vine forest, wetlands, and beach and estuary communities which are most likely to support the threatened fauna species that are likely or possibly occur in the Project area, although some survey effort was still employed within areas of Darwin Stringybark woodland potentially subject to mining. The June 2012 and October 2012 surveys sampled riparian habitats and Darwin Stringybark woodland within proposed mining areas.

Species profiles were developed to identify the known preferred habitat of each threatened fauna species based on a literature review and existing records, particularly records from the Subregion and wider Cape York Peninsula. There was considerable overlap of the preferred habitat of each species, with riparian, wetland and other habitats associated with the main drainage systems providing the most likely habitat for all four species. Consequently, many potential habitat areas identified for field inspection could possibly support multiple target species.

A summary of the different survey activities is listed in **Table 6-3**.

Searches for threatened fauna during foot traverses were generally undertaken during at least one late wet season and one dry season survey event in each search area. The remaining survey activities were conducted as one-off activities or at different sites in different seasons to extend survey coverage. In addition to these survey efforts, it should be noted that substantial vehicle travel time (typically 2 -3 hours return, twice per day) was required to access survey areas within the Project area and many kilometres of tracks were traversed each day providing regular extensive coverage of the Project area and opportunities to detect larger fauna such as the Red Goshawk. The June 2012 and October surveys included survey efforts not employed during previous surveys comprising, motion-sensor cameras and intensive cage trapping for Northern Quolls (June only), and, mist netting for the Bare-rumped Sheathtail Bat.

Table 6-3 Summary of Fauna Survey Effort

Survey Component	Survey Effort
Comprehensive Fauna Sites (May 2007, May 2008)	**12 Sites (48 days/nights)**
Elliot traps	2,400 trap nights
Cage traps	24 trap nights
Pitfall traps	120 pitfall nights
Funnel traps	1,000 trap nights
Hair tubes	288 hair tube nights
Anabat sessions	12 Anabat nights
Harp trap	12 trap nights
Morning bird searches	24 x 1 hour searches
Reptile searches	12 searches
Spotlight searches	24 searches
Call broadcast sessions	13 broadcasts
Vehicle traverses (3 hours/day and 2 hours/night)	80 hours
Supplementary Survey Sites (July 2006, May 2007, May 2008)	**15 Sites (12 days)**
	A variety of survey techniques applied at varying survey intensity and duration.
Targeted (threatened) Fauna Survey	**60 days in total**
27 days December 2007/2008, May 2008/2009 comprising:	extensive foot traverses vehicle traverses coastal observations with spotting scope Anabat sessions harp trapping funnel traps (224 trap nights) spotlight surveys call broadcast sessions nocturnal crocodile spotlight surveys in the Ward River boat-based observational transect in Norman Creek all-terrain vehicle (ATV) traverses of beach habitats.
14 days June 2012 comprising:	cage trapping (240 trap nights at 6 sites) camera traps (117 trap nights at 13 sites) call broadcast sessions (25 owl sessions, 7 raptor sessions) harp traps (43 trap nights) mist nets (12 trap nights; 4 ground level, 8 canopy) vehicle traverses (20 hours)
19 days October 2012 comprising:	extensive foot traverses (23.5 hours at 22 sites) vehicle traverses (20 hours) camera traps (103 traps nights at 15 sites) call broadcast sessions in conjunction with spotlighting (13 owl sessions) mist nets (35 trap nights; 15 ground level, 20 canopy)

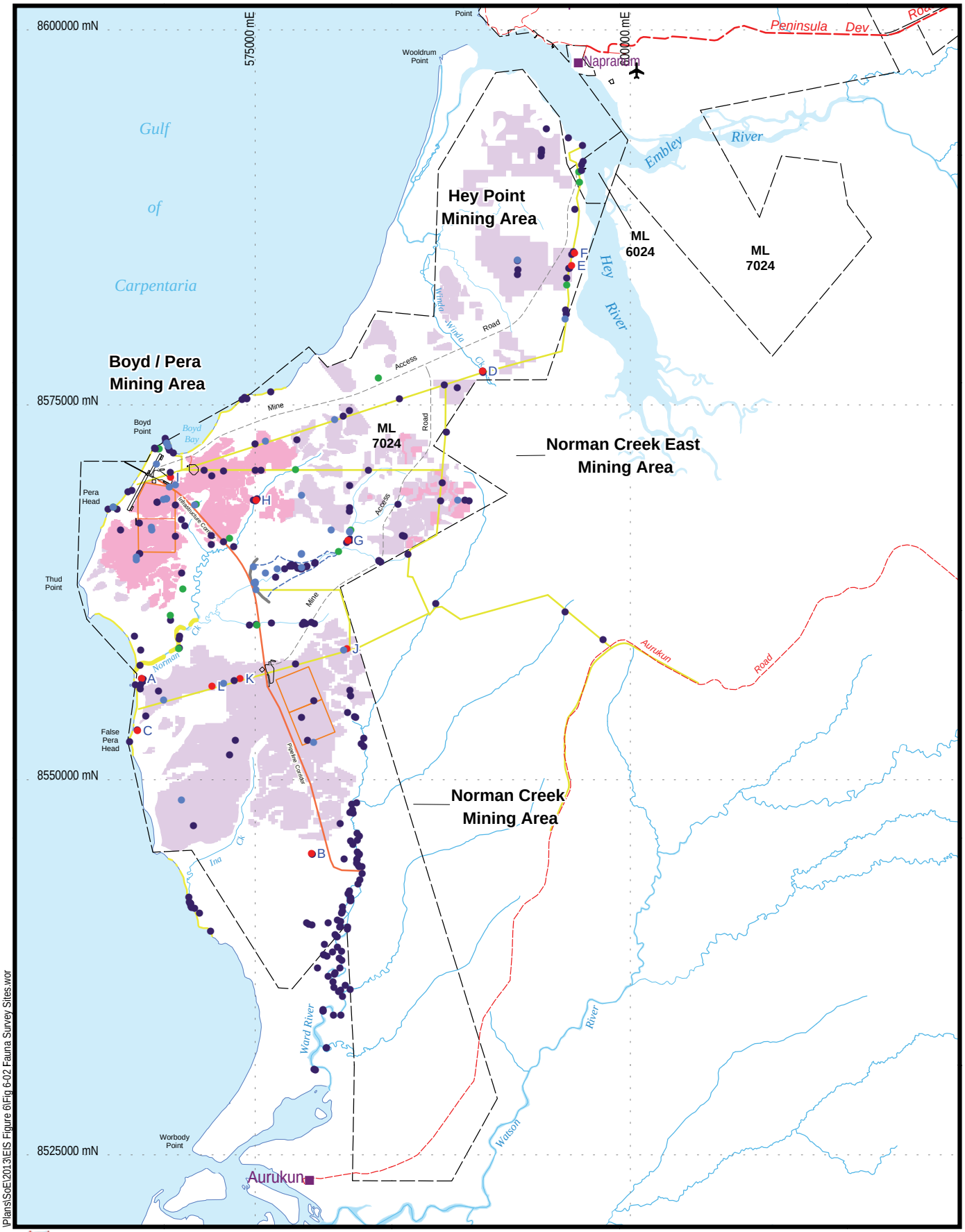
The location of fauna survey sites within the Project area is indicated in **Figure 6-2**.

Sections 6.3.2, **6.4.2**, **6.5.2** and **6.6.2** describe the survey efforts (including the total hours of survey for each species) and results for each species in more detail.

Table 6-4 summarises the detectability of the target fauna species, the suitability of survey timing for each and species specific limitations of the survey approach.

Larger areas including the Dam C footprint and immediate downstream area, and the Boyd TSF area, were subject to survey effort such as trapping, bird searches, or spotlighting. Other areas such as the infrastructure corridors between Boyd infrastructure area, Norman Creek infrastructure area and the Ward River pump, and mine access road corridors were subject to habitat assessment and /or observational survey effort.

The spread of survey events provided survey effort over key seasons for detecting fauna variability within the Project area, namely late dry season (December 2007 and 2008 and October 2012) and post wet season (May 2008 and 2009 and June 2012). A total of 48 days general survey was undertaken at 12 sites and 60 days of targeted survey effort was undertaken.



\Plans\SoE\2013\EIS Figure 6\Fig 6-02 Fauna Survey Sites.wor

Rio Tinto Alcan

- RTA Mining Lease boundary
- Locality
- Road/track
- Freshwater dam
- Tailings storage facility
- Mining Years 1 -13
- Mining Years 14 - 40
- Comprehensive survey site (A - L)
- Supplementary survey site
- Targeted threatened fauna survey site
- Bare-rumped Sheathtail Bat survey site
- ATV beach traverse
- Boat traverse
- Vehicle traverse

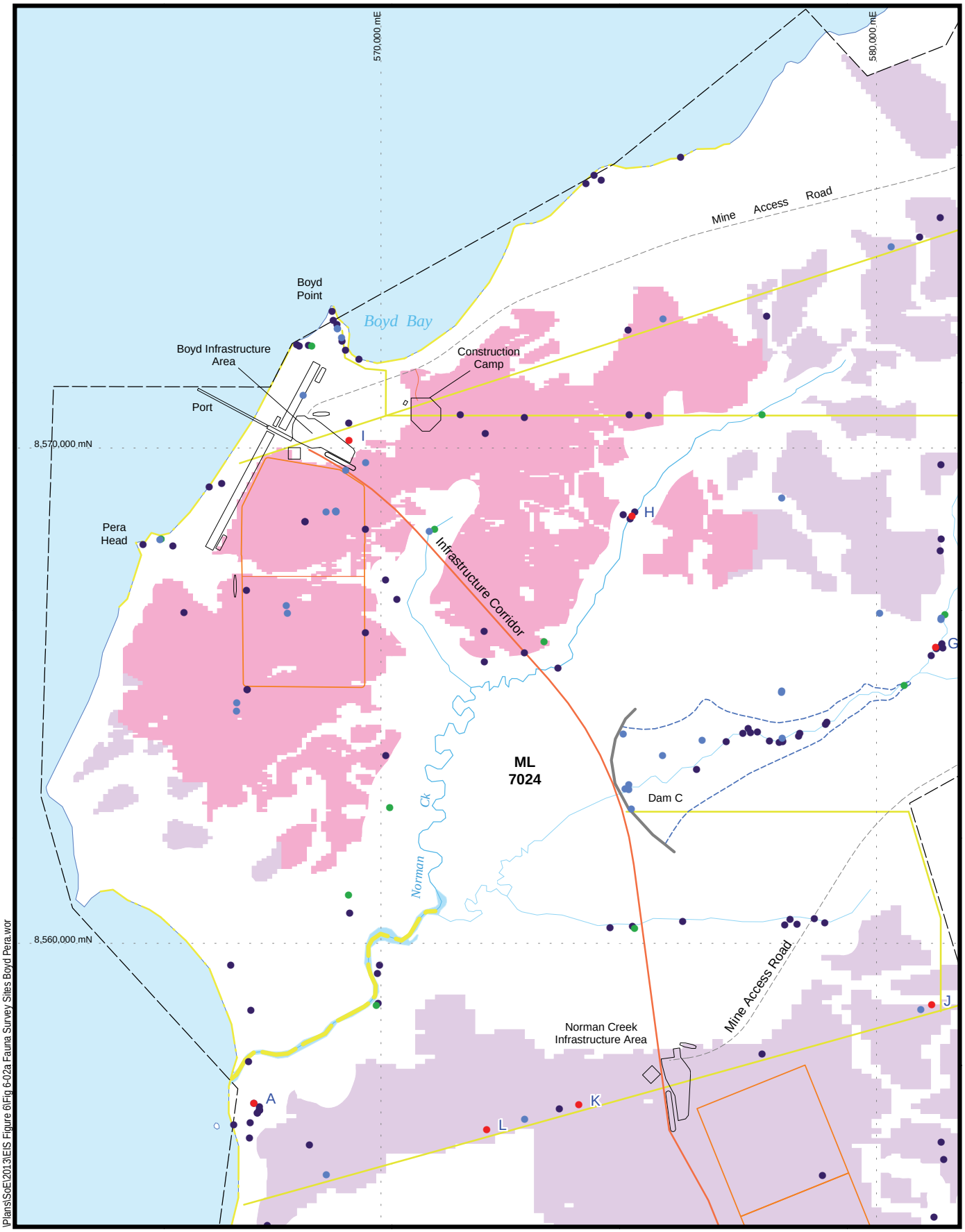
South of Embley Project

Fig. 6-2: Fauna Survey Sites

N

5 0 5km

Datum/Projection: GDA94/MGA Zone 54 Date: 26/10/2012



\Plans\SoE\2013\EIS Figure 6\Fig 6-02a Fauna Survey Sites Boyd Pera.wor

RTA Mining Lease boundary
Locality
Road/track
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Comprehensive survey site (A - L)
Supplementary survey site
Targeted threatened fauna survey site
Bare-rumped Sheathtail Bat survey site

ATV beach traverse
Boat traverse
Vehicle traverse

Rio Tinto Alcan

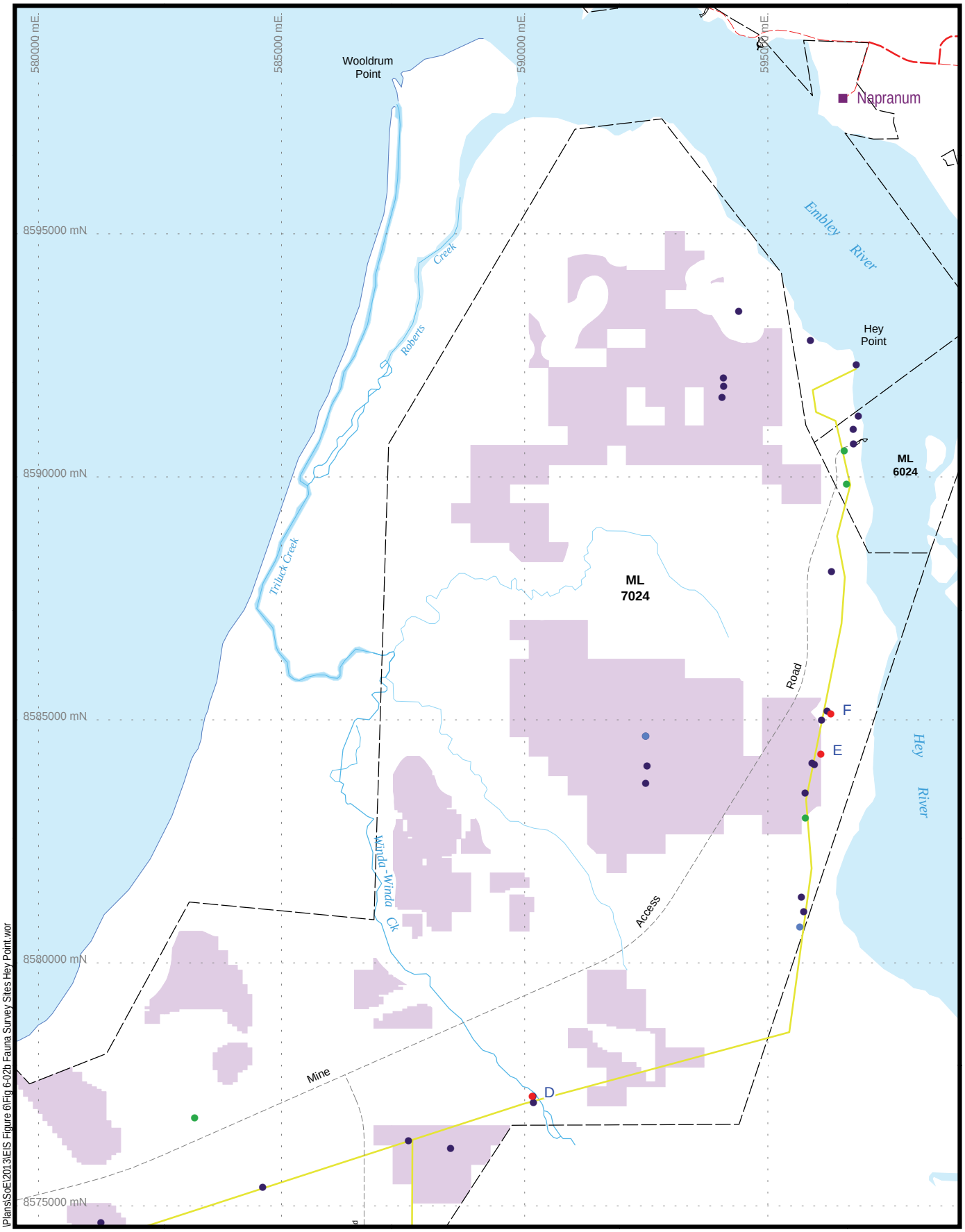
South of Embley Project

Fig. 6-2a: Fauna Survey Sites (Boyd / Pera Mining Area)

N

1 0 2km

Datum/Projection: GDA94/MGA Zone 54 Date: 26/10/2012



\Plans\SoE\2013\EIS Figure 6\Fig 6-02b Fauna Survey Sites Hey Point.wor

RTA Mining Lease boundary
Locality
Road/track
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Comprehensive survey site (A - L)
Supplementary survey site
Targeted threatened fauna survey site
Bare-rumped Sheathtail Bat survey site
Vehicle traverse

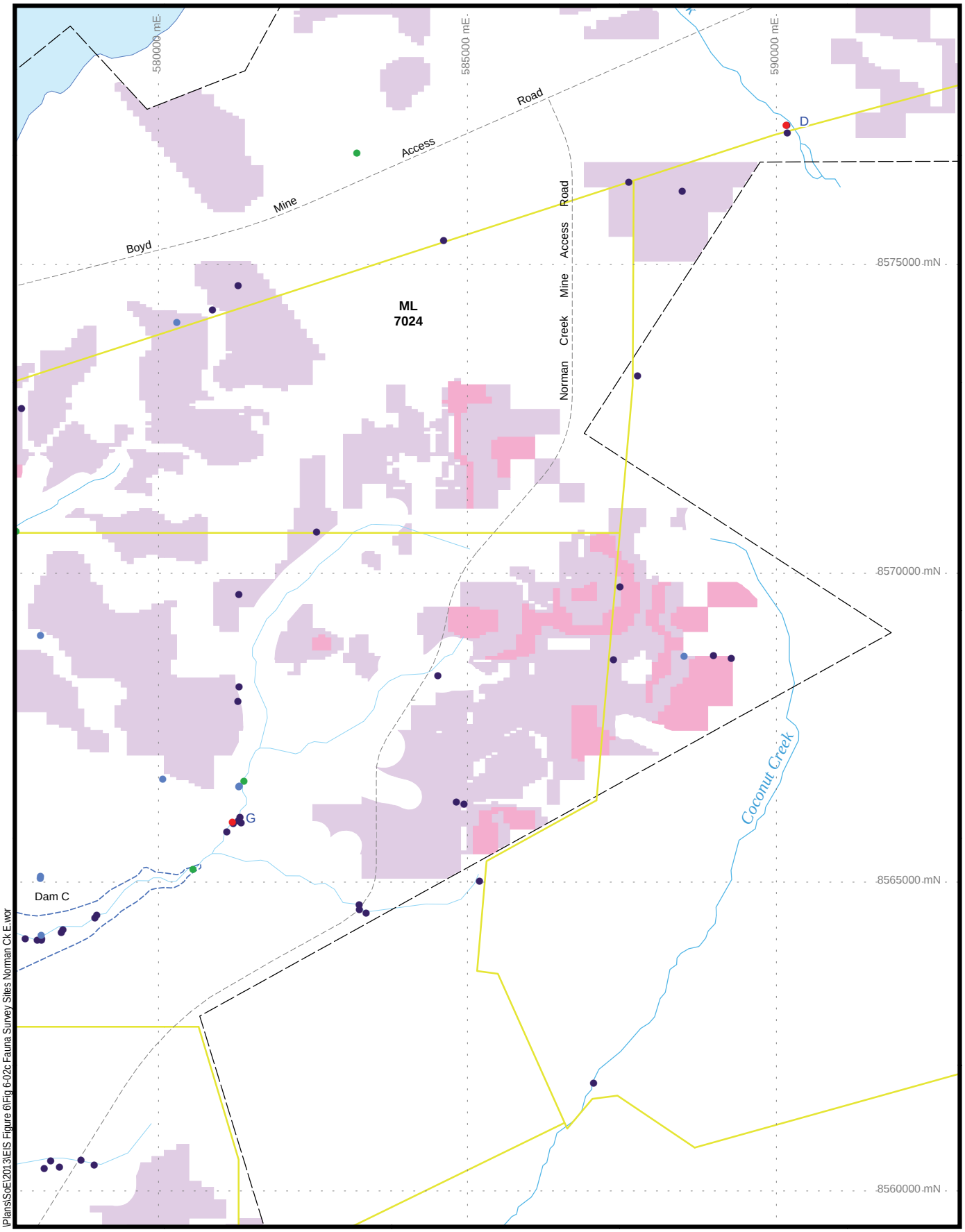
South of Embley Project

Fig. 6-2b: Fauna Survey Sites (Hey Point Mining Area)

N

1 0 1 2km

Datum/Projection: GDA94/MGA Zone 54 Date: 26/10/2012



\Plans\SoE\2013\EIS Figure 6\Fig 6-02c Fauna Survey Sites Norman Ck E.wor

RTA Mining Lease boundary
Locality
Road/track
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Comprehensive survey site (A - L)
Supplementary survey site
Targeted threatened fauna survey site
Bare-rumped Sheathtail Bat survey site
Vehicle traverse

Rio Tinto Alcan

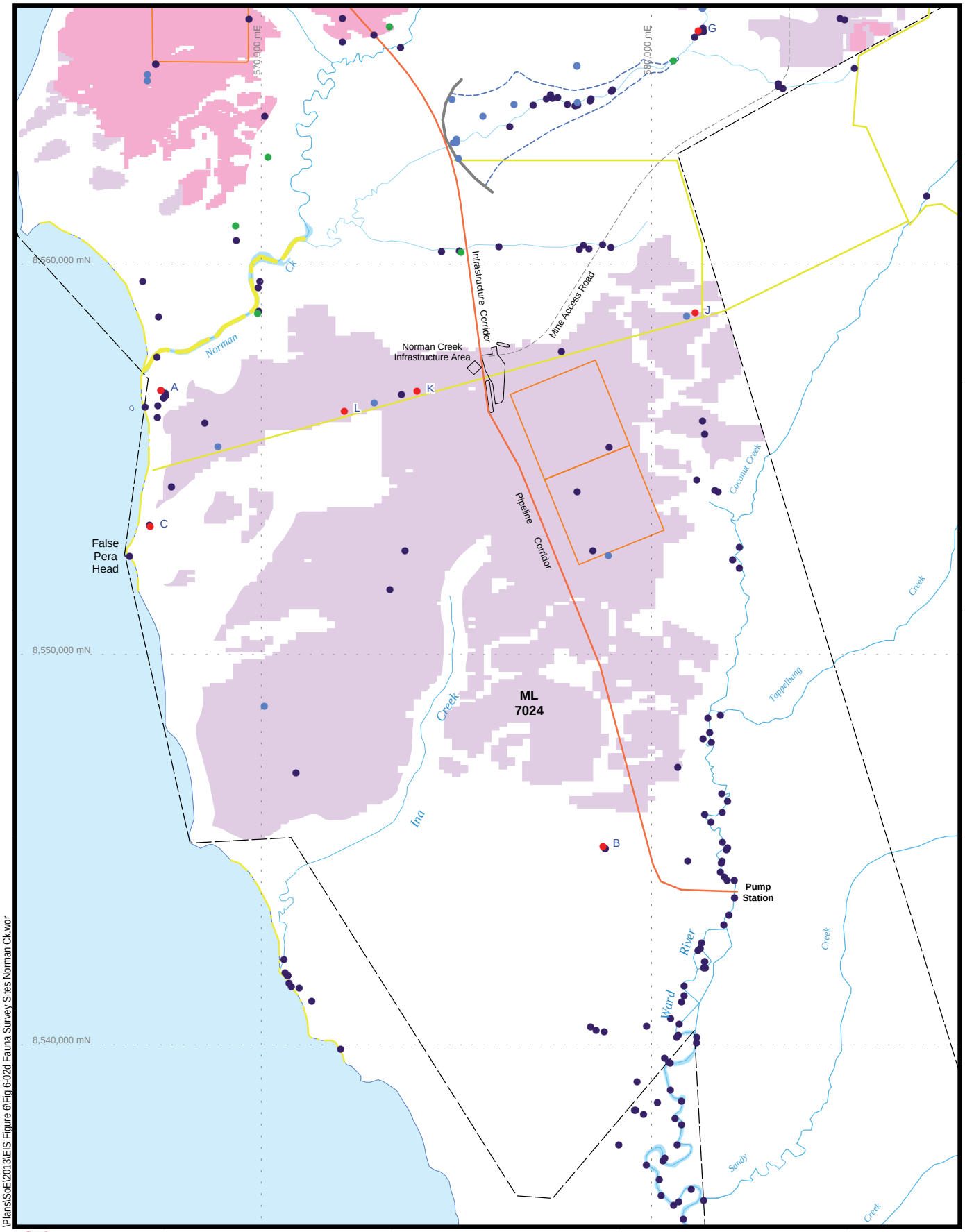
South of Embley Project

Fig. 6-2c: Fauna Survey Sites (Norman Creek East Mining Area)

N

1 0 1km

Datum/Projection: GDA94/MGA Zone 54 Date: 26/10/2012



RTA Mining Lease boundary
Locality
Road/track
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Comprehensive survey site (A - L)
Supplementary survey site
Targeted threatened fauna survey site
Bare-rumped Sheathtail Bat survey site

ATV beach traverse
Boat traverse
Vehicle traverse

Rio Tinto Alcan

South of Embley Project

Fig. 6-2d: Fauna Survey Sites (Norman Creek Mining Area)

N

1 0 1 2km

Datum/Projection: GDA94/MGA Zone 54 Date: 26/10/2012

\Plans\SoE\2013\EIS Figure 6\Fig 6-02d Fauna Survey Sites Norman Ck.wor

Table 6-4 Survey Suitability and Limitations for Threatened Terrestrial Fauna

Common Name	Detectability	Suitability of Survey Timing*			Suitability/Reliability of Survey Effort	Survey Limitations
		Mid dry season (July 2006)	Post wet season (May 2007, 2008 and 2009; June 2012)	Late dry season (December 2007 and 2008)		
Red Goshawk	Generally low detectability of individuals but nests are readily evident and have characteristic form. Large home ranges means very low population density within the landscape. Low detectability of individuals can be ameliorated by survey within the breeding season June-December (courting-fledging) and by use of static observation survey over high suitability habitat.	Good. Commencement of breeding season and courtship displays by adults.	Moderate. Detectability of individuals low but nests apparent.	Good. Likely maximum annual population level with addition of fledglings.	Survey effort = 482 hours, using various survey activities, over a five year period. Survey included targeted searches in most likely habitat and extensive vehicle traverses throughout Project area. Survey effort provided a suitable level of opportunity for encountering individuals or nests.	Some high suitability habitat areas on lower sections of all main drainages could not be readily accessed for survey. Due to the low topographic variability within the Project area there were few elevated vantage points for conducting static observations over high suitability habitat.
Masked Owl	Low detectability due to the low density at which it occurs and its cryptic nature. Use of call playback can increase the overall detectability of the species at certain times of the year.	Good. Potential breeding season and good timing for call playback.	Good. Potential breeding season and good timing for call playback.	Moderate. Outside breeding season; spotlight and night vehicle traverses still valid survey approach.	Survey included a combination of call playback in moderate suitability habitat areas and observational searches during spotlighting sessions and night vehicle traverses. Survey effort provided a suitable level of opportunity for encountering individuals.	Some moderate suitability habitat areas on lower sections of all main drainages could not be readily accessed for survey.

Common Name	Detectability	Suitability of Survey Timing*			Suitability/Reliability of Survey Effort	Survey Limitations
		Mid dry season (July 2006)	Post wet season (May 2007, 2008 and 2009; June 2012)	Late dry season (December 2007 and 2008)		
Northern Quoll	Moderate detectability in suitable habitat areas being fairly readily trapped in cage traps or large Elliot traps and potentially encountered during spotlight searches. The species may also be detected using hair tubes and motion cameras.	Moderate. Low adult population levels at this time.	Good. High adult population levels at this time and high activity by breeding adults.	Good. High population levels including last season's juveniles.	Survey included Elliot traps (Type A for smaller individuals); Hair tube traps; Cage traps (deployed during the preliminary survey events only); Spotlight sessions; and, Nocturnal vehicle traverses. Targeted surveys were undertaken in June 2012 using camera and cage trapping and October 2012 using camera traps. Survey effort was adequate given the lack of high suitability habitat areas where the species may be concentrated.	Cage traps not extensively used due to lack of high suitability habitat to guide deployment.

Common Name	Detectability	Suitability of Survey Timing*			Suitability/Reliability of Survey Effort	Survey Limitations
		Mid dry season (July 2006)	Post wet season (May 2007, 2008 and 2009; June 2012)	Late dry season (December 2007 and 2008)		
Bare-rumped Sheathtail Bat	Very low detectability due to the inability to identify the species from call recordings, and low trappability due to its apparent habitat of flying above the canopy in relatively tall woodland types.	Good.	Good.	Good.	A general bat survey (Anabat and ground Harp trap) was undertaken however it was difficult to target this species due to the lack of information on its call signature and its tendency for flying above the canopy. Targeted surveys were undertaken in June and October 2012. Harp traps and Mist nets were hoisted into gaps within the canopy in June 2012 (refer **Section 6.6.2**). Mist nets were hoisted into gaps within the canopy and set lower (approximately 7 metres high) in October 2012.	Ground level Harp trapping is not optimal for capturing individuals; however, the June 2012 survey method using high level Harp traps and Mist nets is optimal. Tree hollow inspections not undertaken due to elevated (inaccessible) height of most hollows (not possible to access safely).

* Key to suitability of survey timing: Poor - species with low or no detectability at this time. Moderate - species generally detectable at this time with appropriate survey approach. Good - species with high detectability at this time. Excellent - species almost certainly detected at this time.

6.3 Red Goshawk (*Erythrotriorchis radiatus*)

6.3.1 Species Profile

6.3.1.1 Regional Distribution and Population

The Red Goshawk is listed as 'vulnerable' under the EPBC Act.

The Red Goshawk occupies a wide distribution from northern Western Australia (WA) to northern New South Wales (NSW). Habitat utilised in northern Australia is described as tall open forest and woodlands traversed by waterways supporting gallery forest (Garnett *et al.* 2011). The species hunts in open forests/woodland and gallery forests, taking mostly medium to large birds (Czechura and Hobson 2000). The Red Goshawk is known to inhabit large home ranges of between 50 and 220km^2 in Queensland, with foraging activity occurring up to 8km from established nesting sites (Marchant and Higgins 1993).

The most recent population estimate of the Red Goshawk in Queensland is approximately 135-140 breeding pairs, with 65-70 breeding pairs estimated for the Cape York Bioregion (Czechura *et al.* 2010). Most records of the species on Cape York come from the central and eastern sections as shown on **Figure 6-1**. A report in 2010 of an individual from an unspecified location in the Weipa District confirmed the presence of the species in the Weipa Province of the Subregion (Czechura *et al.* 2010) and in August 2012 a pair of birds were sighted perching on the boundary of the East Weipa mine (F. Venter pers. comm., 23 Jan 2013). The species has been previously recorded in riparian gallery forest associated with the lower Wenlock River to the north of the Project area (Blandford and Associates 1994). It was also recorded in the open woodland of the Merluna Plain to the east of the Project area (Winter and Atherton 1985).

Observations of breeding pairs on Cape York indicates a mean distance between nest locations of 20km although smaller distances (10km) have been estimated for populations elsewhere in Queensland (Czechura *et al.* 2010) and this tends to agree with spacing implied by estimates of home ranges up to 220km^2 (Garnett *et al.* 2010, EPA 2006). Based on the estimated bioregional population of 65 to 70 breeding pairs and availability of potentially suitable habitat for the Red Goshawk in the Subregion (18% of the bioregion), it is estimated that the Subregion population could be up to 13 breeding pairs.

6.3.1.2 Regional Ecology and Habitat

Characteristics of known locations of the species on Cape York include extensive mosaics of undisturbed woodland and open forest vegetation with a strong affinity with riparian vegetation, streamlines and lakes (Czechura *et al.* 2010). Preferred nesting habitat appears to be woodland dominated or co-dominated by Darwin Stringybark (*E. tetrodonta*), Molloy Red Box (*Eucalyptus leptophleba*), Bloodwood (*Corymbia* spp.), and *Melaleuca* spp. Nest trees are restricted to trees taller than 20m located within 1km of, and often beside, permanent water (Aumann and Baker-Gabb 1991, Czechura *et al.* 2010).

In winter in eastern Australia, the birds appear to move from nest sites in the ranges to coastal plains, where they are associated with permanent wetlands and often feed on water birds (Czechura and Hobson 2000). It is likely that Red Goshawks also undertake this habitat shift on northern Cape York

as large numbers of waterfowl become concentrated on fewer wetland areas as wet season inundation recedes.

Records of prey items from nest sites reported in Czechura *et al.* (2009) did not identify any waterbird prey but potential seasonal predation of waterbirds may occur outside of the nesting season (e.g. later in the dry season).

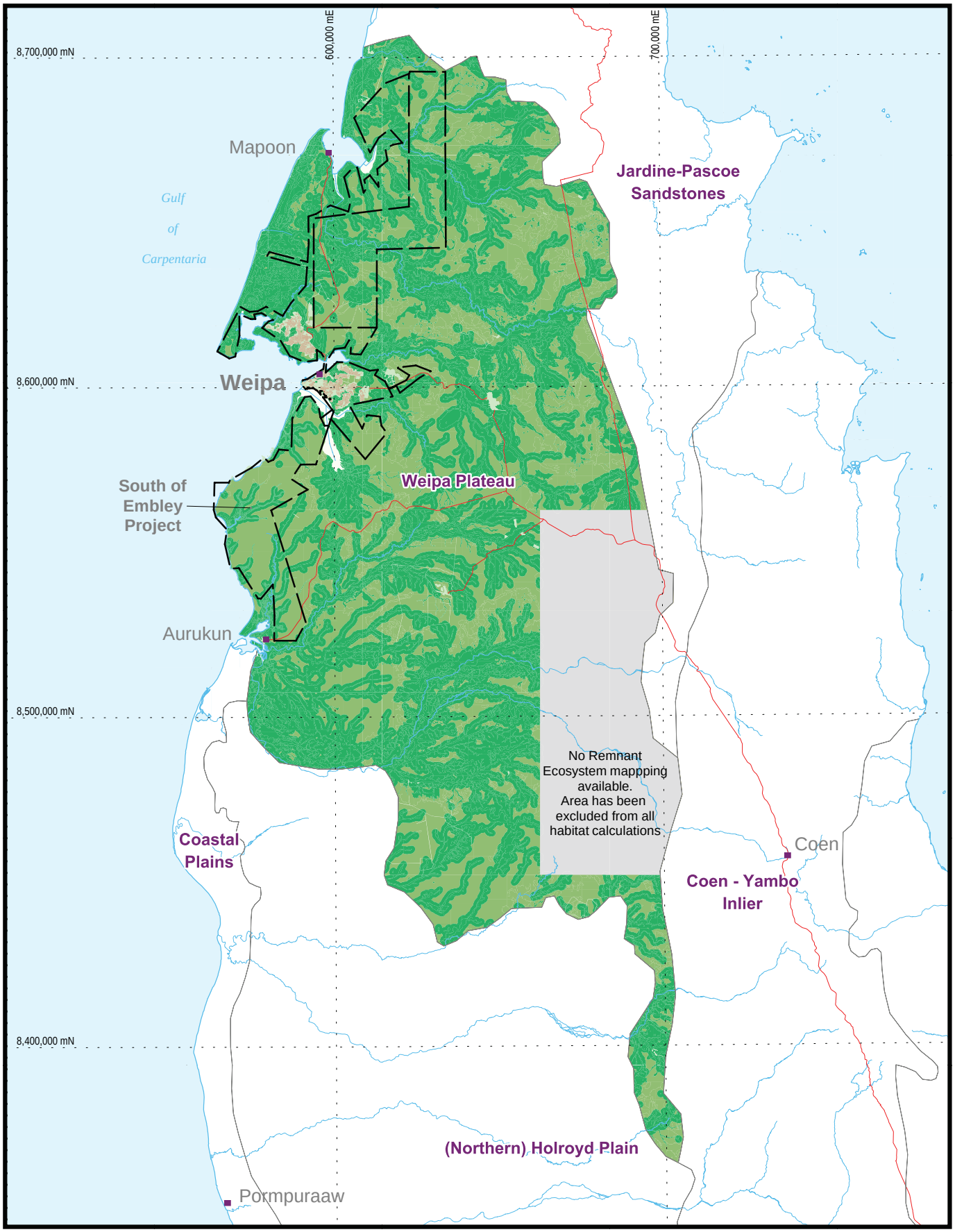
Potential habitat of the Red Goshawk in the Subregion is mapped in **Figure 6-3** and a summary of habitat mapping is provided in **Table 6-5**.

The Subregion contains over 1.4 million hectares of high suitability habitat and close to 850,000 hectares moderate suitability habitat. Habitat available in the Project area for this species is outlined in **Section 6.3.1.3**.

High suitability habitat comprises areas with woodland habitat mosaics particularly associated with riparian, wetland, coastal woodland complexes, and vine forest edges, and includes a 1km buffer of adjacent woodland surrounding permanent or near permanent waterbodies to accommodate potential nesting sites. This habitat is used primarily for nesting, breeding and the main focus of foraging.

Moderate suitability habitat comprises mosaics of medium-tall open forest and woodland located >1km from riparian, wetland or lake habitats but within foraging distance from high suitability habitat. This habitat is typically less productive in terms of prey availability and probably is only used intermittently and seasonally for foraging. For instance, the density of preferred bird prey species within extensive tracts of Darwin Stringybark woodland (RE 3.5.2) is low for most of the year but seasonal bursts of prey availability may occur when species such as the Rainbow Lorikeet, Little Friarbird and Noisy Friarbird are attracted to flowering events, or the Red-winged Parrot and Pale-headed Rosella are attracted to ripening seed capsules of canopy eucalypts. Red Goshawk's prey includes not only these large passerines, but also many (or even predominantly) non-passerines such as parrots, cockatoos and kookaburras (e.g. Czechura *et. al.* 2009, Debus 2012, Aumann and Baker-Gabb 1991, Ryan 2006, NSW National Parks and Wildlife Service, 2002, and Debus *et al.* 1988). The utilisation of moderate suitability habitat depends on the proximity to high suitability habitat, the main focus of hunting and breeding activity. Areas of moderate suitability habitat located beyond a reasonable foraging distance (>8km) from nest sites are unlikely to be used by breeding individuals. Similarly, non-breeding individuals rarely forage further than 8km from their preferred (high suitability) habitat (Marchant and Higgins 1993) possibly because the greater availability of prey within high suitability habitat.

Low/no suitability habitat is comprised of open treeless areas that do not support prey species, or extensive low productivity, homogenous woodlands located some distance (>8km) from riparian or wetland areas. This is based on observations of foraging distance from nest sites, where woodland areas more than 8km from preferred (high suitability) habitat are unlikely to be used by the Red Goshawk (Marchant and Higgins 1993, Czechura *et al.* 2009).



RTA Mining Lease boundary
Cape York Sub-Regions Boundary
Road/track
Locality
River

Red Goshawk Habitat

High Suitability Habitat
Moderate Suitability Habitat
Low / No Suitability Habitat
Suitable Rehabilitation
No mapping

South of Embley Project

Fig. 6-3: Potential Habitat of Red Goshawk (Weipa Plateau Subregion)

N

25 0 25km

Datum/Projection: GDA94/MGA Zone 54 Date: 17/09/2012

Table 6-5 Potential Habitat of Red Goshawk (Weipa Plateau Subregion)

Habitat Suitability Classes		REs and Other Map Units	Map Compilation
High	High suitability habitat comprises areas with woodland habitat mosaics associated with riparian, wetland, coastal woodland complexes, and vine forest edges, and includes a 1km buffer of adjacent woodland surrounding permanent or near permanent waterbodies to accommodate potential nesting sites.	3.1.1a 3.1.3 3.1.5 3.1.6 3.2.10c 3.2.2a 3.2.3 3.2.5a 3.2.7a 3.3.12 3.3.16 3.3.18 3.3.19 3.3.20a 3.3.20b 3.3.21 3.3.22a 3.3.23 3.3.24 3.3.25a 3.3.27c 3.3.28 3.3.31b 3.3.32 3.3.33 3.3.36 3.3.37a 3.3.37b 3.3.38 3.3.39 3.3.42a 3.3.44 3.3.49a 3.3.49b 3.3.50c 3.3.6 3.3.60a 3.3.61a 3.3.66x1b 3.5.4 3.7.1 REs containing permanent or near permanent water 3.3.10a 3.3.14a 3.3.5a 3.3.50a 3.3.63 3.3.64a 3.3.65 3.3.66a 3.3.66x1a 3.3.9 estuary water	High suitability habitat includes all areas mapped as high suitability REs* plus a 1km buffer around RE's containing permanent or near permanent water to accommodate potential nesting within 1km of a permanent watercourse.
Moderate	Mosaics of medium-tall open forest and woodland located adjacent to high suitability habitat but within foraging distance (<8km) from potential nests located within high suitability habitat.	3.10.10 3.10.15b 3.10.21a 3.10.21c 3.10.6a 3.10.6d 3.10.9e 3.11.7 3.11.11 3.11.17b 3.12.14c 3.12.33a 3.2.25 3.5.10 3.5.10x1 3.5.11 3.5.14b 3.5.14c 3.5.18x2 3.5.19x3 3.5.2 3.5.22a 3.5.22c 3.5.22d 3.5.22x2 3.5.24a 3.5.24b 3.5.26 3.5.28 3.5.7a 3.5.7x2a 3.5.7x2b 3.5.8a 3.5.8c 3.5.9a 3.5.9d 3.7.3 3.7.4 3.7.5a 3.7.5b 3.7.6 3.7.6b 3.9.2a 3.9.2b 3.9.2x4 3.9.4 3.9.5 3.9.7	Areas of most other woodland types in the Subregion were identified as moderate suitability habitat but only a band of these habitats within 8km of high suitability habitat were mapped as moderate suitability habitat. The 8km area allows for foraging of individuals from a focal home range point located within high suitability habitat.
Low/No	Open treeless areas or extensive homogenous habitat areas of low productivity without riparian features.	3.3.53x1 3.3.56 3.3.56a 3.5.19x4 3.5.19x7 3.5.29 3.9.8a non-remnant vegetation, rock, sand	A small number of heath and grassland RE's were identified as low or no suitability habitat for the species, and any other habitat areas located further than 8km from a high suitability habitat were mapped as low/or no suitability due to the large foraging distance from high suitability habitat. Note that some areas of these RE's occur as minor components in mixed RE polygons and in this case may be mapped as part of moderate habitat suitability areas.

Note: RE's with an 'x' denote a subdominant vegetation type following the 'x'

*See footnote in **Section 6.1.2** regarding display of areas mapped as multiple RE types

6.3.1.3 Potential Project Area Distribution, Ecology and Habitat

Based on the observed habitat characteristics of the Red Goshawk on Cape York Peninsula, the Project area potentially provides suitable habitat for the species given the mosaic of open forest, woodland, riparian and wetland habitats that occur along the main drainage systems in the area. Notably, nesting locations of the species throughout its range appear tightly associated with permanent water bodies (Czechura *et al.* 2010). The estuaries of the Embley River, Ward River and Norman Creek provide permanent wetland habitat and many open wetlands on the lower sections of drainage systems persist for the majority of the year; however given the generally small size of the catchments in the Project area and the highly seasonal rainfall of the region, many of the smaller streams and depressional swamps do not contain permanent aquatic habitats (refer **Section 4.2.1.4**). Semi-permanent groundwater discharge is observed to maintain streamflows and wetland water levels beyond the wet season period at many sites. The larger Norman Creek system includes perennial stream reaches and aquatic refugia and supports a host of aquatic habitat types including streams, tree swamps, sedge swamps, lagoons and lakes.

It is most likely that wetlands of the lower Ward River area (located immediately downstream of the Project area) provide the best potential areas of dry season foraging for the species as they support a greater abundance of these wetland habitats compared to areas within the Project area. However, the main drainage systems of the Project area (Ward River, Norman Creek and Winda Winda Creek) provide a favourable habitat mosaic for the Red Goshawk, including *Corymbia* dominated woodlands on upper (seasonal) drainage lines and colluvial areas (RE 3.3.21), riparian gallery forest, *Melaleuca* wetlands, seasonal freshwater wetlands on marine plains, mangrove communities, and adjacent tall-very tall Darwin Stringybark woodland.

Habitat assessment was undertaken to develop maps of likely potential habitat within the Project area. These habitat maps provide a greater level of detail than the potential habitat maps for the Subregion as they incorporate site specific information regarding the key habitat and resource requirements for the species.

Suitable habitat for the species exists within the Project area comprising predominantly habitat mosaics associated with the major drainage systems where nesting and main foraging is likely to occur (high suitability habitat), and the more extensive tracts of Darwin Stringybark dominated woodland that is likely to be used to a lesser extent by the species for foraging and movement between high and moderate suitability habitat areas. An expert review of the potential presence of the species within the Project area (Debus 2012) confirmed the high suitability and likely preferential use of non-Darwin Stringybark woodland habitat associated with drainage lines, wetlands and coastal woodland, and the lower suitability of more extensive Darwin Stringybark woodland on the bauxite plateau. A copy of this expert review is included in **Appendix 6-A.** These potential habitat areas are discussed in more detail and presented in **Figure 6-4** and **Table 6-6**. Critical habitat is habitat that the Minister has listed in the Register of Critical Habitat (prepared under Section 207A of the EPBC Act) in relation to an EPBC-listed species or ecological communities. DSEWPaC's Register of Critical Habitat does not identify any critical habitat for the Red Goshawk.

Given the disposition for the species to nest in tall trees within 1km of a permanent water body, it is possible that nests of the species could be located within Darwin Stringybark open forest adjacent to permanent water or coastal habitats, or adjacent to seasonally inundated wetlands or perennial/semi-perennial watercourses with near permanent water supporting riparian gallery forest within the Project area.

With respect to the potential population of Red Goshawk within the Project area, assuming a similar density to that estimated in the Subregion (Czechura *et al.* 2010), the Project area could support a maximum of two breeding pairs.

RTA Mining Lease boundary
Locality
Road/track
River
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Red Goshawk Habitat

High Suitability Habitat
Moderate Suitability Habitat
Low / No Suitability Habitat
Suitable Rehabilitation

Comprehensive survey site (A-L)
Supplementary survey site
Targeted threatened fauna survey site

ATV beach traverse
Boat traverse
Vehicle traverse

South of Embley Project

Fig 6-4: Potential Habitat of Red Goshawk (Project Area)

N

5 0 5km

Datum/Projection: GDA94/MGA Zone 54 Date: 31/10/2012

Table 6-6 Potential Habitat of Red Goshawk (Project Area)

Habitat Suitability Classes		**RE's and Other Map Units**	**Map Compilation**
High	High suitability habitat comprises areas with woodland habitat mosaics associated with riparian, wetland, coastal woodland complexes, and vine forest edges, and includes a 1km buffer of adjacent woodland surrounding permanent or near permanent waterbodies to accommodate potential nesting sites.	3.1.1a 3.1.1c 3.1.3 3.1.5 3.1.6 3.2.10c 3.2.2 3.2.3 3.2.5a 3.3.21 3.3.49b 3.3.60a 3.3.61 3.5.11 3.5.22c 3.5.4 Permanent or near permanent water RE's 3.3.14a 3.3.5a 3.3.50a 3.3.63 3.3.64 3.3.65 3.3.9 estuary water	All high suitability RE's were mapped as high suitability habitat plus a 1km area around RE's containing permanent or near permanent water to accommodate potential nesting within 1km of a permanent watercourse.
Moderate	Mosaics of medium-tall open forest and woodland located adjacent to high suitability habitat but within foraging distance from potential nests located within high suitability habitat.	3.2.25 3.2.6a 3.5.2 3.7.3	Areas of most other woodland types in the Project area were identified as moderate suitability habitat but only a band of these habitats within 8km of high suitability habitat were mapped as moderate suitability habitat. The 8km area allows for foraging of individuals from a focal home range point located within high suitability habitat. Within the Project area the coalesced areas of moderate habitat occupied all areas not already mapped as high suitability habitat.
Low/No	Open treeless areas or extensive homogenous habitat areas of low productivity without riparian features.	Non-remnant vegetation, rock, sand	No low/no suitability habitat appears on the map as all areas are covered by either high or low suitability habitat.

The Queensland EIS recorded the full suite of fauna identified during fauna surveys (refer Section 7.15.1 and Appendix 7F of the Queensland EIS (RTA 2011)). By comparing the reported prey species for Red Goshawk (refer **Section 6.3.1.2**) with the species recorded in the Project area, a list of potential prey species was developed for the Project area (**Appendix 6-B**). The analysis confirms the presence of 85 known or probable prey species in the Project area, with 37 species occurring in Darwin Stringybark open forest and 71 species in riparian/swamp habitats.

6.3.1.4 Threats

Habitat clearing is the major known threat to the Red Goshawk (EPA 2006) and has impacted on the density of individuals in the southern parts of its Queensland range (Garnett *et al.* 2010). Other commonly identified threats to the species (DSEWPaC 2012q, EPA 2006, Czechura *et al.* 2010) include:

- human disturbance including illegal egg collection, disturbance by bird watchers and intentional killing of adults;
- overgrazing, woody thickening of open woodlands, or other changes in land management which could reduce prey availability, and therefore reduce productivity;
- logging of potential nest trees;
- degradation of wetlands which provide seasonal foraging habitat;
- altered fire regimes which have the potential to impact breeding sites and reduce prey availability, thus reducing productivity;
- the occurrence of a catastrophic event which may exaggerate the impact of existing threats; and,
- possible genetic bottlenecks in the population.

The application of persistent organochlorine pesticides may have caused a historic reduction in the population (DSEWPaC 2012q). In 1989, Australia ceased widespread use of organochlorine pesticides and most affected species have now recovered.

6.3.2 Survey and Results

6.3.2.1 Survey Approach

Specific survey efforts and results for the Red Goshawk are detailed below. The suitability of survey timing and species-specific limitations of the survey approach are presented in **Table 6-4** in **Section 6.2**.

The Red Goshawk has low detectability due to the low density at which it occurs and its secretive habits of perching within the foliage of trees when at rest, and hunting within or just above the woodland canopy. These factors combine to make the species difficult to detect even when in close proximity.

The primary challenge for field surveys was to provide meaningful survey effort for the species across the large Project area. The survey approach adopted for the Red Goshawk sought to maximise the opportunity of identifying the species in the wider Project area combined with intensive observation and traverses within areas most likely to support foraging and nesting by the species including future mining areas. This survey approach was similar to that employed in the broader Cape York region by Czechura *et al.* (2010) and was in accordance with the Queensland Government's requirements which were stated in the *Terms of Reference for an environmental impact statement – South of Embley Project* (Queensland Government 2009).

Specifically, the survey approach comprised targeted searches for nests and flying individuals within the habitat mosaics associated with the Norman Creek and Ward River systems and throughout the Darwin Stringybark woodlands (including future mining areas), complemented by survey activities undertaken as part of the overall fauna survey program that provided opportunities for observing the species or nests of the species in the wider Project area.

With respect to the targeted survey effort, on advice from G. Czechura (pers. comm.), areas where there were hot spots of raptor activity or a mosaic of different habitat types were identified as ideal locations for observing the Red Goshawk, if present.

In addition, the Red Goshawk is known to target wetland areas for foraging during winter in south east Queensland, and consequently, wetland areas were targeted during searches, especially during the dry season survey events.

The *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a) provides a recommended survey approach for the Red Goshawk focussing on searches for characteristic nests, but potentially also including observations for birds from elevated vantage points, and call playback surveys. The recommended survey effort is 50 hours of searches over eight days for a 50ha area, with the potential use of vehicles during searches. When surveying a site significantly larger than 50ha the survey guidelines recommend that an appropriate sampling approach be developed to focus the survey effort, and the approach be discussed with DSEWPaC.

The survey approach (for surveys prior to 2012) over the large Project area was not discussed with DSEWPaC prior to the survey being undertaken as it was carried out prior to the release of the survey guidelines. The guidelines recommend "focusing search effort on favoured habitat can be a valuable strategy to maximise the likelihood of detecting target taxa". The survey utilised a sampling approach in favoured habitats as recommended by the guidelines. The guidelines do not specify a particular season for survey but note that some success with call playback survey during the breeding season has been obtained. The 2012 survey plan was sent to DSEWPaC for comment prior to surveys being undertaken.

Targeted surveys were carried out during six survey events over a total period of 50 days between December 2007 and October 2012. **Table 6-7** summarises the survey effort for the Red Goshawk undertaken during all surveys. Survey activities appropriate for the Red Goshawk included extensive foot traverses along the major drainage systems and within Darwin Stringybark communities; terrestrial vehicle traverses throughout the future mining areas; coastal observations with a spotting scope; the boat-based observational transect in Norman Creek; all-terrain vehicle (ATV) traverses of beach habitats, and call playback surveys. The coastal and beach observation activities were relevant for the Red Goshawk as the highest raptor activity was consistently evident within coastal areas.

Foot traverses undertaken during targeted surveys provided the greatest level of survey effort for the Red Goshawk and focussed on likely wetland and riparian habitat that was not accessible by vehicle. The October 2012 foot traverses focussed on the Darwin Stringybark woodlands within future mining areas. Traverses were undertaken during morning and afternoon, providing coverage of the period detailed in the survey guidelines (DEWHA 2010a) when individuals are most likely to be flying (1200 - 1600 hours). A total of approximately 185.5 hours of foot traverses were undertaken in habitats where the Red Goshawk may occur. Vehicle traverses were also conducted on 41 of the 50 targeted survey days and provided additional opportunities to detect the Red Goshawk particularly when accessing targeted survey areas along drainage systems. Vehicle traverses during targeted surveys totalled approximately 116 hours with the remaining targeted survey activities providing an additional 65.6 hours of observations.

Bird searches and vehicle traverses (including travel to and from sites) undertaken during the comprehensive surveys (May 2008 and May 2009) contributed 72 hours of effort, with another 67 hours of survey effort appropriate for the Red Goshawk employed during supplementary surveys (July 2006 and May 2007).

Overall, a total of approximately 482 hours of survey effort appropriate for the Red Goshawk was employed across all surveys.

Table 6-7 Survey Effort for Red Goshawk

Survey activity	No. days /no. sessions	Duration of each survey activity (average hours)	Total survey effort for activity (hours)
Targeted threatened fauna surveys – December 2007/2008, May 2008/2009, June 2012, October 2012 - total survey period of 60days*			
Foot traverses	43 sessions	4.3 hours	185
Coastal observations	6 days	average 4 hours/day	24
ATV beach traverses	2 sessions	4 to 5.5 hours	9.5
Boat traverse of Norman Creek	1 session	6.5 hours	6.5
Vehicle traverses	41 days	average 2.8 hours/day	116
Call playback	7 sessions	0.3 hours (20 minutes)	2.1
		Total for Targeted threatened fauna surveys	300
Comprehensive surveys – May 2007, May 2008 - total survey period of 16 days*			
Bird searches	24 sessions	1 hour	24
Vehicle traverses	16 days	average 3 hours in daylight/day	48
		Total for Comprehensive surveys	*72*
Supplementary surveys (July 2006, May 2007, May 2008) - total survey period of 12 days*			
Bird searches	10 sessions	1 hour	13
Vehicle traverses	12 days	average 3 hours in daylight/day	36
Foot traverses	3 sessions	Average 6 hours/day	18
		Total for Supplementary surveys	*67*
		Grand Total	482

** Only the components of the total survey period that are applicable to the Red Goshawk are presented in this section of the table.

When conducting the comprehensive surveys considerable time was spent travelling to and from survey sites from base camps within the Project area. The two person survey team used these journeys as observational traverses for more mobile and larger fauna, particularly raptors, and a large number of raptor individuals were observed during traverses. For each day of the comprehensive surveys, approximately three hours were spent on vehicle traverses during daylight hours, with the majority of the traverses through Darwin Stringybark woodland. The detectability of raptors from a moving vehicle is lower than for walked traverses; however, much greater spatial survey coverage is achieved. The comprehensive surveys also included morning bird searches (2 x 1 hour duration) at each of the twelve sites which provided intensive search time for the Red Goshawk within both high suitability and moderate suitability habitats.

Foot based searches and traverses provide intensive survey effort for individuals over a smaller area than that covered by vehicle, but focused on high suitability habitat. Bird observations during comprehensive surveys (May 2007 and 2008) provided 24 hours of intensive survey effort, with another 48 hours of vehicle traverses.

In addition to the survey effort for the Red Goshawk during the targeted and comprehensive surveys, some of the supplementary survey activities undertaken for the Project were conducted in high suitability and moderate suitability habitat over six days in July 2006 and six days in May 2007 and also provided substantial field time for the detection of the Red Goshawk using a similar suite of activities.

An additional site visit by the ecologists responsible for the EIS surveys was conducted in September 2009 within the northern section of the Project area as part of the exploration program. This visit provided an additional opportunity for incidental observations of individuals or nests of the species. Five days of vehicle and foot traverses were conducted in a variety of habitats (including wetlands and riparian habitat) where the Red Goshawk may have been detected (note this survey effort is not numerated in **Table 6-7** or indicated in **Figure 6-2**).

Field surveys were conducted during the months of May, July, October and December. The breeding season for the Red Goshawk in northern Australia is between May and December (DEWHA 2010a), with fledglings reported in early November to early December (Czechura *et al.* 2009). The October and December surveys were valuable in that they coincided with the end of the breeding season when any population of the Red Goshawk (if present) would have been highest, with the addition of juvenile individuals. Fledgling birds are known to stay around the nest site for a month or more (DEWHA 2010a) and remain dependent on their parents for between two and five months after fledging (Debus 1998).

6.3.2.2 Survey Results

No individuals or nests of the Red Goshawk were located in the Project area during field surveys and there are no previous records of the species from within the Project area. Given that the species was not observed during field surveys over five years, it is unlikely that the Red Goshawk is abundant within the Project area (it would be more readily detectable in this case). Thus one or two pairs of birds would be a reasonable maximum population number. However, based on the survey results where no individuals were detected, it is also possible that the Project area is not occupied by breeding birds and may only be utilised intermittently by non-breeding adults or dispersing juveniles or alternatively, is not utilised by the species at all. As noted in **Sections 6.3.3.1** and **6.3.3.2**, the proposed disturbance area of high suitability habitat is significantly less than one home range.

There is very little known about the Red Goshawk population in Northern and Western Cape York Peninsula. Under such data deficient circumstances, any sightings of the Red Goshawk in a newly explored area would constitute an “important population” under the meaning of the EPBC Act, since they extend the known limit of the species distribution. Similarly, any confirmed sighting of the Red Goshawk within the Project area would be regarded as an important population. However, if subsequent systematic survey for the species revealed a wider distribution through Northern Cape York Peninsula, then the important population status of the Project area (if the species was to occur) may no longer apply.

Similarly, in the absence of firm data on the distribution of the species on Western and Northern Cape York, any Red Goshawk population confirmed within the Project area would be regarded as a regionally significant population as it may represent a disjunct population or a distributional limit for

the species. Should the Red Goshawk be found during future systematic survey for the species in as yet unsurveyed areas of western and northern Cape York Peninsula during government surveys or baseline surveys by proponents for other projects, then the relative significance of the Project area for the species (if it was to occur) would be diminished.

Although not required by the *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a), the baseline surveys for the Queensland EIS recorded common species (refer Sections 7.13 - 7.15 and Appendix 7F of Queensland EIS, (RTA 2011)), including species that are prey for the Red Goshawk.

Table 6-8 summarises the profiling information for Red Goshawk incorporating the results of fauna surveys.

6.3.3 Relevant Impacts

The following sections outline the potential construction and operational impacts of the Project on the Red Goshawk.

6.3.3.1 Construction Impacts Prior to Mitigation

As discussed in **Section 6.3.2**, the Red Goshawk was not found within the Project area during five separate surveys over a total of 41 targeted survey days, nor has it been reported in the literature as found in the Project area. However, the areas impacted during construction (specifically the Dam C footprint and infrastructure crossings of streams) would disturb 961ha of high suitability habitat for the species. High suitability habitat is the habitat most likely to be utilised for foraging, breeding and shelter. Construction of the Port, Boyd infrastructure area and TSF would disturb 1,483ha of moderate suitability habitat, predominantly Darwin Stringybark dominated forest or woodland.

As shown in **Table 6-9** the total area of disturbance of high suitability habitat during construction would be approximately 961ha which is small compared to the estimated home range (20,000ha) of an individual Red Goshawk (Garnett *et al.* 2011, EPA 2006). The disturbance area represents less than 2.5% of the total area of high suitability habitat within the Project area and <0.1% of the potential high suitability habitat in the Subregion and is therefore a minor component of the habitat for the species.

As shown in **Table 6-9**, approximately 1,483ha of moderate suitability habitat for the species would be disturbed for construction. This represents a small proportion of the overall extent of potential moderate suitability habitat identified for the species in the Project area (2.4%) and Subregion (0.2%).

It is unlikely that the species would nest in moderate suitability habitat as by definition it is located more than 1km from permanent or near permanent water and associated wetland and riparian ecosystems (which is where known Cape York nest sites are exclusively found (Czechura *et al.* 2010)). Furthermore, this moderate suitability habitat is likely to be used less intensively for foraging than high suitability habitat given the relatively low availability of prey in this type of habitat. It is anticipated that, if the Red Goshawk were present, foraging in this habitat would be both spatially and temporally intermittent, as known prey species are only seasonally present in significant numbers in response to flowering events within the woodland. Given the low intensity of use and that any individuals within the disturbed areas would be able to relocate foraging effort to adjacent undisturbed moderate suitability habitat or similar habitat elsewhere in the Project area, it is not anticipated that the displacement of this type of habitat would have any relevant impact on the species if it was present.

Table 6-8 Profile Summary for Red Goshawk

Species **Common Name**	**Key Resources**	**Potential Habitat within Project area**			**Known / estimated Population in Project area**	**Likelihood of Occurrence within Project Area**
		High Suitability Habitat	**Moderate Suitability Habitat**	**Low / no Suitability Habitat**		
Erythrotriorchis radiatus Red Goshawk	Mosaic of open forest/woodland/ riparian/wetland habitats close to permanent water. Trees >20m high for nesting within 1km of a permanent watercourse or wetland. Abundance of moderate sized bird prey.	Habitat mosaics associated with the main drainage systems of the Project area (Ward River, Norman Creek, Winda Winda Creek) including *Corymbia* dominated woodlands on upper (seasonal) drainage lines and colluvial areas (RE 3.3.21), riparian gallery forest, *Melaleuca* wetlands, seasonal freshwater wetlands on marine plains, mangrove communities, and adjacent very tall Darwin Stringybark woodland.	More extensive tracts of Darwin Stringybark dominated woodland and open forest and associated woodlands located between 1km and 8km (maximum foraging distance) away from drainage line habitat mosaics (high suitability habitat).	None present, all parts of the Project area are within foraging distance of high suitability habitat.	Estimated 0- 2 breeding pairs or, 0-2 non-breeding adults or juveniles.	**Mining Area** **Possible:** the open forests of the mining area and adjacent habitats constitute potential foraging habitat for the Red Goshawk, although no sightings of the Red Goshawk were made during surveys. Darwin Stringybark woodlands within 1km of permanent water could be used for nesting. It is possible that nests of the species could occur within proposed mining areas. **Infrastructure footprint** **Possible:** no nests were located within the proposed dam site. However, the Dam C site contains potential foraging and nesting habitat. **Balance of Project area not disturbed** **Possible:** the open forest, woodland, riparian, and wetland habitats that occur throughout the Project area, present suitable nesting and feeding opportunities for the species.

Table 6-9 Habitat Disturbance for Red Goshawk

Phase		High Suitability Habitat				Moderate Suitability Habitat				Low / No Suitability Habitat			
		Total in Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion	Total in the Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion	Total in Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion
Total Habitat		**38,505**	**100.0%**	**1,421,675**	**100.0%**	**61,441**	**100.0%**	**849,624**	**100.0%**	**631**	**100.0%**	**2,210**	**100.0%**
Undisturbed		**33,606**	**87.3%**	**1,416,776**	**99.7%**	**36,682**	**59.7%**	**824,865**	**97.1%**	**631**	**100.0%**	**2,210**	**100.0%**
Disturbed	Construction Disturbance	961	2.5%	961	<0.1%	1,483	2.4%	1,483	0.2%	0	0.0%	0	0.0%
	Operations Disturbance	3,938	10.2%	3,938	0.3%	23,276	37.9%	23,276	2.7%	0	0.0%	0	0.0%
	Total Disturbed	**4,899**	**12.7%**	**4,899**	**0.3%**	**24,759**	**40.3%**	**24,759**	**2.9%**	**0**	**0.0%**	**0**	**0.0%**

The discrete areas of disturbance of potential Red Goshawk habitat resulting from construction are small, representing only 2.5% of the high suitability habitat and 2.4% of the moderate suitability habitat in the Project area. Construction activities are not anticipated to result in a barrier to movement or cause any impacts on accessibility to nearby habitat areas as the species is highly mobile.

Construction of Dam C would disrupt the riparian corridor along the middle branch of Norman Creek. This may force any Red Goshawks that use this area to alter movement patterns in this area; however, habitat continuity around the dam impoundment would be provided by a minimum 200m SoE environmental buffer from mining from the full supply level of the impoundment. The Red Goshawk is a highly mobile species and would be able to utilise peripheral habitat around the Dam C impoundment to maintain connectivity upstream and downstream of the dam. Clearing of habitat within the Dam C area and infrastructure crossings of streams is not anticipated to cause any impacts on accessibility to nearby habitat areas by this highly mobile species.

While all terrestrial fauna are susceptible to road kill to some extent, it is not anticipated that the Red Goshawk would be at substantial risk of collision with construction vehicles given the relatively low number of vehicle movements expected (including a peak of 70 vehicles per day on the PDR from the Archer River Quarry, which would be utilised subject to suitable commercial agreement), and the preference for the species to hunt within treed habitat areas.

With respect to altered light regimes near construction areas, the Red Goshawk is a primarily diurnal predator so there would be a negligible effect on foraging from artificial lighting. No nests of the species were located within infrastructure areas, or any other Project areas, so breeding effort would be unlikely affected by construction related lighting. Birds seeking roosts may be deterred by construction lighting; however extensive alternative roost habitat occurs throughout the Project area. Light from construction areas is likely to be attenuated in a short distance within the tall woodland where the species prefers to nest and roost.

Anticipated increases in noise and air emissions are relatively minor and localised. No nests of the species were located in the vicinity of proposed infrastructure areas where noise levels and air emissions would be highest. The species is highly mobile with a very large home range and foraging and roosting birds that are deterred by local emissions would be able to utilise extensive alternative habitat that occurs throughout the Project area. Additional details on air and noise impacts are provided in **Sections 14.3** and **15.2** respectively.

The Project is unlikely to lead to the introduction of any invasive fauna that would affect the Red Goshawk.

Construction activities could potentially lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If allowed to proliferate within undisturbed habitat of the Red Goshawk, these weeds could lead to an increase in fire intensity in woodland habitats (DEEDI 2011b, NTFRS 2003). This could adversely affect the breeding success and abundance of prey species by destruction of nest trees, and reduction in habitat productivity through alteration of natural vegetation characteristics from ground cover to canopy. Fire related reductions in the abundance of prey species would diminish the foraging value of the habitat for the Red Goshawk. In addition, frequent intense fires have the potential to enhance the decline of older large trees that are favoured as nesting trees by the Red Goshawk. Fire related impacts associated with the introduction of weeds are likely to be isolated to small areas given the typical patchy nature of weed infestations. The magnitude of such impacts is not anticipated to be especially large over

and above the current fire impacts evident within the Project area. Overall impacts associated with uncontrolled weed infestations would therefore be minor.

Hydrological changes resulting from construction activities are not anticipated to affect habitat utilised by the species. Additional details are provided in **Sections 16.2** and **16.4**.

Table 6-10 summarises the potential unmitigated construction impacts on the Red Goshawk.

Table 6-10 Summary of Construction Impacts Prior to Mitigation for Red Goshawk

Action / Issue	Summary of Potential Construction Impacts Prior to Mitigation
Direct Impacts	
Clearing and loss of habitat	Minor, long term. High suitability habitat would be permanently cleared primarily within the Dam C area and to a lesser extent along infrastructure corridors, and within the Boyd infrastructure area. The total area of disturbance (961ha) would be small compared to the home range of the species and represents a minor proportion (2.5% and <0.1%) of the total area of potential high suitability habitat for the Red Goshawk within the Project area and Subregion. Moderate suitability habitat for the species would be cleared in during construction but would represent a very small proportion (2.4% and 0.2%) of the overall extent of potential moderate suitability habitat identified for the species in the Project area and the Subregion. Given the low intensity of use and that any individuals would be able to relocate foraging effort to adjacent undisturbed moderate suitability habitat nearby or similar habitat elsewhere in the Project area, it is not anticipated that the displacement of this type of habitat would have an impact on the species if it was present in the area.
Edge effects	Negligible, short term. Edge effects are anticipated to be negligible given the small amount of high suitability habitat displaced and the negligible noise, light and air quality impacts.
Fragmentation of habitat	Negligible, long term. The small amount of fragmentation of habitat caused by clearing for construction would not affect this highly mobile species.
Effects on movement/breeding/ feeding patterns	Negligible, long term. Impacts to breeding and feeding would be minimal given the limited extent of high suitability habitat removed. Construction of Dam C and infrastructure crossings of streams would disrupt the riparian corridor along the middle branch of Norman Creek and may force Red Goshawks that are present to make minor adjustments to movement patterns in this area; however, they are highly mobile species and would be able to utilise peripheral habitat around the Dam C impoundment to maintain connectivity upstream and downstream of the dam.
Road Kill	Negligible, short term. It is not anticipated that the Red Goshawk would be at substantial risk of collision with construction vehicles given the relatively low number of vehicle movements expected and the preference for the species to hunt within treed habitat areas.
Altered light regime	Negligible, short term The Red Goshawk is primarily a diurnal predator so foraging would not be expected to be affected by artificial lighting. No nests of the species were located within infrastructure areas so breeding effort is unlikely to be affected by construction related lighting. Birds seeking roosts may be deterred by construction lighting; however extensive alternative roost habitat occurs throughout the Project area.

Action / Issue	Summary of Potential Construction Impacts Prior to Mitigation
Indirect Impacts	
Noise	Negligible, short term. Anticipated increases in construction noise are relatively minor and localised (refer **Section 15.2**).
Water Quality	Negligible, long term. Impacts on water quality are discussed in **Section 16.2.5**. There are no impacts on water quality anticipated that would indirectly impact the Red Goshawk through modification of habitat.
Air Quality	Negligible, short term. Temporary increases in dust levels associated with earth moving activities are expected but these would be very localised (refer **Section 14.3**).
Introduction of weeds and pests	Minor, long term. The Project is unlikely to lead to the introduction of any invasive fauna that could affect the Red Goshawk. Construction activities could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If introduced and allowed to proliferate, these weeds could increase fire intensities and adversely affect availability of prey and potential Red Goshawk nesting trees.
Altered hydrological regime	Negligible, long term. Impacts on the hydrological regime are discussed in **Section 16.2.3**. There is no significant change to wetland or riparian habitats that would be utilised by the Red Goshawk.
Altered fire regime	Minor, long term. Construction activities could have minor impacts if certain fire promoting weeds are introduced.

6.3.3.2 Operational Impacts Prior to Mitigation Measures

The majority of potential habitat to be disturbed during the operational phase of the Project is moderate suitability habitat for the Red Goshawk. Moderate suitability habitat is unlikely to be utilised for nesting and would generally be used for foraging opportunities; however, less intensively than high suitability habitat and would be only used seasonally. Specifically, while the mosaic of habitat types within high suitability habitat provide a range of foraging opportunities for the Red Goshawk throughout the year, the woodlands of moderate suitability habitat provide intermittent foraging opportunities in response to the discrete seasonal presence of prey species. Although seasonal foraging in moderate suitability habitat is important to the species, an extensive area of this type of habitat would remain undisturbed in the Project area (36,761ha) and provide ample opportunity for such foraging, should the species be present.

As shown in **Table 6-9**, approximately 23,276ha (37.9% of potential habitat available in the Project area and 2.7% of potential habitat available in the Subregion) of potential moderate suitability habitat would be progressively disturbed during operations over the life of the Project. Simultaneously, mined-out areas would be progressively rehabilitated and this would facilitate re-colonisation of prey species and reinstatement of foraging habitat for the Red Goshawk (refer **Figure 3-13a** to **3-13i**). This would minimise the net reduction in potential moderate suitability habitat. Although the overall productivity of these rehabilitated areas is unlikely to be as high as for undisturbed habitat, rehabilitated vegetation is known to provide seasonally elevated productivity related to flowering events that attract prey species such as the Rainbow Lorikeet (Winter and Alford 1999) (refer **Section 6.3.4.6** for rehabilitation data). The balance of the disturbance in the Project area (3,938ha) provides potential high suitability habitat which would be progressively disturbed during operations over the life

of the Project. These areas contain potential nesting habitat for the species, specifically, areas of Darwin Stringybark woodland within 1km of permanent water (Aumann and Baker-Gabb 1991, Czechura *et al.* 2010, DSEWPaC 2012q). As shown in **Table 6-9**, operations would progressively clear approximately 10.2% (3,938ha) of high suitability habitat within the Project area comprising 0.3% of the high suitability habitat within the Subregion. This represents a small proportion of potential nesting habitat within the Project area and given the anticipated low density of breeding pairs (1-2) potentially occurring within the Project area, substantial areas of nesting habitat would remain available to the species.

Based on observations of vegetation development in rehabilitated areas in the existing Weipa operations, it is anticipated that rehabilitated areas would typically commence to provide potential foraging habitat for the Red Goshawk (commence hosting known prey species) once they reach 5 to 10 years of age (M. Thomas pers. comm.) (refer to further information on suitability of rehabilitation for the Red Goshawk in **Section 6.3.4.6**). The largest area of un-rehabilitated land (approximately 9,000ha) would occur at about Year 30. The largest area of rehabilitated land less than 10 years old (9,000ha) would occur at about Year 45.

Table 6-11 presents estimates of Red Goshawk habitat suitability of rehabilitated areas and shows that almost all of the high and moderate suitability habitat cleared during construction and operations would be rehabilitated. At the end of operations, although a total of 4,899ha of high suitability habitat would have been disturbed, the impact would be mitigated through rehabilitation, providing 331ha of high suitability habitat and 4,433ha of habitat that would provide similar foraging opportunities as the existing moderate suitability habitat. Additional details on a typical estimated rehabilitation sequence are presented in **Section 3.10.4**.

Table 6-11 Red Goshawk Disturbance and Rehabilitation

Red Goshawk Habitat		**Area Disturbed (ha)**		**Rehabilitated To#**				
				High Suitability		**Moderate Suitability**		**Low/No Suitability**
Native Habitat Disturbed	High Suitability Habitat	**4,899**	=	331	+	4,433	+	135*
	Moderate Suitability Habitat	**24,759**	=	0	+	24,417	+	342*
	Low/No Suitability Habitat	-	=	0	+	0	+	0
Total Disturbed		**29,658**	=	**331**	**+**	**28,850**	**+**	**477**
			Difference (ha)	-4,568	+	+4,091	+	+477

* This area is within the footprint of permanent infrastructure (e.g. roads and the spillway of the dam), which may be retained for future use at the end of the life of the Project and are therefore assumed to provide low/no habitat for the Red Goshawk.
# The over-water surface area of Dam C, which may also be retained at the end of the Project life would provide high / moderate suitability foraging opportunities for the Red Goshawk and, for the purposes of this assessment, this area has been split 50% to high suitability and 50% to moderate suitability.

In conclusion, it is unlikely that progressive removal of high and moderate suitability habitat during operations would adversely affect any Red Goshawk individuals, should they be present.

Moderate suitability habitat within mining areas most likely provides a minor component of overall foraging activity and the species is capable of accessing similar areas of moderate suitability of habitat that would not be disturbed by mining. In addition, in the longer term as mining operations and subsequent rehabilitation proceeds, re-colonisation of prey fauna within rehabilitated areas would reinstate potential foraging habitat for the Red Goshawk (refer **Section 6.3.4.6** for rehabilitation data). Although the spatial and temporal pattern of prey availability in rehabilitated areas may be different to undisturbed woodland, all mined areas would support rehabilitation of a suitable age to support Red Goshawk prey species within a decade of the cessation of mining.

If nesting sites (within high suitability habitat) were to be displaced by the Project, there could be an impact on the breeding cycle as Red Goshawk breeding pairs can use the same nest site in successive years (EPA 2006) and therefore the adult birds would be forced to select an alternative site and build another nest (G. Czechura pers. comm.). More significantly, if a nest with eggs or chicks was disturbed during clearing, mortality of those individuals would occur plus potential disruption to the adults' subsequent breeding season. Mortality of juveniles or destruction of eggs would represent a moderate impact given the typically low population density of the species and the uncertainty as to the robustness of the regional population of the species (refer **Section 6.3.1** and **6.3.2**).

With respect to the displacement of breeding adults if an inactive nest was disturbed, it is anticipated that the pair would be capable of re-nesting within the same season or at least in the following season. Debus and Czechura (1988) reported that after clearing of habitat, one pair left their nest site and were presumed to have re-nested 5km away. Aumann and Baker-Gabb (1991) reported that following the failure of a nest the pair concerned constructed a replacement nest. The species is reported to build new nests within the vicinity of a previous nest and also construct new nests on top of the existing nest of other bird species including the Australian Magpie (*Gymnorhina tibicen*), Torresian Crow (*Corvus orru*) and Brown Falcon (*Falco berigora*) (EPA 2006). The species must also be adapted to respond to natural nest attrition. Red Goshawk nests in north-eastern Queensland were reported to be located 20–35m above the ground, toward the edge of the outer canopy of tall eucalypts occurring as emergents or on the edge of more open country (Czechura *et al.* 2010). Given the exposed position of nests and the frequency of cyclones in northern Australia, it is likely there would be some natural loss of nests or nest trees due to cyclones within the Project area, and intentional removal of inactive nests during clearing would be analogous to natural nest attrition.

The removal of nests once breeding activity has been completed is consequently regarded as a discrete, temporary minor impact that would require some response for affected birds, but would not permanently affect their occupation of a home range or subsequent breeding effort.

Clearing of habitat during the operational phase of the Project would be fragmented by progressive operational clearing but the network of proposed SoE environmental buffers, progressive rehabilitation and large areas of potential habitat that would not be disturbed would maintain a network of connected habitat. Overall, fragmentation of moderate suitability habitat may cause a minor impact as it may affect individuals' use of the area, but is not expected to permanently effect any local population of the species, if present. Sequential re-establishment of habitat on rehabilitation areas would redress fragmentation of original habitat over the long term.

With respect to altered light regimes in operational areas, the Red Goshawk is a diurnal predator so foraging would not be affected by artificial lighting. Birds seeking roosts may be deterred by artificial lighting; however, extensive alternative roost habitat occurs throughout the Project area, and light from mining and infrastructure areas is likely to be attenuated within a short distance. These incidental impacts would be limited to mining areas located adjacent to high suitability habitat and would only occur for the short periods of time when mining was occurring in these locations.

Anticipated increases in noise and air emissions are relatively minor and localised. The species is highly mobile with a very large home range and foraging and roosting birds that are deterred by local emissions would be able to utilise extensive alternative habitat that occurs throughout the Project area. Given the localised and relatively low level of noise, it is likely that nesting birds would be able to tolerate emissions which would be attenuated within short distances of woodland habitat. Any impact from noise and air emissions would be negligible and would only occur for the relatively short periods of time when mining was occurring in the area. Additional details on noise and air quality are included in **Sections 14.3** and **15.2**.

The operational phase of the Project is unlikely to lead to the introduction of any invasive fauna that could affect the Red Goshawk, but operational activities could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If introduced and allowed to proliferate within undisturbed habitat of the Red Goshawk, these weeds could lead to an increase in fire intensity in woodland habitats and subsequent changes to prey and nest tree availability (DEEDI 2011b, NTFRS 2003). This could result in localised minor impacts on the species.

Hydrological changes resulting from operational activities are not anticipated to lead to significant changes to wetland or riparian habitats that may be used by the species (refer **Sections 16.2** and **16.4**). Impacts to the availability of prey populations or habitat structure are not expected to occur.

Table 6-12 summarises potential unmitigated operational impacts on the Red Goshawk.

Table 6-12 Summary of Operational Impacts Prior to Mitigation for Red Goshawk

Action / Issue	Summary of Potential Operational Impacts Prior to Mitigation
Direct Impacts	
Clearing and loss of habitat	Moderate, long term. Operational clearing would be predominantly within moderate suitability habitat of the Red Goshawk rather than high suitability habitat which is the focus of breeding and foraging activity. The largest area of un-rehabilitated land (approximately 9,000ha) would occur at about Year 30. The largest area of rehabilitated land less than 10 years old (9,000ha) would occur at about Year 45. Approximately 3,938ha of high suitability habitat would be progressively cleared during operations representing 10.2% of the total area of high suitability habitat within the Project area and 0.3% of the potential habitat in the Subregion. The high suitability habitat to be disturbed comprises potential nesting habitat in Darwin Stringybark woodland. This represents a small proportion of potential nesting habitat within the Project area and given the anticipated low density of breeding pairs (1-2) potentially occurring within the Project area, substantial areas of nesting habitat would remain available to the species. At the end of operations, although a total of 4,899ha of potential habitat would have been disturbed, the impact would be substantially mitigated through rehabilitation. It has been demonstrated that a significant population of Red Goshawk prey fauna will re-colonise mine rehabilitation areas within 10 years of establishment, providing potential moderate suitability foraging habitat for the Red Goshawk. In summary, it is unlikely that progressive removal of Darwin Stringybark open forest for mining would significantly adversely affect any potentially occurring populations of the Red Goshawk as the moderate suitability habitat within mining areas most likely provides a minor component of overall foraging activity and the species is capable of accessing similar adjacent areas of moderate suitability habitat that would not be disturbed by mining. This minor impact would be mitigated by the mine rehabilitation program which would support a significant population of Red Goshawk prey fauna, thereby reinstating potential moderate suitability foraging habitat for the species.
Edge effects	Negligible, long term. Edge effects are anticipated to be negligible given the small amount of high suitability habitat displaced and the negligible noise, light and air quality impacts.

Action / Issue	Summary of Potential Operational Impacts Prior to Mitigation
Fragmentation of habitat	Minor, long term. Clearing of habitat during the operational phase would only affect 10.2% of the potential high suitability habitat available in the Project area and would not substantially fragment high suitability habitat. The more extensive areas of moderate suitability habitat that occur within the proposed mine plan (37.9% of the available potential moderate suitability habitat in the Project area) would be fragmented by operational clearing, but the network of proposed SoE environmental buffers and large areas of potential habitat that would not be disturbed would maintain a network of connected habitat.
Effects on movement/breeding/ feeding patterns	Moderate, long term Fragmentation of high suitability habitat, which would occur during the operational phase, is not anticipated to effect movement or foraging patterns within high suitability habitat. Movement and foraging patterns of individuals within moderate suitability habitat may be affected but this is not anticipated to lead to an overall adverse effect on the local population of the species. The area of potential nesting habitat which overlaps the proposed mining area would be approximately 3,938ha (10.2% of habitat available in the Project area) and there is a low possibility that nests could be disturbed during clearing. If the nests are active this could result in loss of eggs or chicks and disruption to the adults' breeding season. Mortality of juveniles or destruction of eggs would represent a moderate impact given the typically low population density of the species and the uncertainty as to the robustness of the regional population of the species. To address this concern, pre-clearing nest surveys are proposed and appropriate buffers and protection would be provided if any nests are found. With respect to any affected breeding pair, the disturbance of a nest would be analogous to natural nest attrition (e.g. cyclone loss) and is regarded as a temporary minor impact that would not permanently affect their occupation of a home range or subsequent breeding effort.
Road Kill	Negligible, long term. It is not anticipated that the Red Goshawk would be at substantial risk of collision with vehicles given the relatively low number of vehicle movements expected and the preference for the species to hunt within treed habitat areas.
Altered light regime	Negligible, short term. The Red Goshawk is primarily a diurnal predator so foraging would not be affected by artificial lighting. Birds seeking roosts may be deterred by lighting; however extensive alternative roost habitat occurs throughout the Project area, and incidental light from mining and infrastructure areas is likely to be attenuated within a short distance within the treed habitats where the species prefers to roost.
Indirect Impacts	
Noise	Negligible, short term. Increases in noise would be relatively minor and localised (refer **Section 15.2**).

Action / Issue	Summary of Potential Operational Impacts Prior to Mitigation
Water Quality	Negligible, long term. Impacts on water quality are discussed in **Section 16.2.5**. There are no impacts on water quality anticipated that would indirectly impact the Red Goshawk through modification of habitat.
Air Quality	Negligible, short term. Increases in air emissions would be relatively minor and localised (refer **Section 14.3**).
Introduction of weeds and pests	Minor, long term. The operational phase of the Project would be unlikely to lead to the introduction of any invasive fauna that could affect the Red Goshawk. Mining activities could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If introduced and allowed to proliferate, these weeds could increase fire intensity which may lead to localised impacts on prey and nest tree availability.
Altered hydrological regime	Negligible, long term. Impacts on hydrological regime are discussed in **Section 16.2.3**. There is no significant change to wetland or riparian habitats that would be utilised by the Red Goshawk.
Altered fire regime	Minor, long term. Mining activities could have minor impacts on the current fire regime if fire promoting weeds are introduced.

6.3.4 Avoidance, Mitigation, Enhancement Measures and Residual Impacts

Direct and indirect unmitigated impacts associated with the Project on the Red Goshawk are identified in **Table 6-10** and **Table 6-12**. The following mitigation and enhancement measures would reduce these unmitigated impacts.

- pre-disturbance surveys (refer **Section 6.3.4.1**);
- fire management program (refer **Section 6.3.4.2**);
- weed management program (refer **Section 6.3.4.3**);
- feral pig control program (refer **Section 6.3.4.4**); and,
- progressive rehabilitation (refer **Section 6.3.4.6**).

In addition to these mitigation and/or enhancement measures, the following avoidance measures would also reduce/avoid Project related impacts on the Red Goshawk.

- the proposed SoE environmental buffer system (refer **Section 6.3.4.5**); and,
- the general avoidance measures discussed in **Section 3.13** further reduce impacts by siting facilities in areas with less sensitive habitat.

An environmental management plan outline for the Red Goshawk which summarises these avoidance, mitigation and enhancement measures is provided in **Appendix 6-C**. The cost of key avoidance, mitigation and enhancement measures are summarised in **Appendix 5-B**.

Table 6-13 summarises potential unmitigated impacts determined to be minor, moderate or high and the associated avoidance, mitigation and enhancement measures and residual impacts on the Red Goshawk.

Table 6-13 Potential Impacts, Avoidance, Mitigation and Enhancement Measures and Residual Impacts for the Red Goshawk

Potential Impact	Unmitigated Impact Magnitude	Relevant Avoidance, Mitigation and Enhancement Measures	Residual Impact Magnitude
Loss of high suitability habitat and larger areas of moderate suitability habitat during construction and operation	Moderate, long term.	Progressive rehabilitation would limit the amount of habitat displaced at any one time. Most habitat would be rehabilitated at the end of mining. High suitability habitat within the Project area would be protected within the proposed SoE environmental buffers and managed for biodiversity values under weed, fire and feral animal management programs.	Minor, long term.
Introduction of weeds that may intensify fire impacts on foraging and nesting opportunities	Minor, long term.	Weed management program. Fire management program.	Negligible, long term.
Fragmentation of moderate and low/no suitability habitat during operation	Minor, long term,	Rehabilitation of mined areas would redress habitat fragmentation.	Minor, long term.
Potential disruption of active nests during construction and operation	Moderate, short term.	Pre-disturbance surveys for Red Goshawk nests undertaken in potential nesting habitat within the mine plan. Any active nests identified would be buffered until the end of the breeding season.	Negligible, short term.

6.3.4.1 Pre-disturbance Surveys

Pre-disturbance surveys for Red Goshawk nests would be undertaken within parts of the mine and infrastructure areas located within 1km of permanent water supporting riparian gallery forest or, Paperbark wetland; seasonally inundated coastal wetlands and seasonal water courses supporting riparian gallery forest; or an estuary (based on their preferred nesting habitat - Aumann and Baker-Gabb 1991, Czechura *et al.* 2010, DEWHA 2009a). If active Red Goshawk nests are found within these disturbance areas, a 200m buffer around the nesting tree would be excised from the mine plan and the nest monitored until completion of the breeding season, after which vegetation clearing activities would resume. This buffer distance agrees with the minimum buffer distance recommended by the EPA (2006), and is also consistent with recommendations associated with preventing illegal egg collection (Aumann and Baker-Gabb 1991) that prescribe removal of existing nests to encourage the pair to re-nest at a new location. Application of the buffer around known active nests would also mitigate potential impacts on breeding success of known nests associated with operational light emissions.

6.3.4.2 Fire Management Program

A fire management program would be developed in cooperation with Traditional Owners and the relevant WCCCC sub-committee to address the adverse aspects of the current fire regime within the Project area as part of the CHEMP. The fire management program would aim to conserve fire-sensitive flora and vegetation communities and promote overall vegetation diversity by reducing fire intensity and frequency and promoting a regime of early to mid dry season lower intensity burns with a lower frequency. This would be achieved by promoting a regime of planned early to mid dry season lower intensity burning, and suppression (where practicable) of inappropriate fires. These activities would be underpinned by establishment and maintenance of a network of fire breaks to facilitate effective control burns and provide opportunities for combating inappropriate fires.

Public access to the Project area would be controlled, which would help control the prevalence of unwanted fires, although unauthorised access to non-active sections of the Project area may result in the persistence of unauthorised fires, for which strategic fire suppression may be required. While these fire management principles would be applied across undisturbed areas of the Project area, specific controlled burning at a greater frequency would be required to protect infrastructure and rehabilitated areas from fire damage, but would be restricted to the vicinity of such assets.

6.3.4.3 Weed Management Program

With respect to potential weed impacts, a weed management program comprising monitoring and control components would be developed to prevent impacts on undisturbed vegetation. The main focus of the weed management program would be early detection and early control of any weed invasions. The weed management program would have the following attributes:

- the weed management program would be developed and implemented in the early stages of the Project;
- prior to the establishment of the mine access road, any vehicles travelling to the Project area that are deemed to be at risk from weed contamination would be required to be washed down for weeds;
- washdown facilities would be provided at the Humbug barge terminal and all vehicles thoroughly washed before transfer to the Hey River barge/ferry terminal and mine access road;
- runoff from wash-down facilities would be treated before being released;
- annual weed surveys would be conducted post wet season, targeting:
  - all operational areas (mining and infrastructure) and immediately adjacent ecosystems; and,
  - site access roads;
- periodic weed surveys would be conducted at least every three years, targeting:
  - habitats where key weed species are most likely to become established; and,
  - areas within the mining lease where there is high recreational visitation (especially riparian and wetland areas);
- detailed mapping of the above areas would form the basis of the weed management program and guide annual weed surveys;
- training courses would be conducted regularly for relevant mine personnel, highlighting significant weed species and basic identification features for weeds likely to be encountered on the site, to ensure staff have been provided with enough information to accurately identify weed species. Commonly this includes a combination of posters, a herbarium, newsletters and training packages;

- protocols would be established for easy reporting of weed occurrence by any personnel working on site and be of a format that encourages reporting;
- results of the weed survey and any weed reporting would be uploaded to the site GIS in a timely manner so that weed mapping is maintained as a live database; and,
- any weed infestation areas would have controlled access until appropriate treatment and suppression is complete and there is no risk of propagules being translocated.

6.3.4.4 Feral Pig Control Program

The feral pig control program developed in consultation with EHP (refer **Section 7.3.6.4**) would be further refined and implemented in consultation with the Traditional Owners. The program, which would focus on reducing feral pig numbers, would reduce pig damage to riparian and wetlands areas within the management zone that support potential prey for the Red Goshawk. This may lead to an improvement in the quality of these potential habitats and therefore providing greater numbers of prey species in these habitats for the Red Goshawk.

6.3.4.5 SoE Environmental Buffers

The disturbance of most potential high suitability Red Goshawk habitat areas by mining would be avoided by the development of an environmental buffer system. The Queensland Government's *Regional Vegetation Management Code for Western Bioregions* provides recommended clearing set-back distances from watercourses and wetlands (DERM 2009b). In Cape York, the recommended minimum buffer distances from watercourses vary depending on stream order; from wetlands, they depend on the significance of the wetland. These buffer distances are:

- 50m buffer from each high bank of a watercourse with stream order one or two;
- 100m buffer from each high bank of a watercourse with stream order three or four;
- 200m buffer from each high bank of a watercourse with stream order five and above;
- 100m buffer from a natural wetland; and,
- 200m buffer from a natural significant wetland.

The above buffer distances have been included as a condition of approval by the Queensland Coordinator General (Queensland Government 2012). The proposed SoE environmental buffer system exceeds these regulatory requirements.

The proposed SoE environmental buffer system would comprise a methodology for determining set-back distances from sensitive vegetation types, rather than banks of watercourses and wetlands, and the preclusion of mining from within the designated buffers. The sensitive vegetation that would be buffered by Darwin Stringybark woodland would comprise the following vegetation types: riparian, wetland, estuarine, vine forest and coastal vegetation on sand. The relevant vegetation units and equivalent REs are listed in **Table 6-14**. A variable environmental buffer system would be implemented that takes into account factors such as sensitive vegetation type, important locations of threatened flora and fauna, stream order and hydrology when determining buffer distances. In all cases the above Code requirements would be met or exceeded.

Typically, a buffer distance up to 200m would be adopted for vine forest, wetlands, estuaries, coastal vegetation on sand and riparian vegetation along watercourses of stream order three and above. Narrower buffer distances to a minimum of about 100m may be adopted for riparian vegetation along watercourses of stream order one and two, or where significant ecological attributes are absent and physical characteristics are such that a narrower buffer would still provide edge effect protection and filtering of surface runoff flows from disturbed areas.

Table 6-14 Vegetation Units that would be Buffered

Veg. Unit	Description	Equivalent RE
Laterite / bauxite plateau and slopes		
3c	Notophyll vine forest on lateritic or bauxite red earths	3.5.4
Freshwater drainage lines, wetlands and streams		
3b	*Melaleuca* swamp; zone at the most consistent water level	3.3.14a 3.3.9
4a	Riparian gallery forest along permanent and semi-permanent watercourses	
4a1	Narrow mesic fringe along watercourse with Cape York red gum	3.3.9
4a2	Riparian rainforest	3.3.5
4a3	Paperbark dominated riparian strip with rainforest understorey	3.3.9
5e	*C. polycarpa/ E. brassiana* Woodland on colluvial upper reaches of broad drainage basins - yellow podzolics	3.5.22c
5j	Bloodwood-Banksia in upper parts of broad basins – A2 horizon present	
5j1	With Swamp Box (*Lophostemon suaveolens*) and Lily Pily (*Syzygium angophoroides*) – outer fringe of permanent watercourses	3.3.21
5j2	With Broad-leaved Paperbark (*Melaleuca viridiflora*) on floodplains	3.3.49a
5j3	With Swamp Box (*Lophostemon suaveolens*) and Cabbage Palm (*Livistonia muelleri*) – on gentle low slope (e.g. western boundary of Norman Creek near estuary)	3.3.9
5j4	With Broad-leaved Paperbark (*Melaleuca viridiflora*), Lineament Tree (*Asteromyrtus lysicarpa*) +/- Hard Tea-tree (*Melaleuca clarksoniana*) on margins of sinkholes	3.3.14a
7b	*Melaleuca* / Swamp mahogany on the outer margins of drainage depressions	3.3.14a 3.3.50a 3.3.9
12a	Sedgeland in the drainage lines of permanent swamps	3.3.64
12b	Sedgeland in basins of seasonally flooded swamps and drainage depressions	3.3.63 3.3.65
Coastal and beach ecosystems		
3a	Semi-evergreen notophyll vine forest or thicket on coastal dunes	3.2.2
5a	Layered woodland on plains – massive sandy loams	3.2.10c
5c	Woodland on low beach dunes with horse-tail she oak	3.2.6a
5d	Paperbark woodland fringing sandy swales	3.2.3
7a	Mixed shrubby woodland (Sclerophyll vine woodland) on dunefields	3.2.5a
7c	Woodland with Paperbark on sandy swales	3.2.5a
12c	Grassland/herbland on dunefield	3.2.25
Estuary and saltpan ecosystems		
3d	Mangrove; Rhizophora zone	3.1.1a
3e	Mangrove; Landward zone, freshwater conditions (including looking glass mangrove)	3.1.1c
6c	Mangroves; Ceriops zone	3.1.3
8c	Closed scrub in saline strips in estuarine plains – yellow podzolics	3.1.6
9a	Mangrove; highly saline landward zone (mixed species)	3.1.3
12d	Grasslands on low level terraces (narrow bands)	3.2.25
12e	Saltpan, sparse herbfield	3.1.5 3.1.6
12f	Seasonally flooded saline marine plains	3.1.6

A comparison of regulatory requirement and the proposed SoE environmental buffer system is presented in **Table 6-15**.

Table 6-15 Comparison of SoE environmental buffer system to regulatory requirements

Environmental feature	Regulatory Requirements*	SoE Buffer for Mining Areas
Stream order one of two	50m from high bank of watercourse	100m to 200m** from edge of riparian vegetation
Stream order three or four	100m from high bank of watercourse	100m to 200m** from edge of riparian vegetation
Stream order five an above	200m from high bank of watercourse	200m from edge of riparian vegetation
Natural wetland	100m from wetland	200m from edge of wetland vegetation
Natural significant wetland	200m from wetland	200m from edge of wetland vegetation
Tidal areas and marine plants***	200m from boundary of feature	200m from boundary of feature
Vine forest, coastal vegetation on sand, estuaries	Buffer not applicable	200m from edge of relevant vegetation type

* Specified in the Queensland Coordinator General's conditions for the SoE Project and the Environmental Authority for ML7024.
** Set based on site specific factors following field survey.
*** Category B Environmentally Sensitive area as defined by the *Environmental Protection Regulation 2008* (Qld).

Based on currently available information, the area protected by the proposed SoE environmental buffer system would cover as a minimum approximately 17,346ha, which is 8,356ha larger than that which would be required under regulatory requirements.

Surveys would be carried out to define the boundaries of mapped sensitive vegetation types in the field. The field surveys would be carried out prior to clearing for drill lines (which are typically established for detailed orebody definition) and prior to clearing ahead of mining. The surveys would also assess the location and stream order of any watercourses and the presence or absence of significant ecological features such as springs, aquatic refugia and threatened flora and fauna in and around the sensitive vegetation types.

Buffer distances would then be set and mapped based on the findings of the surveys and, where relevant, stream order. Establishment of the buffer distance and authorisation for clearing non-buffered areas would be managed through a ground disturbance approval process. RTA has committed to including the buffer system in the Land and Sea Management Programme which is being developed in collaboration with Traditional Owners.

The proposed SoE environmental buffer system would benefit the Red Goshawk by avoiding direct disturbance of the majority of high suitability habitat within the Project area. This avoids disturbance of potential nesting habitat and the main foraging areas likely to be utilised by the species, if present.

6.3.4.6 Progressive Rehabilitation

The sequential re-establishment of habitat on rehabilitation areas (refer **Section 3.10.4**) would facilitate re-colonisation of prey fauna within the rehabilitated mine areas which would reinstate potential foraging habitat in these areas. Although the Red Goshawk has not been recorded from rehabilitation areas at Weipa, it is possible that the pair of birds sighted on the boundary of the East Weipa mine in August 2012 were hunting prey in nearby young mine rehabilitation. The Peregrine Falcon, a bird hunting specialist, and other bird hunting species including the Square-tailed Kite and Brown Falcon have previously been recorded utilising mine rehabilitation. The largest area of un-rehabilitated land (approximately 9,000ha) would occur at about Year 30. The largest area of rehabilitated land less than 10 years old (9,000ha) would occur at about Year 45.

The suitability of rehabilitation for potential Red Goshawk habitat would be heavily influenced by the ability of the rehabilitation to support suitable prey species. Surveys indicate the presence of 66 known or probable prey species in rehabilitated habitats north of the Embley River (Winter and Alford (1999); Gould (2010) and unpublished Ecotone survey data for RTA (**Appendix 6-B**) compared with 85 known or probable prey species in the Project area, including 37 species occurring in Darwin Stringybark open forest, which would form the majority of the areas to be mined and rehabilitated. The greater variety of habitats in rehabilitated areas compared to the relatively uniform Darwin Stringybark forest habitat is likely to account for the greater number of prey species recorded in mine rehabilitation. The suitability of rehabilitated habitat for a range of native fauna, including prey species for the Red Goshawk has been proposed as a performance indicator for rehabilitation (refer **Table 3-14**).

It is expected that rehabilitation age would also be an important factor in determining habitat suitability as taller vegetation potentially provides more tall cover, perching trees and tall nesting trees. However, an analysis of prey species by age of rehabilitation north of the Embley River yielded no obvious trends of this nature. It is possible that this is partly due to changing rehabilitation techniques over time and the fact that a significant portion of the older rehabilitation is dominated by commercial forests and pastures, whereas younger rehabilitation is generally native vegetation established using more modern rehabilitation techniques. The rehabilitation indicators proposed for the Project would assist in monitoring performance in this area and allow adaptive management where required (refer **Section 3.10** for a full description of proposed rehabilitation).

Table 6-16 summarises the potential impacts on the Red Goshawk as a result of the Project after proposed avoidance and mitigation measures have been considered, in terms of the significant impact criteria for matters of NES (DEWHA, 2009c).

Table 6-16 Impact Assessment Summary - Red Goshawk (*Erythrotriorchis radiatus*)

Will the proposed works…	**Red Goshawk *(Erythrotriorchis radiatus)* - Vulnerable**
….lead to a long-term decrease in the size of an important population?	The Red Goshawk occurs in coastal and sub coastal habitats from northern NSW to the Kimberley, although it has declined significantly in the southern part of its range. The species was not recorded in the Project area during surveys. As the regional distribution of this species is not understood and there are very few records of the species from Northern and Western Cape York, if the Red Goshawk was to occur within the disturbance footprint of the Project area, it would be regarded as an important population. However, if the species is present within the Project area, sufficient foraging, roosting and nesting habitat would remain undisturbed to support the species. The proposed mitigation measures would avoid disturbance of active nests. A long term decrease in any population of the species, if present, is unlikely to occur as a result of the Project given the relatively small impact on habitat and the low density nature of the species (1-2 breeding pairs).
….reduce the area of occupancy of an important population?	The key nesting and foraging habitats (high suitability habitat) for the species would be largely unaffected (87.3% undisturbed high suitability habitat) by the Project and sufficient moderate suitability habitat would remain undisturbed (59.7%) to support the species. The area of occupancy of any population of the species if present would not be reduced significantly.
….fragment an existing important population into two or more populations?	The majority of key nesting and foraging habitat (87.3% undisturbed high suitability habitat) for the species would not be affected by fragmentation. Moderate suitability habitat areas would be fragmented by clearing for mining; however, the network of proposed SoE

Will the proposed works…	**Red Goshawk *(Erythrotriorchis radiatus)* - Vulnerable**
	environmental buffers and large areas of moderate suitability habitat that would not be disturbed (59.7%) would maintain a network of connected habitat. In addition, much of the moderate suitability habitat cleared during operations would be progressively rehabilitated over the life of the Project. Sufficient habitat (70,288ha which represents 70.3% of high and moderate suitability habitat in the Project area) would remain undisturbed to support the species and given the high mobility of the species, any population present would not be fragmented.
....adversely affect habitat critical to the survival of a species?	The Project area does not include any critical habitat areas for the Red Goshawk that are listed under the EPBC Act or identified in Recovery Plans, nor is the Project area regarded as critical habitat for the species given its similarity to other potential habitat areas on northern Cape York Peninsula.
....disrupt the breeding cycle of an important population?	Proposed mitigation measures would avoid disturbance of active nests during construction and operation and consequently the breeding cycle of the species would not be disrupted.
....modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Progressive clearing and rehabilitation would minimise the amount of habitat cleared at any one time and sufficient habitat (70,288ha which represents 70.3% of high and moderate suitability habitat in the Project area) would remain undisturbed to support the species. Fragmentation impacts are not anticipated as the species is highly mobile. Consequently, the species is unlikely to decline as a result of the Project.
....result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Project is unlikely to lead to the introduction of any invasive fauna that could affect the species. Proposed control measures for weeds would be aimed at avoiding the spread of invasive weeds within the habitat of the Red Goshawk.
.....introduce disease that may cause the species to decline?	Disease is not known as a threat to this species. It is not anticipated that the Project would represent a threat with respect to the introduction of disease.
....interfere substantially with the recovery of the species?	The Project is not expected to interfere with the recovery of the Red Goshawk.

6.3.4.7 National Recovery Plan and Threat Abatement Plans

There is a national recovery plan for the Red Goshawk (DERM 2012c) and **Table 6-17** outlines the consistency of the Project with the plan. There are no relevant threat abatement plans for the Red Goshawk. However, the proposed feral pig program, which will reduce pig damage to riparian and wetland habitats, is consistent with the *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs* (DEH 2005) (refer **Table 5-30**).

6.3.5 Offset Measures

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012b), offsets are not required where the residual impact is not likely to be significant (when assessed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c).

Sections 6.3.3 and **6.3.4** of this report documents the results of the impact assessment process and concludes that with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the Project on the Red Goshawk would be minor and therefore not significant (refer **Section 6.1.3**). As such, offsets relating to the Red Goshawk are not required under the Commonwealth offsets policy.

Table 6-17 Consistency of SoE Project with National Recovery Plan for Red Goshawk

Objective	Action	Consistency of SoE the Project with the National Recovery Plan
Identify and map Red Goshawk habitat	• Collate information on known nest sites from the past 25 years. • Produce descriptive maps of important habitat for the Red Goshawk. • Conduct searches to identify previously unknown pairs of Red Goshawks, nest sites, and habitats critical for Red Goshawk survival.	Consistent: • Multiple field surveys conducted. • No known nest sites in Project area. • Potential habitat has been mapped as part of the EIS.
Protect and appropriately manage important habitat areas to ensure long-term survival	• Provide specific information and advice to government agencies and nongovernment organisations to assist with the identification, acquisition and management of important Red Goshawk habitat. • Reduce the effects of habitat fragmentation and habitat degradation by encouraging land owners to enter into voluntary conservation covenants / agreements in areas were Red Goshawks are located to protect both the birds and their habitat. • Conduct research to understand the relationship between habitat fragmentation, prey density and population persistence to better inform Red Goshawk management. • Monitor Red Goshawk habitat.	Consistent: • All relevant information about potential species occurrence made available in the EIS. • No Red Goshawks known to occur in Project area. • Habitat suitability mapping conducted. The majority of high suitability habitat would be protected from mining by unfragmented buffers and undisturbed areas. • Disturbed high suitability habitat is far less than one home range and a large amount of similar habitat would remain in both the Project area and Subregion.
Increase knowledge of Red Goshawk's productive success and survival	• Monitor at least 20 nest sites each year to determine territory occupancy and productivity, and use DNA analyses of feathers to determine adult survival rates. • Train personnel from state and local government to identify and understand the threats to Red Goshawk habitat.	Not applicable. • Multiple field surveys conducted. • No known nest sites in Project area.
Identify important populations of Red Goshawks	• Identify important populations and nest sites of Red Goshawks and use the information to inform monitoring programs and state and federal government planning frameworks. • Ensure location information about Red Goshawk nest sites is secure.	Consistent: • Multiple field surveys conducted. • No known nest sites in Project area. • Potential habitat has been mapped as part of the EIS. • Pre-disturbance surveys are proposed in areas with the potential to have nests.
Increase community awareness about Red Goshawk and conservation of the species	• Produce and distribute information / educational materials on the conservation status and habitat requirements of the Red Goshawk. • Provide feedback to the public and agency personnel on progress of Red Goshawk recovery. • Provide feedback to the public and agency personnel on progress of Red Goshawk recovery.	Not applicable.

6.4 Masked Owl (*Tyto novaehollandiae kimberli*)

6.4.1 Species Profile

6.4.1.1 Regional Distribution and Population

The Masked Owl is listed as 'vulnerable' under the EPBC Act.

The northern race of the Masked Owl occurs with a disjunct distribution between Townsville and the Kimberley region with other races extending down the east coast to Tasmania. On Cape York the Masked Owl has been recorded in the Aurukun area adjacent to the Project area (WildNet Database 2007) although the habitat within which it was recorded is unclear, and the records are not recent (Woinarski 2004). These records indicate the existence of a northern Cape York population (Woinarski 2004) but the current extent and status of this population is poorly known. The species occurs at very low densities outside the Wet Tropics, and is seldom encountered during surveys.

The population size of the species within the Subregion is unknown and the species may not currently occur in the area. Reductions in small mammal populations in tropical woodlands reported in Fitzsimons *et al.* (2010) and Garnett *et al.* (2010) may reduce habitat suitability for the species due to a lack of available prey. The home range of the Masked Owl is not well known but other sub-species have home ranges in the order of 5 to 10km^2. The actual occurrence of the species in an area is most likely to be closely associated with the availability of small-medium ground mammals and tree hollows.

6.4.1.2 Regional Ecology and Habitat

The general habitat preference of this species comprises open forest, riparian gallery forest, rainforest, mangroves and the periphery of *Melaleuca* swamp forest (Garnett *et al.* 2011). The Tiwi Island subspecies is known to inhabit Darwin Stringybark dominated tall woodland on the Tiwi Islands and is reported as particularly widespread in the tallest eucalypt forests in the vicinity of patches of monsoon rainforest (Woinarski 2004). The habitat preference of the northern subspecies is less well known given a lack of records of the species. Specific habitat requirements are poorly known but the species appears reliant on small-medium sized ground mammals as prey and the availability of large tree hollows for nesting (Garnett *et al.* 2010, Woinarski 2004). The availability of small mammal prey appears to be a significant determinant of habitat usage with the species observed to hunt native ground mammals in sugarcane paddocks and adjacent open grassy areas in North Queensland (M. Thomas pers. comm.). Masked Owls usually nest in hollows in forest patches but may forage within open areas supporting prey or along the edge of denser vegetation types such as vine forest, gallery forest or mangroves. The species requires large hollows to accommodate its body size, implying the need for relatively substantial forest trees in close proximity to foraging areas supporting mammal prey.

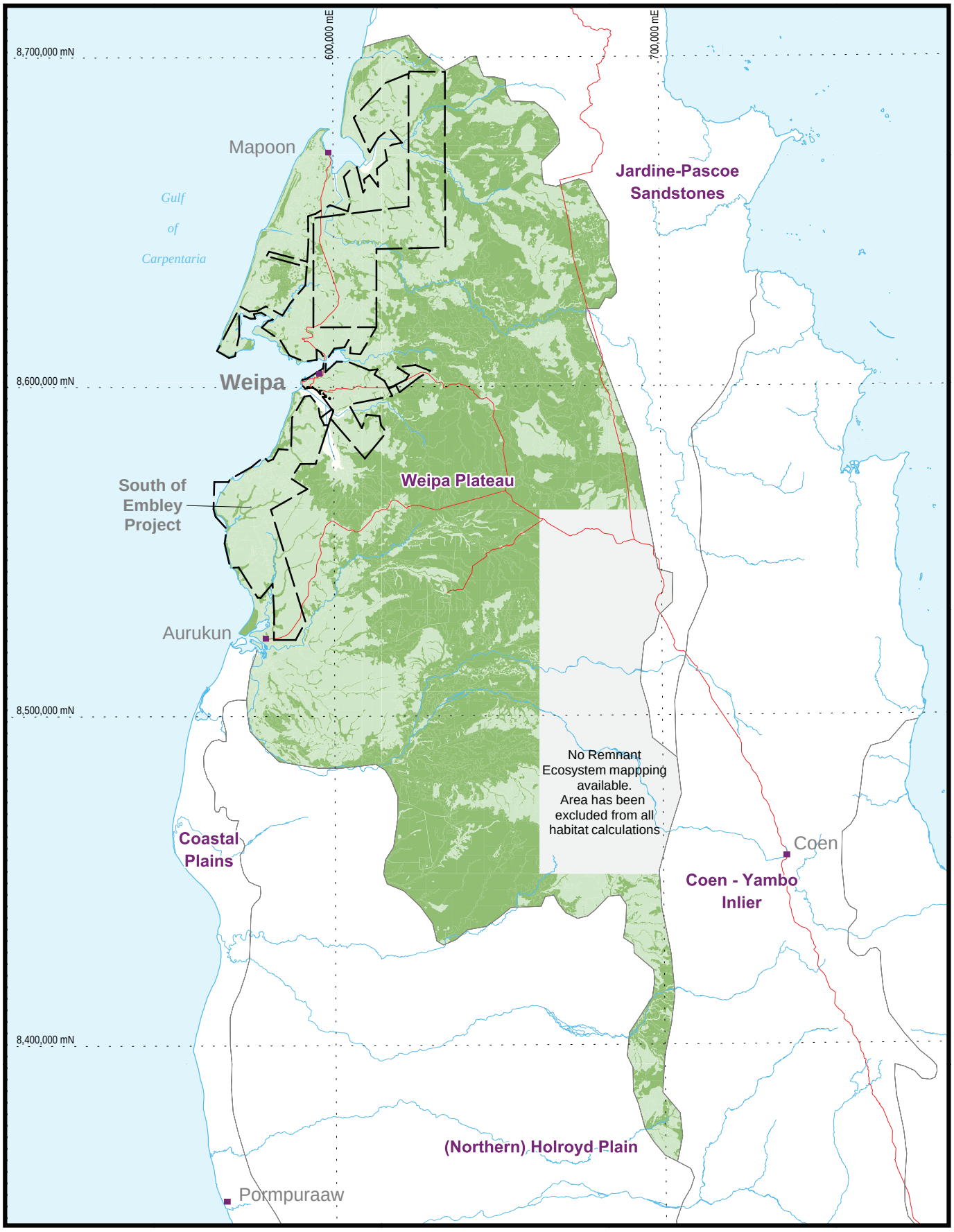
Potential habitat of the Masked Owl in the Subregion is described in **Table 6-18** and mapped in **Figure 6-5**.

High suitability habitat for the Masked Owl is defined as areas of tall closed forest, open forest, woodland, mangrove edges with or without open grassy areas, with persistent abundant small-medium sized ground mammals and large hollow bearing trees. A critical factor supporting Masked Owl populations is the abundant presence of small mammals (Garnett *et al.* 2010, Woinarski 2004). The small mammal surveys within the Project area and similar surveys conducted recently in the Weipa area (RTA 2011, M. Thomas pers. comm.) did not locate any habitat types where small mammals were abundant. Indeed, small mammals appear to be in very low densities or absent from extensive Darwin Stringybark dominated woodland areas in the Project area.

Table 6-18 Potential Habitat of Masked Owl (Weipa Plateau Subregion)

Habitat Suitability Classes		RE's and Other Map Units	Map Compilation
High	Areas of tall closed forest, open forest, woodland, mangrove edges, with or without open grassy areas, with persistent abundant small-medium sized ground mammals and large hollow bearing trees.	nil	No high suitability habitat was mapped within the Subregion due to an anticipated lack of abundant small mammal populations throughout the Subregion. This was based on small mammal survey results from the Project area and wider Weipa area that did not locate any abundant small mammal populations in a variety of habitats.
Moderate	Medium to tall open forest and woodland with mangrove edge or vine forest or *Melaleuca* wetland habitat present, with moderately abundant or seasonally fluctuating small mammal population, with or without large tree hollows.	3.2.2a 3.2.3 3.2.7a 3.3.12 3.3.16 3.3.18 3.3.19 3.3.20a 3.3.20b 3.3.22a 3.3.23 3.3.24 3.3.25a 3.3.27c 3.3.28 3.3.31b 3.3.38 3.3.39 3.3.5a 3.3.6 3.5.4 3.7.1 3.3.10a 3.3.14a 3.3.9 3.10.10 3.10.21a 3.10.21c 3.10.6a 3.10.9e 3.5.10 3.5.10x1 3.5.19x3 3.5.26 3.5.7a 3.5.7x2a 3.5.7x2b 3.5.8a 3.5.8c 3.5.9a 3.5.9d 3.7.4 3.9.2x4	Moderate suitability habitat was mapped as open forest and woodland types providing appropriate structural complexity for the Masked Owl and likely to support appropriate small mammal populations at moderate abundance. The data on small mammal populations from the Project area and other recent surveys in the Weipa area was used to identify woodland REs that were unlikely to support appropriate small mammal populations and these were excluded from moderate suitability habitat.
Low/No	Any habitat with no or low densities of small mammals, with or without tree hollows.	3.1.1a 3.1.3 3.1.5 3.1.6 3.2.10c 3.2.5a 3.3.21 3.3.32 3.3.33 3.3.36 3.3.37a 3.3.37b 3.3.42a 3.3.44 3.3.49a 3.3.49b 3.3.50c 3.3.60a 3.3.61a 3.3.66x1b 3.3.50a 3.3.63 3.3.64a 3.3.65 3.3.66a 3.3.66x1a estuary water 3.3.53x1 3.3.56 3.3.56a 3.5.19x4 3.5.19x7 3.5.29 3.9.8a non-remnant vegetation rock sand 3.10.15b 3.10.6d 3.11.7 3.11.11 3.11.17b 3.12.14c 3.12.33a 3.2.25 3.5.11 3.5.14b 3.5.14c 3.5.18x2 3.5.2 3.5.22a 3.5.22c 3.5.22d 3.5.22x2 3.5.24a 3.5.24b 3.5.28 3.7.3 3.7.5a 3.7.5b 3.7.6 3.7.6b 3.9.2a 3.9.2b 3.9.4 3.9.5 3.9.7	Low/no suitability habitat includes any habitat with anticipated no or low densities of small mammals, regardless of other habitat features that may be present.

Note: RE's with an 'x' denote a subdominant vegetation type following the 'x'



RTA Mining Lease boundary
Cape York Sub-Regions Boundary
Road/track
Locality
River

Masked Owl Habitat

Moderate Suitability Habitat
Low / No Suitability Habitat
No mapping

South of Embley Project

Fig. 6-5: Potential Habitat of Masked Owl (Weipa Plateau Subregion)

N

25 0 25km

Datum/Projection: GDA94/MGA Zone 54 Date: 17/09/2012

A general decline of small mammal populations in tropical woodlands has been observed elsewhere in northern Australia (Fitzsimons *et al.* 2010) and is attributed as the most probable cause of the decline and low density of the Masked Owl (Garnett *et al*. 2010). The cause behind small mammal decline in northern Australia is not accurately known but is believed to be related to a variety of factors including fire regime, feral predators and disease or potential interaction of all of these factors (Fitzsimons *et al.* 2010).

The survey results from the Project area and Weipa areas were extrapolated to the wider Subregion where essentially similar habitat types and ecosystem processes (particularly fire regime, refer **Section 4.2.1.7**) occur to those observed in the Weipa area. Given that no persistent abundant small mammal populations have been located within the Project area or Weipa area it was assumed that a similar lack of small mammal populations were likely to occur throughout the Subregion. Consequently no high suitability habitat was identified in the Subregion.

Moderate suitability habitat for the Masked Owl is defined as medium to tall open forest and woodland with mangrove edge or vine forest or *Melaleuca* wetland habitat present, with moderately abundant or seasonally fluctuating small mammal population, with or without large tree hollows. The small mammal data outlined above was used to identify REs where moderate density small mammal populations are likely to occur and which would constitute moderate suitability habitat. This data was also used to indicate RE types that are unlikely to support appropriate small mammal populations. Areas that were assessed as unlikely to support appropriate small mammal populations were considered low/no suitability habitat, and included Darwin Stringybark woodland (RE 3.5.2).

Low/no suitability habitat is comprised of any habitat with anticipated no or low densities of small mammals, with or without tree hollows.

Moderate suitability habitat is not rare and the Subregion contains over 1.2 million hectares of moderate suitability habitat.

6.4.1.3 Potential Project Area Distribution, Ecology and Habitat

Moderate suitability habitat for the species exists within the Project area as described in **Section 6.4.1.2**, comprising predominantly riparian, wetland and mangrove habitats associated with the Ward River and Norman Creek, but also other areas of riparian gallery forest, *Melaleuca* wetland, mangrove forest and vine forest. The actual suitability of these habitats would depend on the small mammal population present. The Queensland EIS recorded the full suite of fauna identified during fauna surveys (refer Section 7.15.1 and Appendix 7F of the Queensland EIS (RTA 2011)). An analysis of potential Masked Owl prey species identifies only nine probable prey species recorded in the Project area, with only one recorded in open Darwin Stringybark forest, seven species recorded in riparian/swamp habitats, and two other species which occur in habitats that would be largely undisturbed by the Project (refer **Appendix 6-B**). Species included as probable prey comprise all small to medium size marsupials up to the size of a small Brushtail Possum.

Habitat suitability for the Masked Owl may be adversely affected by the observed low densities of small-medium sized mammals in these areas. The very low densities of small mammals in Darwin Stringybark woodland on the bauxite plateau, as determined by the surveys for the Project, is likely to make this habitat unsuitable for the Masked Owl.

Potential habitat for the species within the Project area is presented in **Table 6-19**. Critical habitat is habitat that the Minister has listed in the Register of Critical Habitat (prepared under Section 207A of the EPBC Act) in relation to an EPBC-listed species or ecological community. DSEWPaC's Register of Critical Habitat does not identify any critical habitat for the Masked Owl. Only moderate suitability and

low/no suitability habitat is identified for the Masked Owl. Moderate suitability habitat comprises areas of habitat types that are known to support small mammal populations. Potential habitat for the Masked Owl within the Project area is illustrated in **Figure 6-6**.

Table 6-19 Potential Habitat of Masked Owl (Project Area)

Habitat Suitability Classes		**REs and Other Map Units**	**Map Compilation**
High	Areas of tall closed forest, open forest, woodland, mangrove edges, with or without open grassy areas, with persistent abundant small-medium sized ground mammals and large hollow bearing trees.	nil	No high suitability habitat was mapped within the Project area due to the demonstrated lack of abundant small mammal populations.
Moderate	Medium to tall open forest and woodland with mangrove edge or vine forest or *Melaleuca* wetland habitat present, with moderately abundant or seasonally fluctuating small mammal population, with or without large tree hollows.	3.2.2 3.2.3 3.3.5a 3.5.4 3.3.14a 3.3.9	Moderate suitability habitat includes open forest and woodland types providing appropriate structural complexity and with demonstrated moderate density small mammal populations. A surrounding area of 200m was also included around each habitat area to identify the potential use of peripheral habitat types for roosting.
Low/No	Any habitat with no or low densities of small mammals, with or without tree hollows.	3.1.1a 3.1.1c 3.1.3 3.1.5 3.1.6 3.2.10c 3.2.5a 3.3.21 3.3.49b 3.3.60a 3.3.61 3.5.11 3.5.22c 3.3.50a 3.3.63 3.3.64 3.3.65 estuary water non-rem rock sand 3.2.25 3.2.6a 3.5.2 3.7.3	Low/no suitability habitat includes any habitat with no or low densities of small mammals, regardless of other habitat features that may be present.

Masked Owls may utilise hollows in Darwin Stringybark woodland for nesting as these trees may form suitably large hollows for the species. However, given the lack of small mammals in Darwin Stringybark woodland in the Project area, it is likely that only trees in close proximity to foraging areas along drainage lines or adjacent to vine forest would be selected. It is unlikely that any such nest trees would be located within proposed mining areas given the proposed SoE environmental buffer system (refer **Section 6.3.4.5**) that would protect areas of Darwin Stringybark woodland adjacent to moderate suitability habitat. The vast majority of potential habitat for the species occurs within the proposed SoE environmental buffer system. Suitable foraging and nesting habitat for the Masked Owl occurs within the Dam C area given the presence of small mammals and the presence of suitably sized tree hollows. The potential population size of the Masked Owl within the Project area cannot be accurately estimated as the actual utilisation of potential moderate suitability habitats (as determined by small mammal presence and tree hollow availability) is unknown.

RTA Mining Lease boundary
Locality
Road/track
River
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Masked Owl Habitat

Moderate Suitability Habitat
Low / No Suitability Habitat
Comprehensive survey site (A-L)
Supplementary survey site
Targeted threatened fauna survey site
Vehicle traverse

Rio Tinto Alcan

South of Embley Project

Fig. 6-6: Potential Habitat of Masked Owl (Project Area)

N

5 0 5km

Datum/Projection: GDA94/MGA Zone 54 Date: 31/10/2012

6.4.1.4 Threats

Key threats to the Masked Owl across its distribution include pervasive threats comprising altered fire regimes, invasion by weeds, and grazing by livestock (and feral stock). Effects of these threats appear to have resulted in declines in small mammal prey populations and possibly reduction in availability of tree hollows which reduce habitat suitability for the species (Garnett *et al.* 2011, Woinarski 2004). Competition with arboreal mammals for tree hollows has also been advocated as a potential threat to the species. Land clearing threatens the species by reduction in available habitat.

6.4.2 Survey and Results

6.4.2.1 Survey Approach

Section 6.2 provides a general overview of the survey approach for terrestrial fauna. The following summarises the efforts and results for the Masked Owl. A summary of the suitability of survey timing and species specific limitations of the survey approach is included on **Table 6-4** in **Section 6.2**.

The Masked Owl has low detectability due to the low density at which it occurs and its cryptic nature. As with other large owls, the species is reported to be responsive to call playback, especially during the breeding season, thus use of this method can increase the overall detectability of the species at certain times of the year.

The *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a) provides a recommended survey approach for the Masked Owl focussing on the use of call playback in the lead up to breeding season. Recommended survey effort for a 50ha area is eight hours of call playback survey over four days, targeting suitable habitat. Area and transect searches are not recommended due to the cryptic nature of the species. When surveying a site significantly larger than 50ha the guidelines recommend that an appropriate sampling approach be developed to focus the survey effort, and the approach be discussed with DSEWPaC.

The survey approach prior to 2012 over the large Project area was not discussed with DSEWPaC prior to the survey being undertaken as it was carried out prior to the release of the survey guidelines. The guidelines recommend that "focusing search effort on favoured habitat can be a valuable strategy to maximise the likelihood of detecting target taxa". The survey utilised a sampling approach in potentially favoured habitats as recommended by the guidelines. The primary challenge for field surveys was to provide meaningful survey effort for the species across the large Project area.

Surveys conducted prior to the release of the survey guidelines were conducted in accordance with the Queensland Government's requirements for the Queensland EIS which were stated in the *Terms of Reference for an environmental impact statement – South of Embley Project* (Queensland Government 2009). Prior to the 2012 targeted surveys, the survey plan was sent to DSEWPaC for comment.

The areas of riparian gallery forest, *Melaleuca* wetland and mangrove forest on major drainages along Norman Creek and the Ward River comprise moderate suitability habitat for the species and the areas where the species is most likely to be encountered within the Project area.

The survey approach employed for the Masked Owl in the Project area was a combination of call playback in potential moderate suitability habitat areas and observational searches during spotlighting sessions and night vehicle traverses. The use of call playback to elicit responses from any individuals that may be present within the broadcast area is the preferred survey method as, if successful, it would draw individuals in to the observer that may not have otherwise been observed. The efficacy

of call playback may vary during the year with surveys conducted during the breeding season likely to yield the best results; however, call playback surveys may fail to elicit responses from individuals at certain times of year even if they are present within the broadcast area. Significantly, the species potentially breeds in the eight month period March-October and the breeding season of the Masked Owl is poorly known especially on western Cape York where there are no recent records of the species and little known of the regional breeding ecology of the species. Consequently, identifying the best time to target the species with call playback survey was not possible. Based on previous experience with call playback surveys, it was regarded as prudent to not rely on call playback as the sole survey technique for the Masked Owl, and consequently spotlight sessions and nocturnal vehicle traverses were also included as appropriate survey techniques for the species. A summary of the survey effort applied for the Masked Owl during the surveys are provided in **Table 6-20**.

Table 6-20 Survey Effort for Masked Owl

Survey activity	No. nights	Duration of each survey activity (hours)	No. of sites	Total survey effort for activity (hours)
Comprehensive surveys – May 2007, May 2008 - total survey period of 16 days*				
Call Playback	6	0.3	13	3.9
Spotlight session	12	2 x 0.75	12	18
Vehicle traverses	13	2 (average)		26
			Total for Comprehensive surveys	*47.9*
Targeted threatened fauna surveys – December 2007/2008, May 2008/2009, June 2012, October 2012)- total survey period of 60 days"				
Call Playback	12	0.3	32	10
Spotlight session[#]	12	0.75	24	18
Vehicle traverses	12	2 (average)		32
			Total for Targeted threatened fauna surveys	*60*
Supplementary surveys – July 2006 and May 2007 - total survey period of 12 days*				
Call Playback	2	0.3	6	1.8
Spotlight session	4	0.75	8	6
Vehicle traverses	4	2		8
			Total for Supplementary surveys	*15.8*
			Grand Total	123.7

** Only the components of the overall surveys that are applicable to the Masked Owl are presented in this section of the table.

For the October 2012 surveys, spotlighting is included as part of the call playback component.

Of particular significance in determining likely habitats for targeted call playback was the paucity of small ground mammals and the almost total absence of arboreal mammals within the Project area. The Masked Owl is a predator of small-medium sized terrestrial mammals in particular, and surveys revealed that these were virtually absent from the Darwin Stringybark woodland that covers the majority of the Project area. Call playback was initially undertaken in Darwin Stringybark woodland (i.e. during preliminary surveys in 2006 and 2007). Subsequent call playback surveys focused on habitat areas where the species was regarded as most likely to be foraging if present. This included riparian habitats, Paperbark swamps and the landward margin of mangroves, all of which were found to support at least low densities of ground mammals (mainly *Melomys burtoni*). The October 2012 call playback surveys were conducted primarily in Darwin Stringybark woodland to further sample the dominant vegetation type within the future mining areas.

Call playback surveys were undertaken as part of the comprehensive surveys undertaken in May 2007 and May 2008. All survey events were conducted during the potential breeding season of the species. A single call playback session was conducted at most sites, with two sessions conducted at one site. Each call playback session employed repetitions of the scan/playback/listen technique as recommended in the survey guidelines; with an average total time of 20 minutes for each playback session. During these surveys a total of 3.9 hours of playback was conducted at thirteen sites over six nights.

Additional call playback survey was undertaken for the Masked Owl early in the anticipated breeding season during the targeted threatened fauna surveys in May 2008, May 2009, June 2012 and October 2012. Survey locations included Darwin Stringybark woodland, riparian gallery forest, Paperbark forest, the grassy area on the landward margin of mangrove communities, and the margin of coastal vine forest. An additional 32 sites were surveyed over 12 nights comprising 10 hours of playback survey.

In addition to the call playback surveys, substantial additional survey effort was achieved during spotlight surveys conducted at survey sites during the comprehensive surveys; during additional spotlight surveys carried out as part of targeted threatened species surveys; and during nocturnal vehicle traverses.

Overall, a total of approximately 124 hours of survey effort appropriate for the Masked Owl was employed across all surveys.

6.4.2.2 Survey Results

No Masked Owls were located in the Project area during field surveys and there are no previous records of the species from the Project area.

The home range of the species in northern Australia is estimated to be greater than the 5-10km^2 reported for the Tiwi Islands population (Garnett *et al.* 2010). There is a lack of high suitability habitat for this species in the Project area.

Given the lack of recent records of the Masked Owl on Cape York Peninsula it would appear that the species occurs at most at very low densities within the region. If the species was found to occur within the Project area it would represent the only confirmed population of the species on the Cape York Peninsula. It would be regarded as an important population under the meaning of the EPBC Act, as the Project area would represent the northern limit of the species distribution.

Similarly, in the absence of firm data on the distribution of the species on Cape York Peninsula, any Masked Owl population confirmed within the Project area would be regarded as a regionally significant population as it may represent a disjunct population or a distributional limit for the species.

Although not required by the *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a), the baseline surveys for the Queensland EIS recorded common species (refer Sections 7.13 - 7.15 and Appendix 7F of RTA 2011)), including species that are prey for the Masked Owl.

Table 6-21 summarises the profiling information for the Masked Owl.

6.4.3 Relevant Impacts

The following sections outline the potential construction and operational impacts of the Project on the Masked Owl.

6.4.3.1 Construction Impacts Prior to Mitigation

The Masked Owl was not located within the Project area which contains no high suitability habitat for the species. However some moderate suitability habitat would be impacted, specifically at the Dam C footprint and infrastructure crossings of streams within the Project area. Construction of the Port, Boyd infrastructure area and TSF would not disturb any moderate suitability habitat for the species.

Table 6-22 shows that approximately 326ha of moderate suitability habitat and no high suitability habitat would be disturbed during construction of the Project, which is much less than one home range of the species (estimated at 1,000ha+ (Garnett *et al.* 2010)). The balance of the disturbance (29,332ha) is low/no suitability habitat. The moderate suitability disturbance area represents approximately 3.2% of the total area of moderate suitability habitat within the Project area and <0.1% of the moderate suitability habitat within the Subregion and is therefore a minor component of the potential habitat available for the species.

Potential nesting habitat for the Masked Owl occurs within the Dam C footprint; however, the area is not regarded as especially significant for foraging or breeding by the species. The Dam C site was surveyed for presence of threatened fauna and no nests of the Masked Owl were located. Similarly no nests of the species were located at proposed infrastructure crossings of streams within the Project area.

Overall the potential unmitigated impacts on the Masked Owl from clearing of habitat during construction are anticipated to be minor.

The discrete areas of disturbance to potential Masked Owl habitat resulting from construction are small compared to the overall areas of habitat that would not be affected by construction and would not lead to fragmentation of habitat for the species given the capability of the species to traverse relatively extensive distances.

Construction of Dam C would disrupt the riparian corridor along the middle branch of Norman Creek. Riparian corridors would also be impacted where infrastructure crosses streams. This may force Masked Owls to alter movement patterns in this area; however, habitat continuity around the dam impoundment would be provided by a minimum 200m SoE environmental buffer from mining from the full supply level of the impoundment. The Masked Owl is a highly mobile species and would be able to utilise peripheral habitat around the Dam C impoundment to maintain connectivity upstream and downstream of the dam. Clearing of habitat within the Dam C area and infrastructure crossings of streams is not anticipated to cause any impacts on accessibility to nearby habitat areas by this mobile species.

Table 6-21 Profile Summary for Masked Owl

Species **Common Name**	**Key Resources**	**Potential Habitat within Project area**			**Known / estimated population in Project area**	**Likelihood of Occurrence within Project Area**
		High Suitability Habitat	**Moderate Suitability Habitat**	**Low / no Suitability Habitat**		
Tyto novaehollandiae kimberli Masked Owl (northern)	Medium to large tree hollows for nesting. Availability of small-medium sized ground mammal prey.	No high suitability habitat identified within the Project area due to the paucity of small mammal populations within the Project area.	Riparian, wetland and mangrove habitats and immediately adjoining Darwin Stringybark woodland associated with the Ward River and Norman Creek. Other areas of riparian gallery forest, *Melaleuca* wetland, mangrove forest and vine forest and immediately adjoining Darwin Stringybark woodland throughout the Project area. The actual suitability of these habitat locations would depend on the small mammal population present in each location. Field surveys show that small mammals are generally present in these areas in low densities.	The majority of the Project area comprises low/no suitability habitat due to the lack of small mammals.	Most likely not present but may possibly occur at very low densities.	**Mining Area** **Unlikely:** suitable habitat areas (riparian, wetland and vine forest habitats) and peripheral habitat (Darwin Stringybark open forest habitat adjacent to the moderate suitability habitat areas), are not located within the proposed mining area. **Infrastructure footprint** **Possible:** sections of tall closed forest on major drainages along Norman Creek and the Ward River provide potentially suitable habitat. The Dam C footprint contains some suitable habitat; however, this area is not regarded as especially significant for foraging or breeding. The prevalence of the species may be significantly limited by the apparent paucity of small mammal populations within the Project area. **Balance of Project Area not disturbed** **Possible:** the majority of key habitat resources for the species within the Project area are located in areas not to be disturbed; however, the prevalence of the species may be significantly limited by the apparent paucity of small mammal populations.

Table 6-22 Habitat Disturbance for Masked Owl

Phase		High Suitability Habitat				Moderate Suitability Habitat				Low / No Suitability Habitat			
		Total in Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion	Total in the Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion	Total in Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion
Total Habitat		**0**	**0.0%**	**0**	**100.0%**	**10,321**	**100.0%**	**1,261,705**	**100.0%**	**90,256**	**100.0%**	**1,038,878**	**100.0%**
Undisturbed		**0**	**0.0%**	**0**	**100.0%**	**9,995**	**96.8%**	**1,261,379**	**100.0%**	**60,924**	**67.5%**	**1,009,546**	**97.2%**
Disturbed	Construction Disturbance	0	0.0%	0	0.0%	321	3.1%	321	<0.1%	2,123	2.4%	2,123	0.2%
	Operations Disturbance	0	0.0%	0	0.0%	5	0.1%	5	<0.1%	27,209	30.1%	27,209	2.6%
	Total Disturbed	**0**	**0.0%**	**0**	**0.0%**	**326**	**3.2%**	**326**	**<0.1%**	**29,332**	**32.5%**	**29,332**	**2.8%**

Note: Areas and percentages rounded to nearest ha / percentage point

While all terrestrial fauna are susceptible to road kill to some extent, it is not anticipated that the Masked Owl would be at substantial risk of collision with construction vehicles. This is because the relatively low number of night-time vehicle movements expected within construction areas, the minimal amount of moderate suitability habitat for the species located in construction areas, and the anticipated low density of the species if present, would combine to create a low probability of vehicles and foraging owls intersecting. With respect to construction related traffic travelling to the Project area, a peak of 70 vehicles per day is expected on the PDR from the Archer River Quarry (which would be utilised subject to suitable commercial agreement). The majority of these traffic movements would occur during daylight hours when the Masked Owl is not active and the route includes extensive non-riparian woodland areas that are unlikely to support substantial small mammal communities that would attract foraging owls. There is also a low likelihood of this traffic interacting with Masked Owls and any impact of vehicle strike is anticipated to be negligible.

Artificial lighting near construction areas area may illuminate immediately adjoining suitable habitat for the species and reduce prey activity and foraging success. This would represent a very small area of habitat and light emissions are likely to be attenuated within a short distance into the woodland habitats. Overall, lighting impacts on the Masked Owl are expected to be negligible.

Anticipated increases in noise and air emissions during construction would be relatively minor and localised. No nests of the species were located in the vicinity of the Dam C footprint where construction noise levels and air emissions would be highest. The species is mobile with a relatively large home range and foraging and roosting birds that are deterred by local emissions would be able to utilise extensive alternative moderate suitability habitat that occurs throughout the Project area. Any impact from noise and air emissions would be negligible. Additional details on noise and air emissions are provided in **Sections 14.3** and **15.2**.

Construction of the Project is unlikely to lead to the introduction of any invasive fauna that could affect the Masked Owl, but construction activities could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If introduced and allowed to proliferate within undisturbed habitat of the Masked Owl, these weeds could lead to an increase in fire intensity that could adversely affect the abundance of mammal prey species by altering ground cover characteristics and reducing fire refugia (DEEDI 2011b, NTFRS 2003). In addition, frequent intense fires have the potential to enhance the decline of hollow bearing trees that are favoured as nesting trees by the species.

Hydrological changes resulting from construction activities are not anticipated to affect habitat utilised by the species. Additional details are provided in **Sections 16.2** and **16.4**.

Table 6-23 summarises the potential construction impacts prior to mitigation on the Masked Owl.

6.4.3.2 Operational Impacts Prior to Mitigation

Only a very small area of moderate suitability habitat would be cleared during the operations phase (5ha associated with roads and watercourse crossings). There would be no additional impacts associated with clearing, edge effects, habitat fragmentation or movement of individuals through the landscape. Operation of infrastructure is not anticipated to have any additional effects on nesting or breeding activity of the species.

Table 6-23 Summary of Construction Impacts Prior to Mitigation for Masked Owl

Action / Issue	Summary of Potential Construction Impacts Prior to Mitigation
Direct Impacts	
Clearing and loss of habitat	Minor, long term. Moderate suitability habitat would be permanently disturbed in the Dam C area and to a lesser extent at infrastructure crossings of streams. The total area of disturbance would be small compared to the home range of the species and represents approximately 3% of the total area of moderate suitability habitat within the Project area and a fraction of a precent of the moderate suitability habitat within the Subregion and is therefore a minor component of potential habitat available for the species.
Edge effects	Negligible, short term. Edge effects are anticipated to be negligible given that no high suitability habitat would be displaced and the negligible noise, light and air quality impacts.
Fragmentation of habitat	Negligible, long term. Minor fragmentation of habitat caused by clearing for construction would not affect this highly mobile species.
Effects on movement/breeding/ feeding patterns	Negligible, long term. Construction of Dam C would disrupt the riparian corridor along the middle branch of Norman Creek and may force Masked Owls to make minor adjustments to movement patterns in this area; however, they are highly mobile species and would be able to utilise peripheral habitat around the Dam C impoundment to maintain connectivity upstream and downstream of the dam. The narrow disturbance of riparian corridors at infrastructure crossings of streams would not be of a sufficient magnitude to affect this mobile species.
Road Kill	Negligible, short term. It is not anticipated that the Masked Owl would be at substantial risk of collision with vehicles because the relatively low number of night-time vehicle movements, the minimal amount of moderate suitability habitat for the species located in construction areas, and the anticipated low density of the species if present.
Altered light regime	Negligible, short term. Only very small area of moderate suitability habitat in the Dam C area likely to be affected by light emissions.
Indirect Impacts	
Noise	Negligible, short term. Anticipated increases in noise are relatively minor and localised (refer **Section 15.2**).
Water Quality	Negligible, long term.

Action / Issue	Summary of Potential Construction Impacts Prior to Mitigation
	Impacts on water quality are discussed in **Section 16.2.5**. There are no impacts on water quality anticipated that would indirectly impact the Masked Owl through modification of habitat.
Air Quality	Negligible, short term. Anticipated increases in air emissions are relatively minor and localised compared to existing conditions. The species is highly mobile with a large home range and foraging or roosting individuals would be able to avoid local air quality impact areas. No nests of the species were located in the vicinity of proposed infrastructure areas where minor effects on air quality may occur (refer **Section 14.3**).
Introduction of weeds and pests	Minor, long term. Construction activities could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If introduced and allowed to proliferate these weeds could increase fire intensities and further adversely affect availability of prey and potential Masked Owl nesting trees.
Altered hydrological regime	Negligible, long term. Impacts on the hydrological regime are discussed in **Section 16.2.3**. There is no significant change anticipated to wetland or riparian habitats that would be utilised by the Masked Owl.
Altered fire regime	Minor, long term. Construction activities could have minor impacts on the current fire regime if fire promoting weeds are introduced.

It is not anticipated that there would be substantial permanent lighting, noise or air emissions as these impacts would be relatively minor and localised (refer **Sections 14.3** and **15.2**). Traffic on access roads would be intermittent and there may be some short term local impacts on foraging individuals at crossings of riparian habitats as vehicles pass; however, it is anticipated that individuals would become tolerant of this minimal disturbance, and the overall impact of these on foraging activity by the species would be negligible.

The operational phase of the Project is unlikely to lead to the introduction of any invasive fauna that could affect the Masked Owl, but operational activities could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If introduced and allowed to proliferate within undisturbed habitat of the Masked Owl, these weeds could lead to an increase in fire intensity in woodland habitats and subsequent changes to prey and nest tree availability. This could result in localised minor impacts on the species.

Hydrological changes resulting from operational activities are not anticipated to lead to significant changes to wetland or riparian habitats that may be used by the species. Impacts to the availability of prey populations or habitat structure are not expected to occur.

Table 6-24 summarises the operational impacts to the Masked Owl prior to mitigation.

Table 6-24 Summary of Operational Impacts Prior to Mitigation for the Masked Owl

Action / Issue	Summary of Potential Operational Impacts Prior to Mitigation
Direct Impacts	
Clearing and loss of habitat	Negligible, long term. A 5ha removal is not anticipated to impact any potential individuals that may be located in the area.
Edge effects	Negligible, long term. Edge effects are anticipated to be negligible given that no high suitability habitat would be displaced and the negligible noise, light and air quality impacts.
Fragmentation of habitat	Negligible, long term. Only a small area of potential habitat would be removed. Connections between moderate suitability habitat areas would be maintained by areas not mined.
Effects on movement/breeding/ feeding patterns	Negligible, long term. A 5ha removal is not anticipated to impact any potential individuals that may be located in the area.
Road Kill	Negligible, long term. It is not anticipated that the Masked Owl would be at substantial risk of collision with vehicles because the relatively low number of night-time vehicle movements, the minimal amount of moderate suitability habitat for the species located in mining areas, and the anticipated low density of the species if present.
Altered light regime	Negligible, short term. There may be some intermittent local impacts on foraging individuals at access road crossings of riparian habitats; however, the overall impact of these on the species would be negligible.
Indirect Impacts	
Noise	Negligible, short term. There may be some intermittent local impacts on foraging individuals at access road crossings of riparian habitats; however, the overall impact of these on the species would be negligible (refer **Section 15.2**).
Water Quality	Negligible, long term. Impacts on water quality are discussed in **Section 16.2.5**. There are no impacts on water quality anticipated that would indirectly impact Masked Owl through modification of habitat.
Air Quality	Negligible, short term. Increases in air emissions would be relatively minor and localised (refer **Section 14.3**).

Action / Issue	Summary of Potential Operational Impacts Prior to Mitigation
Introduction of weeds and pests	Minor, long term. Operational activity at Dam C and use of access roads could lead to the introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass. If allowed to proliferate these weeds could lead to localised impacts on prey and nest tree availability.
Altered hydrological regime	Negligible, long term. Impacts on the hydrological regime are discussed in **Section 16.2.3**. There is no significant change anticipated to wetland or riparian habitats that would be utilised by the Masked Owl.
Altered fire regime	Minor, long term Mining activities could have minor impacts on the current fire regime if fire promoting weeds are introduced.

6.4.4 Avoidance, Mitigation, Enhancement Measures and Residual Impacts

Disturbance to potential Masked Owl habitats would be avoided or minimised through implementation of the following:

- the proposed SoE environmental buffer system would exceed the requirement of the Queensland Coordinator General's approval conditions and comprise a methodology for determining set-back distances for mining from sensitive vegetation, instead of from the banks of watercourses and wetlands. The sensitive vegetation would be buffered by Darwin Stringybark woodland would comprise the following vegetation types: riparian, wetland, estuarine, vine forest and coastal vegetation on sand. RTA would work with Traditional Owners and the relevant WCCCC Sub-committee on establishment of environmental buffers as part of the CHEMP. The buffer system would maintain a network of undisturbed habitats and would be enhanced through the proposed fire management program (refer **Section 6.3.4.2** for additional details) which would conserve fire sensitive flora and promote overall vegetation diversity and the feral pig control program (refer **Section 7.3.6.4** for additional details) which would reduce pig damage to riparian and wetland areas. Additional detail on the proposed SoE environmental buffer system is included in **Section 6.3.4.5**;
- habitat continuity around the dam impoundment would be provided by a minimum 200m environmental buffer from mining from the full supply level of the impoundment; and,
- the general avoidance measures discussed in **Section 3.13** further reduce impacts by siting facilities in areas with less sensitive habitat.

Direct and indirect unmitigated impacts associated with the Project on the Masked Owl are identified in **Table 6-23** and **Table 6-24**. The following mitigation and enhancement measures would reduce these unmitigated impacts:

- dusk stag-watching and call-playback surveys would be carried out for this species, concurrent with the Red Goshawk pre-clearing nest surveys (refer **Section 6.3.4.1** for additional details). Survey records and pertinent ecological records would be documented. Surveys would be conducted prior to undertaking any significant disturbance to land located within 200m of permanent water supporting riparian gallery forest of paperbark wetland, seasonally inundated Paperbark wetlands, seasonal watercourses supporting riparian gallery forest or an estuary. Large

hollow trees would be targeted. If any active Masked Owl nests are found within mining areas within the 200m limit, a 200m buffer around the nesting tree would be excised from the mine plan until the end of the breeding season. Any active Masked Owl nesting site identified within the mining path would be monitored until the nesting cycle has been completed, after which clearing activities would resume;

- a fire management program would be developed and implemented (refer **Section 6.3.4.2** for additional details). Enhancement of habitat quality through fire management is the key management measure proposed for the Masked Owl in the 2010 Action Plan (Garnett *et al.* 2010);
- a weed management program would be developed and implemented prior to commencement of construction, and would include weed surveys annually (post wet season) targeting operational areas and site routes (refer **Section 6.3.4.3** for additional details); and,
- progressive rehabilitation (refer **Section 6.3.4.6** for additional details).

Given the high densities of small rodents that are likely to occur in the young mine rehabilitation, it is considered likely that the Masked Owl, if present, could potentially utilise mine rehabilitated areas in preference to open Darwin Stringybark forest and early rehabilitation areas could be utilised as seasonal hunting areas by the species.

The proposed SoE environmental buffer system would benefit the Masked Owl by avoiding direct disturbance of the riparian and vine forest habitats where their favoured small mammal prey are most abundant. The proposed SoE environmental buffer system also prevents disturbance of surrounding woodland up to 200m from the boundary of sensitive vegetation (including riparian and vine forest), providing additional undisturbed areas for roosting and nesting. As a minimum, the proposed SoE environmental buffer system will cover approximately 8,356ha more than the regulatory buffer requirements set out in the Queensland Coordinator General's conditions of approval.

The weed management program would benefit the Masked Owl by controlling the potential establishment of fire promoting weeds during construction and operational phases that could lead to adverse fire effects on habitat features utilised by the species including the availability of trees with hollows and persistent mammal populations.

The 326ha of moderate suitability habitat which would be disturbed is located within the footprint of Dam C and road crossings. This infrastructure is likely to be retained at the end of the life of the Project (subject to consultation with Traditional Owners and other stakeholders, refer **Section 3.11**). These areas are still likely to provide foraging habitat; however, it has been assumed that they would be lower value for the Masked Owl than the pre-clearance vegetation (refer **Table 6-25**).

Table 6-25 Masked Owl Disturbance and Rehabilitation[2]

Masked Owl Habitat		**Area Disturbed (ha)**		**Rehabilitated To#**				
				High Suitability		**Moderate Suitability**		**Low/No Suitability**
Native Habitat Disturbed	High Suitability Habitat	**0**	=	0	+	0	+	0
	Moderate Suitability Habitat	**326**	=	0	+	0	+	326*
	Low/No Suitability Habitat	**29,332**	=	0	+	0	+	29,332
Total Disturbed		**29,658**	=	**0**	**+**	**0**	**+**	**29,658**
Difference (ha)				0	+	-326	+	+326

* This area is within the footprint of Dam C and road crossings, which may be retained for future use at the end of the life of the Project.

[2] Areas and percentages rounded to nearest ha

Although the Masked Owl has not been recorded from rehabilitation areas at Weipa, surveys of rehabilitated mine areas north of the Embley River (Winter and Alford 1999, unpublished Ecotone survey data for RTA) indicate the presence of five probable prey species in rehabilitated habitats compared to nine probable prey species in the Project area. Only one of these occurs in open Darwin Stringybark forest which comprises the vast majority of the areas to be mined (refer **Appendix 6-B**). Given the higher densities of small rodents that are likely to occur in the young mine rehabilitation, it is considered likely that the Masked Owl could potentially utilise mine rehabilitated areas in preference to open Darwin Stringybark forest and early rehabilitation areas could be utilised as seasonal hunting areas by the species, if present.

Note that more advanced rehabilitation techniques have recently reduced the amount of grass cover in young rehabilitation on the mining lease (which is attractive to small rodents). Although it is anticipated that this would consequentially reduce the long term potential for foraging by Masked Owls, the current rehabilitation objective for mined areas is predominantly woodland vegetation (refer **Section 3.10**) which would have a similar function to the existing ecosystems. The suitability of rehabilitated habitat for a range of native fauna, including prey species for the Masked Owl has been proposed as a performance indicator for rehabilitation (refer **Table 3-14**).

An environmental management plan outline for the Masked Owl which summarises these avoidance, mitigation and enhancement measures is provided in **Appendix 6-C**. The cost of key avoidance, mitigation and enhancement measures are summarised in **Appendix 5-B**. **Table 6-26** summarises potential impacts that were minor, moderate or high and the avoidance, mitigation and enhancement measures and residual impacts of the Project associated with the Masked Owl.

Table 6-26 Potential Impacts, Avoidance, Mitigation and Enhancement Measures and Residual Impacts for the Masked Owl

Potential Impact	Unmitigated Impact Magnitude	Relevant Avoidance and Mitigation Measures	Residual Impact Magnitude
Loss of a small area of moderate suitability habitat during construction of Dam C	Minor, long term.	All other areas of moderately suitable habitat protected within the proposed SoE environmental buffers. Protected moderate suitability habitat areas managed with favourable fire regime under the fire management program. Dusk stag-watching and call-playback surveys would be carried out for this species, coincident with the Red Goshawk pre-clearing nest surveys. If a nest is identified they would be protected and buffered.	Minor, long term.
Introduction of weeds that may intensify fire impacts on foraging and nesting opportunities	Minor, long term.	Weed management program. Fire management program.	Negligible, long term.

Table 6-27 summarises the potential impacts on the Masked Owl as a result of the Project after proposed mitigation measures have been considered, in terms of the significant impact criteria for matters of NES (DEWHA 2009c).

Table 6-27 Impact Assessment Summary - Masked Owl (*Tyto novaehollandiae kimberli*)

Will the proposed works…	**Masked Owl (*Tyto novaehollandiae kimberli*) - Vulnerable**
….lead to a long-term decrease in the size of an important population?	The northern race of the Masked Owl occurs between Townsville and the Kimberley region with other races extending down the east coast to Tasmania. The Masked Owl has been recorded in the Weipa area although the habitat within which it was recorded is unclear. The species was not recorded during surveys within the Project area. A population of Masked Owl, if present in the Project area could be regarded as an important population as the species is now rare on Cape York Peninsula with limited recent records. It is not expected that the Project would lead to a long term decrease in the population as the key potential habitats for the species would be largely unaffected by the Project. Specifically, only very small areas of moderate suitability habitat for the species would be affected within the Project area (326ha, which is likely to still be utilised for less intensive foraging). Sufficient foraging, roosting and nesting habitat would remain undisturbed to support the species. The proposed mitigation measures would avoid disturbance of the vast majority of suitable habitat, and potential active nests. A long term decrease in any population of the species present is unlikely to occur as a result of the Project.
….reduce the area of occupancy of an important population?	No high suitability habitat is located in the Project area. The potential moderate suitability habitat for the species would be largely unaffected by the Project and therefore the area of occupancy of the species (if present) is unlikely to be reduced.
….fragment an existing important population into two or more populations?	The most suitable habitats for the species would not be affected by the Project and given the high mobility of the species, minor habitat fragmentation in the Dam C area and at infrastructure crossings would not fragment any population that may be present.
….adversely affect habitat critical to the survival of a species?	The Project area does not include any critical habitat areas for the Masked Owl that are listed under the EPBC Act or identified in Recovery Plans, nor is the Project area regarded as critical habitat for the species given its similarity to other potential habitat areas on northern Cape York Peninsula.
….disrupt the breeding cycle of an important population?	The most suitable habitats for the species would not be affected by the Project and disruption to the breeding cycle of any population present is unlikely.
….modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The most suitable habitats for the species would be largely unaffected by the Project and consequently the species (if present) is unlikely to decline as a result of the Project.
….result in invasive species that are harmful to a vulnerable species becoming established in the	The Project is unlikely to lead to the introduction of any invasive fauna that could affect the species. Proposed control measures for weeds would be aimed at avoiding the spread of invasive weeds that may promote unfavourable fire regime within the habitat of the Masked Owl.

Will the proposed works…	**Masked Owl (*Tyto novaehollandiae kimberli*) - Vulnerable**
vulnerable species' habitat?	
…..introduce disease that may cause the species to decline?	Disease is not known as a threat to this species. It is not anticipated that the Project would represent a threat with respect to the introduction of disease.
….interfere substantially with the recovery of the species?	The Project is not expected to interfere with the recovery of the Masked Owl.

6.4.4.1 National Recovery Plan and Threat Abatement Plans

There is a national recovery plan for the Masked Owl (Woinarski 2004). **Table 6-28** outlines the consistency of the Project with the national recovery plan. There are no relevant threat abatement plans for the Masked Owl. However, the proposed feral pig program, which will reduce pig damage to riparian and wetland habitats, is consistent with the *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs* (DEH 2005) (refer **Table 5-30**).

6.4.5 Offset Measures

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012b), offsets are not required where the residual impact is not likely to be significant (when assessed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c).

Sections 6.4.3 and **6.4.4** of this report documents the results of the impact assessment process and concludes that with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the Project on the Masked Owl would be minor and therefore not significant (refer **Section 6.1.3**). As such, offsets relating to the Masked Owl are not required under the Commonwealth offsets policy.

Table 6-28 Consistency of SoE Project with National Recovery Plan for Masked Owl

Objective	Action	Consistency of the SoE Project with the National Recovery Plan
Enhance communication through operation of a recovery team	• Establish and operate a Recovery Team or regular forum or alliance to assist in the coordination of management actions.	Not applicable.
Undertake research to establish status of taxa, threats and impacts. Prioritise management actions.	• Assess population size, distribution and habitat requirements for the Masked Owl subspecies *T. n. kimberli* and *T. n. melvillensis*. • Undertake targeted studies to evaluate the relative significance of putative threatening processes (invasion of exotic pasture grasses, predation by feral cats, fire regimes). • Examine impacts of land clearing, particularly on the Tiwi Islands, and the Darwin-Daly region (and, for Masked Owl, the response to historic clearing in north-eastern Queensland); and use the resulting knowledge to develop guidelines for habitat protection, corridor configuration etc. for all taxa for landscapes subject to increasingly intensive development.	Not applicable: • Multiple field surveys conducted. • No Masked Owls known to occur in Project area.
Manage populations (or threats to populations) so that their conservation status becomes not threatened	• Maintain and enhance habitat suitability, through fire management. • Minimise impacts of acute land-use factors. • Minimise impacts of spread of exotic pasture plants.	Consistent: • Multiple field surveys conducted. • No Masked Owls known to occur in Project area. • Potential habitat has been mapped as part of the EIS. • Fire and weed management program are proposed to be implemented. • No high suitability habitat located in the Project area. The majority of moderate suitability habitat would be protected from mining in unfragmented buffers and undisturbed areas. • Pre-disturbance surveys are proposed in areas with the potential to have nests.

6.5 Northern Quoll (*Dasyurus hallucatus*)

6.5.1 Species Profile

6.5.1.1 Regional Distribution and Population

The Northern Quoll is listed as 'endangered' under the EPBC Act.

The Northern Quoll is distributed from south east Queensland across northern Australia to the Pilbara, including offshore islands, but has declined in many parts of this range, and currently maintains a disjunct distribution throughout. Core populations currently occur in rocky and/or high rainfall areas (Hill and Ward 2010).

Threatening processes have reduced the range of the species in Queensland to the extent that there has not been a confirmed sighting of the Northern Quoll in the Weipa Plateau Subregion and broader Cape York region for 20 years. Most notably, the arrival of the Cane Toad on the Cape York Peninsula in the 1980s has contributed to the decline of the species in this area, and the threat that Cane Toads pose to the species is supported by recent well documented declines of the species in the Northern Territory and Kimberley region as Cane Toads advance into those areas (Burnett 1997, Woinarski *et al.* 2008, Rankmore *et al.* 2008). However, populations of the Northern Quoll still persist in some parts of Queensland in the presence of the Cane Toad.

There has been no assessment of the overall population of the Northern Quoll or the Queensland population, although a systematic survey for the species in Queensland was conducted in 2006/2007 at four sites in the Weipa Plateau Subregion. No Northern Quolls were recorded at these sites; however there are observational records of the Northern Quoll from three locations on the Wenlock River from circa 2006/2007 and an unconfirmed sighting of a Northern Quoll at the Scherger Air Base in 2012. The latest specimen of the species from Cape York Peninsula (held by the Queensland Museum) is from the Pine River 20km north of Weipa in 1981.

Consultation with Traditional Owners during a targeted survey for the Northern Quoll north of Weipa in 2007 revealed an anecdotal record from around 2001 in vine forest on bauxite north of Weipa (Possum Scrub) (M. Thomas, pers. comm. 2012). Overall the population of the Northern Quoll in the Subregion is unknown and the paucity of recent records strongly implies currently very low densities.

The EPBC Act referral guidelines for the Northern Quoll (DSEWPaC 2011a) include a species distribution model based on best available information. The modelling indicates the species is "known or likely to occur" north of the Embley River and "may occur" in the Project area.

6.5.1.2 Regional Ecology and Habitat

Northern Quolls do not have highly specific habitat requirements in terms of vegetation, occurring in a broad range of habitats, where they are able to change their foraging behaviour to target seasonally available prey (Hill and Ward 2010). However, core populations currently occur in rocky and/or high rainfall areas.

Northern Quolls are omnivores, taking a range of vertebrate and invertebrate prey as well as native fruit, nectar, carrion, and human refuse (DSEWPaC 2012q). Known habitats include closed and open forest, woodland, coastal and beach habitats, shrublands, grasslands and desert within both elevated and lowland areas (DSEWPaC 2012q). The availability of daytime den sites is important to the species, though these may take a variety of forms including rocky outcrops, rock piles, hollow logs, tree hollows, excavated burrows or termite mounds (Hill and Ward 2010).

Habitat critical to the survival of the Northern Quoll has been identified as rocky areas and offshore islands (Hill and Ward 2010) with recent research in the Northern Territory showing that the occurrence of Northern Quolls was correlated with topographic complexity (Woinarski *et al.* 2007). Similarly, declines of the Northern Quoll in Queensland have been predominantly in flatter, lowland areas with the most abundant remaining populations associated with sites of high relief, containing boulders and close to permanent water (Woinarski *et al.* 2008, Burnett 1997). Elevated breeding success has also been associated with individuals that den close to creek lines (Braithwaite and Begg 1995).

Potential habitat of the Northern Quoll in the Subregion is summarised in **Table 6-29** and mapped on **Figure 6-7.**

High suitability habitat for the Northern Quoll is defined as areas of high topographic variability with rocky denning and foraging habitats close to waterways (Woinarski *et al.* 2008). These areas may include a range of vegetation types but commonly woodland. There is no high suitability habitat for the Northern Quoll mapped within the Subregion due primarily to the lack of significant rocky habitats and limited topographic relief[3]. In addition, the Darwin Stringybark dominated woodlands that occur across much of the Subregion are not regarded as high suitability habitat. Although it is possible for Darwin Stringybark woodlands to contain alternative denning habitat such as hollow logs, termite mounds and hollow trees, those features are not abundantly present in the local area due to the impacts on habitat quality from the current regime of extensive frequent fires (M. Thomas pers. comm.). Given that these features were not abundant within the Project area or Weipa area it was assumed that a similar lack of these features was likely throughout the Subregion given the similar fire regime characteristics. Additional details on the fire regime are included in **Section 4.2.1.7**.

Moderate suitability habitat is comprised of areas of relatively structurally complex vegetation (especially woodlands, but also vine forest) with low - high topographic relief, no rocky denning habitat, but containing alternative denning habitat such as hollow logs and trees. These comprise more fire protected habitats than the extensive woodlands subject to regular extensive fires.

Low/no suitability habitat is comprised of areas with low topographic relief, no rocky habitat or alternative denning habitat, and low vegetation diversity. Moderate suitability habitat is not rare and the Subregion contains close to 150,000ha of moderate suitability habitat.

6.5.1.3 Potential Project Area Distribution, Ecology and Habitat

The Northern Quoll was not located in the Project area during field surveys. There are no previous confirmed records of the species from the Project area although it is anticipated that, given records of the species in similar habitat in the Weipa area, the species occurred historically in the Project area though perhaps with limited spatial extent, sometime prior to the arrival of Cane Toads.

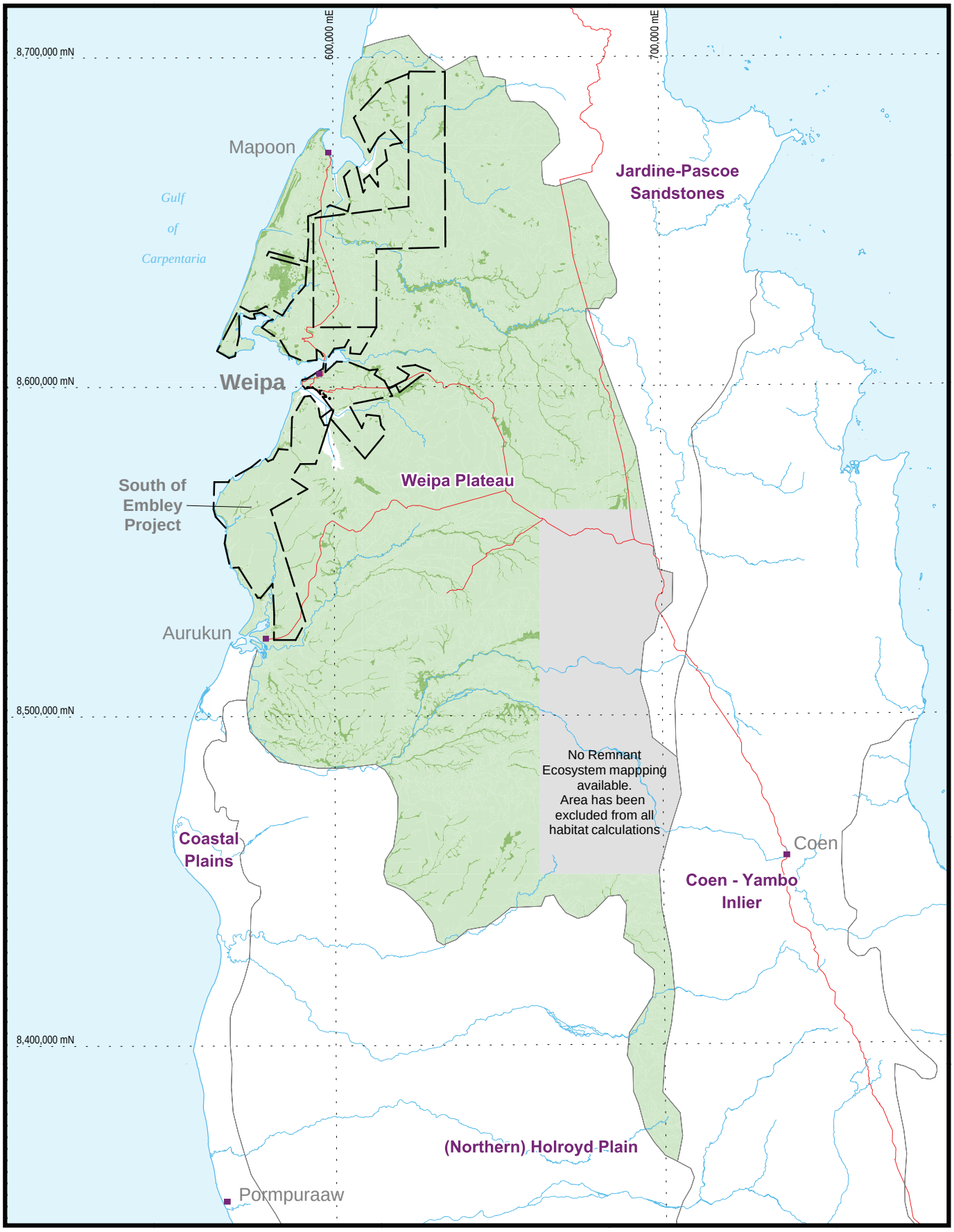
Consultation with Traditional Owners did not indicate any sightings of the species in recent memory (20+ years) within the Project area. However there was a very recent unconfirmed sighting at the Scherger Air Base (July 2012) approximately 24km east of Weipa. While the species may once have utilised Darwin Stringybark woodland, it is concluded on the basis of fauna survey results in the Weipa area over the past six years and assessment of habitat values in this habitat that it currently does not provide very suitable habitat for the species for the following reasons.

[3] Note: a small area of RE 3.12.33 comprising high suitability rocky habitat is incorrectly mapped on Version 6 of the EHP RE mapping within the subregion near the Skardon River. No other high suitability RE's are currently mapped within the subregion.

Table 6-29 Potential Habitat of the Northern Quoll (Weipa Plateau Subregion)

Habitat Suitability Classes		REs and Other Map Units	Map Compilation
High	Areas of high topographic variability with rocky denning and foraging habitats and close to waterways. May include a range of vegetation types but commonly woodland.	nil	No high suitability habitat is mapped for the Subregion. None of the REs present within the Subregion provide extensive rocky habitat.
Moderate	Areas (especially woodlands) with low - high topographic relief, no rocky denning habitat, but containing alternative denning habitat such as hollow logs and trees.	3.2.2a 3.3.38 3.3.39 3.3.5a 3.3.6 3.5.4 3.7.1 3.3.14a 3.3.9	Moderate suitability habitat includes relatively structural complex REs that are likely to provide alternative denning opportunities, primarily fire resistant habitats associated with vine forest and riparian areas.
Low/No	Areas with low topographic relief, no rocky habitat or alternative denning habitat, and low vegetation diversity.	3.1.1a 3.1.3 3.1.5 3.1.6 3.2.10c 3.2.5a 3.3.21 3.3.32 3.3.33 3.3.36 3.3.37a 3.3.37b 3.3.42a 3.3.44 3.3.49a 3.3.49b 3.3.50c 3.3.60a 3.3.61a 3.3.66x1b 3.3.50a 3.3.63 3.3.64a 3.3.65 3.3.66a 3.3.66x1a estuary water 3.3.53x1 3.3.56 3.3.56a 3.5.19x4 3.5.19x7 3.5.29 3.9.8a non-rem rock sand 3.10.15b 3.10.6d 3.11.7 3.11.11 3.11.17b 3.12.14c 3.2.25 3.5.11 3.5.14b 3.5.14c 3.5.18x2 3.5.2 3.5.22a 3.5.22c 3.5.22d 3.5.22x2 3.5.24a 3.5.24b 3.5.28 3.7.3 3.7.5a 3.7.5b 3.7.6 3.7.6b 3.9.2a 3.9.2b 3.9.4 3.9.5 3.9.7 3.2.3 3.2.7a 3.3.12 3.3.16 3.3.18 3.3.19 3.3.20a 3.3.20b 3.3.22a 3.3.23 3.3.24 3.3.25a 3.3.27c 3.3.28 3.3.31b 3.3.10a 3.10.10 3.10.21a 3.10.21c 3.10.6a 3.10.9e 3.5.10 3.5.10x1 3.5.19x3 3.5.26 3.5.7a 3.5.7x2a 3.5.7x2b 3.5.8a 3.5.8c 3.5.9a 3.5.9d 3.7.4 3.9.2x4	Remaining habitat types were mapped as low or no suitability habitat.

Note: RE's with an 'x' denote a subdominant vegetation type following the 'x'



RTA Mining Lease boundary
Cape York Sub-Regions Boundary
Road/track
Locality
River

Northern Quoll Habitat

Moderate Suitability Habitat
Low / No Suitability Habitat
No mapping

South of Embley Project

Fig. 6-7: Potential Habitat of Northern Quoll (Weipa Plateau Subregion)

N

25 0 25km

Datum/Projection: GDA94/MGA Zone 54 Date: 17/09/2012

Firstly, in order for Northern Quolls to make extensive use of Darwin Stringybark woodland appropriate denning opportunities would be required within the habitat type. The favoured rocky denning habitat is not associated with the Project area and alternative denning habitat such as hollow logs and trees are scarce within Darwin Stringybark woodland located in the Project area as the frequent fire regime typically destroys hollow logs rapidly, and hollow trees are quickly felled by fire once an initial fire incursion into the base of the tree occurs. Termite mounds are present within this habitat and suitably hollowed examples could be utilised by Northern Quolls for denning; however, Monitor Lizards and Echidnas that typically breach termite mounds and provide openings to be exploited by other fauna such as Northern Quolls, are relatively scarce in Darwin Stringybark woodland within the Project area and hollow mounds are also uncommon.

Secondly, the general habitat values of Darwin Stringybark woodland in the Project area have been adversely affected by the frequent extensive fire regime (refer **Section 4.2.1.7**), and small-medium sized ground mammals such as rodents, small dasyurids (Dunnarts), bandicoots, and arboreal mammals are extremely scarce (RTA 2011). This is most likely related to the fire induced reduction in vegetation complexity affecting productivity for mammal species and the difficulties extensive fires pose for post-fire re-colonisation of habitat, even for relatively mobile species such as the Northern Quoll.

These observations of low habitat suitability for the Northern Quoll in the Project area are consistent with key findings of a recent study that modelled Northern Quoll habitat in Queensland (Woinarski *et al.* 2008). This study found that in general Northern Quolls were absent from areas of low topographic relief without rocky habitat (such as the Project area) and that the probability of occurrence of the Northern Quoll in Cape York Peninsula has significantly declined over the last 40 years. Particular habitat parameters that had the best correlation with the presence of Northern Quolls comprised (in order of decreasing importance):

- shallower soils;
- greater cover of boulders;
- less fire impact;
- closer to permanent water;
- more extensive cover of rocks with diameter 60cm to 2m;
- greater cover of outcropping rock;
- steeper;
- had more extensive total rock cover; and,
- were less likely to have been burnt recently.

None of these parameters align with the habitat features occurring in extensive Darwin Stringybark woodland and consequently Darwin Stringybark woodland is mapped as low or no suitability habitat for this species within the Project area (refer **Table 6-30**).

Patches of vine forest and riparian forest habitat also do not provide optimal rocky habitat for the species but represent the most likely habitat for encountering the Northern Quoll within the Project area as these fire resistant habitats provide denning opportunities and relatively productive ecosystems in terms of shelter and prey availability. These habitats are mapped as moderate suitability and it is possible that the species could be present within these habitat locations, most likely the riparian communities and coastal vine forest associated with Norman Creek, and the vine forest patches in the Hey Point area. If present, the species may traverse between vine forest and riparian forest through Darwin Stringybark (*E. tetrodonta*) open forest. Potential habitat areas for the species within the Project area are presented in **Figure 6-8** and summarised in **Table 6-30**.

RTA Mining Lease boundary
Locality
Road/track
River
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40

Northern Quoll Habitat

Moderate Suitability Habitat
Low / No Suitability Habitat
Comprehensive survey site (A-L)
Supplementary survey site
Targeted threatened fauna survey site
Vehicle traverse

South of Embley Project

Fig. 6-8: Potential Habitat of Northern Quoll (Project Area)

N

5 0 5km

Datum/Projection: GDA94/MGA Zone 54 Date: 31/10/2012

Rio Tinto Alcan

Table 6-30 Potential Habitat of the Northern Quoll (Project Area)

Habitat Suitability Classes		RE's and Other Map Units	Map Compilation
High	Areas of high topographic variability with rocky denning and foraging habitats and close to waterways. May include a range of vegetation types but commonly woodland.	nil	No high suitability habitat mapped for the Project area as none of the REs present provide substantial rocky habitat.
Moderate	Areas (especially woodlands) with low - high topographic relief, no rocky denning habitat, but containing alternative denning habitat such as hollow logs and trees.	3.3.21 3.2.2 3.3.5a 3.5.4 3.3.14a 3.3.9	Moderate suitability habitat includes relatively structural complex REs that were observed to provide alternative denning opportunities; primarily fire resistant habitats associated with vine forest and riparian areas.
Low/No	Areas with low topographic relief, no rocky habitat or alternative denning habitat, and low vegetation diversity.	3.1.1a 3.1.1c 3.1.3 3.1.5 3.1.6 3.2.10c 3.2.5a 3.3.49b 3.3.60a 3.3.61 3.5.11 3.5.22c 3.3.50a 3.3.63 3.3.64 3.3.65 estuary water non-rem rock sand 3.2.25 3.2.6a 3.5.2 3.7.3 3.2.3	Remaining habitat types were mapped as low or no suitability habitat.

Critical habitat is habitat that the Minister has listed in the Register of Critical Habitat (prepared under Section 207A of the EPBC Act) in relation to an EPBC-listed species or ecological community. DSEWPaC's Register of Critical Habitat does not identify any critical habitat for the Northern Quoll.

There are no current population estimates for the Northern Quoll on Cape York Peninsula. Realistically, it is not anticipated that the Northern Quoll occurs within the Project area given the recent decline of the species on Cape York Peninsula and in lowland habitats in general, and the absence of high suitability habitat for the species. However, given the constraints in employing targeted surveys within the Project area (no suitable target areas exist) and a general lack of survey effort by others for the species in the Subregion it is possible that the species could possibly occur in the Project area but any occurrence is likely to be at very low densities, or on an intermittent basis.

6.5.1.4 Threats

Overall threats identified for the Northern Quoll (DSEWPaC 2012q) include:

- lethal toxic ingestion caused by Cane Toads;
- removal, degradation and fragmentation of habitat as a result of development actions and agricultural activities leading to population isolation;
- inappropriate fire regimes;
- invasion of habitat by weeds;
- predation and or competition associated with feral animals (cats, dogs);
- enhanced exposure to the effects of disease in isolated populations; and,
- hunting or extermination.

The following threats are listed as a key threatening process for the species under the EPBC Act:

- lethal toxic ingestion caused by Cane Toads;
- the invasion of northern Australia by Gamba Grass (*Andropogon gayanus*) and other introduced grasses; and,
- predation by the Feral Cat (*Felis catus*) and European Red Fox (*Vulpes vulpes*).

6.5.2 Survey and Results

6.5.2.1 Survey Approach

Section 6.2 provides a general overview of the terrestrial fauna survey approach. The following summarises the efforts and results for the Northern Quoll. A summary of the suitability of survey timing and species specific limitations of the survey approach are included in **Table 6-4** in **Section 6.2**.

The Northern Quoll is of moderate detectability in suitable habitat areas being fairly readily trapped in cage traps or large Elliot traps and potentially encountered during spotlight searches. The species may also be detected using hair tubes and motion cameras.

The survey of the Project area was undertaken in advance of the release of the *Survey Guidelines for Australia's Threatened Mammals* (DEWHA 2010c), however the survey was generally consistent with the intent of the guidelines. The guidelines provide a recommended survey approach for the Northern Quoll focussing on the use of cage traps and Elliot traps (particularly large size). The guidelines recognise that trapping may be difficult in remote areas and is ethically problematic during the breeding season. The guidelines also suggest the potential use of other survey techniques to complement trapping effort in these areas including:

- daytime searches for potentially suitable habitat resources such as rock overhangs, crevices and boulders;
- daytime searches for latrines;
- daytime searches or use of sand traps to identify the characteristic tracks of the species;
- remote motion activated cameras (camera traps);
- hair tubes;
- spotlight surveys; and,
- community liaison to provide additional records.

The guidelines' recommended survey efforts are provided for a 5ha site including a minimum three night survey using 20 Elliot traps and 10 cage traps. The recommended survey approach is tailored to habitat areas providing high suitability habitat resources for the species. More extensive discussion of the survey guidelines provided in the SPRAT profile (DSEWPaC 2012q) recommends the use of a reconnaissance survey to identify the need for further targeted survey investigations. The objective of the reconnaissance survey is to determine the presence of suitable habitat for the species, in particular, key denning habitats, where targeted surveys can be focussed. Targeted surveys are recommended for any areas where the reconnaissance survey identifies either the presence of the Northern Quoll, or high suitability habitat critical to the survival of the species (Hill and Ward 2010), namely areas of high topographic relief with boulder or rocky habitat and close to permanent water or streamlines. Neither individuals of the species nor habitat matching the description of habitat critical to the survival of the species were located within the Project area.

The Northern Quoll historically occurred in the Weipa area prior to the arrival of the Cane Toad in the 1980s. Specimen records of the species are from beach and vine forest habitats but it is likely that the species utilised all habitats present in the bauxite plateau landscape adjacent to suitable denning habitat, including Darwin Stringybark open forest and associated woodland habitats.

The Northern Quoll has not been trapped on Cape York for at least 20 years (although there have been some recent sightings in the region) and it appears that if the species does persist on the Cape it most likely currently occurs in association with high suitability habitat areas. This agrees with recent survey data for Queensland showing population aggregations associated with critical rocky high relief

habitat (Woinarski *et al.* 2008, Burnett 1997). The Project area does not include rocky structures and high topographic relief and therefore does not support any high suitability habitat critical to the survival of the species. The absence of high suitability habitat within the Project area made it difficult to devise a targeted survey for the Northern Quoll as there were no habitat areas that appeared more likely to support the species than any other. None of the habitats present were considered suitable for a broadscale targeted survey of the species and consequently the primary survey approach adopted for the Northern Quoll was to rely on the wide array of survey techniques included in the overall fauna survey program to detect the species if present, with some specific targeted survey for the Northern Quoll comprising installation of baited camera traps and cage trapping undertaken in June 2012.

During the June 2012 survey, infra-red motion sensor cameras were installed at 14 sites over a nine night period across a range of habitats including Darwin Stringybark woodland, riparian gallery forest and vine forest. Cage trapping was conducted at six sites and followed the recommended survey approach of the survey guidelines for mammals (DEWHA 2011c) comprising 10 cage traps per site set for four consecutive nights. Additional advice was sought from Dr. Scott Burnett (Queensland Quoll expert) as to the optimal bait and deployment of traps and cameras for Northern Quolls. Camera trapping was conducted during the October 2012 survey at 15 Darwin Stringybark woodland sites. Camera traps were used in preference to cage traps which have the potential to cause disturbance or stress to breeding Northern Quolls during this period.

A summary of the survey effort applied for Northern Quoll during the surveys is provided in **Table 6-31**. Survey activities that were undertaken during the comprehensive surveys, targeted threatened fauna surveys and supplementary surveys that are regarded as appropriate for detecting the Northern Quoll comprised:

- cage traps;
- camera traps;
- Elliot traps (Type A for smaller individuals);
- hair tube traps;
- spotlight sessions; and,
- nocturnal vehicle traverses.

The twelve comprehensive survey sites covered a range of habitat types including Darwin Stringybark woodland (five sites), coastal vine forest (one site), vine forest on bauxite (one site), riparian gallery forest and associated alluvial/colluvial woodland (three sites), and Paperbark woodland/colluvial woodland (two sites). Comprehensive surveys expended 2,400 Elliot trap nights; 288 hair tube trap nights; 24 cage trap nights; 18 spotlight hours; and, 26 hours of night time vehicle traverses.

Targeted threatened fauna surveys expended an additional 469 trap nights through deployment of cage traps and camera traps as well as 50 hours of survey effort from spotlight sessions and vehicle traverses. Supplementary survey sites added a further 14 hours of survey effort from spotlight sessions and vehicle traverses.

The detectability of Northern Quolls peaks in the lead up to the mating season when males are actively seeking females and typically are less wary of predators. All males die after mating leading to a significant temporary adult population reduction until young are born (mid dry season) and become independent from their mothers. The timing of surveys within the Project area (i.e. April-June and December) coincided with periods of the Northern Quoll lifecycle when a high adult population would be present (April-May) and when new recruits would be actively independent (December), and consequently surveys were well timed for maximum detectability of the species.

Table 6-31 Survey Effort for Northern Quoll

Survey activity	No. nights	Duration of each survey activity (hours) / no. of traps)	No. of sites	Total survey effort for activity (hours / trap nights)
Comprehensive surveys – May 2007, May 2008 - total survey period of 16 days*				
Elliot traps	4	50 traps	12	2400 trap nights
Hair tubes	4	6 traps	12	288 trap nights
Cage traps	4	2 traps	3	24 trap nights
Spotlight session	12	2 x 0.75 hours	12	018 hours
Vehicle traverses	13	2 hours (average)		26 hours
			Total for Comprehensive surveys	*44 hours* *2,712 trap nights*
Targeted threatened fauna surveys – December 2007/2008, May 2008/2009, June 2012, October 2012 - total survey period of 60 days*				
Cage trapping	4	10 traps	6	240 trap nights
Camera traps	18	29		229 trap nights
Spotlight session	12	0.75 hours	24	18
Vehicle traverses	16	2 hours		32
			Total for Targeted threatened fauna surveys	*50 hours* *469 trap nights*
Supplementary surveys – July 2006 and May2007 - total survey period of 12 days*				
Spotlight session	4	0.75	8	6
Vehicle traverses	4	2 (average)		8
			Total for Supplementary surveys	*14 hours*
			Grand Total	108 hours 3,181 trap nights

** Only the components of the total survey period that are applicable to the Northern Quoll are presented in this section of the table.

6.5.2.2 Survey Results

The Northern Quoll was not located in the Project area during field surveys.

Given the decline of the species on Cape York Peninsula and the apparent perilous state of the species in the region, any population of Northern Quoll located on Cape York Peninsula would be regarded as an important population under the meaning of the EPBC Act as it would satisfy all three criteria comprising:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or,
- populations that are near the limit of the species range.

Similarly, any population of the Northern Quoll located within the Project area, if they occur, would be of regional significance.

Table 6-32 summarises the profiling information for the Northern Quoll.

6.5.3 Relevant Impacts

The following sections outline the potential construction and operational impacts of the Project on the Northern Quoll.

The Northern Quoll was not located within the Project area. The majority of potential habitat for the species occurs within the proposed SoE environmental buffer system. Suitable foraging habitat and sub-optimal denning habitat for the Northern Quoll occurs within the Dam C area given the presence of fire protected vine forest and riparian gallery forest habitat; however, these areas are subject to seasonal inundation, reducing their suitability for permanent occupation. Dam C represents the major disturbance area within potential habitat of the Northern Quoll with smaller areas comprising crossings of riparian habitats of Norman Creek by infrastructure corridors. If present within these moderate suitability habitats, the species would most likely also traverse Darwin Stringybark habitat potentially including areas proposed for mining or within the Boyd infrastructure area; however, only a small portion of this potential habitat would be impacted at any one time and it would be progressively rehabilitated. For the reasons outlined above, while individuals may traverse Darwin Stringybark woodland as part of routine movements it is not anticipated that this habitat would be used extensively for foraging. Progressive rehabilitation would also reinstate habitat values for the species and potential foraging areas over the life of the Project.

6.5.3.1 Construction Impacts Prior to Mitigation

The Northern Quoll was not located within the Project area and no high suitability habitat occurs within the Project area; however some moderate suitability habitat would be displaced during construction specifically at the Dam C footprint and infrastructure crossings of riparian habitats.

The total area of disturbance during construction includes, approximately 184ha of moderate suitability habitat (refer **Table 6-33**). The disturbance area represents approximately 4.5% of the total area of moderate suitability habitat within the Project area and <0.1% of the moderate suitability habitat within the Subregion and is therefore a minor component of the potential habitat available for the species. There are not anticipated to be any relevant edge effects associated with clearing that would impact on the Northern Quoll as the noise, air quality and hydrological impacts would be relatively minor and localised (refer **Sections 14.3**, **15.2**, **16.2** and **16.4**).

With respect to potential disturbance of breeding by the Northern Quoll, suitable foraging habitat and sub-optimal denning habitat for the Northern Quoll occurs within the Dam C area given the presence of fire protected vine forest and riparian gallery forest habitat. However, these areas are subject to seasonal inundation, reducing their suitability for permanent occupation, particularly for breeding. The Dam C site was surveyed for presence of threatened fauna and no sign of the Northern Quoll was detected. Overall, the potential impacts on the Northern Quoll from clearing of habitat during construction are anticipated to be minor.

The discrete areas of disturbance to potential Northern Quoll habitat resulting from construction are small compared to the overall areas of habitat that would not be affected by construction and would not lead to fragmentation of habitat for the species given the capability of the species to traverse relatively extensive distances.

Table 6-32 Profile Summary for the Northern Quoll

Species **Common Name**	**Key Resources**	**Potential Habitat within Project area**			**Known/estimated Population in Project area**	**Likelihood of Occurrence within Project Area**
		High Suitability Habitat	**Moderate Suitability Habitat**	**Low/no Suitability Habitat**		
Dasyurus hallucatus Northern Quoll	High topographic relief habitats. Rocky features such as outcrops or boulders. Proximity to permanent water or streamlines. Availability of prey resources.	No high suitability habitat occurs within or adjacent to the Project area due to a lack of topographic complexity and rocky habitats.	Riparian gallery forest, coastal woodland complexes, and vine forest near the coast and on bauxite.	The majority of the Project area comprises low/no suitability habitat due to the lack of rocky habitat, topographic relief and secure denning habitats.	Most likely not present but may possibly occur at very low densities or intermittently.	**Mining Area** **Unlikely:** this species has declined on Cape York following the spread of Cane Toads to the area. A paucity of favoured rocky habitat and continued exposure to modification and suppression by fire may see limited persistence of the species in suitable habitat within the Project area. Whilst the species may once have utilised Darwin Stringybark woodland it is most likely that patches of vine forest and riparian forest habitat currently provide the most likely habitat for the species within the Project area. **Infrastructure footprint** **Possible:** minor areas of suitable riparian habitats are located within the footprint of the water supply dam, although targeted searches did not locate the species in these areas. The habitat areas within the proposed dam footprint are not regarded as especially significant for foraging or breeding. **Balance of Project area not disturbed** **Possible:** although the optimal habitat for the species, rocky outcrops and other rocky habitat, is not available within the Project area, the Northern Quoll may occur in vine forest and riparian gallery forest. Suitable habitat for the species includes the riparian communities of Norman Creek, and the vine forest patches in the Hey Point area, which are not within proposed mining areas. All vine forest areas, and most riparian habitats within the Project area, are located in areas not to be disturbed.

Table 6-33 Habitat Disturbance for the Northern Quoll

Phase		High Suitability Habitat				Moderate Suitability Habitat				Low/No Suitability Habitat			
		Total in Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion	Total in the Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion	Total in Project Area (ha)	Proportion in Project Area	Total in Subregion (ha)	Proportion in Subregion
Total Habitat		**0**	**0.0%**	**0**	**100.0%**	**4,090**	**100.0%**	**142,720**	**100.0%**	**96,487**	**100.0%**	**2,157,568**	**100.0%**
Undisturbed		**0**	**0.0%**	**0**	**100.0%**	**3,906**	**95.5%**	**142,536**	**99.9%**	**67,013**	**69.5%**	**2,128,094**	**98.6%**
Disturbed	Construction Disturbance	0	0.0%	0	0.0%	184	4.5%	184	0.1%	2,257	2.3%	2,257	0.1%
	Operations Disturbance	0	0.0%	0	0.0%	0	0.0 %	0	0.0%	27,217	28.2%	27,217	1.3%
	Total Disturbed	**0**	**0.0%**	**0**	**0.0%**	**184**	**4.5%**	**184**	**0.1%**	**29,474**	**30.5%**	**29,474**	**1.4%**

Note: Areas and percentages rounded to nearest ha / percentage point

Construction of Dam C would disrupt the riparian corridor along the middle branch of Norman Creek. Riparian corridors would also be impacted where infrastructure crosses streams. This may alter movement patterns in this area; however, they are a mobile species and would be able to utilise peripheral habitat around the Dam C impoundment to maintain connectivity upstream and downstream of the dam. Similarly, the Northern Quoll is able to cross narrow disturbance areas similar to those created by narrow infrastructure corridors and overall movement patterns would not be affected by the Dam C footprint or infrastructure corridors.

While all terrestrial fauna are susceptible to road kill to some extent, it is not anticipated that the primarily nocturnal Northern Quoll would be at substantial risk of collision with construction vehicles. This is because the relatively low number of night-time vehicle movements expected within construction areas, the minimal amount of moderate suitability habitat for the species located in construction areas, and the anticipated low density of the species if present. With respect to construction related traffic travelling to the Project area, a peak of 70 vehicles per day is expected on the PDR from the Archer River Quarry (which would be utilised subject to suitable commercial agreement). The majority of these traffic movements would occur during daylight hours when the Northern Quoll is not active, and the route comprises extensive low habitat suitability areas for the species. Consequently there is also a low likelihood of this traffic interacting with Northern Quolls and any impact of vehicle strike is anticipated to be negligible.

Artificial lighting in the area may illuminate immediately adjoining habitat for the species and reduce prey activity and foraging success. This would represent a very small area of habitat and light emissions are likely to be attenuated within a short distance into the woodland habitats and would only occur for a short period of time during construction. Overall, lighting impacts on the Northern Quoll are likely to be negligible.

Anticipated increases in noise and air emissions are relatively minor and localised. No dens of the species were located in the vicinity of the Dam C area where construction noise levels and air emissions would be highest compared to other moderate suitability habitat areas in the Project area. The species is mobile with home ranges over 100ha for males and approximately 25ha for females. Foraging individuals that may encounter local noise and air emissions would be able to avoid these areas and utilise adjacent alternative habitat or other undisturbed habitat areas that occur throughout the Project area. Any impact from noise and air emissions would be negligible. Additional details on noise and air emissions are provided in **Sections 14.3** and **15.2**.

Construction of the Project is unlikely to lead to the introduction of any new invasive fauna that could affect the Northern Quoll, given the current abundance of Cane Toads (*Bufo marinus*) within the Project area and wider region. The potential introduction (via machinery and light vehicles) and spread of fire promoting weeds such as Gamba Grass and Guinea Grass is unlikely to have a significant impact on the species. While enhanced fire intensity promoted by these weeds could affect the edge of riparian and vine forest vegetation types by promoting hotter fires it is not anticipated that the impacts would lead to extensive changes to riparian and vine forest patches or the potential prey populations they support. Any effects of enhanced edge fires on the species would also be limited by the natural ability of the Northern Quoll to vary dietary items based on availability of prey.

Hydrological changes resulting from construction activities are not anticipated to affect habitat utilised by the species. Additional details are provided in **Sections 16.2** and **16.4**.

Construction activities are not expected to significantly alter the current fire regime. **Table 6-34** summarises the potential unmitigated construction impacts for the Northern Quoll.

Table 6-34 Summary of Construction Impacts Prior to Mitigation for the Northern Quoll

Action / Issue	Summary of Potential Construction Impacts Prior to Mitigation
Direct Impacts	
Clearing and loss of habitat	Minor, long term. The total area of disturbance during construction would include approximately 184ha of moderate suitability habitat. The disturbance area represents approximately 4% of the total area of moderate suitability habitat within the Project area and a fraction of a percent of the moderate suitability habitat within the Subregion and is therefore a minor component of the potential habitat available for the species.
Edge effects	Negligible, short term. Edge effects are anticipated to be negligible given that no high suitability habitat would be displaced and the negligible noise, light and air quality impacts.
Fragmentation of habitat	Negligible, long term. Minor fragmentation of habitat caused by clearing for construction would have negligible effect this highly mobile species.
Effects on movement/breeding/ feeding patterns	Negligible, long term. Construction of Dam C would disrupt the riparian corridor along the middle branch of Norman Creek and may force the Northern Quoll to make minor adjustments to movement patterns in this area; however, they are mobile species and would be able to utilise peripheral habitat around the Dam C impoundment to maintain connectivity upstream and downstream of the dam.
Road Kill	Negligible, short term. It is anticipated that the Northern Quoll would be at negligible risk of collision with vehicles given the minimal amount of moderate suitability habitat for the species located in construction areas and the low volume of vehicle movements.
Altered light regime	Negligible, short term. Only very small area of habitat in the Dam C area is likely to be affected by light emissions.
Indirect Impacts	
Noise	Negligible, short term. Anticipated increases in noise are relatively minor and localised (refer **Section 15.2**). The species is mobile and foraging individuals would be able to avoid local noise impact areas. No dens of the species were located in the vicinity of proposed infrastructure areas where noise levels would be highest.
Water Quality	Negligible, long term. Impacts on water quality are discussed in **Section 16.2.5**. There are no impacts on water quality anticipated that would indirectly impact the Northern Quoll through modification of habitat.
Air Quality	Negligible Anticipated increases in air emissions are relatively minor and localised compared to existing conditions (refer **Section 14.3**). The species is highly mobile and foraging individuals would

Action / Issue	Summary of Potential Construction Impacts Prior to Mitigation
	be able to avoid local air emission areas. No dens of the species were located in the vicinity of proposed infrastructure areas where Project air emissions levels would be highest.
Introduction of weeds and pests	Negligible, long term. It is unlikely that Gamba Grass or Guinea Grass would become established in the fire resistant moderate suitability habitats (vine forest, riparian gallery forest) that are likely to be favoured by the species.
Altered hydrological regime	Negligible, long term. Impacts on the hydrological regime are discussed in **Section 16.2.3**. There is no significant change anticipated to wetland or riparian habitats that would be utilised by the Northern Quoll.
Altered fire regime	Negligible, long term. Construction activities are not expected to significantly impact on the current fire regime.

6.5.3.2 Operational Impacts Prior to Mitigation

There would be no impact to moderate suitability habitat during operations. Operations are not anticipated to have any additional effects on denning or breeding activity of the species if it were present in the Project area.

It is not anticipated that there would be substantial permanent lighting, noise or air emissions associated with mining. These impacts would be limited to mining areas located adjacent to moderate suitability habitat and would only occur for the short periods of time when mining was occurring in these locations. Traffic on access roads would be intermittent and there may be some short term local impacts on foraging individuals at crossings of riparian habitats as vehicles pass; however, it is anticipated that individuals would become tolerant of this minimal disturbance, and the overall impact of these on foraging activity by the species would be negligible.

The operational phase of the Project is unlikely to lead to the introduction of any additional invasive fauna that could affect the Northern Quoll potential habitat.

Hydrological changes resulting from operational activities are not anticipated to lead to significant changes to wetland, riparian or vine forest habitats that may be used by the species (refer **Sections 16.2** and **16.4**). Impacts to the availability of prey populations or habitat structure are not expected to occur.

Operational activities are not expected to significantly adversely alter the current fire regime.

Table 6-35 summarises direct and indirect unmitigated operational impacts for the Northern Quoll.

Table 6-35 Summary Operational Impacts Prior to Mitigation for the Northern Quoll

Action / Issue	Summary of Potential Operational Impacts Prior to Mitigation
Direct Impacts	
Clearing and loss of habitat	None
Edge effects	Negligible, long term. Edge effects are anticipated to be negligible given that no high suitability habitat is displaced and the negligible noise, light and air quality impacts.
Fragmentation of habitat	Negligible, long term. No high or moderate suitability habitat would be removed. Connections between moderate suitability habitat areas would be maintained by areas not mined.
Effects on movement/breeding/ feeding patterns	Negligible, long term. No high or moderate suitability habitat would be removed.
Road Kill	Negligible, long term. There is minimal potential for vehicles and the Northern Quoll to intersect.
Altered light regime	Negligible, short term. There may be some intermittent local impacts on foraging individuals at access road crossings of riparian habitats; however, the overall impact of these on the species would be negligible.
Indirect Impacts	
Noise	Negligible, short term. There may be some intermittent local impacts on foraging individuals at access road crossings of riparian habitats; however, the overall impact of these on the species would be negligible.
Water Quality	Negligible, long term. Impacts on water quality are discussed in **Section 16.2.5**. There are no impacts on water quality anticipated that would indirectly impact Northern Quoll through modification of habitat.
Air Quality	Negligible, short term. Increases in air emissions would be relatively minor and localised (refer **Section 14.3**).
Introduction of weeds and pests	Negligible, long term. Potential introduction of fire promoting weeds is unlikely to affect moderate suitability fire resistant habitats of the species or prey availability.
Altered hydrological regime	Negligible, long term. Impacts on the hydrological regime are discussed in **Section 16.2.3**. There is no significant change anticipated to wetland or riparian habitats that would be utilised by the Northern Quoll.
Altered fire regime	Negligible, long term Operational activities are not expected to significantly impact on the current fire regime.

6.5.4 Avoidance, Mitigation, Enhancement Measures and Residual Impacts

Disturbance to potential Northern Quoll habitats would be avoided or minimised through implementation of the following:

- the proposed SoE environmental buffer system would exceed the requirement of the Coordinator General's approval conditions and comprise a methodology for determining set-back distances for mining from sensitive vegetation, instead of from the banks of watercourses and wetlands. The sensitive vegetation would be buffered by Darwin Stringybark woodland would comprise the following vegetation types: riparian, wetland, estuarine, vine forest and coastal vegetation on sand. All potential moderate suitability habitat for the Northern Quoll would protected from mining by the buffer system. RTA would work with Traditional Owners and the relevant WCCCC Sub-committee on establishment of environmental buffers as part of the CHEMP. The proposed SoE environmental buffer system would maintain a network of undisturbed habitats and would be enhanced through the proposed fire management program (refer **Section 6.3.4.2** for additional details) which would conserve fire sensitive flora and promote overall vegetation diversity and the feral pig control program (refer **Section 7.3.6.4** for additional details) which would reduce pig damage to riparian and wetland areas. Additional detail on the proposed SoE environmental buffer system is included in **Section 6.3.4.5**; and,
- the general avoidance measures discussed in **Section 3.13** further reduce impacts by siting facilities in areas with less sensitive habitat.

Direct and indirect unmitigated impacts associated with the Project on the Northern Quoll are identified in **Table 6-34** and **Table 6-35**.

The following mitigation and enhancement measures would reduce these unmitigated impacts:

- a fire management program would be developed in cooperation with Traditional Owners and the relevant WCCCC Sub-committee as part of the CHEMP (refer **Section 6.3.4.2** for additional details);
- a weed management program would be developed and implemented prior to commencement of construction, and would include weed surveys annually (post wet season) targeting operational areas and site routes (refer **Section 6.3.4.3** for additional details);
- dry culvert cells would be installed at constructed access road crossings of Winda Winda Creek and the southern branch of Norman Creek (upstream of Dam C, the northern crossing on the Norman Creek Access Road) to maintain habitat continuity along the riparian corridor apart from during periodic high flow events that may be utilised by the Northern Quoll; and,
- progressive rehabilitation (refer **Section 6.3.4.6** for additional details).

The proposed SoE environmental buffer system would benefit the Northern Quoll by avoiding direct disturbance of the riparian, vine forest and coastal woodland habitats where the species is most likely to occur within the Project area. The proposed SoE environmental buffer system would also provide a network of inter-connected drainage systems that would facilitate movement of the Northern Quoll within and between suitable habitats. As a minimum, the proposed SoE environmental buffer system will cover approximately 8,356ha more than the regulatory buffer requirements set out in the Queensland Coordinator General's conditions of approval.

While construction and operational activities are not expected to significantly impact on the Northern Quoll (if it was present), the general fire management program would facilitate improvements to habitat of the species by mitigating existing impacts of the current uncontrolled fire regime.

Prescriptions for fire frequency, timing and intensity under such a program would be able to deliver improvements in the condition and biodiversity values of woodland habitats within the Project area.

Dry culvert cells at road crossings of Winda Winda Creek and the southern branch of Norman Creek (upstream of Dam C, the northern crossing on the Norman Creek Access Road) would maintain habitat continuity along the riparian corridor for the Northern Quoll to cross beneath roads, apart from during periodic high flow events, and minimise exposure to vehicle strikes.

Approximately 184ha of moderate suitability habitat which would be disturbed is located within the footprint of Dam C and road crossings (refer **Table 6-36**). This infrastructure is likely to be retained at the end of the life of the Project (subject to consultation with Traditional Owners and other stakeholders, refer **Section 3.10.6**). Progressive rehabilitation of mining areas would also re-establish potential foraging habitat for the species on disturbed areas given the ability of the Northern Quoll to vary dietary intake to suit prey availability. Rehabilitated areas in close proximity to undisturbed suitable habitat areas would be most likely to be utilised by the species.

Table 6-36 Northern Quoll Disturbance and Rehabilitation

Northern Quoll Habitat		**Area Disturbed (ha)**		**Rehabilitated To#**				
				High Suitability		**Moderate Suitability**		**Low/No Suitability**
Native Habitat Disturbed	High Suitability Habitat	**0**	=	0	+	0	+	0
	Moderate Suitability Habitat	**184**	=	0	+	0	+	184*
	Low/No Suitability Habitat	**29,474**	=	0	+	0	+	29,474
Total Disturbed		**29,658**	=	**0**	**+**	**0**	**+**	**29,658**
Difference (ha)				0	+	-184	+	+184

* This area is within the footprint of Dam C and road crossings, which may be retained for future use at the end of the life of the Project.

An environmental management plan outline for the Northern Quoll which summarises these avoidance, mitigation and enhancement measures is provided in **Appendix 6-C**. The cost of key avoidance, mitigation and enhancement measures are summarised in **Appendix 5-B**.

Table 6-37 summarises potential impacts that were minor, moderate or high and the avoidance, mitigation and enhancement measures and residual impacts of the Project associated with the Northern Quoll.

Table 6-37 Potential Impacts, Avoidance, Mitigation and Enhancement Measures and Residual Impacts for the Northern Quoll

Potential Impact	**Unmitigated Impact Magnitude**	**Relevant Mitigation Measures**	**Residual Impact Magnitude**
Loss of a small area of moderate suitability habitat	Minor, long term.	All other areas of moderate suitability habitat protected within the proposed SoE environmental buffers. Protected moderate suitability habitat areas managed with favourable fire regime under weed and fire management program.	Minor, long term

Table 6-38 summarises the potential impacts to the Northern Quoll as a result of the Project after proposed mitigation measures have been considered, in terms of the significant impact criteria for matters of NES (DEWHA 2009c).

6.5.4.1 National Recovery Plans and Threat Abatement Plans

There is a national recovery plan for the Northern Quoll (Hill and Ward 2010). **Table 6-39** outlines the consistency of the Project with the national recovery plan. Two threat abatement plans are listed on the SPRAT database as being relevant to the Northern Quoll, namely the *Threat Abatement Plan for the Predation by the European Red Fox* (DEWHA 2008c) and the *Threat Abatement Plan for Predation by Feral Cats* (DEWHA 2008d). No foxes were identified during field surveys for the EIS (refer **Section 4.2.1.7**) and are unlikely to occur on Cape York. **Table 6-40** outlines the consistency of the Project with the feral cat threat abatement plan.

6.5.5 Offset Measures

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012b), offsets are not required where the residual impact is not likely to be significant (when assessed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c).

Sections 6.5.3 and **6.5.4** of this report documents the results of the impact assessment process and concludes that with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the Project on the Northern Quoll would be minor and therefore not significant (refer **Section 6.1.3**). As such, offsets relating to the Northern Quoll are not required under the Commonwealth offsets policy.

Table 6-38 Impact Assessment Summary - Northern Quoll (*Dasyurus hallucatus*)

Will the proposed works…	**Northern Quoll *(Dasyurus hallucatus)* - Endangered**
….lead to a long-term decrease in the size of a population?	The Northern Quoll is distributed from south east Queensland across northern Australia to the Pilbara but has declined in many parts of this range. The Northern Quoll historically occurred in Darwin Stringybark open forest and associated habitats within the Weipa area prior to the arrival of the Cane Toad in the 1980's. Although numerous records exist for Northern Quoll in the region surrounding Weipa, the majority of these are historical, and no other confirmed sightings are available for the area around Weipa after 1990. The species has not been recorded within the Project area and there is no high suitability habitat present. If the species is present within the Project area, only very small areas of moderate suitability habitat for the species would be affected within the Project area. Sufficient moderate suitability habitat would remain undisturbed to support the species. A long term decrease in any population of the species present is unlikely to occur as a result of the Project.
….reduce the area of occupancy of the species?	The potential habitat for the species would be largely unaffected by the Project and therefore the area of occupancy of the species (if present) is unlikely to be reduced.
….fragment an existing population into two or more populations?	Suitable habitat for the species would not be significantly affected by the Project and, given the mobility of the species, minor habitat fragmentation in the Dam C area would not fragment any population that may be present.
….adversely affect habitat critical to the survival of a species?	The Project area does not include any critical habitat areas for the Northern Quoll that are listed under the EPBC Act or identified in Recovery Plans, nor is the Project area regarded as critical habitat for the species given its similarity to other potential habitat areas on northern Cape York Peninsula.
….disrupt the breeding cycle of a population?	Suitable habitats for the species would not be significantly affected by the Project and disruption to the breeding cycle of any population present is unlikely.
….modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The suitable habitats for the species would be largely unaffected by the Project and consequently the species (if present) is unlikely to decline as a result of the Project.
….result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	The Project is unlikely to lead to the introduction of any additional invasive fauna that could affect the species.
…..introduce disease that may cause the species to decline?	Disease has not been confirmed as a threat to this species. It is not anticipated that the Project would represent a threat with respect to the introduction of disease.
….interfere with the recovery of the species?	The Project is not expected to interfere with the recovery of the Northern Quoll as the Project area does not contain optimal habitat for the species.

Table 6-39 Consistency of SoE Project with National Recovery Plan for Northern Quoll

Objective	Action	Consistency of the SoE Project with the National Recovery Plan
Protect Northern Quoll populations on offshore islands form invasion of Cane Toads, cats and other potential invasive species.	• Maintain biosecurity of important offshore islands through quarantine measures on the mainland and those islands. • Monitor offshore islands supporting Northern Quoll populations to detect the presence of Cane Toads, cats and any other potential invasive predator. • Develop and, where required, implement a strategy for rapid-response control of Cane Toad or cat outbreaks on offshore islands occupied by Northern Quolls.	Not applicable.
Foster the recovery of Northern Quoll sub-populations in areas where the species has survived alongside Cane Toads	• Determine which factors affect survival and recovery of Northern Quolls in areas with Cane Toads. • Use information to assist surviving populations to recover in sympatry with cane toads. • Identify potential refuge habitats in Western Australia and the Northern Territory where Northern Quolls might be most likely to persist in the long-term alongside Cane Toads.	Consistent: • Multiple field surveys conducted. • No Northern Quoll known to occur in Project area. • Project area inhabited by Cane Toads.
Halt Northern Quoll decline in areas not yet colonised with Cane Toads	• Collect baseline data on population densities and monitor trends of Northern Quolls at a series of key sites not currently occupied by Cane Toads. • Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads. • Manage key Northern Quoll populations in areas not currently affected by cane toads to halt population declines. • Identify the effect of pastoral land management practices on Northern Quoll persistence. • Interim fire management at potential key Northern Quoll populations in areas not currently affected by Cane Toads. • Refine models of the current and expected distribution of cane toads and Northern Quolls, incorporating predictions of climate change.	Not applicable - Project area inhabited by Cane Toads.
Halt Northern Quoll decline in areas recently colonised with Cane Toads	• Continue research into the susceptibility of Northern Quolls to Cane Toad poisoning. • Test the efficacy of control measures for cane toads and whether they allow local persistence of Northern Quoll populations.	Not applicable: • Multiple field surveys conducted. • No Northern Quoll known to occur in Project area. • Project area inhabited by Cane Toads for more than 25 years.

Objective	Action	Consistency of the SoE Project with the National Recovery Plan
Maintain secure populations for future re-introductions	• Manage translocated populations of Northern Quolls on Astell and Pobassoo Islands. • NT and WA to maintain captive breeding populations of Northern Quolls. • Protection of key secure populations through protection of habitat in National Parks and Conservation Agreements. • NT and WA to determine the status of Northern Quolls on islands with suitable habitat and assess the potential for future translocations to these islands.	Not applicable.
Reduce risk Northern Quoll populations being decimated by disease	• Increase knowledge and vigilance of disease in Northern Quoll populations.	Not applicable: • Multiple field surveys conducted. • No Northern Quoll known to occur in Project area.
Reduce the impact of predation by feral animals	• Assess the impacts of feral predators on populations of Northern Quolls. • Implement efforts to protect key Northern Quoll populations from the impacts of feral predators.	Consistent: • Multiple field surveys conducted. • No Northern Quoll known to occur in Project area. • Feral pig control program proposed for riparian habitats.
Raise public awareness	• Develop new and promote existing materials for educating the public on the need for quarantine measures at important island habitat for Northern Quolls and along major routes westward into Western Australia. • Develop new and promote existing materials for educating the public on the need for quarantine measures at important island habitat for Northern Quolls and along major routes westward into Western Australia. • Implement a broader public education and awareness campaign on Northern Quolls and feral species (particularly Cane Toads and cats). • Develop and implement public education and awareness campaign on land management threats to Northern Quolls.	Not applicable.

Table 6-40 Consistency of SoE Project with the Threat Abatement Plan for Predation by the Feral Cat with regard to the Northern Quoll

Objective	Action	Consistency of the SoE Project with the Threat Abatement Plan
Prevent feral cats occupying new areas in Australia and eradicate feral cats from high-conservation-value 'islands'	• Collate data on islands and on isolated mainland 'islands', assess their conservation value, the likelihood of significant biodiversity impacts from cats, and if there are no cats present, rank the level of risk of cats being introduced and having impacts in these areas. • Work with communities, landholders and managers in and adjacent to cat-free areas of high conservation value to minimise the chance of an incursion. • Develop management plans to prevent, monitor and, if incursions occur, contain and eradicate any incursion by feral cats for 'islands' with high conservation values. • Implement management plans for high-conservation-value 'islands', including prevention and monitoring actions, and containment or eradication actions if incursions occur. • Eradicate established populations of feral cats from areas with high conservation values where this is considered feasible and cost-effective and is a high conservation priority. • Monitor (using national monitoring protocols) native prey species in areas from which feral cats have been eradicated.	Not applicable.

Promote the maintenance and recovery of native species and ecological communities that are affected by feral cat predation	• Identify priority areas for feral cat control based on:
	  • the significance of the population of the affected native species or of the ecological community;
	  • the degree of threat posed by foxes to species and ecological communities relative to other threats;
	  • the cost-effectiveness of maintaining feral cat populations below an identified 'damage threshold' in the region; and,
	  • the feasibility of effective remedial action.
	• Conduct and monitor regional feral cat control, through new or existing programs, in priority areas.
	• Apply existing and new incentives to promote and maintain on-ground feral cat control on private or leasehold lands within or adjacent to priority sites.
		Consistent:
		• Multiple field surveys conducted.
		• No Northern Quoll known to occur in Project area.
		• The Queensland Coordinator General requires RTA to maintain plans and procedures for an effective pest management program (including managing feral cats) (Queensland Government 2012).

Improve knowledge and understanding of feral cat impacts and interactions with other species and other ecological processes	• Develop simple and cost-effective methods for monitoring populations of foxes and the impacts of feral cats, including reliable methods for monitoring feral cats and key native species at different densities. • Investigate interactions between feral cats and native carnivores to identify the significance of competition and predation by feral cats. • Determine the nature of interactions between feral cats, foxes and wild dogs to effectively integrate control activities for all three species. • Determine impacts of cat-borne diseases, such as toxoplasmosis, on native species.	Not applicable.

Objective	Action	Consistency of the SoE Project with the Threat Abatement Plan
	• Identify any unintended effects that feral cat control may cause if conducted in isolation from other management activities.	
Improve the effectiveness, target specificity, integration and humaneness of control options for feral cats	• Develop an effective toxin–bait for cats. • Determine appropriate baiting strategies for various regions. • Ensure that habitat rehabilitation and management of potential prey, competitors and predators of feral cats are considered in feral cat control programs. • Test and disseminate information on exclusion fence designs regarding their cost-effectiveness for particular habitats or topography. • Continue to promote the adoption and adaptation of model codes of practice and standard operating procedures for the humane management of feral cats.	Not applicable.

Increase awareness of all stakeholders of the objectives and actions of the Threat Abatement Plan, and of the need to control and manage feral cats	• Promote:
	  • broad understanding of the threat to biodiversity posed by feral cats and support for their control;
	  • support for the actions to be undertaken under this plan ;
	  • the use of humane and cost-effective feral cat control methods ;
	  • best-practice effective cat control in all tenures; and,
	  • understanding of predation by feral cats as a key threatening process.
	• Develop specific communication campaigns to accompany the release of new broadscale cat control techniques, in order to address public sensitivities about cat control.
		Consistent:
		The Queensland Coordinator General requires RTA to maintain plans and procedures for an effective pest management program (including managing feral cats) (Queensland Government 2012).

6.6 Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*)

6.6.1 Species Profile

6.6.1.1 Distribution and Population

The Bare-rumped Sheathtail Bat is listed as 'Critically Endangered' under the EPBC Act.

A recent review of bats of Cape York observed a paucity of records for the Bare-rumped Sheathtail Bat and an inability to practically capture the species or identify it using existing echolocation call recognition techniques (Reardon *et al.* 2010 un. pub.). Reardon *et al.* (2010) concluded that there is no way to easily determine whether this species is common or very rare and argue that the current EPBC Act listing of this species (Critically Endangered) may be overly conservative. Notwithstanding the need to employ a conservative approach when assessing such poorly known species, Reardon *et al.* (2010) recommended that the status of this species be considered data deficient until further progress is made to establish a reliable survey method.

The habitat and general ecology of the Bare-rumped Sheathtail Bat is poorly known since the species has only been recorded from 25 localities across northern Australia from Ayr to Iron Range in Queensland and in Kakadu National Park and near Roper River in the Northern Territory. Based on the few available records, the species is apparently represented as two separate populations in northern Australia: an isolated population near Darwin (centred on Kakadu National Park) and a narrow band (< 40km wide) along the North Queensland east coast (Schulz and Thomson 2007). These two geographic groups are thought to belong to separate subspecies, *S. saccolaimus saccolaimus* from the Northern Territory and *S. saccolaimus nudicluniatus* from North Queensland.

The syntype specimens of *nudicluniatus* were first collected from coastal lowlands near Cardwell in the Queensland Wet Tropics (Mahoney and Walton 1988). A recent record from Iron Range on eastern Cape York (Murphy 2002) extends the known occurrence of the species a further 88km north of the original Cape York specimen from Attack Creek, 45km north of Coen (Qld museum specimen from 1978). Coles *et al.* (2012) attributed echolocation call sequences recorded using the new full spectrum call recording technology to the species from the Iron Range and Lakefield National Park, as well as near Cooktown, Cairns and south of Townsville.

An approach based on the analysis of full spectrum call recordings is still under development as a reliable detection technique for the Bare-rumped Sheathtail Bat. The Cape York records from Attack Creek (45km north of Coen) and Iron Range are shown on **Figure 6-1**.

There are currently no records of the Bare-rumped Sheathtail Bat within the Weipa Plateau Subregion and the species has not been recorded from the wider western Cape York Peninsula area. Habitat modelling using BIOCLIM and a limited number of locality records has been undertaken for the *National recovery plan for the bare-rumped sheathtail bat Saccolaimus saccolaimus nudicluniatus* (Schulz and Thomson 2007) and the modelling did not identify the western Cape York Peninsula area as potential habitat for the species. This may reflect the genuine dissimilarity of habitats on the western Cape compared to those on the east coast, or alternatively, the very low detectability of the species and low survey effort in the Subregion. The current population of the species within the Subregion cannot be estimated as there are no records for the species.

6.6.1.2 Ecology and Habitat

The Bare-rumped Sheathtail Bat is known primarily from tropical eucalypt woodland but may also utilise rainforest (EHP 2012a). With respect to the known localities of the species in Queensland, a common factor is the proximity of extensive forested ranges associated with the Great Dividing Range. On this basis the Bare-rumped Sheathtail Bat can be considered an east coast species associated with rainforests, gallery forests and adjacent woodlands. Both of the Cape York records are in close proximity to the Great Dividing Range and at both locations individuals were located in an area supporting eucalypt woodland adjacent to a denser habitat type comprising riparian forest and monsoon (vine) forest.

The specimen from Iron Range was found in eucalypt woodland dominated by Darwin Stringybark (*E. tetrodonta*), Clarkson's Bloodwood (*Corymbia clarksoniana*), and Carbeen (*Corymbia tessellaris*). The specimen was roosting in a Darwin Stringybark tree hollow adjacent to gallery forest on a narrow seasonal stream and within 1km of the extensive rainforests of the Claudie River flood plain (Murphy 2002). The Attack Creek locality comprised riparian rainforest flanked by eucalypt woodland (Schulz and Thomson 2007) with consideration of aerial imagery indicating more extensive rainforest areas of the Macrossan Range located approximately 5km to the east.

Although there are similarities in the woodland communities occurring on the east coast and west coast of the Cape York Peninsula, there are substantial differences between them with respect to substrate, topography and climate which lead to differentiation between vegetation communities.

Both of the recorded locations for the species on Cape York come from the Coen-Yamba Inlier Subregion (Sattler and Williams 1999) on the eastern side of the Cape York Peninsula which is characterised by the elevated landforms of the Great Dividing Range. The landform and climate of the Coen-Yamba Inlier is consistent with the other east coast landforms where the species occurs in a narrow coastal band near Townsville, including extensive forested coastal ranges and significant on-shore winds producing the characteristic east coast rainfall and humidity patterns. This contrasts starkly with the low topographic relief of the laterite landform within the Weipa Plateau Subregion, a lack of extensive forested ranges or extensive rainforest areas, and a lack of the east coast humid on-shore weather patterns.

While the woodlands of the west coast provide structural habitat features similar to those known to be utilised by the species (i.e. availability of extensive woodland canopy for foraging, availability of suitable tree hollows), structural features alone cannot be used to identify habitat preferences.

This is evident by the fact that this species is not found (or at least has not been recorded) in many other tropical woodland types in northern Australia that provide the similar structural features.

Given the lack of records of the species within the Weipa Plateau Subregion and significant geographic differences which affect vegetation and habitat features between the west coast and east coast of Cape York, it is not possible to reliably characterise the potential habitat utilisation of the species within the Subregion. The two known records of the Bare-rumped Sheathtail Bat from eastern Cape York do not provide a sufficiently robust basis for modelling habitat for the species on the west coast of Cape York given the substantial geographic differences between the two areas, as evidenced by BIOCLIM modelling for the species (Schulz and Thomson 2007). Therefore, predictive habitat mapping for the species cannot be effectively undertaken for the Weipa Plateau Subregion.

The confirmed roost of the species found on the east coast of Cape York was in a tree hollow adjacent to gallery forest and rainforest (Murphy 2002). The only other documented roosts in Queensland were a tree hollow (near Townsville) adjacent to riparian gallery forest (Schulz and Thomson 2007), and a recently discovered roost in a paperbark tree (*Melaleuca sp.)* within a riparian area in the Cairns

Botanic Gardens (G. Ford pers. comm. 2012). Roosts have been confirmed in tree hollows that have entrances as low as 6-8 m above ground level (Schulz and Thomson 2007). Observations to date from both Queensland and the Northern Territory have indicated that larger vertical hollows in the main trunk of trees are preferred. Overseas, the species roosts mainly in tree hollows as well, but has also been found in shallow caves, rocky crevices and buildings, and it might also use some of these alternatives in Australia (Schulz and Thomson 2007; Csorba *et al.* 2008).

Bare-rumped Sheathtail Bats are insectivorous and forage primarily for aerial insects over the woodland/forest canopy, though they may fly lower when foraging over open habitats or along forest edges (e.g. vine forest ecotones). Little is known of their breeding ecology, but females have been found pregnant or with young in December, and lactating during the wet season. Females give birth to a single young (EHP 2012a, Schulz and Thomson 2007). No information is available on potential seasonal or breeding movements undertaken by the species.

Limited but definitive reference echolocation calls of this species have only recently been recorded, and there have been some initial observations of characters that might allow it to be distinguished from other bats that make similar calls (Milne *et al.* 2009; Corben 2010; Coles *et al.* 2012; Ford *et al.* 2012). However, substantial additional call data from all three Australian *Saccolaimus* species and development of analysis techniques is required to enable unambiguous identification based on acoustic recordings.

6.6.1.3 Threats

Known and likely threats to the Bare-rumped Sheathtail Bat are described by Schulz and Thomson (2007). The primary known threat is habitat loss from land clearing. Other related and likely threats include:

- vegetation change due to clearing of understorey vegetation for agriculture and livestock grazing, altered fire regimes, saltwater intrusion and invasion by exotic weed species;
- timber collection and the targeted removal of hollow-bearing and dead trees, resulting in destruction of roosts;
- competition for hollows;
- disease; and,
- loss of climatically defined habitat such as tropical forests caused by anthropogenic emissions of greenhouse gases (identified as a key threatening process under the EPBC Act).

6.6.2 Survey and Results

6.6.2.1 Survey Approach

Section 6.2 provides a general overview of the survey approach. The following summarises the efforts and results for the Bare-rumped Sheathtail Bat. A summary of the suitability of survey timing and limitations of the survey approach are included on **Table 6-4** in **Section 6.2**.

The Bare-rumped Sheathtail Bat has low detectability due to the current limited ability to unambiguously identify the species from echolocation call recordings, as well as low trapability due to its habit of flying above the canopy in relatively tall woodland types. The use of full spectrum call recordings allows it to be readily distinguished from species of molossid bat based on fundamental harmonic frequency and harmonic intervals that are not evident from AnaBat-format calls, and some non-search phase calls appear to be diagnostic (Corben 2010, Coles *et al.* 2012, Ford *et al.* 2012), but much more work is required to determine if it can be distinguished from other emballonurid bats that share the same broad foraging habitat.

The *Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010b) were not available at the time of the initial field surveys between 2007 and 2009, however they provide a recommended survey approach for the Bare-rumped Sheathtail Bat focussing on:

- the use of acoustic detection including overnight static sets as a minimum, and walked or vehicle based transects;
- trapping with mist nets deployed at or above the canopy level, near waterbodies or along forest or woodland edges; and,
- identification and searches of potential roost hollows using cameras or acoustic recording of emerging bats.

The recommended survey effort for a 50ha site is 16 mist net nights over a minimum four nights, 16 static bat detector nights over a minimum four nights, and one to two hours of roost tree searches per day. The survey guidelines acknowledge that comprehensive surveys at the same intensity are not feasible for large sites. In these situations, the guidelines recommend that an appropriate sampling approach be developed to focus the survey effort, and the approach be discussed with DSEWPaC. Taking this into account, a practical and effective survey approach was developed for the species to clarify actual presence/absence, habitat usage and distribution within the Boyd TSF and the Dam C area, where planned initial disturbance for construction of Project infrastructure would occur. Additional details on this approach are provided below.

2007-2009 Surveys

The general bat survey effort undertaken for the Project between 2007 and 2009 at comprehensive survey sites and threatened fauna survey sites did not target the Bare-rumped Sheathtail Bat specifically as the species was not indicated as a potential inhabitant of western Cape York on Protected Matters Search or in the recovery plan for the species (Schulz and Thomson 2007). Nevertheless, the surveys undertaken did provide an opportunity to indicate the occurrence of the species. Bat survey effort was based on the use of AnaBat detectors and ground-deployed harp traps.

The survey effort included overnight and partial night stationary deployment of AnaBat units, plus overnight harp trap sets at all twelve comprehensive survey sites and at additional locations as part of the targeted threatened fauna surveys (refer **Section 6.2**) During the supplementary surveys harp traps were deployed at four additional sites (two during July 2006 and two during May 2008).

Although the species could not be definitively identified using AnaBat call analysis at the time of these surveys, the AnaBat system represented the best available call recognition technique at that time, and the collection of AnaBat call sequences provided the potential for recordings to be re-analysed if reliable reference calls for the species become available in the future allowing the retrospective and unambiguous identification of the species. In addition, the presence of calls attributed to one or more of the three candidate *Saccolaimus* species at each survey site (Bare-rumped Sheathtail Bat *Saccolaimus saccolaimus nudicluniatus*, Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*, Papuan Sheathtail Bat, *Saccolaimus mixtus*) provided an indication of the potential presence of the Bare-rumped Sheathtail Bat; and, conversely, the absence of *Saccolaimus* calls at a site suggested the absence of *Saccolaimus* species during the survey event (bearing in mind the limitations of the sampling effort and such factors as detector range).

Table 6-41 summarises the survey effort. A total of 12 detector (AnaBat) nights and 16 harp trap nights were conducted during the comprehensive and supplementary surveys in a range of habitats including potential flyways within Darwin Stringybark woodland, coastal vine forest, vine forest on bauxite, riparian gallery forest and associated alluvial/colluvial woodland, and Paperbark woodland/colluvial woodland.

Table 6-41 Survey Effort for Bare-rumped Sheathtail Bat

Survey activity	Duration of survey activity	No. of sites	Total survey effort for activity(hours/trap nights)
Comprehensive surveys - May 2007, May 2008 - total survey period of 16 days **			
AnaBat survey	overnight	12	12 survey nights
Harp traps	overnight	12	12 trap nights
Total for Comprehensive surveys			*12 survey nights* *12 trap nights*
Supplementary surveys - July 2006, May2007, May 2008 - total survey period of 12 days **			
Harp traps	overnight	4	4 trap nights
Total for Supplementary surveys			*4 trap nights*
Targeted threatened fauna surveys - December 2007/2008, May 2008/2009, June 2012, October 2012 - total survey period of 60 days **			
*December 2007/2008, May 2008/2009 Surveys - total survey period of 27 days***			
AnaBat survey	overnight	16	16 survey nights
Harp traps	overnight	10	10 trap nights
June 2012 October 2012 Surveys - total survey period of 20 nights			
Harp traps	overnight	11	43 trap nights
Mist nets	3.5 - 5 hours per net	45	47 trap nights
Total for Targeted threatened fauna surveys			*16 survey nights* *100 trap nights (Harp trap and mist net)*
Grand Total			28 survey nights (AnaBat survey) 116 trap nights (Harp trap and mist net)

** Only the components of the overall supplementary surveys that are applicable to the Bare-rumped Sheathtail Bat are presented in this section of the table.

Note: that the applied mist net technique included multiple linked mist nets deployed at each site thus producing substantial net area compared to the standard single or double mist net method.

During the threatened fauna surveys, AnaBat detectors were deployed for 16 nights and harp traps were deployed for 10 nights at ground level in various locations potentially inhabited by the species including on the edge of vine forest and riparian gallery forest, within gallery forest over water, and on tracks through woodland habitat.

Systematic roost searches were not included in survey activities as they were inaccessible due to the generally elevated height of hollows (typically 10m and above); however, lower hollows were opportunistically inspected where possible.

2012 Surveys

Additional targeted surveys were conducted in June 2012 and October 2012 to determine whether the species is present within the Project area. The survey's included recognised bat specialists Dr. Kyle Armstrong and Mr. Glenn Hoye on the survey team.

The June 2012 survey focused on the proposed Boyd TSF and the Dam C area where initial disturbance for construction of Project infrastructure would occur. Habitats surveyed included Darwin Stringybark woodland in the Boyd TSF area and riparian gallery forest, *Melaleuca* wetland and Darwin Stringybark woodland within the Dam C area. Surveys provide the opportunity to produce new knowledge on the actual presence and habitat utilisation of the species that may be extrapolated to the wider Project area and used for development of impact mitigation programs should the species be found to be present. The October 2012 survey resampled a sub-set of sites in the initial disturbance area and also extended survey effort into the future mining footprint (Darwin Stringybark). The survey was conducted over 10 nights; however the survey was conducted by two survey teams each night enabling the survey effort in the mining areas to be completed without reducing the proposed repeat survey effort in the initial disturbance area. Upon completion of the October survey 20 equivalent survey nights were completed in the initial disturbance area (10 equivalent nights over each survey period) and 10 equivalent survey nights in the future mining footprint. The survey approach was discussed with DSEWPaC. This constitutes the most intensive endeavour targeting the Bare-rumped Sheathtail Bat within Australia to date.

The June 2012 survey programme included two main survey methods aimed at trapping of individuals. Both harp traps and mist nets were deployed within the canopy of vegetation to target the high flying species and the survey completed a total of 39 harp trap nights at eleven sites, and twelve mist net nights at ten sites. Based on the experience gained during the July 2012 survey event mist nets were determined to provide the most effective trapping method for high flying species, compared to harp traps, given the much larger net area and ability to set nets high in the canopy. Consequently mist nets were utilised solely during the October 2012 survey and a total of 35 mist nets were deployed over 20 sites. The survey effort is summarised in **Table 6-41**.

Triple bank harp traps were attached to ropes draped over branches within the woodland canopy and hoisted into gaps within the canopy that could potentially be used by high flying species as flyways when foraging through the canopy. Traps were typically deployed between 15-25m above ground level with the height depending on the height of the canopy and availability of gaps at each site. Usually a single triple bank harp trap was deployed in this way although two triple bank harp traps were secured together and used as a single unit at one site. Harp traps were deployed at each site for between two and ten consecutive nights with an average deployment of 3.4 nights.

Mist nets were erected using 7m telescopic poles (four sites in June 2012; 15 sites in October 2012) and rope and pulley assemblies attached to canopy trees (six sites in June 2012; 20 sites in October 2012). The rope and pulley assemblies enabled a vertical stack of three mist nets to be successively attached and hoisted into the canopy allowing the entire space between the canopy up to 25m and about 3m above the ground to be netted. The pole mounted mist nets were not deployed as high, being limited by the length and rigidity of the poles to a maximum 7m height.

Significant effort in locating potential roosts in the trunks of trees or dead stags was planned but not implemented because of safety and practical limitations related to the height of potentially suitable hollows which were typically higher than could be practically reached with 10m pole mounted cameras.

6.6.2.2 Survey Results

The Bare-rumped Sheathtail Bat was not recorded during surveys within the Project area and there are no previous records of the species from the Project area or wider Subregion.

AnaBat acoustic analysis during the 2007-2009 surveys identified the presence of *Saccolaimus* spp. at 10 sites and attributed these calls predominantly to Yellow-bellied Sheathtail Bat *(Saccolaimus flaviventris)* with probable records of Papuan Sheathtail Bat (*Saccolaimus mixtus)* and Beccari's Freetail Bat *(Mormopterus beccarii)*. No calls were able to be attributed unambiguously to the Bare-rumped Sheathtail Bat, given the limitations stated in **Section 6.6.2.1**.

Bat species captured during the June and October 2012 surveys included 92 individuals of the high flying species, Northern Freetail Bat (*Chaerophon jobensis*), Little red flying-fox (*Pteropus scapulatus*) Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) and Papuan Sheathtail Bat (*Saccolaimus mixtus*). This has proven the effectiveness of mist nets set high in the canopy to capture species with a similar high flying habit to the Bare-rumped Sheathtail Bat.

In the June 2012 survey a total of 16 individuals of the Papuan Sheathtail bat were captured from three sites, all of which comprised rope mounted mist nets hoisted 25m into the canopy of Darwin Stringybark. During the October 2012 survey, where much greater effort was given to rope mounted mist nets in canopy, a total of 38 Papuan Sheathtail Bats and 16 Yellow-bellied Sheathtail Bats were captured from 15 of 20 sites. Only one individual of the Papuan Sheathtail Bat was captured in a pole mounted 7m high mist net. These results demonstrates the effectiveness of this trapping technique through the unprecedented number of captures of *Saccolaimus*, and provides some basis for concluding the rarity or absence of the Bare-rumped Sheathtail Bat from the area during the surveys. Of interest was the recapture of one Papuan Sheathtail Bat after two nights from a site at least 10km away (identified from the biopsy wing punch, but not individually marked). This demonstrates that these high flying species range widely at night while foraging.

The capture of 54 Papuan Sheathtail Bats is of interest as this species is of similar size and has a similar fast, high-flying foraging behaviour to the Bare-rumped Sheathtail Bat. It is not known at this stage whether the Papuan Sheathtail Bat and Bare-rumped Sheathtail Bat species co-inhabit areas of habitat. The current known distribution of the two species is mutually exclusive with the Papuan Sheathtail Bat apparently distributed over the northernmost tip of Cape York and down the west coast to just south of Aurukun. This area includes all of the bauxite areas between Aurukun and Vrilya Point (near Cape York), including the Project area. The distributions of the Bare-rumped Sheathtail Bat and the Yellow-bellied Sheathtail Bat do overlap, but no information is available on how they might partition themselves by foraging habitat or diet.

Without the benefit of recorded locations for the species within or nearby the Project area, or anywhere within the Subregion, it is not possible to reliably predict potential habitat for the species within the Project area or Weipa Subregion.

Similarly, the potential population size of this species within the Project area (if it was present) cannot be estimated without ecological and distributional data for the species on Western Cape York Peninsula. The *National recovery plan for the bare-rumped sheathtail bat* (Schulz and Thomson 2007) identifies all populations as important for the long-term conservation of the species. Given the lack of recent records of this species throughout its distribution (Schulz and Thomson 2007), which has been suggested to reflect a significant decline in the population (DSEWPaC 2012r) (note comments on species status by Reardon *et al.* (2010) in **Section 6.6.1.1**), any occurrence of the Bare-rumped Sheathtail Bat located within the Project area would be regarded as important under the *Matters of*

National Environmental Significance: Significant Impact Guidelines 1.1 (DEWHA 2009c), as it would meet all three of the following criteria:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or,
- populations that are near the limit of the species range.

Any population of the species confirmed on Cape York Peninsula would be of regional and national significance given the apparent recent decline.

Table 6-42 summarises the profiling information for the Bare-rumped Sheathtail Bat.

6.6.3 Future Surveys

Additional surveys for the species are proposed during 2013 to strengthen the assessment of the presence/absence of the species within the Project. The survey will extend survey effort within the future mining footprint surveyed in the October 2012, and if present, determine the patterns of habitat utilisation by the species.

These surveys will use, as a minimum, the techniques developed during the 2012 surveys that are appropriate for the Bare-rumped Sheathtail Bat and other high flying bat species, specifically rope hoisted mist nets set high in the canopy. The surveys will also meet the requirements of the DEWHA (2010b) survey guidelines.

Using the survey protocol developed in conjunction with bat experts from the 2012 work, the 2013 surveys will employ a stratified survey program across the balance of the Project area to provide survey effort within representative examples of all of the main woodland and forest habitats present whilst also providing an appropriate level of spatial resolution. The goal of the surveys will be to employ a highly significant survey effort to ensure:

- appropriate opportunity of encountering the species if indeed it is present; and conversely; and,
- provide sufficient evidence to substantiate the absence of the species from the Project area should it not be detected during the surveys.

It is important to note that the results of the 2012 surveys has led to a significant enhancement of the current knowledge with respect to a practical survey approach for high flying species, such as the Northern Freetail Bat, Yellow-bellied Sheathtail Bat and Papuan Sheathtail Bat. This information could be used to enhance and improve the current survey guidelines for the Bare-rumped Sheathtail Bat.

Table 6-42 Profile summary for Bare-rumped Sheathtail Bat

Species **Common Name**	**Key Resources**	**Potential Habitat within Project area**	**Known/estimated population in Project area**	**Likelihood of Occurrence within Project Area**
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheathtail Bat	Poorly known but includes availability of tree hollows for roosting and availability of flying insect prey.	Given the lack of data on this species on Cape York and the absence of records or data on habitat utilisation in western Cape York Peninsula it is not possible to predict potential habitat within the Project area.	No known population. Population estimates not possible without basic ecological information for western Cape York Peninsula.	**Data deficient**: The actual presence or distribution of this species is not known. There is an absence of records and data on habitat utilisation on western Cape York. Although the Project area provides structural habitat features similar to those known to be utilised by the species on the east coast, there are significant geographic differences between the known habitat on the east coast of Cape York and the habitat present in the Project area. High trapping effort using appropriate equipment (mist nets hoisted into canopy) has returned capture of 70 individuals belonging to two other *Saccolaimus* species, but not the Bare-rumped Sheathtail Bat.

6.6.4 Relevant Impacts

The previous sections have outlined the deficiency of data on the Bare-rumped Sheathtail Bat throughout its range and especially on Cape York. The geographic and habitat differences between the two known record locations for the species adjacent to the Great Dividing Range on Eastern Cape York, and the Project area and wider Subregion have been highlighted. **Section 6.6.2** outlined the survey effort undertaken to determine if this species is present in the Project area.

Given the lack of records, differences in geography and habitat between the known records and the Project area, and the fact the species has not been found during current survey efforts, there is no evidence to suggest that the species is present in the Project area and therefore it is not yet possible to develop predictive habitat mapping. If the species does occur, then disturbance to high suitability or moderate suitability habitat would be a relevant impact.

If the species is found within the Project area during surveys planned for 2013, RTA would first consider avoidance. If that was not possible RTA would then assess the potential impact on the species and liaise with DSEWPaC to develop an appropriate package of mitigation measures to manage any impacts on the species prior to clearing in the relevant area and document them in an environmental management plan.

6.6.4.1 National Recovery Plan and Threat Abatement Plans

There is a national recovery plan for the Bare-rumped Sheathtail Bat (Schulz and Thomson 2007). **Table 6-43** outlines the consistency of the Project with the national recovery plan. There are no relevant threat abatement plans for the Bare-rumped Sheathtail Bat.

Table 6-43 Consistency of SoE Project with National Recovery Plan for Bare-rumped Sheathtail Bat

Objective	Action	Consistency of the SoE Project with the National Recovery Plan
Develop more effective detection techniques and undertake systematic surveys	• Obtain voucher* echolocation calls from individuals confirmed to be the Bare-rumped Sheathtail Bat through the collection of calls from flying individuals, the fly-out of individuals from roosts or released individuals that have been captured. • Where reliable voucher calls are obtained and the echolocation call is determined to be diagnostic, review libraries of reference calls of bats collected in the north-eastern Queensland and the Top End of the Northern Territory for the presence of this species. • Conduct targeted surveys using a range of non-lethal techniques during the wet season (when the majority of records have been obtained), concentrating sampling effort around recent localities and in areas of north-eastern Queensland identified by the BIOCLIM analyses as occurring within the predicted distribution. • Increase public and landholder awareness of the species through the production and distribution of an information sheet to assist in the location of roosts.	Consistent: • Systematic 2012 surveys carried out with enhanced netting techniques and acoustic detection methods.
To increase protection of known roosts both inside and outside reserve lands	• Protect all roosts located within and outside conservation reserves through ensuring all known roosts are recorded on WildNet and Northern Territory Wildlife Atlas databases and through discussions and information sessions with relevant land managers and landholders.	Consistent: • If the species is found within the Project area during future surveys, RTA would assess the potential impact on the species and liaise with DSEWPaC to develop an appropriate package of mitigation measures to manage any impacts on the species prior to clearing in the relevant area.
Characterise roosting requirements, foraging requirements and potential seasonal differences	• On availability, supply researchers, departmental staff and consultants with voucher echolocation calls to assist with the assessment of the potential presence of this bat in proposed development areas within the predicted distribution in north-eastern Queensland and in the Darwin-Mary River area of the Northern Territory.	Consistent: • Should voucher echolocation calls be obtained, these would be used to identify potential presence or absence and habitat utilisation of the species in the Project area.
All current and located roosts are protected from known threating processes	• Determine the roosting requirements during both the non-breeding and breeding seasons. • Compare roosts used with available roosting habitat to investigate roost site selection. • Identify the diet in the dry and wet seasons by analysing droppings collected from trapped individuals or collected at roosts and identify foraging habitat by the identification of feeding buzzes recorded using a bat detector.	Not applicable - No roosts known to occur in Project area.

Objective	Action	Consistency of the SoE Project with the National Recovery Plan
Establish monitoring sites to investigate population trends	• Dependent on the location of roosts and the results of targeted surveys, establish sites for bi-annual monitoring to document the seasonality of occurrence of the species in the dry and wet season. This monitoring should be conducted twice yearly beyond the life of the plan to assess population trends.	Not applicable - No known population found in Project area.
Clarify taxonomic status of species	• Conduct a genetic study investigating the taxonomic status of populations in north-eastern Queensland and the Northern Territory by the use of existing material, in addition to material collected in Action 1.1, and molecular techniques. • Conduct a genetic study comparing the taxonomic status of Australian populations with those from New Guinea, Timor and elsewhere within the species' distribution using existing (e.g. museum specimens) material and molecular techniques. This investigation is recommended to be undertaken by, or in conjunction with, an experienced bat taxonomist.	Not applicable - No known population found in Project area.

* A " voucher" specimen is a specimen of, for example, a rodent which may be taken if the sampler thinks it is a new species or occurring well outside its previously known range. The voucher specimen is usually lodged with a museum and confirmed by the curators and becomes proof of that record of that species. Similarly for bats a voucher echolocation call would be a recording of bat calls from a particular location that can be compared (using visual representations of the acoustic patterns) to a call sequence that is known to be produced by a certain species and if the calls are shown to be the same, the call becomes proof of the occurrence of that species at that location.

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