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North Star Magnetite Project – Environmental Scoping Document
Response to requested terrestrial fauna items
Fortescue Metals Group

Attention: **Shaun Grein**

MEMO

Introduction

Fortescue Metals Group (Fortescue) commissioned *ecologia* Environment (*ecologia*) to address two items in the proposed Environmental Scoping Document (ESD) for the North Star Magnetite Project (Assessment No. 1946). The project will be assessed through a Public Environmental Review.

North Star is located approximately 110 km south-east of Port Hedland. The North Star study area was surveyed by *ecologia* (2011a, b, 2012a, b, c, e) through a series of level 1 and level 2 biological assessments and targeted surveys for conservation significant species. These reports identified that three species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*) and Pilbara Olive Python (*Liasis olivaceus barroni*), occur at North Star. Two further species, Greater Bilby (*Macrotis lagotis*) and Mulgara (*Dasycercus cristicauda/D. blythi*) were identified as potentially occurring within the study area. The project was identified by the Environmental Protection Authority as likely to have a significant impact on threatened species and communities, with particular regard to Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python.

The two items that *ecologia* will address in the preparation of the ESD are:

ITEM 1

Discussion of potential impacts to Fauna as a result of the proposal, with particular regard to Matters of National Environmental Significance (MNES), and provision of quantitative data on impacts of the proposal to species of conservation significance.

ITEM 2

Where vegetation to be cleared provides habitat for EPBC listed species, the PER should also provide an assessment of habitat quality in terms of site condition and context and species stocking rate, as described in the EPBC Act Offsets Assessment Guide.

Methods

The impacts of the project with regard to each EPBC Act listed species were assessed using the MNES Significant Impact Guidelines (DEWHA 2009). Data from project-related and regional assessments were utilised to estimate the level of potential impact.

The offsets assessment guide provides a flow chart describing the key considerations required to determine the quality of habitats (Figure 1). The questions identified in this flow chart are answered in this report in relation to each species.

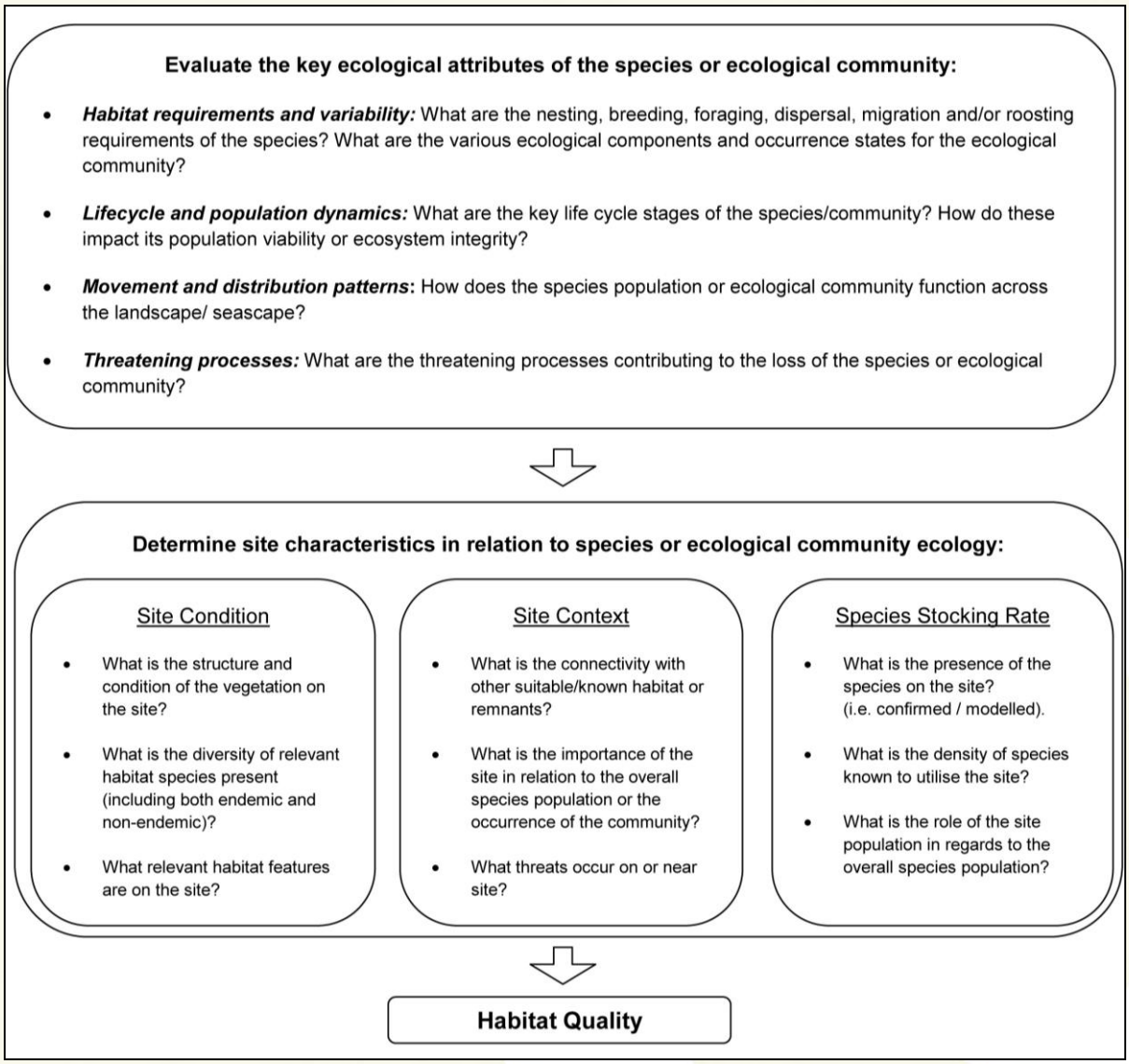

Figure 1 - Flow chart describing the assessment of habitat quality

A brief discussion of Greater Bilby and Mulgara is included as these species were identified as likely to occur in the study area (Greater Bilby diggings and Mulgara have been recorded). The DEC priority listed Brush-tailed Mulgara and the EPBC Act listed Crest-tailed Mulgara are discussed together due to taxonomic revisions of the two species resulting in uncertainty of records. The project is not expected to impact these species significantly. Grey Falcon is also discussed, as this species was recorded in the study area. Though not currently listed under the EPBC Act, the conservation status of Grey Falcon was recently (6 November 2012) upgraded to Schedule 1 (Vulnerable) under the *Wildlife Conservation Act 1950* (WC Act). As with Mulgara and Greater Bilby, the project is not expected to impact Grey Falcon significantly.

Fauna habitat, vegetation and vegetation condition mapping of the North Star study area was completed by *ecologia* (2012c, d, e) and was reinterpreted along with data collected from vertebrate fauna surveys (*ecologia* 2011a, b, 2012b, c) to map the condition and quality of fauna habitats. Records of the species of interest, from *ecologia* surveys as well as other sources, were mapped to provide an up-to-date picture of population distribution and occurrence.

The impact area comprises four main areas: the North Star mining area, the infrastructure zone to the east of the mining area, the slurry corridor zone extending to the north-west and the water corridor zone extending to the north-east. The total size of the impact area is 201,680 ha, though the total area of disturbance is expected to be limited to 5,300 ha. The majority of the mining and infrastructure areas was assessed during the North Star project (*ecologia* 2011a, b, 2012c, d), whereas areas of the water corridor and slurry corridor zones (totalling 135,272.89 ha) were not assessed for habitat type or condition during either the North Star project or the Canning Basin project (Table 1). The impact to fauna and fauna habitats within the water corridor and slurry corridor areas are not expected to be significant due to the nature of expected disturbance in these areas (long linear pipeline infrastructure) and the limited local impact that are associated this infrastructure.

Table 1 – Areas of North Star the site unassessed for habitat type and condition

Name of area	Size of area (ha)
Infrastructure Zone	0.67
Slurry Corridor Zone	2112.7
Process Rejects Zone (mining area)	121.14
Water Corridor Zone De Grey River Crossing	91,332.21
Water Corridor Zone	41,828.02

The condition of each area of habitat was assessed using a modified version of the vegetation condition scale described by Trudgen (1991). By including feral fauna in the condition scale, their potential impact on native fauna is considered. The modified condition scale is described in Table 2.

Table 2 – Fauna habitat condition scale

Habitat condition	Criteria
Excellent	Pristine or nearly so, no obvious signs of damage caused by European man or introduced fauna (cattle, cat, dog, rabbit). No signs of recent, extensive fires.
Very good	Some relatively slight signs of damage caused by the activities of European man, e.g. damage to tree trunks by repeated fires or occasional vehicle tracks, and very few signs of introduced fauna.
Good	More obvious signs of damage caused by the activities of European man, including some obvious impact to vegetation structure such as caused by low levels of grazing or by selective logging. Some signs of recent fires. Some evidence of introduced fauna in low abundance.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of European man such as partial clearing or very frequent fires. Confirmed presence of introduced fauna in moderate abundance.
Very poor	Severely impacted by grazing, introduced fauna, fire, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management.
Completely degraded	Areas that are completely or almost completely without vegetation communities and are heavily impacted by extensive fires and/or introduced species, e.g. cow paddock.

Results

Northern Quoll (*Dasyurus hallucatus*), EPBC Act Endangered, WC Act Schedule 1 (Endangered)

The Northern Quoll is the smallest of the four Australian quoll species. Northern Quolls are mostly nocturnal (Oakwood 2008) and are primarily insectivorous, with some vertebrate prey and fruit also consumed (Braithwaite and Begg 1995).

The Northern Quoll formerly occurred across northern Australia from the Pilbara region in Western Australia to south-eastern Queensland. A 75% reduction in habitat range occurred during the 20th century (Braithwaite and Griffiths 1994), so that the species is now restricted to the Pilbara and northern Kimberley in Western Australia, and to a few discrete populations across the Northern Territory and eastern Queensland. Populations of the Northern Quoll have been lost from most of the north-eastern Top End of the Northern Territory, Cape York Peninsula and the Einasleigh Uplands of northern Queensland (DEWHA 2005). This reduction in population size, along with the male die-off that occurs after breeding, results in slow population recovery. These factors resulted in the listing of the Northern Quoll as Endangered under the EPBC Act in 2005 (DSEWPaC 2011). The Northern Quoll is likely to continue to decline over most of its mainland range and some of its island range (DSEWPaC 2013a).

Habitat requirements and variability:

Northern Quolls are most common on dissected rocky escarpments, but are also found in eucalypt forest and woodland (Oakwood 2008). Northern Quolls are both terrestrial and partially arboreal (Braithwaite and Begg 1995) and use a variety of den sites, including rock crevices, tree hollows, logs, termite mounds and goanna burrows (Oakwood 2008). Daytime den sites provide important shelter and protection for Northern Quolls from predators and weather. Breeding tends to occur near creeklines, where individuals go to drink when water is available.

Habitat critical to the survival of Northern Quolls comprises areas where quolls are least exposed to threats or are least likely to be exposed to threats in the future, namely rocky areas and offshore islands (Hill and Ward 2010). Rocky areas such as gorges and gullies provide prime habitat for Northern Quolls, particularly if these are located near a water source (Braithwaite and Griffiths 1994). The importance of rocky habitat is summarised in the National Recovery Plan for Northern Quoll (Hill and Ward 2010):

"Recent modelling of island populations in the Northern Territory established that occurrence of northern quolls was related to ruggedness or topographic complexity (Woinarski et al*. 2007). Analyses by Woinarski* et al*. (2008) show that northern quoll declines in Queensland have mainly been in lowland and flatter (less rugged) areas and a recent survey found the most abundant remnant populations on the Queensland coast were at sites with large boulders (Foster and Oakwood pers. comm. 2008). Rocky areas retain water and have a diversity of microhabitats, so support higher floristic diversity and productivity and thus greater prey density and/or diversity compared to non-rocky adjacent country (Burnett 1997). In addition, cats forage less effectively in rocky areas. Their topographic complexity may also serve to ameliorate fire impacts, and they are typically not used for livestock production. Whilst rocky habitats support denser populations of quolls, the diverse and dispersed nature of rocky areas makes them very difficult to define or map on a national scale."*

Suitable foraging habitat for Northern Quolls includes well-vegetated and/or rocky areas, and is often associated with a creekline or river system. Dispersal habitat for the Northern Quoll relates to habitat traversed by the species when moving from potential denning areas to suitable foraging areas and when seeking mates during the breeding season.

Habitat for the Northern Quoll was classified in three categories:

- Suitable denning habitat.
- Potential denning/foraging habitat.
- Potential foraging/dispersal habitat (riverine).

Suitable denning habitat for the Northern Quoll is widespread within the North Star mining area. It comprises an ironstone ridge approximately 8.7 km in length running north-south along the western border of the tenement, and several rocky gorges running east-west providing water pools and patches of dense vegetation. The infrastructure areas contain patches of suitable denning habitat in the form of rocky gorges with or without pools. This habitat type was not found in the infrastructure corridor (excepting the area of corridor adjacent to the mining area). Instead, it comprised some areas of extensive granite boulder piles which were classified as potential denning/foraging habitat.

A total of 1,796.32 ha was assessed and mapped as potential or suitable habitat for the Northern Quoll (Table 3, Figure 11). Of this, 227.52 ha were classified as suitable denning habitat of excellent condition, and 4.07 ha of rocky areas were identified as potential denning and foraging habitat of excellent condition. River and creekline habitat is likely to be utilised as seasonal foraging and/or dispersal habitat, of which 1,564.73 ha of good to excellent condition was identified.

Table 3 – Area of Northern Quoll habitat identified within the North Star study area

Classification	Condition/Area (ha)					Total
	Excellent	Very good	Good	Poor	Very poor	
Suitable denning habitat	227.52	0	0	0	0	227.52
Potential denning/foraging habitat	4.07	0	0	0	0	4.07
Potential foraging/dispersal habitat (riverine)	310.51	0	1,254.22	0	0	1,564.73

Life cycle and population dynamics:

Northern Quolls are short-lived, with males dying shortly after reproducing (Dickman and Braithwaite 1992; Oakwood 2000). Both sexes mature at 11 months. Due to the discrete male cohorts that arise within populations, any factor that significantly increases mortality rates of female and juvenile Northern Quolls could cause rapid local extinction of quoll populations; if no juvenile males survive to adulthood in one year, there will be no males available for mating the following year (Braithwaite and Griffiths 1994; Oakwood 2000).

In the more northerly areas of their distribution, Northern Quolls mate from late May to June with young born in September and October (King 1989). In the Pilbara, breeding is thought to occur between August and September. However, females have been recorded with pouch young as late as February (How *et al.* 1991). Denning is expected to occur from late September (A. Cook, pers. comm.).

During the breeding season, males adopt a roving strategy, regularly visiting several widely spaced females in rapid succession, presumably to monitor the onset of oestrus. The energetic cost of this behaviour is a likely cause of the annual male die-off, which is a sudden, sharp decline in the Northern Quoll population after the breeding season (Oakwood 2008).

Four of the 20 Northern Quoll individuals captured during the targeted survey at North Star (*ecologia* 2011a), were female. Given females are known to have significantly smaller home ranges than males (Oakwood 2008), this indicates that a permanent breeding population inhabits the North Star study area, as the females were unlikely to have moved into the area from the surrounding region.

Increased activity and mobility due to the roving strategy of male Northern Quolls is expected to have resulted in the increased number of males recorded (sex ratio of 4:1). Most individuals (65%) were recaptured after 1-3 nights, indicating that the population in the study area is relatively sedentary (*ecologia* 2011a).

Movement and distribution patterns:

In the Pilbara, the distribution of quolls is fragmented and the species is mostly confined to ironstone formations and some river systems, and the Burrup Peninsula and adjacent offshore islands (Hill and Ward 2010). The vast majority of Northern Quoll records in the Pilbara have been made in the Chichester IBRA subregion, with the remaining records in the west of the Hamersley region, in the Roebourne region, and in the north-west of the Fortescue region. The North Star study area lies near the centre of the species' distribution in the Pilbara.

During *ecologia*'s surveys (*ecologia* 2011a, b), 83 records (minimum of 20 individuals) were made of Northern Quolls. All records were made in the east of the North Star project area. Previous records of Northern Quolls include: a total of 18 individuals from 12 km west of the study area (Outback Ecology 2010), 10 individuals from Mt Dove (40 km west of the study area) (Outback Ecology 2011a), 23 individuals from Panorama project (3-8 km from the study area) (Bamford and Wilcox 2001; Biota 2007), and three individuals from 10 km south of the study area (NatureMap 2013). NatureMap lists 97 records within 50 km of the North Star study area, including records from the vicinity of Marble Bar and Woodstock (Figure 2).

Northern Quolls are generally considered to be solitary. Females have mutually exclusive denning areas, although foraging areas can overlap. Territoriality is likely to be related to the abundance, dispersion and availability of food (Oakwood 2002).

Female home ranges are stable and up to 35 ha, preferring rocky habitat. Outside of the breeding season, male home ranges are of similar size to those of females. The roving strategy adopted by males during the breeding season causes male home ranges to expand significantly (to over 100 ha), and home ranges can overlap extensively with several female ranges and numerous other male territories (Oakwood 2008).

Individual males from the North Star project area have been recorded travelling up to 3.5 km over several days. During the targeted surveys at the North Star project area one male was recaptured after one night at a location 2.6 km from the location of his first capture. Another Northern Quoll male was recaptured on each of the trapping nights (*ecologia* 2011a) with three of these captures within 200 m of the capture locations of a particular female. Captures of this male indicated he was travelling up to 0.8 km in one night. The extensive movement of males and targeting of particular females clearly show the roving strategy male Northern Quoll exhibit during the breeding season.

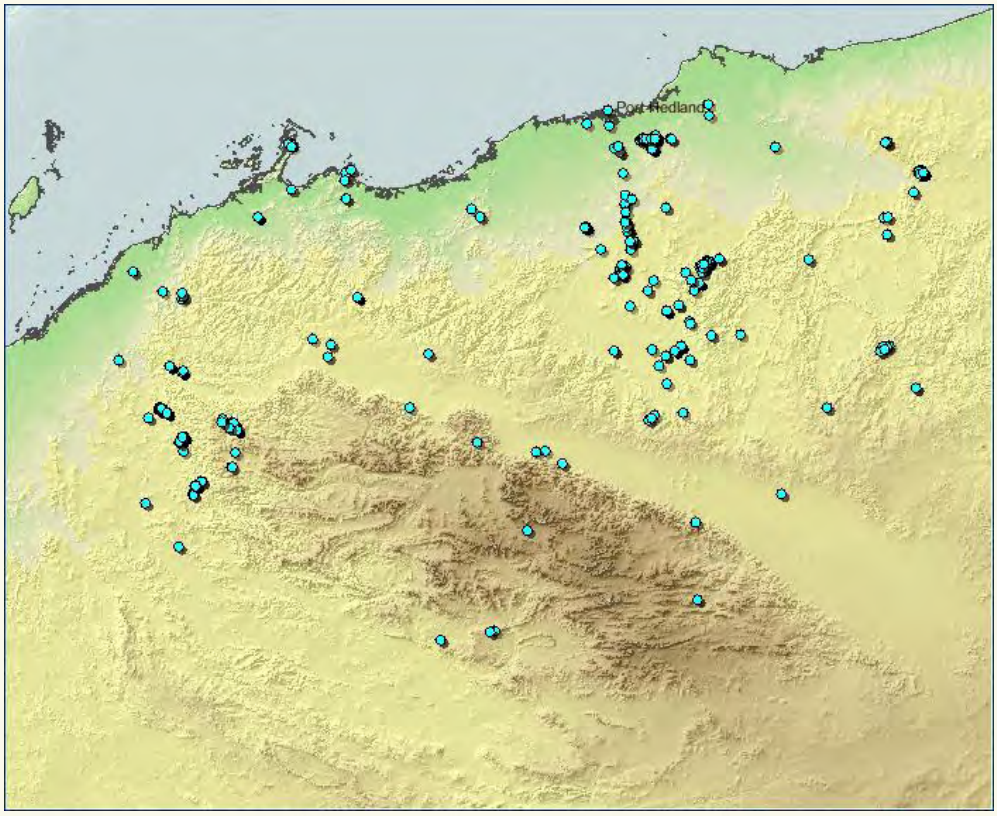

Figure 2 - Northern Quoll records in the Pilbara region (NatureMap 2013)

Threatening processes:

A number of threats are thought be contributing to the species' decline, either directly or in combination with each other. The key processes threatening Northern Quolls, as identified by DSEWPaC (2013a), are lethal toxic ingestion caused by Cane Toads; removal, degradation and fragmentation of habitat as a result of development actions and agricultural activities; inappropriate fire regimes; weeds; and predation by feral animals. The most common cause of adult Northern Quoll mortality is predation, typically by dingoes, feral cats, snakes, owls and kites (Maxwell et al. 1996; Oakwood 2008). Other causes of mortality include domestic dogs, motor vehicles and pesticide poisoning.

The impacts related to Cane Toads are unlikely to be directly relevant the proposed project, given that the Cane Toad is not predicted to become established in the Pilbara. The most relevant key threatening processes directly related to the project include the removal, degradation and fragmentation of habitat as a result of mining, construction and infrastructure.

Any clearing of Northern Quoll habitat reduces a distribution which has already contracted drastically, particularly as a result of other threats such as Cane Toads. Habitat clearing also displaces animals, limits reproduction and can result in direct mortality or extinction of local populations. This may be particularly relevant to the study area given that it is likely to support a resident breeding population of Northern Quolls (*ecologia* 2011a). Habitat clearing results in the fragmentation of habitat which in turn isolates Northern Quoll populations and can reduce the genetic diversity of local populations.

Development actions facilitate the introduction of invasive species (weeds and feral animals) which can result in the degradation of Northern Quoll habitat. Predation by cats and foxes are key threatening processes listed under the EPBC Act. These feral predators, in particular cats, may be having an impact on Northern Quoll populations either through competition for food or direct predation, and these impacts may be exacerbated after fire (DSEWPaC 2013a). The Northern Quoll is considered to be more vulnerable to predation by cats and foxes than other quoll species due to its smaller size (Hill and Ward 2010).

Increased human activity related to construction and mining activity may result in more frequent fires. The level of predation upon Northern Quolls (particularly by dogs, cats and raptors) is increased through the removal of ground cover by fire. Fires can also cause direct mortality of Northern Quolls and may affect habitat quality by reducing the availability of shelter (Hill and Ward 2010). It has been suggested that Northern Quolls do not maintain viable populations in intensively burnt areas in the Kimberley (Radford and Fairman 2008) and this may also apply to the Pilbara.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

The Pilbara Leaf-nosed Bat is a form of the Orange Leaf-nosed Bat (*Rhinonicteris aurantius*), a small, bright-orange coloured bat that occurs across northern Australia. The Pilbara Leaf-nosed Bat is considered an anachronism, a relict from wetter times (Armstrong 2008), and is restricted to the Pilbara region of Western Australia surviving by utilising warm humid roost caves. While it is considered a separate form, formal reclassification has been hampered by the small sample size of the Pilbara population (Armstrong 2008). This distinction is recognised in the EPBC Act with the Pilbara Leaf-nosed Bat's classification as Vulnerable.

Pilbara Leaf-nosed Bats forage mostly on moths and beetles (but they will take most flying insects). They fly and hunt in the same manner as the Orange Leaf-nosed Bat, rapidly with a fast wing beat and following a zigzag flight pattern, usually within a metre of the ground (Armstrong 2008; Churchill 2008). This flight pattern results in the bats frequently being seen and killed by motorists driving at night.

Habitat requirements and variability:

In the western Pilbara these bats roost in caves formed in gorges that dissect siliceous sedimentary geology. They are most often observed in flight over waterholes in gorges, although they are rare even in the Hamersley Ranges where this habitat is common (Armstrong 2008).

During the dry season, the Pilbara Leaf-nosed Bat is dependent on disused mines and caves with very hot and humid roost sites (28-32 °C and 96-100%) and areas of high relief with gorges, watercourses and permanent surface water (Armstrong 2001; Churchill 2008; McKenzie and Bullen 2009). They are unlikely to occur in the shallow 'breakaway' caves that occur along mesas and strike ridges due to the lack of humidity in these caves. During the wet season (November to February) the species abandons its dry season roost caves and becomes a forest or creekline dweller (Churchill 2008).

At dusk, Pilbara Leaf-nosed Bats emerge from their roosting sites to forage in gorges, small gullies and large watercourses, which attract a high number of insects (van Dyck and Strahan 2008). These areas are referred to as foraging habitat.

Pilbara Leaf-nosed Bat calls were recorded from 18 locations in the North Star project area, which were located in close proximity to creek lines and rocky ridges and along gorges (*ecologia* 2011a, b). During the targeted surveys in July 2011 (*ecologia* 2011a), four locations were identified as potential roost caves based on call patterns. Three of these were confirmed to be dry season roost caves during subsequent level 2 surveys based on call patterns (timing and abundance of calls). The caves were located along the ironstone ridge in the east of the North Star project area. The results of call analyses indicate that the North Star study area contains both foraging habitat and roost caves for Pilbara Leaf-nosed Bats.

Habitat for the Pilbara Leaf-nosed Bat was classified in two categories:

- Potential roost cave habitat (dry season).
- Potential roost habitat (wet season).

A total of 1,792.25 ha of potential roost habitat for the Pilbara Leaf-nosed Bat was identified along the north-south orientated ridge and east-west running gorge areas, along major creek lines with fringing eucalypt trees and along cliff faces (Table 4, Figure 11). Of this, 227.52 ha of potential wet season roost habitat were recorded from the Turner River and major creek lines in the centre of the rail corridor. The remaining

1,564.73 ha comprised potential dry season roost caves in the North Star project area and infrastructure corridor. This habitat type could provide roost caves if conditions such as vegetation, depth of caves and climate within the cave are suitable for Pilbara Leaf-nosed Bats.

Table 4 – Area of Pilbara Leaf-nosed Bat habitat identified within the North Star study area

Classification	Condition/Area (ha)					Total
	Excellent	Very good	Good	Poor	Very poor	
Potential roost cave habitat (dry season)	227.52	0	0	0	0	227.52
Potential roost habitat (wet season)	310.51	0	1,254.22	0	0	1,564.73

Life cycle and population dynamics:

Reproductive information on the Pilbara Leaf-nosed Bat is limited. *ecologia* assumes the reproduction of the Pilbara Leaf-nosed Bat takes place at the same time as the Orange Leaf-nosed Bat, with mating occuring in July and females giving birth to a single young in December or January. Because females produce only one young per year, extreme natural fluctuations in population numbers are unlikely (Churchill 1995).

Orange Leaf-nosed Bats form aggregation patterns typical of other leaf-nosed bat species when roosting. They form clusters of individuals maintaining a small distance of 12-15 cm between themselves. Orange Leaf-nosed Bats roost always on the ceiling of caves rather than on vertical surfaces (Churchill *et al.* 1988; Jolly 1988).

Accurate estimates of numbers of Pilbara Leaf-nosed Bats are difficult to obtain as the species is rarely captured in any numbers.

Movement and distribution patterns:

Recent evidence suggests two main stronghold areas for the Pilbara Leaf-nosed Bat, in the western Pilbara and north of Marble Bar. An additional subpopulation occurs in Barlee Range Nature Reserve, where a confirmed roost cave was found (Armstrong 2008).

There is evidence that some roosts might not be occupied in the drier parts of the year, though this is unlikely to change the extent of occurrence. The area of occupancy might decrease during these periods if bats aggregate in fewer roosts. Seasonal movements are still not well understood but some roosts are known to be permanent, some seasonal (based on observations of bats in flight) and others may be only night roosts (Armstrong 2001; Churchill 2008). There is no evidence to suggest extreme fluctuations in numbers or their distribution.

Regional records of the Pilbara Leaf-nosed Bat are limited (Figure 3). Only seven potential roost caves have been identified in the region (DEC 2013; Outback Ecology 2011b). A confirmed roost cave is located approximately 10 km north-east of the study area at Lalla Rookh mine (DEC 2011; Molhar 2007). Pilbara Leaf-nosed Bats have also previously been recorded foraging within 100 km of the study area (*ecologia* internal database).

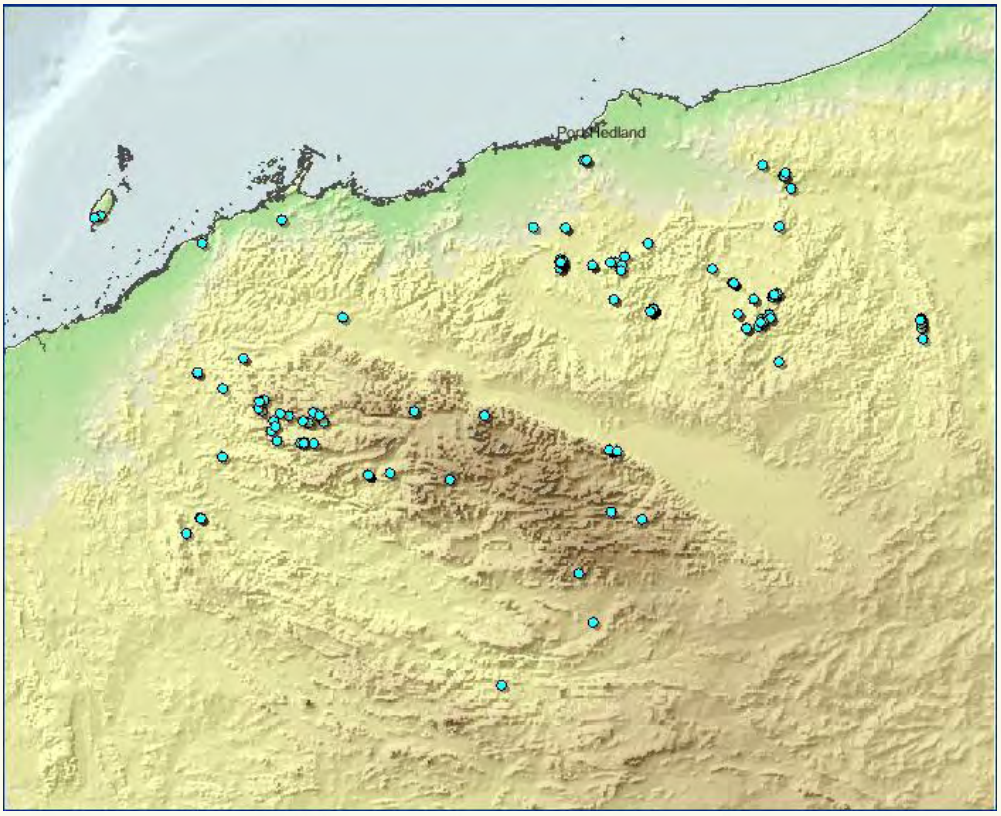

Figure 3 - Pilbara Leaf-nosed Bat records in the Pilbara region (NatureMap 2013)

Threatening processes:

Colonies of Pilbara Leaf-nosed Bats in mines in the eastern Pilbara are subject to several pressures, including human visitation, and the collapse and flooding of disused mines (Armstrong 2008; DEWHA 2008b). The key processes threatening Pilbara Leaf-nosed Bats, as identified by DSEWPaC (2013d), are heat and water loss; mine collapse; flooding of roost caves; natural predators; mine development; blasting in adjacent workings; human entry of roosts; road kills; and site rehabilitation.

Given that there are no disused mines within the North Star study area, their collapse or deliberate filling (site rehabilitation) are not threats that are relevant to the project. Likewise, flooding of disused mines or of roost caves is not considered a relevant threat.

Large colonies of this species are known to be heavily predated upon by Ghost Bats (*Macroderma gigas*) and, therefore, Pilbara Leaf-nosed Bats exit caves at high speed and rapidly enter thicker vegetation (Churchill 2008). Other predators include snakes such as python species (Churchill 2008). The project is unlikely to increase the threat of natural predators on Pilbara Leaf-nosed Bats.

The species tends to fly low to the ground and displays a curiosity for light sources, making them susceptible to vehicle strike. Almost half of the Western Australian museum specimens from the Pilbara were collected following collision with a vehicle or were found in car parks, presumably after falling off a vehicle (Armstrong 2001). Sporadic occurrences of road kill are unlikely to have a significant impact on the population size.

However, if a busy haul or access road is to be located close to a known roost or foraging site, it might contribute to a local decline (DSEWPaC 2013d).

The key threats associated with the project are mortalities resulting from heat and water lost due to the destruction or disturbance of roost caves. This can occur due to clearing of roost caves, human entry or visitation of caves, or nearby construction or mining activities, including blasting. The Pilbara Leaf-nosed Bat is susceptible to dehydration and hypothermia, and their removal from the high humidity and hot temperature of their roost caves will result in death within hours. Pilbara Leaf-nosed Bats are sensitive to disturbance and will abandon roost caves if disturbed. Human entry of roost caves and capture of Pilbara Leaf-nosed Bats may easily be avoided and, as such, is unlikely to be a relevant threat to the project. However, any construction or mining activities within 50 m of roost caves will impact on this species. If roost caves are impacted upon, there is the potential for a loss in the local population of this species. The scarcity of roost sites means that the loss of even one will result in a reduction in area of occupancy (DSEWPaC 2013d).

The development of the North Star project will result in a loss of wet and dry season roost habitat as well as foraging habitat for the Pilbara Leaf-nosed Bat and, therefore, will impact this species on a local level. Works undertaken around July (mating season) and November to March (when females are heavily pregnant or with young) may have a particularly high impact (Armstrong 2001). The level of impact at a regional scale will be determined by the nature of development/mining activities in the surrounding region and their proximity to roost caves.

Pilbara Olive Python (*Liasis olivaceus barroni*), EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

The Pilbara subspecies of the Olive Python only occurs in the ranges of the Pilbara region of Western Australia. This subspecies can grow to 4 m, but has an average size of 2.5 m (Cogger 2000). Females are slightly longer than males (Shine and Slip 1990). The Pilbara Olive Python is an adept swimmer, often hunting in water, and individuals have been seen feeding in the entrance of bat roost caves. These strategies allow them to feed on a variety of vertebrates, including rock wallabies, bats, ducks and pigeons.

Habitat requirements and variability:

Pilbara Olive Pythons inhabit watercourses and areas of permanent water in rocky gorges and gullies (Pearson 2003). The pythons shelter in caves and rock crevices, particularly in the colder months (DEWHA 2008a). Critical habitat for Pilbara Olive Pythons can be defined as areas that may contain escarpments and gorges, preferably with rock crevices and outcrops near water holes, which attract prey species.

Critical and suitable habitat is present within the North Star study area (ecologia 2011a). The habitat comprises rocky gorges with semi-permanent or permanent water pools and large creek beds such as the Turner River. The Pilbara Olive Python has the potential to occur anywhere throughout the North Star study area while they are dispersing over the summer months. The python is likely to shelter in rocky breakaways and gorges over the cooler winter months, when this species aestivates within deep rocky crevices. Critical habitat for the Pilbara Olive Python includes areas where surface water collects, such as deep bowls and depressions within rocky gorges. Some of these areas within the North Star mining area appear to have a permanent (spring) source of water. All six Pilbara Olive Python individuals captured during the fauna surveys (*ecologia* 2011a, b) were found in rocky gorges with surface water present.

In total, 66,284.71 ha of Pilbara Olive Python habitat were recorded within the North Star study area (Table 5). Of this, 1,796.32 ha were classified as critical habitat of good to excellent condition. This habitat comprised creek lines with pools and rock faces, and permanent water pools with or without vegetation along rocky gorges running east-west off the ridges within the North Star mining area and in the north and south of the proposed mine areas. A further 64,488.39 ha were classified as potential habitat of varying condition. This comprised cliffs, dry rock faces and creek lines without rock faces.

Table 5 – Area of Pilbara Olive Python habitat identified within the North Star study area

Classification	Condition/Area (ha)					Total
	Excellent	Very good	Good	Poor	Very poor	
Critical habitat	542.1	0	1,254.22	0	0	1,796.32
Potential habitat	56,882.35	3,985.37	44.05	3,550.41	26.21	64,488.39

Life cycle and population dynamics:

The breeding season occurs in winter (June to August). Males can travel up to 3 km in search of females in this time. Males and females move into shelter, such as a cave, where they stay together for up to three weeks and mate repeatedly before the male returns to his home range (Pearson 2003).

Eggs are laid in October and hatch in approximately January. Little is known about incubation or the average number of young (Pearson 2003). Pilbara Olive Pythons are known to have an increased activity pattern in the warmer months, particularly when young disperse from their place of birth, searching for food (Pearson 2003).

Population size estimates are difficult due to the species' cryptic nature and lack of a reliable trapping or census methodology (DEWHA 2008a).

Movement and distribution patterns:

In the warmer months, Pilbara Olive Pythons can move widely, usually remaining in close proximity to water and rock outcrops (DEWHA 2008a). In late winter or early spring, males will travel large distances to find, and mate with, females (DEWHA 2008a). Radio-tracking of Pilbara Olive Pythons indicates they have large home ranges, from 87.76 ha to 449.26 ha, and that males have larger home ranges than females (Tutt *et al.* 2004).

Pilbara Olive Python records in the Pilbara have been typically recorded from the McKay, Rocklea and Newman land systems, which are described as hills and ranges (*ecologia* internal database, NatureMap). The North Star study area lies in the north of the Pilbara Olive Python's known distribution.

The targeted survey conducted by *ecologia* (2011a) recorded secondary signs of Pilbara Olive Pythons (a sloughed skin, the remains of a Pilbara Olive Python and scats) from three locations. Pilbara Olive Pythons had also been recorded from within 100 km of the project area previously (Outback Ecology 2006, *ecologia* Internal Database, NatureMap, DEC Threatened Fauna Database, DSEWPaC Protected Matters Database). In 2010 *ecologia* recorded one individual crossing the road in the vicinity of Marble Bar (approximately 62 km east of the project area). A further four records of this species exist, comprising one specimen recorded from Marble Bar, two at Woodstock and one approximately 18 km north of the study area (DEC 2013). The two records from Woodstock were collected in 1965 and 1988 and represent historical records. Figure 4 provides an overview of the species' distribution and records.

The species' presence was confirmed during phase 2 of the North Star surveys (*ecologia* 2011b), with records of six Pilbara Olive Python individuals. Given the rarity of encounters with this subspecies, these records, particularly given their frequency, were considered significant.

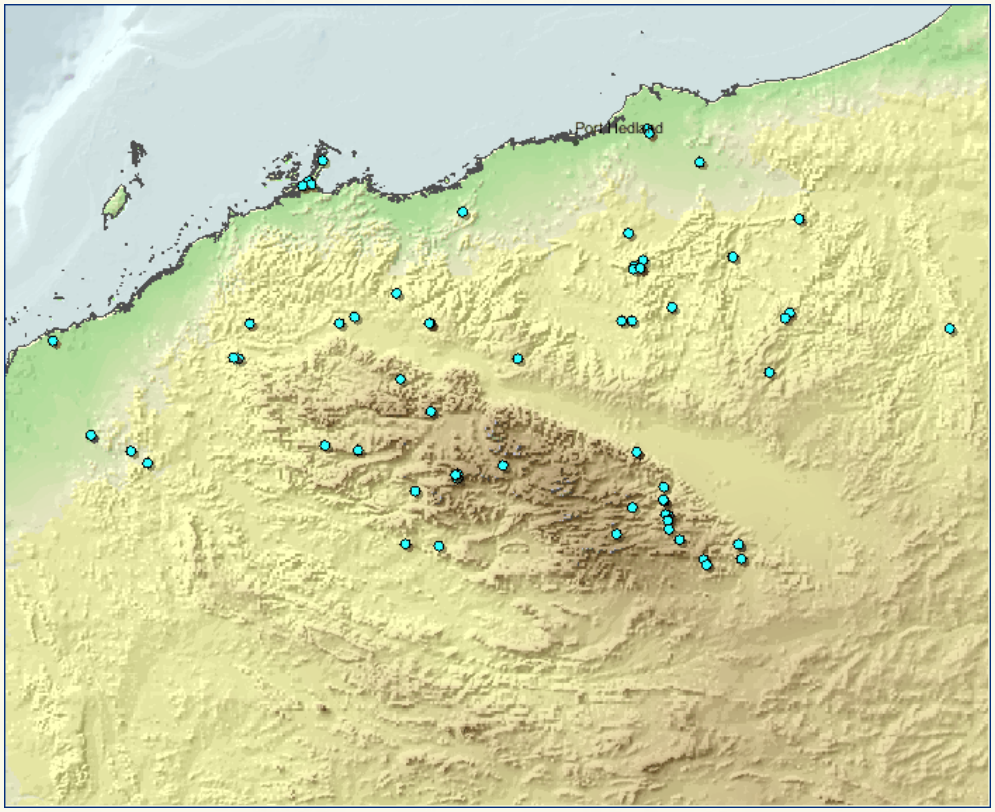

Figure 4 - Pilbara Olive Python records in the Pilbara region (NatureMap 2013)

Threatening processes:

The main threats to this subspecies are predation by feral cats and foxes, particularly of juveniles, competition with foxes and cats for food, major fire events and destruction of habitat, particularly from mining and infrastructure development (DSEWPaC 2013b; Pearson 2003). Pilbara Olive Pythons are often killed on Western Australian roads both accidentally and deliberately. They are slow-moving and their instinctive response to approaching cars is to freeze (Pearson 2003).

In areas such as the Burrup Peninsula, mining developments may directly affect the habitat of the Olive Python (Pilbara subspecies), alter prey availability to the species and increase deaths through road impacts (Pearson 2003). Increased human visitation to water holes may also disturb Pilbara Olive Pythons (DSEWPaC 2013b).

Mulgara (*Dasycercus blythi* / *D. cristicauda*), DEC Priority 4 / EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

Until recently, the Crest-tailed Mulgara (*Dasycercus cristicauda*; EPBC Act Vulnerable) was synonymous with the Brush-tailed Mulgara (*Dasycercus blythi*; DEC Priority 4). Since previous records did not distinguish between the two species, there is some ambiguity over their exact distributions. However, in recent times, the Crest-tailed Mulgara has been found in the central Simpson Desert at the junction between South Australia, Queensland and the Northern Territory (Menkhorst and Knight 2009).

The Crest-tailed Mulgara digs and inhabits burrows predominantly in dunes with a sparse cover of Sandhill Canegrass (*Zygochloa paradoxa*) or areas around saltlakes with Nitre Bush (*Nitraria billardieri*) (Masters 2008). Brush-tailed Mulgaras occur in spinifex grasslands throughout much of the arid zone, digging burrows in flats between low sand dunes (Woolley 2008).

Believed to be generally solitary, Mulgaras construct several single-entranced, multi-tunnelled burrows within their home range (Woolley 2008). According to Koertner *et al.* (2007), home ranges and burrows encompass both mature spinifex and open regrowth areas, with Mulgaras not preferring either habitat type over the other. However, utilisation of open habitats might increase the risk of predation, especially following fire. Mulgaras are nocturnal hunters, feeding on arthropods and small vertebrates. Breeding is thought to occur from late winter to spring (Woolley 2008).

Mulgaras are known to occur in the area, with four records in the study area, including one older record (1958) and three more recent records (2001) (NatureMap). Accurate species identification of these records is difficult at this stage as the species are currently undergoing taxonomic revision (Ric How, Western Australian Museum, pers. comm.). A possible Mulgara burrow was also recorded approximately 35 km from the study area (*ecologia* Internal Database, NatureMap). Suitable habitat for Mulgaras exists within the study area, particularly within the sandy plains with spinifex and scattered granites in the west of the project area, 43,479.21 ha of which were identified (Table 6, Figure 11).

Little is known about the cause of decline and threatening processes to Mulgara, making it difficult to determine potential impacts. However, it is likely that environmental degradation and habitat homogenisation negatively affect the species. Changes in fire regimes, grazing by introduced herbivores including cattle and rabbits, and predation by introduced predators are also likely threatening processes (Pavey et al. 2006). Therefore, habitat degradation, altered fire regimes and changes to flora and fauna assemblages (particularly an increase in introduced species) may impact on local populations of Mulgara. Due to the aforementioned taxonomic revision, the distributions of each Mulgara species are uncertain. However, it is likely that Brush-tailed Mulgara are widely distributed and may be locally abundant in some areas. Pavey et al. (2011) describes an increase in identified habitat preference, including gibber plains as suitable habitat. The project is, therefore, anticipated to have a low impact on Mulgara at a local or regional scale.

Greater Bilby (*Macrotis lagotis*), EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

The Greater Bilby is a nocturnal marsupial with soft, silky fur (Pavey 2006). It uses its strong forelimbs and claws to construct an extensive tunnel system of up to 3 m long and 1.8 m deep in which it shelters during the day. Its long tongue is an adaptation to its specialised diet of seeds, insects, bulbs, fruit and fungi (Johnson 2008).

Once common over 70% of mainland Australia's arid and semiarid regions, Greater Bilbies are currently patchily distributed through the Tanami, Great Sandy and Gibson Deserts (Maxwell *et al.* 1996). Isolated populations also occur in south-west Queensland and to the north-east of Alice Springs. Greater Bilbies occur in a variety of habitats, including spinifex grassland, acacia shrubland, open woodland and cracking clays (Johnson 2008; Maxwell *et al.* 1996). The species underwent a sudden and widespread collapse in population size in the early 1900s, and the distribution may still be contracting and fragmenting.

Several records of Greater Bilbies exist from within 100 km of the study area (NatureMap, DEC Threatened Fauna Database, DSEWPaC Protected Matters Database), including at least two recent records (2001 and 2006, DEC 2013). The nearest Greater Bilby record is approximately 2.7 km to the south of the infrastructure corridor component of the project (DEC 2013).

Within the North Star study area, Greater Bilbies are most likely to occur in sandy plains with spinifex and scattered granites. This habitat type is present in the western part of the North Star mining area and in the proposed borefield area, where several Greater Bilby diggings were recorded. A total of 43,479.21 ha of this habitat has been identified in the study area (Table 6, Figure 11). Similar habitat exists outside the North Star study area, and it is likely that any Greater Bilbies present would disperse into surrounding areas, particularly given the species' capacity to travel over large distances.

The key processes threatening Greater Bilbies are predation by feral predators, mainly foxes but also cats and dingos (DSEWPaC 2013c). Clearing of habitat for grazing and changed fire regimes are also potential threats (Southgate 1990). Other threats include competition with and disruption of habitat by livestock and rabbits (Southgate 1990). While mining and construction activities may exacerbate the effects of fire, the key impact to Greater Bilbies associated with the project is the clearing of habitat.

Grey Falcon (*Falco hypoleucos*), DEC Schedule 1 (Vulnerable)

While Grey Falcons are not EPBC Act listed species, they are included here as their conservation status under state legislation (WC Act) has recently been upgraded to Schedule 1. Fauna listed as Schedule 1 are fauna which are rare or likely to become extinct, are declared to be fauna that is in need of special protection. The Grey Falcon has been classified as Vulnerable.

Grey Falcons are a rare, nomadic species sparsely distributed across much of arid and semi-arid Australia. In Western Australia they are restricted to the northern half. Grey Falcons once occurred across much of Western Australia, with sightings as far south as York and New Norcia during colonial times. However, the current distribution is now thought to be restricted to north of 26 °S (Johnstone and Storr 1998). Because the species is sparsely distributed over an extremely large area, sightings of this species are very uncommon.

The Grey Falcon occurs in a wide variety of arid habitats, including open woodlands and open acacia shrubland, hummock and tussock grasslands and low shrublands, and may also be seen around swamps and waterholes that attract prey (Ehmann and Watson 2008). As such, Grey Falcon may occur anywhere within the North Star study area, which comprises 201,679.47 ha.

Like other falcons, this species preys primarily on birds such as parrots and pigeons, although reptiles and mammals are also taken (Ehmann and Watson 2008). Two to three eggs are laid in winter in the nests of other birds of prey and ravens, typically in tall eucalypt trees near water (Ehmann and Watson 2008; Garnett and Crowley 2000).

A family of four Grey Falcons was recorded during the second phase of the North Star level 2 survey (*ecologia* 2011b), along the Mount Newman rail. Five individuals were also sighted during the Canning Basin project survey, just outside the project area. Though widely distributed, Grey Falcons are rarely sighted. This sighting confirms the species' presence in the area, as ascertained by numerous previous records within 100 km of the study area (Biota 2005, *ecologia* Internal Database, NatureMap, Birdata).

Some Grey Falcon individuals may be impacted through loss of foraging habitat and prey resources, as well as by loss of nesting sites. However, Grey Falcons are highly mobile, widely distributed and not restricted to any particular habitat type. Therefore, the impacts to Grey Falcons at a local and regional scale are anticipated to be low due to the ability of the Grey Falcon to move away from disturbance.

Determine site characteristics in relation to species or ecological community ecology:

Site Condition

What is the structure and condition of the vegetation on the site?

The Canning Basin area (northern portions of the impact area) and the western half of the North Star area are made up of flat and undulating sandy and rocky plains, with scattered rivers and drainage lines (*ecologia* 2012a). The eastern portion of the North Star area consists of both rocky hills and rocky outcrops dissected with creeks and drainage lines. Within the North Star study area, gullies, gorges and dyke communities can be found, which are in very good condition and are significant in the local context for providing habitat of high specificity (*ecologia* 2012d).

In a wider context, the vegetation of both areas can be described as a mosaic of *Triodia* hummock grasslands and *Acacia* open shrublands. Different vegetation communities can be found in much smaller proportions, such as river beds and drainage lines which support *Corymbia* or *Eucalyptus* open woodlands, and the vegetation of gullies and dykes. The vegetation in gullies, gorges and dykes is of particular significance as it is different from the rest of the area, supporting some priority taxa such as *Pityrodia* sp. Marble Bar, and habitat-specific taxa, like *Ficus platypoda* (*ecologia* 2012a, d).

The majority of the vegetation of the Canning Basin and North Star areas is in either excellent or very good condition (*ecologia* 2012a, d). The poorer-condition vegetation tends to be in drainage lines, river beds and adjacent loamy plains, with some grazing activity and strong presence of introduced taxa apparent. At the time of surveying, the North Star study area showed no evidence of extensive fires within the last 5 years.

The condition of each impact zone and each habitat was assessed, and the areas of each condition category were calculated (Table 6 and Table 7) and mapped (Figure 11 and Figure 12).

Table 6 – Habitat condition in the impact area by habitat type

Area name	Total area (ha)	Condition	Area (ha)
Sandy plains with spinifex and shrubs	42,655.92	Excellent	38,702.04
		Very Good	3,953.88
Acacia shrubland on hard soil	26.88	Excellent	26.88
Alluvial plain grasslands	5,079.82	Excellent	1,485.36
		Good	44.05
		Poor	3,550.41
Creekline	285.33	Excellent	252.78
		Good	32.55
Granite outcrop	4.07	Excellent	4.07
River system	1,279.40	Excellent	57.73
		Good	1,221.67
Rocky ridge/breakaway/gorge	227.52	Excellent	227.52
Sandy plains with spinifex and scattered granites	823.29	Excellent	823.29
Stony spinifex grassland plain	15,902.48	Excellent	15,844.78
		Very Good	31.49
		Very Poor	26.21

Table 7 – Habitat condition in the impact area by impact zone

Area name	Condition	Area (ha)
Camp Zone	Excellent	158.78
Infrastructure Zone	Excellent	3979.39
	Very Good	31.49
	Good	133.92
	Very poor	25.72
Low Grade Stockpile Zone	Excellent	359.45
Pit Zone	Excellent	634.69
Power Station Zone	Excellent	42.66
Process Rejects Zone	Excellent	427.02
	Very Poor	0.5
Process Zone	Excellent	136.52
Slurry Corridor Zone	Excellent	122.47
TSF Zone	Excellent	1333.64
Waste Rock Dump Zone	Excellent	854.12
Water Corridor Zone	Excellent	44717.61
	Very Good	1758.98
	Good	427.78
Water Corridor Zone – De Grey River Crossing	Excellent	4658.1
	Very Good	2194.9
	Good	736.58
	Poor	3550.41

What is the diversity of relevant habitat species present (including both endemic and non-endemic)?

None of the listed conservation significant fauna species are reliant on particular habitat species, though the Pilbara Leaf-nosed Bat may utilise large eucalypt trees with hollows along watercourses during the summer wet season, and Mulgara require mature spinifex hummocks for shelter. Species present within the North Star study area are not directly dependent on certain habitat species but rely on particular habitat types and vegetation components instead. For example the Pilbara Leaf-nosed Bat is strongly associated with humid caves during the dry season, located along the rocky ridge in the west of the study area and eucalypt trees along riverbeds as roost sites during the wet season (Churchill 2008).

What relevant habitat features are on the site?

Species recorded from the North Star area were relatively diverse, as expected from the variety of habitats present within the North Star study area. The Canning Basin area comprises habitats of lower elevation with a lack of rocky ridges and breakaways which limited the diversity of fauna within the area.

Communities inhabiting sandy plains were distinguishable from fauna communities occurring within rocky habitats such as rocky ridges. The fauna communities recorded from the flats with sandy substrate and occasional granites were relatively diverse due to the soft substrate and the ability of species to construct burrows. Specialised species such as Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*), the skink *Ctenotus piankai* and the burrowing skink *Lerista bipes* but also amphibians such as the Desert Spadefrog (*Notaden nichollsi*) were recorded which are not known to occur in rocky habitats.

The granite boulders in the west of the North Star project area harbour the endemic Eastern Pilbara Spiny-tailed Skink (*Egernia ebsisolus*) and provide refuges for a number of rock-dwelling species such as the Pilbara Rock Monitor (*Varanus pilbarensis*) and the Spiny-tailed Monitor (*Varanus acanthurus*). In general, the granite boulders may harbour endemics but are not known to be inhabited by a large variety of fauna species.

The creekline habitat, which includes major creeklines and river systems (including tributaries), is located in the centre of the Canning Basin project area (De Grey and Strelley rivers) and the west of the North Star project area (Turner River). The fauna assemblage of this habitat type is different to any other habitat type, particularly when surface water is present. Waterbirds and a generally high diversity of avifauna are characteristic during these times.

The most relevant habitat feature for the Northern Quoll, the Pilbara Leaf-nosed Bat and the Pilbara Olive Python are the rocky gorges, cliffs and gullies with eucalypt trees and/or *Ficus* sp. communities. This vegetation and landform structure provides moisture and increased humidity, which is essential for the Pilbara Leaf-nosed Bat. Suitable caves along these gorges and cliffs can be narrow, particularly around the entry of the cave, providing humidity and moisture with an almost inhospitable climate for any other native mammal species. Pilbara Olive Pythons and Northern Quolls, on the other hand, can be found within the open features of the ridge top and the breakaways, with males of each species moving large distances during breeding seasons as they search for females.

Riverbeds and major creeklines were recorded throughout the North Star study area. Areas of smaller creekline tributaries located in the mining area (associated with all components) had enclosed rocky characteristics which form suitable habitat for Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python. The open, flatter habitats in the west (infrastructure zone), are of lower suitability for these three species.

With regard to Mulgara and Greater Bilby, the North Star project comprises some areas of potential habitat in the infrastructure zone, slurry corridor zone and water corridor zones in the form of sandy plains, which were slightly impacted by grazing cattle, in proximity to drainage lines. The spinifex communities covering these plains did not show any signs of recent fires and were of excellent condition. Sand plains with spinifex were also recorded from the north of the Canning Basin area showing significant secondary signs of Greater Bilby activities and, apart from cleared vehicle tracks, a low level of impact by feral fauna and other human activity.

Figure 5 - Rocky gorge within the study area with suitable cliff habitat for the Northern Quoll

Figure 6 - Suitable habitat for the Northern Quoll present within the study area

Figure 7 - Cliff face with potential roost cave(s) 1 for the Pilbara Leaf-nosed Bat

Figure 8 - Potential roost cave 2 for the Pilbara Leaf-nosed Bat

Figure 9 - Potential roost cave 3 for the Pilbara Leaf-nosed Bat

Figure 10 - Suitable habitat for Pilbara Olive Python present within the study area

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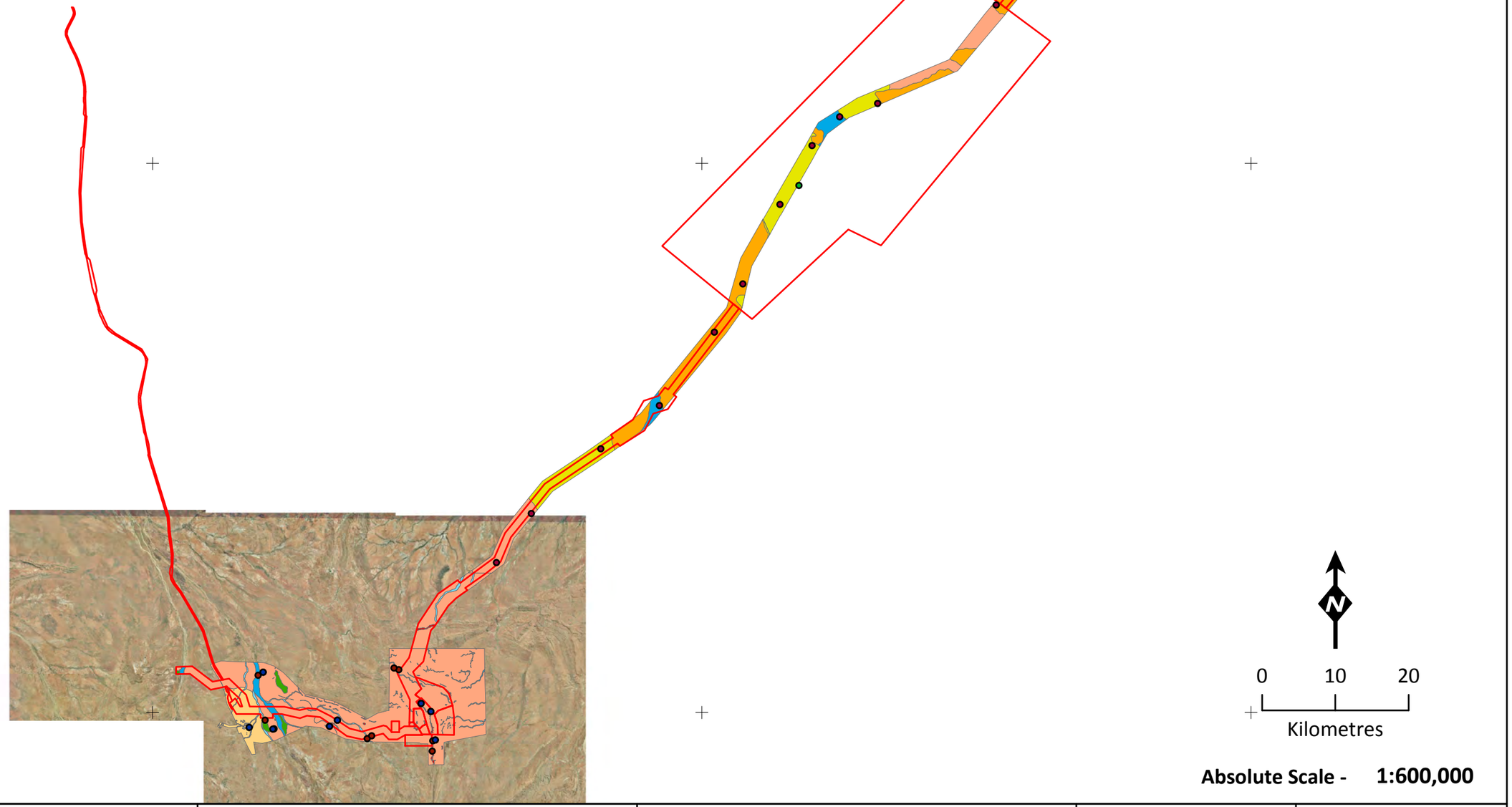
Legend

- Fauna site
- Impact area

Habitat Type

- Creekline
- River system
- Acacia shrubland on hard soil
- Alluvial plain grasslands
- Granite outcrop
- Rocky ridge/breakaway/gorge
- Sandy plains with spinifex and scattered granites
- Sandy plains with spinifex and scattered shrubs
- Stony spinifex grassland plain



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Kilometres

Absolute Scale - 1:600,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Fauna habitats in the North Star study area

Figure: 11
Project ID: 1500

Drawn: RY
Date: 06/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RYxxx

A3

675000

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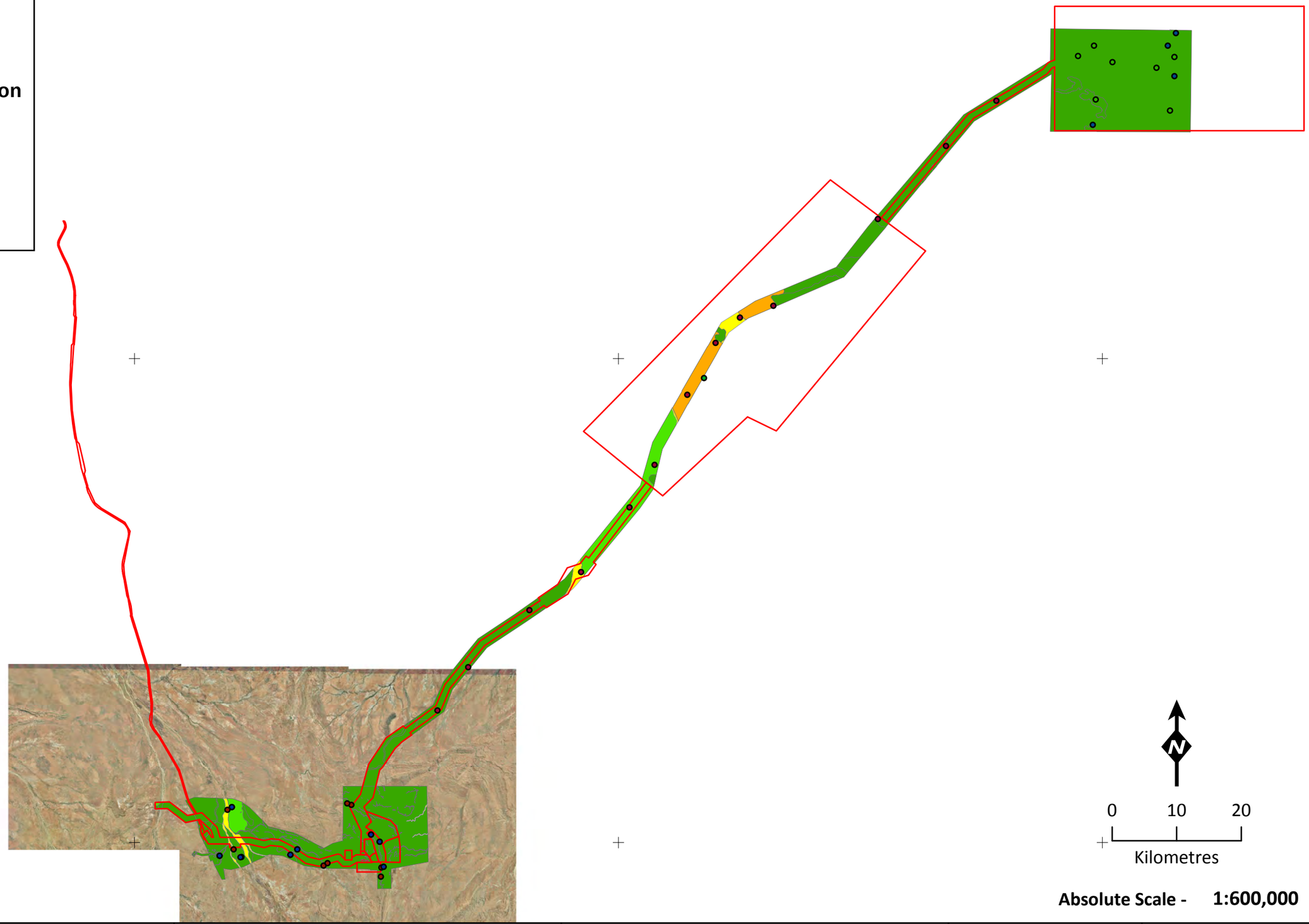
7650000

Legend

- Fauna site
- Impact area

Fauna habitat condition

- Excellent
- Very good
- Good
- Poor
- Very poor



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Kilometres

Absolute Scale - 1:600,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Fauna habitat condition of the North Star study area

Figure: 12
Project ID: 1500

Drawn: RY
Date: 06/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RYxxx

A3

Discussion

ITEM 1

Discussion of potential impacts to Fauna as a result of the proposal, with particular regard to Matters of National Environmental Significance (MNES), and provision of quantitative data on impacts of the proposal to species of conservation significance.

Northern Quoll (*Dasyurus hallucatus*), EPBC Act Endangered, WC Act Schedule 1 (Endangered)

Significant impacts to the endangered Northern Quoll that may result from the North Star project were assessed according to the Significant Impact Guidelines (DEWHA 2009) as follows:

The project will lead to a long-term decrease in the size of a population.

The North Star study area supports a permanent, breeding population of Northern Quoll. The National Recovery Plan for Northern Quoll defines 'core populations' as those occurring in rocky and/or high rainfall areas (Hill and Ward 2010), which is applicable to the local population at North Star. A minimum population size of 23 is known to occur in the study area. Population estimates could not be derived based on available data, but it is likely, given the frequency of records in and near to the North Star study area, that a relatively large population of Northern Quolls occurs in the study area. Clearing and degradation of critical habitat is likely to reduce the size of this local population over the long term.

The project will reduce the area of occupancy of the species.

A total of 1,796.32 ha of Northern Quoll habitat was identified from the North Star study area. The area of occupancy of Northern Quoll will be reduced by a proportion of the amount of habitat impacted by the project. The proportion will depend on the type of impacts of the project, because mining activities such as clearing, active mining and processing will preclude occupancy of Northern Quoll from those areas.

The project will fragment an existing population into two or more populations.

The project is likely to pose a barrier to Northern Quoll dispersal to some extent, particularly during infrastructure construction. However, insufficient data is available on the distribution of Northern Quolls surrounding the North Star study area to determine whether the project would fragment the existing population over the long term. Anecdotal evidence (D. Cancilla personal observation) suggests that Northern Quoll adapt to disturbed sites and will utilise areas within mining operations such as camps and rock piles.

The project will adversely affect habitat critical to the survival of a species.

Up to 231.59 ha of critical (denning) habitat was identified within the North Star mine component of the study area. Areas that have not been assessed may contain some additional critical habitat, however the majority of the unassessed areas occur in the Canning Basin area and along the slurry pipeline and are unlikely to have any significant habitat, based on current assessments.

The project will disrupt the breeding cycle of a population.

The breeding cycle of the local Northern Quoll population may be disrupted if clearing and construction activities result in disturbance to denning habitat, particularly in spring and summer (i.e. the breeding season), or significant mortalities of female and juvenile male Northern Quolls. This is particularly relevant given the discrete male cohorts that arise as a result of the post-mating die-off typical of Northern Quolls.

The project will modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

A total of 231.59 ha of denning/foraging habitat and 1,564.73 ha of foraging/dispersal habitat were identified in the study area. At least 292.4 of potential denning habitat and 1,277.6 ha of foraging/dispersal habitat occurs adjacent to the North Star study area, based on previous habitat assessments, and is not expected to be impacted. The loss of this habitat will reduce the total area of available local habitat for the Northern Quoll and, therefore, lower the local population size. The significance of this is unknown, and thus the likelihood that the removal of habitat will cause species population decline, is unknown.

The project will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.

The project has the potential lead to an increase in feral cat and dog numbers, which are already present in the study area. This may result in an increase of predation on Northern Quolls and competition for food resources. Rocky habitats (critical/denning habitat) are likely to become particularly important to Northern Quoll as refuges, as these are less accessible to feral predators. No new invasive species that are likely to affect Northern Quolls are expected to be introduced as a result of the project.

The project will introduce disease that may cause the species to decline.

Disease is currently not implicated in the decline of Northern Quoll, and the project is unlikely to introduce new diseases into the environment.

The project will interfere with the recovery of the species.

Any clearing of habitat will result in a reduction of the species' available habitat and distribution, which has already contracted drastically (Braithwaite and Griffiths 1994).

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

Significant impacts to the vulnerable Pilbara Leaf-nosed Bat that may result from the North Star project were assessed according to the Significant Impact Guidelines (DEWHA 2009) as follows:

The project will lead to a long-term decrease in the size of an important population of a species.

Based on the currently known distribution of Pilbara Leaf-nosed Bats, the subspecies occurs in two main stronghold areas: in the western Pilbara and north of Marble Bar. The North Star study area occurs on the eastern edge of the latter range, suggesting that the Pilbara Leaf-nosed Bats occurring in the study area may form an important population. Lalla Rookh mine, near to the North Star study area, is known to support a significant colony of Pilbara Leaf-nosed Bats. If roost caves are impacted by the project, it may lead to a long-term decrease in the size of this population. Pilbara Leaf-nosed Bats were recorded from 18 locations in the North Star study area. Due to the nature of records (bat call recordings, which do not allow the identification of individuals), population estimates could not be made. If roost caves are cleared or disturbed, the project is likely to lead to a long-term decrease in the local population size.

The project will reduce the area of occupancy of an important population.

1,792.25 ha of Pilbara Leaf-nosed Bat (wet and dry season) habitat was identified from the North Star study area. The loss of this habitat will result in a reduction of occupancy of the same amount.

The project will fragment an existing important population into two or more populations.

The project is unlikely to pose a barrier to Pilbara Leaf-nosed Bat dispersal due to the aerial nature of the species.

The project will adversely affect habitat critical to the survival of a species.

A total of 227.52 ha of potential critical (dry season roost) habitat was identified within the North Star study area. Three dry season roost caves were identified along the ironstone ridge in the east of the North Star project area, two of which are located in the pit zone.

The project will disrupt the breeding cycle of an important population.

Reproductive information on the Pilbara Leaf-nosed Bat is limited. Breeding may occur in roost caves present in the North Star study area. Clearing of these caves or disturbance within 50 m of the caves may disrupt the breeding cycle of local populations of Pilbara Leaf-nosed Bat.

The project will modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The project may result in the destruction or degradation of 227.52 ha of potential dry season roost habitat and 1,564.73 ha of potential wet season roost habitat, with a further 135,394.74 ha unassessed for habitat type/condition. At least 292.4 of dry season roost habitat and 1,277.6 ha of potential wet season roost habitat occur adjacent to the North Star study area, based on previous habitat assessments. Additionally, a significant colony of Pilbara Leaf-nosed Bats is known to occur at Lalla Rookh mine, 10 km north-east of the study area.

The project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The project is unlikely to introduce or facilitate invasive species that are harmful to Pilbara Leaf-nosed Bats.

The project will introduce disease that may cause the species to decline.

Disease is currently not implicated in the decline of Pilbara Leaf-nosed Bat, and the project is unlikely to introduce new diseases into the environment.

The project will interfere substantially with the recovery of the species.

Any clearing of or disturbance to roost caves will result in a reduction of the species' distribution and habitat availability, which is already limited.

Pilbara Olive Python (*Liasis olivaceus barroni*), EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

Significant impacts to the vulnerable Pilbara Olive Python that may result from the North Star project were assessed according to the Significant Impact Guidelines (DEWHA 2009) as follows:

The project will lead to a long-term decrease in the size of an important population of a species.

Given there are too few records of Pilbara Olive Python to estimate population size, it is difficult to establish the importance of a population. The recording of seven individuals within the North Star study area, given the rarity of encounters with this subspecies, suggests the North Star study area may support an important population of Pilbara Olive Python. Clearing and degradation of critical habitat is likely to reduce the size of this local population over the long term.

The project will reduce the area of occupancy of an important population.

1,796.32 ha of critical habitat and 64,488.39 ha of potential habitat were identified in the North Star study area. The loss of this habitat will result in a reduction of occupancy of the same amount.

The project will fragment an existing important population into two or more populations.

The project is likely to pose a barrier to Pilbara Olive Python dispersal to some extent, particularly during infrastructure construction. However, insufficient data is available on the distribution of Pilbara Olive Pythons surrounding the North Star study area to determine whether the project would fragment the existing population over the long term.

The project will adversely affect habitat critical to the survival of a species.

A total of 1,796.32 ha of potential critical habitat were identified within the North Star study area. A further 135,394.74 was not assessed and may contain additional critical habitat.

The project will disrupt the breeding cycle of an important population.

The breeding cycle of the local Pilbara Olive Python population may be disturbed if clearing and construction activities hinder the dispersal of males when searching for females (from June to August), or caves/crevices harbouring females are disturbed during mating or egg incubation (from October to January).

The project will modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

A total of 1,796.32 ha of critical habitat and 64,488.39 ha of potential habitat for the Pilbara Olive Python was identified in the North Star study area. At least 1,617.40 ha of critical habitat and 24,284 ha of potential habitat occur adjacent to the North Star study area, based on previous habitat assessments. Impacts are expected to be limited to 5,300 ha and although several individual are expected to be killed during construction and mining activities, a decline in the species population is expected to be minimal.

The project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The project may facilitate an increase in feral cats and dogs, which may increase predation of Pilbara Olive Pythons and competition for food resources. Rocky habitats (critical habitat) are likely to become particularly important to Pilbara Olive Python as refuges, as these are less accessible to feral predators.

The project will introduce disease that may cause the species to decline.

Disease is currently not implicated in the decline of Pilbara Olive Python, and the project is unlikely to introduce new diseases into the environment.

The project will interfere substantially with the recovery of the species.

Any clearing of critical habitat will result in a reduction of the species' distribution and habitat availability, which is already limited.

Mulgara (*Dasycercus blythi / D. cristicauda*), DEC Priority 4 / EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

Significant impacts to the vulnerable/Priority 4 Mulgara that may result from the North Star project were assessed according to the Significant Impact Guidelines (DEWHA 2009) as follows:

The project will lead to a long-term decrease in the size of an important population of a species.

There is no evidence to suggest that an important population of Mulgara occurs in the North Star study area.

The project will reduce the area of occupancy of an important population.

There is no evidence to suggest that an important population of Mulgara occurs in the North Star study area.

The project will fragment an existing important population into two or more populations.

There is no evidence to suggest that an important population of Mulgara occurs in the North Star study area.

The project will adversely affect habitat critical to the survival of a species.

A total of 43,479.21 ha of potential Mulgara habitat was identified within the North Star study area. A further 135,394.74 ha was not assessed and may contain additional habitat. No habitat critical to the survival of the species was identified in the North Star study area.

The project will disrupt the breeding cycle of an important population.

There is no evidence to suggest that an important population of Mulgara occurs in the North Star study area.

The project will modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

A total of 43,479.21 ha of potential Mulgara habitat was identified within the North Star study area. At least 8,095.80 ha of habitat occur adjacent to the North Star study area, based on previous habitat assessments. The areas of potential habitat are not expected to be impacted to the extent that a decline in the species would be reasonably expected as impacts from construction of infrastructure and water and slurry pipelines are the only impacts expected in this area.

The project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The project may facilitate an increase in feral cats and dogs, which may increase predation of Mulgara.

The project will introduce disease that may cause the species to decline.

Disease is currently not implicated in the decline of Mulgara, and the project is unlikely to introduce new diseases into the environment.

The project will interfere substantially with the recovery of the species.

The project is not expected to significantly impact this species.

Greater Bilby (*Macrotis lagotis*), EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable)

Significant impacts to the vulnerable Greater Bilby that may result from the North Star project were assessed according to the Significant Impact Guidelines (DEWHA 2009) as follows:

The project will lead to a long-term decrease in the size of an important population of a species.

The large area over which the Greater Bilby occurs, the nomadic nature of the species' and the fragmented nature of the species' occurrence preclude the identification of important populations of Greater Bilby. It is unlikely that any Greater Bilby occurring in the North Star study area form an important population.

The project will reduce the area of occupancy of an important population.

The large area over which the Greater Bilby occurs, the nomadic nature of the species' and the fragmented nature of the species' occurrence preclude the identification of important populations of Greater Bilby. It is unlikely that any Greater Bilby occurring in the North Star study area form an important population.

The project will fragment an existing important population into two or more populations.

The large area over which the Greater Bilby occurs, the nomadic nature of the species' and the fragmented nature of the species' occurrence preclude the identification of important populations of Greater Bilby. It is unlikely that any Greater Bilby occurring in the North Star study area form an important population.

The project will adversely affect habitat critical to the survival of a species.

Given the large area over which the Greater Bilby occurs and the fragmented nature of its occurrence, identification of habitat critical to the species is difficult. A total of 43,479.21 ha of potential Greater Bilby habitat was identified within the North Star study area. A further 135,394.74 was not assessed and may contain additional habitat. Impacts expected to occur in the areas of Greater Bilby habitat (Water extraction and linear infrastructure) are not expected to adversely affect significant areas of Greater Bilby habitat

The project will disrupt the breeding cycle of an important population.

The large area over which the Greater Bilby occurs, the nomadic nature of the species' and the fragmented nature of the species' occurrence preclude the identification of important populations of Greater Bilby. However, it is unlikely that Greater Bilby occurring in the North Star study area form an important population.

The project will modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

43,479.21 ha of potential Greater Bilby habitat was identified within the North Star study area. At least 8,095.80 ha of habitat also occurs adjacent to the North Star study area, based on previous habitat assessments. Impacts expected to occur in the areas of Greater Bilby habitat (Water extraction and linear infrastructure) are not expected to adversely affect significant areas of Greater Bilby habitat, and therefore are not expected to cause a decline in the species.

The project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The project may facilitate an increase in feral cats and dogs, which may increase predation of Greater Bilby.

The project will introduce disease that may cause the species to decline.

The role of disease in Greater Bilby decline is currently being investigated. At present, there is insufficient knowledge on this topic to assess the potential effect the project may have on the introduction and spread of disease in the study area; however, it is unlikely to introduce diseases into the environment.

The project will interfere substantially with the recovery of the species.

The project is not expected to significantly impact this species.

Grey Falcon (Falco hypoleucos), DEC Schedule 1 (Vulnerable)

Significant impacts to the vulnerable Grey Falcon that may result from the North Star project were assessed according to the Significant Impact Guidelines (DEWHA 2009) as follows:

The project will lead to a long-term decrease in the size of an important population of a species.

No important populations are likely to occur in the study area. The project will not impact sufficient areas of habitat to cause a long-term decrease of Grey Falcon populations.

The project will reduce the area of occupancy of an important population.

The project will not impact sufficient areas of habitat to cause a reduction of occupancy of Grey Falcon populations.

The project will fragment an existing important population into two or more populations.

The aerial and nomadic nature of Grey Falcons precludes fragmentation of populations by the development of the project.

The project will adversely affect habitat critical to the survival of a species.

Critical habitat for Grey Falcon was not recorded in the North Star study area.

The project will disrupt the breeding cycle of an important population.

The development of the North Star study area is unlikely to disrupt the breeding cycle of the Grey Falcon. The aerial and nomadic nature of this species allows movement away from disturbance. Tall structures constructed for mining operations and infrastructure (such as radio towers) are often utilised by Grey Falcons for nesting.

The project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Although Grey Falcon may occur throughout the North Star study area, no critical habitat was identified in the study area. Foraging habitat for this species is extensive in the region and easily accessible due to the aerial and nomadic nature of the species.

The project will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

The project is unlikely to affect the impacts of invasive species on the Grey Falcon.

The project will introduce disease that may cause the species to decline.

Disease is currently not implicated in the decline of Grey Falcon, and the project is unlikely to introduce new diseases into the environment.

The project will interfere substantially with the recovery of the species.

The project is not expected to significantly impact this species.

ITEM 2

Where vegetation to be cleared provides habitat for EPBC listed species, the PER should also provide an assessment of habitat quality in terms of site condition and context and species stocking rate, as described in the EPBC Act Offsets Assessment Guide.

Site Context

What is the connectivity with other suitable/known habitat or remnants?

The rocky ridge running north-south through the North Star project area is broken up in sections which extend north along "Falls Pound". The ridge also extends south for approximately 8 km outside the proposed impact area until it reaches the tributaries of the Turner River and the Shaw River. The majority of critical rocky habitat continues to the north with intersecting valleys similar to the Glacier Valley.

Several areas outside of the currently proposed impact area were assessed during the previous biological assessments. These areas provide an indication of site connectivity to habitat available outside of the impact area. The habitat types and condition are presented in Table 8 and Table 9.

Table 8 – Condition of habitat in areas assessed outside of the North Star impact area

Habitat condition	Area of habitat (ha)
Excellent	28,118.6
Very good	2,9332.4
Good	883.5

Table 9 – Habitat types in areas assessed outside of the North Star impact area

Habitat type	Area of habitat (ha)
Sandy plains with spinifex	6,030.0
Acacia shrubland on hard soil	457.8
Alluvial plain	1,342.5
Creekline	518.9
Granite outcrops	47.4
River system	758.7
Rocky ridge/breakaway	292.4
Sandy plains with spinifex and granite	2,065.8
Stony spinifex grassland	20,387.9

What is the importance of the site in relation to the overall species population?

The Chichester Range is known to provide suitable Northern Quoll habitat which is reflected by the high proportion of records (87% of all Pilbara records) in the Chichester IBRA subregion (NatureMap, ecologia internal database). Records are known from west of the infrastructure zone and north-east of the North Star mining areas, indicating that this region may represent a large population of Northern Quoll in the Pilbara. Although it is difficult to adequately interpret the significance of the populations in the study area due to limited published survey data in the surrounding area, the suitability and condition of the habitat within the ridges and gorges of the North Star study area is considered excellent (Table 2). The study area comprises several areas that provide suitable denning habitat for the Northern Quoll, and the North Star project supports a resident population of Northern Quoll based on the presence of four females over approximately 12 km. Given the substantial reduction in the distribution of the Northern Quoll (95% between 1980 to 2010; DSEWPaC 2013a), the presence of good quality habitat for Northern Quoll in the study area suggests the site may be important to the overall species population. This is particularly relevant given the Pilbara region is outside the predicted range of the Cane Toad and the Pilbara may become an important refuge for the species.

Due to the limited number of previous records and fauna surveys, the significance of the North Star study area as critical habitat for Pilbara Leaf-nosed Bats cannot be easily determined. Sightings, recordings and roost caves are not commonly recorded in the Pilbara. The bat calls recorded and the presence of potential roost caves in the study area indicate a high likelihood that the project area is an important refuge for the Pilbara Leaf-nosed Bat. Pilbara Leaf-nosed Bats were recorded from 14 locations within the study area, with some of the recordings likely to be of bats foraging in the vicinity of their roosting cave. These records indicated that the western cliff edges in North Star might provide important habitat for this species and might represent critical habitat and/or significant populations of this species. Based on the call patterns recorded, three roost caves were identified in the west of the North Star project area. Given that not all areas of suitable habitat were surveyed due to inaccessibility, additional Northern Quolls and Pilbara Leaf-nosed Bats are anticipated to inhabit the study area. This indicates that the populations of these species may be locally and regionally significant.

An overall assessment of habitat for the Pilbara Olive Python within the North Star mining area determined it to be of good to excellent condition. The quality of the habitat was reflected by the high number of records during the surveys of the study area. This suggests that this area may be significant for this subspecies. Though few records exist for Pilbara Olive Python (69 currently available on NatureMap, including six records made by ecologia from within the study area), this subspecies is fairly widely distributed through the region. However, there is insufficient information on the population size for this subspecies to determine the level of regional impact with any certainty.

Suitable habitat for Mulgara and Greater Bilby is present within the North Star study area, particularly within the proposed borefield component of the Canning Basin, where several Greater Bilby diggings were recorded. This habitat extends outside the study area and is unlikely to be of high significance to the overall species' populations.

Grey Falcons, though rarely recorded, are widespread and occupy a variety of habitats. As such, the North Star study area is unlikely to be of particularly high significance to the overall population of this species.

What threats occur on or near site?

The study area occurs near pastoral leases and areas used for exploration and mining by other mining companies.

The primary threats to EPBC Act listed species that occur on the site include the following:

- Habitat clearing – This threat is relevant to all species in question and is the threat likely to have the highest impact on species populations. Clearing of habitat results in a further reduction of already restricted available habitat and distribution, and may cause mortality, displacement, interruption of breeding, and loss of foraging ground. The destruction of potential roost caves in particular is likely to impact Pilbara Leaf-nosed Bats.
- Habitat fragmentation – Habitat fragmentation may isolate populations, causing a reduction of genetic diversity of local populations. This threat is particularly relevant for Northern Quoll and Pilbara Olive Python.
- Weeds – Mining and construction activities facilitate the introduction of weeds, which may degrade habitat. This is unlikely to affect foraging habitat for all species in question as weed species are not expected to cause large scale alteration in habitat or prey abundance.
- Feral predators – Development activities may increase feral predator populations in the area, which will increase predation pressure and competition for food with native species such as Northern Quoll, Pilbara Olive Python and Mulgara.
- Fire – mining activities and increased human visitation may increase the frequency of fires at the site. As well as causing direct mortality, fires may degrade habitat by removing ground cover, making Northern Quoll more susceptible to predation, and reducing the prey available to Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python. Fire may also result in removal of habitat for Mulgara and Greater Bilby.
- Vehicles – All species are susceptible to mortality and injury caused by vehicle strike.
- Disturbance to roost caves – Pilbara Leaf-nosed Bats readily vacate roost caves if the cave is visited by humans or if disturbance occurs within 50 m of the cave.

Species Stocking Rate

What is the presence of the species on the site? (i.e. confirmed/modelled).

Northern Quoll: 56 captures totalling 20 individuals (four female and 16 male) were recorded using mark recapture techniques from the North Star study area during targeted fauna surveys. The remains of an unmarked northern Quoll and two skulls were also located during the targeted survey, resulting in a minimum of 23 known individuals. A further 14 captures of a minimum of five individuals (based on site locations and capture dates) were recorded during the level 2 baseline surveys. Six Northern Quolls were recorded visually (observed directly and motion cameras) and secondary evidence was recorded from another two locations. This equates to 81 records from at least 23 individual Northern Quolls. Northern Quolls were consistently recorded in areas of rocky cliff or rocky gorge habitat. All Northern Quoll records, including regional records, are presented in Figure 13 and Figure 14.

Pilbara Leaf-nosed Bat: Confirmed echolocation calls were recorded from 18 locations across the North Star study area, and were located in close proximity to creek lines, rocky ridges and along gorges. Of the four potential roost locations identified, three were confirmed to be potential dry season roost caves (based on call timing and activity levels). These were located along the ironstone ridge in the east of the North Star project area. Calls recorded immediately after sunset and before sunrise indicate bats leaving their roost cave, whereas calls recorded scattered throughout the night indicate bats foraging. Results of call analyses indicate that the North Star study area contains both foraging habitat and roost caves for Pilbara Leaf-nosed Bats in the mining area (Pit Zone). All Pilbara Leaf-nosed Bat records, including regional records, are presented in Figure 15 and Figure 16.

Pilbara Olive Python: Six Pilbara Olive Python individuals and secondary signs of Pilbara Olive Pythons from three locations (a sloughed skin, the remains of one Pilbara Olive Python and scats) have been recorded from the North Star study area, resulting in at least seven individuals recorded. Given the rarity of encounters with this subspecies, these records, particularly given their frequency, were significant. All individuals were opportunistically captured in rocky gorges with surface water present, which represents critical habitat for the species. All Pilbara Olive Python records, including regional records, are presented in Figure 16.

Greater Bilby: Potential Greater Bilby diggings have been recorded from eleven locations in the northern parts of the North Star study area (Canning Basin area). All Greater Bilby records are presented in Figure 18.

Mulgara: Mulgara were not recorded on the North Star study area during *ecologia* surveys, but four previous records from other sources exist: one older (1958) and three more recent records from 2001 (DEC 2013). The 1958 record is of a specimen that was retained with the Western Australian Museum, and the 2001 records were of trapped individuals. All Mulgara records are presented in Figure 18. Habitat suitable for Mulgaras exists in the study area in the water corridor zone (Canning Basin areas) and the eastern parts of the infrastructure zone.

Grey Falcon: Two records of Grey Falcon were made by *ecologia*. The first was of four individuals in the North Star project area, along the Mount Newman rail. The second sighting was of five individuals and was made during the Canning Basin project survey, just outside the project area. These records are presented in Figure 18.

600000 675000 750000 825000

7725000

7650000

Legend

Northern Quoll records

- Regional records
- North Star records
- Impact area
- Towns
- FMG rail
- Rail
- River
- Roads

PORT HEDLAND

GOLDSWORTHY LTD RAILWAY

MOUNT NEWMAN RAILROAD

LALLA ROOKH

MARBLE BAR

N

0 10 20

Kilometres

Absolute Scale - 1:700,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Northern Quoll records

Figure: 13
Project ID: 1500

Drawn: AN
Date: 14/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projecton: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AN016

A3

675000

7650000

MOUNT NEWMAN RAILROAD

Legend

Northern Quoll records

- Regional records
- North Star records
- Impact area
- Towns
- FMG rail
- Rail
- River
- Roads

N

0 2.5 5

Kilometres

Absolute Scale - 1:175,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Northern Quoll records - North Star mine area

Figure: 14
Project ID: 1500

Drawn: AN
Date: 14/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projecton: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AN017

A3

600000
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Legend

Pilbara Leaf-nosed Bat

- Regional records
- North Star records
- Pilbara Leaf-nosed Bat roost caves
- Impact area
- Towns
- FMG rail
- Rail
- River
- Roads

PORT HEDLAND

GOLDSWORTHY LTD RAILWAY

MOUNT NEWMAN RAILROAD

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Kilometres

Absolute Scale - 1:700,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Pilbara Leaf-nosed Bat records

Figure: 15
Project ID: 1500

Drawn: AN
Date: 14/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projecton: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AN018

A3

675000

7650000

Legend

Pilbara Leaf-nosed Bat

- Regional records
- North Star records
- Pilbara Leaf-nosed Bat roost caves
- Impact area
- Towns
- FMG rail
- Rail
- River
- Roads

LALLA ROOKH

MOUNT NEWMAN RAILROAD

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0 5 10

Kilometres

Absolute Scale - 1:225,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Pilbara Leaf-nosed Bat records - North Star mine area

Figure: 16
Project ID: 1500

Drawn: AN
Date: 14/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projecton: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AN019

A3

600000 675000 750000 825000

7725000

7650000

Legend

- Impact area
- Towns
- FMG rail
- Rail
- River
- Roads

Pilbara Olive Python

- Regional records
- North Star records

PORT HEDLAND

GOLDSWORTHY LTD RAILWAY

MOUNT NEWMAN RAILROAD

LALLA ROOKH

MARBLE BAR

N

0 10 20

Kilometres

Absolute Scale - 1:700,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Pilbara Olive Python records

Figure: 17
Project ID: 1500

Drawn: AN
Date: 14/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projecton: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AN017

A3

600000
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PORT HEDLAND
GOLDSWORTHY LTD RAILWAY
MOUNT NEWMAN RAILROAD
LALLA ROOKH
MARBLE BAR

Legend

- Impact area
- Towns
- FMG rail
- Rail
- River
- Roads

Bilby

- Regional records
- North Star records

Mulgara

- Regional records

Grey Falcon

- North Star records

N

0 10 20
Kilometres

Absolute Scale - 1:700,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

Greater Bilby, Mulgara and Grey Falcon records

Figure: 18
Project ID: 1500

Drawn: AN
Date: 14/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AN021

A3

What is the density of species known to utilise the site?

The data collected within the site are insufficient for any meaningful estimates of species densities. However, mapping of species records in the site provides an indication of density and distribution. Further surveys of the site may provide additional data which could be used to derive density estimates.

What is the role of the site population in regards to the overall species population?

Due to the paucity of data and remoteness of their distributions, meaningful population estimates are not available for any of the species in question, with the exception of Grey Falcon. In 1990, the first population estimate was made for Gray Falcons, suggesting that there 'may be only 1000 pairs' (Brouwer and Garnett 1990). Schoenjahn (2011) evaluated this estimate based on several assumptions and recalculated the population estimate as 200 to 350 pairs of Grey Falcons. However, further research into the biology and ecology of Grey Falcon is required before an accurate population estimate may be made.

It is, therefore, not possible to assess the role of the site's populations in regards to the overall populations of the species until further research is available. Further surveys of the site may provide additional data which may be used to derive population estimates.

Best regards,
Damien Cancilla
Zoology Team Leader

20th February 2013

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