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REPORT

CORUNNA DOWNS PROJECT: VERTEBRATE FAUNA IMPACT ASSESSMENT

Prepared for Atlas Iron Limited

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QUALITY STATEMENT

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Executive Summary

Atlas Iron Limited (Atlas) commissioned MWH Australia Pty Ltd (MWH) to undertake a vertebrate fauna impact assessment (this Assessment) for the development of the proposed Corunna Downs Project (the Project). The Project is located approximately 33 kilometres (km) south-west of Marble Bar (by road) in the Pilbara region of Western Australia. The overarching objective of this Assessment was to identify and assess the potential impact of the Project on broad fauna habitats, vertebrate fauna assemblages and vertebrate fauna of conservation significance. Included within this was an assessment to the impact of matters of national environmental significance, which for the purposes of this Assessment, were defined as fauna that are listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

The area to be assessed as part of this Assessment (the Development Envelope) comprises a 2,263 ha parcel of land that is contained completely within the Study Area, an 18,845 ha parcel of land used for the baseline surveys. An indicative disturbance footprint (the Disturbance Footprint), which covers approximately 423.12 ha, is presented in this Assessment. The Disturbance Footprint is contained entirely within the Development Envelope, but the exact layout is subject to change. Regardless of the final layout of the disturbance, Atlas has committed to locating the Project within the Development Envelope and disturbing no more than 423.12 ha.

A total of 11 fauna habitats were mapped across the Study Area. Ten of these intersect with the Development Envelope and have the potential to be affected by land clearing during the construction and operation of the Project. Clearing of up to 423.12 ha of vegetation in the Application Area will represent the greatest direct impact on terrestrial vertebrate fauna habitats. Twenty significant microhabitat features were recorded in the Study Area, of which nine are located within the Development Envelope. These features provide important sources of shelter, food and water for species of conservation significance. Other impacts of the Project on terrestrial fauna habitats are likely to include vehicle collisions, noise and vibration, dust emissions, artificial lighting, altered hydrology, altered fire regimes and the presence of introduced flora and fauna.

Of the broad fauna habitats that have potential to be adversely affected, three are considered to be of significance to fauna assemblages and/or fauna of conservation significance; Rocky Ridge and Gorge, Drainage Line and Riverine. Rocky Ridge and Gorge habitat within the Development Envelope is considered significant and relatively uncommon within the broader landscape, as it comprises cliffs, hillsides, rock faces and gorges featuring outcropping ironstone, fallen boulders, caves, overhangs, crevices and water pools. This habitat type occupies 249.26 ha of the Development Envelope and is important habitat for fauna of conservation significance including, but not limited to, the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python. The local impacts associated with clearing Rocky Ridge and Gorge habitat is likely to be significant, as rehabilitation is unlikely to restore the key habitat features that define this habitat type, such as caves, crevices and overhangs.

Drainage Line and Riverine habitats consist of watercourses, rivers, creeks and channels that support grassy *Eucalyptus*, *Corymbia* and *Melaleuca* woodlands subject to regular flooding and seasonal ponding. These are considered significant habitat types for fauna as they provides a range of microhabitats, such as permanent, semi-permanent and seasonal water pools, moist depressions, sedges and rushes on alluvial soil. The Drainage Line and Riverine habitats, which occupy 55.72 ha and 37.72 ha of the Development Envelope, respectively, are considered significant habitats for their ability to provide foraging and dispersal habitats for the Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python.

A total of 174 species were recorded in the Study Area. The inventory of fauna developed from baseline surveys of the Study Area suggests that vertebrate fauna assemblages in the Study Area are representative of those in equivalent parts of the Pilbara bioregion, and that the Study Area does not represent an area of particularly high biodiversity from a regional perspective. The Survey did however confirm the presence of six species of fauna of conservation significance within the Development Envelope, the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Western Pebble-mound Mouse and Rainbow Bee-eater.

Impacts of the Project on fauna of conservation significance, at the local scale, are expected to be Moderate for the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python. That is permanent population decline is expected but no there is perceived threat to each population's persistence. The Peregrine Falcon, Spectacled Hare-wallaby and Western Pebble-mound Mouse although confirmed to be present in the Study Area, are expected to experience Low localised impact. *Anilios ganei*, Brush-tailed Mulgara and the Long-tailed Dunnart were not recorded, however if are present, are expected to receive a low level of impact. The Greater Bilby, Grey Falcon, *Ctenotus nigrilineatus*, *Ctenotus uber johnstonei*, Eastern Great Egret and Rainbow Bee-eater are expected to receive a Minimal level of impact, if present.

The impacts to the Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python are deemed to be Significant under the Commonwealth's *Matters of National Environmental Significance: Significant impact guidelines 1.1*. This is largely due to the removal of suitable habitat, and in the instance of the Pilbara Leaf-nosed Bat, the proximity of a mining pit with relation to a Non-permanent Breeding Roost. As such, the project should be referred to the DoE regarding each of these species. Various management measures have been recommended to reduce impacts of the overall Project and for each species.

Atlas Iron Limited

Corunna Downs Project:
Vertebrate Fauna Impact Assessment

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1 Introduction

1.1 Background

Atlas Iron Limited (Atlas) commissioned MWH Australia Pty Ltd (MWH) to undertake a vertebrate fauna impact assessment (this Assessment) for the development of the proposed Corunna Downs Project (the Project). This Assessment is based on data obtained and analysed during a vertebrate fauna baseline survey conducted over the area, via numerous field trips, between February 2014 and October 2016 (the Survey; MWH 2016b). Atlas required the Assessment to facilitate future environmental approvals for the Project, which would involve the construction and operation of an iron ore mine and associated supporting infrastructure.

1.2 Project Location and Description

The Project is located approximately 33 kilometres (km) south-west of Marble Bar (by road) in the Pilbara region of Western Australia. The area covered during the Survey consisted of an 18,845 hectare (ha) parcel of land (the Study Area). The area to be assessed as part of this Assessment (the Development Envelope) comprises a 2,263 ha parcel of land that is contained completely within the Study Area. At the time of this Assessment, the exact disturbance footprint for the Project had not yet been finalised; thus, the Development Envelope has been considered for the purposes of assessing potential impacts of the Project. An indicative disturbance footprint (the Disturbance Footprint), which covers approximately 423 ha, is however presented. The Disturbance Footprint is contained entirely within the Development Envelope. Regardless of the final layout of the Disturbance, Atlas has committed to locating the Project within the Development Envelope and disturbing no more than 423 ha. Two Exclusion Zones have also been applied to the Study Area surrounding two regionally significant caves, delineating a zone within which development will be excluded.

The existing environment of the Study Area was documented in detail by MWH (2016b). For summaries of the biogeographic region, climate, land systems and land use, as well as biological and ecological information on vertebrate fauna of conservation significance, please refer to MWH (2016b).

1.3 Report Scope and Objectives

The overarching objective of this Assessment was to identify and assess the potential impact of the Project on broad fauna habitats, vertebrate fauna assemblages and vertebrate fauna of conservation significance within the Development Envelope. This Assessment, and the supporting survey reports, are aligned with relevant guidelines including the following:

- EPA (2002), *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection*;
- EPA (2004), *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*;
- EPA and DEC (2010), *Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*;
- DEWHA (2010a) *Survey Guidelines for Australia's Threatened Bats;*
- DEWHA (2010b), *Survey Guidelines for Australia's Threatened Birds;*
- DSEWPaC (2011a), *Survey Guidelines for Australia's Threatened Mammals;*
- DSEWPaC (2011b), *Survey Guidelines for Australia's Threatened Reptiles;* and
- DoE (2016c), *EPBC Act Referral Guidelines for the Endangered Northern Quoll* Dasyurus hallucatus.

1.4 Background to Protection of Fauna

Fauna of conservation significance within this report are defined as species listed as Threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the *Wildlife Conservation Act 1950* (WC Act). The term within this report extends also to those species listed as Priority fauna on the WA Department of Parks and Wildlife's (DPaW) *Priority Species List.* This list comprises fauna which have not been assigned statutory protection but are considered to be of conservation significance as they are near threatened, or threatened but data deficient, generally rare but not threatened, require monitoring, or have been recently removed from a threatened category.

A key objective of this Assessment was to identify and assess the potential impacts of the Project to such species. This is an essential step in ensuring that any future Environmental Impact Assessment for the Project is adequately informed, due to the legislative protection afforded to these species. Therefore discussion of fauna of conservation significance comprises a large portion of this report.

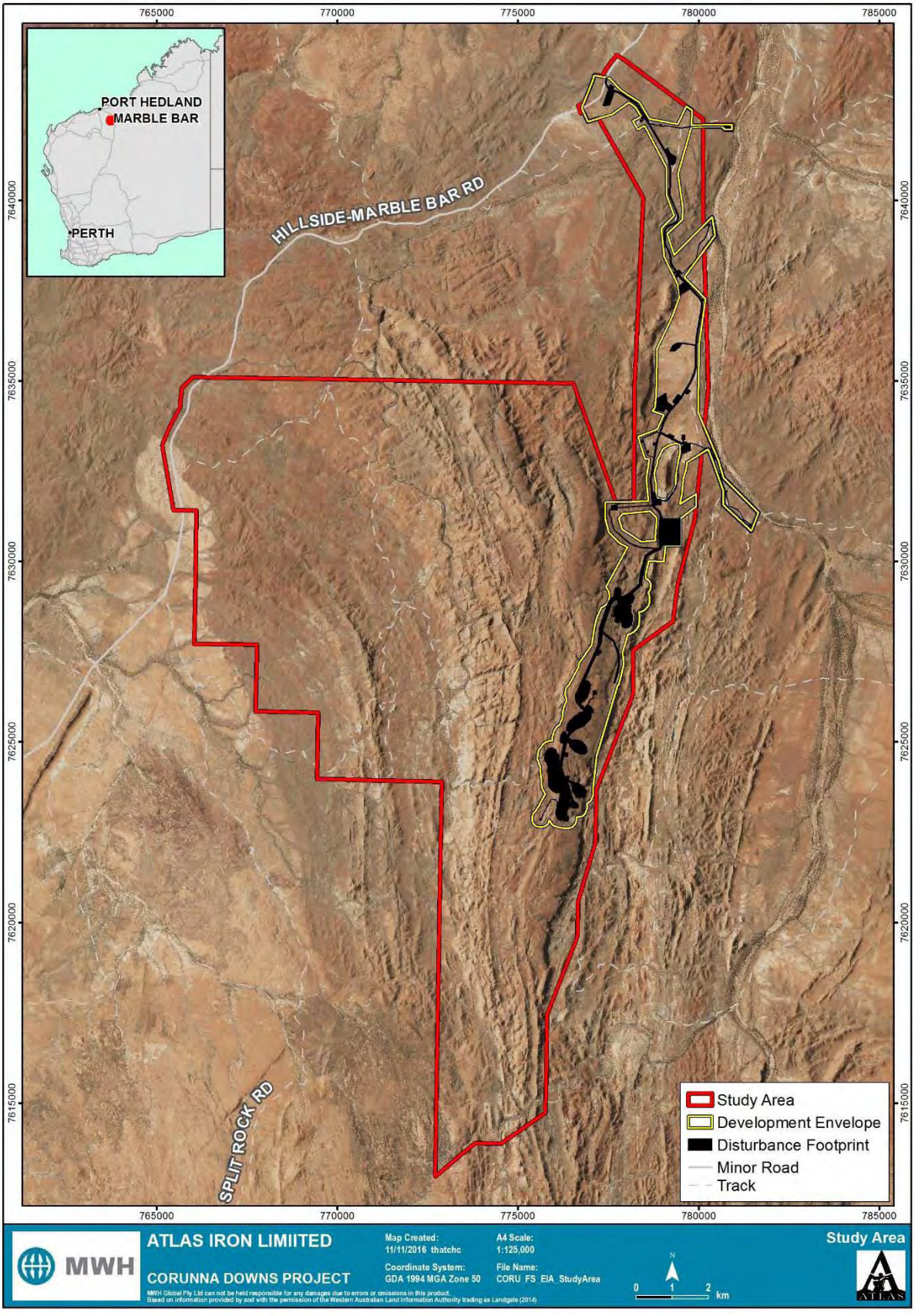

Figure 1-1: The Study Area, Development Envelope and Disturbance Footprint

2 Impact Assessment

2.1 Threatening Processes

Threatening processes relevant to the Pilbara bioregion have been identified by Regional Development Australia (RDA) *Pilbara: State of the Environment Report* (2013), and include land clearing, fragmentation, altered fire regimes and introduced flora and fauna. Threatening processes specifically associated with the Project are discussed in **Section 2.1.1** to **Section 2.1.9**. The impact of clearing and vehicle collision will be wholly contained within the Development Envelope, however other threatening processes, noise and vibration, dust emissions, artificial lighting, altered hydrology, altered fire regimes, introduced flora and fauna, are not restricted, and will potentially impact species and individuals occurring within and outside the Development Envelope. The degree to which this occurs varies accordingly to each threatening process and each species.

2.1.1 Clearing

Clearing of vegetation is a necessary part of the Project, and represents the most direct impact to fauna habitats and fauna assemblages. Development of the Project will result in a maximum loss of 423.12 ha (Disturbance Footprint), and this may occur anywhere within the Development Envelope according to Project requirements.

Clearing is believed to be the largest and most widespread threat to Australian biodiversity, and is regarded as the most dominant threat to biodiversity within the eastern Pilbara region (Evans *et al.* 2011). Clearing would reduce the size and quality of habitats, through edge effects and habitat fragmentation, and is likely to heighten the effects of other threatening processes such as introduced flora (Keighery 2010), introduced fauna (Doherty *et al.* 2015) and altered fire regimes (Knorr *et al.* 2014). The impact of clearing is particularly high when landforms, such as caves, cliff lines and overhangs are removed, as there is limited opportunity and ability to recreate and rehabilitate such habitat features post mine closure.

Of the 11 fauna habitats identified within the Study Area, 10 intersect with the Development Envelope and have the potential to be affected by land clearing during the construction and operation of the Project (**Table 2-1**; **Figure 2-1**). All habitats occurring within the Development Envelope are represented by a small percentage of their overall extent within the Study Area, and all are well connected to area outside the Development Envelope (i.e. no habitats are confined to the Development Envelope). Of these habitats, Ironstone Ridge Top, Spinifex Stony Plain and Stony Rises compose the three most represented habitats in the Development Envelope (**Table 2-1**). Each of these three habitats is considered to be widespread and of limited significance, with the exception of the Rocky Ridge and Gorge habitat (MWH 2016b).

The Rocky Ridge and Gorge habitat is the fourth most common habitat type within the Development Envelope (**Table 2-1**). This habitat type occurred predominantly on the periphery of the Ironstone Ridgetop habitat, and was characterised by outcropping ironstone, gorges, fallen boulders, caves, overhangs, rocky crevices and water pools (MWH 2016b). This habitat type was noted as the most important habitat type within the Study Area, due to the regular occurrence of significant microhabitat features (caves and water sources) which provide important sources of shelter, food and water for species of conservation significance (MWH 2016b). Approximately 249.26 ha of Rocky Ridge and Gorge habitat intersects the Development Envelope, this represents only 14.1% of the overall Rocky Ridge and Gorge habitat within the Study Area (**Table 2-1**), suggesting that the fauna assemblage and those fauna of conservation significance occurring throughout this habitat, will remain within the Study Area. The remaining broad fauna habitats that are at greatest risk of land clearance (Spinifex Sandplain, Rocky Foothills, Drainage Line and Riverine) are widely represented in the Pilbara bioregion (van Vreeswyk *et al.* 2004).

Of the significant microhabitat features identified during the Survey, nine are located within the Development Envelope, comprising two semi-permanent water sources, two permanent water sources, four Nocturnal Refuges and one Non-permanent Breeding Roost of the Pilbara Leaf-nosed Bat. Another regionally important cave was also recorded within the vicinity of the Development Envelope, CO-CA-01 a Permanent Diurnal roost for the Pilbara Leaf-nosed Bat. Atlas have committed to protecting this cave via a 450m and the Non-permanent Breeding Roost via a 50m buffered Exclusion zone. Other significant microhabitat features are unlikely to occur within the Development Envelope, given the extensive search effort that was expended across the area (**Figure 2-2**).

In addition to habitat loss, land clearance is likely to result in the direct loss of individual animals. Species at greatest risk are those that reside in habitats that are more limited in their extent or species that are sedentary in nature and will be unable to move during clearing activities. However, even mobile fauna, which may be able to avoid direct mortality, may face subsequent impacts depending on the availability of suitable habitat elsewhere and the ability to disperse there. While fauna may be able to escape direct mortality by dispersing into nearby habitats the overall carrying capacity of the Study Area will be reduced, and required niches may already be filled (Parker *et al.* 2015). Individuals may either fail to establish due to competition and thus not survive long term, or displace their competitors and they, in turn, will not survive long term (Parker *et al.* 2015).

Table 2-1: Habitat extents in the Study Area, Development Envelope and Disturbance Footprint

Fauna habitat	Category#	Extent within* (ha)		
		Study Area	Development Envelope	Disturbance Footprint
Stony Rises	• Widespread • Limited significance	7,703	532.74 (6.9%)	79.10 (1.0%)
Rocky Foothills	• Widespread • Limited significance	4,458	76.27 (1.7%)	11.04 (0.2%)
Spinifex Stony Plain	• Widespread • Limited significance	1,876	607.97 (32.4%)	99.66 (5.3%)
Rocky Ridge and Gorge	• Widespread • Significant	1,766	249.26 (14.1%)	42.29 (2.4%)
Ironstone Ridgetop	• Widespread • Limited significance	1,543	537.93 (34.9%)	167.03 (10.8%)
Drainage Line	• Widespread • Significant	502	55.72 (11.1%)	2.70 (0.5%)
Granitic Uplands	• Limited extent • Limited significance	238	0.17 (0.1%)	-
Calcrete	• Limited extent • Limited significance	235	7.79 (3.3%)	6.71 (19.2%)
Spinifex Sandplain	• Limited extent • Limited Significance	195	157.60 (80.8%)	12.86 (6.6%)
Riverine	• Limited extent • Significant	167	37.72 (22.6%)	1.73 (1.0%)
Granite Outcrop	• Limited extent • Significant	163	-	-
	Totals	**18,845**	**2,263.19**	**423.12**

#see (MWH 2016b) for definitions.
*percentages denote extent of that habitat type as a proportion of that habitat existing within the Study Area

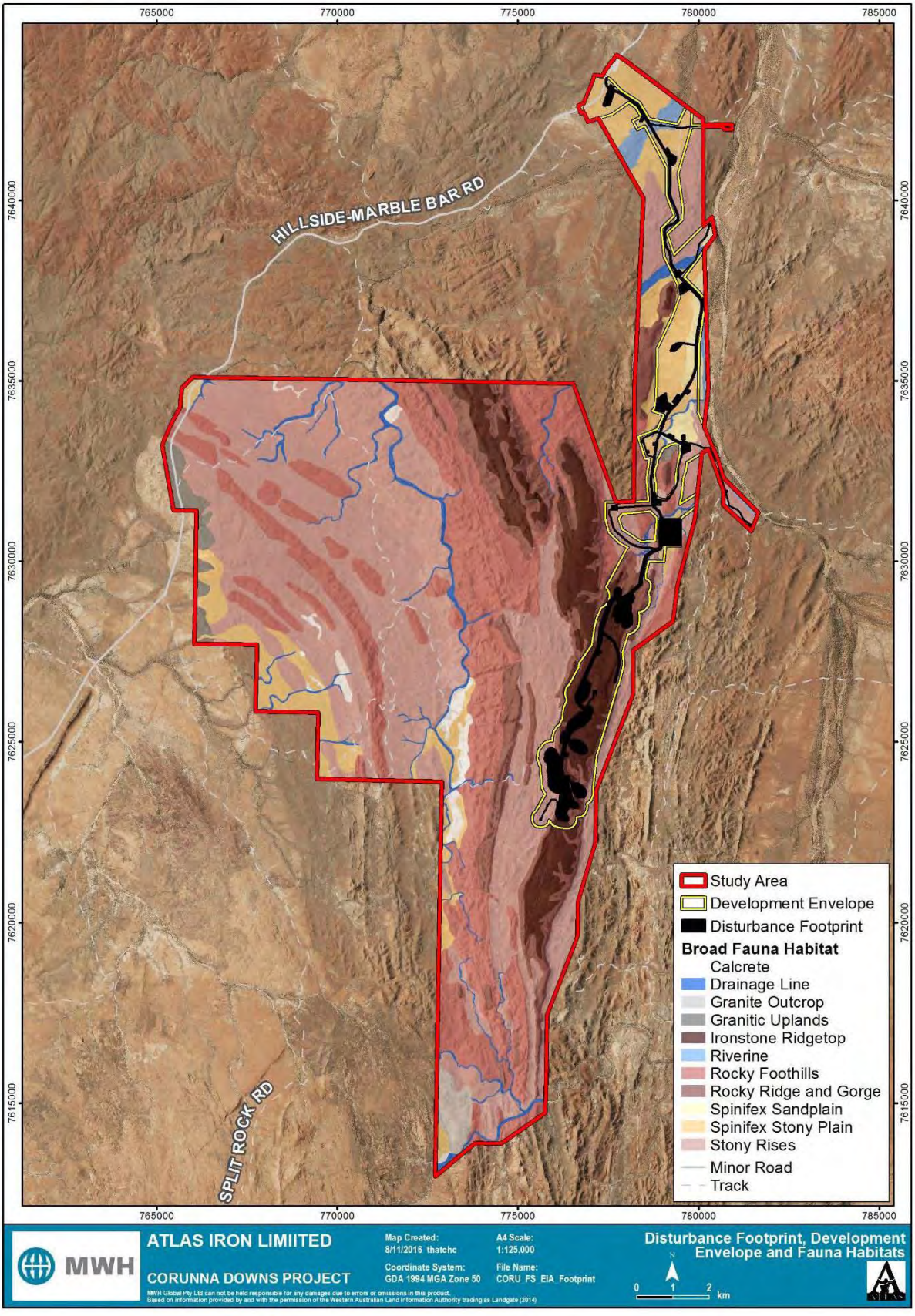

Figure 2-1: Development Envelope and Disturbance Footprint with respect to fauna habitats

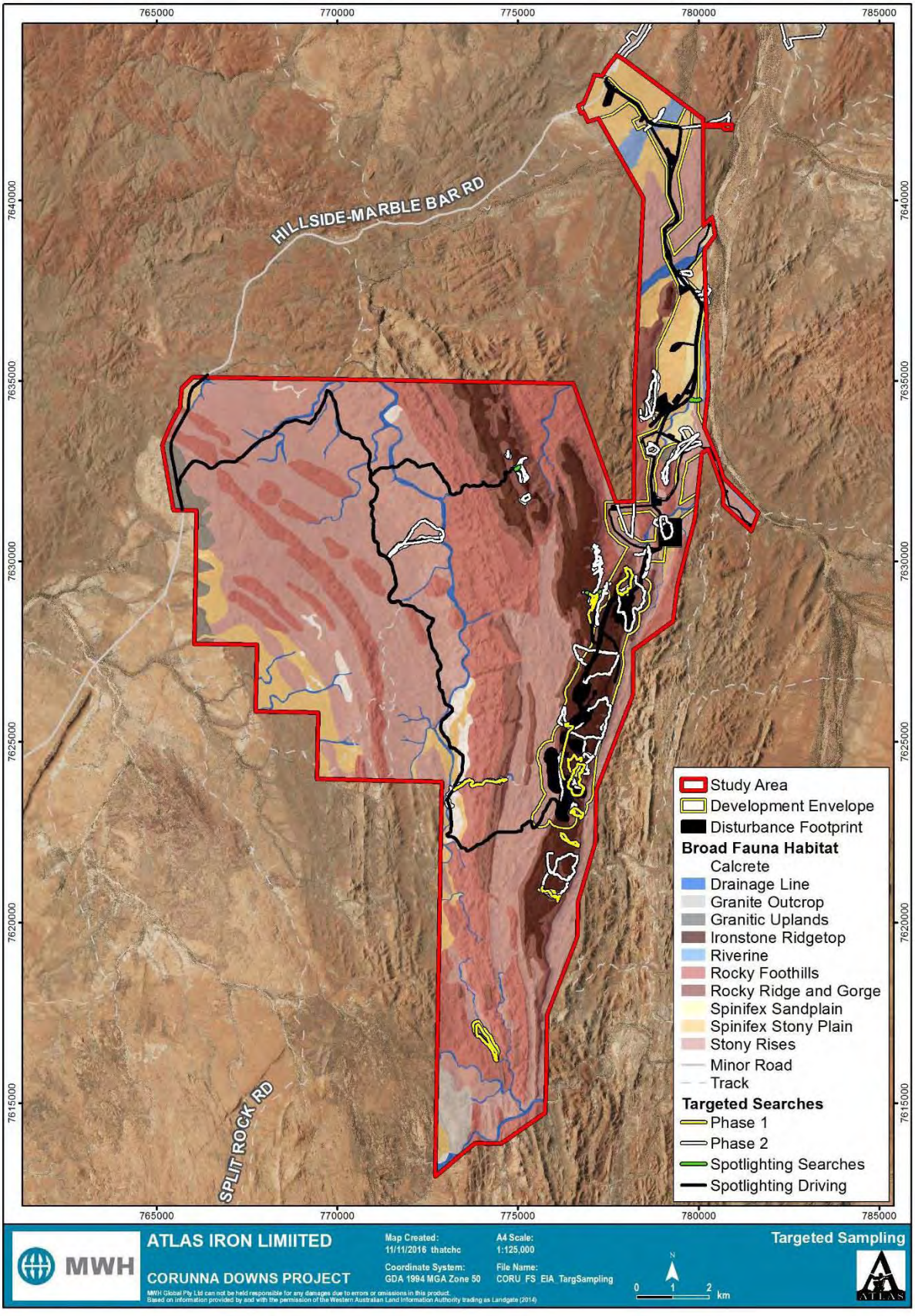

Figure 2-2: Development Envelope, Disturbance Footprint and targeted survey effort

2.1.2 Vehicle Collision

The construction of roads, extends well beyond the impacts caused by habitat loss, including reducing habitat quality, altering animal behaviour, promoting activity of predatory (often introduced) fauna, and the most significant, direct mortality through vehicle collision (Polak *et al.* 2014). Once constructed, the Project would involve comparatively high vehicle movements on a continuous basis and consequently, fauna mortality through vehicle collisions are likely to increase. Incidents typically only involve individuals; however, the cumulative effect can be considerable (Gleeson and Gleeson 2012). Collisions with animals are more likely to occur at night (Rowden *et al.* 2008). Additionally, increases in vehicle collision is likely to promote species which feed on road-kill carrion, potentially driving other species away from the area and altering the local species assemblage (Dickman 1996).

Roads within the Disturbance Footprint bisect each habitat type found in the Study Area, except for the Calcrete, Granitic Uplands and Granite Outcrop habitats (**Figure 2-1**). Ground-dwelling species that forage within intersecting habitat are most likely to be at risk, this includes species of conservation significance such as the Northern Quoll (Cramer *et al.* 2016b), Pilbara Olive Python (Burbidge 2004, Pearson 2003), Macropods such as the Spectacled Hare-wallaby (Rowden *et al.* 2008) and larger reptiles. Aerial species, such as the Pilbara Leaf-nosed Bat and the Ghost Bat, may also be at risk when foraging at low altitudes. The Pilbara Leaf-nosed Bats, in particular, has a curiosity for light sources which has resulted in an extensive number of vehicle collisions (Cramer *et al.* 2016a, van Dyck and Strahan 2008).

2.1.3 Noise and Vibration

The development and ongoing operation of the Project is likely to generate noise and vibration due to blasting, general operation of heavy machinery and vehicles, diesel generators and the presence of personnel. The effects of noise on wildlife have been well studied, although responses vary depending on age and sex (for a comprehensive summary see Newport *et al.* 2014). Impacts caused by noise range from interruptions in feeding and resting behaviour, to complete abandonment of an area (Newport *et al.* 2014). Noise may lead to reduced population densities in small mammals, nest failure and decreased population densities in birds (Slabbekoorn and Ripmeester 2008), abandonment of roost sites for bats (K. Armstrong *pers. comm.* in Woinarski *et al.* 2014), and reduced hunting efficiency in bats due to disturbance of their echolocation system (Siemers and Schaun 2010). Constant levels of noise may also interfere with species communication, via acoustic interference (Parris and Schneider 2009). Species that may be especially at risk of disturbed communication are those that use calls to communicate or navigate.

Ghost Bats are easily disturbed when roosting; young may be dislodged by adults in rapid take-offs and individuals may not return to roost sites after being disturbed (K. Armstrong *pers. comm.* in Woinarski *et al.* 2014), although no major diurnal roosts were recorded within the Study Area. The Pilbara Leaf-nosed Bat is also susceptible to mining activity when in close proximity to roosting sites, and this is likely to occur if blasting activities occur at distances up to 50 m at CO-CA-03. Several drill and blast trials have been conducted surrounding diurnal roosts to determine adequate buffer distances from roosts, using the social

calls and diurnal flight behaviour as disturbance characteristics. For the Koodaideri iron ore project, this was determined to be >160 m (Biota 2013), while at other roosts 500 m was not adequate, presumably due to the noise and vibration conduciveness of the rock strata (**Appendix A**). Diurnal drilling and blasting trials at Mt Dove, showed that such activities has little to no effect on the Pilbara Leaf-nosed Bat visitation to Nocturnal Refuges, although the 20 m buffer at was insufficient to protect against physical damage to cave structure (Outback Ecology 2011b).

2.1.4 Dust Emissions

The development and operation of the Project will create dust emissions due to construction, blasting, haulage and general traffic activities, the impacts of which will not be confined to the Development Envelope. Dust emissions have the potential to affect surrounding vegetation and water sources which fauna rely on, as well as impacting individuals directly. High levels of dust have been associated with a reduction in plant growth and productivity and, alteration of soil chemistry leading to changes in vegetation community structure (Farmer 1993). Such effects are likely to impact on faunal assemblages via a reduction in food resource availability and shelter. Studies in semi-arid regions of Western Australia have however failed to prove negative effects of dust on arid-zone flora, suggesting that the impact of dust emissions within such ecosystems is not as prominent as witnessed in other systems (Matsuki *et al.* 2016).

Dust may directly pollute water bodies by increasing turbidity or potentially altering water chemistry. Those water sources most at risk include the four significant water sources located within the Development Envelope and the six located within 1 km of the Development Envelope (**Figure 2-5**). This may in turn affect fauna and flora dependent on these water sources including, but not limited to, the Pilbara Olive Python, Northern Quoll and Pilbara Leaf-nosed Bat. Additionally, significant reductions in Ghost Bat and Pilbara Leaf-nosed Bat activity has been witnessed at mine sites within the region, believed to be due to heavy airborne dust clouds (**Appendix A**).

2.1.5 Artificial Light

Exposure of fauna to artificial light may interfere with biological and behavioral activities that are governed by the length of day (photoperiod), including reproduction, dormancy, foraging and migration (Bradshaw and Holzapfel 2007, Le Corre *et al.* 2002, Stone *et al.* 2015). Some examples include reduced foraging activity in nocturnal mice (Bird *et al.* 2004) and suspension of normal feeding and reproductive behaviour in nocturnal frogs (Bird *et al.* 2004, Harder 2002). Light pollution has also been shown to interfere with timing of songbird choruses, potentially leading to reduction in breeding success or survival (Miller 2006). See Longcore and Rich (2004) for a broad review of some of the ecological consequences of light pollution. The Project will operate 24 hours a day and is likely to require substantial artificial lighting during construction and ongoing operation. This artificial lighting may have detrimental effects on resident mammal, bird, reptile, and amphibian species occurring within the vicinity of light sources, both within and outside the Development Envelope.

Excessive light is likely to have an effect on the natural foraging behaviour of bats, in particular the Pilbara Leaf-nosed Bat, which is thought to be attracted to light sources (Cramer *et al.* 2016a). Long-term studies at Mt Dove, has however shown that Pilbara Leaf-nosed Bat activity is not impacted by artificial illumination, and perhaps increase species activity presumably due to increased foraging resources (C. Knuckey *unpub. data*).

2.1.6 Altered Hydrology

Availability of water and nutrients is the primary limiting factor in arid and semi-arid environments (James et al. 1995). The degree to which ecosystems depend on water varies with the particular structure and function of ecosystems, which in turn are likely to vary over time (Hatton and Evans 1998). For example, floodplains, flood-outs and riparian fringes are the most productive habitats in the landscape because soils are fertile and water supply is relatively continuous as a result of reliable run-on and accessible ground water. The vast majority of ecosystems in the Pilbara region do not feature accessible water for any length of time. However, small occurrences of productive, water dependent ecosystems are scattered within the region which provide critical refuge and habitat for specific species, particularly during times of drought (James et al. 1995). Water-dependent ecosystems are those that are totally, partially or seasonally dependent on groundwater (Nevill et al. 2010), or the retention of surface water following substantial rainfall; that is, they require the input of water to maintain their current composition and functioning (Murray et al. 2003). These ecosystems are typically limited in their extent, but they represent a key resource to a diversity of fauna (Murray et al. 2003).

Water dependent ecosystems in the Study Area include semi-permanent and permanent water sources within the Drainage Line and Rocky Ridge and Gorge habitats and, to a lesser extent, temporary waterholes and associated vegetation within the Drainage Line and Riverine habitats. Removal of water from these habitat types, or a change in the timing, quantity, quality or distribution of water available to them (see Kingsford et al. 2004), may have negative impacts on the fauna assemblages within.

The term ‘altered hydrology’ relates specifically to a range of actions that may impact upon water dependent ecosystems via diversion of natural hydrological flows and reduction in the extent of watersheds. In the Development Envelope and its broader surrounds, water sources in Drainage Line and Rocky Ridge and Gorge habitats may experience reduced hydrological input due to alteration of natural flows as part of construction of roads and mine infrastructure. Additionally, dewatering (such as for dust suppression) and local reductions in groundwater recharge, may impact upon groundwater dependent ecosystems within the area, including outside the Development Envelope (Nevill et al. 2010). As a consequence, vegetation reliant on available groundwater, such as riparian *Melaleuca* or *Eucalyptus* spp. may be negatively affected. While species of fauna inhabiting these areas may be adapted to surviving without the direct consumption of water, the removal of these riparian habitats will have effects on vegetation and resources within these microhabitats that they depend on for foraging and sheltering.

Two semi-permanent and two permanent water sources were recorded within the Development Envelope. An additional six water sources were located within 1 km of the Development Envelope and may be impacted by altered hydrology from within the Development Envelope. Such features are likely to be important water sources for the Pilbara Leaf-nosed Bat and Northern Quoll (Woinarski *et al.* 2014) and for hunting habitat features for the Pilbara Olive Python (Pearson 2003). One of the permanent water sources (currently within the Disturbance Footprint) was noted as being intrinsically associated with the Non-permanent Breeding Roost of the Pilbara Leaf-nosed Bat (MWH 2016b), thus any impact to hydrology within this area is likely to significantly impact the occupancy of this cave by the species.

2.1.7 Altered Fire Regimes

The development and ongoing operation of the Project may alter the fire regime of the Development Envelope through the introduction of unplanned fire caused by vehicle movements and/or other Project activities such as hot work. Fire may impact fauna via direct contact, or indirectly by long-term habitat modification brought about by inappropriate fire frequency and intensity (Woinarski *et al.* 2014). The value of many habitats to fauna lies in the mosaic of ages (Parr and Andersen 2006, Southgate *et al.* 2007, Woinarski 1999). Introduction of too frequent, hot or extensive fires during hot, dry times of the year can eliminate this mosaic, and reduce the capacity of these habitats to support diverse assemblages of vertebrate (Law and Dickman 1998).

Inappropriate fire regimes, such as large, hot fires late in the dry season, are likely to have adverse effects on fauna habitat and could alter fauna assemblages present in the Development Envelope. For example, fire is known to be of fundamental importance to habitat suitability for the Spectacled Hare-wallaby (van Dyck and Strahan 2008). Species most at risk of direct impact include small, sedentary species which occur in homogenous, fire-prone habitats, such as the Western Pebble-mound Mouse, *Ctenotus nigrilineatus*, and species which occur primarily in fire refuge habitats, such as the Rocky Ridge and Gorge, like the Northern Quoll (Woinarski *et al.* 2001) and Pilbara Olive Python (Pearson 2003). Additionally, some species, due to their life histories are susceptible to fire, such as the Ghost Bat (Bullen and McKenzie 2011) and Spectacled Hare-wallaby (Ingleby and Westoby 1992).

2.1.8 Introduced Flora

Environmental weeds already present in the Development Envelope may be spread due to increased vehicle usage and new weed species may be brought into the Development Envelope by mobile equipment during construction and operation of the Project. Weed invasion is widely recognised as having a negative impact on fauna species, as it can fundamentally alter the composition and structure of native vegetation communities (Cowie and Werner 1993, Gordon 1998). In the extreme, entire ecosystems can be modified directly (Sodhi and Ehrlich 2010), and indirectly through increase fuel loads which in-turn alter the local fire regime (Miller *et al.* 2010).

Invasion by non-native species typically results in declines in native plant species richness, but the response of fauna may be more complicated, with individual invasions potentially resulting in increase, decrease or no-change scenarios for different assemblages (Grice 2006). For example, even at low densities, Buffel Grass (*Cenchrus ciliaris*) can affect the composition of ground vegetation and birds (Smyth *et al.* 2009, Young and Schlesinger 2015). The habitats within the Study Area are largely weed free (MWH 2016b), and there is potential for substantial change to occur to vegetation communities should invasive flora be introduced and become established.

2.1.9 Introduced Fauna

Introduced fauna, both herbivorous and predatory, can cause fundamental changes to ecosystems and are thought to have contributed to the decline and extinction of many species in Australia (Abbott 2002, Burbidge and McKenzie 1989, Ford *et al.* 2001, Short and Smith 1994, Woinarski *et al.* 2014, 2015). Of the 20 key threatening processes listed under the EPBC Act, 12 are concerned with introduced flora and fauna, including predation by the Red Fox (*Vulpes vulpes*) and the feral Cat (*Felis catus*) which are known to have major negative impacts on small and medium-sized native vertebrates in Australia (Dickman 1996).

Four species of introduced fauna, European Cattle (*Bos taurus*), Camel (*Camelus dromedarius*), feral Cat and House Mouse (*Mus musculus*), were recorded in the Study Area during the Survey (MWH 2016b). An additional five species have been recorded within the vicinity of the Study Area: Fox (*Vulpes vulpes*), Donkey (*Equus asinus*), Horse (*Equus caballus*), Rabbit (*Oryctolagus cuniculus*); and Pig (*Sus scrofa*) (MWH 2016b). Of the nine species with the potential to occur in the Study Area, all but three, the feral Cat, House Mouse and Domestic Cattle – are listed as 'Declared Pests' under the *Biosecurity and Agriculture Management Act 2007* (WA), which calls for reduction of their numbers when they are running wild or feral.

The Project may provide additional resources or habitat which may attract and support a greater abundance of feral animals in the area. Introduced predators may also be attracted into the Development Envelope as a result of the scavenging opportunities generated by the presence of road kill along roads (Dickman 1996), which may in turn adversely affect populations of native fauna. Of particular concern would be an increase in the size or density of the local population of feral Cats, which are not only a direct predator of the Northern Quoll, Pilbara Olive Python and other ground-dwelling fauna, but also compete for food resources and habitat requirements with these and others.

2.2 Impacts on Fauna Habitats

Fauna habitat loss as a direct result of land clearing and excavation is considered to be the primary impact of the Project on terrestrial vertebrate fauna. Land clearance is listed as a Key Threatening Process under the EPBC Act, although it is also recognised as a necessary component of developing a resources project in an undeveloped area.

A maximum of 423.14 ha of fauna habitat within the Development Envelope will be removed for the Project, potentially affecting instances of nine broad fauna habitats present in the Study Area (**Figure 2-1**). Of the broad fauna habitats that have potential to be adversely affected, three are considered to be of significance to fauna assemblages and/or fauna of conservation significance; Rocky Ridge and Gorge, Drainage Line and Riverine. The other broad fauna habitat types to be affected by the Project include; Spinifex Stony Plain, Ironstone Ridgetop, Stony Rise, Spinifex Sandplain, Rocky Foothills and Calcrete. Each of these is considered to be of limited significance and are therefore excluded from further discussion.

2.2.1 Rocky Ridge and Gorge

Although ridgeline habitats and their associated gorge systems are relatively common in the Capricorn land system, not all occurrences of this habitat type can be considered equivalent. Rocky Ridge and Gorge habitat within the Development Envelope is considered significant and relatively uncommon within the broader landscape, as it comprises cliffs, hillsides, rock faces and gorges featuring outcropping ironstone, fallen boulders, caves, overhangs, crevices and water pools. Six species of conservation significance were recorded in the Rocky Ridge and Gorge habitat of the Study Area; the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Peregrine Falcon and Rainbow Bee-eater. Other fauna of conservation significance not recorded during field surveys but nonetheless Likely to occur in Rocky Ridge and Gorge include the Long-tailed Dunnart and the blind snake *Anilios ganei*.

The Development Envelope incorporates a total of 249.26 ha of Rocky Ridge and Gorge habitat, which represents 14.1% of the total amount of Rocky Ridge and Gorge habitat present in the Study Area (**Table 2-1**). The remaining Rocky Ridge and Gorge habitat is located outside the Development Envelope in the northern and southern sections of the Study Area (**Figure 2-1**). While only a small portion of the total Rocky Ridge and Gorge habitat is located within the Development Envelope, it is likely that this will have a significant impact of the species contained within, due to the reliance upon this habitat type and the scarcity of this habitat within the surrounding region. This applies particularly to the significant microhabitat features mentioned in **Section 2.3**. Impacts to the Rocky Ridge and Gorge habitat, specifically, on the landforms, caves and other physical features, will be permanent due to the inability to restore such features therefore representing a long-term impact to this habitat and the species which inhabit it.

2.2.2 Drainage Line

Drainage Line habitat consists of minor watercourses, creeks and channels that support grassy *Eucalyptus*, *Corymbia* and *Melaleuca* woodlands subject to regular flooding and seasonal ponding. This is a significant habitat type for fauna as it provides a range of microhabitats, such as permanent, semi-permanent and seasonal water pools, moist depressions, sedges and rushes on alluvial soil (How *et al.* 1991). The Drainage Line habitat type is scattered throughout the Study Area (**Figure 2-1**), and its linear arrangement provides linkages between other sources of food and water (How *et al.* 1991). This habitat type is important for allowing fauna to move about the Study Area and the broader surrounding landscape. During the Survey four species of conservation significance were recorded within this habitat type, the Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Rainbow Bee-eater (MWH 2016b) Other fauna of conservation significance not recorded during field surveys but nonetheless Likely to occur in the Drainage Line habitat include the Eastern Great Egret.

The Development Envelop encompasses a total of 55.72 ha of Drainage Line habitat across several locations (**Figure 2-1**), which represents 11.1% of the total amount of Drainage Line habitat present in the Study Area (**Table 2-1**). This habitat type is widespread in the broader landscape, and the affected areas are contiguous with surrounding occurrences of Drainage Line habitat. Fauna occurring within this habitat type are therefore unlikely to be substantially impacted by the Project, from a regional perspective. Nonetheless, where Drainage Line habitat is cleared, steps should be taken to minimise local hydrological impacts so as to retain ecological function in semi-permanent water pools and moist depressions, both within the Development Envelope and downstream.

2.2.3 Riverine

The Riverine habitat contains very similar microhabitats to that of the Drainage Line and as such contains a very similar ecological role. The Riverine habitat type is located in the north-east margins of the Study Area (**Figure 2-1**), and its linear arrangement provides linkages between other sources of food and water (How *et al.* 1991). This habitat type is important for allowing fauna to move about the Study Area and the broader surrounding landscape. During the Survey two species of conservation significance were recorded within this habitat type, the Northern Quoll and Rainbow Bee-eater (MWH 2016b). Other fauna of conservation significance not recorded during field surveys but nonetheless Likely to occur in the Drainage Line habitat include the Pilbara Leaf-nosed Bat and Eastern Great Egret.

The Development Envelop encompasses a total of 37.72 ha of Riverine habitat, which represents 22.6% of the total amount of Riverine habitat present in the Study Area (**Table 2-1**), although a substantial amount is known to occur outside the Study Area to the east (in association with the Emu Creek system). This habitat type is widespread in the broader landscape, and the affected areas are contiguous with surrounding occurrences of Riverine habitat. Fauna occurring within this habitat type are therefore unlikely to be substantially impacted by the Project, from a regional perspective. Nonetheless, where Riverine habitat is cleared, steps should be taken to minimise local hydrological impacts so as to retain ecological

function in semi-permanent water pools and moist depressions, both within the Development Envelope and downstream.

2.3 Impacts on Significant Microhabitat Features

A number of significant microhabitat features were recorded within the Study Area including caves, and permanent/semi-permanent water sources. These features were highlighted because they provide important sources of shelter, food and water for species of conservation significance. Many of these features were located within the Rocky Ridge and Gorge habitat and were not commonly recorded in other broad habitat types of the Study Area. Significant microhabitat features recorded in the Study Are comprises one Permanent Diurnal Roost of the Pilbara Leaf-nosed Bat, one Non-permanent Breeding Roost of the Pilbara Leaf-nosed bat, eight Nocturnal Refuges of the Pilbara Leaf-nosed Bat and/or Ghost Bat, six semi-permanent water sources and five permanent water sources.

Of these significant microhabitat features recorded, nine are located within the Development Envelope, including the Non-permanent Breeding Roost of the Pilbara Leaf-nosed bat, four Nocturnal Refuges, two semi-permanent water sources and two permanent water sources. Atlas have committed to a 450 m exclusion buffer around the entrance of the Pilbara Leaf-nosed Bat Permanent Diurnal Roost, and a 50 m buffer surrounding the entrance of the Pilbara Leaf-nosed Bat Non-permanent Breeding Roost, to reduce impacts to the species (despite it being located within the Development Envelope). One of the permanent water sources within the Development Envelope (CO-WS-14), was noted as being intrinsically associated with the Non-permanent Breeding Roost of the Pilbara Leaf-nosed Bat (CO-CA-03; MWH 2016b), thus any impact to hydrology within this area is likely to significantly impact the occupancy of this cave by the species. Additionally, one permanent water source (CO-WS-01) which sits outside of the current Disturbance Footprint, borders a main haul road and is likely to be impacted by overburden and water run-off associated with the construction of this infrastructure. A Pilbara Olive Python was recorded from this water source.

2.4 Impacts to Vertebrate Fauna Assemblages

A total of 326 vertebrate fauna species, comprising 38 native mammal, nine non-native mammals, 165 birds, 104 reptiles and 10 amphibians, were identified as potentially occurring in the Study Area during the desktop study component of the Survey (MWH 2016b). A total of 174 species were recorded in the Study Area, comprising, 28 native mammals, four introduced mammals, 72 birds, 66 reptiles and four amphibians (MWH 2016b). This total included one species not identified by the desktop study, the Monk Snake *Parasuta monachus*, although this species is relatively common and widespread through the region (Cogger 2014). The majority of these species form assemblages that occur across a variety of habitats present within and surrounding the Study Area. These assemblages are similar to those found in the surrounding landscape, as determined by previous surveys (MWH 2016b).

In terms of vertebrate fauna assemblages, the Study Area was not determined to be an area of exceptionally high biodiversity from a regional point of view. Clearing of vegetation and vehicle collisions are likely to result in the direct loss of individuals during initial clearing activities; however, those assemblages occurring across a range of habitats or those occurring in widespread habitats are unlikely to be significantly impacted by the Project. From a regional perspective, the impacts of the Project on fauna assemblages are unlikely to be significant.

2.5 Impacts to Vertebrate Fauna of Conservation Significance

The desktop study of the Survey identified 32 species of conservation significance that potentially occur in the Study Area; 12 of these were considered Unlikely to occur and are not discussed further in this Assessment (MWH 2016b). Of the remaining 20 species, eight species were Confirmed within the Study Area, three were assessed as Likely to occur, and nine were assessed as Possible to occur (**Table 2-3**). For definitions regarding the likelihood of occurrence for species of conservation significance, refer to (MWH 2016b).

Pre-determined categories were used to rank the expected local impacts of the Project on fauna of conservation significance (**Table 2-2**; **Table 2-3**). These impacts were considered within a broader, regional context (**Table 2-3**). Impacts were assessed based on the assumption that no management actions or mitigation strategies would be implemented. Of the 20 species assessed, four were assessed as having a Moderate level of impact (Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python), six were assessed as having a Low level of impact, six were assessed as having a Minimal level of impact, and four were assessed as having Negligible impact (**Table 2-3**).

Species specific management actions and strategies to manage the impacts of the Project on fauna of conservation significance were also developed (**Table 2-3**). The level of impact of the Project on these species is likely to be reduced should the recommended actions and strategies be implemented. More general management recommendations are provided in **Section 3**.

Table 2-2: Ranking criteria for Project local impacts on fauna of conservation significance

Impact	Description[#]
Negligible	No perceived effect on population
Minimal	No population decline expected
Low	Short-term population decline expected within Development Envelope (recovery expected after life of the Project)
Moderate	Permanent population decline expected – no perceived threat to population persistence
High	Permanent population decline expected – persistence of local population threatened
Extreme	Local population extinction likely

[#]these impacts can be expected within the Development Envelope and surrounding 10 km

Table 2-3: Project impacts on fauna of conservation significance, with suggested management actions

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions
Northern Quoll **(*Dasyurus hallucatus*)** **Endangered – EPBC Act** **Schedule 2 – WC Act** The species is threatened by several, interacting factors. The largest, Cane Toads (*Bufo marinus*), currently threatens outside of the Pilbara although this is likely to become an issue in the coming decades (Tingley *et al.* 2013). Within the Pilbara the current largest threats to the species are: inappropriate fire regimes; predation by feral Cats, wild dogs and foxes; habitat loss and fragmentation (mostly associated with mining ventures); and habitat degradation due to invasive pasture grasses (Woinarski *et al.* 2014).	**Moderate** • The species was recorded on 36 occasions within the Study Area; of which nine were located within the Development Envelope and one within the Disturbance Footprint (**Figure 2-3**). Twenty-six records (72%) were recorded from the Rocky Ridge and Gorge habitat, one was recorded from the Drainage Line and Riverine habitats each. • Clearing of habitat critical to the survival of the species is likely to pose the largest threat from the Project: ○ Habitat critical to the Northern Quoll comprises rugged, rocky areas, often in close association with permanent water (Molloy *et al.* 2016, Oakwood 2000), and major drainage lines and treed creek lines (DoE 2016c) – this is consistent with Rocky Ridge and Gorge, Drainage Line and Riverine habitats within the Study Area. Although the occurrence of the species is not uniform throughout these habitats. ○ The Rocky Ridge and Gorge habitat represents suitable denning and foraging habitat. Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint. ○ The Drainage Line and Riverine habitats represent suitable foraging and dispersal habitat of the species. Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively. ○ Two semi-permanent and two permanent water sources, which may support the species, are located within the Development Envelope. One permanent water source is located within the Disturbance Footprint (**Figure 2-3**). ○ Reducing the amount of suitable denning habitat is likely to reduce the long term local population size of the species. Northern Quoll, particularly males, are highly territorial; the number of individuals which occupy a given amount of quality habitat is limited. While individuals may escape direct mortality of mining activity, they are unlikely to compete with other individuals in the long term. • Vehicle collisions with the species is likely to increase, particularly during night-time hours and where infrastructure intersects habitat critical to the species. • Altered hydrological regimes within the Development Envelope may impact the quality and availability of water within Drainage Line, Riverine and Rocky Ridge and Gorge habitat both within and downstream of the Development Envelope, that this species utilises. • Frequent fire in habitat critical to the species is a significant threat to the species. An increase in fire frequency, directly through mining activity or indirectly through increasing fuel loads via introduced flora species, is likely to have short term impacts on the species. • The species is preyed upon by both Dog/Dingo and feral Cats (Woinarski *et al.* 2014, 2015). The increase in either population is likely to impact the species within and surrounding the Development Envelope. • A permanent population decline in and surrounding the Development Envelope is expected, due to the permanent loss of habitat from development of the Project. Additionally, individuals are expected to be lost during clearing and from vehicle collisions during operations.	• The species has been recorded in most surveys conducted within the vicinity of the Study Area; East West Rail Spur (20 km S; Outback Ecology 2014a), Mt Webber, (37 km W; ecologia Environment 2010, Outback Ecology 2013), Turner River (37 km W; Outback Ecology 2010), McPhee (55 km SE; Outback Ecology 2012b), Abydos (65 km NW; Bamford Consulting Ecologists 2009a, Outback Ecology 2011a), Abydos-Woodstock Reserve (65 km W; How *et al.* 1991), Nullagine (75 km SE; Bamford Consulting Ecologists 2009b), Wodgina (105 km NW; Outback Ecology 2009, 2012a). • Northern Quoll abundance within the Study Area was varied. Areas of high densities were located outside the Development Envelope (**Figure 2-3**). In such locations the population density was relatively high compared to nearby records in the eastern Pilbara region, such as Mt Webber (MWH 2016c), Nullagine (Bamford Consulting Ecologists 2009b) and McPhee Creek (Outback Ecology 2012b), although not as high as recorded in other areas such as Abydos (MWH 2016a) and Wodgina (MWH 2016d). • Habitats within the Development Envelope, are connected to similar habitat outside the Development Envelope (north and south within the Study Area), as well as similar habitat outside the Study Area (particularly to the north; **Figure 1-1**). Therefore the species is unlikely to be completely removed from the local region. • In the Pilbara, the species occurs in fragmented populations, mainly in rocky ridgeline and outcrop type habitats (Woinarski *et al.* 2014), however the genetic connectively, and therefore dispersal capabilities, of the species is thought to be high (Spencer *et al.* 2013). Therefore development of the Project is unlikely to results in a loss of genetic diversity or loss of a distinctive population.	• Implement an appropriate monitoring program, consistent with DoE (2016c) and DPaW (Dunlop *et al.* 2014) requirements and guidelines, to monitor the impacts of the Project on the Northern Quoll population. • During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the Northern Quoll (e.g. Rocky Ridges and Gorge) and minimise destruction of supporting Northern Quoll habitats (e.g. Drainage Line, Riverine) wherever possible. • Consider including large rocky material and microhabitat features suitable for Northern Quoll habitation when creating waste rock landforms and during rehabilitation post closure. • Minimise activities such as rock blasting or heavy machinery operation during the breeding season (May - November) (DoE 2016c).
Greater Bilby **(*Macrotis lagotis*)** **Vulnerable – EPBC Act** **Schedule 3 – WC Act** Largest threat to the species is posed by predation from the Red Fox and feral Cats (Woinarski *et al.* 2014). Also inappropriate fire regimes, although to a lesser extent (van Dyck and Strahan 2008).	**Minimal** • The species was not recorded within the Study Area and was assessed as Possible to occur only. Targeted searches within the most suitable habitat failed to record the species, therefore if present, the species is likely to occur in low densities, potentially representing a sink population and therefore not dependent on the Development Envelope. • Clearing of habitat critical to the survival of the species is likely to pose the largest threat from the Project: ○ If present, the species is most likely to occur within the Spinifex Sandplain habitat, which comprises approximately 195 ha (1.1%) of the Study Area, 157.60 ha of the Development Envelope and 12.86 ha of the Disturbance Footprint (**Table 2-1**). • If present, vehicle collisions with the species may occur, particularly during night-time hours and where infrastructure intersects habitat critical to the species. Approximately 2.8 km of roads in the Disturbance Footprint intersect the Spinifex Sandplain habitat.	• The Greater Bilby population within the Pilbara is sparsely scattered and often occurring in low numbers (Woinarski *et al.* 2014). • The nearest record of the species is located ~35 km east of the Study Area from 1967 (*n* = 1), and ~35 km south-west of the Study Area from 2015 (*n* = 19). Additionally, multiple records are located ~43 km south-west of the Study Area from McPhee Creek (Outback Ecology 2014b). • Habitat of similar suitability or higher, is located outside the Development Envelope in the Study Area and also likely to occur east of the Study Area, based on satellite imagery.	• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are likely to support the Greater Bilby (e.g. Spinifex Sandplain) wherever possible. • If the presence of the species is confirmed within the Study Area, the species should be included in the Projects Significant Species Management Plan, which should include specific management and monitoring targets for the species.

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions

Ghost Bat
(*Macroderma gigas*)
 	
Vulnerable – EPBC Act
Schedule 3 – WC Act
 	
Five moderate-severe threats have been identified for the species (Woinarski *et al.* 2014). The most severe being (human) disturbance to maternity roost sites, followed by habitat loss caused by mining, collision with fences, contamination of roost sites within old mines and collapse of roost sites within old mines (Woinarski *et al.* 2014).
	Moderate
	• The species was recorded on 10 occasions within the Study Area; of which four were located within the Development Envelope and three within the Disturbance Footprint (**Figure 2-4**). All 10 records were recorded from Nocturnal Refuges within the Rocky Ridge and Gorge habitat, including one temporary diurnal roost (CO-CA-01).
	• Clearing of habitat critical to the survival of the species is likely to pose the largest threat from the Project:
	  ○ No maternity caves or significant diurnal roosts were identified as occurring within the Development Envelope, despite an extensive amount of Survey effort expended in the area (**Figure 2-4**).
	  ○ Rocky Ridge and Gorge habitat, particularly areas containing caves, represents habitat critical for the species as it provides potential night roosting habitat as well as foraging habitat. However all habitats may be utilise by the species for foraging. Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint.
	  ○ Six Nocturnal Refuges were located within the Study Area, of these three are located within the Development Envelope.
	  ○ Removal of the habitat critical to the species is likely to impact upon the foraging capacity of the Study Area and may result in a local population decline, by reducing the species ability to utilise the area. The recovery of the population post-closure is unlikely given the inability to restore microhabitats within such habitats.
	• Vehicle collisions with the species are likely to increase, particularly during night-time hours and where infrastructure is located within Rocky Ridge and Gorge habitat and Nocturnal Roosts of the species.
	• Fire is known to cause local abandonment of diurnal roosts by the species (Armstrong and Anstee 2000). An increase in fire frequency, particularly within Rocky Ridge and Gorge habitat, either directly through mining activity or indirectly through increasing fuel loads via introduced flora species is likely to have short term impacts on the species.
	• Vegetation simplification, through introduced flora, or altered hydrological regimes may impact on foraging strategies at productive riparian sites.
	• The impacts of artificial lighting to the species is not well understood, but could potentially alter prey behaviour and abundance. Additionally the species is highly impacted by other human-caused disturbances.
	• The impact of dust emissions on the species is unknown but is likely to be a factor influencing nightly foraging behaviour of the species and has caused decline at other mines within the region (DoE 2016a).
	• Collisions with fences is known to be a significant threatening process for the species, particularly barbed wire and single-line wire fencing (Armstrong and Anstee 2000).
		• Within the Pilbara region the species has a very widespread but patchy distribution (Armstrong and Anstee 2000).
		• Two regionally important maternity roosts are located within the vicinity of the Study Area; Klondyke Queen Mine (~25 km north-east) and Comet Mine (~20 km north). Headcounts of the species from both these mines range from 20-366 and 35-100, respectively (DoE 2016a). It is likely that individuals from these two roosts frequent the Development Envelope on a nightly and/or seasonal basis.
		• Given the regional decline of the species and the condition of nearby diurnal roost (Klondyke and Comet, are likely to collapse; DoE 2016a), all caves which have recorded the species should be considered significant to the species.
		• Habitats important to the species within the Development Envelope, are connected to similar habitat outside the Development Envelope (within the Study Area), as well as similar habitat outside the Study Area (particularly to the north; **Figure 2-4**). Therefore the species is unlikely to be completely removed from the local region.
		• The extent of the regional population is more likely to be limited by the extent and condition of diurnal roost sites as oppose to the extent of foraging habitat. No significant diurnal roosts will be removed as part of the Project.
		• The timing of Ghost Bat visitation at CO-CA-01 suggests a diurnal roost is present within the vicinity of this cave. However given the coverage of targeted searches over the Development Envelope this is likely to occur outside this area (**Figure 2-2**).
			• Implement an appropriate monitoring program to assess the distribution and abundance of the Ghost Bat population.
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Rocky Ridges and Gorge). Specifically caves where the species has been recorded.
			• Establish buffer zones, where possible, to minimise impacts at all significant Nocturnal Refuges and Diurnal Roosts identified within the Study Area. Impacts may include vibration, noise, and light, disturbance from visitation and damage to the cave.
			• To reduce the impact of artificial light on this species during the night, use light shielding and position lights to illuminate areas such as pathways and roads, rather than the habitat and night sky, and avoid inadvertent illumination of important habitat features, such as caves and overhangs.
			• Ensure suitable dust control for the Project, particularly on haul roads and within pits near diurnal roosting sites.
			• Avoid the use of single-line wire fencing, particularly barbed wire.

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)
 	
Vulnerable – EPBC Act
Schedule 3 – WC Act
 	
• Three major threats identified the species, the most severe being the potential loss of roosting habitat due to mining (Woinarski *et al.* 2014); followed by collapse of roost sites within old mines (Hall *et al.* 1997) and human disturbance causing roost abandonment (Armstrong 2001).
	Moderate
	• The species was recorded on 41 occasions within the Study Area; of which 21 were located within the Development Envelope and five within the Disturbance Footprint (**Figure 2-5**).
	• A Permanent Diurnal Roost and Non-permanent Breeding Roost were identified within the Study Area. Additionally, eight Nocturnal Refuges and eleven significant water sources were recorded.
	• Atlas has committed to a 450 m buffered exclusion zone surrounding the entrance of the Permanent Diurnal Roost. The nearest infrastructure in the Disturbance Footprint is a haul road and a mining pit, located 450 and 470 meters from the cave entrance, respectively. Both features are located on the opposite side of a deep gully, on a separate ridge. Therefore drilling and blasting activities (which create noise and vibration impacts) associated with the nearby pit are unlikely to travel through the ridge system and impact this diurnal roost. A 500 m buffered exclusion zone has proven adequate at Cattle Gorge (**Appendix A**) and 200 m buffer was adequate at Koodaideri (Biota 2013), a 500 m buffer is recommended by regional bat expert Bob Bullen (**Appendix A**)
	• Atlas has committed to a 50 m buffered exclusion zone surrounding the entrance of the Non-permanent Breeding Roost. The nearest proposed infrastructure in the Disturbance Footprint is a mining pit located 50m from the entrance of the cave. Drilling activity conducted at 50 m in unlikely to disrupt bat activity (based on previous studies conducted by Bullen and Creese 2014). However blasting within 50-450 m from the entrance of the cave is likely to disrupt the colony roosting within and may cause abandonment of the roost during this period.
	  ○ The likely success of a 50 m buffer on the structural integrity of the cave is unknown and will dependent largely on the rock strata of the system. A 20 m buffer was not appropriate for ensuring structure of a Nocturnal Refuge cave at Mt Dove.
	  ○ Additionally it is believed that use of the cave is related to the presence of a permanent pool, approximately 5 m from the entrance which is fed by springs and seeps associated with the upstream gorge system. Alteration to the hydrogeology of the springs and seeps may affect the permanency of the pool and therefore also impact the suitability of the cave for roosting.
	• Clearing of habitat critical to the survival of the species is likely to pose one of the largest threats from the Project:
	  ○ Rocky Ridge and Gorge habitat, particularly areas containing caves, represents habitat critical for the species as it provides potential night roosting habitat as well as foraging habitat. Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint.
	  ○ The Drainage Line and Riverine habitats represent suitable foraging and dispersal habitat of the species. Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively.
	  ○ Water sources are important to the persistence of a local population due to the water-dependency of the species (Baudinette *et al.* 2000). Five Nocturnal Refuges and four significant water sources are located within the Development Envelope and two Nocturnal Refuges and one permanent water source are located in the Disturbance Footprint.
	  ○ Removal of the Rocky Ridge and Gorge, Drainage Line and Riverine habitat is likely to impact upon the foraging capacity of the Study Area and may result in a local population decline. The recovery of the population post-closure is unlikely given the inability to restore microhabitats within such habitats.
	• Vehicle collisions with the species are likely to increase, particularly during night-time hours and where infrastructure is located within Rocky Ridge and Gorge habitat and within the vicinity of Nocturnal Roosts of the species.
	• Artificial lighting appears to be of little impact to the species, and it appears the species is attracted to such areas for foraging (C. Knuckey *unpub. data*).
	• Six significant water sources, important to the species, are located within 1 km of the Development Envelope (in addition to those within the Development Envelope) and may be indirectly impacted by water drawdown or altered hydrological regimes.
	• The impact of dust emissions on the species is unknown but is likely to be a factor influencing nightly foraging behaviour or the species (**Appendix A**).
		• Six Permanent Diurnal Roosts are known to occur within 60 km of Marble Bar, suggesting a high regional population of the species. Additionally a number of Non-permanent Breeding Roosts and Transitory Diurnal Roosts are known to occur (MWH 2016b).
		• The distribution of the species is limited by the scarcity of caves that possess the required microclimates for roosting (Armstrong 2001, Churchill 1991). With only 30 known roosts within the Pilbara, many of which are in unstable disused mine shafts, the occurrence of these two naturally occurring roosts is of high regional conservation value to the species.
		• Very little Rocky Ridge and Gorge habitat appears to be located outside the Study Area within 20 km of both roosts (limit of nightly flying distance for individuals), suggesting that the Rocky Ridge and Gorge habitat within the Study Area is important to the local population.
		• If foraging habitat is removed, it is possible that a small number of individuals within the population will be lost to predation, dehydration/desiccation or disorientation, as a consequence of disruption to an established foraging pattern. Thus, a short-term decline may be expected within the region, although some recovery is expected following the rehabilitation of foraging areas after the life of the Project, although not all habitat critical to the species is likely to be restored back to equal value.
		• One important Nocturnal Refuge was located outside the Study Area in Glen Herring Gorge, although more are likely to occur (McKenzie and Bullen 2009).
			• Implement an appropriate monitoring program to assess activity of the Pilbara Leaf-nosed Bat population at significant foraging and roosting locations and monitor for any potential declines in population. Additionally the monitoring program should seek to monitor water sources within the Study Area, to determine if water use and interruption associated with the Project affects important water sources for the species.
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Rocky Ridges and Gorge). Specifically caves where the species has been recorded and where development will disrupt hydrology surrounding roosting sites and water sources.
			• Establish buffer zones, where possible, to minimise impacts at all significant Nocturnal Refuges and Diurnal Roosts identified within the Study Area. Impacts may include vibration, noise, and light, disturbance from visitation and damage to the cave.
			• To reduce the impact of artificial light on this species during the night, use light shielding and position lights to illuminate areas such as pathways and roads, rather than the habitat and night sky and avoid inadvertent illumination of important habitat features, such as caves, overhangs and water sources.
			• Ensure suitable dust control for the Project, particularly on haul roads and within pits near diurnal roosting sites.

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions

Pilbara Olive Python
(*Liasis olivaceus barroni*)
 	
Vulnerable – EPBC Act
Schedule 3 – WC Act
 	
The main threats identified to the species are predation of juvenile and prey items (such as the Northern Quoll and Rock-wallabies) by the feral Cat and Red Fox, and destruction of habitat from resources development (Pearson 2003). Also major fire events are likely to impact the species (Pearson 2003).
	Moderate
	• The species was recorded on four occasions within the Study Area; of which three are located within the Development Envelope and one within the Disturbance Footprint (**Figure 2-6**).
	• Clearing of habitat critical to the survival of the species is likely to pose the largest threat from the Project:
	  ○ Rocky Ridge and Gorge represents habitat critical to the survival of the species, providing suitable sheltering and hunting microhabitats for the species. Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint.
	  ○ Removal of Rocky Ridge and Gorge habitat is likely to reduce resource available to the species within the Study Area and may result in a local population decline. The recovery of the population post-closure is unlikely given the inability to restore microhabitats within such habitats.
	  ○ The Drainage Line and Riverine habitats represent suitable foraging and dispersal habitat of the species. Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively.
	  ○ Six semi-permanent and five permanent water sources were recorded within the Study Area. Of these, two permanent and two semi-permanent water sources are located within the Development Envelope and one permanent water source is located within the Disturbance Footprint. Each of these is likely to be of importance to the species.
	• Six significant water sources, important to the species, are located within 1 km of the Development Envelope (in addition to those within the Development Envelope) and may be indirectly impacted by water drawdown or altered hydrological regimes.
	• Vehicle collisions with the species is likely to increase, particularly during night-time hours and where infrastructure intersects habitat critical to the species.
	• Juveniles of the species is preyed upon by the Red Fox and by feral Cats (Pearson 2003). An increase in either population is likely to impact the species within and surrounding the Project.
	• Impacts to prey species, such as the Northern Quoll and Rothschild Rock-wallaby may reduce the food resources available to the persisting population.
	• Additional water bodies such as Turkeys Nests and sewage ponds, associated with mining or development, appear to benefit the species (Pearson 2003).
		• Although the species is patchily distributed, the Pilbara Olive Python is widespread across the Pilbara (DPaW 2016).
		• The species was recorded during eight of the eleven surveys conducted within the vicinity of the Study Area (MWH 2016b).
		• There is limited Rocky Ridge and Gorge habitat located in the surrounding area (10 km), therefore there is limited ability for individuals to move to similar habitat in nearby areas. Additionally the number of semi-permanent and permanent water sources in the Study Area, is relatively large compared to surrounding survey areas, suggesting the Study Area an important area for the species (MWH 2016b).
		• Habitats within the Development Envelope, are connected to similar habitat outside the Development Envelope (within the Study Area), as well as similar habitat outside the Study Area (particularly to the north; **Figure 1-1**). Therefore the species is unlikely to be completely removed from the local region.
			• Implement an appropriate monitoring program to assess the distribution and abundance and monitor the impact of the Project on the Pilbara Olive Python population. Additionally the monitoring program should seek to monitor water sources within the Study Area, to determine if water use and interruption associated with the Project affects important water sources for the species.
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Rocky Ridges and Gorge, Drainage Line and Riverine habitats). Specifically water sources where the species has been recorded and where development will disrupt hydrology surrounding water sources.
			• If the species is encountered in areas close to infrastructure, authorised snake handlers should relocate individuals to undisturbed areas of suitable habitat.

Grey Falcon
(*Falco hypoleucos*)
 	
Schedule 3 – WC Act
 	
Largest threat to species is associated with clearing for agriculture, which has reduced habitat in semi-arid zones (Garnett *et al.* 2011). Also grazing by exotic herbivores is likely to have reduced regeneration of trees in the arid zone, therefore reducing nesting habitat availability (Garnett *et al.* 2011).
	Minimal
	• The species was not recorded within the Study Area and was assessed as Possible to occur only. Failure to record the species, despite extensive survey effort suggests that if present, the species is likely to occur in low densities or as a visitor only.
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	  ○ Rocky Ridge and Gorge, Drainage Line and Riverine habitat may contain suitable nest sites, such as cliff lines and trees in elevated locations (Garnett *et al.* 2011).
	  ○ Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint. Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively.
	  ○ Suitable habitat is located outside the Development Envelope, within the Study Area and within the surrounding region. The species is unlikely to be reliant on habitats within the Development Envelope.
	• The species is highly mobile and adults, during the non-breeding season, would be expected to disperse ahead of clearing.
		• The Grey Falcon is widespread across much of Australia with scattered records through the Pilbara region (Barrett *et al.* 2003, Garnett and Crowley 2000).
		• The species was not recorded from any Survey conducted within the vicinity of the Study Area (MWH 2016b).
		• Suitable foraging and nesting habitat for the Grey Falcon is widespread across the Pilbara Region.
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Rocky Ridges and Gorge, Drainage Line and Riverine habitats). Specifically cliff line in Rocky Ridge and Gorge habitat and mature tress lining Drainage Line and Riverine habitats.

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions
Peregrine Falcon **(*Falco peregrinus*)** **Schedule 7 – WC Act** Habitat loss appears to be a major threat, particularly in woodland areas where the species nests in areas with cliffs. Other threats include accidental poisoning from dog baits and historically agricultural chemicals DDT and Deildrin which cause a decrease in eggshell thickness (DoE 2016d).	**Low** • The species was recorded on one occasion within the Study Area, which was not located within the Development Envelope of Disturbance Footprint (**Figure 2-7**). • Clearing of suitable habitat is likely to pose the largest threat of the Project to the species. ○ Rocky Ridge and Gorge, Drainage Line and Riverine habitats in the Development Envelope may contain suitable nest sites (optimal nesting locations are cliff faces, but tree hollows may also be used; Johnstone *et al.* 2013), for the species. Therefore a minimal amount of potential nesting habitat may be removed. ○ Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint. Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively. ○ Suitable habitat is located outside the Development Envelope, within the Study Area and within the surrounding region. The species is unlikely to be reliant on habitats within the Development Envelope. • The species is highly mobile and adults, during the non-breeding season, would be expected to disperse ahead of clearing.	• The Peregrine Falcon is widespread across much of Australia with scattered records through the Pilbara region (Barrett *et al.* 2003, Garnett and Crowley 2000). • The species was recorded from one other Survey conducted within the vicinity of the Study Area (MWH 2016b), at Abydos-Woodstock Reserve, located 65 km south-west of the Study Area (How *et al.* 1991). • Suitable foraging and nesting habitat for the Peregrine Falcon is widespread across the Pilbara Region.	• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Rocky Ridge and Gorge, Drainage Line and Riverine habitats). Specifically cliff line in Rocky Ridge and Gorge habitat and mature trees lining Drainage Line and Riverine habitats.
Anilios ganei **Priority 1 – DPaW Priority List** Specific threats to the species are unknown. The species is listed because it is only known from a limited number of isolated, all on lands not managed for conservation and/or the species appears to be under immediate threat from known threatening processes.	**Low** • The species was not recorded within the Study Area but was assessed as Likely to occur, based on habitat preferences and the proximity of previous records. • Clearing of suitable habitat is likely to pose the largest threat of the Project to the species. ○ The habitat requirements of the species are largely unknown although it is believed the species is associated with moist gorges and gullies (Doughty *et al.* 2011), represented by the Rocky Ridge and Gorge habitat of the Study Area. ○ Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint. ○ Due to the limited mobility of the species, individuals will not be able to relocate in advance of progressive clearing. • Altered hydrological regimes within the Development Envelope may impact the quality of habitat within the Rocky Ridge and Gorge habitat (including outside the Development Envelope) that this species utilises.	• Clearing of the Rocky Ridge and Gorge habitat in the Development Envelope will reduce the amount of high quality habitat available for this species within the region. • The species was recorded from three surveys conducted within the vicinity of the Study Area (Outback Ecology 2010, 2013, 2014a). • Little is known of the regional distribution of this species; however, it is unlikely that any local impacts would manifest at a regional scale.	• Not applicable
Ctenotus nigrilineatus **Priority 1 – DPaW Priority List** Specific threats to the species are unknown. The species is listed because it is only known from a single location near Woodstock (How *et al.* 1991) and little is known about its biology or habitat preferences.	**Minimal** • The species was not recorded within the Study Area but was assessed as Possible to occur, based on habitat preferences and previous records. • Clearing of suitable habitat is likely to pose the largest threat of the Project to the species. ○ The habitat requirements of the species are largely unknown although it is believed the species is associated with spinifex at the base of granite outcrops (How and Dell 2004, Storr *et al.* 1999), represented by the Spinifex Stony Plain and Spinifex Sandplain habitats of the Study Area. ○ Approximately 607.97 ha of the Spinifex Stony Plain habitat is located in the Development Envelope, including 99.66 ha in the Disturbance Footprint. Approximately 157.60 ha of the Spinifex Sandplain habitat is located in the Development Envelope, including 12.86 ha in the Disturbance Footprint. ○ Due to the limited mobility of the species, individuals will not be able to relocate in advance of progressive clearing. ○ It is likely that if present, the species will suffer a short-term loss in population size due to clearing, however successful rehabilitation may be applied within these habitats. • An increase in the feral Cat population is likely to impact the species within and surrounding the Project. • As the species has a preference for spinifex habitats, it's likely that the local population will be impacted in the short-term by alteration of the local fire regime.	• Clearing of the Spinifex Stony Plain and Spinifex Sandplain habitats in the Development Envelope will reduce the amount of high quality habitat available for this species however only a small portion of such habitat is located within the Development Envelope compared to that located in the wider Study Area (**Figure 1-1**). • The species was only recorded from one survey conducted within the vicinity of the Study Area (How and Dell 2004, How *et al.* 1991). • Little is known of the regional distribution of this species; however, it is unlikely that any local impacts would manifest at a regional scale.	• Not applicable

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions

Ctenotus uber johnstonei
 	
Priority 2 – DPaW Priority List
 	
Specific threats to species unknown. The species is listed because its distribution is poorly known, with some occurrences on lands managed for conservation and/or the species appears to be under immediate threat from known threatening processes.
	Minimal
	• The species was not recorded within the Study Area but was assessed as Possible to occur, based on habitat preferences and previous records.
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	  ○ The habitat requirements of the species are largely unknown although it is believed the species is associated compacted clayey soil with sparse plant cover, represented by sections of the Spinifex Stony Plain habitat of the Study Area.
	  ○ Approximately 607.97 ha of the Spinifex Stony Plain habitat is located in the Development Envelope, including 99.66 ha in the Disturbance Footprint.
	  ○ Due to the limited mobility of the species, individuals will not be able to relocate in advance of progressive clearing.
	  ○ It is likely that if present, the species will suffer a short-term loss in population size due to clearing, however successful rehabilitation may be applied within these habitats.
	• An increase in the feral Cat population is likely to impact the species within and surrounding the Project.
		• Clearing of the Spinifex Stony Plain habitat in the Development Envelope will reduce the amount of high quality habitat available for this species within the region.
		• Little is known of the regional distribution of this species; however, it is unlikely that any local impacts would manifest at a regional scale.
			• Not applicable

Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)
 	
Priority 3 – DPaW Priority List
 	
Most severe threats identified as predation by the Red Fox, habitat loss and fragmentation (Woinarski *et al.* 2014). Moderate threats comprise predation by feral Cats and inappropriate fire regimes (Woinarski and Fisher 1995).
	Low
	• The species was recorded on one occasion within the Study Area which was not located within the Development Envelope or Disturbance Footprint (**Figure 2-7**).
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	  ○ The habitat requirements of the species are largely unknown although it is believed the species is associated with spinifex plains (Ingleby 1991, Ingleby and Westoby 1992), represented by the Spinifex Stony Plain and Spinifex Sandplain habitats of the Study Area.
	  ○ Approximately 607.97 ha of the Spinifex Stony Plain habitat is located in the Development Envelope, including 99.66 ha in the Disturbance Footprint. Approximately 157.60 ha of the Spinifex Sandplain habitat is located in the Development Envelope, including 12.86 ha in the Disturbance Footprint.
	  ○ It is likely that if present, the species will suffer a short-term loss in population size due to clearing, however successful rehabilitation may be applied within these habitats.
	• An increase in the feral Cat and/or Red Fox population is likely to impact the species within, and surrounding, the Project.
	• As the species has a preference for spinifex habitats where large mature hummocks may provide refuge habitat from predators, it's likely that the local population will be impacted by alteration of the local fire regime.
		• Within the Pilbara the species is considered relatively rare (Woinarski *et al.* 2014), with very few recent records of the species (DPaW 2016). It is believed that without suitable management the species could be functionally lost from the region within the next 20 years (Carwardine *et al.* 2014).
		• The species was recorded in three of the 11 surveys conducted within the vicinity of the Study Area (MWH 2016b). The lack of recent records of the species in the region suggests that local area could be of importance to the species.
		• The area where the species was located in the Study Area is located >5 km from the Disturbance Footprint (**Figure 2-7**).
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Spinifex Stony Plain and Spinifex Sandplain habitats). Specifically old growth Spinifex habitats.
			• Design and implement a fire management plan that accounts for the Mainland Spectacled Hare-wallaby and significant habitat within the area.

Brush-tailed Mulgara (*Dasycercus blythi*)
 	
Priority 4 – DPaW Priority List
 	
Most severe threat identified as habitat loss (by clearing) and fragmentation (including for mining and tourism developments) (Woinarski *et al.* 2014). Other major threats include predation by feral Cats (Pavey *et al.* 2012), inappropriate fire regimes (Körtner *et al.* 2007), habitat change due to livestock and feral herbivores (Haythornthwaite and Dickman 2006) and habitat degradation by weeds (i.e. Buffel grass) (Woinarski *et al.* 2014).
	Low
	• The species was not recorded within the Study Area but was assessed as Possible to occur, based on habitat preferences and previous records.
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	  ○ The species is associated with spinifex on sandplains, represented by the Spinifex Sandplain habitats of the Study Area.
	  ○ Approximately 157.60 ha of the Spinifex Sandplain habitat is located in the Development Envelope, including 12.86 ha in the Disturbance Footprint.
	  ○ It is likely that if present, the species will suffer a short-term loss in population size due to clearing, however successful rehabilitation may be applied within these habitats.
	• Vehicle collisions with the species is likely to increase, particularly during night-time hours and where infrastructure intersects habitat critical to the species.
	• The species is preyed upon by both Dog/Dingo and feral Cats (Woinarski *et al.* 2014, 2015). The increase in either population is likely to impact the species within and surrounding the Project.
	• Frequent fire in habitat critical to the species is a significant threat to the species. An increase in fire frequency, directly through mining activity or indirectly through increasing fuel loads via introduced flora species is likely to have short term impacts on the species.
		• As the species was not recorded within the Study Area, despite an extensive amount of survey effort, it is unlikely that if present, the population of the species existing within the Study Area represents a regionally significant population.
		• The species occurs widely throughout the region and state and was recorded in three of the 11 surveys conducted within the vicinity of the Study Area (How *et al.* 1991, Outback Ecology 2010, 2014a).
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Spinifex Sandplain habitat). Specifically old growth Spinifex habitats.
			• Design and implement a fire management plan that accounts for the Brush-tailed Mulgara and significant habitat within the area.

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions

Western Pebble-mound Mouse (*Pseudomys chapmani*)
 	
Priority 4 – DPaW Priority List
 	
Habitat loss and fragmentation (due to mining) is regarded as most severe threat to the species, specifically iron-ore mining which destroys mounds and habitat (Woinarski *et al.* 2014); predation by cats is unknown by may be significant (Woinarski *et al.* 2014).
	Low
	• The species was recorded on 13 occasions during the Survey, including 10 inactive mounds, one active mound and two direct captures.
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	  ○ Nine of the records were recorded within Stony Rises habitat, three within Ironstone Ridgetop habitat and one within Spinifex Stony Plain, these three habitat are likely to provide the most suitable habitat for the species within the Study Area.
	  ○ Approximately 532.74 ha of the Stony Rises habitat is located in the Development Envelope, including 79.10 ha in the Disturbance Footprint. Approximately 537.93 ha of the Ironstone Ridgetop habitat is located in the Development Envelope, including 167.03 ha in the Disturbance Footprint. Approximately 607.97 ha of the Spinifex Stony Plain habitat is located in the Development Envelope, including 99.66 ha in the Disturbance Footprint.
	  ○ Due to the limited mobility of the species, individuals will not be able to relocate in advance of progressive clearing.
	  ○ It is likely that the species will suffer a short-term loss in population size due to clearing, however successful rehabilitation may be applied within these habitats.
	• An increase in the feral Cat population is likely to impact the species within and surrounding the Project.
		• Habitat within the Development Envelope is small relative to available habitat in the wider Study Area and within the wider region Pilbara region (van Vreeswyk *et al.* 2004).
		• The species was recorded in ten of the 11 surveys conducted within the region and from two database searches (MWH 2016b).
			• Avoid clearing of pebble-mounds wherever possible. This includes inactive mounds, which may be re-used by subsequent generations (Anstee 1996, Anstee and Armstrong 2001)
			• Record location and status (i.e. active or inactive) of mounds if encountered and demarcate appropriately.

Long-tailed Dunnart (*Sminthopsis longicaudata*)
 	
Priority 4 – DPaW Priority List
 	
No major threats identified to species, and protected on the basis of being (a) rare and not considered threatened although could be if circumstances change; or (b) is not conservation dependent but is close to quantifying for Vulnerable.
	Low
	• The species was not recorded within the Study Area but was assessed as Likely to occur, based on habitat preferences and previous records.
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	  ○ The species is often associated with rugged rocky areas (Gibson and McKenzie 2009, van Dyck and Strahan 2008), represented by the Rocky Ridge and Gorge and Rocky Foothills habitats of the Study Area.
	  ○ Approximately 249.26 ha of the Rocky Ridge and Gorge habitat is located in the Development Envelope, including 42.29 ha in the Disturbance Footprint. Approximately 76.27 ha of the Rocky Foothills habitat is located in the Development Envelope, including 11.04 ha in the Disturbance Footprint.
	  ○ Due to the limited mobility of the species, individuals will not be able to relocate in advance of progressive clearing.
	• An increase in the feral Cat population is likely to impact the species within and surrounding the Project.
	• Given the trapping effort expended in the Study Area (MWH 2016b), the species is likely to occur in low densities within the Study Area, if at all present, particularly in the Development Envelope
		• Clearing of the Rocky Ridge and Gorge and Rocky Foothills habitat in the Development Envelope will reduce the amount of high quality habitat available for this species within the region.
		• The species was recorded from one survey conducted within the vicinity of the Study Area (Outback Ecology 2012b), however the species is has a widely scattered distribution through Western Australia and the Pilbara (Gibson and McKenzie 2009).
		• Little is known of the regional distribution of this species; however, it is unlikely that any local impacts would manifest at a regional scale.
			• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the Long-tailed Dunnart (e.g. Rocky Ridges and Gorge, and Rocky Foothills).
			• Consider including large rocky material and microhabitat features suitable for Long-tailed Dunnart habitation when creating waste rock landforms and during rehabilitation post closure.

Fork-tailed Swift (*Apus pacificus*) **Migratory – EPBC Act** **Schedule 5 – WC Act** Species migratory between Australia and much of Asia. Therefore protected under international agreements CAMBA, JAMBA and ROKAMBA. There are no significant threats to the Fork-tailed Swift in Australia. Potential threats include habitat destruction and predation by feral animals (DoEE 2016).	**Negligible** • The species was not recorded within the Study Area but was assessed as Possible to occur, based on habitat preferences and previous records. • Within Australia the species is almost entirely an aerial species, and therefore has the possibility to fly-over any of the habitats present within the Development Envelope. Although is unlikely to be dependent on any habitat in particular. • It is unlikely that the species will be adversely impacted by development of the Project	• Potential habitat is widespread and common through region (Johnstone *et al.* 2013),	• Not Applicable

Species Threats and reasoning for listing	Localised impacts	Regional context	Species specific management actions
Migratory Shorebirds (various): • **Wood Sandpiper (*Tringa glareola*)** • **Common Greenshank (*Tringa nebularia*)** • **Sharp-tailed Sandpiper (*Calidris acuminata*)** **Migratory – EPBC Act** **Schedule 5 – WC Act** Species migratory between Australia and Siberia, and through much of Asia. Therefore protected under international agreements CAMBA, JAMBA and ROKAMBA. Habitat loss and degradation are the largest threats to the species, particularly the availability of foraging and roosting sites required for successful migration and breeding (DoEE 2016).	**Negligible** • None of these species were recorded within the Study Area, and all were assessed as Possible to occur, based on habitat preferences and previous records. • Each of these species occurs within Australia on a seasonal basis only (Johnstone *et al.* 2013). • Each of the species has a possibility of occurring within the Drainage Line and Riverine habitat types for foraging only although neither species is reliant on these habitats within the Study Area. • It is unlikely that any of these species will be adversely impacted by development of the Project	• The potential habitat within the Development Envelope is small relative to available habitat in the wider region (Johnstone *et al.* 2013).	• Not Applicable

Eastern Great Egret (*Ardea modesta*)
 	
Schedule 5 – WC Act
 	
Species migratory between Australia and much of Asia. Habitat loss and/or degradation of foraging and especially breeding habitat is the largest threat to the species (DoEE 2016).
	Minimal
	
	• The species was not recorded within the Study Area but was assessed as Likely to occur, based on habitat preferences and nearby records.
	• Clearing of suitable habitat is likely to pose the largest threat of the Project to the species.
	• The species is likely to nest and forage within the Drainage Line and Riverine habitat types.
	  ○ Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively.
	  ○ The species is highly mobile and is able to avoid direct impacts of clearing out of the nesting season.
	• Altered hydrological regimes within the Development Envelope may impact the quality and availability of water within adjacent Drainage Line and Riverine habitat (including outside the Development Envelope) that this species utilises.
	• It is unlikely that the species will be adversely impacted by development of the Project
		• Potential habitat is widespread and common through region (Johnstone *et al.* 2013), and potential habitat within the Development Envelope is small relative to available habitat in the wider region.	• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Drainage Line and Riverine habitats).

Rainbow Bee-eater (*Merops ornatus*)
 	
Schedule 5 – WC Act
 	
Species migratory between Australia and eastern Indonesia. The Cane Toad is perceived as being the only major threat to the species as it has been documented feeding on eggs and especially nestlings (Garnett *et al.* 2011).
	Minimal
	
	• The species was recorded from 61 records within the Study Area, of which 11 were located within the Development Envelope and nine within the Disturbance Footprint (**Figure 2-7**). The species was recorded from Drainage Line (*n* = 28), Calcrete (*n* = 9), Ironstone Ridgetop (*n* = 27), Riverine (*n* = 7), Rocky Ridge and Gorge (*n* = 12), Spinifex Stony Plain (*n* = 2), Spinifex Sandplain (*n* = 1) and Stony Rises (*n* = 1).
	• Clearing of suitable breeding habitat is likely to pose the largest threat of the Project to the species.
	  ○ Approximately 55.72 ha and 2.70 ha of Drainage Line habitat, is located within the Development Envelope and Disturbance Footprint, respectively. Approximately 37.72 ha and 1.73 ha of Riverine habitat, is located within the Development Envelope and Disturbance Footprint, respectively.
	  ○ The species is highly mobile and is able to avoid direct impacts of clearing out of the nesting season.
	• It is unlikely that the species will be adversely impacted by development of the Project
		• Potential habitat is widespread and common through region (Johnstone *et al.* 2013), and potential habitat within the Development Envelope is small relative to available habitat in the wider region.	• During the design and planning phase of the Project, consider aligning infrastructure footprints to avoid habitats that are known to, or have been identified as, likely to support the species (e.g. Drainage Line and Riverine habitats).