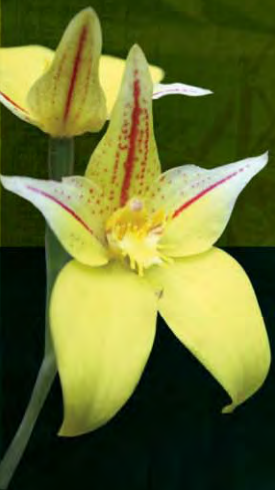


NOVEMBER 2011



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**FORTESCUE METALS GROUP
NORTH STAR PROJECT
TARGETED CONSERVATION SIGNIFICANT FAUNA SURVEY**

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FORTESCUE METALS GROUP
NORTH STAR PROJECT
TARGETED CONSERVATION SIGNIFICANT FAUNA SURVEY

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ACRONYMS

CAMBA	China-Australia Migratory Bird Agreement
DEC	Department of Environment and Conservation
DSEWPac	Department of Sustainability, Environment, Water, Population and Community
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GBIF	Global Biodiversity Information Facility
JAMBA	Japan-Australian Migratory Bird Agreement
NHMRC	National Health and Medical Research Centre
SAC	Species Accumulation Curve
WC Act	<i>Wildlife Conservation Act 1950</i>

EXECUTIVE SUMMARY

In April 2011 *ecologia* Environment (*ecologia*) conducted the first phase of a Level 2 vertebrate fauna assessment of the Fortescue Metals Group North Star Project area. During the survey, Northern Quolls (*Dasyurus hallucatus*) were recorded from three locations (one on video, one observed, two captured) in the northern part of the North Star Project area and extensive suitable habitat was recorded for Northern Quoll, Pilbara Leaf-nosed Bat (*Rhinonictoris aurantia* - Pilbara form) and Pilbara Olive Python (*Liasis olivaceus barroni*). As Northern Quolls is listed under the *Environmental Protection and Biodiversity Act 1999* as endangered and Pilbara Leaf-nosed Bats and Pilbara Olive Pythons are listed as vulnerable, Fortescue Metals Group (Fortescue) commissioned *ecologia* to undertake a targeted conservation survey of the North Star Project area, associated infrastructure corridor and proposed infrastructure areas. The purpose of the survey was to provide information regarding the presence and area of suitable habitat of the three threatened species within the Project area.

Trapping methods and layout were conducted in accordance with the referral guidelines for Northern Quolls, survey guidelines for threatened reptiles of Australia, survey guidelines for threatened mammals of Australia and survey guidelines for threatened bats of Australia. Northern Quolls were targeted using typically one trap (large Elliott trap or cage trap) placed approximately every 100 m along linear denning/shelter habitat. In total, 172 traps were placed in suitable accessible habitat within the Project area over seven nights. In addition to trapping, nine remote sensing cameras were set up at 34 locations for three consecutive nights, and searches for secondary signs (scats, tracks etc.) were conducted for 103.5 hours. Two SM2Bat recorders were set up at 25 locations within potential Pilbara Leaf-nosed Bat habitat for a total of 287.5 hours. Pilbara Olive Pythons were targeted during opportunistic surveys along cliff faces and rocky ridges for approximately 103.5 hours.

A total of 20 Northern Quolls were captured during the survey, additional individuals were recorded on motion cameras at three locations. Two species of native mammal (Common Rock-rat (*Zygomys argurus* and Wolley's Pseudantechinus (*Pseudantechinus wolleyae*)) were also trapped which indicated that the trapping methods and density was adequate for small to medium sized mammals. The Pilbara Leaf-nosed Bat was recorded from 14 of the 25 recording sites, and a Ghost Bat (*Macroderma gigas*) was recorded at a single location. Secondary evidence in the form of sloughed skin, scats and remains of the Pilbara Olive Python was recorded during opportunistic searches from three locations within the North Star Project.

Large areas considered to be suitable habitat of the Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python were recorded within the North Star Project. The proposed rail corridor also contains patches of potential foraging and dispersal habitat for Northern Quoll and Pilbara Olive Python comprising granite boulder piles on sand plains and/or major creek lines with fringing eucalypts.

Northern Quolls appear to be widespread within the North Star proposed mining area and proposed infrastructure areas. A total of 900.7 ha of potential Northern Quoll habitat was identified within the Project area. Of this, 294.4 ha was classified as suitable denning habitat, 108.4 ha was identified to be potential denning/foraging habitat with a low number of crevices and/or limited extent in area. Riverine foraging/dispersal habitat, which comprised 403.0 ha, consisted of low quality rocky habitat without rocky boulders and crevices and eucalypt woodland along Turner River. The remaining 94.9 ha of rocky habitat were identified on aerial photography but due to access limitations these areas were not assessed for their suitability as habitat for the Northern Quoll during the survey.

Previous surveys revealed numerous records of the Northern Quoll in the surrounding region which indicated that the Project area occurred within the Northern Quolls distribution. NatureMap data comprised six records of Northern Quoll made approximately 20 km northeast of the North Star Project area in 2010, indicating that this area could be potentially significant for Northern Quoll.

Pilbara Leaf-nosed Bats were recorded in high densities from 14 locations within the Project area. A total of 712.94 ha of potential roost habitat was identified within the Project area and consisted of a mix of cliff face habitat with associated caves and gullies (Dry season roost habitat, 294.35 ha) and major creekline habitat with fringing eucalypt trees (wet season roost habitat, 418.58 ha)

Secondary evidence in the form of potential scats, remains and sloughed skin of Pilbara Olive Python was recorded from three locations within the Project area. A total of 1045.2 ha of Pilbara Olive Python habitat was identified within the Project area. Of this, 432.0 ha of critical habitat (rocky gorges with surface water) was identified in the Project area and is classified as good to excellent habitat for this species. Further 520.7 ha of potential habitat of moderate quality were also recorded, consisting of cliffs and rock faces with no surface water and creek lines with no rock faces. An area of 92.5 ha of rocky habitat was identified on aerial photography but its suitability for Pilbara Olive Pythons has not been assessed due to access limitations.

The North Star Project area will directly impact suitable denning and roosting habitat for Northern Quolls and Pilbara Leaf-nosed Bats and suitable habitat for Pilbara Olive Pythons. It is anticipated that the local population of the three species will be impacted by the development of the proposed project. Impacts to regional populations are not known at present. Referral of the Project to the DSEWPaC is, therefore, highly recommended

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Fortescue Metals Group Limited (Fortescue) is developing the Pilbara Iron Ore and Infrastructure Project, which involves a series of iron ore mines in the Pilbara region of Western Australia, and associated rail and port infrastructure. Fortescue intends to expand its current operations to include the development of a new mine site, North Star, approximately 100 km south of Port Headland and 25 km east of the Fortescue Rail Line together with support infrastructure such as camps and road access (Figure 1.1).

As part of the environmental approvals processes for the proposed North Star Project, *ecologia* Environment (*ecologia*) was commissioned by Fortescue to undertake a comprehensive vertebrate fauna assessment of the North Star Project area. During the first phase survey, recordings of Northern Quolls (*Dasyurus hallucatus*) were made in the North Star Project area and suitable habitat was recorded for Northern Quoll, Pilbara Olive Python (*Liasis olivaceus barroni*) and Pilbara Leaf-nosed Bat (*Rhynonictoris aurantia* - Pilbara form). Northern Quolls, Pilbara Olive Pythons and Pilbara Leaf-nosed Bats are listed under the *Environmental Protection and Biodiversity Act 1999* and therefore a targeted conservation significant vertebrate fauna survey was recommended and subsequently conducted. The purpose of the survey was to provide information on the presence and suitable habitat of the three threatened species within the Project area, and to assess potential impacts and identify appropriate management strategies. Additional conservation significant vertebrate fauna were also recorded but these are detailed separately in the Level 2 vertebrate fauna report of the North Star Project area.

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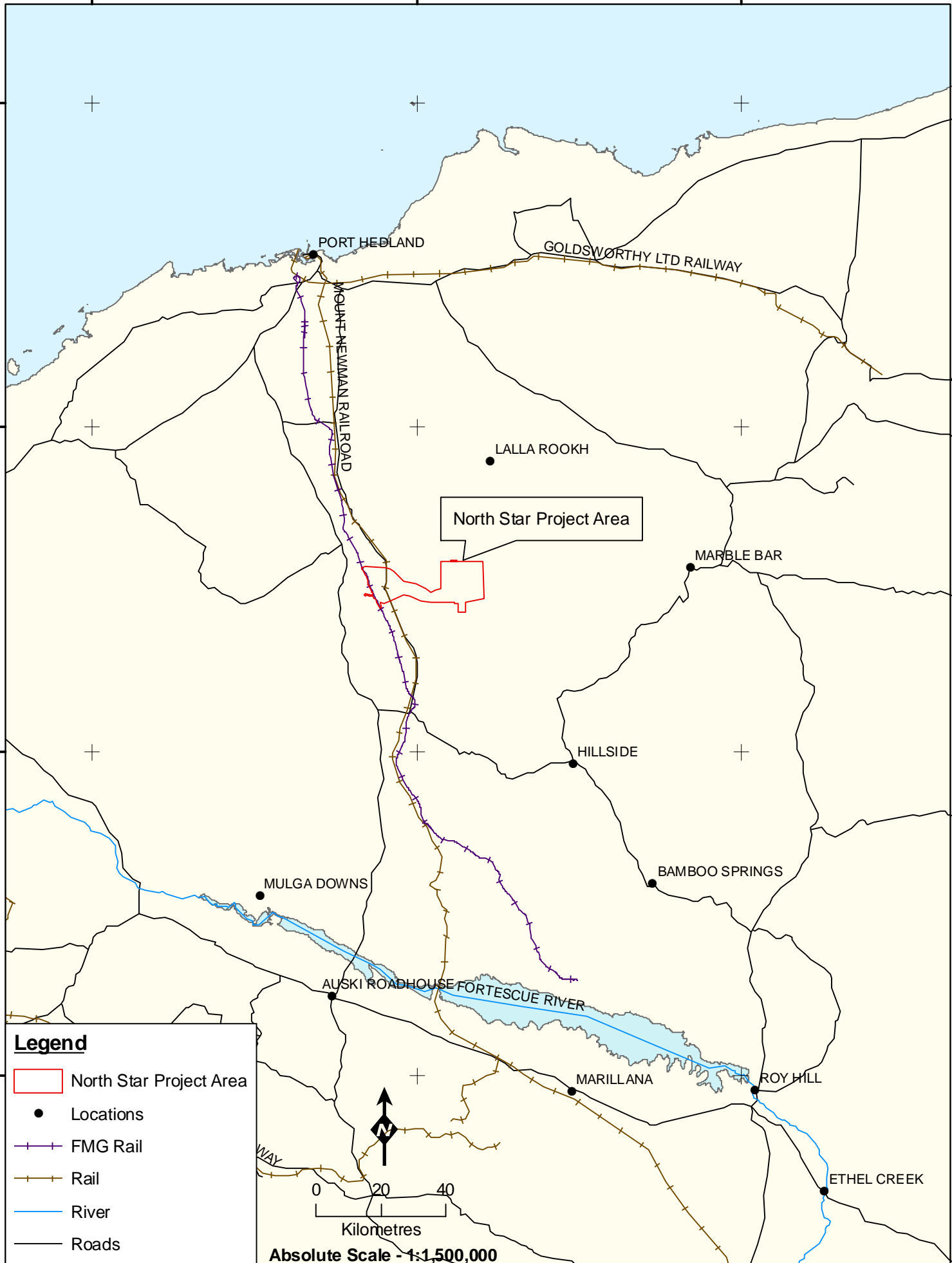
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Legend

- North Star Project Area
- Locations
- +— FMG Rail
- +— Rail
- River
- Roads



Absolute Scale - 1:1,500,000



Location of the Project Area

Figure: 1.1
Project ID: 1373

Drawn: AH
Date: 18/08/11

Coordinate System
Name: GDA1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Urique Map ID: AH367

1.2 LEGISLATIVE FRAMEWORK

The *Environmental Protection Act 1986* is “an Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of environmental pollution, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing.” Section 4a of this Act outlines five principles that are required to be addressed to ensure that the objectives of the Act are addressed. Three of these principles are relevant to native fauna and flora:

- *The Precautionary Principle*

Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

- *The Principles of Intergenerational Equity*

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- *The Principle of the Conservation of Biological Diversity and Ecological Integrity*

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

In addition to these principles, projects undertaken as part of the Environmental Impact Assessment (EIA) process are required to address guidelines produced by the Environmental Protection Authority (EPA), in this case Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004), principles outlined in EPA Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010).

Native flora and fauna in Western Australia that are formally recognised as rare, threatened with extinction, or as having high conservation value are protected at a federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a state level under the *Wildlife Conservation Act 1950* (WC Act). International agreements include the Japan-Australian Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

The EPBC Act 1999 was developed to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance, to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources, and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species (and in particular to prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species. In addition to the principles outlined in Section 4a of the EPBC Act, Section 3a of the EPBC Act includes a principle of ecologically sustainable development dictating that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations. Schedule 1 of the EPBC Act contains a list of species that are considered Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable and Conservation Dependent.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all flora and fauna within Western Australia is protected; however, the Minister may, via a notice published in the *Government Gazette*, declare a list of fauna

identified as rare, likely to become extinct, or otherwise in need of special protection (Appendix A). The current listing was gazetted in August 2010.

In addition, the Department of Environment and Conservation (DEC) maintains a Threatened and Priority Fauna list which includes species removed from the WC Act and other species known from only a few populations or in need of monitoring. Five Priority codes are recognised (Appendix A).

1.3 TARGETED SURVEYS FOR REFERRAL TO THE DSEWPAC

When conservation significant species listed under the EPBC Act are likely to be impacted by a project, the project is required to be referred to the Department for Sustainability, Environment, Water, Population and Communities (DSEWPac). DSEWPac has released a number of guidelines to assist proponents with the referral process and typically targeted surveys are required to provide regulators with sufficient information to make an informed decision about the impact of each project.

Northern Quoll were recorded during initial environmental impact assessment surveys of the Project area in 2011 and suitable habitat for Pilbara Olive Python and Pilbara Leaf-nosed Bat was recorded within the Project area. Based on referral guidelines for Northern Quoll (DSEWPac 2011a) and survey guidelines for reptiles bats and mammals (DEWHA 2010a; DSEWPac 2011b, c), targeted surveys were undertaken to determine the abundance and distribution of Northern Quoll within the Project area and to determine the presence of Pilbara Olive Python and Pilbara Leaf-nosed Bat from within the Project area.

1.4 SURVEY OBJECTIVES

Fortescue commissioned *ecologia* Environment (*ecologia*) to undertake a targeted survey of the conservation significant fauna of the North Star Project area as part of the environmental impact assessment for the project.

The EPA's objectives with regards to fauna management are to:

- maintain the abundance, species diversity and geographical distribution of terrestrial fauna; and
- protect Specially Protected (Threatened) fauna, consistent with the provisions of the WC Act.

The aim of this study was to provide sufficient information to the EPA and the DSEWPac to assess the impact of the project on the conservation significant fauna of the area, thereby ensuring that these objectives will be upheld.

This report satisfies the requirements documented in *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment, EPA Guidance Statement No. 56 and Position Statement No. 3 and Referral guidelines for Northern Quoll, Threatened Bats and Reptiles* (DSEWPac 2011a, b, c), by providing:

- a review of background information (including literature and database searches) for EPBC listed species that potentially occur in the North Star Project area, including an appraisal of the current level of knowledge for the area, and a review of previous surveys conducted in the area that are relevant to the current study.
- a review of regional and biogeographical significance, including the conservation status of species recorded in the Project area.

- a description of potential habitat occurring in the Project area, including mapping and area calculations, and
- a detailed summary of the findings of the current targeted survey.

2 SURVEY METHODS

2.1 LITERATURE REVIEW AND DATABASE SEARCH

Three databases (*ecologia* internal database, NatureMap (DEC and WAM records) and GBIF (Global Biodiversity Information Facility)) were consulted to determine the regional occurrence of Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat. Several reference books and scientific journal papers were consulted to determine biological and ecological information for these species (referenced throughout this document).

2.2 DETERMINATION OF SURVEY SAMPLING DESIGN AND INTENSITY

ecologia was commissioned by Fortescue to conduct the vertebrate fauna assessment of the North Star Project for inclusion into their environmental approval documentation for this project. The first phase of the Level 2 survey was conducted between 29th March and 9th April 2011. Information from this survey was utilised to develop the survey methods for this current targeted survey. Habitat assessments were conducted during the first phase Level 2 survey to determine the likelihood of occurrence of fauna species and to aid in the impact assessment for the project.

2.2.1 Northern Quoll

Habitat mapping information was used to identify and delineate potential Northern Quoll habitat within the Project area. This area was then assessed to determine the accessibility of each area for survey to ensure trapping complied with animal welfare. The total area of habitat identified prior the survey and the relative accessibility is presented below in Table 2.1 and Figure 2.1.

Table 2.1 - Area of Potential Northern Quoll Habitat Identified Prior to Survey

Accessibility of Potential Northern Quoll habitat	Area (ha)
Access Sufficient for Trapping	209.39
Access Sufficient for Opportunistic Searches	201.45
No Access available	189.18
Total area of Potential Northern Quoll Habitat	600.02

Areas with no access were identified using aerial photography, vegetation descriptions and topographic data. Their suitability to be classified as foraging or breeding habitat for Northern Quolls could not be assessed due to access limitations.

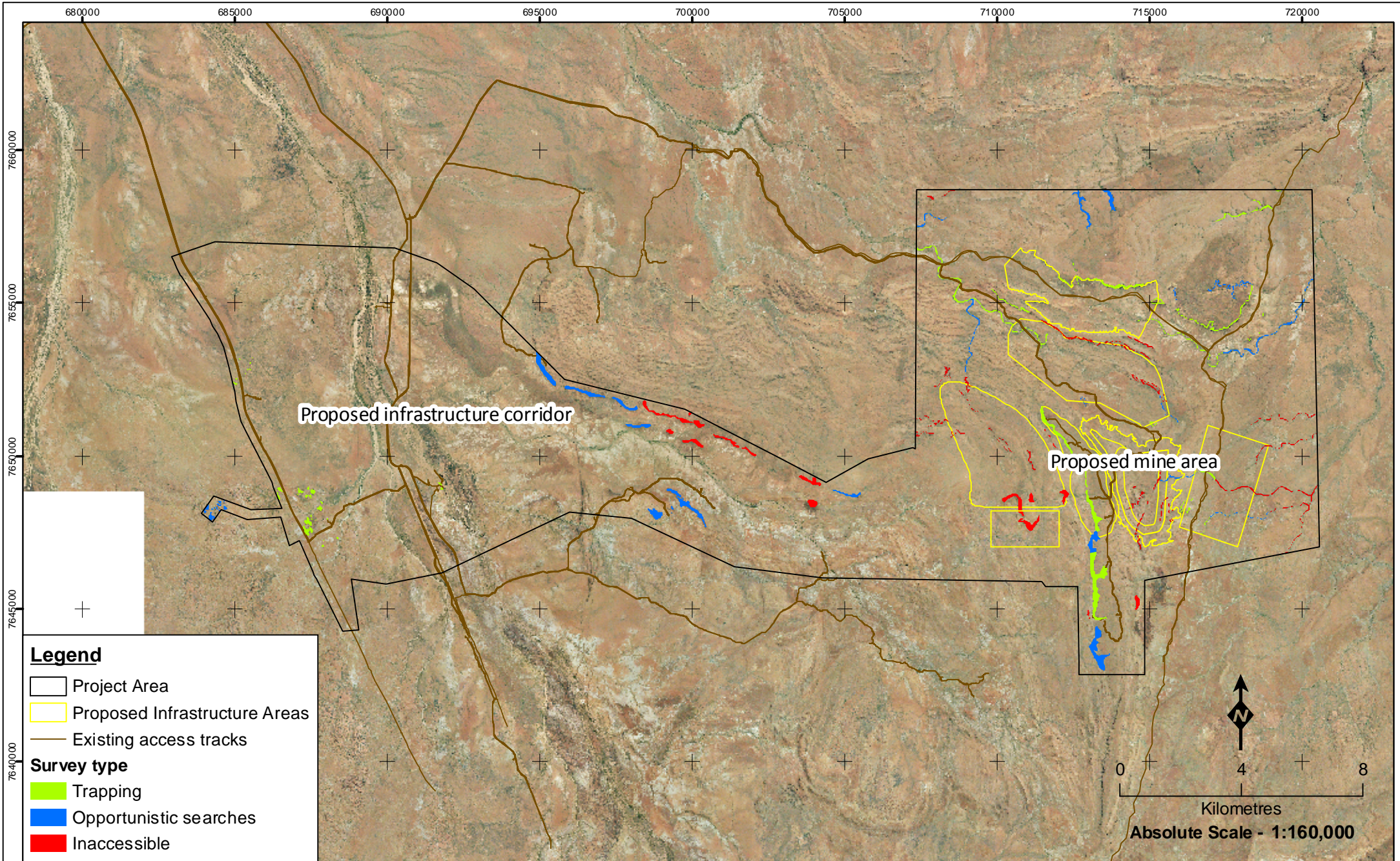
Trapping survey effort was designed using the formula described in the referral guideline document (DSEWPac 2011a) which is described below. The trapping effort was calculated using only the area of potential habitat that is accessible for trapping (Tim McGrath, DSEWPac 2011, pers. comms.). The Referral guidelines also recommend that traps are left open for a minimum of seven nights and that if two or more individuals are caught twice, the traps should be closed after four nights.

$$y=50x^{0.5}$$




y= number of trapnights, x = area of potential habitat in hectares

Based on the above formula, 723.5 trap nights were recommended to determine the presence and abundance of Northern Quoll within the North Star Project area. Based on the recommendation that traps are open for a minimum of seven nights, a total of 103 traps were estimated to be required to accurately determine the presence and abundance of Northern Quoll in the Project area. Due to the limitation of access, additional traps were set up in areas identified during the survey as accessible potential habitat. As a result, a total of 172 cage traps were used to determine the presence and abundance of Northern Quolls.

In addition to cage traps, Motion Cameras were set up at areas of suitable Northern Quoll habitat with access sufficient for trapping and opportunistic searches.



Legend

-  Project Area
-  Proposed Infrastructure Areas
-  Existing access tracks

Survey type




-  Trapping
-  Opportunistic searches
-  Inaccessible

Figure: 2.1
Project ID: 1373

Drawn: AH
Date: 01/06/11



Survey Types at Potential Northern Quoll Habitat Identified Prior Survey

Coordinate System
Name: GDA1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AH343

2.2.2 Pilbara Leaf-nosed Bat

Habitat mapping was used to identify areas that this species is thought to prefer and that had the potential to provide roosting caves. Passive acoustic recorders were used to confirm the species presence. The recorders are described as the most appropriate of non invasive survey and the survey guidelines for Threatened Bats (DEWHA 2010a) indicate that 16 survey nights are recommended for areas less than 50 ha over a minimum of four nights, repeated twice with six months separating surveys.

Based on the area of suitable dry season roosting habitat within the Project area (294 ha), approximately 80 survey nights were recommended.

However, a total of 25 survey nights was conducted during the targeted survey with additional bat recorders set up during the Level 2 vertebrate fauna survey. The survey effort and results are combined in the Level 2 vertebrate fauna report.

2.2.3 Pilbara Olive Python

Survey methods for Pilbara Olive Pythons are relatively simple, consisting of nocturnal road spotting transects, opportunistic searches for individuals, sloughed skin and faecal pellets (DSEWPaC 2011c). The DSEWPaC's survey guidelines for reptiles (DSEWPaC 2011c) do not provide recommendations for survey intensity, however the guidelines can be interpreted such that all suitable habitat should be searched for primary and secondary evidence of this species, i.e. scats, skin and remains.

2.3 SURVEY TIMING

The targeted survey was conducted in winter over two survey periods from the 7th - 15th July 2011 and from 22nd - 30th July 2011.

2.4 FAUNA HABITAT ASSESSMENT

Fauna habitat types were determined during the initial phase Level 2 survey conducted in April 2011. The distribution and extent of each habitat was estimated and mapped using aerial photographs, topography and GIS software to help estimate the location and area of each habitat type. During the targeted survey the location and extent of suitable habitat for the listed conservation significant fauna species was re evaluated and adjusted accordingly. Suitable habitat for each species was then given a suitability classification and the area of each classified habitat calculated and reported. Some areas were assessed as potential habitat using aerial photography, topography and vegetation descriptions. These areas were mapped as desktop assessed but inaccessible for ground truthing due to the lack of access tracks. Therefore their suitability and classification as denning, dispersal or foraging habitat for the targeted species could not be assessed.

2.5 SITE SELECTION AND TRAPPING

All accessible areas of suitable Northern Quoll habitat were targeted and the number of traps per site based on the extent of the habitat, ability to transport traps and ability to allow all traps to be checked within three hours of sunrise (DSEWPaC 2011a). Opportunistic search areas were assessed to accurately determine suitability as habitat for conservation significant fauna species, and actively searched for secondary evidence of the targeted species.

A total of 17 trapping sites were established in areas of suitable habitat (Table 2.2, Figure 2.2).

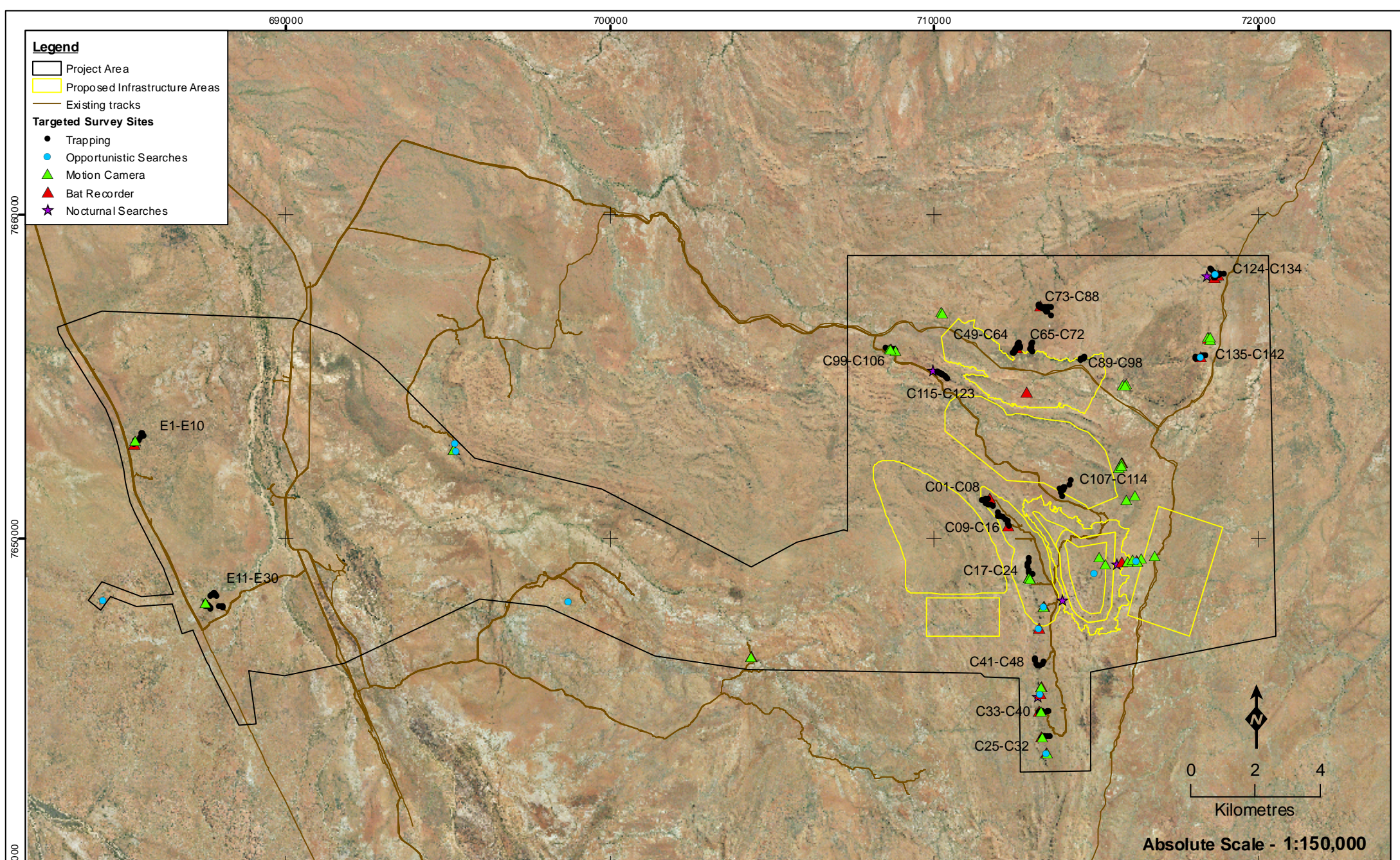
Survey trap sites from the previous Phase 1 of the Level 2 survey at North Star proposed mining area and infrastructure corridor are mapped in Figure 2.3 in conjunction with the targeted survey sites set up during the targeted surveys of the Project area.

Table 2.2 – Fauna Survey Site locations

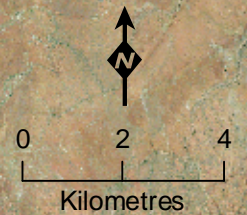
Site	Survey Area	Survey Type	Number of Traps	Location	
				Easting	Northing
A	North Star proposed mining area	Trapping	8	711709	7651197
B	North Star proposed mining area	Trapping	8	712315	7650404
C	North Star proposed mining area	Trapping	8	712918	7649398
D	North Star proposed mining area	Trapping	8	713297	7643801
E	North Star proposed mining area	Trapping	8	713394	7644638
F	North Star proposed mining area	Trapping	8	713164	7646403
Y	Infrastructure Corridor	Trapping	20	688165	7647772
Z	Infrastructure Corridor	Trapping	10	685090	7652841
1	Proposed Infrastructure Areas	Trapping	16	712517	7655862
2	Proposed Infrastructure Areas	Trapping	8	712979	7655872
3	Proposed Infrastructure Areas	Trapping	16	713394	7657128
4	Proposed Infrastructure Areas	Trapping	10	714535	7655547
5	Proposed Infrastructure Areas	Trapping	8	708615	7655839
6	Proposed Infrastructure Areas	Trapping	8	713958	7651503
7	Proposed Infrastructure Areas	Trapping	9	710192	7655094
8	Proposed Infrastructure Areas	Trapping	11	718659	7658149
9	Proposed Infrastructure Areas	Trapping	8	718198	7655629
NS Opp1	Infrastructure Corridor	Opportunistic	-	684335	7648110
NS Opp2	Infrastructure Corridor	Opportunistic	-	698701	7648059
NS Opp3	Infrastructure Corridor	Opportunistic	-	695230	7652709
NS Opp4	Infrastructure Corridor	Opportunistic	-	695186	7652948
NS Opp5	North Star proposed mining area	Opportunistic	-	713377	7647922
NS Opp6	North Star proposed mining area	Opportunistic	-	713205	7647235
NS Opp7	North Star proposed mining area	Opportunistic	-	713448	7643390
NS Opp8	North Star proposed mining area	Opportunistic	-	713236	7645210
NS Opp9	North Star proposed mining area	Opportunistic	-	713205	7647235
AA Opp1	Proposed Infrastructure Areas	Opportunistic	-	718659	7658149
AA Opp2	Proposed Infrastructure Areas	Opportunistic	-	718659	7658149
AA Opp3	Proposed Infrastructure Areas	Opportunistic	-	718223	7655604
AA Opp4	Proposed Infrastructure Areas	Opportunistic	-	716219	7649314
AA Opp5	Proposed Infrastructure Areas	Opportunistic	-	714916	7648960
BatRec 01	Proposed Infrastructure Areas	Bat recorder	1	712272	7650376
BatRec 02	Proposed Infrastructure Areas	Bat recorder	1	713307	7643882
BatRec 03	North Star proposed mining area	Bat recorder	1	713448	7643390
BatRec 04	North Star proposed mining area	Bat recorder	1	713285	7645431
BatRec 05	Infrastructure Corridor	Bat recorder	1	685276	7652908
BatRec 06	Infrastructure Corridor	Bat recorder	1	704322	7646345
BatRec 07	Proposed Infrastructure Areas	Bat recorder	1	712831	7654516
BatRec 08	North Star proposed mining area	Bat recorder	1	711676	7651226
BatRec 09	North Star proposed mining area	Bat recorder	1	712922	7648806
BatRec 10	North Star proposed mining area	Bat recorder	1	713217	7644678
BatRec 11	North Star proposed mining area	Bat recorder	1	713262	7645204
BatRec 12	Infrastructure Corridor	Bat recorder	1	695165	7652746
BatRec 13	North Star proposed mining area	Bat recorder	1	713368	7647895
BatRec 14	North Star proposed mining area	Bat recorder	1	713205	7647235

Site	Survey Area	Survey Type	Number of Traps	Location	
				Eastings	Northing
BatRec 15	Proposed Infrastructure Areas	Bat recorder	1	718626	7658052
BatRec 16	Proposed Infrastructure Areas	Bat recorder	1	718754	7658120
BatRec 17	Proposed Infrastructure Areas	Bat recorder	1	715775	7652328
BatRec 18	Proposed Infrastructure Areas	Bat recorder	1	708641	7655822
BatRec 19	Proposed Infrastructure Areas	Bat recorder	1	713235	7657191
BatRec 20	Proposed Infrastructure Areas	Bat recorder	1	715785	7652347
Bat Rec 21	Proposed Infrastructure Areas	Bat recorder	1	718223	7655604
Bat Rec 22	Proposed Infrastructure Areas	Bat recorder	1	718436	7656200
Bat Rec 23	Proposed Infrastructure Areas	Bat recorder	1	716220	7649315
Bat Rec 24	Proposed Infrastructure Areas	Bat recorder	1	715757	7649289
Bat Rec 25	Proposed Infrastructure Areas	Bat recorder	1	712542	7655888
NSMC 1	North Star proposed mining area	Motion Camera	1	712917	7648809
NSMC 2	North Star proposed mining area	Motion Camera	1	713311	7643886
NSMC 3	North Star proposed mining area	Motion Camera	1	713463	7643392
NSMC 4	North Star proposed mining area	Motion Camera	1	713284	7645431
NSMC 5	North Star proposed mining area	Motion Camera	1	713278	7644659
NSMC 6	North Star proposed mining area	Motion Camera	1	712944	7648754
NSMC 7	North Star proposed mining area	Motion Camera	1	713368	7647895
NSMC 8	Infrastructure Corridor	Motion Camera	1	695165	7652746
NSMC 9	Infrastructure Corridor	Motion Camera	1	687490	7648024
NSMC 10	Infrastructure Corridor	Motion Camera	1	685307	7653032
NSMC 11	Infrastructure Corridor	Motion Camera	1	704322.5	7646345
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AAMC2	Proposed Infrastructure Areas	Motion Camera	1	708595	7655841
AAMC3	Proposed Infrastructure Areas	Motion Camera	1	715923	7654756
AAMC4	Proposed Infrastructure Areas	Motion Camera	1	708808	7655799
AAMC5	Proposed Infrastructure Areas	Motion Camera	1	715893	7654739
AAMC6	Proposed Infrastructure Areas	Motion Camera	1	708657	7655824
AAMC7	Proposed Infrastructure Areas	Motion Camera	1	715785	7652347
AAMC8	Proposed Infrastructure Areas	Motion Camera	1	710220	7656988
AAMC9	Proposed Infrastructure Areas	Motion Camera	1	715704	7652164
AAMC10	Proposed Infrastructure Areas	Motion Camera	1	710242	7656936
AAMC11	Proposed Infrastructure Areas	Motion Camera	1	715767	7652269
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AAMC13	Proposed Infrastructure Areas	Motion Camera	1	718439	7656215
AAMC14	Proposed Infrastructure Areas	Motion Camera	1	718515	7656233
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AAMC18	Proposed Infrastructure Areas	Motion Camera	1	715966	7649280
AAMC19	Proposed Infrastructure Areas	Motion Camera	1	716122	7649359
AAMC20	Proposed Infrastructure Areas	Motion Camera	1	715278	7649220
AAMC21	Proposed Infrastructure Areas	Motion Camera	1	715067	7649430
AAMC22	Proposed Infrastructure Areas	Motion Camera	1	716184	7651333
AAMC23	Proposed Infrastructure Areas	Motion Camera	1	715936	7651195

Datum: WGS84
 Zone:50K



- Legend**
- Project Area
 - Proposed Infrastructure Areas
 - Existing tracks
- Targeted Survey Sites**
- Trapping
 - Opportunistic Searches
 - ▲ Motion Camera
 - ▲ Bat Recorder
 - ★ Nocturnal Searches



Absolute Scale - 1:150,000



Location of Fauna Sites Within the Project Area

Figure: 2.2
Project ID: 1373

Drawn: AH
Date: 18/08/11

Coordinate System
Name: GDA1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AH368

690000

700000

710000

720000

Legend

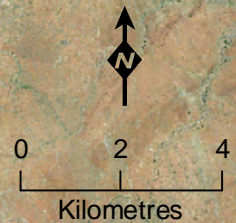
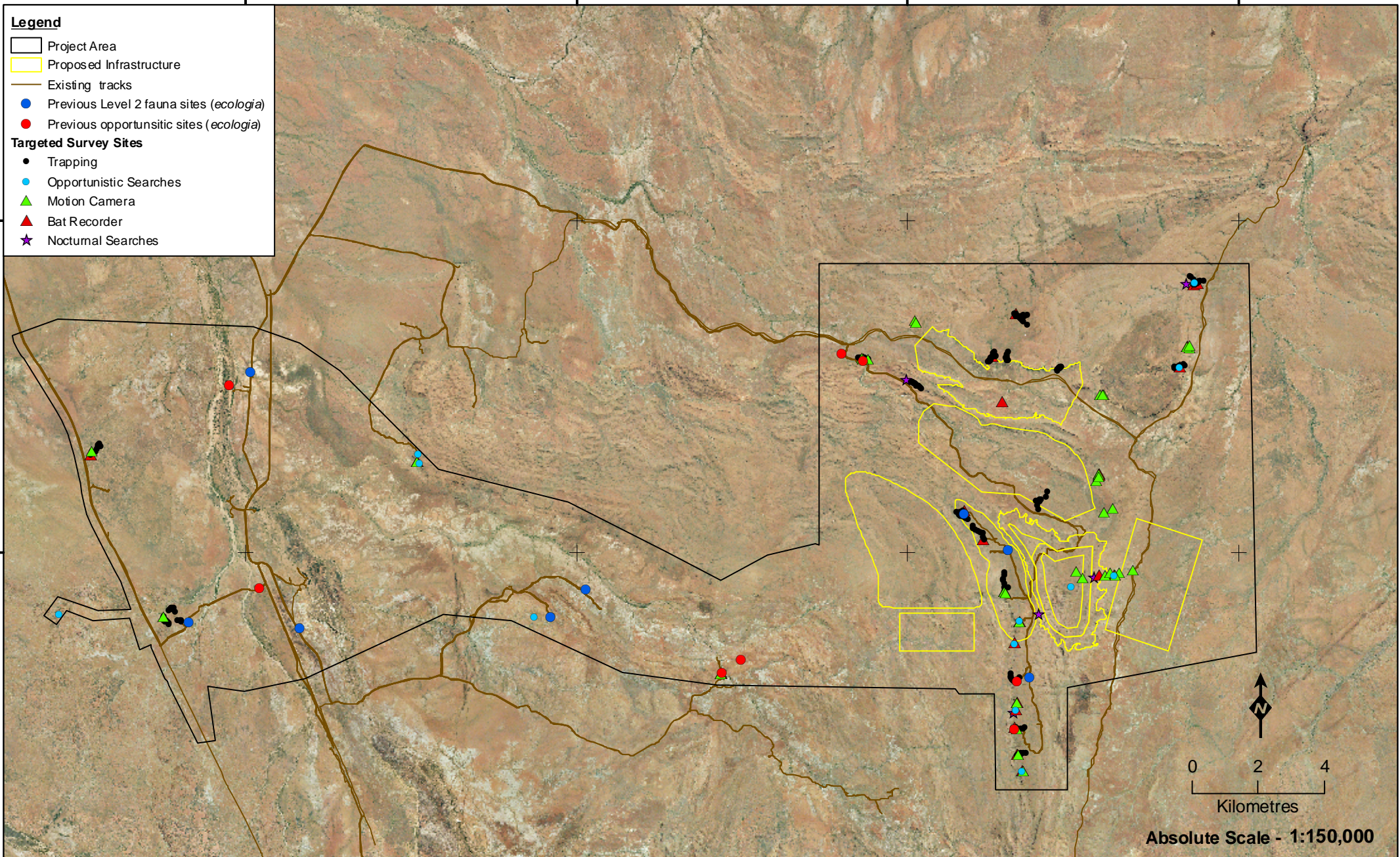
- Project Area
- Proposed Infrastructure
- Existing tracks
- Previous Level 2 fauna sites (*ecologia*)
- Previous opportunistic sites (*ecologia*)

Targeted Survey Sites

- Trapping
- Opportunistic Searches
- ▲ Motion Camera
- ▲ Bat Recorder
- ★ Nocturnal Searches

7660000

7650000



**Level 2 Fauna Sites
and Current Targeted
Survey Sites**

Figure: 2.3
Project ID: 1373

Drawn: AH
Date: 18/08/11

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

Unique Map ID: AH370

2.6 SAMPLING METHODS

The survey methods adopted by *ecologia* were aligned with the EPA’s Guidance tatement No. 56 (EPA 2004), Position Statement No. 3 (EPA 2002), *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010) and survey guidelines for Northern Quolls, Pilbara Leaf-nosed Bats and Pilbara Olive Pythons developed by the Federal Government (DEWHA 2010a, b, c; DSEWPaC 2011b, c).

The survey was undertaken using methods described in sections below.

2.6.1 Northern Quoll

Seventeen survey sites were established with a total of 172 cage and large Elliott traps (Table 2.2) set at 50 -100 m spacing. All traps were baited with universal bait (peanut butter, oats and sardines) and changed every two days and all traps were shaded with Hessian bags (cage traps) and industrial roof insulation (Elliott traps) to minimise the likelihood of trap death due to heat/cold stress.

All traps were checked each morning and captured quolls were marked using ear notches, measured and released. Each quoll was marked with a unique ear notch number using the system shown below in Figure 2.4, which allowed recaptured quolls to be quickly identified and released immediately. The ear notch was retained and sent to the Western Australian Museum (WAM) for future genetic analysis (WA Museum TM381-TM400). Previous surveys used Passive Integrated Transponder (PIT) tags to identify individuals, but due to the annual nature of the surveys and short life span of Northern Quolls (1-2 years) it is estimated that only two captures over the life of the animal will be made. Therefore *ecologia* did not consider this system for future work.

The following parameters were recorded for captured Northern Quolls: weight, sex, head and short pes length, reproductive condition and health condition noted (ascertained from thickness of tail and general appearance: 1 = Poor, 3 = Average, 5 = Good). Health status of males is a good indicator of reproduction timing as their condition declines steadily throughout the breeding season resulting in post reproduction male die-off.

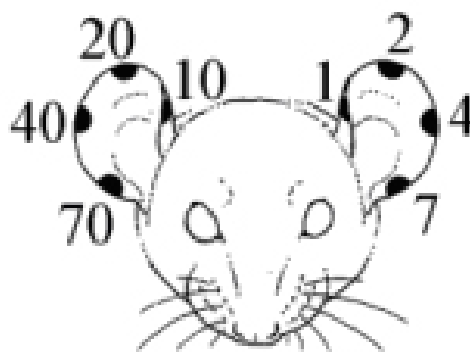


Figure 2.4 – Ear notch identification system

2.6.2 Pilbara Leaf-nosed Bat

Bat echolocation calls were detected using Sm2bat 384 kHz and an Anabat II system. The Anabat Bat Detector is able to transform ultrasonic bat echolocation calls using zero crossing and the resulting calls were saved on an Olympus digital recorder. The Sm2bat has a high sampling frequency, enabling calls to be recorded without being transformed.

During the first phase of the Level 2 survey of the Project area, one Anabat II system and one SM2bat were used to survey bat species at eight trapping and opportunistic sites. During the targeted survey, two Sm2bat recorders were set up at 25 locations within the Project area (Table 2.2, Figure 2.2). Site locations were selected by the presence and condition of suitable roost habitat for Pilbara Leaf-nosed Bats such as deep humid caves.

2.6.3 Pilbara Olive Python

Opportunistic surveys were conducted in suitable habitat such as rock faces of rocky ridges, rocky gorges and rock faces along creek lines. Targeted searches included all water bodies that were encountered. As the suitable habitat for Pilbara Olive Python is similar to that required by both the Northern Quoll and Pilbara Leaf-nosed Bat, opportunistic searches could be carried out concurrently while checking traps in the early morning.

2.6.4 Opportunistic Data

2.6.4.1 Nocturnal Searching

The Project area was searched at night using a combination of road transects and opportunistic ground searches using head torches and hand held spotlights. As all targeted species can be considered nocturnal, this method is typically useful; however cooler conditions (reduced activity of some species), logistical issues and safety requirements limited the amount of nocturnal work that could be completed.

A total of 29 hours of nocturnal searches was conducted at five locations within the Project area (Figure 2.2).

2.6.4.2 Diurnal Searching

Both trap and opportunistic survey sites were searched by hand for primary or secondary evidence of the Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat. Sites were selected in habitat likely to support conservation significant fauna.

Fauna were also recorded while searching, travelling and establishing traps within the Project area during the day and night. Tracks, diggings and scats were recorded where possible.

A total of 74.5 hours of targeted diurnal searches was conducted during the survey to identify the presence and abundance of fauna of conservation significance (Table 2.2, Figure 2.2).

2.6.4.3 Camera Trapping

Motion sensing cameras were used to detect fauna species in areas with a high likelihood of animal activity such as water sources. The Bushnell Trophy Cam was used. The camera is triggered by

movement by a highly sensitive passive infra-red motion sensor and functions day and night taking either video footage or photos (Bushnell Outdoor Products 2009).

Motion sensing cameras were set up at 34 locations which were selected on the basis of possible shelter/den sites such as caves or crevices in boulders. Sardines were used as bait to attract Northern Quolls. A total of 52 nights of recording was analysed (Figure 2.2, Table 2.2).

2.7 SURVEY EFFORT

Survey effort expended within the Project area included the following:

- 172 traps were open for 1137 trapnights;
- approximately 29 hours of diurnal searches and 74.5 hours of nocturnal searches were spent surveying for Northern Quoll;
- approximately 29 hours of diurnal searches and 74.5 hours of nocturnal searches were spent targeting Pilbara Olive-Pythons;
- approximately 45 hours were spent surveying for roost caves for Pilbara Leaf-nosed Bat;
- Camera trapping using motion-sensing cameras were deployed for 1248 hours; and
- 278.5 hours of recordings were analysed to determine presence of Pilbara Leaf-nosed Bat and Ghost Bat.

2.8 ANIMAL ETHICS

Surveying was conducted as per *ecologia's* Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (NHMRC 2004) and as per EPBC Act guidelines for Northern Quolls (DSEWPaC 2011a)

2.9 SURVEY TEAM

Field survey team members and external consultants are listed in Table 2.3. The survey was conducted under DEC Regulation 17 Licence SF007862.

Table 2.3 – Field Survey Personnel

Survey Member	Qualification	Experience
Damien Cancilla	B.Sc. (Hons)	7 years
Astrid Heidrich	M.Sc.	6 years
Jordan Vos	-	6 years
Bret Stewart	B.Sc. (Hons)	6 years
Bruce Greatwich	B.Sc.	3 years
Leigh Smith		2 years
Jesse Forbes-Harper	BA, B.Sc. (Hons)	1 years
Bob Bullen (external Consultant)	Bat calls	12 years

3 RESULTS

3.1 LITERATURE REVIEW AND DATABASE SEARCH

3.1.1 Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll is the smallest of the four Australian Quoll species and is primarily insectivorous, with some vertebrate prey and fruit also consumed (Braithwaite and Begg 1995). Northern Quolls are both arboreal and terrestrial (Braithwaite and Begg 1995) and are primarily nocturnal (Oakwood 2008). Northern Quolls are generally considered to be solitary, with females having mutually exclusive denning areas, although foraging areas can be overlapping, with territoriality likely to be related to the abundance, dispersion and availability of food (Oakwood 2002).

Male and female home ranges are of similar size outside of the breeding season, however during the breeding season male home ranges expand significantly and can overlap extensively with several female ranges and numerous other male territories (Oakwood 2008). Female home ranges are up to 35 ha, preferring rocky habitat. Males can occupy territories of over 100 ha which overlap with territories of females and occasionally other males (Oakwood 2008). Individual males have been recorded travelling up to 3.5 km over seven days. In the more northerly areas of their distribution mating occurs from late May to June with young born in September and October (King 1989), while in the Pilbara breeding is thought to occur between August and September. However, females have been recorded with pouch young as late as February (How *et al.* 1991). During the breeding season, males adopt a roving strategy, regularly visiting several widely spaced females in rapid succession, presumably to monitor the onset of oestrus. The energetic cost of this behaviour is a likely cause of the annual male die-off which is a sudden, sharp decline in the Northern Quoll population after the breeding season (Oakwood 2008).

Northern Quoll formerly occurred across northern Australia from the Pilbara region in Western Australia to south-eastern Queensland. A 75% reduction in habitat range occurred during the 20th century, so that the species is now restricted to the Pilbara and north Kimberley in Western Australia and a few discreet populations across the Northern Territory and eastern Queensland (Braithwaite and Griffiths 1994). This reduction in the population size along with the male die-off that occurs after breeding, resulting in a slow population recovery ability, resulted in the listing of the Northern Quoll as Endangered in 2005 under the EPBC Act (DSEWPac 2011a).

Reduction of the population size of Northern Quoll is thought to be a result of a combination of several factors. The most common cause of adult mortality is predation, typically by dingoes, feral cats, snakes, owls and kites (Maxwell *et al.* 1996; Oakwood 2008). The level of predation upon Northern Quolls is increased through the removal of groundcover by fire. Other causes of mortality include domestic dogs, motor vehicles and pesticide poisoning. There is also evidence to implicate poisoning following predation upon cane toads as a factor in more recent population declines (Woinarski *et al.* 2008). For this reason the Pilbara region of Western Australia is considered an important refuge area as cane toads are currently not thought to pose a threat to this region due to the arid conditions.

The majority (87%; 111 of 127 records) of Northern Quoll records in the Pilbara have been recorded from the Chichester IBRA subregion (NatureMap, *ecologia* internal database, Global Biodiversity Information Facility; GBIF) (Figure 3.1). The remaining individuals were caught in the west of the Hamersley region (6.3%), the Roebourne region (3.9%) and in the north-west of the Fortescue region (2.7%). The Project area lies near the centre of the species' distribution in the Pilbara. NatureMap

lists 20 records within 50 km of the North Star Project area. Another 30 records were made by the WA Museum within 50 km of the North Star Project area.

During previous surveys conducted by ecologia Environment, 21 individuals and 39 scats or tracks have been recorded within 50 km of the Project area (Figure 3.4). All records were from the northern or north-western part of the Project area with the exception of one individual which was captured in 2010 approximately 34 km south-east of the Project area. In addition, the WA Museum lists further 62 records of the Northern Quoll from within 50 km of the Project area with records from the vicinity of Marble Bar, Woodstock, approximately 10 km north east, 20 km east, 40 km south and 40 km north of the Project area (WA Museum, NatureMap, Figure 3.4).

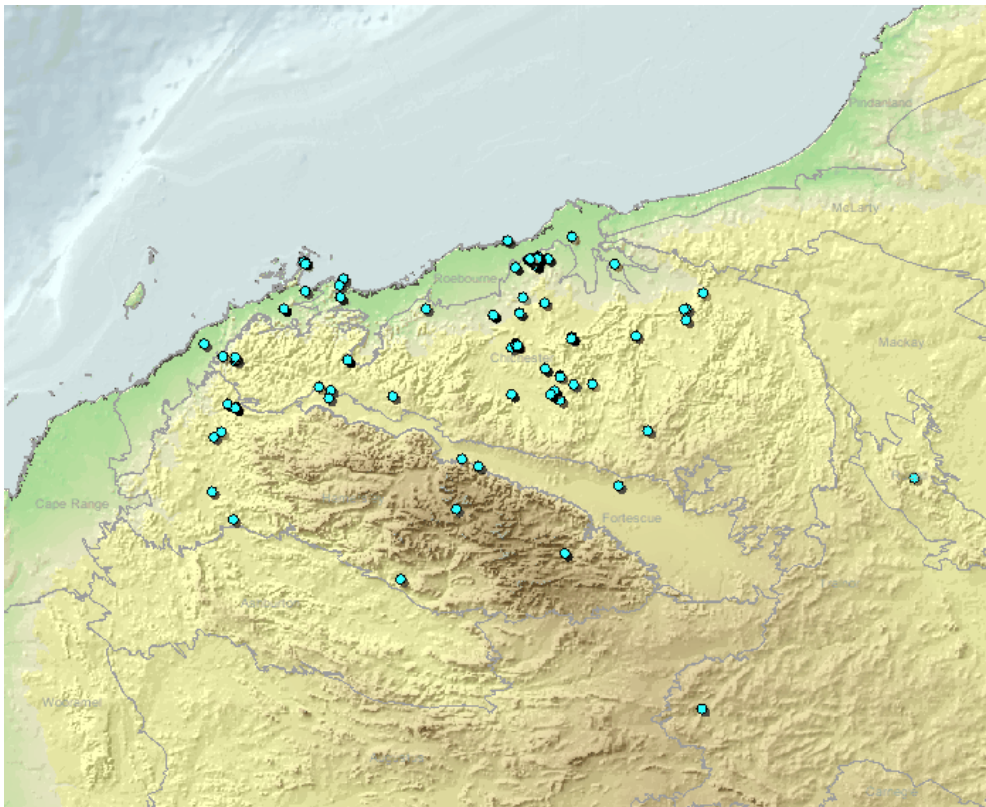


Figure 3.1 – Northern Quoll records in the Pilbara region (NatureMap 2011)

3.1.2 Pilbara Leaf-nosed Bat (*Rhinonictoris aurantia*)

The Pilbara form of the Orange Leaf-nosed Bat (*Rhinonictoris aurantia*) is a small brightly orange coloured bat that occurs across northern Australia. During the tropical dry season this species roosts in warm and very humid caves (32°C and 95% humidity) as they are exceptionally vulnerable to cooling and desiccation. They feed mostly on moths and beetles (but will take most flying insects) and hunt by flying in a zigzag pattern usually within a metre of the ground (Churchill *et al.* 2008), resulting in them frequently being seen and killed by motorists driving at night.

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

At dusk Pilbara Leaf-nosed Bats emerge from their roosting sites to forage in gorges, small gullies and large watercourses for insects such as moths, beetles and flying termites. They fly and hunt in the same manner as the Orange Leaf-nosed Bat, rapidly with a fast wing beat following zigzag flight pattern low to the ground (Armstrong 2008; Churchill 2008). Reproductive information is limited, however *ecologia* assumes the reproduction of the Pilbara Leaf-nosed Bat takes place at the same time as the Orange Leaf-nosed Bat, with mating occurring in July and females giving birth to a single young in December or January.

Recent evidence suggests two main stronghold areas for the Pilbara Leaf-nosed Bat; in the western Pilbara and north of Marble Bar (Armstrong 2008). In the western Pilbara, these bats roost in caves formed in gorges that dissect siliceous sedimentary geology. They are most often observed in flight over waterholes in gorges, although they are rare even in the Hamersley Ranges where this habitat is common (Armstrong 2008). The Pilbara Leaf-nosed Bat roosts in disused mines with very hot and humid roost sites (28-32°C and 96-100%) and areas of high relief with gorges, watercourses and permanent surface water (Armstrong 2001; Churchill 2008; McKenzie and Bullen 2009). They are unlikely to occur in the shallow 'breakaway' caves that occur along mesas and strike ridges. During the wet season (November to February) the species abandons its dry season roost caves and becomes a forest or creekline dweller (Churchill 2008).

They are susceptible to disturbance and will abandon roost caves if disturbed. Colonies in mines in the eastern Pilbara are subject to several pressures, including human visitation, and the collapse and flooding of disused mines (Armstrong 2008; DEWHA 2008b). The Pilbara leaf-nosed Bat is susceptible to dehydration and hypothermia and removal from the high humidity and hot temperature of their roost caves will result in death within hours. Large colonies of this species are known to be heavily predated upon by Ghost Bats (*Macroderma gigas*) and therefore the Pilbara Leaf-nosed Bats exit the caves at high speed and rapidly enter thicker vegetation, presumably to avoid the ghost bats (Churchill 2008).

Regional records of the Pilbara Leaf-nosed Bat are limited and only seven locations in the vicinity of major rivers (Shaw River and Turner River) within 35 km of the Project area were identified (Figure 3.2 and Figure 3.5). All records are recent records from 2006 and 2010 (NatureMap).

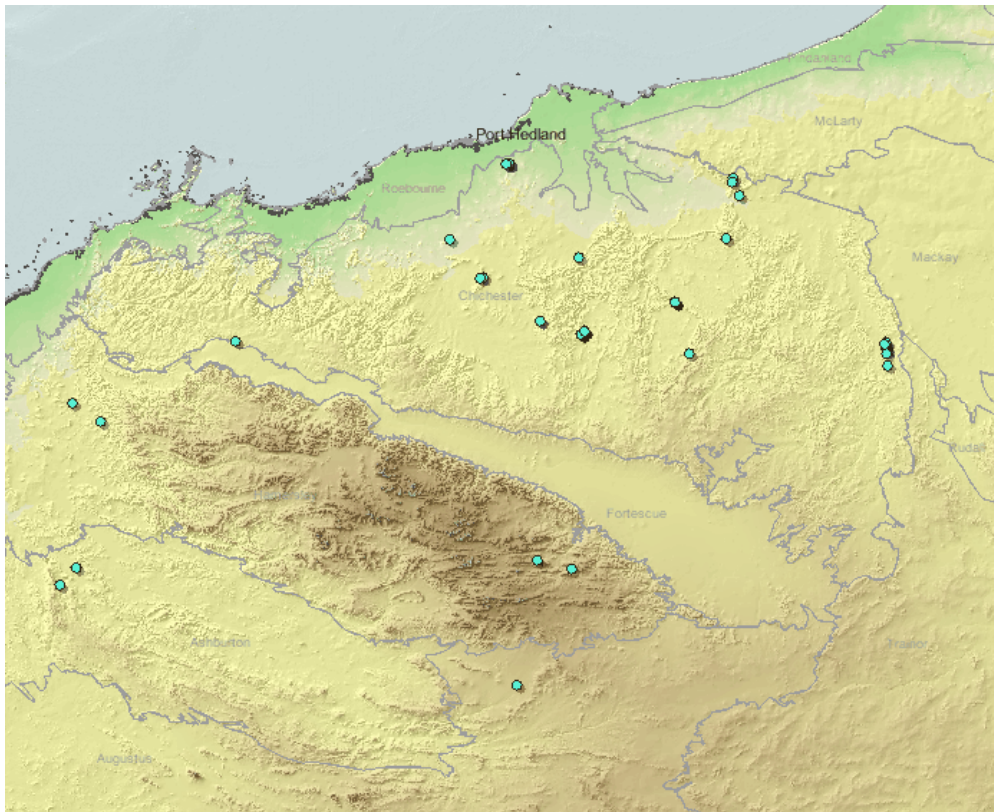


Figure 3.2 – Pilbara Leaf-nosed Bat records in the Pilbara region (NatureMap 2011)

3.1.3 Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara subspecies of the Olive Python only occurs in the ranges of the Pilbara region of Western Australia. It inhabits watercourses and areas of permanent water in rocky gorges and gullies (Pearson 2006). This subspecies is an adept swimmer, often hunting in water, and individuals have been seen feeding in the entrance of bat roost caves, both strategies allowing them to feed on a variety of vertebrates, including rock wallabies, bats, ducks and pigeons. Individuals spend the cooler winter months sheltering in caves and rock crevices. In the warmer months the pythons can move widely but usually in close proximity to water and rock outcrops (DEWHA 2008a). Mating takes place in winter (June-August). Males can travel up to three kilometres in search of females. They usually stay together for up to three weeks in which mating occurs repeatedly before the male returns to his home range (Pearson 2006).

Population size estimates are difficult due to the species cryptic nature and lack of a reliable trapping or census methodology (DEWHA 2008a). The main threats to this subspecies come from predation from feral cats and foxes, particularly of juveniles, competition with foxes for food, and destruction of habitat (Pearson 2006). Pilbara Olive Pythons are often killed on WA roads by accident or deliberately. They are slow moving and their instinctive response to approaching cars is to freeze (Pearson 2006)

Pilbara Olive Python records in the Pilbara have been typically recorded from the McKay, Rocklea and Newman Land Systems, which are described as hills and ranges (*ecologia* internal database, Global Biodiversity Information Facility; GBIF, NatureMap). The Project area lies in the north of the species' distribution. All regional records of the Pilbara Olive Python are mapped in Figure 3.3 and Figure 3.6. During a previous survey in 2010 *ecologia* Environment recorded one individual crossing the road in the vicinity of Marble Bar (approximately 62 km east of the Project area)(Figure 3.3 and Figure 3.6). Further four records of this species exists, comprising one specimen recorded from Marble Bar (approx. 65 km east of Project area), two at Woodstock (approx. 43 km south of the Project area) and one approximately 18 km north of the Project area (NatureMap). The two records from Woodstock were collected in 1965 and 1988 and represent historical records.

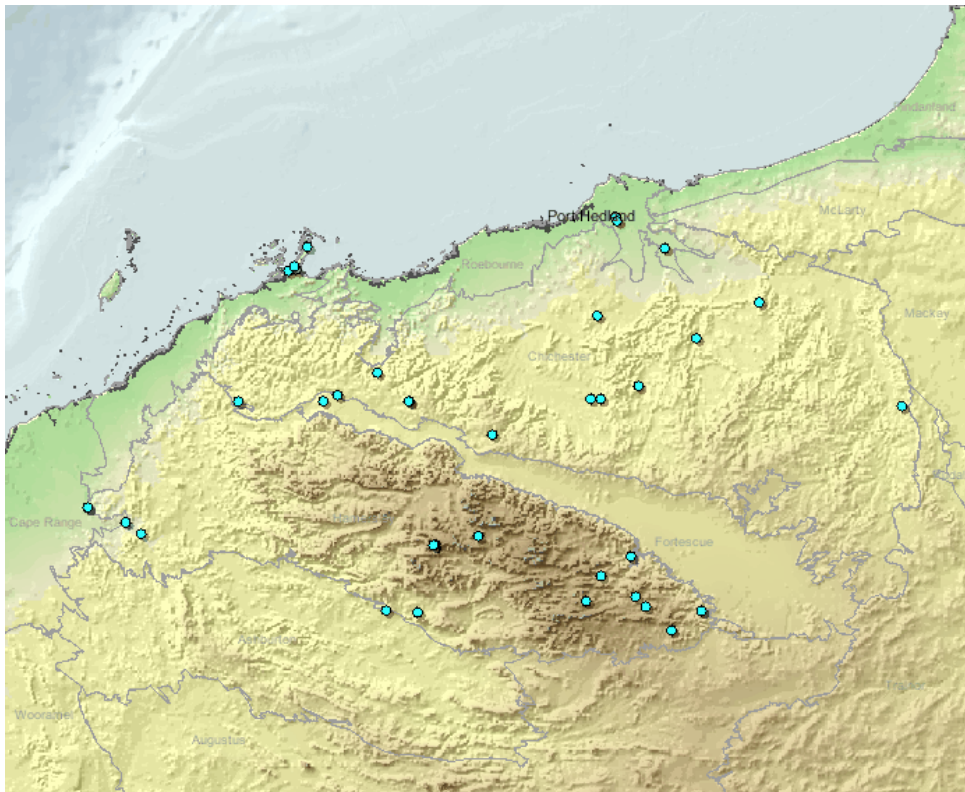
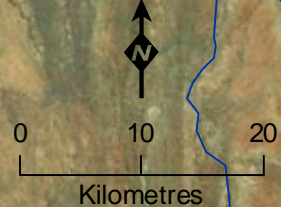


Figure 3.3 – Pilbara Olive Python records in the Pilbara region (NatureMap 2011)



- Legend**
- Project Area
 - ▲ Northern Quoll (WA Museum & NatureMap)
 - ★ Northern Quoll (*ecologia* previous surveys)
 - FMG Rail
 - Existing Rail
 - River



Absolute Scale - 1:620,000



Regional Records of the Northern Quoll

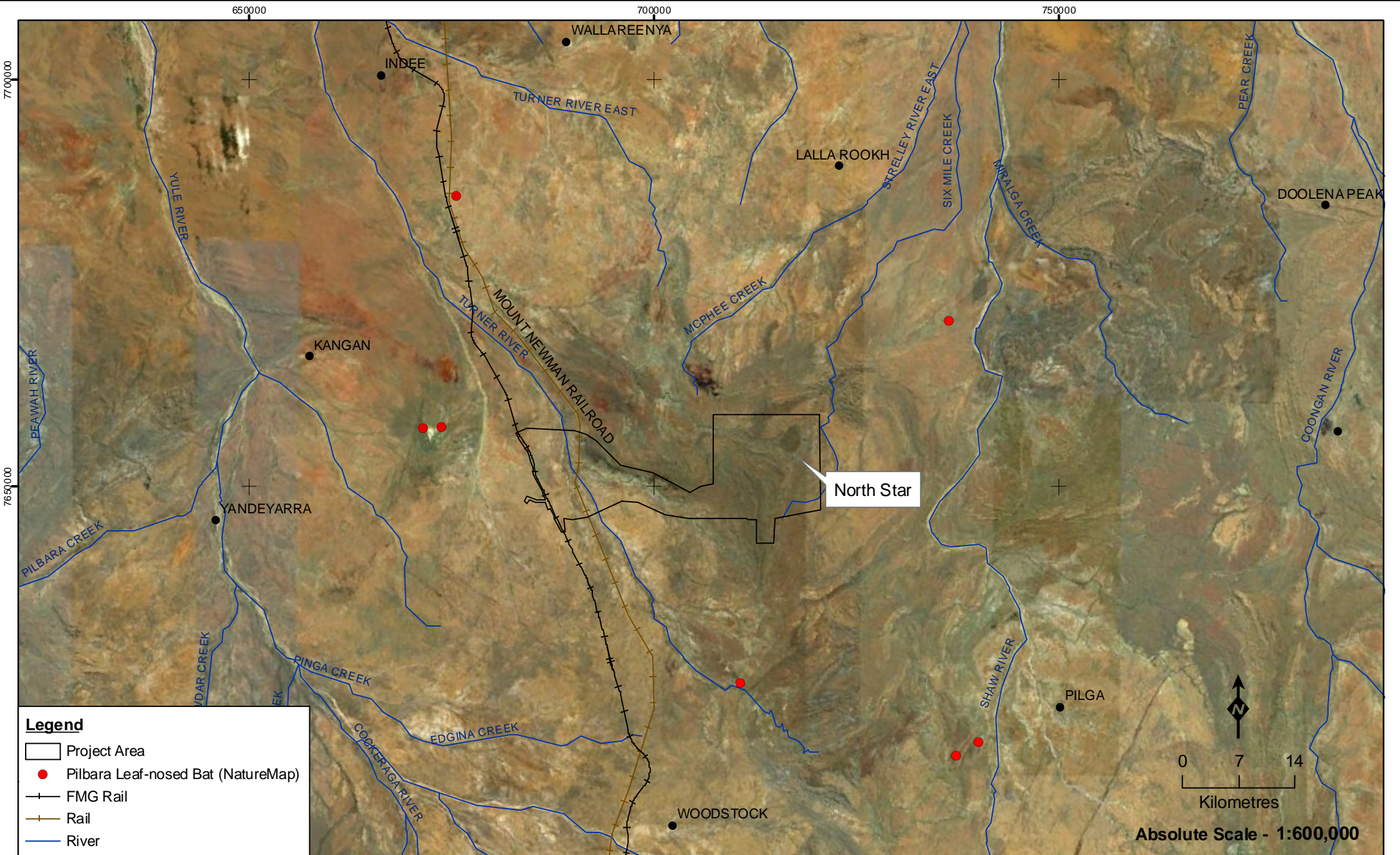
Figure: 3.4
Project ID: 1373

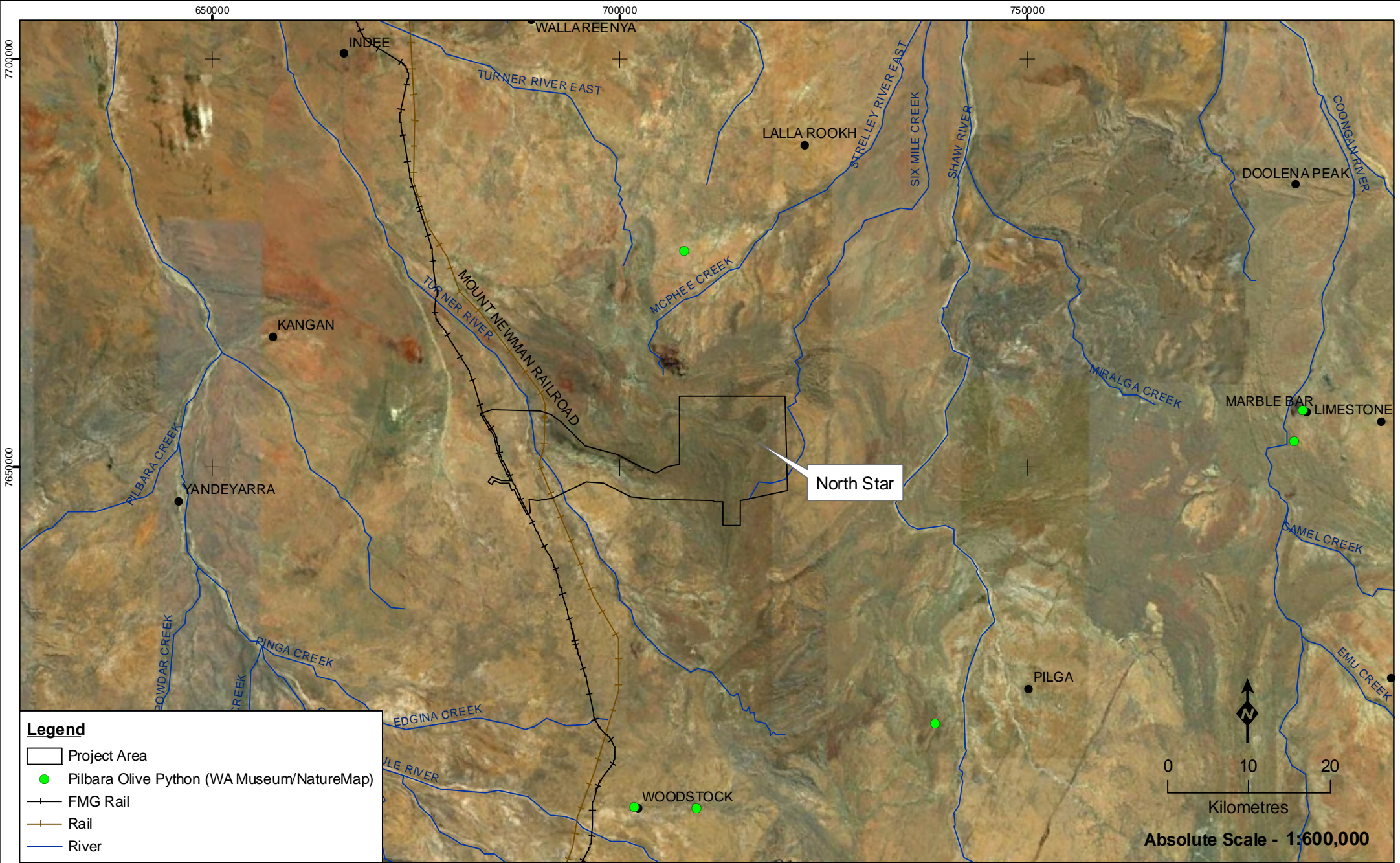
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Drawn: AH
Date: 08/11/11

Unique Map ID: AH380

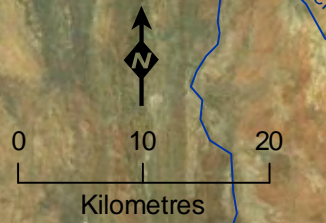
A4





Legend

- Project Area
- Pilbara Olive Python (WA Museum/NatureMap)
- FMG Rail
- Rail
- River



Absolute Scale - 1:600,000



Regional Records of the Pilbara Olive Python

Figure: 3.6
Project ID: 1373

Coordinate System
Name: GDA1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Drawn: AH
Date: 08/11/11

Unique Map ID: AH381

A4

3.2 SURVEY RESULTS

3.2.1 Northern Quoll

3.2.1.1 Habitat

Habitat for the Northern Quoll was classified in five categories:

- Suitable denning habitat
- Potential denning/foraging habitat
- Riverine foraging/dispersal habitat
- Desktop assessed/inaccessible

Suitable denning habitat for the Northern Quoll is widespread within the North Star mining area. It comprises an ironstone ridge approximately 8.7 km in length running north-south along the western border of the tenement, and several rocky gorges running east-west providing water pools and patches of thick vegetation. The Infrastructure areas contain patches of suitable denning habitat in the form of rocky gorges with or without pools. This habitat type was not found in the infrastructure corridor (excepting the area of corridor adjacent to the mining area). Instead, it comprised some areas of extensive granite boulder piles which were classified as potential denning/foraging habitat (Figure 3.9).

A total of 900.7 ha was assessed and mapped as potential or suitable habitat for the Northern Quoll (Table 3.4, Figure 3.7 - Figure 3.9). Approximately 294.4 ha of this area were classified as suitable denning habitat. Additional 108.4 ha of rocky areas were identified as potential denning and foraging habitat. The Turner River in the east of the rail corridor is likely to be utilized as seasonal foraging and/or dispersal habitat. It comprises a total of 403.0 ha. The remaining 94.9 ha were inaccessible due to a lack of access tracks and therefore the suitability for denning or foraging could not be assessed through ground truthing.

Table 3.4 – Areas of suitable and potential Northern Quoll habitat within the Project area

Classification	Area (ha)
Suitable denning habitat	294.4
Potential denning/foraging habitat	108.4
Potential foraging/dispersal habitat (riverine)	403.0
Desktop assessed / inaccessible	94.9
Total	900.7

The proposed infrastructure corridor contains areas of suitable habitat in form of granite boulder piles (which have a potential to provide shelter and foraging habitat) and the Turner River provides suitable foraging and dispersal habitat in the form of well vegetation riverine habitats. However, there were access restrictions due to Aboriginal heritage sites covering most of the Turner River, suitable habitat within the heritage sites were not assessed during the survey (Shaun Grein, 01/07/2011, written communication).

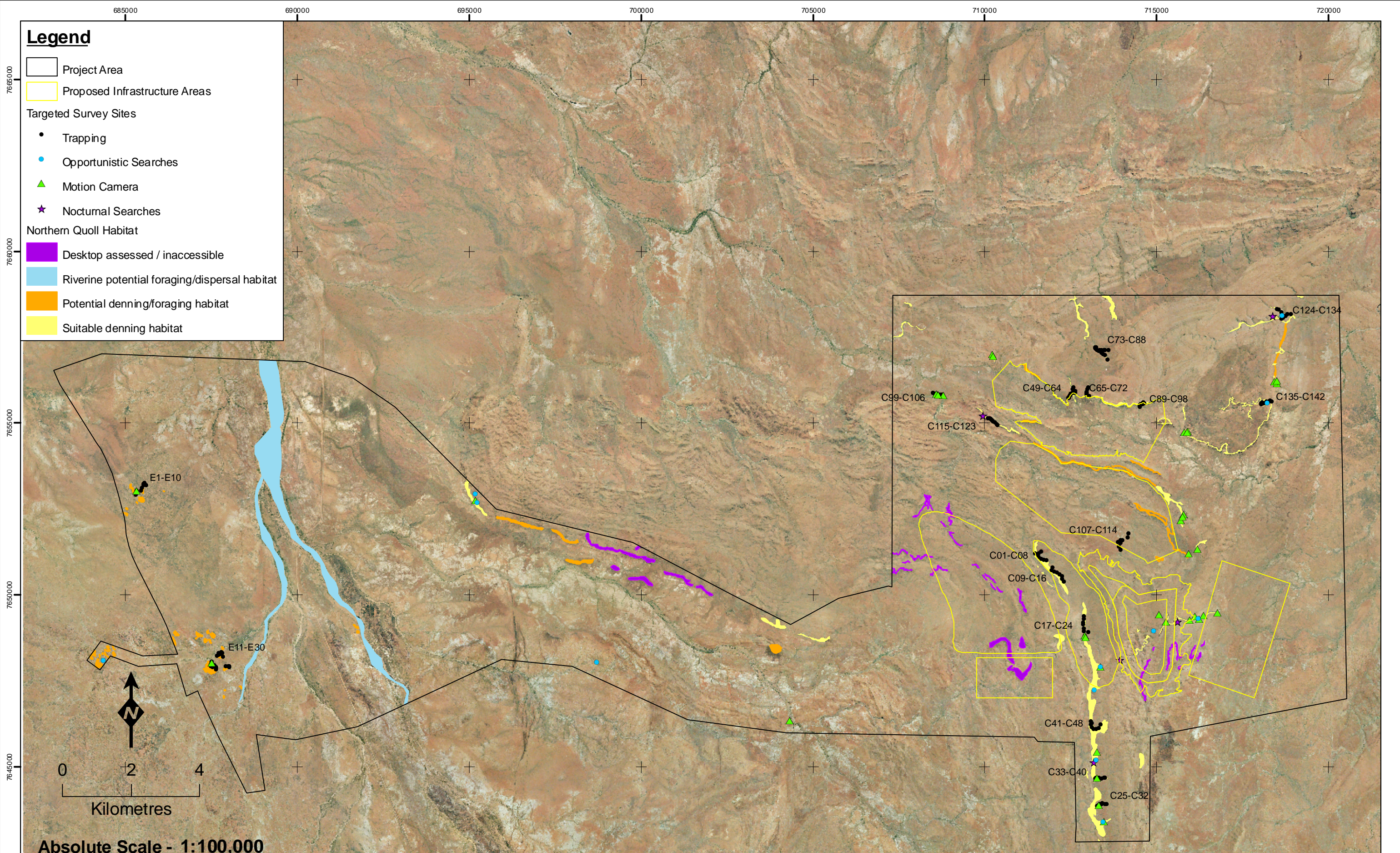


Figure 3.7 – Rocky gorge with suitable cliff habitat for the Northern Quoll



Figure 3.8 – Suitable habitat for the Northern Quoll

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Absolute Scale - 1:100,000



Northern Quoll Habitat within the Project Area

Figure: 3.9
Project ID: 1373

Drawn: AH
Date: 08/11/11

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

Unique Map ID: AH388

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3.2.1.2 Trapping Data

Four records of Northern Quolls were made during the initial phase of the Level 2 vertebrate fauna survey conducted for the Project area. Two trapping records were made at trap site NS5, one individual was recorded using a motion cameras and another one was observed during nocturnal surveys by *ecologia*.



Figure 3.10 – Northern Quoll recorded during initial phase of Level 2 survey

During the current targeted survey a total of 20 individual Northern Quolls were captured within the North Star proposed mining area and proposed infrastructure areas. No Northern Quolls or secondary evidence such as scats and tracks were recorded from the proposed infrastructure corridor (Figure 3.15). All captured individuals were measured and weighed, had their health condition assessed and tissue samples collected. Details of all captured individuals are described in Appendix B. All quolls appeared to be in good condition with good to moderate fat stores although one individual from the Project area was showing some signs of condition deterioration in the form of torn ears and fur loss. The pouches of females were undeveloped indicating that mating activity had not taken place (Figure 3.12). The sex ratio of 4:1 was significant, with a larger number of male quolls than female quolls recorded. This result may be based on the occasionally larger number of males born (Oakwood 2000) or the males' tendency to roam further in search of females prior to and during the mating season. The latter is supported by records of two males travelling distances of 0.8 km and 2.6 km over a single night (Appendix B, North Star Male#1, Additional Area Male#5).



Figure 3.11 – Captured Northern Quoll (North Star Male#1)



Figure 3.12 – Undeveloped Pouch of a Captured Female

Nine out of ten Northern Quolls captured within the North Star Project area were recaptured during the survey, therefore some traps were subsequently closed for seven trapping nights in accordance with the EPBC Act guidelines for Northern Quolls to prevent stress and significantly reduced foraging time. The number of recaptures within North Star proposed mining area is higher than the number of recaptured individuals in the Infrastructure Area where only four out of ten individuals were encountered more than once.

In addition to trapped individuals, Northern Quolls were recorded on motion camera at three locations (Figure 3.13). At all three locations the motion cameras were set up in areas that were not suitable for trapping due to access not sufficient for trapping and therefore no cage trapping was conducted at these sites. Two Northern Quoll skulls and two scat piles were found at additional three locations within the Infrastructure areas.

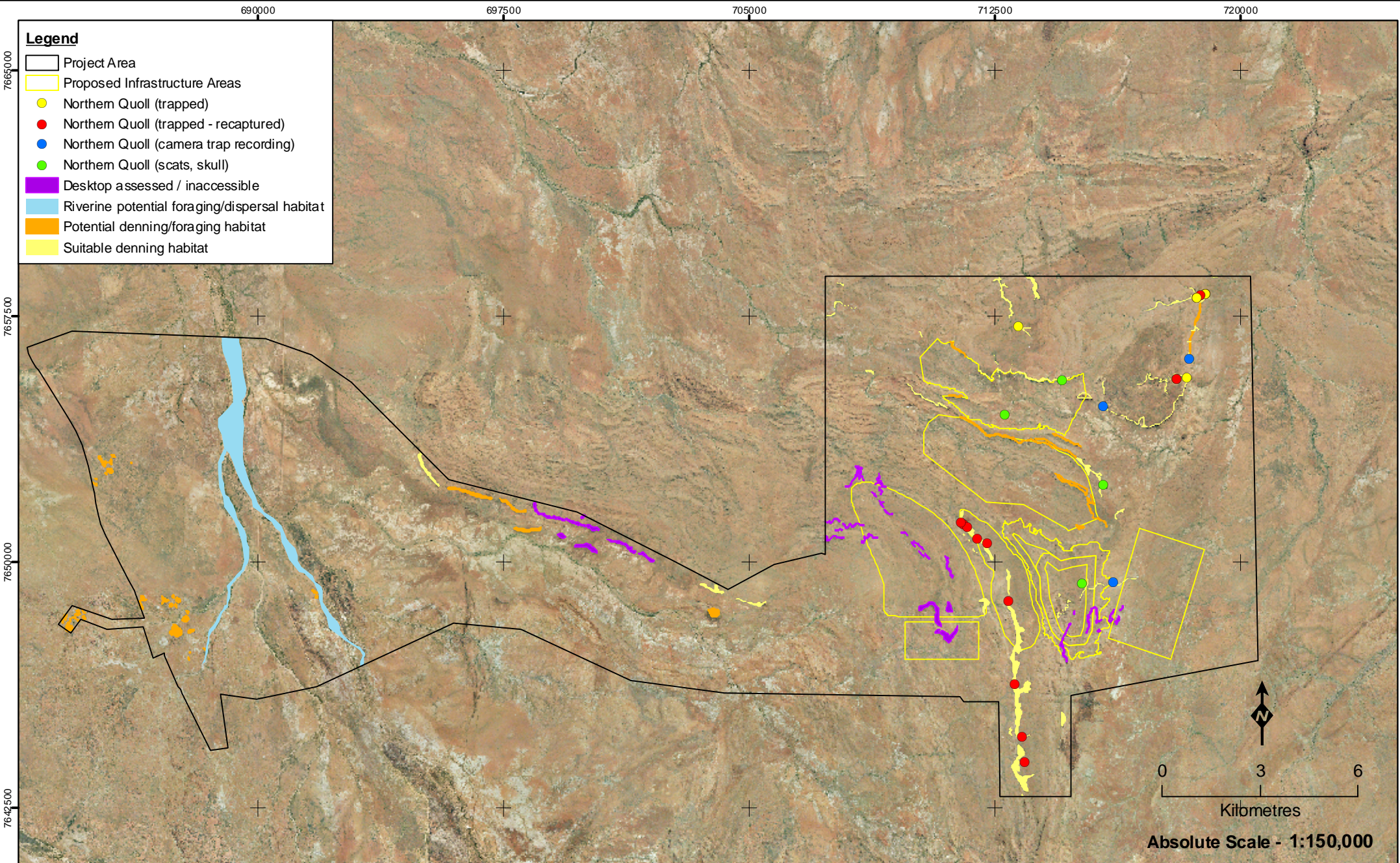


Figure 3.13 – Northern Quoll Recorded on Motion Sensoring Camera

A Northern Quoll skull was found underneath the buildings at Glacier Valley camp where Northern Quolls had been seen previously (Shadi Sayadi, FMG personnel, pers. comm.), Figure 3.14). The camp is located on a rocky spinifex plain which is surrounded by rocky ranges and breakaways with patches of suitable denning habitat. Northern Quolls are known to travel long distances through moderately suitable or foraging habitat while searching for food resources and/or mating partners.



Figure 3.14 – Northern Quoll Skull Recorded



3.2.2 Pilbara Leaf-nosed Bat

3.2.2.1 Habitat

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

- Potential roost cave habitat (Dry Season)
- Potential roost habitat (Wet Season)

A total of 712.94 ha potential roost habitat for the Pilbara Leaf-nosed Bat was identified along the north-south orientated ridge and east-west running gorges area, along major creek lines with fringing eucalypt trees and along cliff faces in the south and north within the North Star project (Figure 3.19). Of these, potential wet season roost habitat was recorded from the Turner River and major creek lines in the centre of the rail corridor. This habitat comprised a total of 418.58 ha. The remaining 294.35 ha comprised potential dry season roost caves in the North Star Project area and infrastructure corridor. This habitat type could provide roost caves if conditions such as vegetation, depth of caves and climate within the cave is suitable for Pilbara leaf-nosed Bats.

Table 3.5 – Area of potential Pilbara Leaf-nosed Bat habitat within the Project area.

Classification	Area (ha)
Potential roost cave habitat (Dry Season)	294.35
Potential roost habitat (Wet Season)	418.58
Total	712.94

3.2.2.2 Trapping Data

Pilbara Leaf-nosed Bats were recorded from 14 locations within the Project area (Figure 3.20). Of these, four records were likely to be recordings of bats foraging in the vicinity of their roost cave. The remaining ten records of Pilbara Leaf-nosed Bat were likely to be bats foraging along ridges and in the vicinity of creek lines (Table 3.6). Calls recorded in a regular pattern or in scattered sections during night time indicated that transient Pilbara Leaf-nosed Bats were recorded foraging (Appendix C1, Appendix C2) whereas individuals recorded in two sections of activity immediately after sunset and before sunrise were expected to be bats leaving and returning to their potential roost cave (Appendix C4, Appendix C5). Call pattern of six of the recordings are shown in Appendix C.

The most number of calls were recorded from two caves (Roost cave 1, 2) within small gullies with semipermanent water pools in the centre of the North Star proposed mining area (Table 3.6, Figure 3.16). Potential roost cave 3 was located in an open gully with moderately dense vegetation of shrubs and spinifex. No water was recorded from this open gully which did not indicate that caves in this gully have the ability to provide necessary humidity. The SM2Bat recorder was set up at the top of the gully from where one large cave (Figure 3.17) and two smaller caves were visible. Safety concerns and difficult accessibility did not allow the entry and assessment of the depth of the three caves and therefore the condition and suitability could not be confirmed during this survey. The most western potential roost cave (Roost cave 4) is located along a large creek bed with fringing eucalypt trees approximately 10 m above a semipermanent waterhole (Figure 3.18). The creekline also comprises suitable wet season roost habitat in form of surface water and large eucalypt trees which can provide a high humidity.



Figure 3.16 – Potential roost cave 1 (Top) and roost cave 2 (Bottom) for the Pilbara Leaf-nosed Bat (66 calls and 59 calls recorded)








Figure 3.17 – Potential roost cave 3 (10 calls recorded)





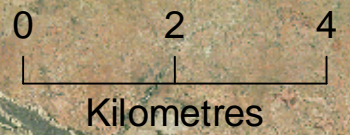
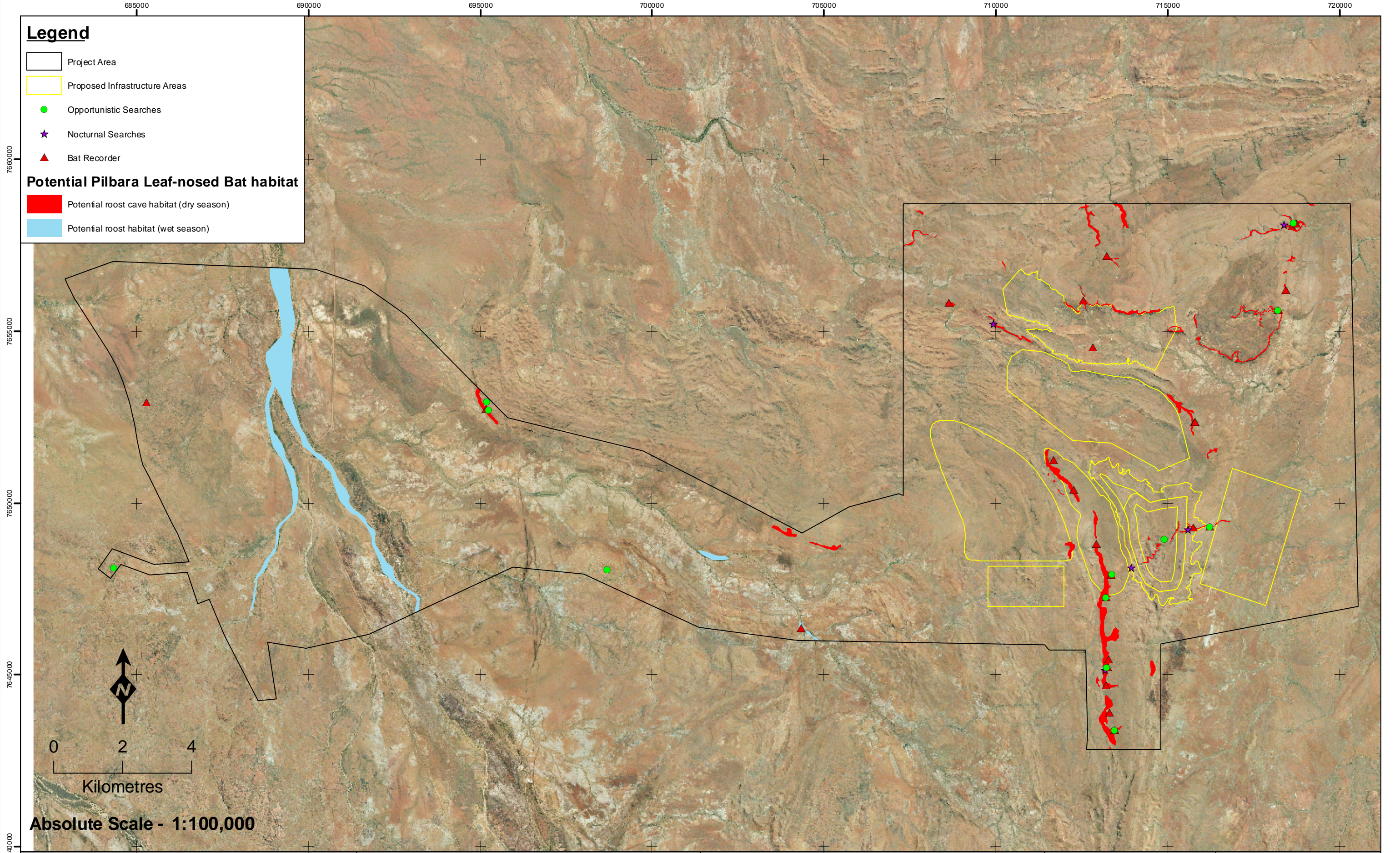
Figure 3.18 – Potential roost cave 4 (40 calls recorded)

Legend

-  Project Area
-  Proposed Infrastructure Areas
-  Opportunistic Searches
-  Nocturnal Searches
-  Bat Recorder

Potential Pilbara Leaf-nosed Bat habitat

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



Absolute Scale - 1:100,000



Potential Pilbara Leaf-nosed Bat Habitat within the Project Area

Figure: 3.19
Project ID: 1373

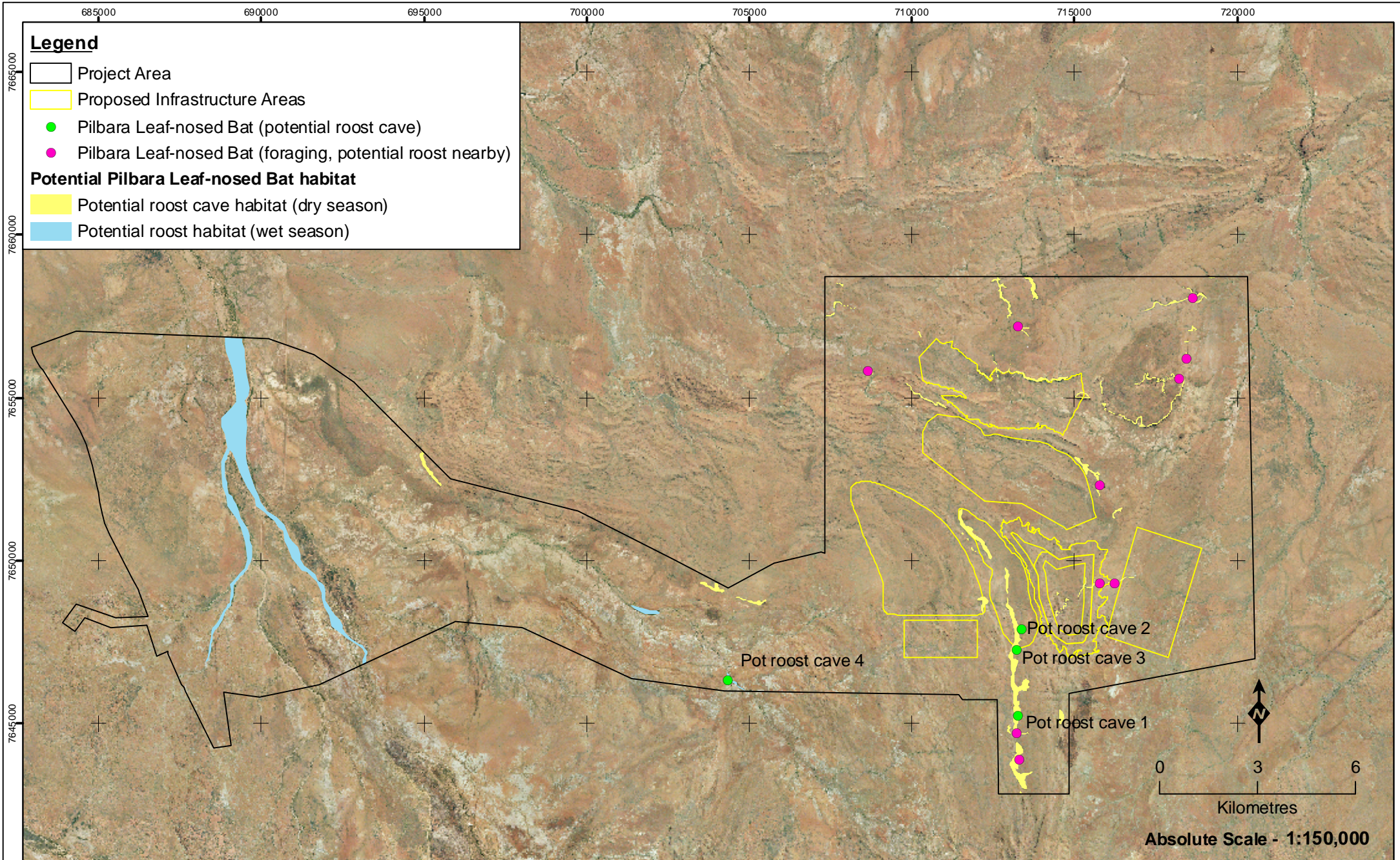
Coordinate System
 Name: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Drawn: AH
Date: 08/11/11

Unique Map ID: AH389

A3

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3.2.3 Pilbara Olive Python

3.2.3.1 Habitat

Habitat for the Pilbara Olive Python was classified in three categories:

- Critical Habitat (critical to the survival of the species)
- Potential Habitat (species might use this habitat as travel ground)
- Desktop assessed/Inaccessible for ground truthing

Suitable habitat for the Pilbara Olive Python within the Project area is of moderate to excellent condition. This species can travel long distance between suitable habitat and available food sources and therefore the species can be recorded from areas of 'Potential Habitat'. However, 'Critical Habitat' for this species consists of semipermanent water pools within rocky gorges and large permanent pools with thick vegetation along gorges which was observed in the North Star Project area. Some suitable habitat was found in the proposed infrastructure corridor in form of pools along the Turner River. Due to existing heritage sites along this river and the low impact of the proposed infrastructure corridor, the Turner River was not surveyed in detail during the current survey.

In total, 1045.28 ha of habitat was recorded within the Project area and mapped in Figure 3.22. Of this, 432.0 ha were classified as 'critical habitat' of good to excellent habitat and targeted during searches. This habitat comprised creek lines with pools and rock faces and permanent water pools with or without vegetation along rocky gorges running east-west off the ridges within the North Star Mining area and in the north and south of the Additional Area (Figure 3.20). Further 520.7 ha were classified as potential habitat. This comprised cliffs, dry rock faces and creek lines without rock faces. The remaining 92.5 ha were inaccessible and these areas were assessed by aerial photography, vegetation description and landsystems. An assessment of this habitat through ground truthing to classify if the areas are critical to the species or potential travel ground was not possible.

Table 3.7 – Area of potential Pilbara Leaf-nosed Bat habitat within the Project area

Classification	Area (ha)
Critical Habitat	432.0
Potential Habitat	420.7
Desktop Assessed / Inaccessible	92.5
Total	1045.28





Figure 3.21 – Suitable Habitat for Pilbara Olive Python Present within the Project area

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685000 690000 695000 700000 705000 710000 715000 720000

7665000
7660000
7655000
7650000
7645000




Legend

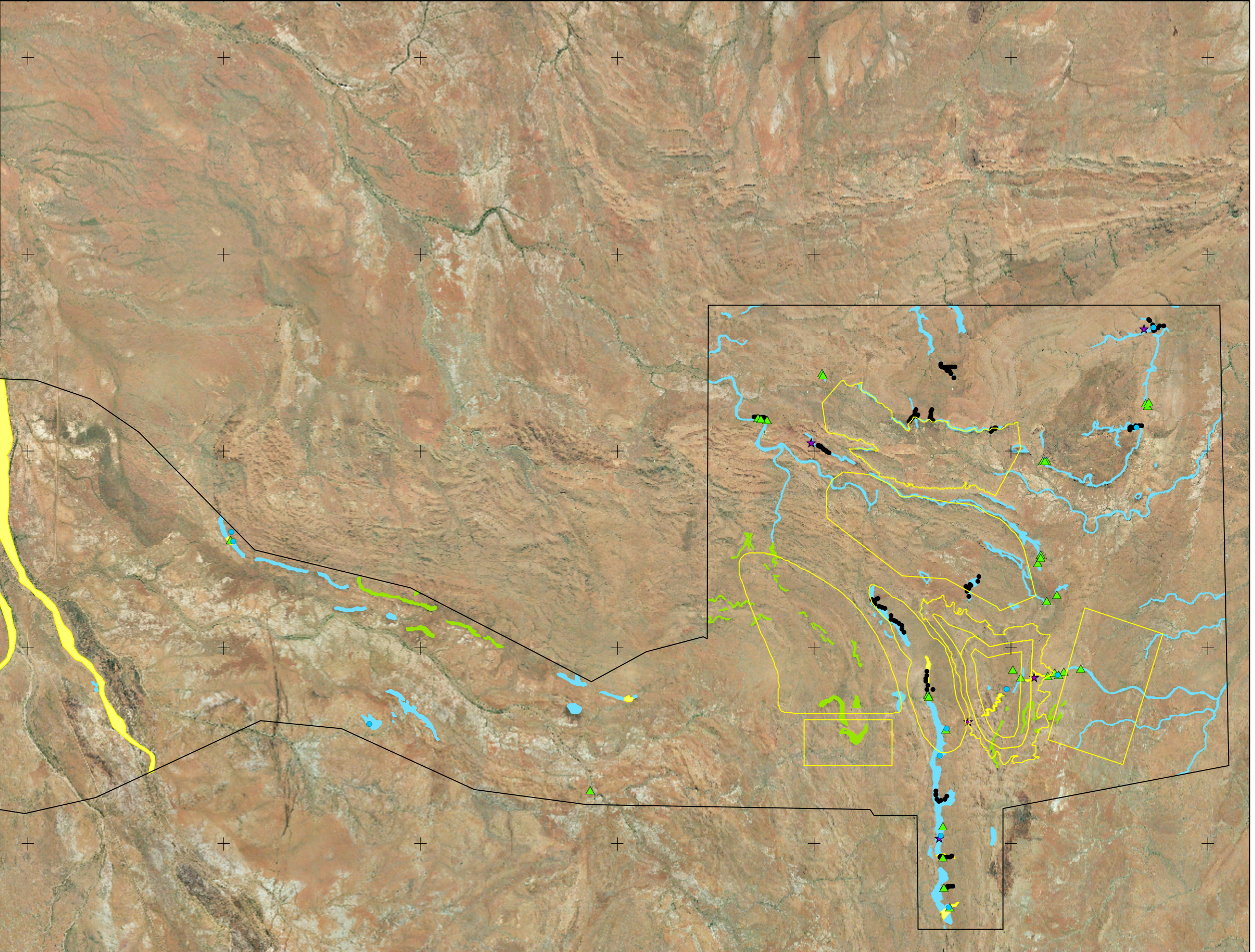
-  Project Area
-  Proposed Infrastructure Areas

Targeted Survey Sites

-  Trapping
-  Opportunistic Searches
-  Motion Camera
-  Nocturnal Searches

Potential habitat for the Pilbara Olive Python

-  Critical habitat
-  Potential habitat
-  Desktop assessed / inaccessible



Absolute Scale - 1:100,000



Pilbara Olive Python Habitat within the Project Area

Figure: 3.22
Project ID: 1373

Drawn: AH
Date: 08/11/11

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

Unique Map ID: AH390

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3.2.3.2 Targeted Searches

Secondary evidence of the Pilbara Olive Python was recorded from three locations within the North Star proposed mining area and infrastructure areas during the current survey (Figure 3.24). A relatively fresh sloughed skin was found next to a water pool in a rocky gully running east-west off the tenements ridge. Remains of a dead individual and a potential scat pile were found within the proposed infrastructure areas near permanent pools (Table 3.8).

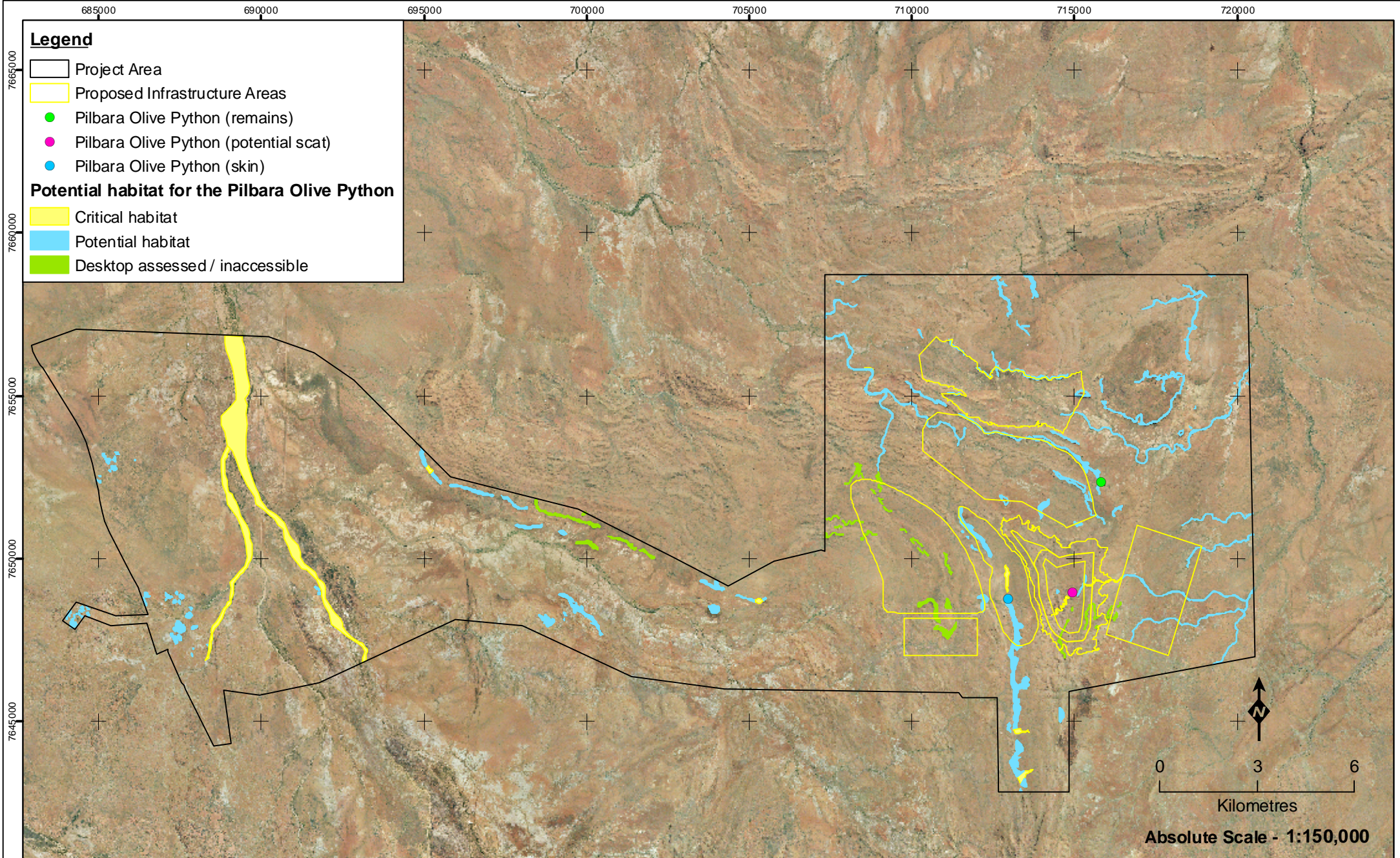


Figure 3.23 – Pilbara Olive Python Remains and Potential Scats (from top to bottom)

Table 3.8 – Pilbara Olive Python Record Information

Record	Date	Coordinates	
		Easting	Northing
Sloughed skin	14/07/11	712944	7648754
Remains	25/07/11	715787	7652345
Potential Scats	29/07/11	714916	7648959

Datum: WGS84
Zone: 50K

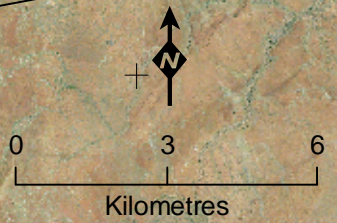


Legend

- Project Area
- Proposed Infrastructure Areas
- Pilbara Olive Python (remains)
- Pilbara Olive Python (potential scat)
- Pilbara Olive Python (skin)

Potential habitat for the Pilbara Olive Python

- Critical habitat
- Potential habitat
- Desktop assessed / inaccessible



Location Of Pilbara Olive Python Records

Figure: 3.24
Project ID: 1373

Drawn: AH
Date: 08/11/11

Unique Map ID: AH385

Coordinate System
 Name: GDA1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

3.3 SURVEY LIMITATIONS

Limitations of the current survey are summarised in Table 3.9 below. Given the few limitations encountered, it can be confirmed that an adequate level of survey has been undertaken.

Table 3.9 – Summary of Survey Limitations

Constraint	Relevant (yes/no)	Comment
Competency/ experience of the consultant carrying out the survey.	No	All staff were experienced in Northern Quoll trapping and bat survey techniques, with survey staff conducting Northern Quoll monitoring surveys and using bat recorder (Anabat 2 system and SM2 Bat) over the past 4 years. SM2 recordings were analysed by Bob Bullen (bat call analysis expert)
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Weather conditions during the North Star survey were mainly cold and wet. Northern Quolls and Pilbara Leaf-nosed Bats were surveyed adequately. Further targeted searches for the Pilbara Olive Pythons were conducted during the Phase 2 Level 2 survey.
Proportion of fauna identified, recorded and/ or collected.	No	Fauna was identified by <i>ecologia</i> staff in the field. SM2 recordings were analysed by Bob Bullen (bat call analysis expert)
Sources of information (previously available information as distinct from new data).	No	The majority of regional records of conservation significant fauna is of recent history.
The proportion of the task achieved and further work which might be needed.	No	All accessible areas were surveyed adequately and impacts of the proposed project can be adequately assessed
Timing/ weather/ season/ cycle.	No	Weather conditions were cold and rainy during the North Star survey and warm and sunny during the infrastructure areas survey. However, the activity of Northern Quolls and Pilbara Leaf-nosed Bats were not impacted or reduced. Pilbara Olive Python may have been less active and therefore the likelihood to encounter the species within the North Star Project area was reduced. The second phase of the Level 2 survey was conducted in October when conditions are warmer and Pilbara Olive Pythons are more active.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No	No disturbances affected the survey results.
Intensity (in retrospect was the intensity adequate).	No	Traps were set up in all Northern Quoll habitats suitable for trapping.
Completeness (e.g. was relevant area fully surveyed).	No	Habitat of good and medium quality was adequately surveyed
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	Staff was experienced in targeted Northern Quoll and Bat surveys and targeted searches for Pilbara Olive Pythons in the Pilbara region.
Remoteness and/ or access problems.	Yes, partially	A total of 94.9 ha of potential Northern Quoll habitat were inaccessible and not trapped. Potential Pilbara Olive Python habitat of a total of 92.5 ha was not accessible for targeted searches.
Availability of contextual (e.g. biogeographic) information on the region).	No	Background information of the Pilbara region is available and known.

4 DISCUSSION

During this survey, 22.4% (20 of 89 records total) of all Northern Quoll individuals recorded within 50 km were recorded from the North Star Project area (NatureMap, WA Museum, *ecologia* internal database). NatureMap lists seven records of the Pilbara Leaf-nosed Bat within 50 km of the Project area. This species was recorded from 14 locations within the North Star Project area during this survey, which represents twice as many records within the proposed mining area and infrastructure corridor than previously recorded in the region. Secondary evidence of the Pilbara Olive Python was recorded from three locations during this survey. With six records of Pilbara Olive Python in the region (within 50 km, NatureMap) the North Star Project area comprises a third of the records in the vicinity (Figure 3.4, Figure 3.5), particularly in the proposed North Star Mining area. However, not all areas of suitable habitat were surveyed due to inaccessibility; therefore a larger number of Northern Quolls and Pilbara Leaf-nosed Bats are anticipated to inhabit the Project area. This indicates that the populations of these species may be locally and regionally significant. DSEWPaC's Significant Impact Criteria is addressed in Table 4.10.

4.1 NORTHERN QUOLL

Four of the 20 Northern Quoll individuals captured were female. As females are known to have significantly smaller home ranges and do not roam prior to the breeding season (Oakwood 2008), the presence of females in the Project area indicated a permanent breeding population inhabiting the North Star Project area and were not expected to have moved into the area from the surrounding region. Males adopt a roaming strategy during the breeding season which is expected to have resulted in the increased number of males recorded (sex ratio of 4:1). However, 65% of all individuals trapped and marked in the proposed mining area were recaptured after 1-3 nights, indicating that the population in this area is relatively sedentary (Figure 3.15). Due to the large number of individuals recaptured along the ridge within the Project area, traps were closed after six nights of trapping to reduce the impact on trapped individuals such as reduced foraging time and stress through trapping and handling. However, the number of traps installed for this survey was higher than the recommended number of traps deemed adequate by DSEWPaC's survey guidelines for Northern Quolls. Therefore the trapping effort was deemed adequate.

One male (North Star Male #1) was recaptured each day over the seven trapping nights (Nearby traps were closed when individuals were recaptured, however, the individuals moved along the ridge to more distant traps). Of these captures, the male was captured three times within 200 m of individual North Star Female #6.

One male displayed roaming strategy during the survey (Additional Area, male#5). It was recaptured after one night at a location 2.6 km from the location of first capture. Another male (North Star, Male #1) which was recorded from the North Star proposed mining area travelled 0.8 km within one night and recaptured each night travelling southwards of the original location of capture along the same ridge. The long distances some males have travelled could indicate that a number of male Northern Quolls were moving in and out of the Project area utilising a variety of habitats.

The Chichester Range is known to provide suitable habitat which is reflected by the number of regional records (87%) in the Chichester region to the north of the Project area (NatureMap, *ecologia* internal database, Figure 3.4). Records are known from the east and north-east of the Project area which indicates that this region may represent a large population of Northern Quoll in the Pilbara. Due to the limited published survey reports in the surrounding area, it is difficult to interpret

adequately the significance of the populations in the Project area, however the suitability of the habitat within the ridges and gorges of the Project area is considered excellent.

4.2 PILBARA LEAF-NOSED BAT

Pilbara Leaf-nosed Bats were recorded from 14 locations within the Project area. Based on the call pattern recorded from four of the locations the recordings were likely to be recordings of bats foraging in the vicinity of their roosting cave. These records indicated that the western cliff edges might provide important habitat for this species and might represent critical habitat and/or significant populations of this species. Consequently, careful management of drilling activities is required due to their potential to damage caves and destroy suitable habitat.

Due to the limited number of previous records and fauna surveys, the significance of this area as critical habitat for Pilbara Leaf-nosed Bats cannot be easily determined. However, sightings, recordings and roost caves are not commonly detected in the Pilbara which indicates that there is a high likelihood that the Project area is an important refuge for the Pilbara Leaf-nosed Bat.

4.3 PILBARA OLIVE PYTHONS

Pilbara Olive Pythons are known to have an increased activity pattern in the warmer months. The weather conditions during the targeted survey at North Star were cold and partially rainy and thus not optimal for the python's activity. However, a sloughed skin was recorded from critical habitat, although no individual was observed. The remains of one Pilbara Olive Python and potential scats were found during the survey. Further targeted searches are to be conducted during the 2nd phase of the Level 2 survey at Project area in October 2011 when temperatures are warmer and the activity of this species is increased. The results are to be summarised in the Level 2 survey report.

Despite the low number of records during the survey, a large area (432.0 ha) of critical habitat (suitable foraging and breeding habitat) was present within the Project area. The habitat comprised rocky gorges with semipermanent or permanent water pools and large creek beds such as the Turner River which represented a significant area for this species.

Table 4.10 – Relevance of the Significant Impact Criteria (DEWHA 2006)

Significant Impact Criteria	Relevance
Long-term decrease in the size of a population	Yes Project will impact a large area of important suitable habitat for all three EPBC listed species thus resulting in a reduced local population size. Surrounding area needs to be assessed to compare significance of the Project area.
Reduction in the area of occupancy of the species	Yes/No Pilbara Leaf-nosed Bats will potentially lose several roost caves. Pilbara Olive Pythons could potentially lose several areas of hunting and refuge habitat Northern Quolls are likely to colonise disturbed areas and mine camps.
Fragmentation of an existing population into two or more populations	No Some remnant corridors of habitat remain connecting populations in the region.
Adverse affect to habitat critical to the survival of a species	Possibly Suitable roost caves are required by Pilbara Leaf-nosed bats and the loss of caves within the Project area may adversely impact the regional populations.
Disruption to the breeding cycle of a population	Possibly Loss of roost caves will impact the seasonal cycle of Pilbara Leaf-nosed Bats and potentially reduce the availability of suitable denning habitat for breeding Northern Quolls.
Modification, destruction, removal, isolation or reduction to the availability or quality of habitat to the extent that the species is likely to decline	Yes The Project area contains approximately 294.4 ha of suitable Northern Quoll denning habitat, 712.94 ha potential roost habitat for the Pilbara leaf-nosed Bat and 432.0 ha of critical habitat for the Pilbara Olive Python. Regional records of the Pilbara Leaf-nosed Bat and Pilbara Olive Python are very limited and therefore the loss of these areas is anticipated to result in a decline of this species on a local level. Impacts on a regional level are unknown.
Establishment of invasive species that are harmful to an endangered species in the endangered species' habitat	No No introduced fauna harmful to the three targeted species was recorded from the Project area..
Introduction of disease that may cause the species to decline	No No diseases are expected to be introduced.
Interference with the recovery of the species	Yes Suitable roost and denning habitat appears to be limited to a few areas of the Pilbara and loss of this habitat will reduce the total possible population size of Pilbara Leaf-nosed Bats and Northern Quolls as suitable roost caves and denning habitat is critical to this species survival during the dry cool winter months and the breeding season. Critical habitat for the survival of the Pilbara Olive Python is limited to gorges and rocky waterpools.

5 CONCLUSION

A targeted conservation significant (EPBC list species) vertebrate fauna survey was conducted, conforming to relevant guidelines and best practice, within the North Star Project area. The main conclusions of this targeted survey were:

- Three EPBC listed conservation significant fauna species, Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python were recorded within the Project area. A single DEC Priority 4 listed species (Ghost Bat) was also recorded within the Project area.
- Twenty Northern Quoll individuals were recorded from within the Project area, mainly within the proposed mining and infrastructure areas. Northern Quolls were recorded at additional three locations using motion cameras, and further three locations from secondary evidence.
- 900 ha of suitable Northern Quoll habitat was identified from within the Project area. 294 ha of this habitat was confirmed as suitable denning habitat, with the remaining habitat classed as foraging and/or dispersal habitat.
- Pilbara Leaf-nosed Bats were recorded from 14 locations within the Project area. Based on analysis of the timing of the call density peaks, four of these locations were considered to be associated with roost cave locations. The majority of records were from the proposed North Star mining area and infrastructure areas and consisted of gorge habitat with permanent water.
- 712 ha of suitable Pilbara Leaf-nosed Bat habitat was identified from within the Project area. 294 ha of this habitat consisted of potential roost cave habitat, which was considered highly important and uncommon in the Pilbara region.
- Secondary evidence of Pilbara Olive Python was recorded from three locations within the Project area. Remains of one individual, a sloughed skin and a single scat were recorded from within the mining and infrastructure areas.
- 1045 ha of suitable Pilbara Olive Python habitat was identified from within the Project area. 432 ha is considered critical habitat and consists of rocky gorges or cliff faces with permanent surface water.
- Further development of the North Star Project could result in significant impacts to Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python. Referral of the Project to the DSEWPaC is, therefore, highly recommended.

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APPENDIX A EXPLANATION OF CONSERVATION CODES

Appendix A1 Definitions of categories under the *Environment Protection and Biodiversity Conservation Act*.

Conservation Code	Definition
Extinct (EX)	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the wild (EW)	A species is categorised as extinct in the wild if it is only known to survive in cultivation, in captivity or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	The species is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable (VU)	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent (CD)	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of five years.

Appendix A2 Definition of Schedules under the *Wildlife Conservation Act 1950*.

Schedule	Definition
Schedule 1 (T)	<i>Threatened Fauna</i> (Fauna that is rare or is likely to become extinct) <i>Threatened Flora</i> (Declared Rare Flora - Extant) http://www.dec.wa.gov.au/content/view/full/852/2010/1/1/ - Taxa-defn Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
Schedule 2 (X)	<i>Presumed Extinct Fauna</i> <i>Presumed Extinct Flora</i> (Declared Rare Flora – Extinct) Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
Schedule 3 (IA)	<i>Birds protected under an international agreement</i> Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4 (S)	<i>Other specially protected fauna</i> Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.

Appendix A3 Definition of DEC Threatened and Priority Codes.

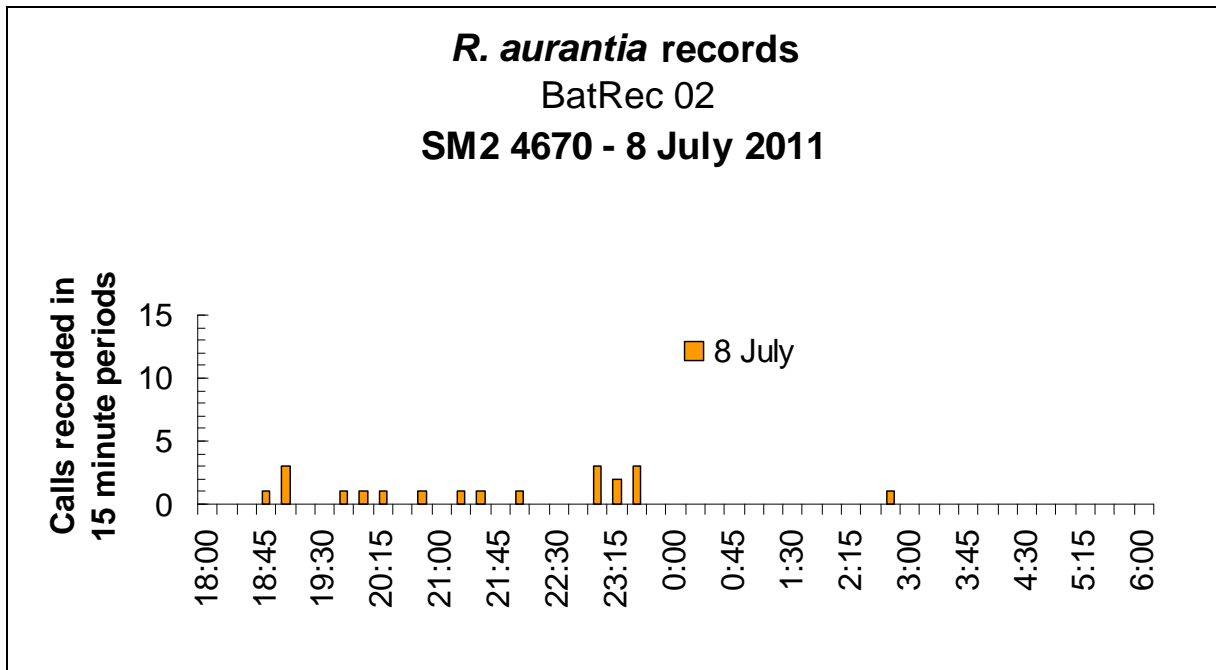
Threatened	Definition
Critically Endangered (CR)	Considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Considered to be facing a high risk of extinction in the wild.
Priority	Definition
Priority 1 (P1)	<i>Taxa with few, poorly known populations on threatened lands.</i> Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2 (P2)	<i>Taxa with few, poorly known populations on conservation lands.</i> Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3 (P3)	<i>Taxa with several, poorly known populations, some on conservation lands.</i> Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4 (P4)	<i>Taxa in need of monitoring.</i> Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5 (P5)	<i>Taxa in need of monitoring.</i> Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

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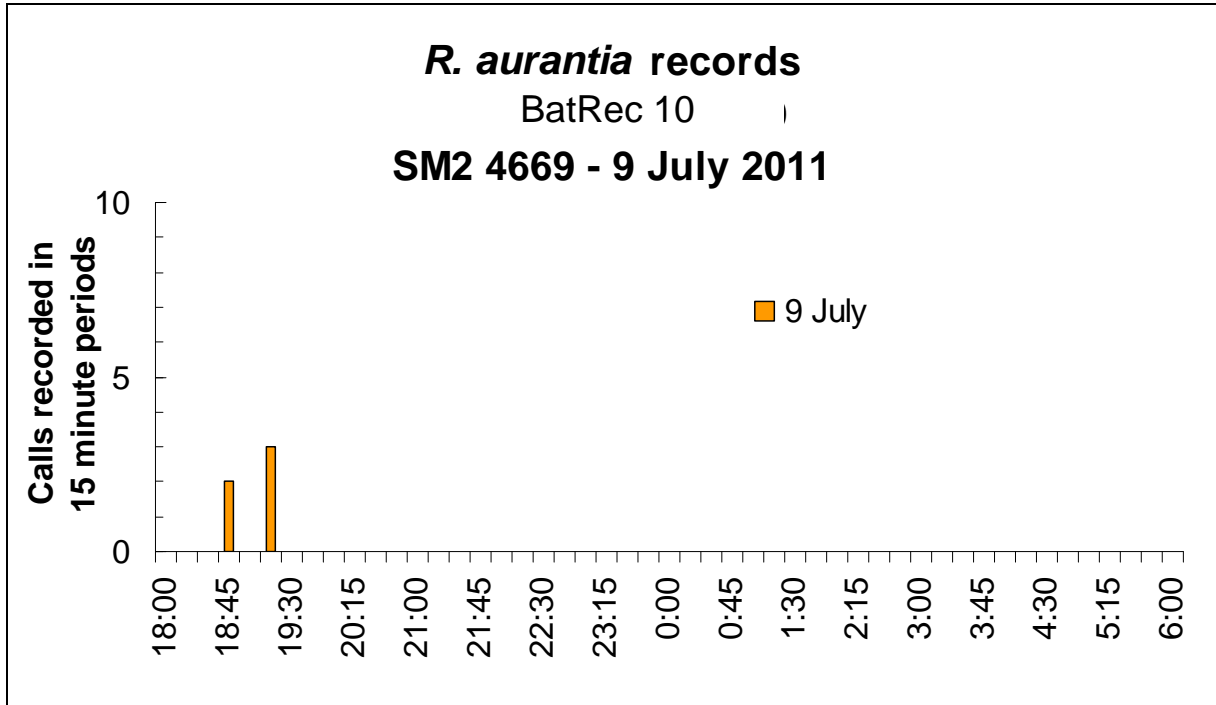
APPENDIX B MORPHOMETRIC DATA FROM CAPTURED INDIVIDUALS

**APPENDIX C RECORDED CALL PATTERN PILBARA LEAF-NOSED BAT
(EXAMPLES)**

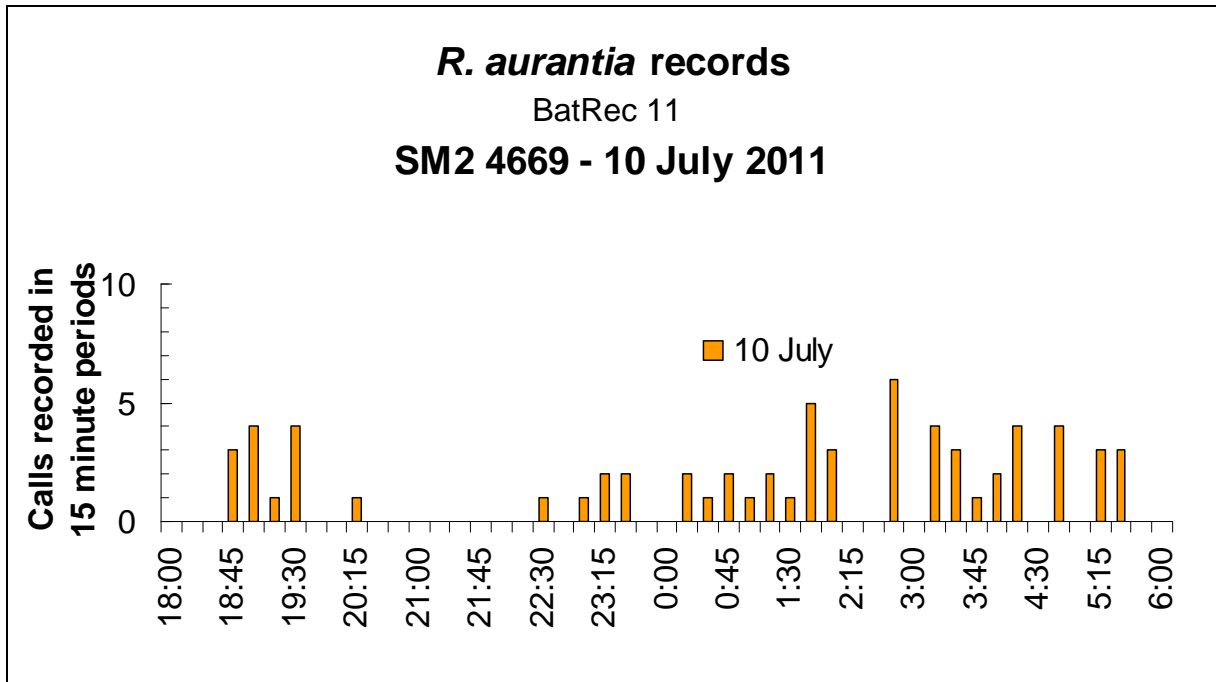
Appendix B1



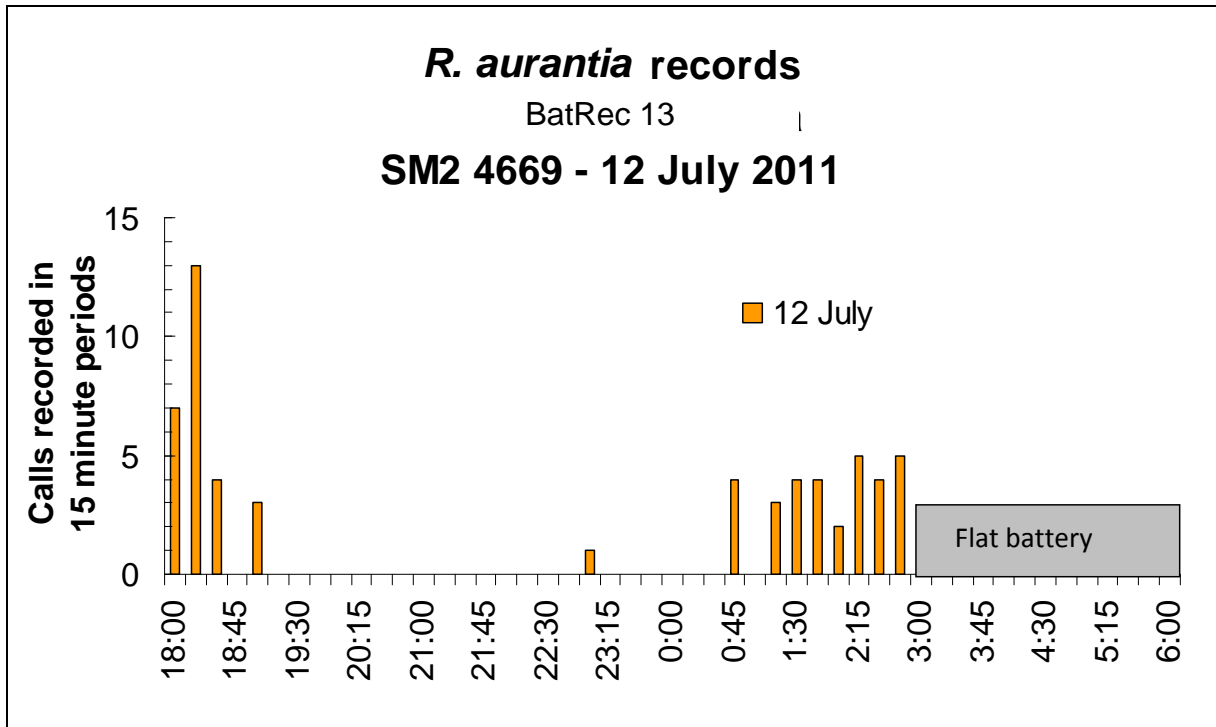
Appendix B2



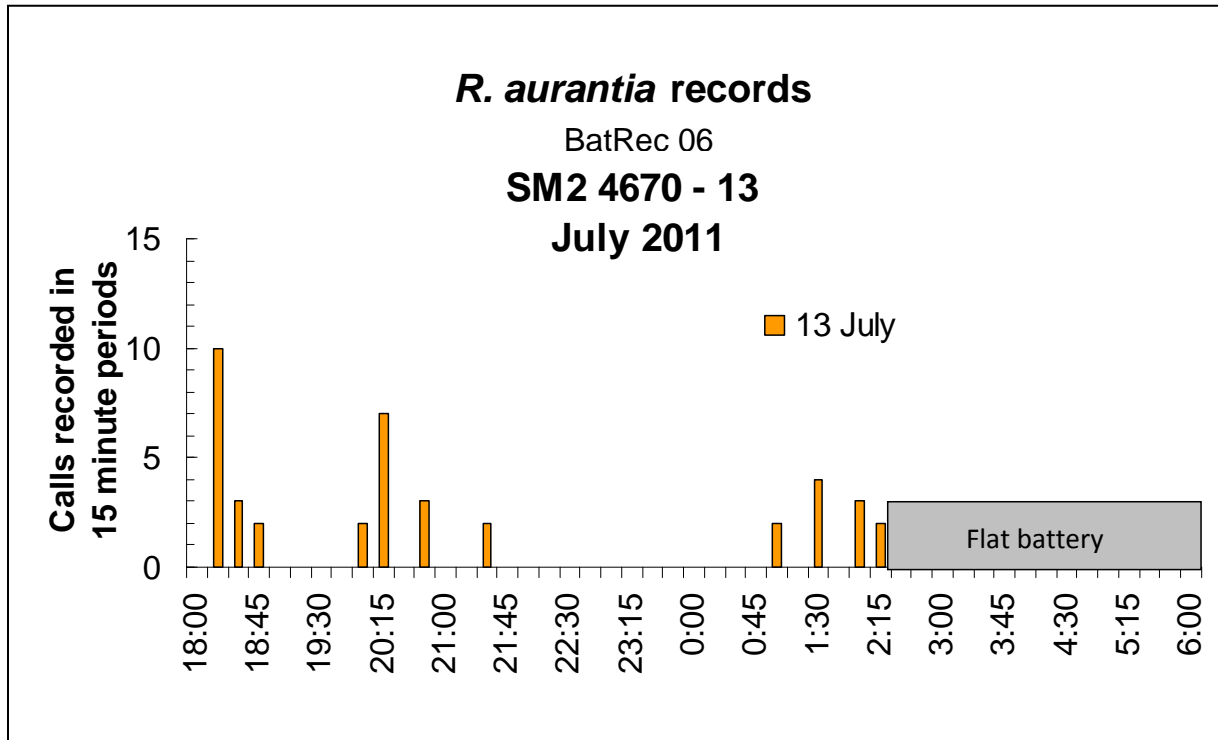
Appendix B3



Appendix B4



Appendix B5



Appendix B6

