PRIMARY GOLD

Appendix C - Ecological Assessment Memoramdum

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THREATENED FAUNA SURVEY REPORT

Rustlers Roost, Quest 29 and Toms Gully, Arnhem Hwy, NT

Prepared for:

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Document Information and Control

Version	Author, Position, Business / Company	Date	Reviewed by (Name, Position, Company)	Date
0.1 (draft –no survey results for Bare-rumped Sheathtail Bat)	Mihkel Proos, Principal Environmental Consultant, Connect Environmental	30/6/22	Timothy Kinny, Senior Environmental Scientist, CDM Smith	1/7/22
1.0 (interim - no survey results for Bare-rumped Sheathtail Bat)		5/7/22	-	-
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Executive Summary

Connect Environmental was engaged by CDM Smith Australia Pty Ltd to conduct a fauna survey of the Rustlers Roost and Quest 29 open cut mine redevelopment project. Rustlers Roost and Quest 29 are brownfield sites on mineral leases located in the Mount Bundey area, approximately 85 km south-east of Darwin in the Northern Territory (NT). The main mine redevelopment areas of Rustlers Roost and Quest 29 are located between 5 km and 12 km directly south-west of the Arnhem Highway on Old Mount Bundey Station, Perpetual Pastoral Lease (PPL) 1163 and McKinlay River Pastoral Station (PPL 1184). An accommodation camp for the project workforce will be located on ML 29814 which is part of the Toms Gully mine tenements.

The assessment focused on the threatened species listed by DEPWS in their letter dated 15 April 2021 (ref: DEPWS2021/0051). Existing information in relation to previous survey effort, results, vegetation communities, habitats and their respective condition was used to inform the survey approach. The surveys focused on filling in perceived gaps in ecological knowledge related to the target threatened fauna from previous surveys. Consequently, the project scope was defined as:

- The three survey areas are Rustlers Roost, Quest 29 and Toms Gully (accommodation camp).
- The survey objective was to determine whether the following species are present or absent in the three survey areas (species as listed in the DEPWS letter):
  - Gouldian Finch (*Erythrura gouldiae*)
  - Red Goshawk (*Erythrotriorchis radiatus*)
  - Northern Quoll (*Dasyurus hallucatus*)
  - Partridge Pigeon (*Geophaps smithii smithi*)
  - Pale Field-rat (*Rattus tunneyi*)
  - Yellow-spotted Monitor (*Varanus panoptes*)
  - Merten's Water Monitor (*Varanus mertensi*)
  - Mitchell's Water Monitor (*Varanus mitchelli*)
  - Yellow-snouted Gecko (*Lucasium occultum*).
- Two additional fauna species were surveyed as they also may occur within the survey areas. These are the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus*) and Masked Owl (*Tyto novaehollandiae kimberli*).

The survey was conducted in April and May 2022. The approach was based on relevant guidelines, consideration of each species ecology and the efforts of previous surveys within the survey area. The survey involved:

- The deployment of 34 cameras across the three survey areas.
- Active searches for:
  - Nests of Red Goshawks
  - Individuals of Red Goshawks, Partridge Pigeons and Yellow-spotted Monitors.
  - Merten's and Mitchell's Water Monitors.
- Broadcast survey for Masked Owls.
- Bat echolocation survey for the Bare-rumped Sheathtail Bat.
- Yellow-Snouted Gecko survey.

Four threatened fauna species were detected:

- Partridge Pigeon – detected at one location in the Rustlers Roost survey area.
- Black-footed Tree-rat – detected on six occasions (five within the Rustlers Roost survey area and one along the haul road).
- Northern Brushtail Possum – detected at three locations (two in the Rustlers Roost survey area and one within the Toms Gully survey area).
- Merten's Water Monitor – detected at eight locations (six within the Rustlers Roost survey area, one along the Haul Road and one adjacent to the south-east corner (outside) of the Rustlers Roost survey area).

No threatened fauna species was detected in the Quest 29 survey area.

The loss of habitat is likely to be a key impact to these species from the proposed mine redevelopment. The maximum area of suitable (or potentially suitable) habitat for each confirmed species is shown in **Table 1** though these are likely to be conservative given that not all habitat within each survey area is likely to be occupied.

Table 1 Area of potential habitat within each survey area for detected threatened species

Species	Areas detected	Estimated density or distribution	Area (ha)				Total (ha)
			Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Partridge Pigeon	Rustlers Roost	Very low density	312	18	7	0	**337**
Black-footed Tree-rat	Rustlers Roost, Haul Road	Widespread (density unclear)	321.5	18.5	0	0	**340**
Northern Brushtail Possum	Rustlers Roost, Toms Gully	Patchy	321.5	18.5	7.2	0	**329**
Merten's Water Monitor	Rustlers Roost, Haul Road	Appeared common	20	1-2	0	0	**21-22**

No species was expected to be significantly impacted by the proposed mining redevelopment largely because:

- For the Partridge Pigeon:
  - Only one detection was made suggesting that it occurs at very low densities in the local area.
  - The species area of occupancy is reported to be 9,600 km^2 (Davies et al, 2021), which is unlikely to be affected by the proposed mining redevelopment.
  - The habitats within the disturbance footprint are unlikely to be critical to the survival of the species.
  - Key threats to the species including altered fire regimes, cats and grassy weeds (such as Gamba Grass) are likely to influence the distribution and abundance of the species far greater than this proposed mine redevelopment.
- For the Black-footed Tree-rat:
  - The surrounding land uses, habitats and fire histories appear similar, suggesting that the species is likely to occur elsewhere in the region.
  - Key threats to the species including altered fire regimes, habitat loss due to urban and industrial development, cats, habitat degradation from introduced herbivores and livestock, and invasive

grasses are likely to influence the distribution and abundance of the species far greater than this proposed mine redevelopment.

- For the Northern Brushtail Possum:
  - There appears to be ample similar habitats in the surrounding areas.
  - There are a high number of NT-wide records (>7,000) in the last five years (as per the NT Fauna Atlas) from key areas such Tiwi Islands, Cobourg Peninsula, Kakadu National Park, and the greater Darwin and Katherine areas. It is more likely that these areas would contain habitat critical to the survival of the species.
  - Existing land uses on and around the disturbance footprints are likely to continue.
- For Merten's Water Monitor:
  - Overall, the habitats within the survey areas are substantially impacted by existing mining or pastoral activities. Many areas are ephemeral, lack complex riparian vegetation, and are weed-infested. However, Annie's Dam apparently provides habitat of reasonable quality for the species. Cane Toads are present throughout the area.

While not detected, four additional threatened fauna species were determined to potentially occur based on the assessment of habitat suitability. The following conclusions were made in relation to habitats and the level of residual impact for each species:

- For Gouldian Finches, potentially suitable breeding habitat was identified in the mid-western and mid-eastern sections of the Rustlers Roost survey area, measuring approximately 35 and 5 ha respectively. The mid-eastern area is nestled within disturbed areas from previous mining activities and is probably only marginal in terms of habitat suitability. Both areas were wooded and undulating with Salmon Gums (*E. tintinnans*) forming a minor component of the vegetation communities. Several other *Eucalyptus* and *Corymbia* species were also present.
- However, several factors suggest that the general area may not be utilised substantially by the species and, consequently, may not be habitat critical to its survival:
  - The species was not detected during any of the three surveys conducted in 2016 and 2017 by Low Ecological Services or in 2022 by Connect Environmental.
  - There is a moderate frequency of fires which is thought to reduce the availability of tree hollows (DEPWS, 2021b).
  - The altered fire regime and pastoralism evident in the local area may have altered food availability (DEPWS, 2021b).
- For Red Goshawks, no nests were identified during the surveys, however potential nesting habitat may occur in the northern sections of Rustlers Roost in areas of tall *E. miniata* or *E. tetrodonta* forests. There is some indication that the area may not be ideal given the current and recent land uses in the area and subsequent fragmentation of habitats. A low residual impact is expected.
- For the Yellow-spotted Monitor and Mitchell's Water Monitor, neither species was recorded during surveys conducted in 2016 and 2017 by Low Ecological Services and 2022 by Connect Environmental. All creeks appear to be ephemeral and standing water is mostly confined to existing pits or dams from previous mining operations. Some floodplain habitat occurs around Annie's Dam within the Rustlers Roost survey area. It is possible that the species occasionally uses such an area as this however given the history of land use, the area is unlikely to be critical to each species survival. A low residual impact is expected.

A range of measures specific to species that were detected, or that potentially occur, were recommended to reduce the level of impact from the proposed mining redevelopment. These are in addition to measures that

would ordinarily be implemented to reduce general environmental impacts, which are not listed here. These include:

- For Black-footed Tree-rat and Northern Brush-tailed Possum:
  - A pre-clearance survey should be conducted to determine whether there is breeding activity and, if so, the area should be avoided until such time that no breeding activity is evident.
  - A trapping program should be conducted immediately prior to any vegetation clearance activities to capture and relocate affected individuals.
  - Spotting and catching of Black-footed Tree-rats and Northern Brush-tailed Possums (and individuals of any fauna species) should be conducted during vegetation clearing activities.
- For Red Goshawks:
  - It is recommended that a search for nests is conducted in the breeding season immediately prior to proposed vegetation clearing. Focus areas should include the tall *Eucalyptus miniata* or *E. tetrodonta* forests in the northern sections of the Rustlers Roost area.

Contents

Table of Tables

Table of Figures

1 Introduction

1.1 Overview

Connect Environmental was engaged by CDM Smith Australia Pty Ltd to conduct a fauna survey of the Rustlers Roost and Quest 29 open cut mine redevelopment project ('the project'). Rustlers Roost and Quest 29 are brownfield sites on mineral leases located in the Mount Bundey area, approximately 85 km south-east of Darwin in the Northern Territory (NT). The main mine redevelopment areas of Rustlers Roost and Quest 29 are located between 5 km and 12 km directly south-west of the Arnhem Highway on Old Mount Bundey Station, Perpetual Pastoral Lease (PPL) 1163 and McKinlay River Pastoral Station (PPL 1184). An accommodation camp for the project workforce will be located on ML 29814 which is part of the Toms Gully mine tenements.

1.2 Scope

The assessment focused on the threatened species listed by DEPWS in their letter dated 15 April 2021 (ref: DEPWS2021/0051). Existing information in relation to previous survey effort, results, vegetation communities, habitats and their respective condition was used to inform the survey approach. The surveys focused on filling in perceived gaps in ecological knowledge related to the target threatened fauna from previous surveys. Consequently, the project scope was defined as:

- The three survey areas are Rustlers Roost, Quest 29 and Toms Gully (accommodation camp), as shown in **Figure 1**. The existing pit in the Rustlers Roost survey area was not surveyed.
- The survey objective was to determine whether the following species are present or absent in the three survey areas (species as listed in the DEPWS letter):
    - Gouldian Finch (*Erythrura gouldiae*)
    - Red Goshawk (*Erythrotriorchis radiatus*)
    - Northern Quoll (*Dasyurus hallucatus*)
    - Partridge Pigeon (*Geophaps smithii smithi*)
    - Pale Field-rat (*Rattus tunneyi*)
    - Yellow-spotted Monitor (*Varanus panoptes*)
    - Merten's Water Monitor (*Varanus mertensi*)
    - Mitchell's Water Monitor (*Varanus mitchelli*)
    - Yellow-snouted Gecko (*Lucasium occultum*).
- Two additional potentially occurring species were included because these species could be surveyed with little additional effort. These are the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus*) and Masked Owl (*Tyto novaehollandiae kimberli*).
- Land unit and/or vegetation mapping is also required in areas of the altered footprint (as per the *Rustlers Roost and Quest 29 Open-Cut Mine Redevelopment: Draft Environmental Impacts Statement (EIS)* (CDM Smith, 2021a) and the *Significant Variation Report* (CDM Smith, 2021b)) that were not investigated as part of previous surveys.
- Survey effort was influenced by, amongst other things, the previous survey effort undertaken by Low Ecological Services P/L (LES, 2017) and EcOz (EcOz, 2021).
- Upon engagement of the consultancy (April 2022), the survey timing may not have been optimal to maximise detectability for species such as the Gouldian Finch and Yellow-snouted Gecko. While this

limitation is considered in the survey results and subsequent impact assessment, results of surveys conducted by Low Ecological Services in November 2016 and May 2017 were also considered.

1.3 Exclusions, Assumptions and Limitations

The survey was designed to enhance existing ecological survey data to a level that addresses correspondence from DEPWS (Ref DEPWS2021/0051, dated 15 April 2021) that stated that there was "sufficient uncertainty to warrant further assessment of the proposal's risks/impacts to threatened species… ". The surveys focused on fauna, whereas vegetation and flora surveys were conducted by other specialists.

In relation to fauna, there are several inherent limitations to all assessments of this nature, including:

- Records obtained through NR Maps are not necessarily an accurate representation of the abundance and distribution of a species in any given area. Survey effort in that area is also a factor.
- The surveys were just a snapshot in time. Over time, including from season to season, habitat conditions and population abundance and distributions may change. In this regard, any cryptic or transient fauna may have not been detected, even though they may occur in the local area. Nevertheless, the survey methods used are designed to maximise the detection of the target species and, accordingly, follow published survey guidelines. As such, if a species is not detected, it is generally assumed to not occur at the time of the survey which therefore forms the basis of the subsequent impact assessment.
- However, for this project, previous survey results (LES, 2017) also provide relevant data and given their timing (November 2016 and May 2017), add an element of temporal variability to the assessment.
- Assessments and conclusions made by Connect Environmental are based on available information at the time of preparation of this report.

Specific limitations relating to this survey include:

- The survey was conducted during April to May which is a time when some reptile species may be less active and therefore more difficult to detect.

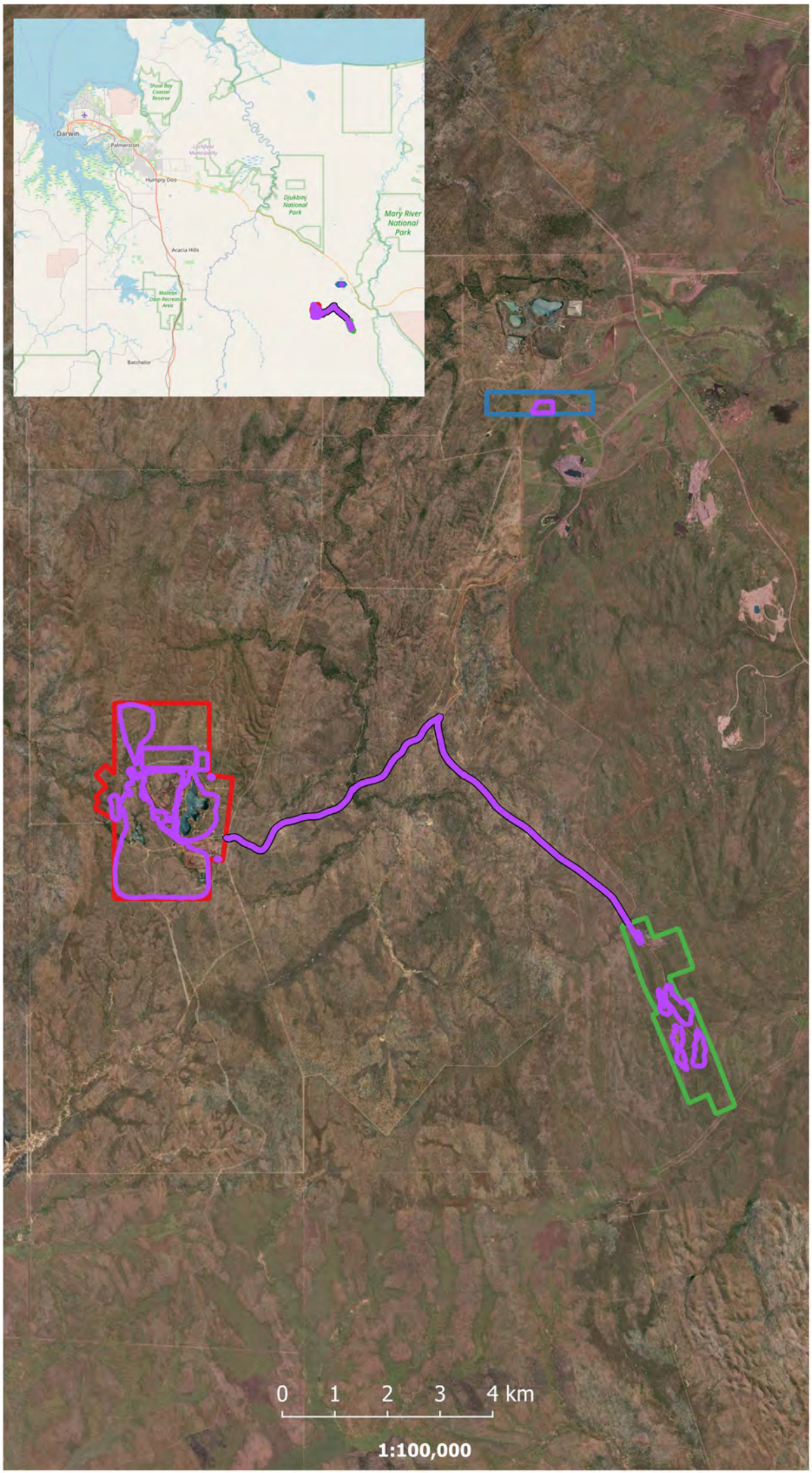
1.4 Personnel

Mihkel Proos led the assessment with assistance from Justin Bott, as shown in **Table 1**.

Table 2 Project Team

Team Member	Relevant experience	Role
Mihkel Proos	Mihkel's background lies in terrestrial ecology, having completed over 30 surveys across northern Australia over the last decade. He has 20 years' experience in the environmental field, with core experience in ecology, approvals and management. He has worked for the NT and Australian Governments in project assessment and science roles.	Project Manager, survey team leader, reporting
Justin Bott	Justin recently completed a Bachelor of Science (Ecology) at Charles Darwin University. He has assisted in conducting field surveys with Connect Environmental since 2019.	Field assistant, photo identification

Figure 1 - Project layout and location



Key

- Disturbance footprint / survey area
- Haul Road
- Toms Gully
- Quest 29
- Rustlers Roost

Background: ESRI Satellite, OpenStreetMap

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

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2 Previous Surveys and Additional Relevant Background Information

2.1 Previous Surveys

Existing ecological assessments reviewed as part of this assessment include:

- GHD, 2015. *Toms Gully Mine, Biodiversity Report*. Report for Primary Gold Limited.
- LES (Low Ecological Services P/L), 2017. *Toms Gully, Rustlers Roost and Quest 29, Flora and Fauna Report*. Prepared for Primary Gold Limited.
- EcOz (EcOz Pty Ltd), 2021. *Rustlers Roost and Quest 29 Open-Cut Mine Redevelopment, Referral Report*. Prepared for Primary Gold Limited.

2.2 Fire History

The number of fires within each survey area from 2000 to 2020 is shown in **Figure 2**, **Figure 3** and **Figure 4**.

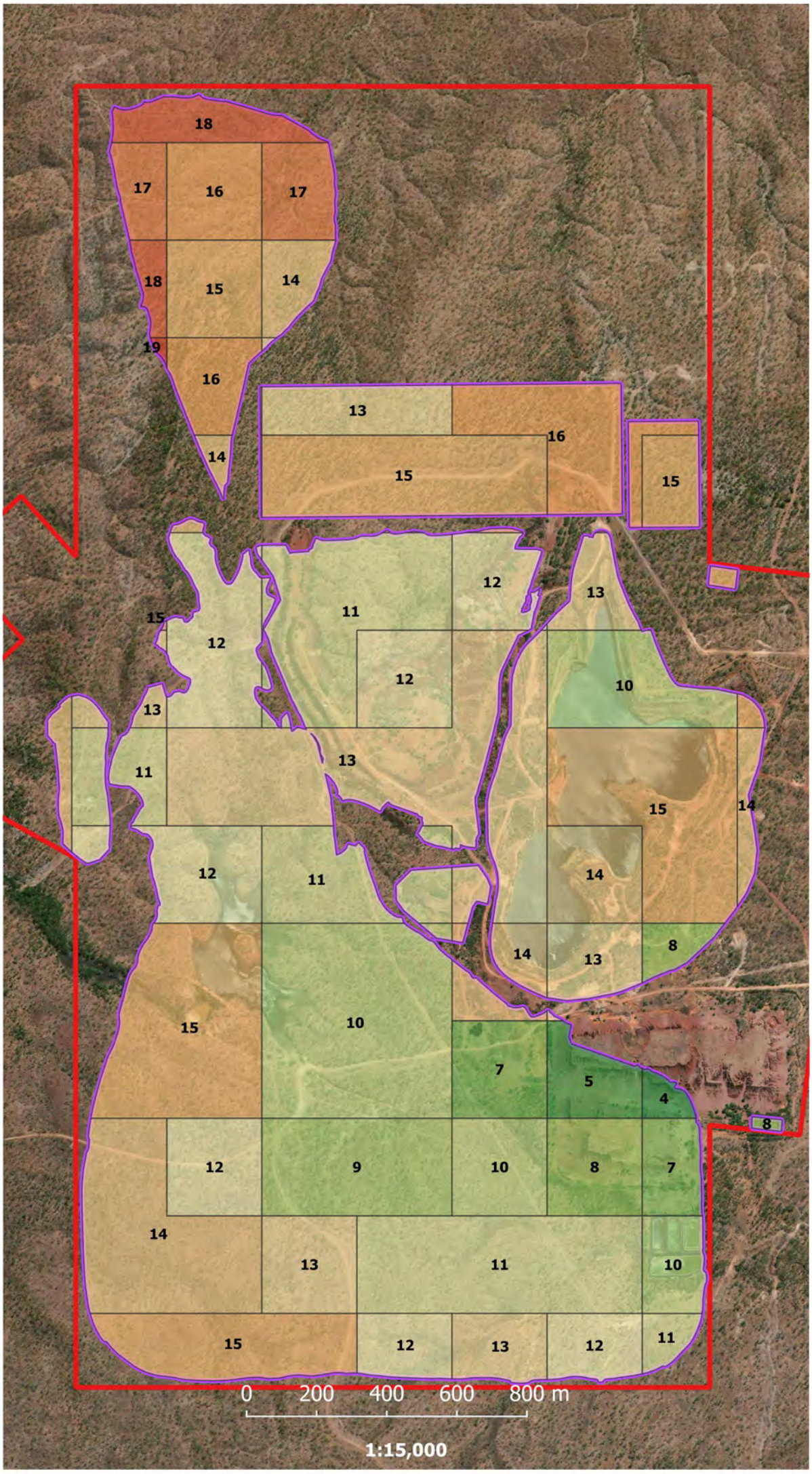

Figure 2 - Fire history (2000-2020) in the Rustler's Roost survey area

Key

- Disturbance footprint / survey area
- Rustler's Roost project area

ESRI Satellite

Fire frequency (number of fires between 2000-2020 (source: NAFI, 2022))

- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19

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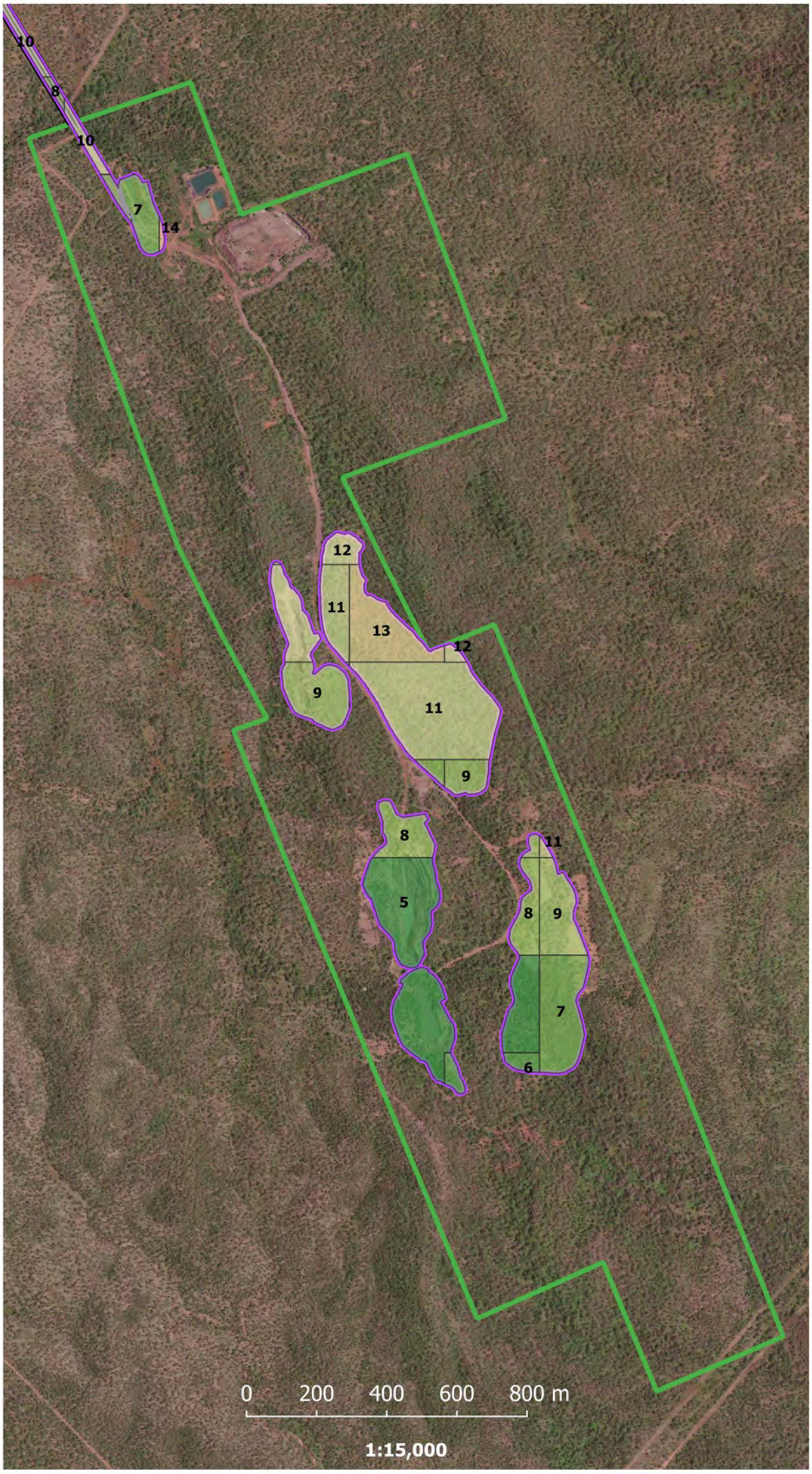

Figure 3 - Fire history (2000-2020) in the Quest 29 survey area

Key

- Disturbance footprint / survey area
- Quest 29 Project Area

ESRI Satellite

Fire frequency (number of fires between 2000-2020 (source: NAFI, 2022))

- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

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Figure 4 - Fire history (2000-2020) in the Toms Gully survey area

Key

- Disturbance footprint / survey area
- Toms Gully project area

ESRI Satellite

Fire frequency (number of fires between 2000-2020 (source: NAFI, 2022))

- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

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3 Survey Methodology

The survey was conducted in from April to May 2022. The approach was based on relevant guidelines, consideration of each species ecology and the efforts of previous surveys within the survey area (refer to **Section 2**). **Table 3** describes the survey type, location and effort for each targeted threatened species. The following sections detail the various methods used for each target species.

3.1 Cameras

Thirty-four Reconyx HP2W cameras were deployed across the three survey areas. Locations are shown in **Figure 5**, **Figure 6** and **Figure 7**. Camera locations were determined prior to the survey at a density of approximately one camera per 50 ha of suitable habitat with additional cameras placed along creeks. Previous survey locations (conducted by LES (2017)) also influenced camera locations. Upon arrival at the pre-defined camera location, each camera was sited according to suitable micro-habitat characteristics (e.g., suitable tree to mount the camera) and a brief habitat description was recorded. Site characteristics are described in **Table 4**.

Cameras were deployed in accordance with *A guide for the use of remote cameras for wildlife survey in northern Australia* (Gillespie *et al*., 2015), summarised as:

- Cameras were placed on suitable trees (min. 10 cm diameter) and facing south, where possible, to prevent glare and sun damage to the camera lens and sensor.
- All vegetation is cleared to 1 m from the camera tree and to a minimum of 1.5 m around the bait station (and in between the camera and bait station).
- A bait station was placed between 1 and 2.5 m from the base of the tree (depending on the focal length of the camera) consisting of a metal stake with the bait housing at 30 cm above the ground.
- The bait station is made of vented pcv pipe with aluminium gauze to restrict access by ants.
- Bait stations were baited with at least a golf ball size mixture of oats, peanut butter and honey.
- Cameras were aimed so that the centre of the image was pointed at the base of the bait station.
- Cameras were set at a height of approximately 40-60 cm to the top of the camera housing. Cameras needed to be high enough off the ground to minimise mud splash during rain.
- Camera settings:
    - 24-hour operation.
    - Medium-high or high sensitivity trigger.
    - 3 photos per trigger at 1 second apart.
    - 30 seconds ‘quiet period’ between each trigger.

Table 3 Target species and habitats, survey method and effort

Species	Scientific name	Survey method	Target areas / habitats	Approach and effort		
				Rustlers Roost	Quest 29	Toms Gully
Gouldian Finch	*Erythrura gouldiae*	Vegetation survey	*Eucalyptus tintinnans* in patches on rocky hills	Drive and walk to locate patches of *E. tintinnans*.		
Red Goshawk	*Erythrotriorchis radiatus*	Nest searches	Tall, open forest and woodland, watercourses	Walking and driving looking for nests		
Masked Owl	*Tyto novaehollandiae*	Call playback (including spotlighting)	All	3 sites, each site surveyed on 3 consecutive nights	1 site, surveyed on 3 consecutive nights	1 site, surveyed on 3 consecutive nights
Partridge Pigeon	*Geophaps smithii smithii*	Camera traps	Well-drained eucalypt woodland	24 cameras	7 cameras	3 cameras
		Flushing surveys				
Northern Quoll	*Dasyurus hallucatus*	Camera traps	Eucalypt woodland			
Pale Field-rat	*Rattus tunneyi*		Dense vegetation near drainage lines in grassy woodland			
Yellow-spotted Monitor	*Varanus panoptes*	Camera traps Active searches	Grasslands, woodlands			
Bare-rumped Sheathtail Bat[1]	*Saccolaimus saccolaimus*	Bat echolocation recorders	*Eucalyptus* and *Corymbia* forests and woodlands	6 recorder nights	2 recorder nights	Nil
Merten's Water Monitor	*Varanus mertensi*	Camera traps Active searches along creek lines that contained water	Drainage lines, dams	5 cameras	2 cameras	1 camera
Mitchell's Water Monitor	*Varanus mitchelli*					

[1] *The Bare-rumped Sheathtail Bat was not a target species however was surveyed for using bat echolocation recorders as it may occur in the area.*

Species	Scientific name	Survey method	Target areas / habitats	Approach and effort		
				Rustlers Roost	Quest 29	Toms Gully
Yellow-snouted Gecko	*Lucasium occultum*	Nocturnal searches	*Eucalyptus miniata* and *E. tetrodonta* open forests (land units 2a and 2b)	Spotlight (walking) along five transects *with a buffer of up to 100 m from the transect line*.	Spotlight (walking) along one transect *with a buffer of up to 100 m from the transect line*.	Spotlight (walking) along two transects *with a buffer of up to 100 m from the transect line*.

Table 4 Camera site attributes

Site	Cam	Deployed	Retrieved	No. nights	Habitat description (landform, soils, dominant tree species etc)
Rustlers Roost					
C1		7/4/22	8/4/22	1	Pipe outflow
R1	27	7/4/22	4/5/22	27	Rocky, brown clay soils, Bloodwood (*Corymbia bleeseri*), Ironwood (*Erythrophleum chlorostachys*), Hills Salmon Gum (*Eucalyptus tintinnans*)
R2	5	7/4/22	4/5/22	27	Weedy, Bloodwood (*Corymbia bleeseri*), Acacia spp., Milkwood (*Alstonia actinophylla*), Northern Salmon Gum (*Eucalyptus bigalerita*)
R3	39	7/4/22	4/5/22	27	Adjacent to creek, weedy (Calopo, Hyptis), Darwin Box (*Eucalyptus tectifica*), Northern Salmon Gum (*Eucalyptus bigalerita*), Ironwood (*Erythrophleum chlorostachys*), Pindan Wattle (*Acacia platycarpa*)
R4	52	7/4/22	4/5/22	27	Ironwood (*Erythrophleum chlorostachys*), Darwin Woollybutt (*Eucalyptus miniata*), Bloodwood (*Corymbia bleeseri*), *Gardenia megasperma*
R5	30	7/4/22	4/5/22	27	On edge of Annie's Dam, *Gardenia megasperma*, Salmon Gum (*Eucalyptus bigalerita*), Bloodwood (*Corymbia bleeseri*).
R6	34	7/4/22	4/5/22	27	Bloodwood (*Corymbia bleeseri*), Ironwood (*Erythrophleum chlorostachys*), Sand Palm (*Livistona humilis*), Green Plum (*Buchanania obovata*), laterite, sandy loam, moderate leaf litter.
R7	38	7/4/22	4/5/22	27	Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Rough-leaf Cabbage Gum (*Corymbia confertiflora*), Hills Salmon Gum (*Eucalyptus tintinnans*), *Gardenia megasperma*, Sand Palm (*Livistona humilis*)
R8	37	7/4/22	4/5/22	27	Bloodwood (*Corymbia bleeseri*), Ironwood (*Erythrophleum chlorostachys*), Darwin Woollybutt (*Eucalyptus miniata*), *grevillea decurrens*, Sand Palm (*Livistona humilis*).
R9	36	7/4/22	4/5/22	27	Darwin Woollybutt (*Eucalyptus miniata*), Bloodwood (*Corymbia bleeseri*), *Gardenia megasperma*, Sand Palm (*Livistona humilis*). Siltstone rock.
R10	9	7/4/22	4/5/22	27	Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), Sand Palm (*Livistona humilis*)
R11	44	7/4/22	4/5/22	27	Ridge, Hills Salmon Gum (*Eucalyptus tintinnans*), Darwin Woollybutt (*Eucalyptus miniata*)
R12	41	7/4/22	4/5/22	27	*Gardenia megasperma*, Bloodwood (*Corymbia bleeseri*), Northern Salmon Gum (*Eucalyptus bigalerita*), Green Plum (*Buchanania obovata*), Ironwood (*Erythrophleum chlorostachys*)
R13	42	7/4/22	4/5/22	27	Bottom of slope near edge of Annie's Dam and Broad-leaved Paperbark (*Melaleuca viridiflora*), Darwin Woollybutt (*Eucalyptus miniata*), Small-fruited Bloodwood (*Corymbia dichromophloia*), Ironwood (*Erythrophleum chlorostachys*)

Site	Cam	Deployed	Retrieved	No. nights	Habitat description (landform, soils, dominant tree species etc)
R14	50	7/4/22	4/5/22	27	Small gully, Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), *Acacia* spp.
R15	35	7/4/22	4/5/22	27	Edge of creek, Ironwood (*Erythrophleum chlorostachys*), Small-fruited Bloodwood (*Corymbia dichromophloia*), Hills Salmon Gum (*Eucalyptus tintinnans*)
R16	17	7/4/22	4/5/22	27	Laterite, dense leaf litter, Darwin Stringybark (*Eucalyptus tetrodonta*), Bloodwood (*Corymbia bleeseri*), Green Plum (*Buchanania obovata*).
R17	12	7/4/22	4/5/22	27	Ironwood (*Erythrophleum chlorostachys*), Bloodwood (*Corymbia bleeseri*), Small-fruited Bloodwood (*Corymbia dichromophloia*)
R18	48	7/4/22	4/5/22	27	Granitic, Small-fruited Bloodwood (*Corymbia dichromophloia*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*).
R19	32	8/4/22	6/5/22	28	Creek line, Darwin Stringybark (*Eucalyptus tetrodonta*), Ironwood (*Erythrophleum chlorostachys*), Rough-leaf Cabbage Gun (*Corymbia confertiflora*)
R20	28	8/4/22	4/5/22	26	Bloodwood (*Corymbia bleeseri*), Small-fruited Bloodwood (*Corymbia dichromophloia*), *Grevillea decurrens*
R21	51	8/4/22	4/5/22	26	Darwin Woollybutt (*Eucalyptus miniata*), Darwin Stringybark (*Eucalyptus tetrodonta*)
R22	49	8/4/22	4/5/22	26	Darwin Stringybark (*Eucalyptus tetrodonta*), Darwin Woollybutt (*Eucalyptus miniata*), *Gardenia megasperma*, Sand Palm (*Livistona humilis*), *Grevillea decurrens*
R23	6	8/4/22	4/5/22	26	Darwin Woollybutt (*Eucalyptus miniata*), Darwin Stringybark (*Eucalyptus tetrodonta*), Bloodwood (*Corymbia bleeseri*)
R24	15	8/4/22	4/5/22	26	Darwin Woollybutt (*Eucalyptus miniata*), Darwin Stringybark (*Eucalyptus tetrodonta*), Bloodwood (*Corymbia bleeseri*)
Quest 29					
C2	7	8/4/22	5/5/22	27	Riparian, Calopo on banks, Ironwood (*Erythrophleum chlorostachys*), Salmon Gum (*Eucalyptus alba*), Weeping Paperbark (*Melaleuca leucadendra*) zone
R24-2	31	8/4/22	5/5/22	27	Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), *Gardenia megasperma*.
R25	1	8/4/22	5/5/22	27	Very weedy (Hyptis, Calopo, Cobblers Peg), Darwin Woollybutt (*Eucalyptus miniata*)
R26	16	8/4/22	5/5/22	27	Closed forest on edge of rocky hill, Ironwood (*Erythrophleum chlorostachys*), Salmon Gum (*Eucalyptus alba*), Calopo, *Terminalia* sp.
R27	45	8/4/22	5/5/22	27	Ironwood (*Erythrophleum chlorostachys*), Darwin Woollybutt (*Eucalyptus miniata*), Darwin Box (*Eucalyptus tectifica*), *Acacia* spp., Hyptis.

Site	Cam	Deployed	Retrieved	No. nights	Habitat description (landform, soils, dominant tree species etc)
R28	8	8/4/22	5/5/22	27	Gully, Darwin Woollybutt (*Eucalyptus miniata*), Sandpaper Fig (*Ficus aculeata*), Ironwood (*Erythrophleum chlorostachys*)
R29	23	8/4/22	5/5/22	27	Along dam edge, Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), *Acacia* spp.
Toms Gully					
R30	40	8/4/22	5/5/22	27	Hilltop, rocky, Darwin Stringybark (*Eucalyptus tetrodonta*), Ironwood (*Erythrophleum chlorostachys*), Bloodwood (*Corymbia bleeseri*)
R31	21	8/4/22	5/5/22	27	Hill side, rocky, Darwin Stringybark (*Eucalyptus tetrodonta*), Green Plum (*Buchanania obovata*)
R32	29	8/4/22	5/5/22	27	Creek line, sandstone rocky country
Total	**34 cam's**	**7/4/22**	**6/5/22**	**915**	-

3.2 Active Searches

Active searches were conducted for:

- The nests of Red Goshawks in and around Annie's Dam, watercourses or other tall forests and woodlands.
- Red Goshawks, Partridge Pigeons and Yellow-spotted Monitors while driving and walking around each of the survey areas (which were often when deploying, checking or retrieving other fauna monitoring equipment).
- Merten's and Mitchell's Water Monitors along watercourses that contained water (see locations in **Figure 5**, **Figure 6** and **Figure 7**). Most, if not all, watercourses that contained water within each of the survey areas were searched on at least one occasion at least at 1-2 sites / transects. Creek crossings along the haul road were also searched at least twice.

3.3 Masked Owl Call Broadcast Surveys

Broadcast surveys were conducted at five sites on three consecutive nights (4-6 May 2022) across the three survey areas. Three sites were at Rustlers Roost, one each was at Quest 29 and Toms Gully. The site at Toms Gully was surveyed on only two occasions. Their locations are in **Figure 5**, **Figure 6** and **Figure 7**, respectively. The design and methodology were based on the *Survey protocol for masked owls in the NT Tyto novaehollandiae* (DLRM, 2010) with key features being:

- Survey sites were selected prior to the survey and located 1-2 km apart.
- At each site, the following procedure was conducted:
  - Broadcast the call of the Masked Owl (calls were provided to Connect Environmental by DEPWS in 2021).
  - For the first five minutes of the broadcast, listen for calls of Masked Owls and watch for silhouettes of birds flying into the area around the speaker (i.e. no spotlighting).
  - In the second five minutes, keep listening for owl calls but use a spotlight to look for owls in the trees around the site.
  - When spotlighting, do an initial scan of all the nearby trees, then spend the rest of the five minutes doing a more-careful search of the trees for owls and small mammals (potential prey).

- A loudspeaker connected to a portable Bluetooth speaker which was connected via Bluetooth to a phone that had the call recordings was used.

3.4 Bat Echolocation Survey

An acoustic survey was conducted for microchiropteran bats with a focus on the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus*). While it was not indicated by DEPWS as a species of concern, an acoustic survey was considered appropriate given the potential for the species to occur in the area. The acoustic survey considered the recommended survey approach contained within the *Survey guidelines for Australia's threatened bats* (DEWHA, 2010a) as well as the previous surveys conducted for the species in the project area. **Table 5** contains the details of the acoustic surveys.

Table 5 Bare-rumped Sheathtail Bat echolocation call recorder site details

Date	Site	Unit	Mounting tree species	Vegetation description	Landform description	Other notes
Rustlers Roost						
4-5/5/22	A-RR1	A1 (Song Meter Mini Bat)	*Corymbia dichromophloia*	*Corymbia polysciada*, *Eucalyptus miniata*, *Corymbia dichromophloia* low open woodland	Low hills; relief between 5-20m; slope gradients between 6-15%; extensive surface stone outcrop.	Along vehicle track, 45 deg tilt towards sky
	A-RR2	A2 (Song Meter Mini Bat)	*Corymbia dichromophloia*			Along vehicle track, 45 deg tilt towards sky
	A-RR3	Anabat Swift	*Corymbia dichromophloia*	*Melaleuca viridiflora*	Dam	Placed on water's edge overlooking water (no tilt)
5-6/5/22	A-RR4	A1 (Song Meter Mini Bat)	*Eucalyptus miniata*	Open grassland, disturbed, adjacent to eucalypt low open woodland	Disturbed	Adjacent to tracks and cleared area, 45 deg tilt towards sky
	A-RR5	A2 (Song Meter Mini Bat)	*Corymbia bleeseri*	*Corymbia polysciada*, *Eucalyptus miniata*, *Corymbia dichromophloia* low open woodland	Low hills; relief between 5-20m; slope gradients between 6-15%; extensive surface stone outcrop.	45 deg tilt towards sky
	A-RR6	Anabat Swift	*Eucalyptus tetrodonta*			30 deg tilt towards sky
Quest 29						
6-7/5/22	A-Q1	A1 (Song Meter Mini Bat)	*Corymbia ptychocarpa*	Mixed species open forest.	Creek system, disturbed	Disturbed site, adjacent to dam along vehicle track, very weedy, 45 deg tilt towards sky
	A-Q2	A2 (Song Meter Mini Bat)	*Eucalyptus alba*	*Corymbia polysciada*, *Eucalyptus miniata* low open woodland	Siltstone rugged terrain	Adjacent to creek line along vehicle track, very weedy, 45 deg tilt towards sky

3.5 Yellow-Snouted Gecko Survey

Eight spotlighting transects were walked by two field staff on three consecutive nights (4-6 May 2022), totaling 20 person hours, searching for Yellow-snouted Geckos (**Table 6**). All transects were centred along tracks. At each transect, each staff member walked in separate areas along the transect and up to 100 m perpendicular to the transect into the adjacent woodland. Two general search methods were employed, aligning with methods specified in the *Survey guidelines for Australia's threatened reptiles* (DSEWPaC, 2011):

1. A headtorch with or without binoculars to detect eyeshine.
2. A head torch to detect small animals moving along the ground, which was often held in the hand closer to the ground to aid in detecting moving shadows.

Table 6 Yellow-snouted Gecko transect descriptions

Site	Approx. transect length	Total time spent searching (person hours)	Habitat description (landform, soils, dominant tree species etc.)
Rustlers Roost			
R-S1-1	440 m	1.5 hours	Darwin Woollybutt (*Eucalyptus miniata*), Bloodwood (*Corymbia bleeseri*), *Gardenia megasperma*, Sand Palm (*Livistona humilis*). Siltstone rock.
R-S1-2	490 m	1.5 hours	
R-S2	360 m	3 hours	Ironwood (*Erythrophleum chlorostachys*), Darwin Woollybutt (*Eucalyptus miniata*), Bloodwood (*Corymbia bleeseri*), *Gardenia megasperma*
R-S3	340 m	3 hours	Adjacent to rock wall, perimeter track
R-S4	370 m	3 hours	Laterite, dense leaf litter, Darwin Stringybark (*Eucalyptus tetrodonta*), Bloodwood (*Corymbia bleeseri*), Green Plum (*Buchanania obovata*)
R-S5	750 m	3 hours	Darwin Stringybark (*Eucalyptus tetrodonta*), Darwin Woollybutt (*Eucalyptus miniata*), *Gardenia megasperma*, Sand Palm (*Livistona humilis*), *Grevillea decurrens*
Quest 29			
Q-S1	360 m	3 hours	Adjacent to creek, weedy, Darwin Woollybutt (*Eucalyptus miniata*)
Toms Gully			
T-S1	100 m	1 hour	Hill slope, Darwin Stringybark (*Eucalyptus tetrodonta*), Ironwood (*Erythrophleum chlorostachys*), Bloodwood (*Corymbia bleeseri*)
T-S2	120 m	1 hour	Habitat not suitable for the Yellow-snouted Gecko as it lacks Darwin Stringybark (*Eucalyptus tetrodonta*) and Darwin Woollybutt (*Eucalyptus miniata*)
Total	**3.33 km**	**20 person hours**	

3.6 Incidental Observations

All fauna species incidentally observed during the survey were recorded.

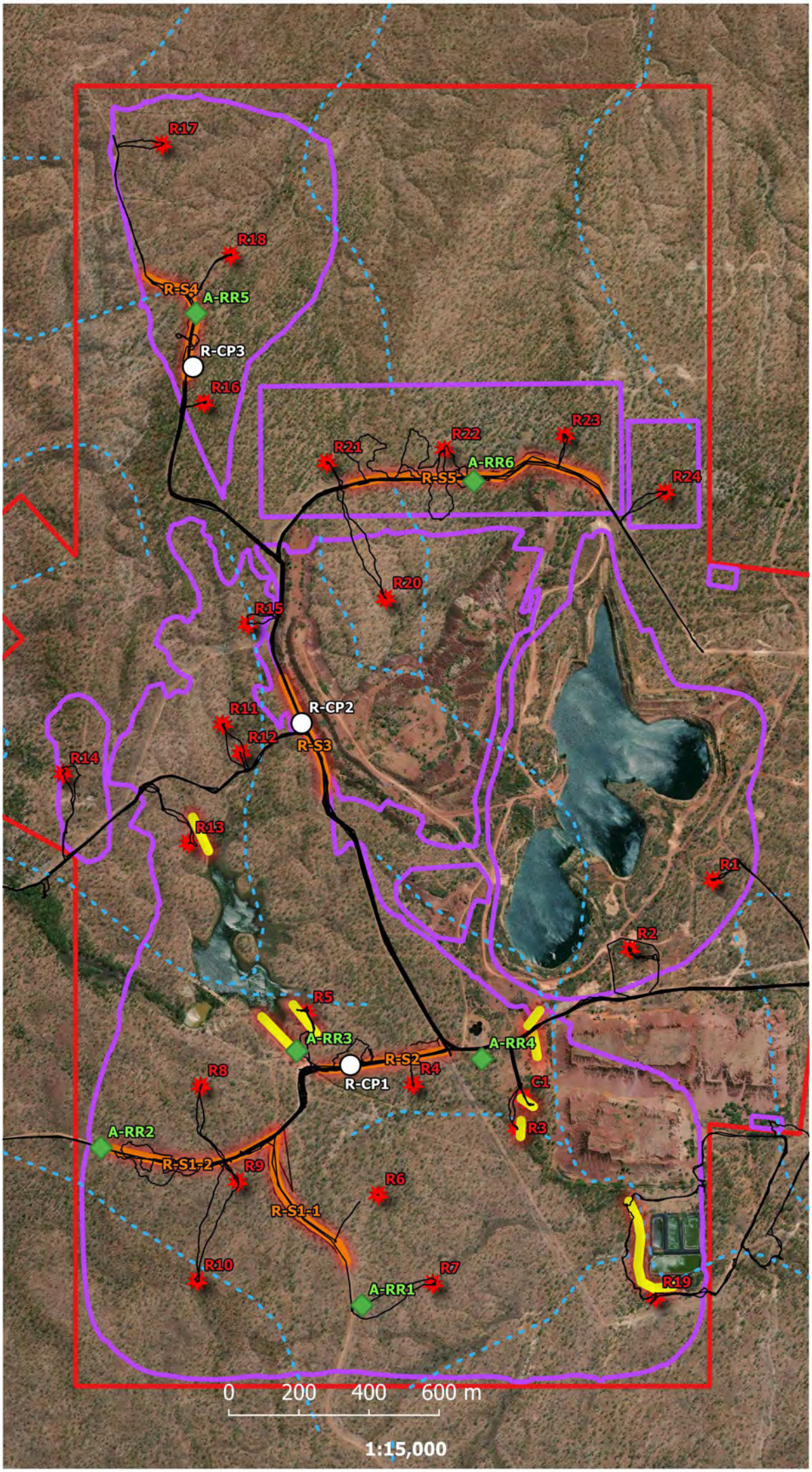

Figure 5
-
Survey effort - Rustler's Roost

Key

- Camera
- Bat echolocation recorder
- Masked Owl call broadcast site
- Yellow-snouted Gecko survey transect
- Water Monitor search area
- Vehicle and walking tracks
- Streams (NT Govt)
- Disturbance footprint / survey area
- Rustler's Roost project area

ESRI Satellite

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

CONNECT environmental

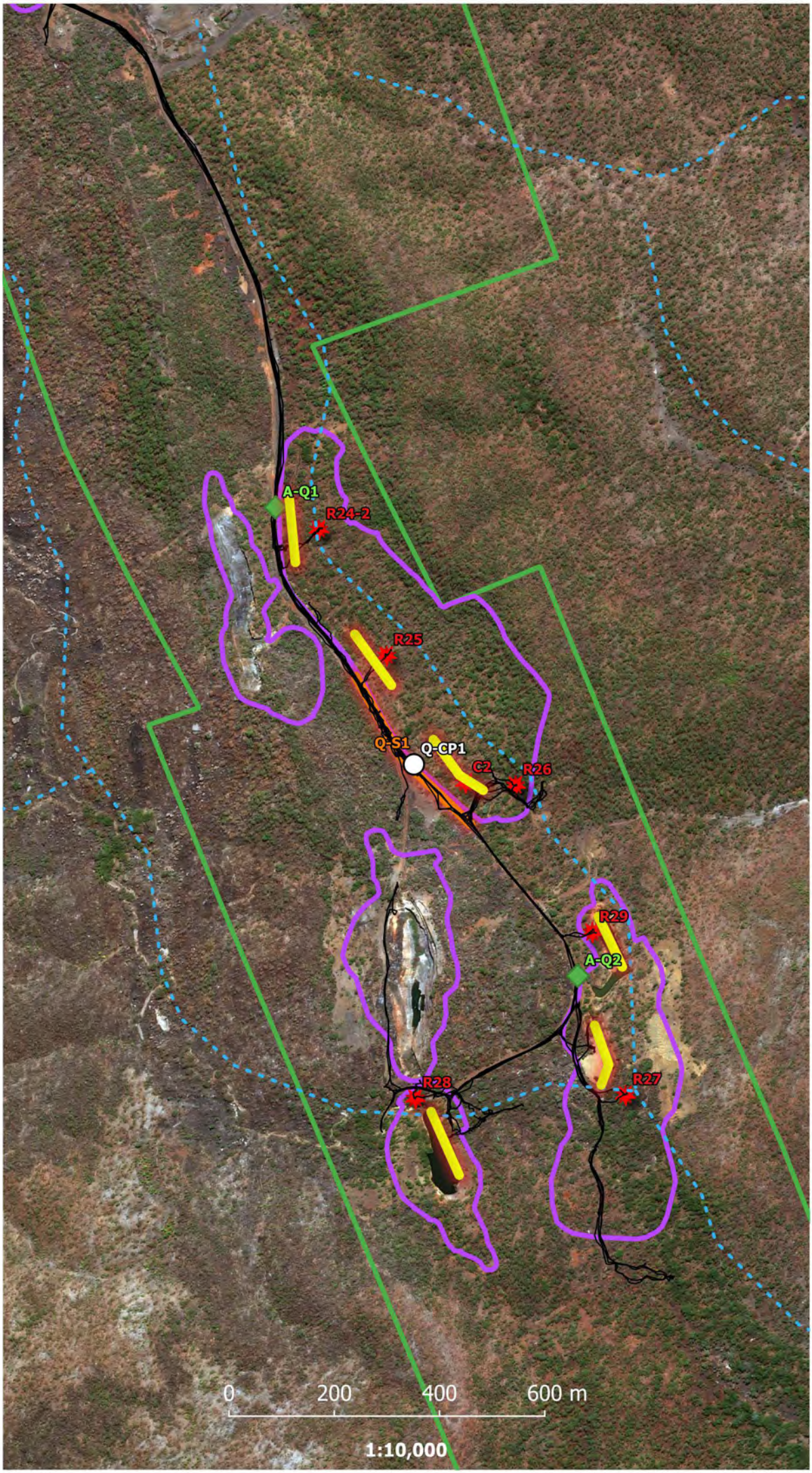

Figure 6
- Survey effort - Quest 29

Key

- Camera
- Bat echolocation recorder
- Masked Owl call broadcast site
- Yellow-snouted Gecko survey transect
- Water Monitor search area
- Vehicle and walking tracks
- Streams (NT Govt)
- Disturbance footprint / survey area
- Quest 29 project area

ESRI Satellite

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

CONNECT environmental

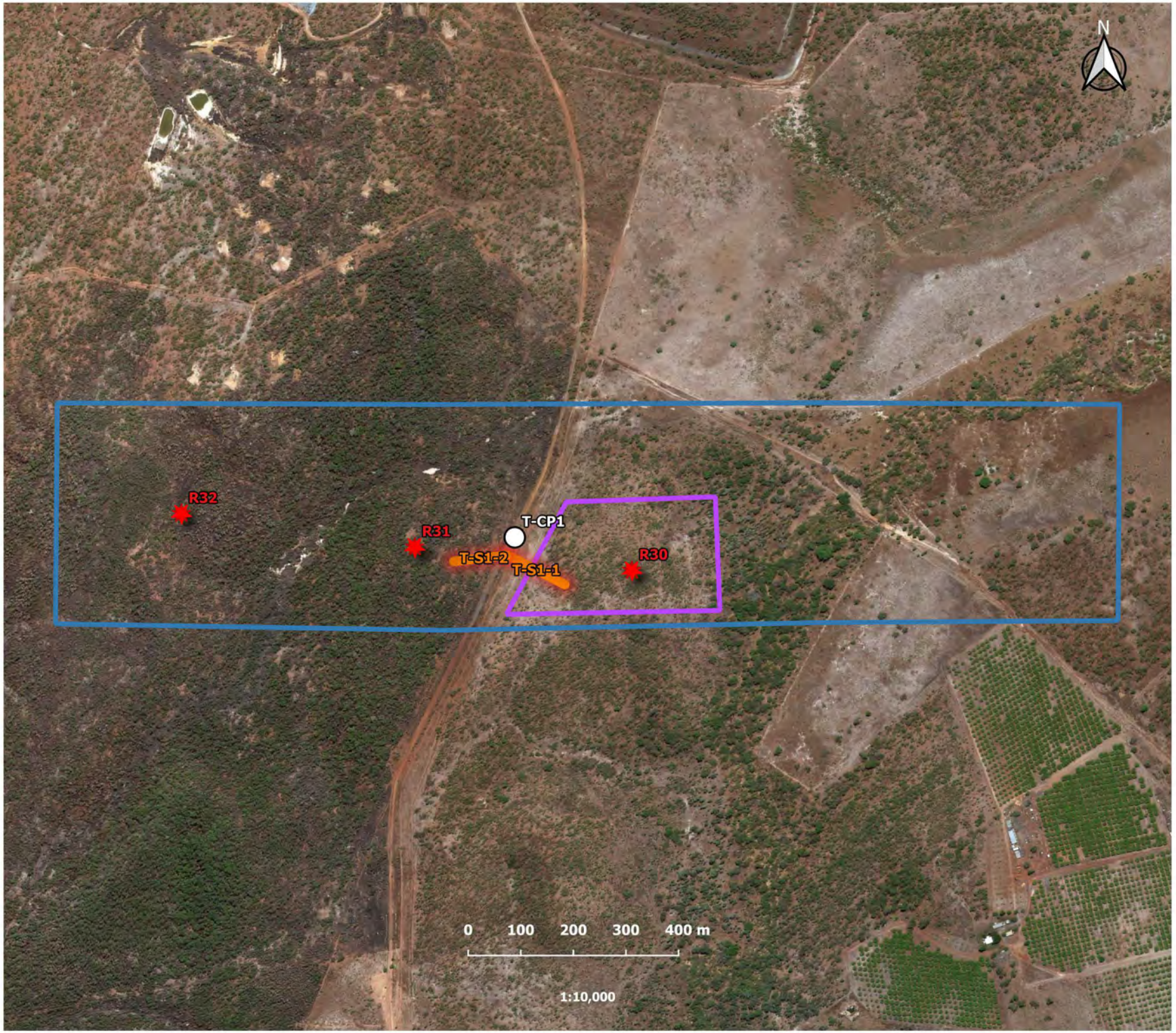

Figure 7

Survey effort - Tom's Gully

Key

- Camera
- Masked Owl call broadcast site
- Yellow-snouted Gecko survey transect
- Disturbance footprint / survey area

Background - ESRI Satellite

Client: CDM Smith
Date: 12 June 2022
Datum: GDA94
Author: M. Proos

CONNECT environmental

4 Results

4.1 Land Units / Vegetation Types

Land unit mapping was collated from two sources to produce a single product for the purposes of this report. This includes:

- Field-verified land units from the initial referral for the existing project footprint (EcOz, 2020 and 2021).
- Existing land unit for Mount Bundey Station mapping created by Forster and Fogarty in 1975 (Forster & Fogarty, 1975). This mapping was used in areas not covered in the EcOz field-verified land unit mapping.

The subsequent map for each project area is shown in **Figure 8**, **Figure 9** and **Figure 10**. A description of the land units is provided in **Table 7**.

Table 7 Land units in each project area (EcOz, 2020 and 2021; Forster & Fogarty, 1975)

Land unit	Brief description	Area (ha)			
		Rustlers Roost	Quest 29	Toms Gully	Haul Road
2a	Hills and ridges with some steep slopes; *Eucalyptus miniata*, *Corymbia polysciada*, *C. dichromophloia* and occasional *C. clavigera* low to mid high woodland	0	18.5	0	0
2b	Rises and ridges; slope 6-15%; *Corymbia polysciada*, *Eucalyptus miniata*, *C. dichromophloia* and occasional *E. tinannans* low to mid high open woodland	312	0	7.2	0
3b	Erosional slopes; *Eucalyptus clavigera*, Erythrophleum, *Xanthostemon*, *Calytrix* spp., *Corymbia foelscheana* low woodland	0.2	0	0	0
5c	Alluvial plains; perennial grassland	0	0	0.1	0
6a	Creek channel; *Corymbia bella* and *C. polycarpa*, *Ficus racemosa* and occasional *Melaleuca leucadendra*, *Alstonia actinophylla*, *Barringtonia acutangula* and Banyan trees mid high woodland to open forest.	0	9.9	0	0
6a1	Minor creek lines and broad drainage systems; *Corymbia bella*, *C. polycarpa* and *C. grandiflora* mid high (10 to 15 m tall) and occasional *Eucalypt bigalerita* woodland.	9.3	0	0	0
Annie's Dam[2]	A dam containing native vegetation including *Melaleuca nervosa* and *M. viridiflora*.	10	0	0	0
Disturbed	Previously cleared areas and highly modified.	127.1	16.2	0	22.3
Total	-	**458.6**	**44.6**	**7.3**	**22.3**

[2] *While obviously not a land unit, Annie's Dam contains 'natural' features and habitat for fauna (as opposed to disturbed mining-related water bodies that exist elsewhere in the footprint).*

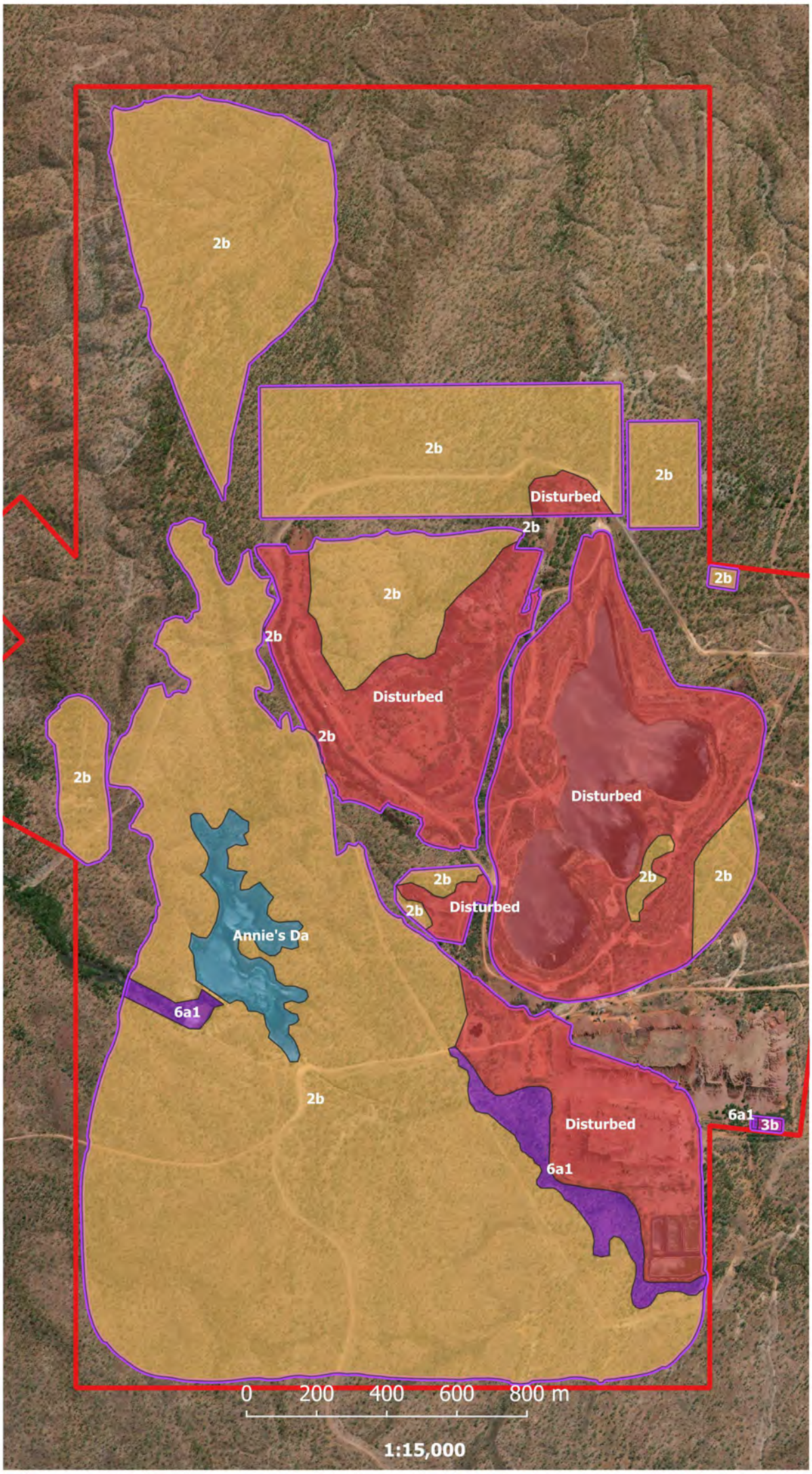

Figure 8 - Land units in the Rustlers Roost survey area

Key

- Disturbance footprint / survey area
- Rustlers Roost project area

Land units

- 2b
- 3b
- 6a1
- Disturbed

ESRI Satellite

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

CONNECT environmental

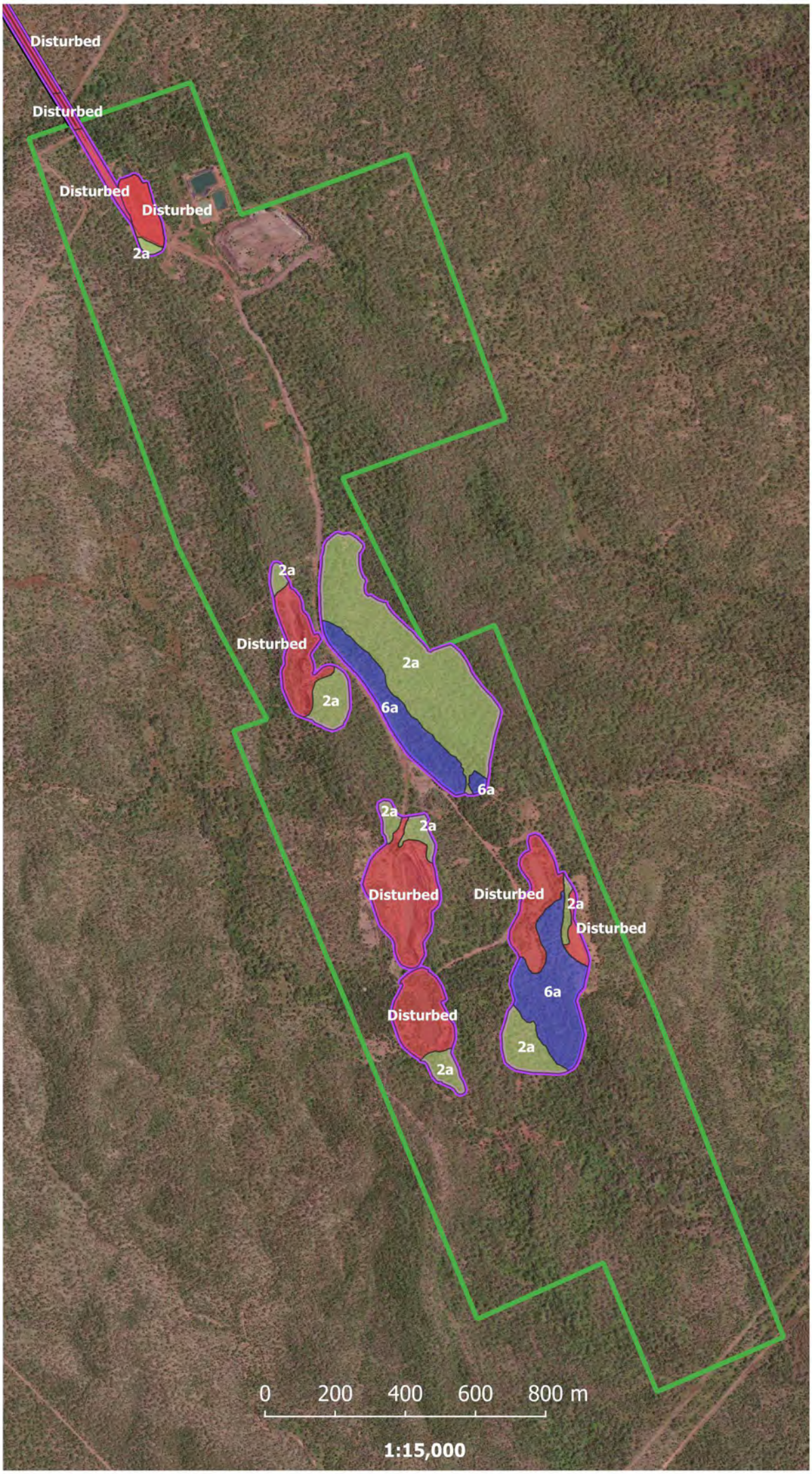

Figure 9

Land units in the Quest 29 survey area

Key

- Disturbance footprint / survey area
- Quest 29 project area

Land units

- 2a
- 6a
- Disturbed

ESRI Satellite

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

CONNECT environmental

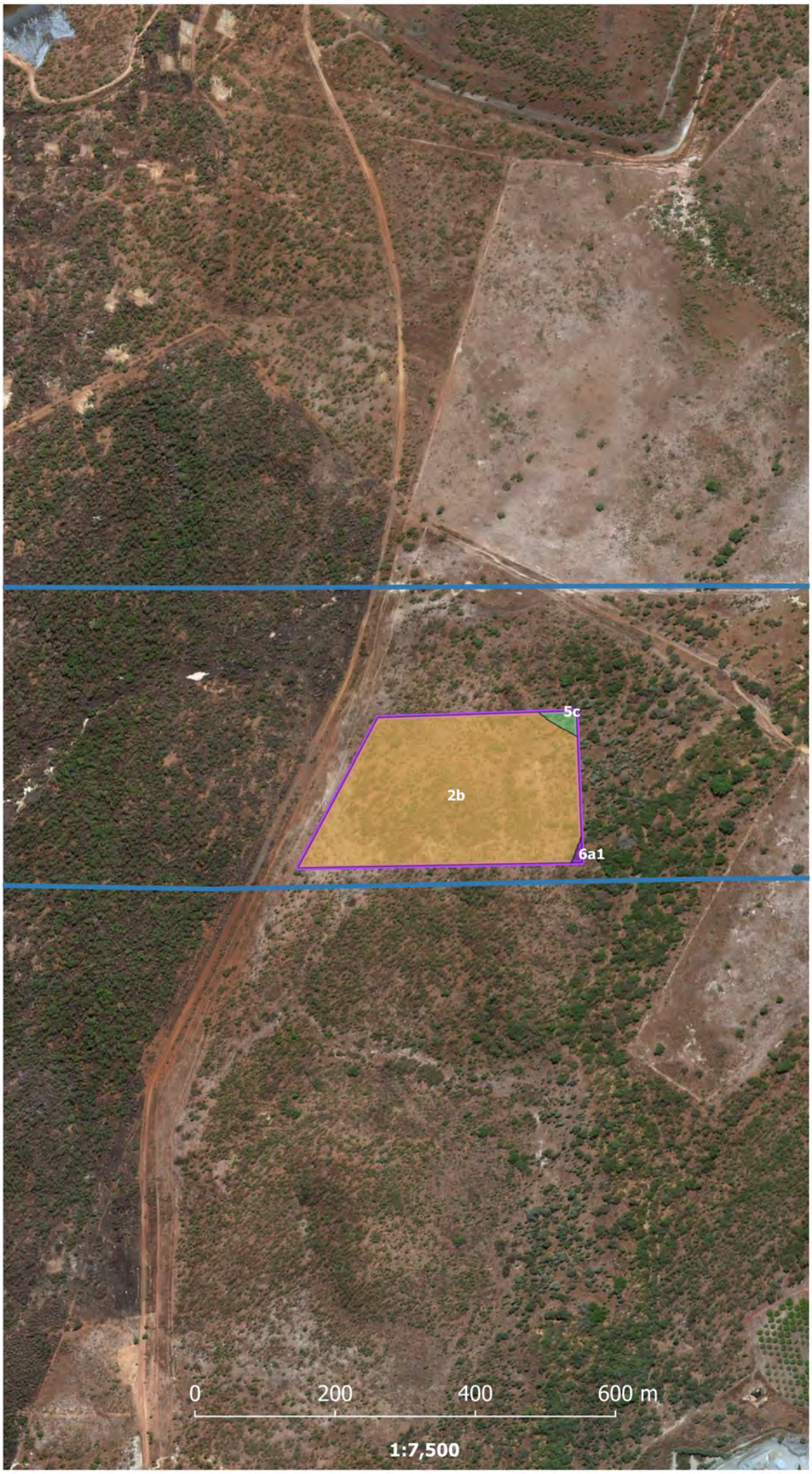

Figure 10 - Land units in the Toms Gully survey area

Key

Disturbance footprint / survey area

Toms Gully project ar

Land units

2b

5c

6a1

ESRI Satellite

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

CONNECT environmental

4.2 Cameras

Fourteen mammal, three amphibian, six reptile and 20 bird species were detected on cameras. The results are detailed in **Table 9**, **Table 10** and **Table 11**. Four threatened species were detected (Northern Brushtail Possum, Black-footed Tree-rat, Merten's Water Monitor and Partridge Pigeon). The three species detected on the highest number of cameras were the Agile Wallaby (23 cameras), the Peaceful Dove (19 cameras) and the Northern Brown Bandicoot (13 cameras).

4.3 Masked Owl Call Broadcast Surveys

No Masked Owls were detected during the broadcast surveys, however three other owl species were (refer to **Table 8**).

Table 8 Broadcast survey results (fauna species heard or observed)

Common name	Scientific name	Rustlers Roost			Quest 29	Toms Gully	Total
		R-CP1	R-CP2	R-CP3	Q-CP1	T-CP1	
Birds							
Australian Owlet-nightjar	*Aegotheles cristatus*	x					1
Southern Boobook	*Ninox novaeseelandiae*	x	x	x	x	x	5
Eastern Barn Owl	*Tyto javanica*	x					1
Total		**3**	**1**	**1**	**1**	**1**	**3 spp.**

4.4 Bat Echolocation Survey

Call data analysis positively identified seven bat species, as shown in **Table 12**. Up to four other species may also have been recorded, but poor data quality, lack of local reference calls and/or interspecific call similarities precluded reliable identification of additional species. Many calls were labelled as low frequency emitting species from the Molossidae or Emballonuridae families and a lack of diagnostic information prevented identification to species level. The Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus*) was not identified from the dataset. Refer to **Appendix A** for the full report.

4.5 Yellow-snouted Gecko Survey Transects

The results of the Yellow-snouted Gecko survey spotlighting walking transects are shown in **Table 13**. No Yellow-snouted Geckos were detected. A total of 24 other fauna species were observed, including the Crowned Gecko (*Lucasium stenodactylus*) and one threatened species (Black-footed Tree-rat).

Table 9 Birds detected on camera (green shading indicates a threatened species)

Site	Cam	Cattle Egret	Australian white-Ibis	Greater Bowerbird	Partridge Pigeon	Emerald Dove	Bar-shouldered Dove	Diamond Dove	Peaceful Dove	Grey Shrike-thrush	White-winged Triller	Pheasant Coucal	Blue-Winged Kooka-burra	Northern Fantail	Torresian Crow	Magpie Lark	Willie Wagtail	Double Bar Finch	Masked Finch	Crimson Finch	Brown Quail	Total
Rustlers Roost																						
C1																						0
R1	27								x						x	x						3
R2	5						x	x	x			x			x		x	x		x		8
R3	39	x	x						x			x			x						x	6
R4	52																					0
R5	30						x		x	x	x				x							5
R6	34								x						x		x					3
R7	38							x	x													2
R8	37				x			x	x		x								x			4
R9	36																					0
R10	9						x								x			x				3
R11	44																x					1
R12	41													x								1
R13	42								x													1
R14	50								x													1
R15	35								x													1
R16	17								x													1
R17	12								x						x							2
R18	48																					0
R19	32						x		x													2
R20	28																					0
R21	51								x										x			2
R22	49							x			x											2
R23	6								x													1
R24	15																					0
Quest 29																						
C2	7																					0
R24-2	31								x													1
R25	1			x					x													2
R26	16						x					x	x									3
R27	45								x		x						x					3
R28	8																					0
R29	23																					0
Toms Gully																						
R30	40						x															1
R31	21								x													1
R32	29			x		x	x															3
Total	**35 cam's**	**1**	**1**	**2**	**1**	**1**	**7**	**4**	**19**	**1**	**4**	**3**	**1**	**1**	**7**	**1**	**4**	**2**	**2**	**1**	**1**	**20 species**

Table 10 Mammals detected on cameras (green shading indicates a threatened species, blue shading indicates an unconfirmed detection due to an unclear image or lack of identifying features)

Site	Cam	Northern Brown Bandicoot (*Isoodon macrourus*)	Agile Wallaby (*Macropus agilis*)	Antilopine Wallaroo (*Osphranter antilopinus*)	Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*)	Black-footed Tree-rat (*Mesembriomys gouldii*)	Dasyurid (unknown species)	Western Chestnut Mouse (*Pseudomys nanus*)	Black Rat (*Rattus rattus*)	Common Rock-rat (*Zyzomys argurus*)	Short-beaked Echidna (*Tachyglossus aculeatus*)	Cat (*Felis catus*)	Cattle (*Bos taurus*)	Wild Dog / Dingo (*Canis familiaris dingo*)	Pig (*Sus scrofa*)	TOTAL
Rustlers Roost																
C1																0
R1	27	x	x	x							x					4
R2	5	x	x	x				x			x				x	5
R3	39	x	x										x		x	4
R4	52															0
R5	30		x													1
R6	34										x					1
R7	38			x												1
R8	37	x	x	x												3
R9	36			x	x											2
R10	9	x	x		x	x									x	5
R11	44		x													1
R12	41		x													1
R13	42	x	x			x										3
R14	50	x				x		x					x			4
R15	35		x	x									x			3
R16	17	x	x	x									x	x		5
R17	12			x											x	2
R18	48		x										x			2
R19	32		x													1
R20	28	x		x							x					3
R21	51	x		x							x					3
R22	49		x								x					2
R23	6			x		x					x	x				4
R24	15		x				x									2
Quest 29																
C2	7		x												x	2
R24-2	31	x	x												x	2
R25	1		x													1
R26	16		x												x	2
R27	45	x	x						x[3]							3
R28	8															0
R29	23		x						x							2
Toms Gully																
R30	40	x	x		x					x						4

[3] *Images show the animal apparently lacking the typical features of Rattus tunneyi (noted here to rule out that threatened species)*

Site	Cam	Northern Brown Bandicoot (*Isoodon macrourus*)	Agile Wallaby (*Macropus agilis*)	Antilopine Wallaroo (*Osphranter antilopinus*)	Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*)	Black-footed Tree-rat (*Mesembriomys gouldii*)	Dasyurid (unknown species)	Western Chestnut Mouse (*Pseudomys nanus*)	Black Rat (*Rattus rattus*)	Common Rock-rat (*Zyzomys argurus*)	Short-beaked Echidna (*Tachyglossus aculeatus*)	Cat (*Felis catus*)	Cattle (*Bos taurus*)	Wild Dog / Dingo (*Canis familiaris dingo*)	Pig (*Sus scrofa*)	TOTAL
R31	21		x													1
R32	29	x														1
Total	**34 cam's**	**13**	**23**	**11**	**3**	**4**	**1**	**2**	**2**	**1**	**7**	**1**	**5**	**1**	**7**	**14 species**

Table 11 Reptiles and frogs detected on cameras (green shading indicates a threatened species)

Site	Cam	Northern Ctenotus (*Ctenotus borealis*)	Frill-necked Lizard (*Chlamydosaurus kingii*)	Two-lined dragon (*Diporiphora bilineata*)	Mertens' Water Monitor (*Varanus mertensi*)	Spotted Tree Monitor (*Varanus scalaris*)	Varanus sp.	Ornate Burrowing Frog (*Platyplecturm ornatum*)	Marbled Frog (*Limnodynastes convexiusculus*)	Cane Toad (*Rhinella marina*)	TOTAL
Rustlers Roost											
C1					x						1
R1	27			x							1
R2	5				x			x	x	x	4
R3	39										0
R4	52										0
R5	30	x			x						2
R6	34										0
R7	38										0
R8	37	x								x	2
R9	36										0
R10	9									x	1
R11	44									x	1
R12	41										0
R13	42				x						1
R14	50									x	1
R15	35										0
R16	17										0
R17	12										0
R18	48										0
R19	32			x							1
R20	28										0
R21	51			x							1
R22	49										0
R23	6										0
R24	15	x									1
Quest 29											
C2	7										0
R24-2	31										0
R25	1										0
R26	16						x				1

Site	Cam	Northern Ctenotus (*Ctenotus borealis*)	Frill-necked Lizard (*Chlamydosaurus kingii*)	Two-lined dragon (*Diporiphora bilineata*)	Mertens' Water Monitor (*Varanus mertensi*)	Spotted Tree Monitor (*Varanus scalaris*)	Varanus sp.	Ornate Burrowing Frog (*Platyplecturm ornatum*)	Marbled Frog (*Limnodynastes convexiusculus*)	Cane Toad (*Rhinella marina*)	TOTAL
R27	45										0
R28	8										0
R29	23										0
Toms Gully											
R30	40										0
R31	21		x				x				2
R32	29										0
Total	**34 cam's**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**5**	**1**	**9 species**

Table 12 Bat species confirmed ('definite') during the bat echolocation surveys

Common name	Scientific name	Conservation status[4]		Rustlers Roost						Quest 29		Total
		EPBC Act	TPWC Act	A-RR1	A-RR2	A-RR3	A-RR4	A-RR5	A-RR6	A-Q1	A-Q2	
Northern Freetail Bat	*Chaerephon jobensis*	Not listed	LC	x	x	x		x				4
Orange Leaf-nosed Bat	*Rhinonicteris aurantia*	Not listed	NT					x				1
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	Not listed	LC	x	x	x		x	x			5
Little Broad-nosed Bat	*Scotorepens greyii*	Not listed	LC					x				1
Common Sheath-tailed Bat	*Taphozous georgianus*	Not listed	LC	x								1
Arnhem Sheath-tailed Bat	*Taphozous kapalgensis*	Not listed	NT	x	x			x				3
Northern Cave Bat	*Vespadelus caurinus*	Not listed	LC		x			x				2
Total		**-**	**-**	**4**	**4**	**2**	**0**	**6**	**1**	**0**	**0**	**7 spp.**

Table 13 Yellow-snouted Gecko spotlighting transect results (green shading indicates a threatened species)

Common name	Scientific name	Rustlers Roost						Quest 29	Toms Gully		Total
		R-S1-1	R-S1-2	R-S2	R-S3	R-S4	R-S5	Q-S1	T-S1-1	T-S1-2	
Birds											
Australian Owlet-nightjar	*Aegotheles cristatus*		x				x				2
Bush Stone-curlew	*Burhinus grallarius*						x				2
Spotted Nightjar	*Eurostopodus argus*	x	x								2
Southern Boobook	*Ninox novaeseelandiae*		x					x	x		3
Eastern Barn Owl	*Tyto javanica*			x							1

[4] *LC = least concern, NT = near threatened,*

Common name	Scientific name	Rustlers Roost						Quest 29	Toms Gully		Total
		R-S1-1	R-S1-2	R-S2	R-S3	R-S4	R-S5	Q-S1	T-S1-1	T-S1-2	
Mammals											
Black-footed Tree-rat	*Mesembriomys gouldii gouldii*					x					1
Short-beaked Echidna	*Tachyglossus aculeatus*						x				1
Reptiles											
Children's Python	*Antaresia childreni*	x			x						2
Rainbow Skink	*Carlia* sp.					x					1
Northern Dtella	*Gehyra australis*	x	x	x		x	x				5
Bynoe's Gecko	*Heteronotia bynoei*	x	x		x	x	x				5
Crowned Gecko	*Lucasium stenodactylum*				x						1
Frogs											
Cane Toad	*Bufo marinus*	x	x			x		x			4
Giant Frog	*Cyclorana australis*			x							1
Marbled Frog	*Limnodynastes convexiusculus*		x	x			x	x			4
Green Tree Frog	*Litoria caerulea*	x	x	x							3
Peter's Frog	*Litoria inermis*	x	x	x	x		x	x			6
Rocket Frog	*Litoria nasuta*			x		x	x				3
Roth's Tree Frog	*Litoria rothii*			x							1
Red Tree Frog	*Litoria rubella*			x							1
Tornier's Frog	*Litoria tornieri*							x			1
Wotjulum Frog	*Litoria watjulumensis*			x	x	x	x				4
Northern Spadefoot Toad	*Natoden melanoscaphus*						x				1
Ornate Burrowing Frog	*Platyplectrum ornatum*	x	x					x			3

Common name	Scientific name	Rustlers Roost						Quest 29	Toms Gully		Total
		R-S1-1	R-S1-2	R-S2	R-S3	R-S4	R-S5	Q-S1	T-S1-1	T-S1-2	
Total		**8**	**10**	**11**	**5**	**7**	**10**	**6**	**1**	**0**	**25 spp.**

4.6 Incidental Sightings

Fauna incidentally observed during the surveys are listed in **Table 14**. This does not include diurnal bird species. Two threatened species were incidentally observed (Black-footed Tree-rat and Merten's Water Monitor).

Table 14 Incidental sightings of fauna (excluding diurnal birds) (green shading indicates a threatened species)

Common name	Scientific name	Rustlers Roost	Quest 29	Toms Gully	Haul Road[5]	Total
Birds						
Australian Owlet-nightjar	*Aegotheles cristatus*				x	1
Spotted Nightjar	*Eurostopodus argus*	x			x	2
Southern Boobook	*Ninox novaeseelandiae*	x			x	2
Mammals						
Cattle	*Bos taurus*	x			x	2
Dingo / Wild Dog	*Canis familiaris dingo*	x				1
Black-footed Tree-rat	*Mesembriomys gouldii gouldii*				x[6]	1
Feral Pig	*Sus scrofa*	x				1
Reptiles						
Children's Python	*Antaresia childreni*	x			x	2
Black-headed Python	*Aspidites melanocephalus*		x			1
Freshwater Crocodile	*Crocodylus johnstoni*	x				1
Olive Python	*Liasis olivaceus*				x	1
Merten's Water Monitor	*Varanus mertensi*	x			x	2
Frogs						
Cane Toad	*Bufo marinus*	x	x		x	3
Dahl's Aquatic Frog	*Litoria dahlii*	x				1
Wotjulum Frog	*Litoria watjulumensis*				x	1
Total		**10**	**2**	**0**	**10**	**15 spp.**

4.7 Detected Threatened Fauna

Four threatened fauna species were detected:

- Partridge Pigeon
- Black-footed Tree-rat
- Northern Brushtail Possum
- Merten's Water Monitor.

[5] *Including creek lines along the Haul Road*

[6] *Observed while driving along the Haul Road*

Observations of each species are discussed in the following sections. No threatened species was detected within the Quest 29 survey area, which is consistent with results of survey conducted in 2016 and 2017 (LES, 2017). However, habitats within that area may still provide some resources for threatened fauna. It is possible that these species occur in other areas, however the survey methodology was designed to reduce the risk of 'false negative' results. Further, the survey objective was to determine the presence or absence of a species at a site. Using the survey results, some inferences could be made of finer-scale areas that each detected species occupies within the local landscape, however a more conservative approach was taken which was to simply assume that a species that has been detected in an area could occupy all apparently suitable habitats in that area. The areas that an individual utilises would likely change from season to season or in response to other variables such as fire, changes in land use or threatening processes, though it is important to recognise the limitations and practicalities of the survey approach.

4.7.1 Partridge Pigeon

Partridge Pigeons were detected at only one location (site R8 (camera 37); approximately 250 m south of Annie's Dam in the Rustlers Roost project area) (refer to **Figure 13** and **Figure 14**). Habitat within the detection area was comprised of a *Corymbia* and *Eucalyptus* woodland with dominant species being Bloodwood (*Corymbia bleeseri*), Ironwood (*Erythrophleum chlorostachys*), Darwin Woollybutt (*Eucalyptus miniata*), *Grevillea decurrens* and Sand Palm (*Livistona humilis*).

Partridge Pigeons live in grassy eucalypt woodlands across the top end (DEPWS, 2021d). They forage on the ground for grass and shrub seeds and make small scale movements seasonally in response to changes in the abundance and distribution of suitable seed (DEPWS, 2021d).

It is possible that all, or most, suitable habitat within all three survey areas (refer to **Table 15**) is occupied by the species but that it occurs at very low densities. The survey results align with those from surveys conducted in 2016 and 2017, when the species was not detected (LES, 2017). The NT Fauna Atlas contains records of the species from in the northern section of the Toms Gully mining project. Much of the lower lying habitats within the Quest 29 survey area is heavily infested with weeds including Calopo (*Calopogonium mucunoides*) and Cobbler's Peg (*Bidens pilosa*) which would likely have made these areas unsuitable for the species.

Table 15 Areas of potential suitable habitat for the Partridge Pigeon in each survey area

Species	Areas detected	Suitable land units[7]	Estimated density or distribution	Area (ha)				Total (ha)
				Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Partridge Pigeon	Rustlers Roost	2b, 2b, 3b	Very low density	312	18	7	0	**337**

4.7.2 Black-footed Tree-rat

Black-footed Tree-rats were detected on six occasions, of which five were within the Rustlers Roost survey area (refer to **Figure 13**) and one while driving along the haul road. Four of the detections in the Rustlers Roost survey area were on camera and one (of two individuals) during a spotlighting transect for Yellow-snouted Geckos. Brief habitat descriptions at each of the detection sites is provided in **Table 16**. The species was not detected in the Toms Gully and Quest 29 survey areas.

Black-footed Tree-rats typically live in *Eucalyptus miniata* and/or *E. tetrodonta* woodlands that have a well-vegetated shrub layer (DEPWS, 2021a). They are known to forage at least 500 m from roost sites (TSSC,

[7] *Land units which contain apparently suitable habitat though the species may not have been recorded there and therefore may not actually be suitable.*

2015c) within a home range of approximately 67 ha in unfragmented habitats (Rankmore, 2006). Diurnal den sites for an individual are distributed across an area of at least 15 ha (DEPWS, 2021c).

Within the Rustlers Roost survey area, specific parts of the habitats used by the species will vary over time and in response to biotic and non-biotic interactions such as fires, habitat productivity, feral animals and land use activities. As such, given the species was detected in most parts of the survey area, it is concluded that all suitable land units (shown in **Table 17**) could be utilised by the species.

In the Quest 29 survey area, many of the lower lying valley floors and drainage depressions were matted with a dense layer of weeds including Calopo and Cobbler's Peg. Some areas were also heavily modified by previous mining activities and contained tracks, dams, pits or rock piles with substantially modified and simplified vegetation communities. These areas were not expected to provide suitable habitat for Black-footed Tree-rats. However, the steeper slopes and ridges with remnant woodlands areas frequently contained tall *E. miniata* woodland with good shrub and ground layer vegetation. These areas were not specifically targeted for cameras because they were fragmented and on the fringes of the survey area, however there is no obvious reason to suggest that the species does not occupy them (except where patches of suitable habitat are isolated), particularly as the surrounding landscape is mostly intact. As such, areas mapped as land unit 2a in the Quest 29 survey area are determined as being potentially suitable for the species (refer to **Table 17**).

In the Toms Gully survey area, the species was not detected despite the presence of apparently suitable habitat. Some lower lying areas, particularly adjacent to vehicle tracks, were devoid of intact vegetation communities and contained patches of Gamba Grass. On the slopes, Cobbler's Peg and Hyptis were patchily distributed amongst remnant vegetation, in some areas creating thick, almost impenetrable blankets. Specifically, in the proposed accommodation facility area, habitats were somewhat isolated with cleared areas for horticulture and vehicle tracks viewable in the vicinity of its western, northern and eastern boundaries. All in all, in theory, the cameras should have detected the species if it was there and therefore it is concluded that the species was not present in those areas at the time of the surveys.

Table 16 Habitat descriptions at the locations of the Black-footed Tree-rat detections

Detection type	Site (cam no.)	Dominant tree species and habitat description
Rustlers Roost		
Spotlighting transect	R-S4	Laterite, dense leaf litter, Darwin Stringybark (*Eucalyptus tetrodonta*), Bloodwood (*Corymbia bleeseri*), Green Plum (*Buchanania obovata*)
Camera	R10 (cam 9)	Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), Sand Palm (*Livistona humilis*)
Camera	R13 (cam 42)	Bottom of slope near edge of Annie's Dam and Broad-leaved Paperbark (*Melaleuca viridiflora*), Darwin Woollybutt (*Eucalyptus miniata*), Small-fruited Bloodwood (*Corymbia dichromophloia*), Ironwood (*Erythrophleum chlorostachys*)
Camera	R14 (cam 50)	Small gully, Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), *Acacia* spp.
Camera	R23 (cam 6)	Darwin Woollybutt (*Eucalyptus miniata*), Darwin Stringybark (*Eucalyptus tetrodonta*), Bloodwood (*Corymbia bleeseri*)
Haul road		
Incidental observation	Haul road	Apple Gum (*Corymbia polysciada*), Darwin Woollybutt (*Eucalyptus miniata*) low open woodland

Table 17 Areas of potential suitable habitat for the Black-footed Tree-rat in each survey area

Species	Areas detected	Suitable land units[8]	Estimated density or distribution	Area (ha)				Total (ha)
				Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Black-footed Tree-rat	Rustlers Roost, Haul Road	2a, 2b, 3b, 6a, 6a1 (except at Quest 29 where it is 2a only)	Widespread (density unclear)	321.5	18.5	0	0	**340**

4.7.3 Northern Brushtail Possum

Northern Brushtail Possums were detected at three locations, of which two were in the Rustlers Roost project area and one was within the Toms Gully project area (refer to **Figure 13**). Brief habitat descriptions at each of the detection sites are provided in **Table 18**.

Northern Brushtail Possums typically live in tall eucalypt woodlands where they use tree hollows as daytime shelters (TSSC, 2021). They've also been recorded in mangroves, rainforests and semi-urban areas (TSSC, 2021). The species breeds year-round (McKay, 2017; TSSC, 2021) with home range estimates of:

- 1.12 ha for males (slightly smaller for females) and a range length of up to 165 m (Kerle, 1998).
- 4 ha for males (2.5 ha for females) (Ganslosser, 1990 cited in Milich (2002).

Ward (1984) suggests that most home range estimates (for New Zealand possums) are likely to be significantly low because they are based on trapping rather than radio tracking.

Whilst limited conclusions can be made using the survey results, particularly because cameras were deployed at a rate of approximately one camera per 50 ha (which is a greater spacing than the reported home ranges for Northern Brushtail Possums (see below), there are some inferences that can be made based on the survey findings:

- The species is assumed not to be widespread or abundant but rather that it occurs patchily in suitable habitat.
- The species could occur in the Quest 29 survey area though only in areas not heavily affected by previous mining activities. These areas often contained thick mats of weeds such as Calopo and Cobbler's Peg or had been cleared and would provide little value to the species. Areas more suitable for the species were observed to be confined to slopes or ridges (i.e., away from creek lines or depressions).

In this regard, all apparently suitable habitats within the Rustlers Roost survey area are acknowledged as containing known or probable habitat for Black-footed Tree-rats.

Table 18 Habitat descriptions at the locations of the Northern Brushtail Possum detections

Detection type	Site (cam no.)	Dominant tree species and habitat description
Rustlers Roost		
Camera	R9 (cam 36)	Darwin Woollybutt (*Eucalyptus miniata*), Bloodwood (*Corymbia bleeseri*), Gardenia (*Gardenia megasperma*), Sand Palm (*Livistona humilis*). Siltstone rock.
Camera	R10 (cam 9)	Darwin Woollybutt (*Eucalyptus miniata*), Ironwood (*Erythrophleum chlorostachys*), Green Plum (*Buchanania obovata*), Sand Palm (*Livistona humilis*)
Toms Gully		

[8] *Land units which contain apparently suitable habitat though the species may not have been recorded there and therefore may not actually be suitable.*

Detection type	Site (cam no.)	Dominant tree species and habitat description
Camera	R30 (cam 40)	Darwin Stringybark (*Eucalyptus tetrodonta*), Ironwood (*Erythrophleum chlorostachys*), Bloodwood (*Corymbia bleeseri*), hilltop, rocky.

Table 19 Areas of potential suitable habitat for the Northern Brushtail Possum in each survey area

Species	Survey areas detected	Suitable land units[9]	Estimated density or distribution	Area of apparently suitable habitat (ha)				Total (ha)
				Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Northern Brushtail Possum	Rustlers Roost, Toms Gully	2a, 2b, 3b, 6a and 6a1 (except at Quest 29 where it is 2a only)	Patchy	321.5	18.5	7.2	0	**329**

4.7.4 Merten's Water Monitor

Merten's Water Monitor was detected at eight locations, of which six were within the Rustlers Roost survey area, one along the Haul Road and one adjacent to the south-east corner (outside) of the Rustlers Roost survey area (refer to **Figure 13**). Brief habitat descriptions and a photo at each of detection point is provided in **Table 20**.

Within the Rustlers Roost survey area, areas of suitable habitat include:

- Land unit 6a1 (9.2 ha) – two areas exist:
  - A drainage line that is fed by a creek running south from the eastern side of the existing pit snaking its way to the western side of the existing heap leach pad and exiting the survey area at the south-east corner. This creek is also fed by an apparent overflow pipe from the existing pit which, in April 2022, was flowing heavily and flooding the mapped land unit area.
  - A drainage line to the south-west of Annie's Dam.
- Annie's Dam (~10 ha)
- Small dams and waterways within the mapped disturbed areas (approximately 1-2 ha).

The existing pit area was not surveyed. Most of these areas appear to contain water during the wet season only, although it is understood Annie's Dam contains some water all year round.

While the species was not detected within the Quest 29 survey area, it probably occurs there, at least from time to time. At least two water bodies exist within previously disturbed areas (with a total area of approximately 1 ha) and about 1 km of ephemeral creek line habitat. While the area is substantially affected by previous mining activities, aquatic habitats still appeared to be able to support organisms including fish and crustaceans.

[9] *Land units which contain apparently suitable habitat though the species may not have been recorded there and therefore may not actually be suitable.*

Table 20 Locations of Merten's Water Monitor detections

Detection type	Site (cam no.)	Dominant tree species and habitat description	Photo of habitat at site of detection
Rustlers Roost			
Camera	C1	At pipe outlet, weedy (Calopo, Hyptis), Darwin Box (*Eucalyptus tectifica*), Northern Salmon Gum (*Eucalyptus bigalerita*), Ironwood (*Erythrophleum chlorostachys*), Pindan Wattle (*Acacia platycarpa*)	 7 April 2022

Detection type	Site (cam no.)	Dominant tree species and habitat description	Photo of habitat at site of detection
Incidental	Near C1	Disturbed ponds, dead trees along some areas of depression.	 4 May 2022

Detection type	Site (cam no.)	Dominant tree species and habitat description	Photo of habitat at site of detection
Camera	R2 (cam 5)	Weedy, Bloodwood (*Corymbia bleeseri*), Acacia spp., Milkwood (*Alstonia actinophylla*), Northern Salmon Gum (*Eucalyptus bigalerita*)	 4 May 2022
Camera	R5 (cam 30)	On edge of Annie's Dam, *Gardenia megasperma*, Salmon Gum (*Eucalyptus bigalerita*), Bloodwood (*Corymbia bleeseri*).	-
Incidental	Near R5		-
Camera	R13 (cam 42)	Bottom of slope near edge of Annie's Dam and Broad-leaved Paperbark (*Melaleuca viridiflora*), Darwin Woollybutt (*Eucalyptus miniata*), Small-fruited Bloodwood (*Corymbia dichromophloia*), Ironwood (*Erythrophleum chlorostachys*)	-
Haul Road			

Detection type	Site (cam no.)	Dominant tree species and habitat description	Photo of habitat at site of detection
Incidental	Creek crossing 2.3 km east of Rustlers Roost	Adjacent to bridge, deeply incised creek line, *Lophostemon lactifluus*, *Melaleuca viridiflora*.	-
Outside project areas			
Incidental	450 m east of wastewater ponds at south-east corner of Rustlers Roost project area	Shallow rocky creek crossing, open.	 7 May 2022

Table 21 Areas of potential suitable habitat for Merten's Water Monitor in each survey area

Species	Areas detected	Suitable land units[10]	Estimated density or distribution	Area (ha)				Total (ha)
				Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Merten's Water Monitor	Rustlers Roost, Haul Road	6a1, Annie's Dam, disturbed areas	Appeared common	20	1-2	0	0	**21-22**

4.8 Undetected Threatened Fauna

4.8.1 Gouldian Finch

Gouldian Finches were not targeted during the surveys as the survey timing was unsuitable for the methods that were considered appropriate (i.e., water hole counts). No Gouldian Finches were observed, however three other finch species were (Double-barred Finches, Masked Finches and Chestnut-breasted Mannikins). The Gouldian Finch's breeding season is approximately from February to October, during which time it occupies rocky hills dominated by Salmon Gums (*Eucalyptus tintinnans*), or Snappy Gums (*E. leucophloia* or *E. brevifolia*) (DEPWS, 2021b; TSSC, 2016a). During the non-breeding season, they disperse into the surrounding landscape in search of suitable grass seeds (TSSC, 2016a).

Two areas of potentially suitable breeding habitat were observed throughout the three survey areas, both of which occurred in the Rustlers Roost survey area (refer to **Figure 11**). The largest area was west and north of Annie's Dam where the terrain is hilly. Salmon Gums (*E. tintinnans*) were not observed to be a dominant feature of the landscape but were present occasionally. Another, smaller area was observed east of the existing pit on the hill side. The total of these areas is 43.6 ha, though this includes creek lines.

Breeding habitat is described by the TSSC (2016a) as "ridges dominated by cavity bearing trees such as… Territory salmon gum (*E. tintinnans*)." Rather, these areas were dominated by Small-fruited Bloodwood (*Corymbia dichromophloia*), Bloodwood (*C. bleeseri*), Darwin Woollybutt (*E. miniata*) and Ironwood (*Erythrophleum chlorostachys*), and not Salmon Gums.

No areas of potentially suitable breeding habitat for Gouldian Finches were observed in either the Quest 29 or Toms Gully survey areas. However, the species is likely to occur in all three survey areas when foraging during the non-breeding season.

Table 22 Potentially suitable breeding habitat for Gouldian Finches

Species	Areas detected	Suitable land units[11]	Estimated density or distribution	Area (ha)				Total (ha)
				Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Gouldian Finch	None	2b	Uncertain (some marginal breeding habitat observed)	43.6	0	0	0	**43.6**

[10] *Land units which contain apparently suitable habitat though the species may not have been recorded there and therefore may not actually be suitable.*

[11] *Land units which contain apparently suitable habitat though the species may not have been recorded there and therefore may not actually be suitable.*

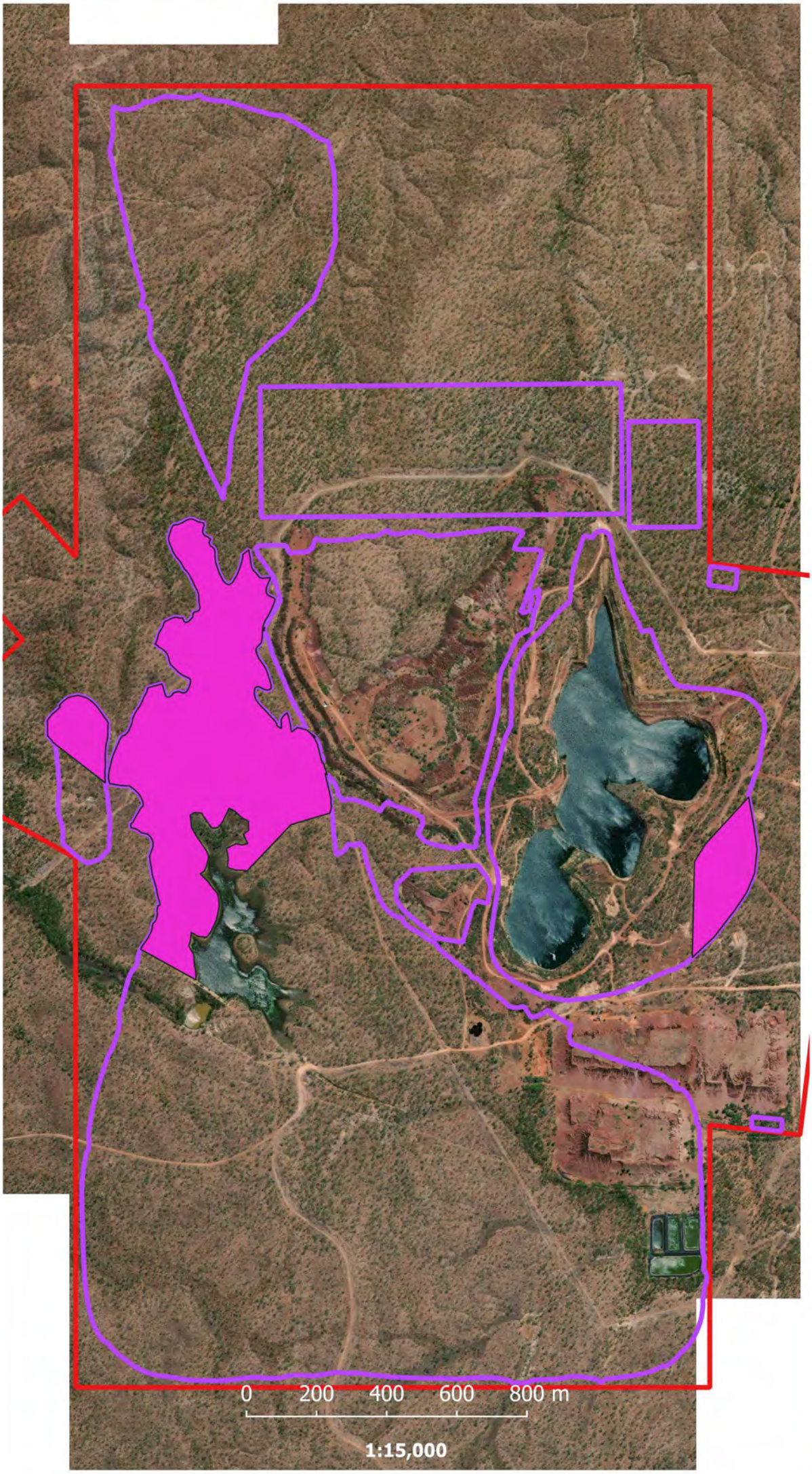

Figure 11
-
Potential breeding habitat for Gouldian Finches

Key

- Potential Gouldian Finch breeding habitat
- Disturbance footprint / survey area
- Rustler's Roost project area

ESRI Satellite

N

Client: CDM Smith
Date: 12 June 2022
Author: M. Proos
Geodatum: GDA 94 (z52)

CONNECT environmental

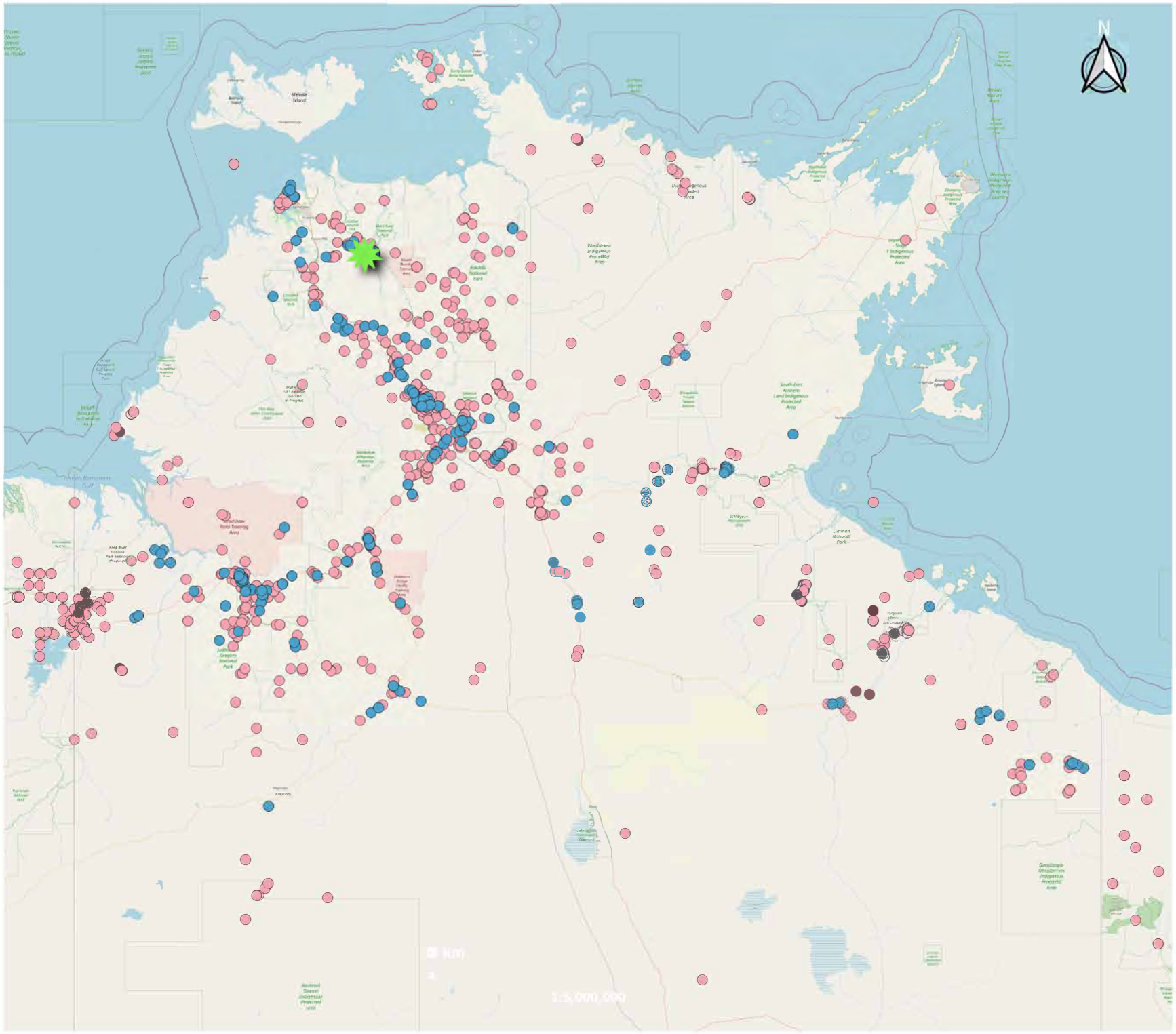

Figure 12
-
Gouldian Finch records as per the NT Fauna Atlas

Key

- Gouldian Finch
- Gouldian Finch (last 5 years)
- Project area

Background - OpenStreetMap

Client: CDM Smith
Date: 12 June 2022
Datum: GDA94
Author: M. Proos

CONNECT environmental

4.8.2 Red Goshawk

No Red Goshawk nests or individuals were observed during the surveys. Red Goshawks are reported to start nest-building in May, which was at the time of the surveys. Therefore, it is possible that nests had not been constructed by the time the surveys were conducted.

4.8.2.1 Rustlers Roost

Some areas of potentially suitable habitat were detected in the northern half of the Rustlers Roost survey area in areas where disturbances from mining or cattle were less evident and taller eucalypts (Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*) dominated the landscape. This includes within the areas of the proposed Process Plant and North Waste Rock Dump.

Within the southern parts of the Rustlers Roost survey area, Bloodwoods (*Corymbia bleeseri* and *C. dichromophloia*) were more prominent in the landscape and pastoral and mining activities (i.e., cattle grazing, tracks, fences and mining infrastructure) were more obvious. Consequently, it was concluded that Red Goshawks were less likely to use these areas.

Annie's Dam could be a source of prey (waterbirds) for Red Goshawks.

4.8.2.2 Quest 29

In general, Quest 29 was heavily disturbed, fragmented and weed infested. In addition, very few small mammals were detected. As a result, it was concluded that Red Goshawks are unlikely to utilise the habitats within Quest 29, at least for nesting or for foraging on a frequent basis. However, the landscape immediately surrounding Quest 29 appeared more intact and suitable for the species to utilise (though these areas were not investigated).

4.8.2.3 Toms Gully (Accommodation Camp)

The Toms Gully survey area did not appear particularly suitable for Red Goshawk nesting given its position in the landscape and co-dominance of Bloodwoods (*Corymbia bleeseri*), which are not known to grow over 20 m (NTH, 2013). The area could comprise suitable foraging habitat for the species.

4.8.3 Northern Quoll

Northern Quolls would probably have been detected in the survey areas if they occurred there. The species was once common in eucalypt forests though now appears to have retracted to rocky areas that provide refuge from threats (DEPWS, 2021c). Their home ranges are reported as being from 35-100 ha depending on its status of breeding (i.e., breeding / non-breeding) (DEPWS, 2021c).

4.8.3.1 Rustlers Roost

Similar to areas across the species' distribution, it appears that Cane Toads, existing land uses and threatening processes (e.g., frequent fires) have either reduced the quality of habitats within the Rustlers Roost survey area to the point where the species is unable to survive or individuals have succumbed to Cane Toad poisoning.

The northern parts of the Rustlers Roost survey area contained areas of taller eucalypts (Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*) though are burned frequently (almost annually – refer to **Section 2.2**). This high frequency of fire has reduced vegetation richness and structural complexity (including mid-storey vegetation) and coarse woody debris (such as hollow logs), which is a common consequence of areas that burn frequently (Aponte *et al*., 2014, cited in GBAP, 2021; Burbidge & McKenzie, 1989 and Woinarski & Ash, 2002 cited in Lawes *et al*., 2015).

The central western part that contains rocky hills is also exposed to frequent fires (on average one every two years) and, similarly, lacks vegetation with structural complexity.

Within the southern parts, Bloodwoods (*Corymbia bleeseri* and *C. dichromophloia*) were more prominent in the landscape and pastoral and mining activities (i.e., cattle grazing, tracks, fences and mining infrastructure) were more obvious.

Overall, no areas of 'habitat critical to the survival of the species', as defined in the *EPBC Act referral guidelines for the endangered northern quoll Dasyurus hallucatus* (DoE, 2016), were observed in the Rustlers Roost survey area.

4.8.3.2 Quest 29

In general, the Quest 29 survey area was heavily disturbed, fragmented and weed infested. In addition, very few small mammals were detected. As a result, it was probably expected that Northern Quolls (or any threatened fauna species) would not be detected there. On average, habitats within the Quest 29 survey area burn every two years (refer to **Section 2.2**) which would have substantially modified vegetation structural complexity. Given that the proposed disturbance area is centred on existing mining disturbance areas, the value of habitats is limited for Northern Quolls. As such, it is not expected that any areas of 'habitat critical to the survival of the species', as defined in the *EPBC Act referral guidelines for the endangered northern quoll Dasyurus hallucatus* (DoE, 2016), occur within the Quest 29 survey area.

4.8.3.3 Toms Gully (Accommodation Camp)

The accommodation camp part of the Toms Gully survey area comprises a low hill dominated by Darwin Woollybutt (*E. miniata*) and Darwin Stringybark (*E. tetrodonta*). At the top of the hill was a rocky outcrop with small rocks. The outcrop was probably not sufficient in extent or with large enough boulders to comprise suitable refuge habitat for Northern Quolls (i.e., they were not a range, escarpment, mesa, gorge, breakaway, or boulder field as described in the *EPBC Act referral guidelines for the endangered northern quoll Dasyurus hallucatus* (DoE, 2016)). Fires occur on average every 3-4 years and this is supported by greater structural complexity in vegetation when compared to Rustlers Roost where fires are more frequent.

4.8.4 Pale Field-rat

The Pale Field-rat was not detected in any of the survey areas. Of the three survey areas, Rustlers Roost contained habitat features that most closely resembled suitable habitat for the Pale Field-rat.

4.8.5 Yellow-snouted Gecko

Despite approximately 20 person hours of active searches, the Yellow-snouted Gecko was not detected in any of the survey areas. Similarly, the species was not detected during spotlighting surveys conducted by Low Ecological Services P/L in November 2016 and May 2017 (12 sites over six nights during each survey; LES, 2017).

4.8.6 Yellow-spotted Monitor

The Yellow-spotted Monitor was not detected in any of the survey areas.

4.8.7 Mitchell's Water Monitor

Mitchell's Water Monitor was not detected in any of the survey areas.

4.9 Introduced Species

Five introduced species were detected during the surveys – Wild Dog / Dingo, Feral Cat, Cane Toad, Feral Pigs and Cattle.

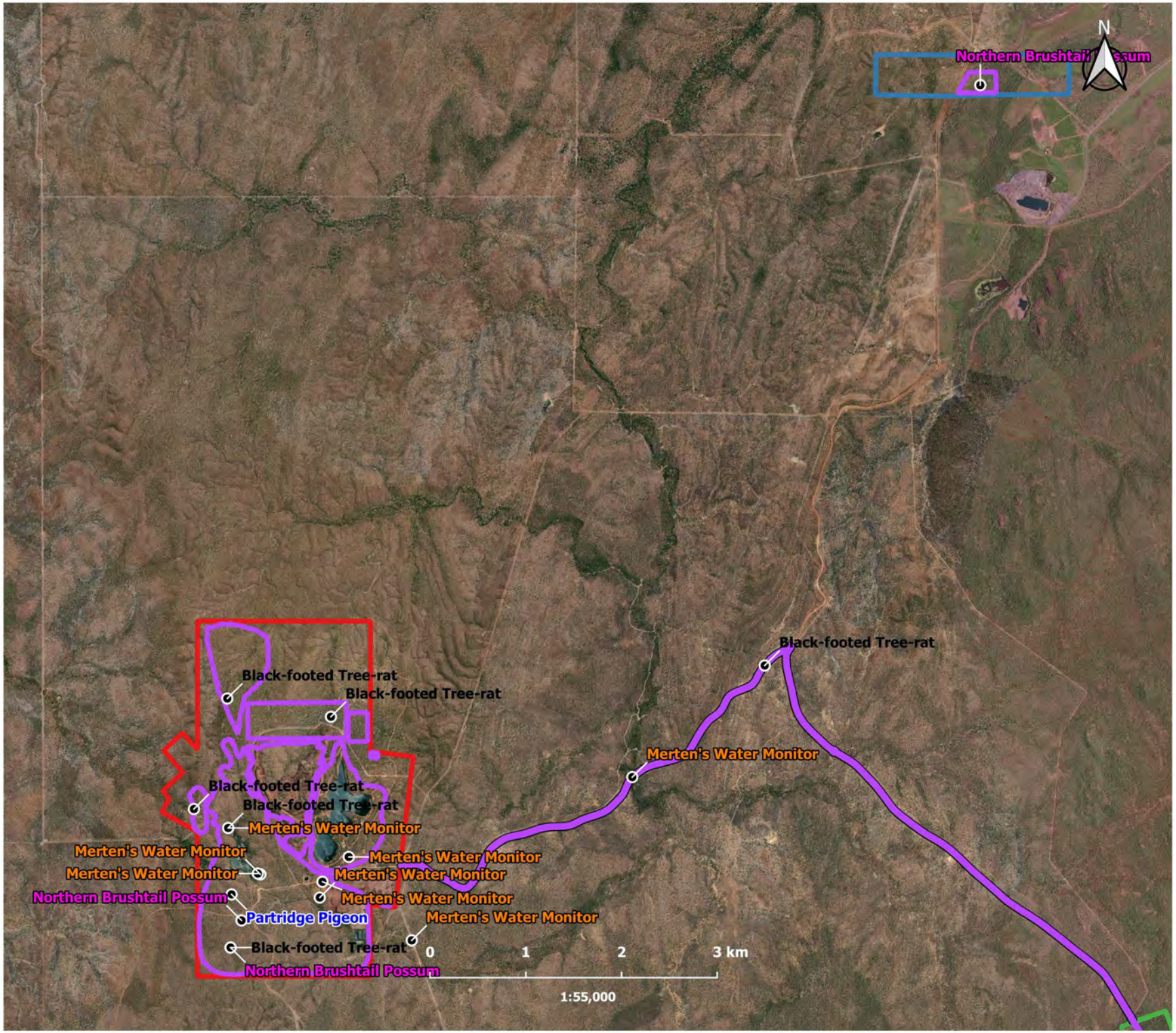

Figure 13

Locations of detected threatened species

Key

- Threatened species detection
- Disturbance footprint / survey area
- Haul road
- Tom's Gully
- Quest 29
- Rustler's Roost

Background - ESRI Satellite

Client: CDM Smith
Date: 12 June 2022
Datum: GDA94
Author: M. Proos

CONNECT environmental

Figure 14 Partridge Pigeon at camera site R8 (camera 37)

Figure 15 Black-footed Tree-rat at site R10 (camera 42)

Figure 16 Northern Brushtail Possum at site R10 (camera 9)

Figure 17 Merten's Water Monitor at site R13 (camera 42)

5 Likelihood of Occurrence of Undetected Target Species

Each target species that was not detected during the surveys has been assessed for its likelihood of being present in the survey areas, though was simply not detected or was not present at the time of the surveys. The assessment is based on the suitability of habitats observed within each survey area and the number and age of other records of each species in the region. **Table 23** contains the results of the assessment.

Table 23 Likelihood of occurrence of undetected target threatened species

Species	Assessment		
	Rustlers Roost	Quest 29	Toms Gully[12]
Gouldian Finch	**Possible (breeding)** – Wooded hills with Salmon Gums (*E. tintinnans*) were present in the mid-western parts of the Rustlers Roost survey area though they were not a dominant tree species like at a well-known breeding site 50 km north of Katherine (the Yinberrie Hills). Further, the area has a recent history of frequent fires (2000-2020) and pastoralism, which have contributed to the marked decline of the species (DEPWS, 2021). The species was also not observed during three surveys (November 2016 and May 2017 by Low Ecological Services, and May 2022 by Connect Environmental). While, in theory, these factors are likely to mean that the area may not be important for the species, it cannot be confirmed that the species does not breed in the area or will not breed in suitable trees in the future. No suitable habitat (wooded hills with *E. tintinnans*) was observed in the northern or southern areas of the Rustlers Roost survey area.	**Unlikely (breeding)** – No suitable breeding habitat (rocky hills dominated by *E. tintinnans*) was evident within the Quest 29 survey area. It probably forages sometimes in the area.	**Unlikely (breeding)** - No suitable breeding habitat (rocky hills dominated by *E. tintinnans*) was evident within the Toms Gully proposed accommodation site. It probably forages sometimes in the area.

[12] *The proposed accommodation site only.*

Species	Assessment		
	Rustlers Roost	Quest 29	Toms Gully[12]
Red Goshawk	**Possible** – Overall, given the history of mining and pastoralism and the tendency of Red Goshawks to avoid areas of fragmented native vegetation (TSSC, 2015), individuals of the species are probably unlikely to nest across much of the Rustlers Roost project area, particularly in the southern half where Bloodwoods (*Corymbia bleeseri*) were more prominent in the landscape and pastoral and mining activities were more obvious. The northern half (within the proposed Process Plant and North WRD) appeared less disturbed and more aligned to known nesting habitat features, such as taller forests and woodlands dominated by Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*). No nests were observed, noting that the survey may have been conducted prior to the nesting season, although the species was also not detected during previous surveys (LES, 2017).	**Unlikely -** Whilst the creek line that runs parallel to the main track contains tall eucalypt trees, the general area was heavily infested with weeds (see **Figure 18**), fragmented and no small native mammal species were detected. As such, it is not expected that Red Goshawks would nest in this area, and only very infrequently hunt there, if at all.	**Unlikely (nesting)** – Nesting habitat not apparently present.
Masked Owl	**Unlikely -** While parts of the Rustlers Roost survey area, particularly in the northern half (e.g., the proposed Process Plant and North WRD), may contain suitable some habitat features for the species, its lack of detection in the region (according to the NT Fauna Atlas) aligns with the results of this survey. The species has been impacted by significant changes to the environmental resulting from altered fire regimes, grazing by cattle and large feral herbivores, weeds and the significant reduction in the abundance of small mammals across northern Australia (TSSC, 2015).		
Northern Quoll	**Unlikely** – No rocky areas are present that contain suitable water or denning habitats.	**Unlikely -** While the creek line that runs parallel to the main track contains tall eucalypt trees, the general area was heavily infested with weeds (see **Figure 18**), fragmented and no small native mammal species were detected. As such, it is not expected that the Northern Quoll would occupy this area.	**Unlikely** – In general, the proposed accommodation site contained no areas of critical habitat. One small area of rock outcrop at the top of the hill was not sufficiently large or complex to support denning or temporary sheltering sites for the species.
Pale Field-rat	**Unlikely** – Some creek lines could contain suitable habitat in the form of grassy or shrubby areas, however the species probably would have been detected if it occurred there. The area is burned on average every two years and some parts are obviously affected by cattle and previous mining activities.	**Unlikely -** The species was not detected and, in general, creeks and dams (from mining activities) were mostly heavily infested with weeds and fragmented.	**Unlikely** – no suitable habitat was observed.

Species	Assessment		
	Rustlers Roost	Quest 29	Toms Gully[12]
Yellow-snouted Gecko	**Unlikely** – Overall, given the species has not been detected during three rounds of spotlighting surveys (November 2016 and May 2017 by Low Ecological Services, and May 2022 by Connect Environmental), it is probably unlikely to occur. However, given there doesn't appear to be a clear picture of its density, distribution or specific habitat requirements, there is a small possibility that the species is present in some small pockets of habitat and was not detected.	**Unlikely** – There was no suitable habitat for the species across most of the survey area. Some small areas containing *E. tintinnans* were probably marginally suitable for the species though the species was not detected in those areas.	**Unlikely** – Suitable habitat (*E. miniata* or *E. tetrodonta* open forest) did not appear to exist. Nocturnal searches were conducted anyway and the species was not detected.
Yellow-spotted Monitor	**Possible** – Given the species was not detected during three rounds of surveys (November 2016 and May 2017 by Low Ecological Services, and May 2022 by Connect Environmental), the species doesn't appear to be present, at least in high numbers. Some suitable habitat exists though the status of the species locally is not known. It is possible that the species occurs infrequently or during particular times of the year not covered by these surveys.	**Unlikely** – Habitats within the Quest 29 survey area were degraded and probably not ideal for the species to occupy for substantial periods. It may occur there infrequently.	**Unlikely** - Suitable habitat for the species did not appear to exist and the species was not detected.
Mitchell's Water Monitor	**Possible** – Despite not being detected during three surveys (November 2016 and May 2017 by Low Ecological Services, and May 2022 by Connect Environmental), the species may occur at low densities, is thought to be difficult to detect and therefore it is possible that it was simply not detected. However, all creeks within the survey areas appeared ephemeral and standing water seemed to be restricted to mining infrastructure (pits, dams) and possibly Annie's Dam. In that regard, the area is probably not important for the species.	**Unlikely** – Potentially suitable habitats were substantially affected by previous mining activities and the species was not detected.	**Unlikely** - Suitable habitat for the species did not appear to exist and the species was not detected.

Figure 18 The creek line parallel to the main access track in the Quest 29 project area (note the Calopo matting on the right-hand side of the creek)

6 Impact Assessment

6.1 Impacts

Potential or anticipated impacts to threatened fauna species as a result of the project include:

- The loss of suitable habitat for the four detected threatened fauna species as shown in **Table 24**.
- The loss of potentially suitable habitat for four additional potentially occurring threatened fauna species.
- Fragmentation of habitats.
- Displacement of individuals.
- Disruption to breeding success or activities.
- The introduction or spread of weeds reducing habitat quality for threatened fauna.
- Downstream / off site impacts as a results of water contamination from potential acid mine drainage, hydrocarbon spills or turbid water.
- Changes to groundwater quality and flow (not assessed in this report).
- Erosion and sedimentation.
- Construction / mining noise, vibration and light.
- Dust.

It is important to note that the impacts listed here and quantified in the following sections are based on the results of the surveys. Over time, the abundance and distribution of individuals of threatened species are likely to change (even seasonally). This may be demonstrated when considering previous survey results (e.g., LES, 2017). Further, some impacts will be temporary, rather than permanent. For example, sources of water that currently exist on site (i.e., the pits) will be lost during the mining activities, however after mining, they may fill, or be filled, with water to form water sources for wildlife again.

Table 24 Area of known or likely habitat for detected threatened species

Species	Areas detected	Suitable land units[13]	Estimated density or distribution	Area (ha)				Total (ha)
				Rustlers Roost	Quest 29	Toms Gully	Haul Road	
Partridge Pigeon	Rustlers Roost	2b, 2b, 3b	Very low density	312	18	7	0	**337**
Black-footed Tree-rat	Rustlers Roost, Haul Road	2a, 2b, 3b, 6a, 6a1 (except at Quest 29 where it is 2a only)	Widespread (density unclear)	321.5	18.5	0	0	**340**
Northern Brushtail Possum	Rustlers Roost, Toms Gully	2a, 2b, 3b, 6a and 6a1 (except at Quest 29 where it is 2a only)	Patchy	321.5	18.5	7.2	0	**329**
Merten's Water Monitor	Rustlers Roost, Haul Road	6a1, Annie's Dam, disturbed areas	Appeared common	20	1-2	0	0	**21-22**

[13] *Land units which contain apparently suitable habitat though the species may not have been recorded there and therefore may not actually be suitable at this point in time.*

6.2 Detected Threatened Fauna

6.2.1 Partridge Pigeon

6.2.1.1 Significance of the Individuals Detected

Partridge Pigeons were detected on only one camera and not observed otherwise despite extensive driving and walking across the three survey areas. It was also not recorded during surveys in 2016 and 2017 by Low Ecological Services. There are 335 records of the species across the NT in the last five years in the NT Fauna Atlas (as of March 2022). These are distributed from Cobourg Peninsula and the Tiwi Islands south to the greater Darwin region, Pine Creek, Katherine and Kakadu. As such, the single detection for this project doesn't appear to be significant.

6.2.1.2 Significance of the Potential Impacts

To assist in determining the significance of the potential impacts of the project on the species, an assessment against the significant impact criteria contained within the Australian Government's *Significant Impact Guidelines* (DoE, 2013) was undertaken (**Table 27**). The species is listed as vulnerable under both the EPBC and TPWC Acts. To aid in the assessment, discussion of 'important' population and 'habitat critical to the survival of the species' is provided in **Table 25** and **Table 26**, respectively.

Table 25 'Important' population assessment for the Partridge Pigeon detection within the Rustlers Roost survey area

Key factor defining an 'important' population	Assessment
Populations identified in recovery plans	No
Key source populations either for breeding or dispersal	**Unlikely** - Whilst the mainland population status of the species is reported to be declining, it is unclear whether the population is comprised of several sub-populations (Davies *et al*., 2021), some of which may be isolated (e.g., on Cobourg Peninsula) (Garnett *et al*, 2007, cited in TSSC, 2015b). Given the habitats within the survey area are not isolated and contain habitats typical of those in the region, it appears unlikely that the individual/s detected within the Rustlers Roost survey area is part of a key source population or one that is necessary for maintaining genetic diversity. Such populations are more likely to be isolated populations, those where higher densities of birds exist or where habitats are protected and managed for species conservation.
Populations that are necessary for maintaining genetic diversity	
Populations that are near the limit of the species range	No – The detected individual is within the species known range.

Table 26 Assessment of habitat critical to the survival of the Partridge Pigeon

Criteria	Assessment
'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:	
for activities such as foraging, breeding, roosting, or dispersal	**Unlikely** - Given the widespread distribution of the species, their mobile nature, and the reasonably high number of records (335) within the last five years across the NT in the NT Fauna Atlas, it appears unlikely that the habitats within the disturbance footprint are critical for the species at a regional scale. Given that *Eucalyptus miniata* and *E. tetrodonta* woodlands are ubiquitous across the top end of the
for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)	
to maintain genetic diversity and long-term evolutionary development, or	

Criteria	Assessment
for the reintroduction of populations or recovery of the species or ecological community	NT, it is likely that ample habitat exists across its range.

Table 27 Significant impact assessment for the Partridge Pigeon

Significant Impact Criteria for 'vulnerable' species	Assessment
Lead to a long-term decrease in the size of an important population Reduce the area of occupancy of an important population Fragment an existing important population into two or more populations Adversely affect habitat critical to the survival of a species Disrupt the breeding cycle of an important population Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely -** The loss of 337 ha of potentially suitable habitat is unlikely to impact the species because: ▪ It was detected at only one site (on a camera) suggesting that it occurs at very low densities in the local area. ▪ The species area of occupancy is reported to be 9,600 km^2 (Davies *et al*, 2021), which is unlikely to be affected by the proposed mining redevelopment. ▪ The habitats within the disturbance footprint are unlikely to be critical to the survival of the species (refer to Table **26**). ▪ *Eucalyptus miniata* and *E. tetrodonta* woodlands are ubiquitous across the top end of the NT. ▪ Key threats to the species including altered fire regimes, cats and grassy weeds (such as Gamba Grass) are likely to influence the distribution and abundance of the species far greater than the proposed works associated with this project. These threats already occur within the local area and region.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely -** A wide range of weeds already occur within the disturbance footprint.
Introduce disease that may cause the species to decline	**Unlikely -** The proposed mining development is unlikely to introduce a disease which already isn't present in the environment.
Interfere with the recovery of the species	**Unlikely -** The loss of 337 ha of habitat, of which the species is expected to occupy in very low densities (if at all for some of it), is unlikely to interfere with the recovery of the species because greater threats exist across its range such as altered fire regimes, invasive grasses, cats, habitat loss from horticulture and forestry (presumably on Melville Island) and habitat degradation from cattle and feral herbivores (DEPWS, 2021b). The habitats within the disturbance footprint, at present, do not appear to be important areas for the species given their condition and the low rate of species detection there.

6.2.2 Black-footed Tree-rat

6.2.2.1 Significance of the Individuals Detected

Black-footed Tree-rats were detected at six locations, of which five were within the Rustlers Roost survey area and one along the haul road. While there are only two records within the NT Fauna Atlas within 25 km of the survey areas (as of September 2021), there are over 1,800 records in the NT from the last five years (as of March 2022). However, some or many of these records appear to be detections of the species at the same site on consecutive nights. Nevertheless, the six detections during these surveys does not appear significant in comparison. However, any record of a threatened species should be noted with some importance, simply by its nature.

6.2.2.2 Significance of the Potential Impacts

To assist in determining the significance of the Black-footed Tree-rats identified within the Rustlers Roost survey area, an assessment against the significant impact criteria contained within the Australian Government's *Significant Impact Guidelines* (DoE, 2013) was undertaken. These guidelines are used for NT-listed species also, in the absence of NT-specific impact criteria. Black-footed Tree-rats are listed as Endangered under both the EPBC Act and NT TPWC Act. An assessment of whether the habitats within the Rustlers Roost survey area are critical to the survival the species is provided in **Table 32**, and an assessment against the significant impact criteria for critically endangered or endangered species is in **Table 33**.

Table 28 Assessment of habitat critical to the survival of the Black-footed Tree-rat

Criteria	Assessment
Is the area necessary:	
For activities such as foraging, breeding, roosting, or dispersal	**Unlikely -** The Rustlers Roost area doesn't appear to be necessary for the species when ample habitat exists in the region, there are over 1,800 records of the species in the NT Fauna Atlas in the last five years and the area does not appear to be a refuge from known threatening processes such as fire and introduced herbivores and livestock. Surrounding land uses appear similar and widespread. Further, *Eucalyptus miniata* and *E. tetrodonta* woodlands are ubiquitous in the top end.
For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)	
To maintain genetic diversity and long-term evolutionary development, or	
For the reintroduction of populations or recovery of the species or ecological community.	

Table 29 Significant impact assessment for the Black-footed Tree-rat

Criteria	Assessment
Will the action:	
Lead to a long-term decrease in the size of a population	**Unlikely** – While there are very few local records of the species (two within 25 km (not including the results of this survey)), it is probable that the species occurs in the surrounding areas. However, the size or extent of the local or regional population is not known. Nevertheless, the surrounding land uses, habitats and fire histories appear similar and *Eucalyptus miniata* and/or *E. tetrodonta* woodlands are ubiquitous across the top end. Further, over 1,800 records of the species have been made in the NT within the last five years alone (as per the NT Fauna Atlas (March 2022)). Therefore, the paucity of local records is more likely related to survey effort. In addition, much of the affected habitat fringes existing mining areas and any animals are expected to disperse into adjacent habitats.
Reduce the area of occupancy of the species	**Unlikely** – Using available data (i.e., results of the surveys and existing NT Fauna Atlas data), it is unlikely that the loss of habitats will reduce the area of occupancy (AOO) of the species. The AOO for the species is estimated by Woinarski and Burbidge (2016) to be 50,000 km^2. The proposed project is unlikely to reduce this extent.
Fragment an existing population into two or more populations	**Unlikely** – The proposed mining activities are unlikely to fragment an existing population of Black-footed Tree-rats because the proposed disturbance footprints radiate out from existing cleared areas from previous mining operations and therefore there is already fragmentation of habitats within the landscape.

Criteria	Assessment
Adversely affect habitat critical to the survival of a species	**Unlikely** – As discussed in **Table 28**, habitats within the disturbance footprint are unlikely to be critical to the survival of the species.
Disrupt the breeding cycle of a population	**Unlikely** – While some individuals may be displaced or disturbed during vegetation clearing activities, the surrounding population is unlikely to be disturbed to a significantly greater extent than already experienced from existing land uses or threatening processes.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely** – Given the high number of records across the NT in the last five years (over 1,800) according to the NT Fauna Atlas, it is unlikely that the removal of habitats within the disturbance footprint will cause the species to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	**Unlikely** – Many weeds already occur in the local area.
Introduce disease that may cause the species to decline, or	**Unlikely** – The author is unaware of any diseases that may cause the species to decline. Disease is not listed as a threat to the species in its Conservation Advice (TSSC, 2015c).
Interfere with the recovery of the species.	**Unlikely -** Given the high number of recent NT-wide records and extensive apparent habitat in the region, it is unlikely that the proposed mining redevelopment will interfere with the recovery of the species.

6.2.3 Northern Brushtail Possum

6.2.3.1 Significance of the Individual Detected

Northern Brushtail Possums were detected at three locations, of which two were in the Rustlers Roost survey area and one was within the Toms Gully survey area. While there is only one record within the NT Atlas within 25 km of the survey areas (as of September 2021), there are over 7,000 records in the NT from the last five years (as of March 2022). However, many of these records may be at the same site on consecutive nights. Nevertheless, the three detections during these surveys does not appear significant.

6.2.3.2 Significance of Potential Impacts

To assist in determining the significance of the potential impacts of the project on the species, an assessment against the significant impact criteria contained within the Australian Government's *Significant Impact Guidelines* (DoE, 2013) was undertaken (**Table 32**). The species is listed as vulnerable under the EPBC Act though is not listed under the TPWC Act. To aid in the assessment, discussion of an 'important' and 'habitat critical to the survival of the species' is provided in **Table 30** and Table 31, respectively.

Table 30 'Important' population assessment for the Northern Brushtail Possum detections

Key factor defining an 'important' population	Assessment
Populations identified in recovery plans	No
Key source populations either for breeding or dispersal	**Unlikely** - In the absence of defining what constitutes a population of the species (though presuming it is not the entire population of the species), it has been recorded over 7,000 times in the NT Fauna Atlas in the last five years across the NT in key areas including the Tiwi Islands, Cobourg Peninsula, Kakadu National Park, and the greater Darwin and Katherine

Key factor defining an 'important' population	Assessment
Populations that are necessary for maintaining genetic diversity	areas. Further, the survey areas are not managed for species conservation and are run as pastoral properties (Rustlers Roost) or are substantially disturbed from previous mining operations (Quest 29). Consequently, it is unlikely that individuals from these areas would be a key source population for breeding, dispersal or maintaining genetic diversity.
Populations that are near the limit of the species range	No – The detected individual is within the species known range.

Table 31 Assessment of habitat critical to the survival of the Northern Brushtail Possum

Criteria	Assessment
'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:	
for activities such as foraging, breeding, roosting, or dispersal	**Unlikely** - The habitats within the disturbance footprint are unlikely to be critical to the survival of the species because: ▪ There appears to be ample similar habitats in the surrounding areas. ▪ The habitats are not protected and do not appear to be managed for species conservation but rather are run as pastoral properties with several areas containing evidence of previous mining operations. ▪ There are a high number of NT-wide records (>7,000) in the last five years (as per the NT Fauna Atlas) from key areas such Tiwi Islands, Cobourg Peninsula, Kakadu National Park, and the greater Darwin and Katherine areas. It is more likely that these areas would contain habitat critical to the survival of the species. ▪ Existing land uses on and around the disturbance footprints are likely to continue.
for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)	
to maintain genetic diversity and long-term evolutionary development, or	
for the reintroduction of populations or recovery of the species or ecological community	

Table 32 Significant impact assessment for the Northern Brushtail Possum

Significant Impact Criteria for 'vulnerable' species	Assessment
Lead to a long-term decrease in the size of an important population	**Unlikely -** The loss of approximately 329 ha of potentially suitable habitat (noting that 'occupied' habitat is likely to be just a fraction of this) is unlikely to significantly impact the species because: ▪ The individuals detected are unlikely to be part of an important population, as described in **Table 30**. ▪ The habitats on site do not appear to be critical to the survival of the species, as assessed in **Table 31**. ▪ Key threats to the species (TSSC, 2021) – reported to be frequent, extensive, intensive fires, cats, invasive grasses, diseases carried by black rats, land clearing from agriculture, forestry and mining (particularly on the Tiwi Islands), grazing and climate change – are likely to influence the distribution and abundance of the species far greater than this proposed mining project.
Reduce the area of occupancy of an important population	
Fragment an existing important population into two or more populations	
Adversely affect habitat critical to the survival of a species	
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	

Significant Impact Criteria for 'vulnerable' species	Assessment
Disrupt the breeding cycle of an important population	**Unlikely -** The individuals detected are unlikely to be part of an important population, as described in **Table 31**.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely -** The areas of habitat are largely already disturbed from current or previous land uses (pastoralism and/or mining), including areas of heavy weed infestation.
Introduce disease that may cause the species to decline	**Unlikely -** The TSSC (2021) describe diseases carried by Black Rats (*Rattus rattus*) could have contributed to population declines of small mammals. Black Rats are already present within the Quest 29 area and most likely in the Rustlers Roost area as well.
Interfere with the recovery of the species	**Unlikely -** The proposed works are relatively minor in relation to existing threats faced by the species. TSSC (2021) lists the key threats to the species as frequent, extensive, intensive fires, cats, invasive grasses, diseases carried by black rats, land clearing from agriculture, forestry and mining (particularly on the Tiwi Islands), grazing and climate change. The proposed works are unlikely to significantly increase any of these threats and, as such, are unlikely to interfere with the recovery of the species.

6.2.4 Merten's Water Monitor

To assist in determining the significance of the Merten's Water Monitors detected, an assessment against the significant impact criteria contained within the Australian Government's *Significant Impact Guidelines* (DoE, 2013) was undertaken. These guidelines are used for NT-listed species also, in the absence of NT-specific impact criteria. Suitable habitat for the species is in both the Rustlers Roost and Quest 29 survey areas.

6.2.4.1 Significance of the Records

Mertens Water Monitor is listed as Vulnerable under the TPWC Act and is not listed under the EPBC Act. There are 15 records within 25 km listed in the NT Fauna Atlas (as of September 2021). The relatively high number of detections during this project within and near to the Rustlers Roost survey area indicates that the species is persisting, despite the previous mining activities and the presence of Cane Toads. **Table 33** provides an assessment of the 'importance' of the detections based on the criteria in the EPBC Act *Significant Impact Guidelines*.

Table 33 'Important' population assessment for the Mertens Water Monitor detections within the Rustlers Roost survey area

Key factor defining an 'important' population	Assessment
Populations identified in recovery plans	No
Key source populations either for breeding or dispersal	**Unlikely** – Whilst the regional status of the species is unknown, it is unlikely that any individuals on site form a population that is a key source population or necessary for maintaining genetic diversity. There are over 150 records of the species in the NT Fauna Atlas across the top end in the last five years (since 2017) and it is likely that many more sightings were not recorded in the NT Fauna Atlas.
Populations that are necessary for maintaining genetic diversity	
Populations that are near the limit of the species range	No – The detected individuals are within the species known range.

6.2.4.2 Significance of Potential Impacts

Suitable habitat for Merten's Water Monitor within the Rustlers Roost or Quest 29 survey areas is unlikely to constitute habitat critical to the survival of the species, as assessed in **Table 34**. The potential impacts to the species from the proposed mining project are also unlikely to cause significant harm to the species, as described in **Table 35**.

Table 34 Assessment of habitat critical to the survival of Merten's Water Monitor

Criteria	Assessment
'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:	
for activities such as foraging, breeding, roosting, or dispersal	**Unlikely -** Overall, the habitats within the survey areas are substantially impacted by existing mining or pastoral activities. Many areas are ephemeral, lack complex riparian vegetation, and are weed-infested. However, Annie's Dam apparently provides habitat of reasonable quality for the species. Cane Toads are present throughout the area. There is no clear reason to suggest that the habitats within the survey areas are necessary to maintain the species in the long term. Better quality, and more natural, habitat is expected to occur within the surrounding landscape.
for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)	
to maintain genetic diversity and long-term evolutionary development, or	
for the reintroduction of populations or recovery of the species or ecological community	

Table 35 Significant impact assessment for Mertens Water Monitor

Significant Impact Criteria for 'vulnerable' species	Assessment
Lead to a long-term decrease in the size of an important population of a species	**Unlikely** – The individuals detected are unlikely to be part of an important population (as assessed in **Table 33**).
Reduce the area of occupancy of an important population	
Fragment an existing important population into two or more populations	
Disrupt the breeding cycle of an important population	
Adversely affect habitat critical to the survival of a species	**Unlikely** - The habitat in the survey area is unlikely to constitute habitat critical to the survival of the species given its location within a disturbed setting and proximity of suitable habitat in the region (as assessed in **Table 34**).
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely** - The proposed mining project is unlikely to significantly impact suitable habitat to the extent that the species is likely to decline because most of the habitat is already isolated and in a disturbed setting. In addition, there appears to be ample suitable habitat in the region.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely** - Several invasive grasses are already present in the survey area and region, including Gamba Grass. Cane Toads are also established in the survey areas.
Introduce disease that may cause the species to decline	**Unlikely** - The author is not aware of any diseases that affect the species or that is likely to be introduced by the proposed mining activities.

Significant Impact Criteria for 'vulnerable' species	Assessment
Interfere substantially with the recovery of the species	**Unlikely** – Whilst it is unclear how many individuals inhabit the survey area, the proposed mining project is unlikely to interfere substantially with the recovery of the species given that the habitat is within a disturbed setting and there appears to be ample suitable habitat in the region.

6.3 Undetected Potentially Occurring Threatened Fauna

Several threatened species were not detected though may occur within the survey areas, as assessed in **Section 5**. These are:

- Gouldian Finch (breeding) - Rustlers Roost only
- Red Goshawk (nesting) – Rustlers Roost only
- Yellow-spotted Monitor – Rustlers Roost only (possibly elsewhere infrequently)
- Mitchell's Water Monitor – Rustlers Roost only.

Considering the survey results (including by Low Ecological Services in 2016-2017), a 'qualitative threat assessment' (i.e., risk assessment) has been undertaken for those threatened species that potentially occur even though they were not detected. It is specific to potential impacts from the proposed mining activities (**Section 6.1**).

The risk assessment provides an indication of the level of impacts to any relevant species both before and after any recommended impact avoidance and mitigation measures are implemented. It is based on the principles and procedures of the *Australian/New Zealand Standard for Risk Management ISO 31000:2009* (Standards Australia 2009; AZ/NZS 4360:1999) and *HB 203: 2000 Environmental Risk Management – Principles and Process* (Standards Australia 2009) and is taken from the Species Expert Assessment Plan (SEAP) Manual (TSSC, 2015c).

The potential significance of an impact is based on the likelihood and consequence of the impact to that species. The definitions used for likelihood are shown in **Table 36**. The definitions used to determine the consequence of an impact to a threatened species are shown in **Table 37**. Based on these, the level of threat was determined by the matrix shown in **Table 38**. The results of the risk assessment are shown in **Table 39**.

It is important to note that most, if not all, of the potentially occurring threatened species will not be substantially affected by the proposed development and are already affected to a greater extent by existing threats in the wider region such as inappropriate fire regimes, loss of critical or important habitat and Cane Toads. Nevertheless, it is prudent to recognise the cumulative effect on species, which includes activities such as those proposed within the survey areas.

Table 36 Impact likelihood definitions

Score	Likelihood	Description
1	Rare	The outcome is not expected to occur; no record of occurring but not impossible; may occur in exceptional circumstances
2	Unlikely	The outcome will only occur in a few circumstances; uncommon but known to occur elsewhere
3	Possible	The outcome may occur; some evidence to support it will happen
4	Likely	The outcome will occur in most circumstances
5	Almost certain	The outcome is expected to occur

Table 37 Impact consequence definitions

Consequence	Insignificant	Minor	Moderate	Major	Critical
Impact on population[3, 4]	Minimal impact on local population numbers; area affected negligible compared to total population; minimal or acceptable impact on population size	Minor impact on local population numbers. Population in other locations not impacted	Moderate impact on local population numbers. Some impacts on populations in other locations; moderate and/or short-term effects	Major population reduction or loss of local population; recovery measure in years to decades; serious and significant impact on species	Population reduction which may results in species extinction; recovery period is greater than decades; very significant and serious impact on high value species
Fragmentation of habitat / loss of habitat connectivity / reduce the areas of occupancy[5]	Minimal losses of local habitat only, recovery likely in a relatively short period of time; threats are covered by current management or legislation	Minor losses of local habitat requiring recovery over short term	Moderate loss of local habitat requiring recovery over a short to medium term and resulting in loss of connectivity between habitats at a local scale	Loss of local habitat with no potential for recovery, or partial loss of habitat across large areas and/or with limited potential for recovery in the medium to long term. Results in a net reduction in connectivity over a large area	Complete loss of local habitat with no potential for recovery and loss of habitat in other locations with limited potential for recovery in the long term resulting in a significant impact on habitat connectivity over a large area
Impact on habitat critical to the survival of the species[6]	Minimal modification, destruction, removal or decrease of local habitat only, recovery likely in a relatively short period of time; insignificant impact to habitat or threat activity only occurs in a very small area of habitat; limited damage to minimal area of low significance; minor effects on physical environment	Minor modification, destruction, removal or decrease of local habitat requiring recovery over short term	Moderate modification, destruction, removal or decrease of local habitat requiring recovery over a short to medium term and resulting in loss of connectivity between habitats at a local scale	Modification, destruction, removal or loss of local habitat with no potential for recovery, or partial loss of habitat across large areas and/or with limited potential for recovery in the medium to long term. Results in a net reduction in connectivity over a large area; habitat is affected which may endanger the species and habitat long term survival – 70-90% habitat affected or removed; 30% fragile habitat affected or removed; 10-20% critical habitat affected or removed	Significant impact resulting in the removal, destruction, fragmentation and degradation of habitat; the entire habitat is in danger of being affected or removed, that >90% habitat, >50% fragile habitat, and >30% critical habitat
Disruption to breeding cycle[7]	Minimal impact on any aspect of the breeding cycle;	Minor disruption to the breeding cycle	Moderate disruption to breeding cycle resulting in modification of behaviour both within the direct impact zone and at nearby locations; long term recruitment and/or population dynamics are not adversely impacted	Direct impacts on breeding cycle resulting in a net decline in size of the population; there is limited information to judge the impact	Complete disruption of breeding cycles over several seasons with significant population decline and possible extinction
Impact of invasive species and/or disease[8]	Minimal impact on local population numbers or habitat quality	Minor impact on local population numbers or habitat quality. Population in other locations not impacted	Moderate impact on local population numbers or habitat quality. Some impacts on populations in other locations	Major population reduction or loss of local population or loss of habitat quality	Population reduction which may results in species extinction loss of critical habitat extent or quality
Interaction with species migration	Minimal impact on species migratory patterns	Results in minor behavioural modification on a local scale or impacts to physical conditions of animal interfering with migration for the short term only. Unlikely to negatively impact on the overall success of migration	Results in modification of behaviour or animal conditions such that there is potential for medium term impacts, with some possibility of individuals failing to complete migration	Results in modification of behaviour or animal condition such that there is potential for medium to long term impacts, both locally and in nearby locations, with some individuals failing to complete migration	Significant impact resulting in either complete failure, or failure of majority of individuals, to complete migration in that cycle

Table 38 Level of threat matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Critical
Almost Certain	Low	Medium	High	Severe	Severe
Likely	Low	Medium	Medium	High	Severe
Possible	Low	Low	Medium	High	Severe
Unlikely	Low	Low	Low	Medium	High
Rare	Low	Low	Low	Medium	High

Table 39 Risk assessment for threatened species that may occur within the survey areas though were not detected

Common name	Key impacts[14]	Inherent[15] risk			Recommended mitigation	Residual[16] risk		
		Likelihood[17]	Consequence	Rating and justification		Likelihood	Consequence	Rating and justification
Gouldian Finch	▪ Loss of potential nesting habitat and associated foraging habitat within Rustlers Roost.	Possible	Minor	**Low** – Potentially suitable breeding habitat was identified in the mid-western and mid-eastern sections of Rustlers Roost, measuring approximately 35 and 5 ha respectively. The mid-eastern area is nestled within disturbed areas from previous mining activities and is probably only marginal in terms of habitat suitability. Both areas were wooded and undulating with Salmon Gums (*E. tintinnans*) forming a minor component of the vegetation communities. Several other *Eucalyptus* and *Corymbia* species were also present. However, several factors suggest that the general area may not be utilised substantially by the species and, consequently, may not be habitat critical to its survival: ▪ The species was not detected during any of the three surveys conducted in 2016 and 2017 by Low Ecological Services or in 2022 by Connect Environmental. ▪ There is a moderate frequency of fires which is thought to reduce the availability of tree hollows (DEPWS, 2021b). ▪ The altered fire regime and pastoralism evident in the local area may have altered food availability (DEPWS, 2021b).	-	Possible	Minor	**Low**
Red Goshawk	▪ Loss of potential nesting and associated foraging habitat within Rustlers Roost.	Possible	Minor	**Low** – No nests were identified during the surveys, however potential nesting habitat may occur in the northern sections of Rustlers Roost in areas of tall *E. miniata* or *E. tetrodonta* forests. There is some indication that the area may not be ideal given the current and recent land uses in the area and subsequent fragmentation of habitats.	▪ Prior to clearance and within the same breeding season, check for and avoid any active Red Goshawk nests for the duration of the nesting activity.	Possible	Minor	**Low**
Yellow-spotted Monitor	▪ Loss of potential breeding or foraging habitat.	Possible	Insignificant	**Low** – The species has not been recorded in any of the survey areas during surveys conducted in 2016 and 2017 by Low Ecological Services and 2022 by Connect Environmental. All creeks appear to be ephemeral and standing water is mostly confined to existing pits or dams from previous mining operations. Some floodplain habitat occurs around Annie's Dam within the Rustlers Roost survey area. It is possible that the species occasionally uses such an area as this however given the history of land use, the area probably isn't critical to the species survival.	-	Possible	Insignificant	**Low**
Mitchell's Water Monitor	▪ Loss of potential breeding or foraging habitat.							

[14] *These are the key impacts, and others are listed in **Section 7**.*

[15] *With no mitigation measures in place.*

[16] *Following the application of appropriate impact mitigation measures.*

[17] *Likelihood of the impact occurring, should the project proceed.*

7 Conclusions and Recommendations

Four threatened species were detected within the survey areas – all four species in Rustlers Roost and one in the Toms Gully proposed accommodation area. None was detected in the Quest 29 survey area. No detected species was concluded to be significantly impacted by the proposed mining project, though there will be a residual loss of confirmed habitat for each species.

Similarly, four additional threatened fauna species that were not detected though may occur are unlikely to be significantly impacted though a residual loss of potential habitat is expected.

A range of measures specific to species that were detected, or that potentially occur, is recommended to reduce the level of impact from the proposed mining activities (refer to **Table 40**). Measures are recommended only where they are feasible, realistic or practical, hence not all species are listed. These are in addition to measures that would ordinarily be implemented to reduce general environmental impacts, which are not listed here.

Table 40 Recommendations to reduce the level of impact to threatened species that do or may occur

Species	Risk / potential impact	Mitigation recommendations
Detected species		
Black-footed Tree-rat	Loss of habitat. Disturbance during breeding activities.	▪ A pre-clearance survey should be conducted to determine whether there is breeding activity and, if so, the area should be avoided until such time that no breeding activity is evident. ▪ A trapping program should be conducted immediately prior to any vegetation clearance activities to capture and relocate affected individuals. ▪ In addition, spotting and catching of Black-footed Tree-rats and Northern Brush-tailed Possums (and individuals of any fauna species) should be conducted during vegetation clearing activities.
Northern Brush-tailed Possum		
Potentially occurring species		
Red Goshawk	Loss of nesting habitat Disturbance during nesting	▪ Conduct a search for nests in the breeding season immediately prior to proposed vegetation clearing. Focus areas should include the tall *Eucalyptus miniata* or *E. tetrodonta* forests in the northern sections of the Rustlers Roost area.

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9 Appendix A: Bat call analysis report

Technical Memorandum

July 29, 2022

To	Mihkel Pros, Connect Environmental	**Contact No.**	0411019569
Copy to	-	**Email**	mproos@connectenvironmental.com.au
From	Craig Grabham Senior Ecologist GHD 03 52731869 craig.grabham@ghd.com	**Project No.**	12587579 – task 003
Project Name	12587579 Bat call analysis for Connect Environmental		
Subject	Project 3 – Rustlers Roost (v2)		

1. Introduction

Dear Mihkel,

Please find the draft results enclosed within for analysis of bat call data for the Rustlers Roost project.

2. Call identification, data processing and analysis

Bat calls were recorded during field surveys undertaken by Connect Environmental over three nights during May 2022 using a combination of in situ (stationary) Song Meter Mini (Wildlife Acoustics Inc) and Anabat Full Spectrum Swift (Titley Electronics) bat detectors . The detectors was programmed to turn on 30 minutes before sunset and 30 minutes post sunrise.

Call identification was assisted by consulting distribution information for potential species (Milne various dates, Churchill 2008; Van Dyck et al. 2013 and records from Australasian Bat Society BatMap (June 2022). No reference calls were collected during the survey. Data was processed and analysed using a combination of manual review and automated techniques using Kaleidoscope Pro (Wildlife Acoustic, version 5.4.6) and Anabat Insight (Titley Scientific, version 2.0.1). The following process was used:

1. Calls were initially processed in Kaleidoscope Pro using the basic cluster analysis function with the following parameters: 4 – 180 kHz frequency range, 1 – 5000 ms minimum and maximum length of detected pulses, a maximum inter-syllable gap of 500 ms and a minimum of 2 pulses detected. This function clusters same and similar bat calls into clusters based on the parameter and cluster function inputs. Following the completion of this process files within each cluster were reviewed and labelled as a species or species group. Species groups refer to a file containing a specie or multiple species which overlaps considerably with respect to call characteristics (see Table 1).
2. In addition to the semi-automated process undertaken during step 1, for each night, the first hour of data was manually reviewed for bat calls using Anabat Insight by visually comparing the time-frequency graph (spectrogram) and call characteristics (e.g. peak frequency, characteristic frequency and call shape) with species call descriptions from published guidelines (Milne various dates, Armstrong and

Cole 2007; Guppy et al. 1985; Hanrahan et al. 2021; Hourigan 2011). Files were manually labelled according to species or species group.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills et al. 1996 & Duffy et al. 2000 for similar process) as summarised in Table 1. A conservative approach was taken when analysing calls due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species.

As noted by Armstrong et al (2021) *Saccolaimus* species can be difficult to separate from other low frequency emitting species in Australia including other members of the Emballonurid family (e.g. *Taphozous* species) and members of the Molossidae family (e.g. *Chaerophon jobensis* and *Ozimops* species). Here it was chosen to use the approach outlined in Armstrong et al. (2021) to differentiate between species within the Emballonuridae and Molossidae families, including the summary of acoustic variables presented in Table 2 and harmonic profiles presented in Table 5 and sources within. Criteria from Table 4 of Armstrong et al (2021) was used to manually review files to identify potential candidate calls for additional analysis for *S. saccolaimus*.

Species nomenclature follows Armstrong, K.N., Reardon, T.B., and Jackson, S.M. (2020). A current taxonomic list of Australian Chiroptera. Australasian Bat Society. Version 2020-06-09.

Table 1 Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap often making it too difficult to distinguish between species for e.g. *Chaerephon jobensis/Saccolaimus flaviventris* *Saccolaimus flaviventris/saccolaimus* *Chalinolobus gouldii /Ozimops petersi, O. lumsdenae* *Scotorepens sandborni/greyii* *Pipistrellus adamsi/westralis* *Pipistrellus westralis/ Miniopterus orianae orianae* *Nyctophilus sp.* The calls of *Nyctophilus geoffroyi / walker/ daedalus* cannot always be distinguished during the analysis process and are therefore lumped together. *Nyctophilus sp/Myotis macropus.* *LFE – low frequency emitting* species from the Molossidae or Emballonuridae families. Calls from this group may be from one or more species however lack of diagnostic information, particularly harmonic profile prevented identified to species.

3. Analysis results

Seven species were positively (Definite) identified of the 16 or so species that are known to occur from the locality of the study area. As many as four other species may also have been recorded, but poor data quality, lack of local reference calls and/or interspecific call similarities precluded reliable identification of additional species. Table 2 presents a summary of the species recorded for each site for each survey period as a result of the bat call analysis.

Many calls from each survey night were labelled as LFE (*low frequency emitting* species from the Molossidae or Emballonuridae families). Calls from this group may be from one or more species however

lack of diagnostic information, particularly harmonic profile prevented identification to species level. A sample of files labelled as LFE contained possible candidate calls for the threatened *Saccolaimus saccolaimus*. These files were provided to Dr Kyle Armstrong (Specialised Zoological) for further examination. None of the files reviewed were definitely identified as *Saccolaimus saccolaimus*. See Appendix A for example spectrograms for positively identified bats species.

Table 2 Summary of species and species groups

Species or Species group	A1-SMM 4-5/5/22	A1-SMM 5-6/5/22	A1-SMM 6-7/5/22	A1-SMM 4-5/5/22	A1-SMM 5-6/5/22	A1-SMM 6-7/5/22	Swift 4-5/05/2022	Swift 5-6/05/2022
Chalinolobus gouldii	Pr	-	-	-	Pr	Pr	-	-
Chaerephon jobensis	D	-	-	D	D	-	D	-
Miniopterus orianae	Pr	-	-	Pr	Pr	-	Pr	-
Nyctophilus walkeri	-	-	-	Pr	Pr	-	Pr	-
Pipistrellus adamsi	-	-	-	Pr	Pr	-	-	-
Rhinonicteris aurantia - nt	-	-	-	-	D	-	-	-
Saccolaimus flaviventris	D	-	-	D	D	-	D	D
Scotorepens greyii	-	-	-	-	D	-	-	-
Taphozous georgianus	D	-	-	-	-	-	-	-
Taphozous kapalgensis - nt	D	-	-	D	D	-	-	-
Vespadelus caurinus	-	-	-	D	D	-	-	-
Chalinolobus nigrogriseus/ Scotorepens greyii	✓	-	-	✓	✓	✓	✓	✓
Nyctophilus arnhemensis/ N.geoffroyi / N. walker/ N. daedalus	✓	-	-	✓	✓	-	✓	-
M. orianae/N. walkeri	✓	-	-	✓	✓	✓	✓	✓
Pipistrellus westralis/ Miniopterus orianae orianae		-	-	✓	✓	✓	✓	✓
Saccolaimus flaviventris/ Chaerephon jobensis	✓	-	-	✓	✓	✓	✓	✓
Number of species (D)	4	-	-	4	6	0	2	1
Approx survey effort (hrs:mins)	10.5	No bat calls**	No bat calls**	10.5	10.5	6.5	10.5	2.5

Table 2 notes:
Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one *Nyctophilus* species where recorded.
** - D, PR or species group calls not identified
See Table 1 for confidence rating e.g. D or Pr
Conservation status: ce, e, v - species listed under the *NT Territory Parks and Wildlife Conservation Act 2006* / nt, dd – species listed as near threatened or data deficient under the International Union for the Conservation of Nature (IUCN) red list categories and criteria / CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection.

4. Report and analysis limitations

– The identifications made herein were based on data recorded and provided by Connect Environmental. GHD were not responsible for the design of the bat survey, set-up of equipment or collection of any data
– The scope of this report included the identification of bats species from the data provided. GHD were not asked to provide comment regarding the impacts to any bat species identified in this report
– GHD was not provided with a detailed habitat description of the survey area, nor did GHD undertake any site visits of the survey area
– The semi-automated analysis process of step 1 does not always capture all 'softer' Ghost Bat calls and other species with softer calls and sometimes calls with few pulses. Noting these limitations, the manual review of all files during step 2 of the analysis process for each night ensured no emergence or early calls were missed. It is important to note that some species like the Ghost Bat project low intensity calls making it difficult to detect with a bat detector therefore ultrasonic surveys should not be the primary means of surveying for such species.

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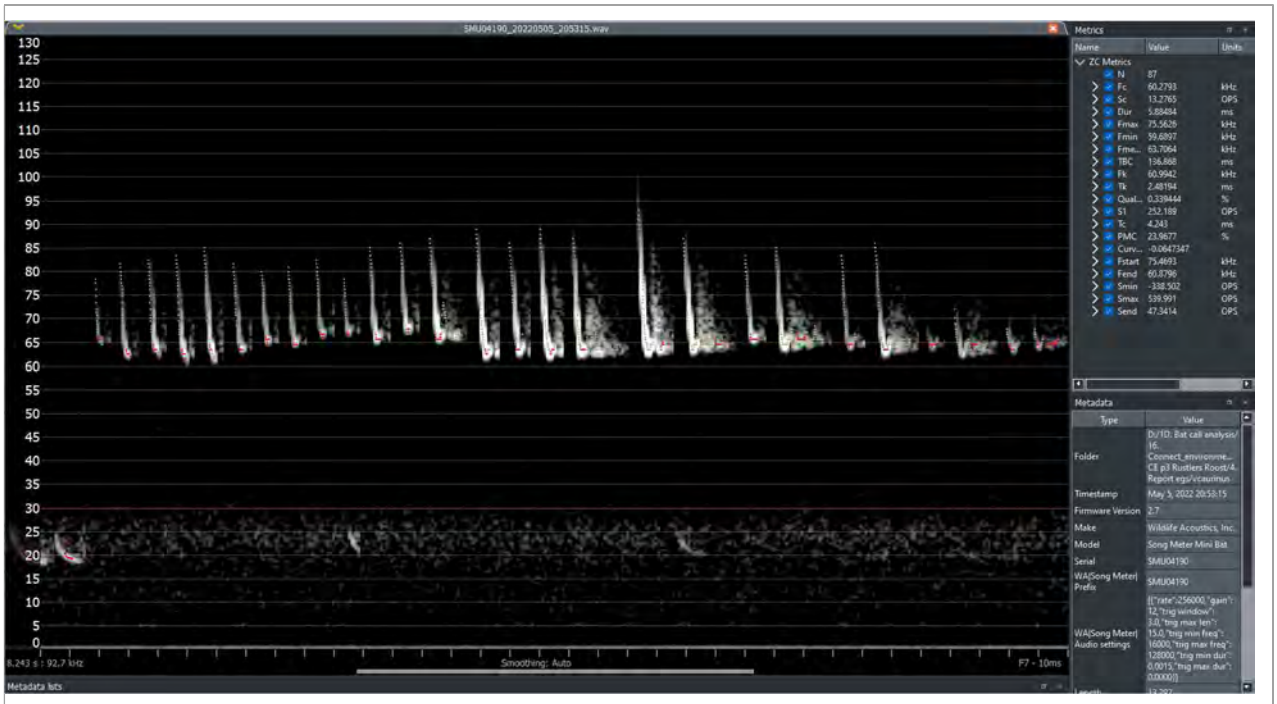
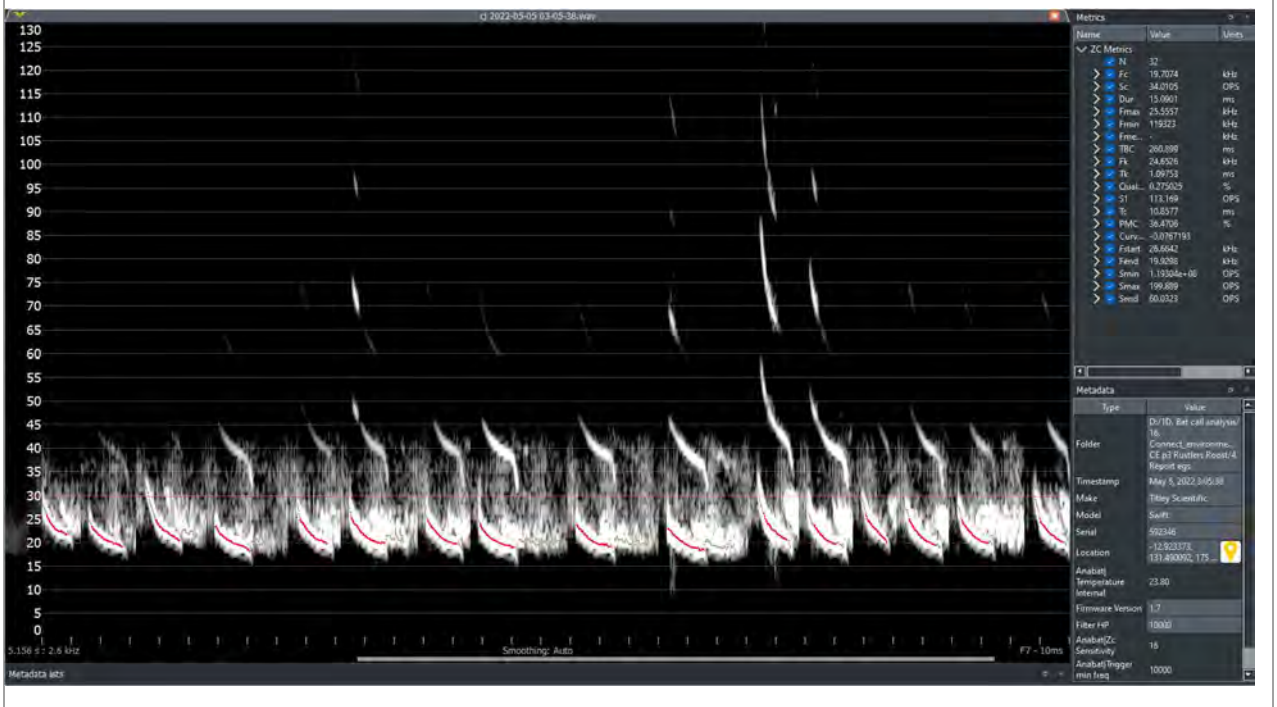
Regards

Craig Grabham
Senior Ecologist

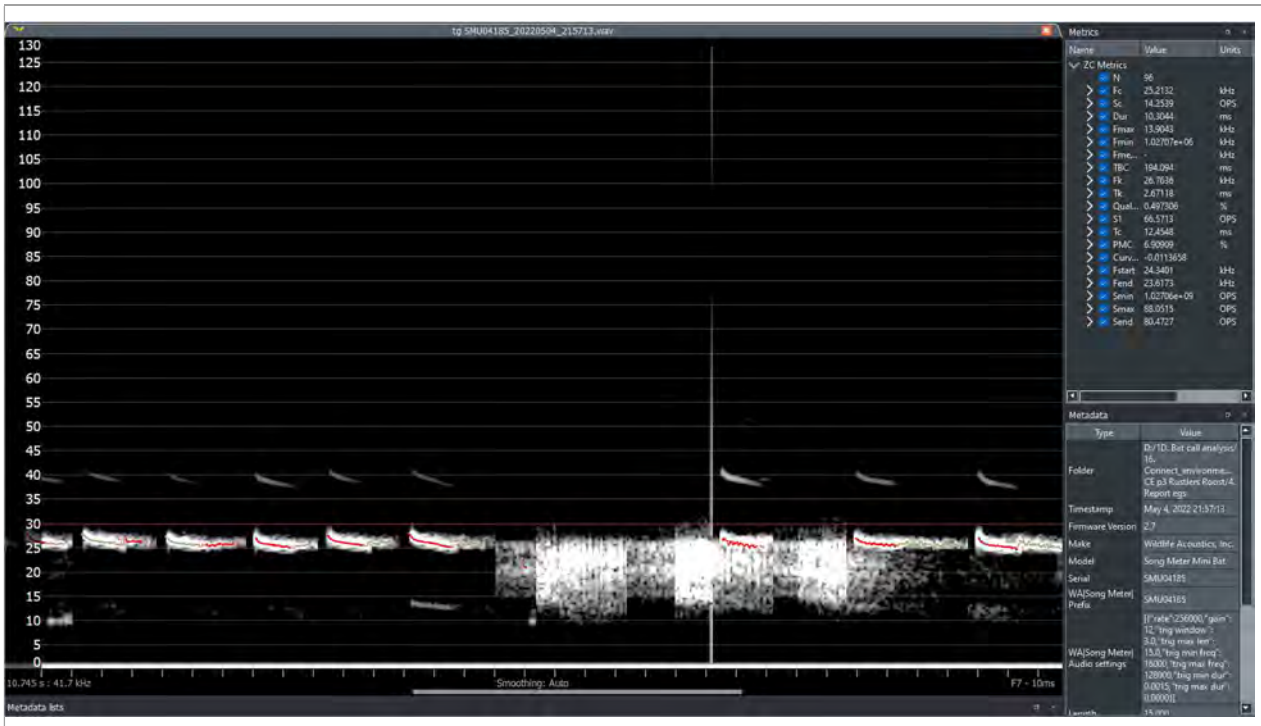
Appendix A – Example spectrograms for positively identified bat species



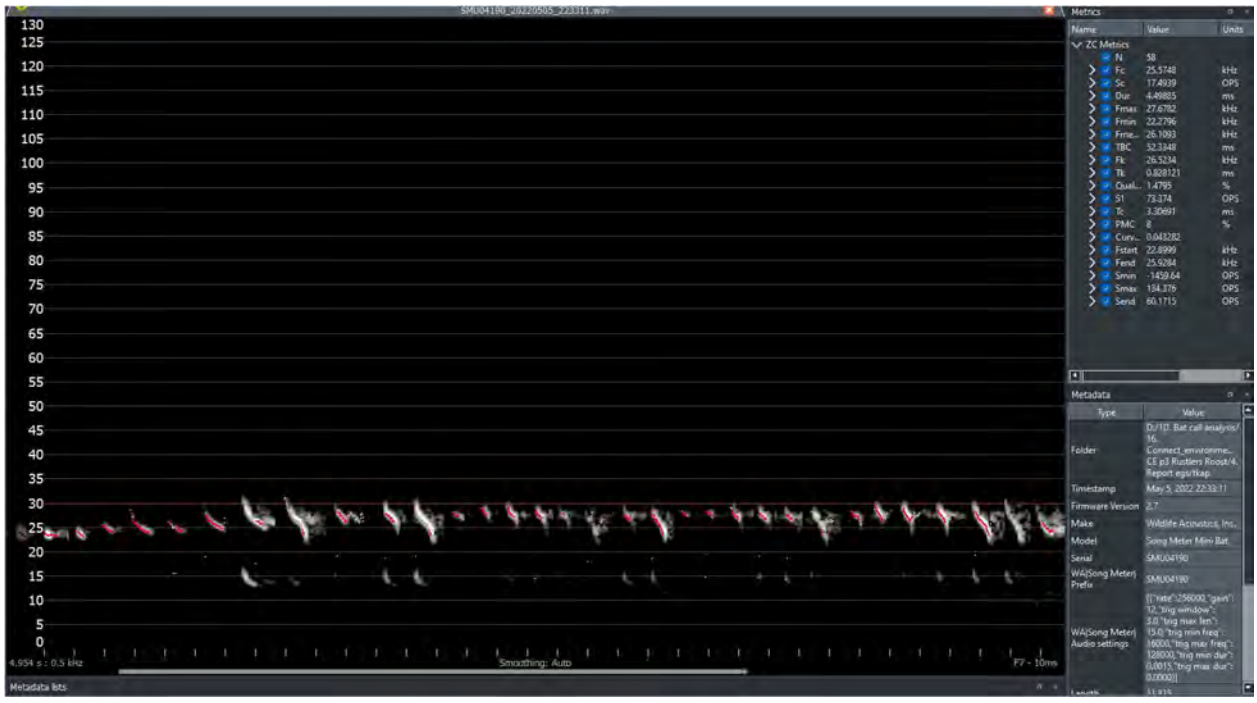
Vespadelus caurinus - Anabat Insight – linear, F7 compressed



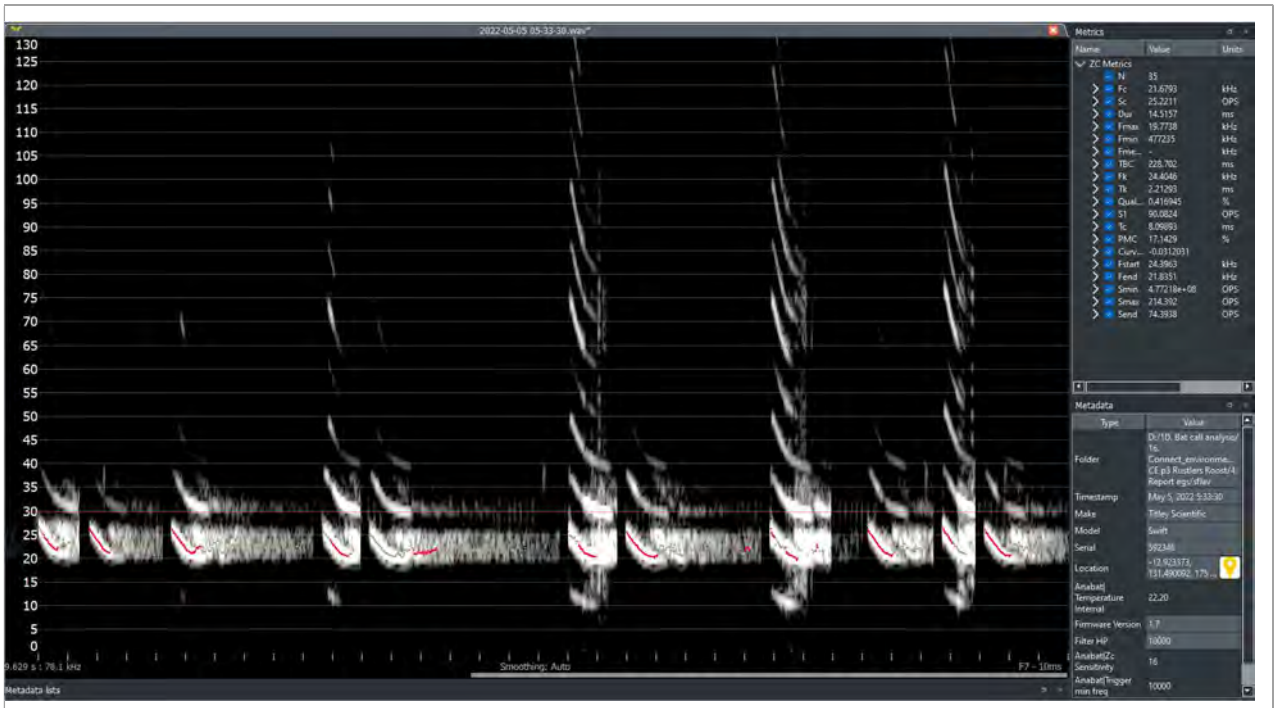
Chaerophen jobensis - Anabat Insight – linear, F7 compressed



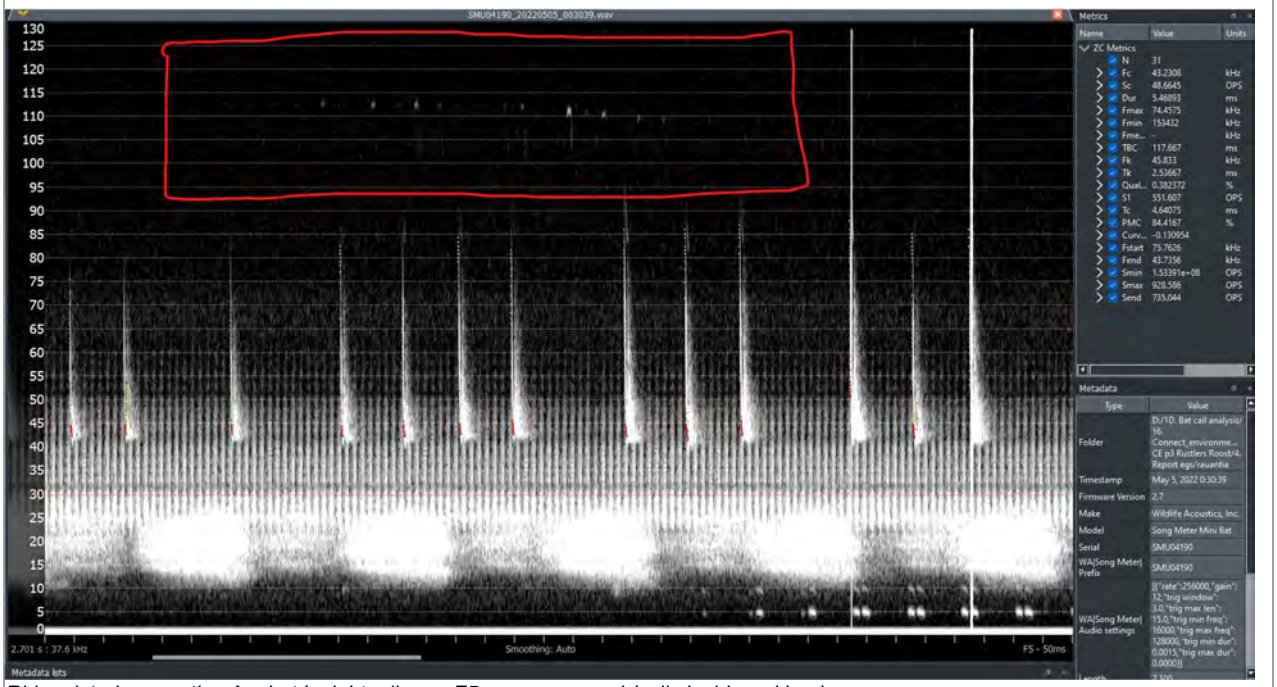
Taphozous georgianus - Anabat Insight – linear, F7 compressed



Taphozous kapalgensis - Anabat Insight – linear, F7 compressed



Saccolaimus flaviventris - Anabat Insight – linear, F7 compressed



Rhinonicteris aurantia - Anabat Insight – linear, F5 uncompressed (calls inside red box)