



# Ecological values assessment for Holtze residential urban development

Department of Infrastructure, Planning & Logistics



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# EXECUTIVE SUMMARY

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The Department of Infrastructure, Planning and Logistics propose to develop an urban residential development area within the suburb of Holtze, approximately 17 km south-east of Darwin and immediately north-east of the Palmerston. To inform an assessment of the potential impacts from the project, EcOz Environmental Consultants were engaged to assess and report on the ecological values within the Holtze site.

Some ecological studies were undertaken within the Holtze site in 2014-15. In 2020, additional studies were undertaken to address new information requirements with respect to certain threatened species. This report incorporates results from both studies.

There are seven land units. In general, the site consists of flat to gently undulating upland surfaces that slope steeply towards the Stuart Highway along the southern boundary of the site. The lowland drainage areas comprise the upper reaches of the Mitchell Creek catchment. The only watercourses are first order drainage lines in the south-eastern corner and centre south of the site which form the headwaters for Mitchell Creek. These only flow for short periods after rainfall in the wet season and do not contain any permanent water.

With regards to weed species, Gamba Grass and Mission Grass patches were mainly located along the northern boundary and along access tracks to the south of the Holtze site located at the base of the rocky ridge. The remaining surveyed weed populations were mainly focused on the northern boundary and within the northern access corridors adjoining Wallaby-Holtze Road.

The only significant vegetation type within the Holtze site is riparian vegetation associated with intermittent stream south-east portion of the site, and possibly some vegetation containing large *Eucalyptus miniata* and *Eucalyptus tetradonta* has the potential to have hollows suitable for fauna.

A total of 66 threatened species were considered in the 'likelihood of occurrence' assessment. Five species were considered to have a reasonable chance of occurring within the project area, and so were targeted in field studies. Field studies confirmed that two threatened flora species – Darwin Cycad (*Cycas armstrongii*) and *Typhonium praetermissum*, and one threatened fauna species – Black-footed Tree-rat (*Mesembriomys gouldii gouldii*) – do occur. One species – Mertens' Water Monitor (*Varanus mertensi*) – has a high likelihood of occurring, meaning that the species may occur within the Holtze site because there is suitable habitat; however, field studies were not undertaken to confirm this. The remaining species – Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus*) – was not detected and is considered unlikely to occur.

Darwin Cycad is present in varying densities; the highest occur on the rocky ridge areas in the south.

In total, 315 *Typhonium praetermissum* plants were recorded during the abundance survey, noting that this total does not include those plants located outside of the abundance survey areas as recorded in the detection surveys and previous assessments across the project area. The majority of records were located north-east of the hospital and in the western section of the Holtze site. There were a few isolated plants in the southern part that were considered incidental records and were not recorded within the high to moderate likelihood areas.

Suitable habitat for the Mertens' Water Monitor is restricted to ephemeral first-order drainage lines in the south of the Holtze site. As this species does not forage far from water, it is likely that – if present – it only occurs within the Holtze site during the wet season (when the creeks contain water); using off-site downstream areas during the dry season (i.e. Mitchell Creek) and migrating upstream in the wet season in search of food resources and breeding opportunities.

The Black-footed Tree-rat species was recorded once in the southern end of the Holtze site. The species appears to be confined to the denser, less disturbed woodland on the steeper sloped areas.

# 1 INTRODUCTION

---

The Department of Infrastructure, Planning and Logistics (DIPL) propose to develop an urban residential development area within the suburb of Holtze, approximately 17 km south-east of Darwin and immediately north-east of the Palmerston. The development area is referred throughout this document as the 'Holtze site' (Figure 1-1).

The project is being referred to the Northern Territory Environmental Protection Authority to determine if formal assessment is required pursuant to the *Environmental Assessment Act* (Northern Territory). The referral also gives consideration as to whether assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required. To inform an assessment of the potential impacts from the project, EcOz Environmental Consultants (EcOz) were engaged to assess and report on the ecological values within the Holtze site.

To address these requirements, this report presents:

- An overview of the existing environment relevant to ecology – i.e. land units, hydrology and threatening processes.
- An assessment of the ecological values that are known to occur, or have a reasonable likelihood of occurring, within the Holtze site.

As explained in the referral, a body of work was prepared in 2014-15 for a similar proposal. That included ecological studies of the Holtze site. In 2020, additional studies were undertaken to address new information requirements with respect to certain threatened species. This report incorporates results from both studies.

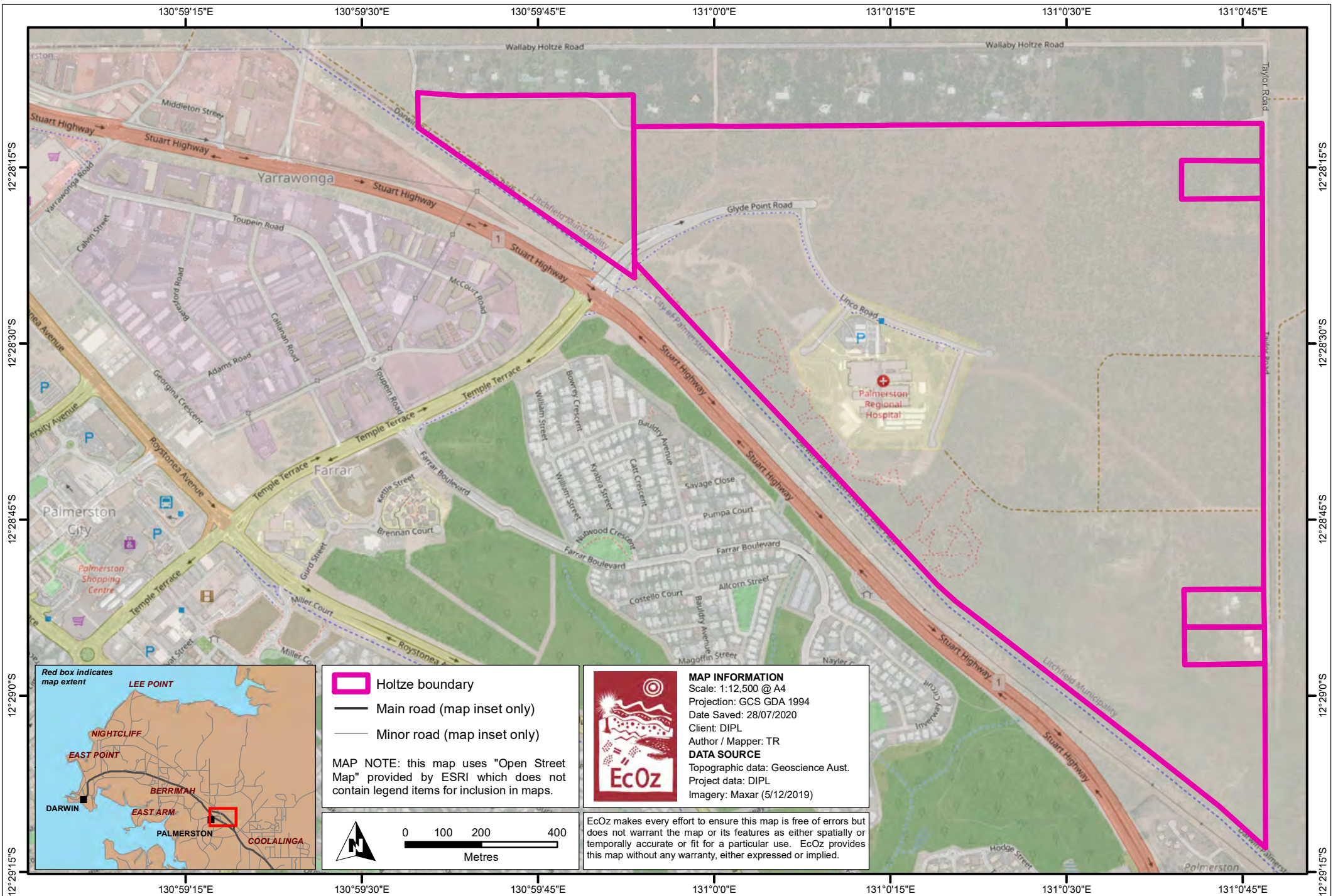


Figure 1-1. Map showing the location of Holtze site

## 2 EXISTING ENVIRONMENT

This chapter describes the environmental context of proposed development site, with a particular focus on habitat and environmental processes relevant to environmental values. This information was obtained from the NT Government datasets (particularly NR Maps) and field surveys.

### 2.1 Land units

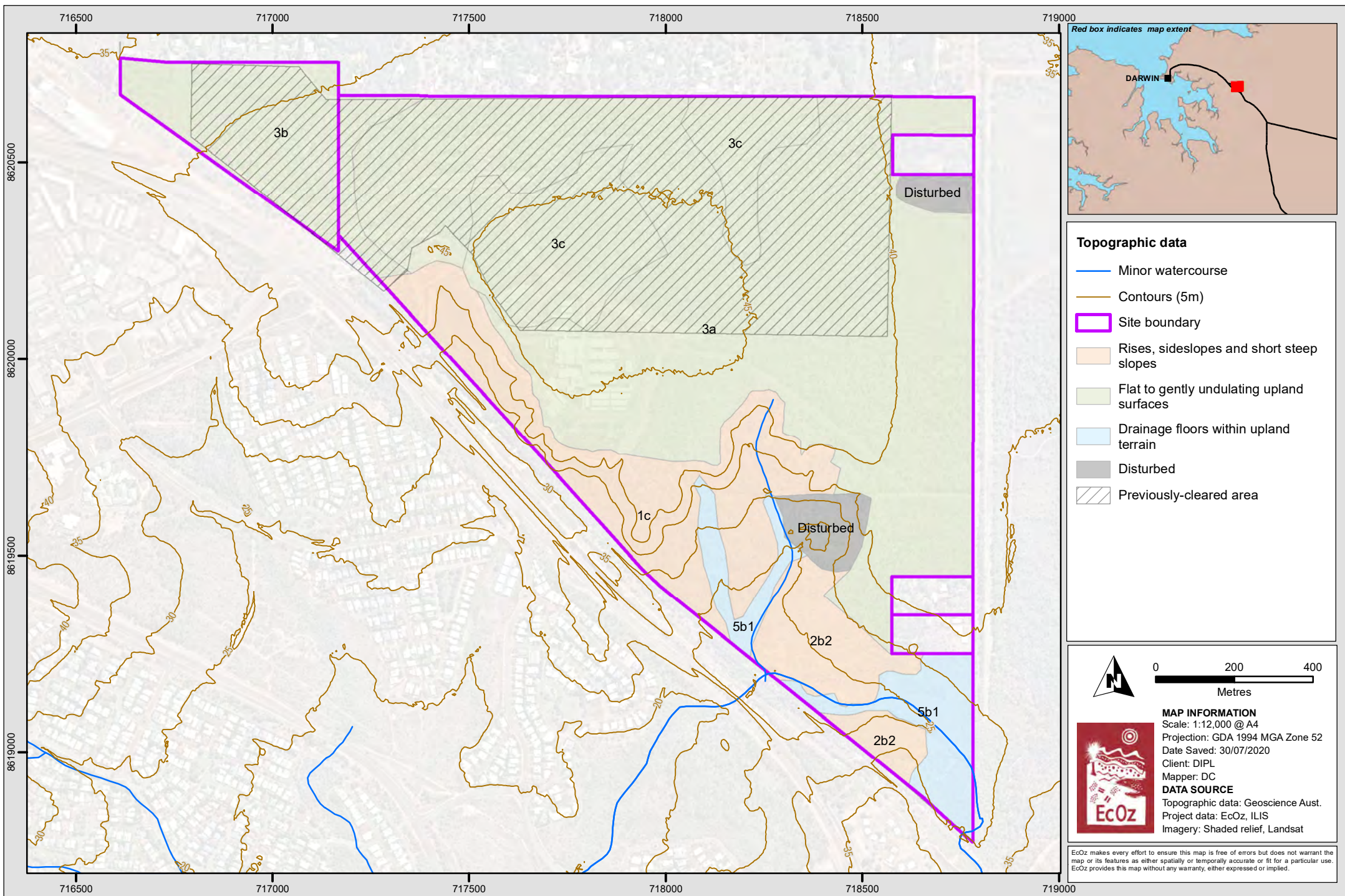
A land unit is a reasonably homogenous part of a land surface, distinct from surrounding terrain with consistent properties in landform, soil and vegetation (Jessop & King 1997). As such, each land unit has a characteristic pattern on aerial imagery. Land unit mapping by Fogarty et al. (1984) at a scale of 1:15,000 was revised in 2014 by EcOz after a ground-truthing survey was undertaken – see Appendix A. Seven land units occur within the Holtze site (see Table 2-1 and Figure 2-1). In general, the site consists of flat to gently undulating upland surfaces (land units 3a, 3b and 3c) that slope steeply towards the Stuart Highway along the southern boundary of the site (land unit 1c). The lowland drainage areas (land unit 5b1) comprise the upper reaches of the Mitchell Creek catchment.

Inspection of historical aerial imagery indicates that the northern portion of the proposal area – approximately 90 ha – was cleared in the late 1960s and now comprises re-growth vegetation.

**Table 2-1. Land units within Holtze site**

No.	Landform	Soil	Vegetation	Slope	Drainage
1c	Rises and short steep slopes	Organosols	Woodland of <i>E. tetradonta</i> , <i>E. miniata</i> , over <i>S. intrans</i> and <i>H. triticeus</i>	5 - 15%	Nil to low level of seasonal soil waterlogging
2b2	Side slopes	Hydrosols	Low woodland of <i>C. latifolia</i> , <i>E. tectifera</i> and <i>Grevillea pteridifolia</i> over <i>H. triticeus</i>	2 - 5%	Moderate level of seasonal soil waterlogging
3a	Flat to gently undulating upland surfaces	Brown Kandosols	Open forest of <i>E. tetradonta</i> , <i>E. miniata</i> +/- <i>Erythrophleum chlorostachys</i> over <i>S. intrans</i> and <i>H. triticeus</i>	0 - 2%	Nil to low level of seasonal soil waterlogging
3b			Open woodland of <i>E. tetradonta</i> , <i>E. miniata</i> +/- <i>C. bleeseri</i> , over <i>S. intrans</i> and <i>H. triticeus</i>	0.5 - 2.5%	
3c			Low open woodland of <i>C. latifolia</i> and <i>E. tectifera</i> over <i>S. intrans</i> and <i>H. triticeus</i>	0 - 2%	
5b1	Drainage lines with upland terrains	Hydrosols	Open woodland/shrubland of <i>Grevillea pteridifolia</i> and <i>Pandanus spiralis</i> over mixed grasses	1-4 %	Very slow. High level of seasonal soil waterlogging

*C.* = *Corymbia*, *E.* = *Eucalyptus*, *H.* = *Heteropogon*, *S.* = *Sorghum*



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\EZ20050 - Holtze NOI\Project files\Figure 2-1. Map of land units within Holtze.mxd

**Figure 2-1. Map of land units within the Holtze site**

## 2.2 Hydrology

The only mapped watercourse for the Holtze site is a first order drainage line in the south-eastern corner – the headwaters for Mitchell Creek. Land unit mapping shows there are similar drainage lines in centre south of the site that also feed into Mitchell Creek. These only flow for short periods after rainfall in the wet season and do not contain any permanent water.

## 2.3 Threatening processes

### 2.3.1 Weeds

Some species of introduced flora are declared to be weeds under the NT *Weeds Management Act* because of the environmental and economic harm they can cause. Class A weeds are to be eradicated by land owners and occupiers. Class B must have their growth and spread controlled by land owners and occupiers. The Commonwealth Government has also categorised some species as Weeds of National Significance (WoNS).

A weed survey was undertaken by EcOz between the 15 and 18 January 2015. The survey mainly focused on areas of existing disturbance – accessible by vehicle – including tracks and unofficial dump sites. Additional records were compiled while undertaking targeted *Typhonium praetermissum* surveys on foot in 2020.

The following declared weeds were recorded within the Holtze site:

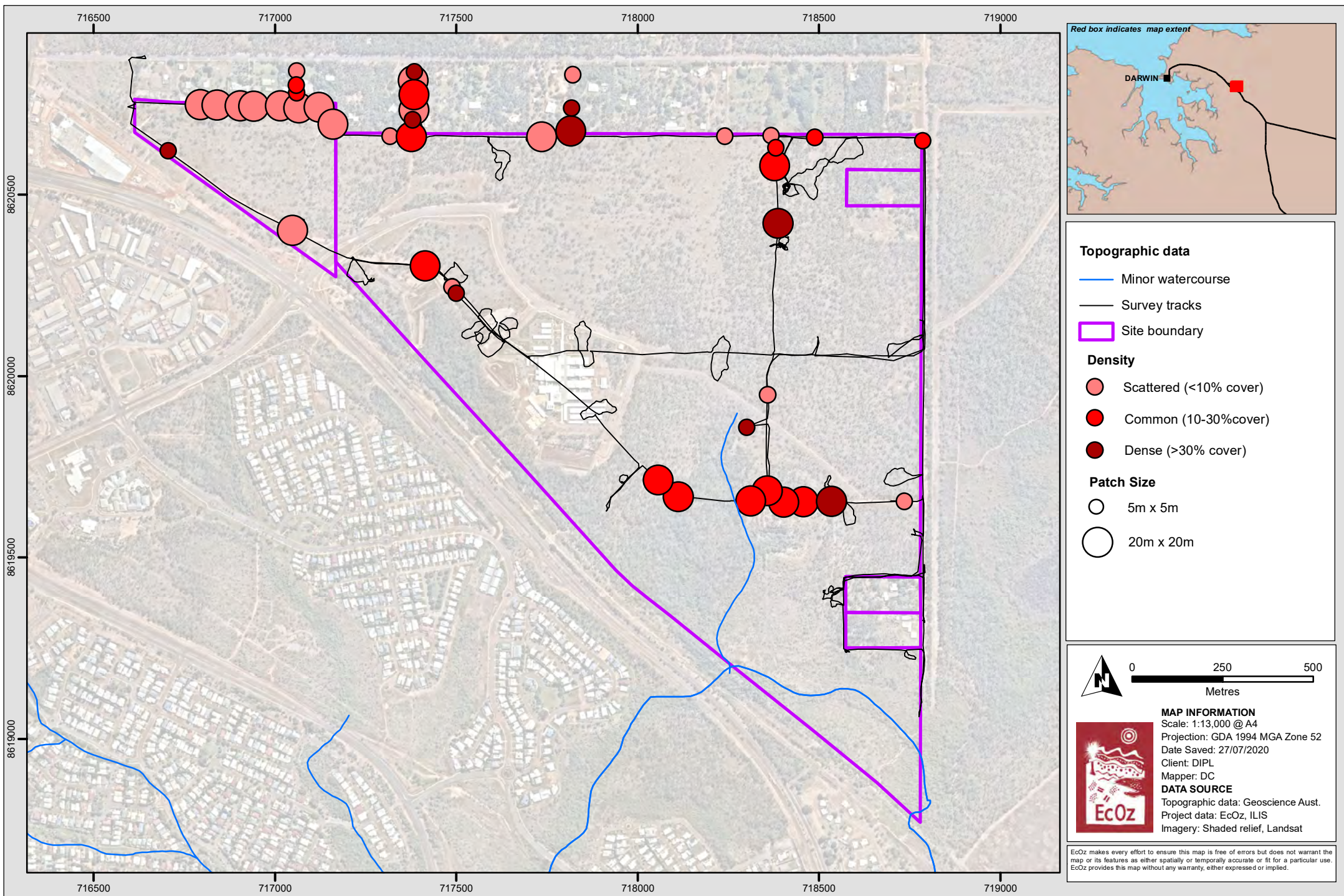
- Gamba Grass (*Andropogon gayanus*) – see, e.g., Figure 2-2
- Mission Grass (*Cenchrus polystachios*)
- Hyptis (*Hyptis suaveolens*) – see, e.g., Figure 2-2
- Spinyhead Sida (*Sida acuta*)
- Flannel Weed (*Sida cordifolia*)
- Neem (*Azadirachta indica*)

Three weed distribution maps have been produced for Gamba Grass (Figure 2-3), Mission Grass (Figure 2-4) and the remaining weed patches of Hyptis, *Sida sp.* and Neem (see Figure 2-5). Survey tracks have been displayed to show the extent of the survey.

Gamba Grass and Mission Grass populations were mainly located along the northern boundary and along access tracks to the south of the Holtze site located at the base of the rocky ridge. The remaining surveyed weed populations were mainly focused on the northern boundary and within the northern access corridors adjoining Wallaby-Holtze Road.

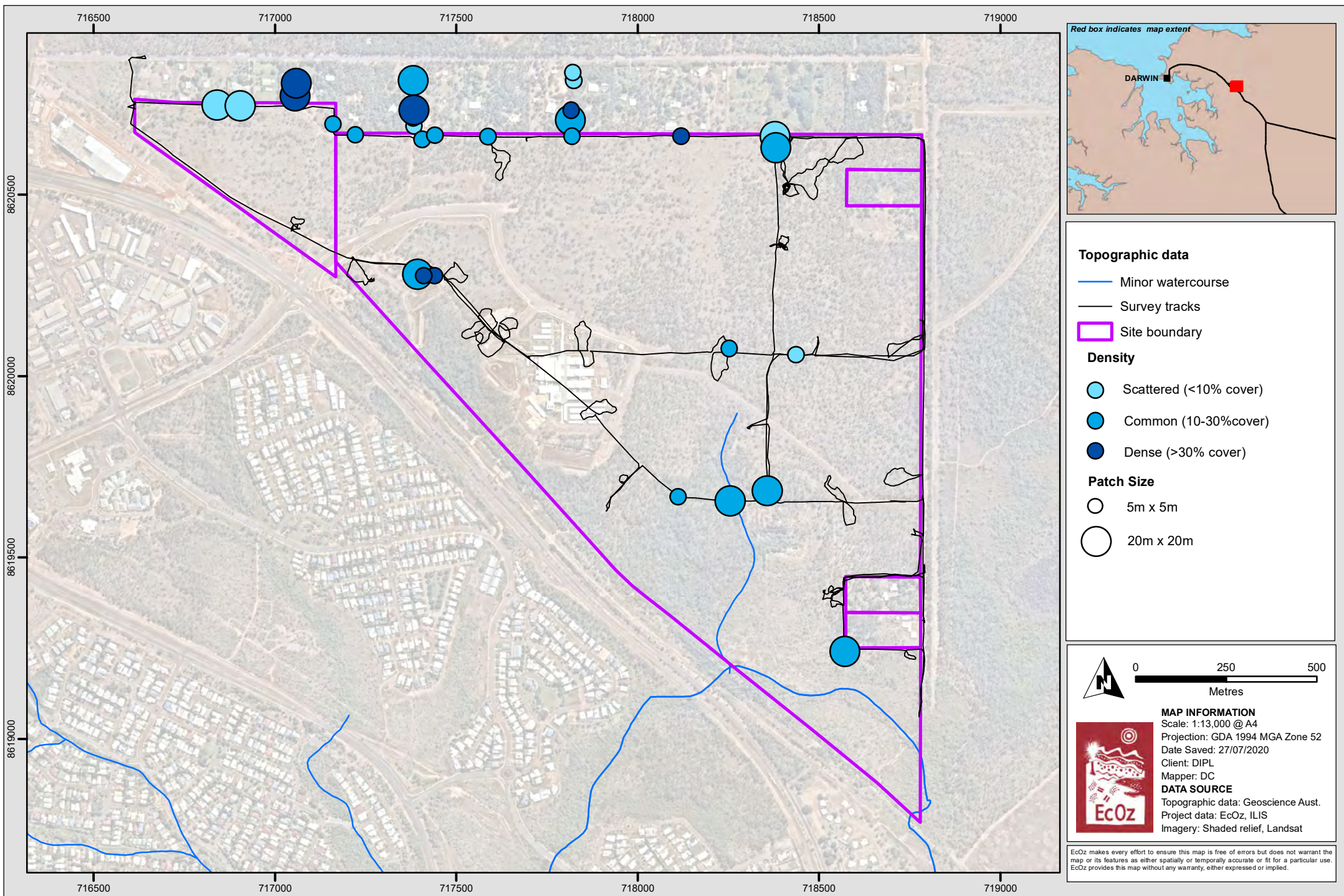


**Figure 2-2. Photographs of weed infestations at the Holtze site: Gamba Grass (left) and Hyptis (right)**



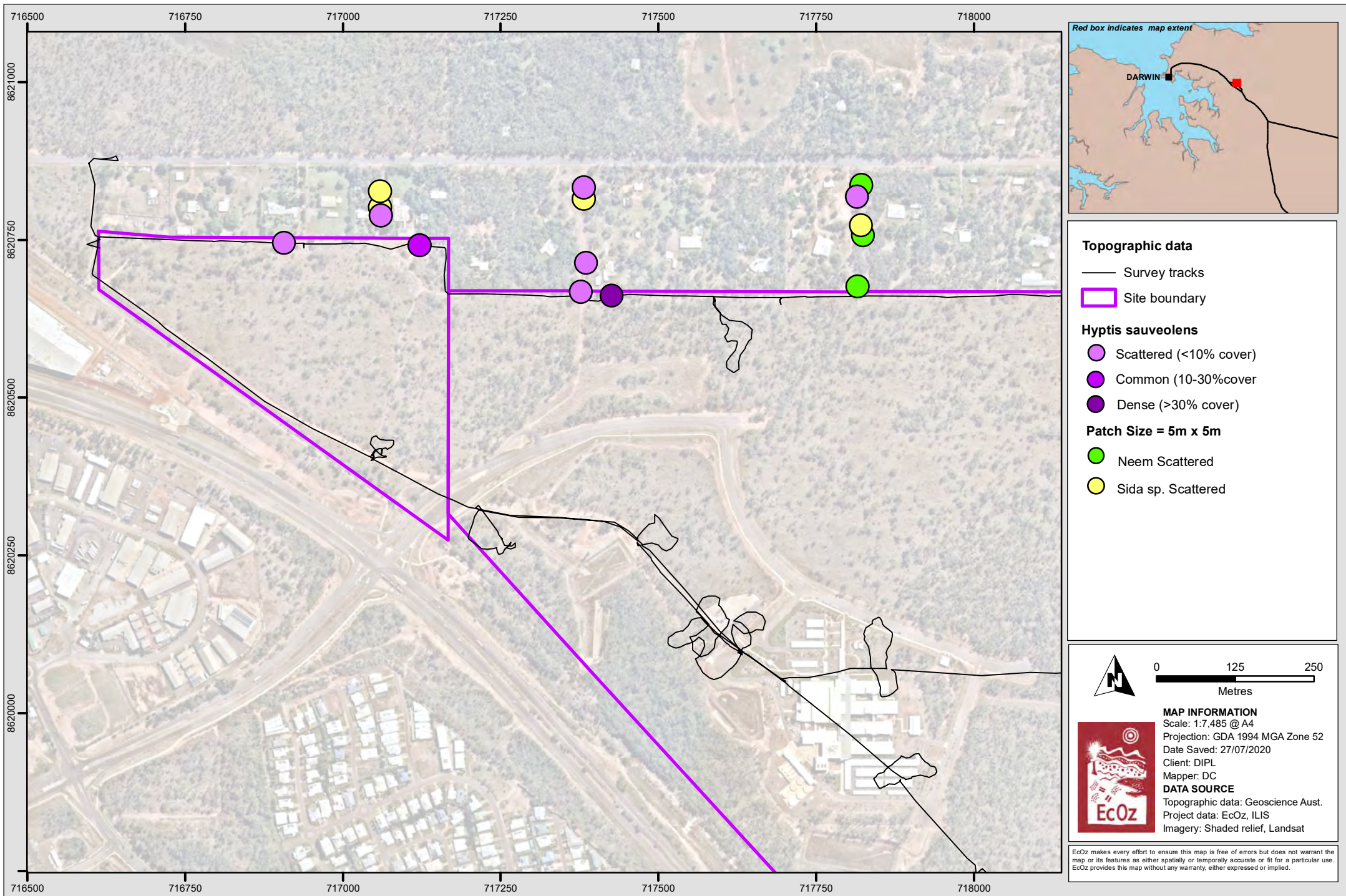
Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\IEZ20050 - Holtze NOI\Project files\Figure 2-3. Map of Gamba Grass patch locations, sizes and densities.mxd

**Figure 2-3. Map of Gamba Grass patch locations, sizes and densities**



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\IEZ20050 - Holtze NOI\Project files\Figure 2-4. Map of Mission Grass patch locations, sizes and densities.mxd

**Figure 2-4. Map of Mission Grass patch locations, sizes and densities**



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\EZ20050 - Holtze NOI\Project files\Figure 2-5. Map of Hyptis, Sida sp. & Neem patch locations, sizes and densities.mxd

**Figure 2-5. Map of Hyptis, Sida sp. & Neem patch locations, sizes and densities**

### 2.3.2 Pest animals

According to the NT Fauna Atlas, the introduced fauna species listed in Table 2-2 are widespread and abundant within the region, and hence likely to occur within the Holtze site. Cane Toads, Feral Cats and Feral Pigs are all listed as a Key Threatening Process under the *EPBC Act*.

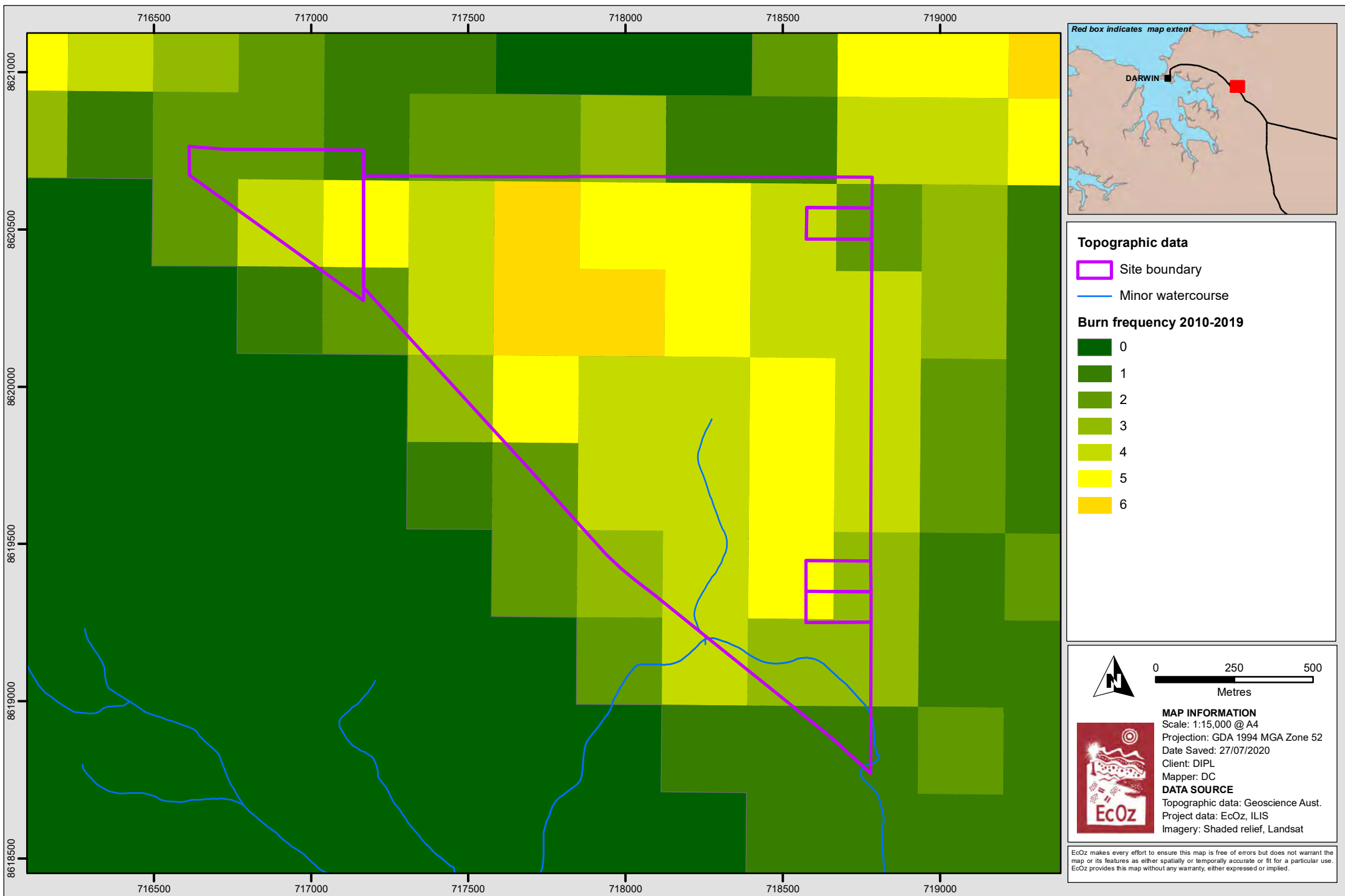
**Table 2-2. Pest animals that are likely to occur within the Holtze site**

Common name	Scientific name	Habitats	Impacts
Wild Dog	<i>Canis lupus</i>	Various	Prey on many species of native animals
Feral Cat	<i>Felis catus</i>	Various	
Feral Pig	<i>Sus scrofa</i>	Riparian areas and wetlands	Physical damage to wetlands
House Mouse	<i>Mus domesticus</i>	Various	Compete with native species. May impact upon native vegetation via seed predation
Black Rat	<i>Rattus rattus</i>	Various	Compete with, and prey on, native species
Cane Toad	<i>Rhinella marina</i>	Various	Known to cause population reductions in a range of predatory species (due to poisoning by ingestion)
Asian House Gecko	<i>Hemidactylus frenatus</i>	Buildings and adjacent woodlands	Compete with, and prey on, native species

### 2.3.3 Fire

Fire is a regular occurrence in the bioregion. Regular fires have always been a natural part of the environment in the Top End. However, frequent fires can result in fewer flora species and reduced structural complexity (McKay 2017), both of which can also significantly diminish the habitat quality for fauna and facilitate weed invasion.

Using regional fire history and fire scar mapping obtained through the [Northern Australia and Rangelands Fire Information](#) website, an analysis of Holtze site shows it has experienced fire between 1 and 7 times in the past 10 years, with the highest frequency in the centre of the site – see Figure 2-6. The majority of the site last burnt in 2017.



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\IEZ20050 - Holteze NOI\Project files\Figure 2-6. Map of fire frequency (years burnt) between 2010-19.mxd

**Figure 2-6. Map of fire frequency (years burnt) between 2010 and 2019**

## 3 ECOLOGICAL VALUES

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Although the ecological component of the natural environment has undoubted value, according to legislation or government guidelines there are certain aspects of that component that are considered of especial value. This chapter discusses which of those values are known to occur within the Holtze site. Much of the discussion is based on field surveys whose methods are detailed in appendices to this report.

### 3.1 Significant vegetation

In the NT, certain vegetation types are considered significant under the *Land Clearing Guidelines* (DENR 2019) due to their unique and/or inherently high biodiversity values. They are rainforest, vine thicket, closed forest or riparian vegetation, mangroves, monsoon vine forest, sand sheet heath and vegetation containing large trees with hollows suitable for fauna. Also of value are wetlands and groundwater-dependent ecosystems.

According to the ground-truthed land unit mapping, the only significant vegetation type within the Holtze site is riparian vegetation associated with intermittent stream south-east portion of the site – i.e. land unit 5b1, and possibly some vegetation containing large *Eucalyptus miniata* and *Eucalyptus tetrodonta* that has the potential to have hollows suitable for fauna.

The other vegetation types that occur within the Holtze site are common throughout the region.

### 3.2 Threatened species

The International Union for the Conservation of Nature nominates a set of criteria used to identify species at risk of extinction. These criteria are used to define categories of risk which are used by the Northern Territory Government to determine which threatened species are listed under the *Territory Parks and Wildlife Conservation Act* (TPWC Act), and by the Commonwealth Government to determine which threatened species are listed under the *EPBC Act*. This report focuses on species that are listed as Vulnerable, Endangered or Critically Endangered under the *TPWC Act*, the *EPBC Act* or both.

This section outlines the results of the threatened species 'likelihood of occurrence' assessment conducted for this report. The assessment was undertaken using available desktop information and was supplemented by field surveys (detailed later in this chapter). The procedure used and detailed results are presented in Appendix B.

The purpose of this assessment is to identify those species that may need to be included within the project's risk assessment, and those that can be reasonably excluded from further consideration because they are unlikely to occur within the Holtze site.

*Note: This process is not a significant impact assessment as it does not take into account project activities and their potential impacts. This will be covered in the Referral.*

A total of 66 threatened species were considered in the 'likelihood of occurrence' assessment. Five species were considered to have a reasonable chance of occurring within the project area, and so were targeted in field studies. As detailed in the following sections, field studies confirmed that two threatened flora species – Darwin Cycad (*Cycas armstrongii*) and *Typhonium praetermissum*, and one threatened fauna species – Black-footed Tree-rat (*Mesembriomys gouldii gouldii*) – do occur. One species – Mertens' Water Monitor (*Varanus mertensi*) – has a high likelihood of occurring, meaning that the species may occur within the Holtze site because there is suitable habitat; however, field studies were not undertaken to confirm this. The remaining species – Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus*) – was not detected and is considered unlikely to occur.

All other threatened species a low or no likelihood occurring, meaning that apart from the occasional vagrant, it is not expected that these species occur within the Holtze site.

Table 3-1 presents the threatened species that are known to, or are considered to have a high likelihood of occurring, within the proposal area.

**Table 3-1. Threatened species ‘likelihood of occurrence’ assessment summary**

Likelihood	Common name	Scientific name	Class	Status	
				EPBC	TPWC
KNOWN	Black-footed Tree-rat	<i>Mesembriomys gouldii gouldii</i>	Mammal	EN	VU
	Darwin Cycad	<i>Cycas armstrongii</i>	Plant	-	VU
	a herb	<i>Typhonium praetermissum</i>		-	VU
HIGH	Mertens' Water Monitor	<i>Varanus mertensi</i>	Reptile	-	VU

### 3.2.1 Darwin Cycad (*Cycas armstrongii*)

The Darwin Cycad (*Cycas armstrongii*) is a small to medium-sized cycad with a slender trunk. The species occurs in open grassy woodlands where adequate draining appears to be a limiting factor (Kerrigan et al. 2006). It also occurs on rocky outcrops, undulating hills and plains (Holmes et al. 2005). Prime cycad habitat has deep loamy, well-drained soil and the species is frequently associated with *Eucalyptus miniata* and *Eucalyptus tetradonta* (Liddle 2009).

*C. armstrongii* is endemic to the Top End, with abundant populations occurring throughout the greater Darwin region, often forming dense stands (Kerrigan et al. 2006). The species is classified as Vulnerable under the *TPWC Act*, but is not listed under the *EPBC Act*. Although *C. armstrongii* are locally abundant in the Darwin region, their long-term conservation has to be considered as they are long-lived, have a slow reproductive rate and have localised distribution (Liddle 2009).

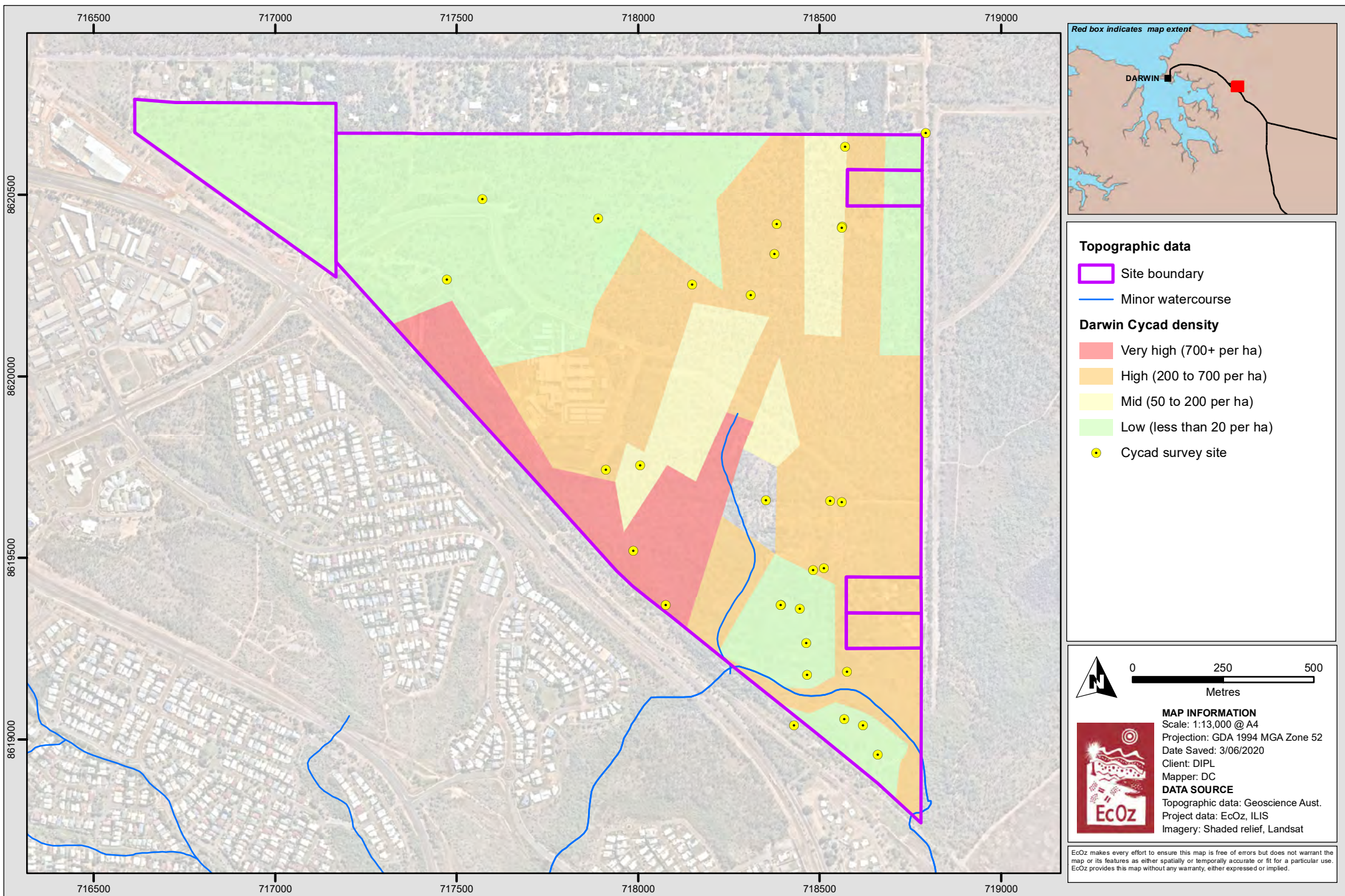
A survey was undertaken across the Holtze site on 4 November 2014 by EcOz to estimate cycad densities. Fifty-five sites were surveyed – see Figure 3-1. Each site included surveying three spatially-separate transects. For each transect, the observer recorded the start location with a GPS and a finish location when the count reached 100 cycads (or 50 in the low density category). All cycads within 25 m on either side of a transect were included in the count.

For each site, only data from a transect with the lowest cycad count were used in the analysis as this will provide a minimum estimate of cycads for the property. Count data from each transect was then averaged for the zone and converted to cycad density per hectare.

A density category was assigned to each zone based on minimum estimated density:

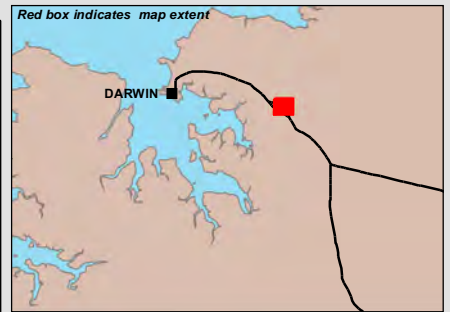
- Low: 20 per ha
- Medium: 50 per ha
- High: 200 per ha
- Very High: 700 per ha

It was found that the site supports *C. armstrongii* in varying densities – see Figure 3-1. The highest densities occur on the rocky ridge areas in the south. Most of the north and west of the Holtze site has a low density of Darwin Cycads



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\EZ20050 - Holtze NOI\Project files\Figure 5-1. Map of cycad survey sites within the Holtze site.mxd

**Figure 5-1. Map of Darwin Cycad survey sites within the Holtze site**



**Topographic data**

- Site boundary
- Minor watercourse

**Darwin Cycad density**

- Very high (700+ per ha)
- High (200 to 700 per ha)
- Mid (50 to 200 per ha)
- Low (less than 20 per ha)
- Cycad survey site

**MAP INFORMATION**  
 Scale: 1:13,000 @ A4  
 Projection: GDA 1994 MGA Zone 52  
 Date Saved: 3/06/2020  
 Client: DIPL  
 Mapper: DC

**DATA SOURCE**  
 Topographic data: Geoscience Aust.  
 Project data: EcOz, ILIS  
 Imagery: Shaded relief, Landsat

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either expressed or implied.

### 3.2.2 *Typhonium praetermissum*

*Typhonium praetermissum* is listed as Vulnerable under the *TPWC Act*. It is a small perennial herb with above-ground parts present during the annual wet season, usually between December and April. This species occurs in open woodland and favours relatively unshaded areas in red brown clay and shallow gravelly soils. *T. praetermissum* plants are typically found in small, relatively open (unshaded) patches of gravel or gravelly sandy substrate supporting less than 20% vegetation ground cover, and located on the edge of lateritic plateau areas.

The species is endemic to the greater Darwin region, extending from the Gunn Point area, south to Noonamah Ridge and west to Cox Peninsula. Previous survey work undertaken within the Holtze site by EcOz in 2015 and by Plaxy Purich in 2017 recorded the species at a number of locations across the site. These occurrences are part of the 'Holtze sub-population' of the species (as per Cuff & Green 2019). The habitat supporting occurrences immediately south of the Section 7773 has since replaced with hospital-related infrastructure.

The NT Department of Environmental, Parks and Water Security (DEPWS) has developed a habitat model for *T. praetermissum* for the Greater Darwin region (Cuff & Green 2019). According to that model, there are large areas – totalling 94 ha – of high likelihood *T. praetermissum* habitat within the Holtze site (see Figure 3-2).

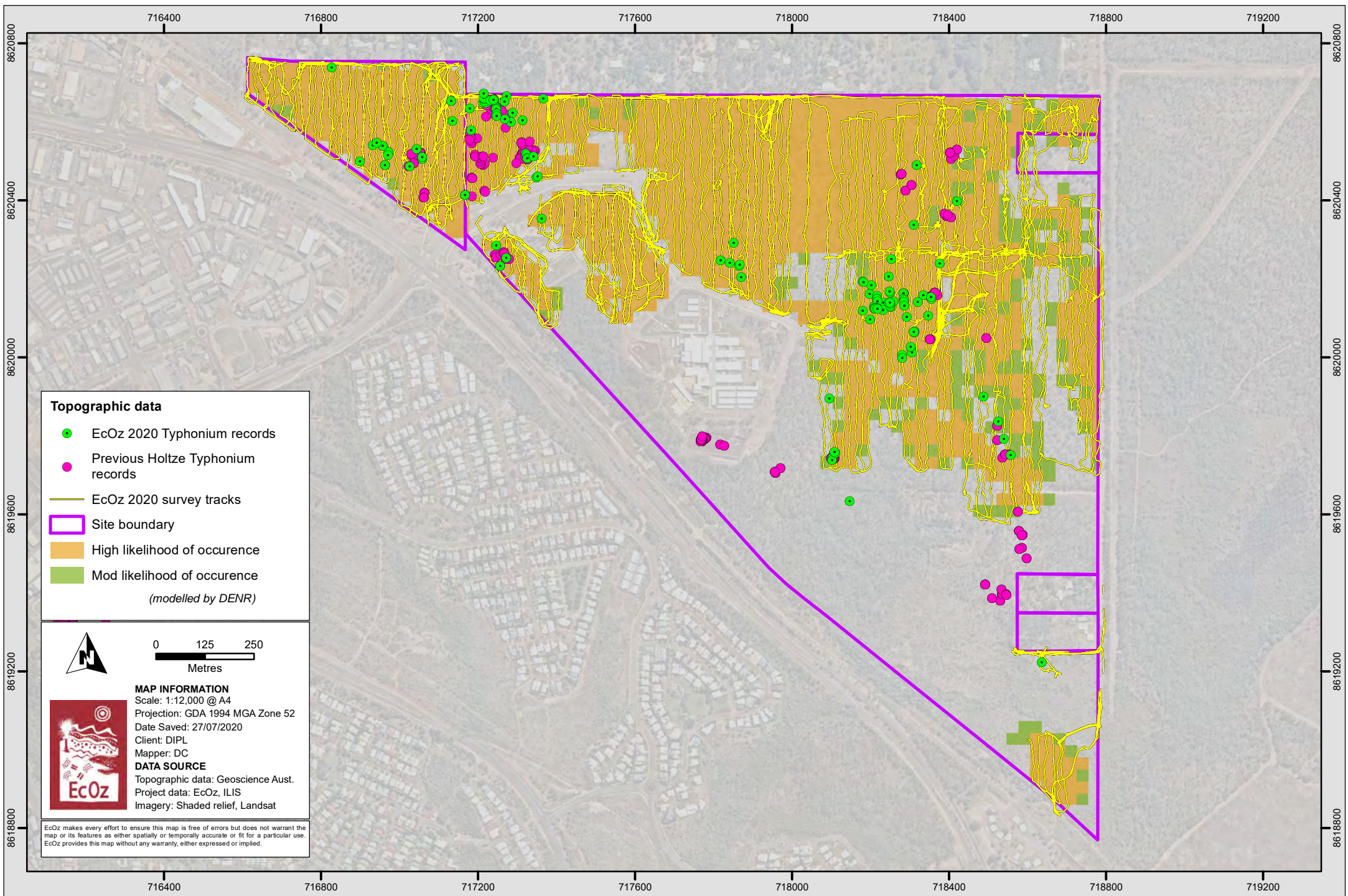
In 2020, the predecessor of DEPWS – the Department of Environment and Natural Resources (DENR) – was utilising a Standard Operating Procedure (SOP) for surveying *T. praetermissum* focussing on areas of modelled high likelihood *T. praetermissum* habitat. The SOP specified an intensive methodology involving two surveys – a detection survey and, if the species is found, an abundance survey. The detection survey was undertaken in 2020 across all high and moderate likelihood habitat within the Holtze site in accordance with the SOP. In 2021, DEPWS replaced the SOP procedure with the *Northern Territory Threatened Plant Survey Guidelines – Supplement 1: Typhonium Field Surveys* (Bickerton et al. 2020). Those guidelines were followed for the abundance survey undertaken in 2021. The detection survey methodology in the guidelines is similar to that in the SOP, except that the survey effort required for a large area (such as the Holtze site) in the guidelines is less than that which is required in the SOP (and which was undertaken in the detection survey).

#### **Detection survey**

A detection survey was undertaken 24 - 25 March and 2 - 3 April 2020, by EcOz ecologists under the leadership of Nicole Clark. The survey was carried out in compliance with DENR's Standard Operating Procedure at the time. It involved experienced surveyors walking parallel transects 17 m apart throughout the area of habitat searching for the plant. This equated to 120 km of transects – see Figure 3-2. Because the survey late in the detection season (January to April), there was insufficient time and resources to also undertake the more intensive abundance survey. That survey was undertaken in 2021 (see next section).

A known reference site within the Holtze site was visited on the first day to ensure that the species was apparent. Genetic sampling was also undertaken as a contribution to a two-year DENR study of the species within the greater Darwin region in order to identify and conserve important occurrences of the species, and to inform regional land development. Thirty plants were genetically sampled within the Holtze site on 7 April 2020 in compliance with the relevant DENR Standard Operating Procedure and after training in the technique by DENR staff.

The site was covered in a dense ground layer of very tall speargrass (*Sorghum intrans*) which resulted in an effective survey width of 2 m either side of the transect. Applying this gives approximately 20% coverage of the area surveyed. Areas modelled as high and medium likelihood, but observed in the field to be supporting wet indicator species and subject to poor drainage species, were considered unlikely habitat and, for this reason, not surveyed. Likewise, areas occupied disturbance including adjacent residential rural properties and flowering weeds were also avoided.



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\EZ20050 - Holtze NOI\Project files\Figure 5-2. Map of survey transects for Typhonium praetermissum within the Holtze site.mxd

**Figure 3-2. Map of detection survey transects for *Typhonium praetermissum* within the Holtze site**

A total of 131 *T. praetermissum* records were made – see Figure 3-2. The detection survey methodology is such that a 'record' could be of a clump of multiple individuals within a 5 m radius (i.e. the extent of the geospatial accuracy of a GPS). For detail on population size, an abundance survey is required.

The majority of records were located north-east of the hospital and in the western section of the Holtze site. There were a few isolated plants in the southern part that were considered incidental records and were not recorded within the high to moderate likelihood areas. The majority of the plants recorded in the western section were recorded in close proximity to existing Holtze records, except for a few additional points recorded towards the most western outer boundary and one on the northern boundary. The majority of the plants identified north of the hospital and north-east were unique, and not overlying existing records. Most records were from well-drained gravels and gravelly sands (Kandosols) that support Eucalypt woodlands. Interestingly, many of the records occur in an area of regrowth after being cleared in the 1960's.

As at the time of writing, the results of the genetic sampling are not known.

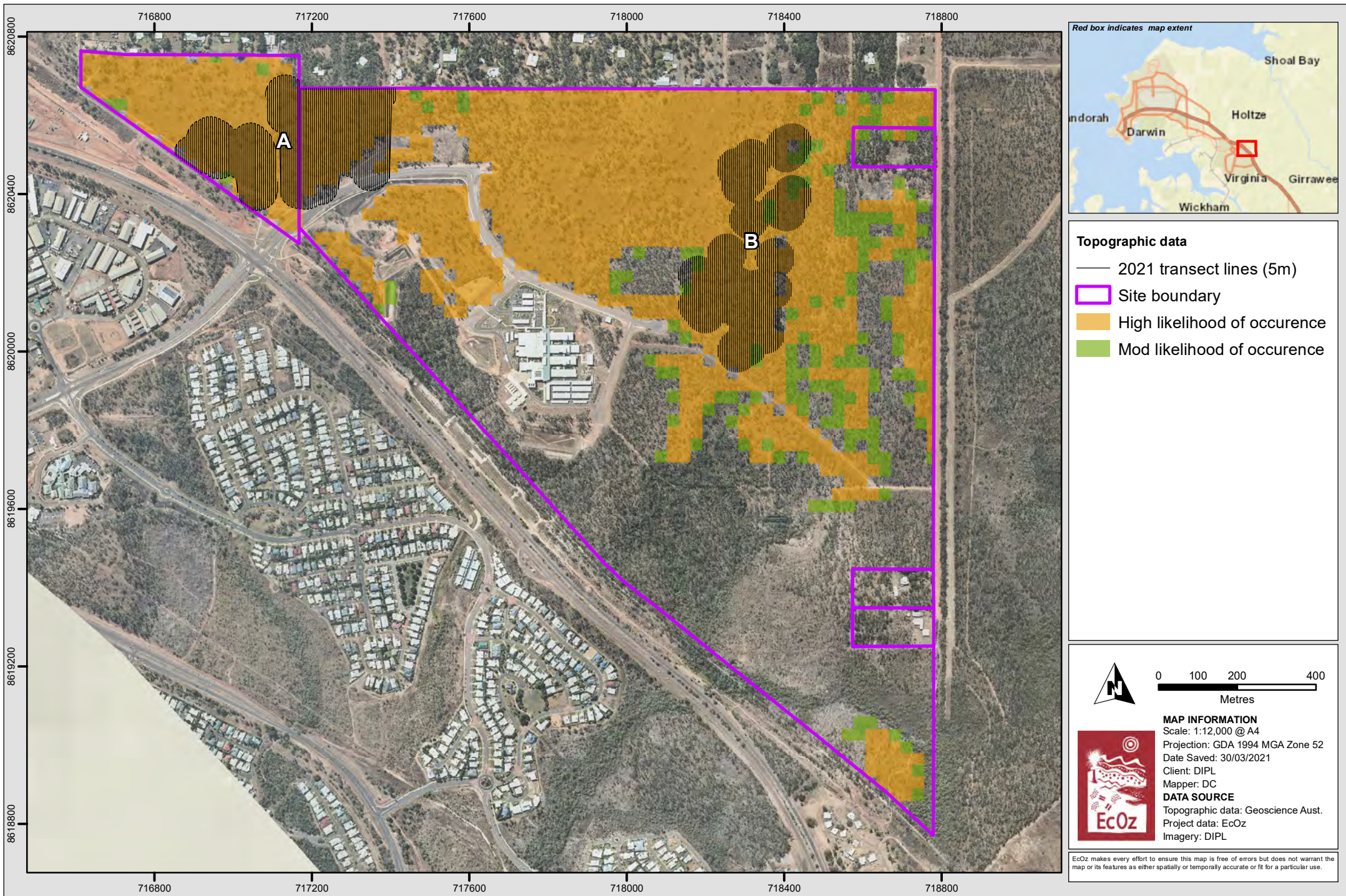
### ***Abundance survey***

The abundance survey was undertaken on 18 - 19 and 22 - 23 March 2021. A team of ecologists undertook the survey, led by botanist Nicole Clarke who has had extensive experience in survey for this species including, recent surveys in the Holtze-Kowandi and Middle Arm areas.

The abundance survey focused on areas of higher occurrence of *Typhonium* as recorded in the 2020 detection surveys. This included two survey areas, one in the north-west (survey area A) and another in the north-east (survey area B) – see Figure 3-3. This was due to the majority of records in the detection survey being located in these two areas. These focus areas for survey were determined in consultation with Nick Cuff (DEPWS) prior to the field survey to confirm the best approach and methodology associated with the survey. The survey was undertaken in accordance with the *Northern Territory Threatened Plant Survey Guidelines – Supplement 1: Typhonium Field Surveys* (Bickerton et al. 2020).

To determine the area for the abundance survey, each previous *Typhonium praetermissum* record collected during the detection survey had a 50 m buffer applied around it to ensure the true limits of a patch are captured as far as is practicable. These records with their buffers were then combined and merged to provide the initial target area for abundance surveys. Where buffer areas intersected, buffers were spatially joined to give the final survey area and a clear differentiation between patches.

Transect lines at 5 m spacing were overlaid onto the abundance survey area and uploaded to a handheld GPS for field reference. Transect lines were then navigated in the field, with surveyors beginning their search on adjacent transects, walking at a similar pace and being careful to not re-record previously observed plants. For each transect, observers had an effective survey width of 4 m (i.e. 2 m on either side of the transect line). A waypoint was recorded for each plant observed.



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\EZ20050 - Holtze NOI\Project files\Report maps\Map of all transect lines.mxd

**Figure 3-3. Map of abundance survey areas for *Typhonium praetermissum* within the Holtze site**

Survey area A covered 11.58 ha and survey area B covered 11.89 ha, with a total of 49 km of transects (spaced 5 m apart) searched across these areas (see Figure 3-6 and Figure 3-7).

Survey conditions during the field assessment were consistent with those recommended in the guidelines, except for a short duration on 23 March, where survey was paused during a rain event and recommenced in the afternoon. Detectability in small portions of the survey areas was compromised by the density of Spear Grass (*Sorghum intrans*) and extra care was taken in these areas to slowly traverse along each transect, sweeping the vegetation back to reveal *Typhonium* plants.

In total, 315 *Typhonium praetermissum* plants were recorded during the abundance survey (see Figure 3-6 and Figure 3-7). This is compared to 131 during the detection survey. The largest number of plants was recorded in survey area A (190 plants); with 123 plants recorded in survey area B. These totals do not include those plants located outside of the abundance survey areas (A and B) as recorded in the detection surveys and previous assessments across the project area.

The survey areas supported a mix of older larger plants and small seedlings (see, e.g., Figure 3-4), often occurring in close proximity to each other. The majority of plants appeared to be in full health, with very few individuals showing signs of deterioration at the end of the season (i.e. yellow leaves).

### **Summary**

The results of the abundance survey for *Typhonium praetermissum* provide supplementary information on the biodiversity values within the project area and fulfil the survey requirements for this threatened species under the NT *Land Clearing Guidelines* (DIPL 2020) and the survey guidelines for the species (Bickerton et al. 2020).

The results from both surveys indicate that the north-west and the north-east of the project area (survey areas A and B) are likely to provide the highest quality habitat for the species on-site. These results also validate the DEPWS habitat modelling for the species, as the majority of records fell within areas modelled as having a high likelihood of occurrence for the species.

Most records within the project area were from well-drained gravels and gravelly sands (Kandosols) that support Eucalypt woodlands (see, e.g., Figure 3-5). The project area has been subject to previous disturbance with many of the records located in areas of regrowth after being cleared in the 1960's.

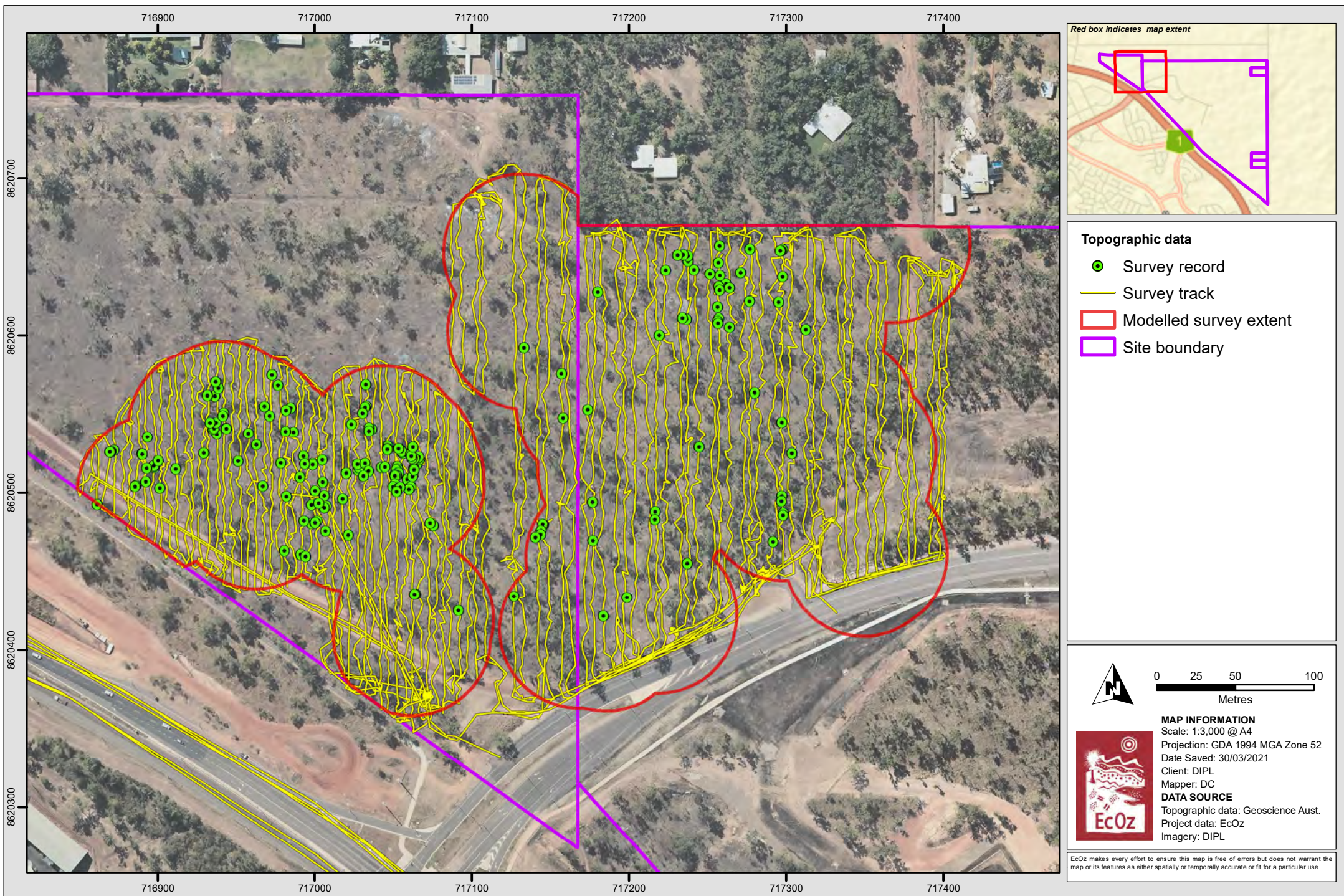
Pending confirmation from genetic analysis, it appears that based on proximity the records of *Typhonium praetermissum* within the project area form part of the larger Holtze sub-population, with records outside of the project area to the south, north-west and north-east. Cuff and Green (2019) identified sub-populations of *Typhonium praetermissum* based on a minimum 2.5 km separation distance between records in continuous, intact potential habitat.



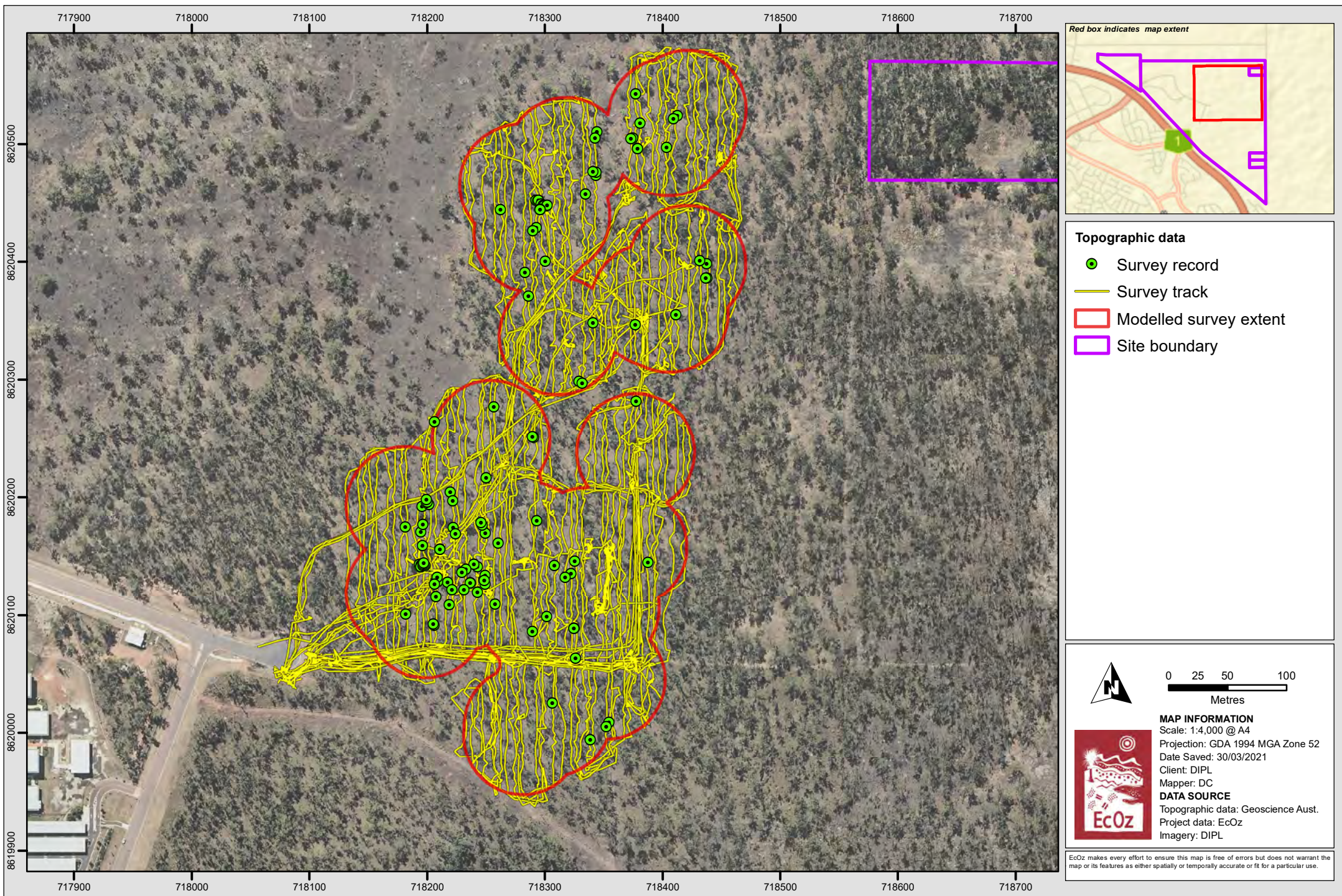
Figure 3-4. Photograph of *Typhonium praetermissum* within the project area (18 March 2021)



Figure 3-5. Photograph of typical *Typhonium praetermissum* woodland habitat within the north-west of the project area (22 March 2021)



**Figure 3-6. Map of abundance survey records for *Typhonium praetermissum* in survey area A**



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\IEZ20050 - Holzke NOI\Project files\Report maps\Map of survey area B.mxd

**Figure 3-7. Map of abundance survey records for *Typhonium praetermissum* in survey area B**

### 3.2.3 Black-footed Tree-rat (*Mesembriomys gouldii gouldii*)

The Black-footed Tree-rat is listed Vulnerable under the *TPWC* Act and as Endangered under the Commonwealth *Environmental Protection and Biodiversity Conservation Act (EPBC Act)*.

The Kimberley and mainland Northern Territory sub-species of the Black-footed Tree-rat (*Mesembriomys gouldii gouldii*) is a medium-sized nocturnal rodent that dens mostly in tree hollows, but may also use clumps of *Pandanus spiralis*. The species is largely arboreal but also forages on the ground. The Black-footed Tree-rat generally requires fruit and seed resources – including *Pandanus* fruits, and fruiting trees and shrubs (Rankmore 2006). The Black-footed Tree-rat predominantly occurs in woodlands and open forests with large trees dominated by *Eucalyptus* and a moderately diverse mid-storey, particularly in patches on tall *E. miniata* and *E. tetradonta* open forest (Rankmore & Friend 2008).

The subspecies is thought to be more prevalent in woodlands with infrequent and low intensity fires (Price et al. 2005). Tree hollows are an important resource for the species and it may be that regularly fired landscaped have fewer larger trees that provide hollows; however, natural events such as cyclones may also reduce the number of trees hence hollow availability (Woinarski & Westaway 2008).

Based on the authors' survey experience, Black-footed Tree-rats have remained relatively abundant in some parts of the Darwin rural area where they have access to suitable nesting habitat and food resources. There are records from 2019 of the species in bushland approximately 3.5 km to the north-east, as well as from 2017 adjacent to the suburb Johnston approximately 1 km south of Holtze site. Black-footed Tree-rats have a large home range (~67 ha) and are capable of travelling over two kilometres in a night (Rankmore & Friend 2008).

A camera trapping survey was designed to determine the presence of the Black-footed Tree-rat within the Holtze site. The location of camera sites was chosen in suitable habitat (based on aerial imagery) that was accessible, and maximised geographic spread across the site. When installing the cameras, site selection was refined based on the ecologists' appraisal of what they considered the 'best quality' tree-rat habitat in the area – i.e. presence of mid-storey food plants and tree hollows / *Pandanus* thickets – targeting ecotones where available.

Camera trap methodology used in this survey employed paired vertical camera set-up described in the *Camera Trapping SOP for the Top End Long-term Monitoring Program* developed by Flora and Fauna Division of DENR (2017) – see Figure 3-8.

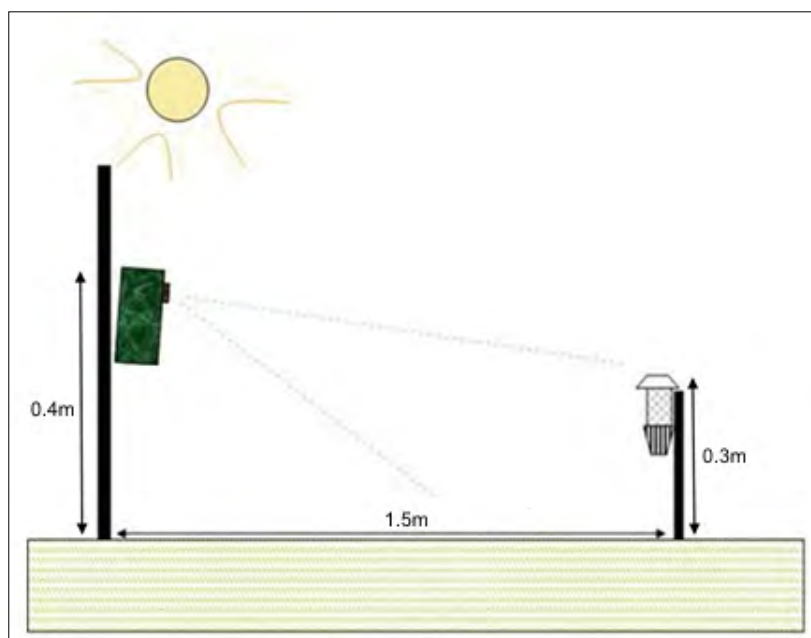


Figure 3-8. Diagram of camera set-up

Each site had two cameras approximately 50 m apart. Camera traps were baited using a mixture of peanut butter and oats in a canister positioned within the camera field of view. Cameras were set to high sensitivity and to take three photographs (with 1-second intervals) per trigger, with a 10-second interval between triggers.

The model of camera used was KeepGuard KG690. These are an older style camera to those preferred in the above mentioned Standard Operating Procedure; however, previous EcOz survey results at Muirhead North, Middle Arm and Darwin Airport confirm that the Black-footed Tree-rat is readily detectable by baited camera traps in the greater Darwin region.

Cameras were deployed at 5 sites on 23 March 2020 and collected two weeks later on 7 April 2020 – a total of 173 trap nights. Traps were deployed by Clare Millen and Ella Mason, on advice from Glen Ewers. The survey period weather ranged between an average minimum of 24.1 °C and maximum of 35.9 °C (recorded at Darwin International Airport climate station 014015, located approximately 12 km north-west of Holtze site). Rainfall was recorded at a daily average of five millimetres, with 13 days experiencing less than five millimetre and only three days receiving greater than 19 millimetres. The maximum rainfall was 32.6 mm of 5 April.

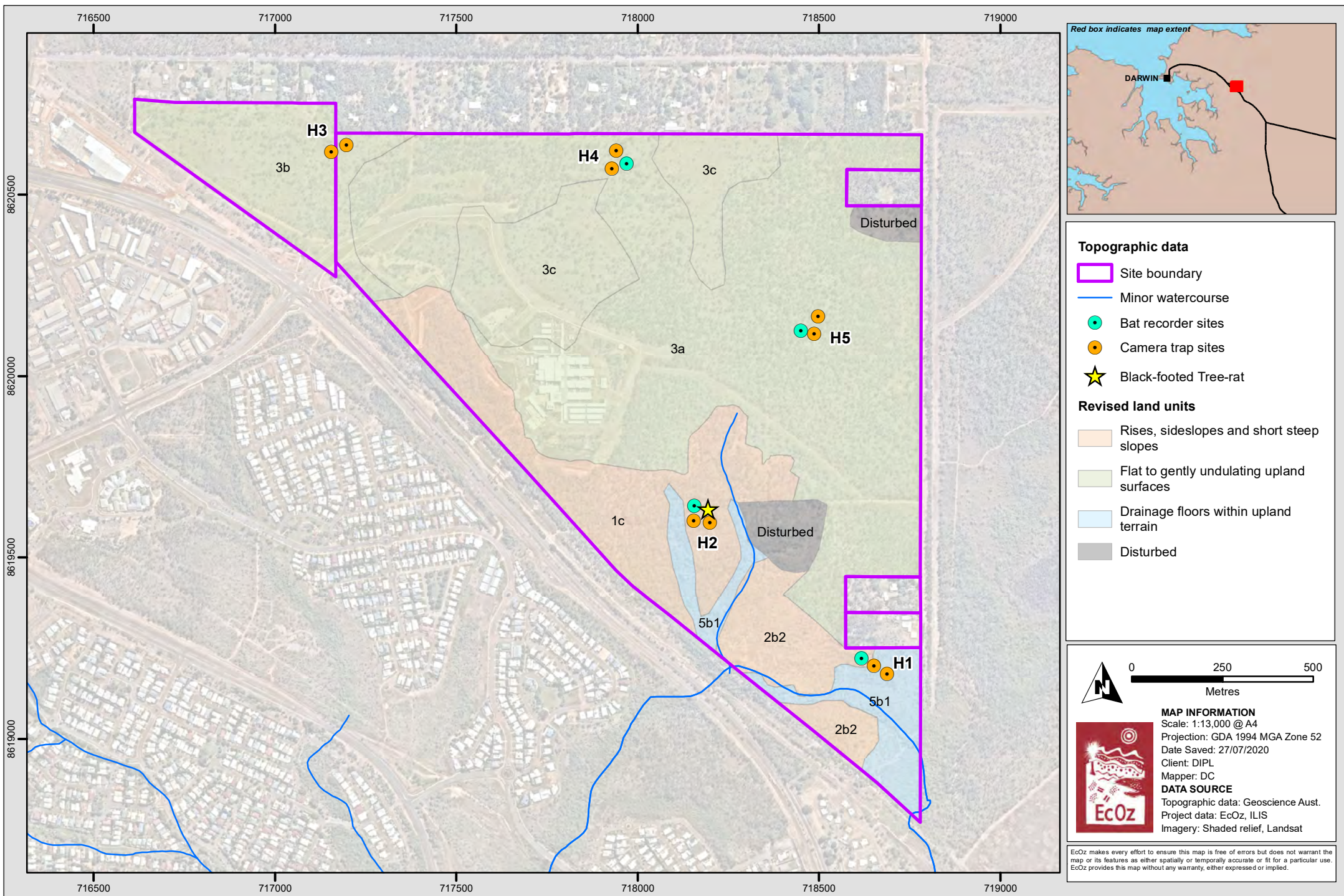
Sites were located in land units 1c, 3c, 3b and 4c – see Figure 3-10 – mostly dominated by *E. miniata*, *E. tetradonta* and *Erythrophleum chlorostachys*. Sites 1, 2 and 5 were free of weeds; however, sites 3 and 4 were near to residential properties and dumped rubbish heaps that have dense infestations of Gamba Grass (*Andropogon gayanus*) and Hyptis (*Hyptis suaveolens*).

The species was recorded once at a Site 1 (in the southern end of the Holtze site) within land unit 1c – see Figure 3-9.

The Black-footed Tree-rat has a high detectability using the survey method employed. The species appears to be confined to the denser, less disturbed woodland within land unit 1c. The site the species was recorded at is also located between two drainage lines which may afford a higher degree of fire protection than elsewhere in the Holtze site.



**Figure 3-9. Camera trap images of Black-footed Tree-rat recorded within the Holtze site**



Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\IEZ20050 - Holtze NOI\Project files\Figure 3-4. Map showing locations of camera survey sites and records within the Holtze site.mxd

**Figure 3-10. Map showing locations of camera survey sites and records within the Holtze site**

### 3.2.4 Mertens' Water Monitor (*Varanus mertensi*)

The Mertens' Water Monitor (*Varanus mertensi*) is a large (up to 1.1 m) dark-grey monitor covered with small cream to yellow spots, and with a strongly laterally-compressed tail. The species is semi-aquatic and arboreal, and occupies edges of freshwater watercourses and lagoons where it forages for aquatic prey (Christian 2004a), which mostly includes fish (but may also opportunistically eat other groups such as frogs). It is seldom seen away from freshwater and is often observed on the edges of freshwater creeks, dropping from vegetation when disturbed. Mertens' Water Monitor can remain submerged for long periods. This species breeds in the early dry season.

This species is found across northern Australia from Cape York Peninsula to the Kimberley (Christian 2004a). Mertens' Water Monitor is known to occur in the Palmerston region, with records since 2010 in a number of suburbs close to the Holtze site.

Mertens' Water Monitor is listed as Vulnerable under the *TPWC Act* due to a known decline in this species abundance because of death associated with predation on the Cane Toad. It is not listed under the *EPBC Act*.

The species has not been surveyed for within the Holtze site. This is because there are no formal survey methods for this species, and also because the cryptic and transitory nature of the species means that non-detection does not rule out the occasional/seasonal presence of the Mertens' Water Monitor within the Holtze area. Therefore, its potential presence has been inferred based on there being suitable habitat and records within the catchment. Suitable habitat for the species is restricted to ephemeral first-order drainage lines in the south of the Holtze site. As this species does not forage far from water, it is likely that – if present – it only occurs within the Holtze site during the wet season (when the creeks contain water); using off-site downstream areas during the dry season (i.e. Mitchell Creek) and migrating upstream in the wet season in search of food resources and breeding opportunities.

### 3.2.5 Bare-rumped Sheath-tail Bat

A preliminary assessment identified Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus*) as having the potential to occur – based on the presence of suitable habitat and proximate records. A survey was undertaken in early 2020 using acoustic recorders. These were placed around the Holtze site in Eucalypt woodland for a single night at five locations (see Figure 3-10 for location). Analysis of the recording was undertaken by Dr Kyle Armstrong – see the report in Appendix D. Six species of bat were detected, but not the Bare-rumped Sheath-tail Bat.

## 3.3 Migratory species

Australia is a signatory to international conventions and agreements to protect migratory species. Such species are protected under the *EPBC Act*. Any migratory species that is also listed as threaten has already been considered in the previous section.

The EPBC Protected Matters Search Tool report (see Appendix C) identified the possibility of migratory species occurring in the region. However, migratory species are not likely within the Holtze site. Many birds listed as wetland species within the PMST report occur almost exclusively in coastal and estuarine environments, neither of which occur within the Holtze site. For migratory bird and marine species, the Holtze site does not contain important habitat (as defined in Commonwealth of Australia 2013), and so they are not considered further.

## 4 CONCLUSION

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The following ecological values are known to, or have a high likelihood of occurring, within the Holtze site:

- **Significant vegetation**
  - Riparian vegetation
- **Threatened species**
  - Darwin Cycad (*Cycas armstrongii*)
  - *Typhonium praetermissum*
  - Black-footed Tree-rat (*Mesembriomys gouldii gouldii*)
  - Mertens' Water Monitor (*Varanus mertensi*).

These are mapped in Figure 4-1.

In general, habitat is largely intact, with only localised weed patches, and a fire history that is moderate for the region.

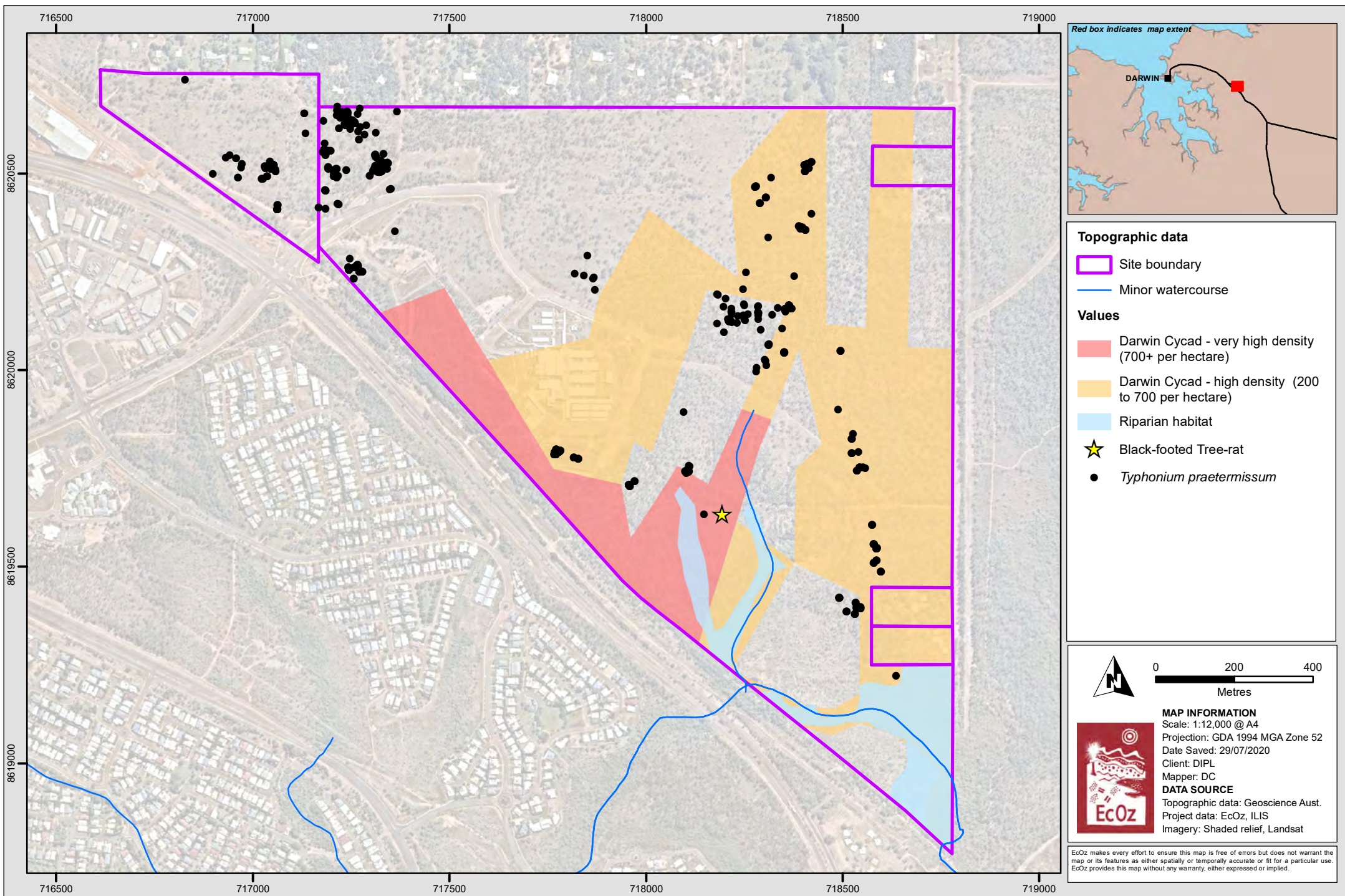


Figure 4-1. Map of ecological values within Holtze site

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## APPENDIX A LAND SUITABILITY ASSESSMENT

As per Appendix E of Referral Report

## APPENDIX B THREATENED SPECIES 'LIKELIHOOD OF OCCURRENCE' ASSESSMENT

The following procedure was used to determine which threatened species have the potential to occur in the Holtze site:

- Species records from the latest version of the [NT Atlas](#) were clipped to the Darwin Coastal bioregion. Bioregions give a broad area with largely similar habitat characteristics and species assemblages. Clipping data to them ensures all potential species are captured in order to undertake a project-specific 'likelihood of occurrence' assessment.
- The [EPBC Protected Matters Search Tool](#) (PMST) was used to generate a report using a 5 km buffer from a centroid within the Holtze site. This PMST is an online enquiry tool managed by the Commonwealth Department of the Environment and Energy which interrogates a range of existing flora and fauna data, as well as predictive modelling to speculate on the presence of species within a search area. The PMST uses a grid system to determine which protected matters it encapsulates for a particular search. The PMST report (Appendix C) was generated on 1 May 2020.
- For each threatened species, the likelihood of it occurring within the Holtze site was then assessed based on desktop information that relates to habitat requirements, distribution, number and dates of proximate records (obtained from NT Atlas and/or [Atlas of Living Australia](#)); the ecological information and field surveys detailed in Section 3 of the main report. Likelihood ratings were defined as follows:
  - **HIGH** – it is expected that this species lives within the Holtze site because there is core habitat and recent proximate records.
  - **MEDIUM** – this species may live within the Holtze site because there is suitable habitat; however, there is evidence that lowers its likelihood of occurrence (known range contraction of the species in the region, no recent records with the search area, substantial loss of habitat within the Holtze site since previous records, species is naturally-rare or occurs at a low density etc.).
  - **LOW** – this species may occur, as a vagrant, within the Holtze site; however, there is only marginally-suitable habitat.
  - **NONE** – there is strong evidence (no suitable habitat and/or the species is considered likely to be regionally-extinct) that this species will not occur within the Holtze site.

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>BIRDS</b>				
<b>White-throated Grasswren</b> <i>Amytornis woodwardi</i>	VU	VU	<p><b>Habitat:</b> Confined to hummock grasslands, sometimes with open shrubland or woodland overstorey, mixed among dense boulder fields or sandstone pavements (Schodde 1982; Noske 1992) and escarpment drainage lines.</p> <p><b>Distribution:</b> NT only – patchily distributed from Nitmiluk National Park to western Arnhem Land (Noske 1992).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat within Holtze site.</li> <li>• Outside of restricted range.</li> </ul>
<p>Noske, R. (1992). The status and ecology of the white-throated grass-wren <i>Amytornis woodwardi</i>. <i>Emu</i>, Vol. 92, pp. 39-51.</p> <p>Schodde, R. (1982). <i>The fairy-wrens - A monograph of the Maluridae</i>. Landsdowne Editions, Melbourne.</p>				
<b>Yellow Chat (Alligator River subspecies)</b> <i>Epthianura crocea tunneyi</i>	EN	EN	<p><b>Habitat:</b> Grassy floodplain depressions and channels, concentrating around refugial waterholes at the end of the dry season (Armstrong 2004).</p> <p><b>Distribution:</b> Top End of the NT, where restricted to a small number of sites in the floodplains from the Adelaide River to the East Alligator River (Woinarski &amp; Armstrong 2006).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable floodplain habitat.</li> <li>• Outside of restricted range.</li> </ul>
<p>Armstrong, M. (2004). <i>The yellow chat Epthianura crocea tunneyi in Kakadu National Park</i>. Report to Parks Australia (North), NT Department of Infrastructure Planning and Environment, Darwin.</p> <p>Woinarski, J. and Armstrong, M. (2006). <i>Threatened Species of the Northern Territory - Yellow Chat (Alligator River subspecies) - Epthianura crocea tunneyi</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0019/206344/yellow-chat.PDF">https://nt.gov.au/_data/assets/pdf_file/0019/206344/yellow-chat.PDF</a> [Accessed 1 May 2018].</p> <p>Schodde, R. and Mason, I.J. (1999). <i>The Directory of Australian Birds: Passerines</i>. CSIRO Publishing, Melbourne.</p>				
<b>Red Goshawk</b> <i>Erythrotriorchis radiatus</i>	VU	VU	<p><b>Habitat:</b> Prefers tall, open Eucalypt forest and riparian areas. Nests in large trees, frequently the tallest and most massive in a tall stand, nest trees are invariably within 1 km of permanent water (Debus &amp; Czechura 1988; Aumann &amp; Baker-Gabb 1991). Rarely breeds in areas with fragmented native vegetation (Aumann &amp; Baker-Gabb 1991; Czechura 2001). Home range of up to 200 km<sup>2</sup> (Czechura &amp; Hobson 2000).</p> <p><b>Distribution:</b> Solitary and secretive hawk that is sparsely distributed across much of northern Australia, from the Kimberley in WA to south-eastern Qld. Within this range, generally confined to taller forests characteristic of higher rainfall coastal and sub-coastal areas (Debus 1998), but there are some isolated records of wandering birds from central Australia (Woinarski 2006).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Marginally-suitable woodland habitat, but no riparian habitat.</li> <li>• Occasional sightings in the Darwin area, but only likely to be recorded as a vagrant species.</li> </ul>
<p>Aumann, T. and Baker-Gabb, D. (1991). <i>A Management Plan for the Red Goshawk</i>. RAOU Report 75, Royal Australasian Ornithologists Union, Melbourne.</p> <p>Czechura G.V. and Hobson R.G. (2000). <i>The Red Goshawk Erythrotriorchis radiatus in northern Queensland: status and distribution</i>. Report to Queensland Parks and Wildlife Service.</p> <p>Czechura G.V. (2001). <i>The status and distribution of the Red Goshawk Erythrotriorchis radiatus on Cape York Peninsula, Queensland</i>. Unpublished report to Birds Australia.</p> <p>Debus, S. and Czechura, G. (1988). Field identification of the Red Goshawk <i>Erythrotriorchis radiatus</i>. <i>Australian Bird Watcher</i>, Vol. 12, pp. 154-159.</p> <p>Debus, S. (1998). <i>The Birds of Prey of Australia</i>. Oxford University Press, Melbourne.</p> <p>Woinarski, J. (2006). <i>Threatened Species of the Northern Territory - Red Goshawk - Erythrotriorchis radiatus</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0018/206352/red-goshawk.pdf">https://nt.gov.au/_data/assets/pdf_file/0018/206352/red-goshawk.pdf</a> [Accessed 1 May 2018].</p>				
<b>Gouldian Finch</b> <i>Erythrura gouldiae</i>	EN	VU	<p><b>Habitat:</b> Prefers areas with an adequate supply of seed from annual and perennial grasses (especially <i>Sorghum</i>), a nearby source of surface water and – in the breeding season – unburnt, hollow-bearing Eucalyptus trees</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Suitable foraging habitat, but no suitable breeding habitat</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			<p>(especially <i>E. tintinnans</i>, <i>E. brevifolia</i> and <i>E. leucophloia</i>) (Tidemann 1996; O'Malley 2006).</p> <p><b>Distribution:</b> Patchily distributed across northern Australia from the Kimberley to north-central Qld (Dostine 1998; Franklin et al. 1999; Barrett et al. 2003; Franklin et al. 2005). In the NT, most known breeding populations occur in the Top End. Non-breeding birds disperse widely (Garnett et al. 2011), greatly increasing the possible range of this species.</p>	<ul style="list-style-type: none"> <li>Occasional sightings in the Darwin area, but only likely to be recorded as a vagrant species</li> </ul>
			<p>Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). <i>The New Atlas of Australian Birds</i>. Royal Australian Ornithologists Union, Melbourne, Victoria.</p> <p>Dostine, P. (1998). <i>Gouldian Finch Recovery Plan Erythrura gouldiae</i>. Gouldian Finch Recovery Team and Parks &amp; Wildlife Commission NT, Darwin.</p> <p>Franklin, D.C., Burbidge, A.H. and Dostine, P.L. (1999). The harvest of wild birds for aviculture: an historical perspective on finch trapping in the Kimberley with special emphasis on the Gouldian Finch. <i>Australian Zoologist</i>, Vol. 31, pp. 92-109.</p> <p>Franklin, D.C., Whitehead, P.J., Pardon, G., Matthews, J., McMahon, P. and McIntyre, D. (2005). Geographic patterns and correlates of the decline of granivorous birds in northern Australia. <i>Wildlife Research</i>, Vol. 32, pp. 399-408.</p> <p>Garnett, S.T., Szabo, J.K. and Dutton, G. (2011). <i>The Action Plan for Australian Birds 2010</i>. CSIRO Publishing, Collingwood, Australia.</p> <p>O'Malley, C. (2006). <i>National Recovery Plan for the Gouldian Finch (Erythrura gouldiae)</i>. WWF-Australia, Sydney and Parks and Wildlife NT, Department of Natural Resources, Environment and the Arts, NT Government, Palmerston.</p> <p>Tidemann, S.C. (1996). Causes of the decline of the Gouldian Finch <i>Erythrura gouldiae</i>. <i>Biological Conservation International</i>, Vol. 6, pp. 49-61.</p>	
<b>Grey Falcon</b> <i>Falco hypoleucos</i>	-	VU	<p><b>Habitat:</b> A generally solitary desert falcon that occurs in areas of lightly-timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm (Ward 2012).</p> <p><b>Distribution:</b> Sparsely distributed through much of the arid and semi-arid regions of Australia but has been recorded from all mainland states and territories. In the NT, the majority of records are from the southern half, but there are records all the way up to Darwin (Ward 2012). A study of breeding records from 2003 to 2011 documented 38 breeding events – all within the hottest climate classes of Australia – with the northern-most record occurring south of Daly Waters (Schoenjahn 2013).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>Occasional sightings in the Darwin area, but only likely to be recorded as a vagrant species</li> </ul>
			<p>Schoenjahn, J. (2013), A hot environment and one type of prey: investigating why the Grey Falcon (<i>Falco hypoleucos</i>) is Australia's rarest falcon, <i>Emu</i>, Vol. 113, pp. 19-25.</p> <p>Ward, S. (2012). <i>Threatened Species of the Northern Territory - Grey Falcon - Falco hypoleucos</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0020/206354/grey-falcon.pdf">https://nt.gov.au/_data/assets/pdf_file/0020/206354/grey-falcon.pdf</a> [Accessed 1 May 2018].</p>	
<b>Crested Shrike-tit (northern subspecies)</b> <i>Falcunculus frontatus whitei</i>	VU	-	<p><b>Habitat:</b> Recorded in eight different woodland types in northern Australia, mainly those dominated by <i>Eucalyptus miniata</i>, <i>E. tetradonta</i> or <i>E. bleeseri</i> (Robinson &amp; Woinarski 1992). Nests have been found in the canopy of <i>E. tectifica</i>, <i>C. grandifolia</i> and <i>C. latifolia</i> at &gt;12 m above the ground in open woodland habitat (Ward et al. 2009).</p> <p><b>Distribution:</b> North-western Australia from the Kimberley in WA, across the Top End of the NT to Borroloola (TSSC 2016). In the NT, recorded in very low densities in many isolated sub-populations (Garnett &amp; Crowley 2000) between north-east Arnhem Land and semi-arid Victoria River District. Scarcity of records suggests that populations are at very low density</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>Suitable habitat within the Holtze site</li> <li>Only one record from the Darwin Coastal bioregion, ~140 km east of Holtze site.</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			(Woinarski 2004). Not known to have disappeared from any area where recorded historically (TSSC 2016).	
			<p>Garnett, S.T. and Crowley, G.M. (2000). <i>The Action Plan for Australian Birds 2000</i>. Environment Australia and Birds Australia, Canberra, ACT.</p> <p>Robinson, D. and Woinarski, J.C.Z. (1992). 'A review of records of the Northern Shrike-tit <i>Falcunculus frontatus whitei</i> in north-western Australia'. <i>South Australian Ornithologist</i>, Vol. 31, pp. 111-117.</p> <p>Threatened Species Scientific Committee (2016). <i>Approved Conservation Advice for Falcunculus frontatus whitei - crested shrike-tit (northern)</i>. Canberra: Department of the Environment. In effect under the EPBC Act from 02-May-2016. Available at: <a href="http://www.environment.gov.au/biodiversity/threatened/species/pubs/26013-conservation-advice-05052016.pdf">http://www.environment.gov.au/biodiversity/threatened/species/pubs/26013-conservation-advice-05052016.pdf</a> [Accessed 1 May 2018].</p> <p>Ward, S.J., Berghout, M. &amp; Baker, B. (2009). Notes on the form and habitat of nests of the Northern Shrike-tit. <i>Northern Territory Naturalist</i>, Vol. 21, pp. 54-60.</p> <p>Woinarski, J.C.Z. (2004). <i>National multi-species Recovery Plan for the Partridge Pigeon [eastern subspecies] Geophaps smithii smithii; crested shrike-tit [northern (sub)-species] Falcunculus (frontatus) whitei; masked owl [north Australian mainland subspecies] Tyto novaehollandiae kimberli; and masked owl [Tiwi Islands subspecies] Tyto novaehollandiae melvillensis, 2004-2008</i>. NT Department of Infrastructure Planning and Environment, Darwin.</p>	
<b>Christmas Island Frigatebird</b> <i>Fregata andrewsi</i>	EN	-	<p><b>Habitat:</b> Inhabits tropical waters of the Indian Ocean. Nests in tall trees, also sometimes on the slope of the inland cliff or higher up on the terraces (Gibson-Hill 1947).</p> <p><b>Distribution:</b> Breeds only on Christmas Island. In non-breeding season, disperses mostly to south-east Asia and Indian Ocean (Marchant et al. 1990). The few NT records are of small numbers of birds seen in during the wet season over the Darwin coastline – usually during north-westerly winds (including McKean et al. 1975).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat – the only NT records have been along the Darwin coastline.</li> </ul>
			<p>Gibson-Hill, C.A. (1947). Notes on the birds of Christmas Island. <i>Bulletin of the Raffles Museum</i>, Vol. 18, pp.87-165.</p> <p>Marchant, S. and Higgins, P.J. (eds.) (1990). <i>Handbook of Australian, New Zealand and Antarctic Birds: Volume 1 - Ratites to Ducks</i>. Oxford University Press, Melbourne, Victoria McKean, J.L., Bartlett, M.C. and Perrins, C.M. (1975). New records from the Northern Territory. <i>Australian BirdWatcher</i>, Vol. 6, pp. 45-46.</p>	
<b>Partridge Pigeon (eastern subspecies)</b> <i>Geophaps smithii smithii</i>	VU	VU	<p><b>Habitat:</b> Open forests and woodlands with an understorey of grasses (Woinarski 2006). Prefers woodland dominated by <i>Eucalyptus tetradonta</i> and <i>E. miniata</i> (Braithwaite 1985; Garnett et al. 2011; Higgins &amp; Davies 1996). According to Fraser (2001), favour a structurally-patchy savanna understorey at a relatively intricate scale. In all seasons, prefer to feed in areas that have an open ground layer (e.g. following fire); however, more likely to nest where there is dense vegetation cover. Require the seeds of certain perennial grasses and sedges that are available early in the wet season when seed is otherwise scarce, particular the perennial grass species <i>Alloteropsis semialata</i> and <i>Chrysopogon</i>. The presence of these grasses may be crucial for survival at this time (Fraser 2001). Largely sedentary; however, can travel distances of 5 to 10 km in the wet season on search of food and water resources (Fraser 2001). Home ranges vary seasonally between 8 – 31 hectares Fraser (2001).</p> <p><b>Distribution:</b> Historically, across the Top End (from Kununurra in WA to Borroloola in the NT). Since early 20<sup>th</sup> century a severe range contraction from the western, eastern and southern parts of the former distribution (Higgins &amp; Davies 1996; Woinarski et al. 2007). Currently, distribution is</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Suitable woodland habitat</li> <li>• No recent records this close to Darwin.</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			limited to sub-coastal NT from Yinberrie Hill in the south, Litchfield NP in the west and (western) Arnhem Land in the east (Garnett et al. 2011).	
			<p>Braithwaite, R.W. (1985). <i>The Kakadu fauna survey: an ecological survey of Kakadu National Park</i>. Australian National Parks &amp; Wildlife Service, Canberra.</p> <p>Fraser, F. (2000). Species profile: Partridge Pigeon <i>Geophaps smithii</i>. <i>Northern Territory Naturalist</i> 16, 38-39.</p> <p>Fraser, F., Lawson V., Morrison S., Christophersen P., McGregor S. and Rawlinson M. (2003). Fire management experiment for the declining partridge pigeon, Kakadu National Park. <i>Ecological Management and Restoration</i> 4, 94–102.</p> <p>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). <i>The Action Plan for Australian Birds 2010</i>. Birds Australia, CSIRO Publishing, Melbourne.</p> <p>Higgins, P.J. and Davies S.J.J.F. (eds) (1996). <i>Handbook of Australian, New Zealand and Antarctic Birds. Volume Three: Snipe to Pigeons</i>. Oxford University Press. Melbourne, Victoria.</p> <p>Woinarski, J.C.Z. (2006). <i>Threatened Species of the Northern Territory - Partridge Pigeon (eastern subspecies) - Geophaps smithii</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0003/206355/partridge-pigeon.pdf">https://nt.gov.au/_data/assets/pdf_file/0003/206355/partridge-pigeon.pdf</a> [Accessed 1 May 2018].</p> <p>Woinarski, J., Pavey, C., Kerrigan, R., Cowie, I. and Ward, S. (Eds) (2007). <i>Lost from Our Landscape: Threatened Species of the Northern Territory</i>. Northern Territory Government, Darwin.</p>	
<b>Masked Owl (northern subspecies)</b> <i>Tyto novaehollandiae kimberli</i>	VU	VU	<p><b>Habitat:</b> Mainly in <i>Eucalyptus</i> tall open forests (especially those dominated by <i>Eucalyptus miniata</i> and <i>E. tetradonta</i>), but also roosts in monsoon rainforests and forages in more open vegetation types, including grasslands (Woinarski &amp; Ward 2012). Usually nests in tree hollows, within patches of closed forest (Garnett et al. 2011). Little else known about the subspecies, but the species in general is resident in pairs within a territory up to 3,000 hectares (Debus 2009). Nest in large hollows with an entrance more than 20 cm wide and that is greater than 10 m above the ground (Debus 2009). Breeding poorly known, but thought to occur between March and October (DEWHA 2010).</p> <p><b>Distribution:</b> Poorly known, with few records from across a broad range in northern Australia. In the NT, records from the Top End, Kakadu, Coburg Peninsula (majority of records) and south-west Gulf country (Woinarski &amp; Ward 2012).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Suitable foraging habitat, but probably not breeding habitat.</li> <li>• No recent records in the urban Darwin area.</li> </ul>
			<p>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). <i>The Action Plan for Australian Birds 2010</i>. CSIRO Publishing. Collingwood, Australia.</p> <p>Woinarski, J.C.Z. and Ward, S. (2012). <i>Threatened Species of the Northern Territory - Masked Owl (north Australian mainland subspecies) - Tyto novaehollandiae kimberli</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/word_doc/0008/373553/masked-owl-mainland-top-end.docx">https://nt.gov.au/_data/assets/word_doc/0008/373553/masked-owl-mainland-top-end.docx</a> [Accessed 1 May 2018].</p>	
<b>Red Knot</b> <b>Great Knot</b> <b>Bar-tailed Godwit (2 subspecies)</b> <b>Eastern Curlew</b> <b>Asian Dowitcher</b> <b>Greater Sand Plover</b> <b>Lesser Sand Plover</b>	-	VU	<p><b>Habitat:</b> Coastal and estuarine areas with tidal mudflats. May roost during high tide on nearby beaches. May also be found at near-coastal swamps and lakes (apart from Red and Great Knot)</p> <p><b>Distribution:</b> Mostly widespread around the northern Australian coast, less common in the south, with few inland records. Eastern Curlew is uncommon across Australia while Asian Dowitcher is rare. Every year these species breed in the northern hemisphere in the summer, and migrate to Australia for the southern hemisphere (austral) summer. Some birds, primarily juveniles, remain in Australia during the winter.</p> <p>[Information above summarised from Chatto (2003), DoE (2015) and Garnett et al. (2011)].</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable coastal/estuarine habitat.</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>Curlew Sandpiper</b>			<p>Chatto, R. (2003). <i>The distribution and status of shorebirds around the coast and coastal wetlands of the Northern Territory</i>. Technical Report 73, Parks and Wildlife Commission of the Northern Territory, Darwin. [online] Available at: <a href="https://dtc.nt.gov.au/_data/assets/pdf_file/0008/279917/2003_shorebirds_rpt76.pdf">https://dtc.nt.gov.au/_data/assets/pdf_file/0008/279917/2003_shorebirds_rpt76.pdf</a> [Accessed 1 May 2018].</p> <p>Department of the Environment (2015). <i>EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i>. Commonwealth of Australia, Canberra, ACT. <a href="http://www.environment.gov.au/epbc/publications/shorebirds-guidelines">http://www.environment.gov.au/epbc/publications/shorebirds-guidelines</a> [Accessed 1 May 2018].</p> <p>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). <i>The Action Plan for Australian Birds 2010</i>. CSIRO Publishing. Collingwood, Australia.</p>	
<b>Australian Painted Snipe</b> <i>Rostratula (benghalensis) australis</i>	EN	VU	<p><b>Habitat:</b> Fringes of permanent and temporary wetlands, swamps and inundated grasslands (Taylor et al. 2013).</p> <p><b>Distribution:</b> Nomadic and scattered across Australia with no predictable occurrence (Rogers 2001), but could occur at any wetland or inundated grassland across its distribution, including nearly all of the NT and Qld (Garnett et al. 2011).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Very few records for the bioregion.</li> </ul>
<p>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). <i>The Action Plan for Australian Birds 2010</i>. CSIRO Publishing. Collingwood, Australia.</p> <p>Rogers, D. (2001). Painted Snipe. <i>Wingspan</i>, Vol. 11 (No. 4), pp. 6-7.</p> <p>Taylor, R., Chatto, R. and Woinarski, J.C.Z. (2013). <i>Threatened Species of the Northern Territory - Australian painted snipe - Rostratula australis</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0018/206361/australian-painted-snipe.pdf">https://nt.gov.au/_data/assets/pdf_file/0018/206361/australian-painted-snipe.pdf</a> [Accessed 1 May 2018].</p>				
<b>MAMMALS</b>				
<b>Fawn Antechinus</b> <i>Antechinus bellus</i>	VU	EN	<p><b>Habitat:</b> Mostly in open forests and woodlands dominated by <i>Eucalyptus miniata</i> and/or <i>E. tetradonta</i>, particularly where these forests have a relatively dense shrubby understorey (Friend 1985; Friend &amp; Taylor 1985). Declines in areas with frequent intense fires (Corbett et al. 2003) but not necessarily common in areas where fire has been excluded for long periods (&gt;20 years; Woinarski et al. 2004). Breeding occurs mid-June to late August, after which a synchronous male die-off occurs (TSSC 2015).</p> <p><b>Distribution:</b> Restricted to the Top End of the NT (Watson &amp; Calaby 2008), with one record from Melville Island. Recent surveys have failed to record it across central and eastern Arnhem Land (TSSC 2015).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Marginally-suitable woodland habitat (no dense understorey).</li> <li>• No recent proximate records, and very few for the greater Darwin region in the past decade.</li> </ul>
<p>Corbett L. K., Andersen, A.N. and Muller, W.J. (2003). Terrestrial vertebrates. In: Andersen, A.N., Cook, G.D. and Williams, R.J. (eds.). <i>Fire in Tropical Savannas: The Kapalga Experiment</i>. Springer-Verlag, New York: pp. 126–152.</p> <p>Friend, G.R. and Taylor, J.A. (1985). Habitat preferences of small mammals in tropical open-forest of the Northern Territory. <i>Australian Journal of Ecology</i>, Vol. 10, pp. 173-185.</p> <p>Friend, G.R. (1985). Ecological studies of a population of <i>Antechinus bellus</i> (Marsupialia: Dasyuridae) in tropical Australia. <i>Australian Wildlife Research</i>, Vol. 12 (No. 2), pp. 151-162.</p> <p>Threatened Species Scientific Committee (2015). <i>Approved Conservation Advice for Antechinus bellus – Fawn Antechinus</i>. Canberra: Department of the Environment. In effect under the EPBC Act from 03-Dec-2015. Available at: <a href="http://www.environment.gov.au/biodiversity/threatened/species/pubs/344-conservation-advice-2015123.pdf">http://www.environment.gov.au/biodiversity/threatened/species/pubs/344-conservation-advice-2015123.pdf</a> [Accessed 1 May 2018].</p> <p>Watson, M.L. and Calaby, J.H. (2008). Fawn Antechinus: <i>Antechinus bellus</i>. In: Van Dyck, S. and Strahan, R. (eds.). <i>The Mammals of Australia: 3rd Edition</i>. Reed New Holland, Sydney.</p> <p>Woinarski, J.C.Z., Risler, J. and Kean, L. (2004). The response of vegetation and vertebrate fauna to 23 years of fire exclusion in a tropical Eucalyptus open forest, Northern Territory, Australia. <i>Austral Ecology</i>, Vol. 29, pp. 156–176.</p>				
<b>Northern Quoll</b> <i>Dasyurus hallucatus</i>	EN	CR	<p><b>Habitat:</b> Wide range of habitats, but since the arrival of Cane Toads generally restricted to the most suitable habitats which are rocky upland areas with numerous crevices and rock piles (Van Dam et al. 2002). Prime habitat in the NT consists of rocky sandstone escarpments and outliers</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Suitable woodland habitat with rocky areas.</li> <li>• However, the species has experienced significant range contraction since Cane Toad invasion and is rarely</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			<p>(Braithwaite &amp; Griffiths 1994). Home range varies from 35 to 100 ha (Oakwood 2002). Breeding occurs in May and June, with male die-off occurring shortly afterwards (Oakwood 2000).</p> <p><b>Distribution:</b> Historically occurred in the NT from Borroloola in the south-east as far west as the NT/WA border (Woinarski et al. 2007), and extends into the Kimberley and Pilbara regions of WA. Dramatic range contraction and population crash associated with Cane Toad invasion. Now occurs across northern Australia in five regional populations – including the Top End in the NT.</p>	encountered in the Top End.
<p>Braithwaite, R.W. and Griffiths, A.D. (1994). Demographic variation and range contraction in the Northern Quoll, <i>Dasyurus hallucatus</i> (Marsupialia: Dasyuridae). <i>Wildlife Research</i>, Vol. 21, pp. 203-218.</p> <p>Oakwood, M. (2000). Reproduction and demography of the northern quoll, <i>Dasyurus hallucatus</i>, in the lowland savanna of northern Australia. <i>Australian Journal of Zoology</i>. 48:519-539.</p> <p>Oakwood, M. (2002). Spatial and social organization of a carnivorous marsupial, <i>Dasyurus hallucatus</i>. <i>Journal of Zoology</i>, London. 257:237-248.</p> <p>Van Dam, R.A., Walden, D.J. and Begg, G.W. (2002). <i>A preliminary risk assessment of cane toads in Kakadu National Park</i>. Supervising Scientist Report 164, Darwin, Northern Territory.</p> <p>Woinarski, J.C.Z., Rankmore, B.R., Fisher, A. and Milne, D. (2007). <i>The natural occurrence of northern quolls Dasyurus hallucatus on islands of the Northern Territory: assessment of refuges from the threat posed by cane toads Bufo marinus</i>. Report to Natural Heritage Trust.</p>				
<b>Northern Brush-tailed Phascogale</b> <i>Phascogale pirata</i>	VU	EN	<p><b>Habitat:</b> No detailed studies, but ecology is probably similar to that reported for phascogales in southern Australia (Rhind 1998). Most records are from tall open forests dominated by <i>Eucalyptus miniata</i> and <i>E. tetradonta</i> (Rhind et al. 2008). Brush-tailed Phascogales are primarily arboreal and seldom feed on the ground.</p> <p><b>Distribution:</b> Probably occurs naturally in low densities (Woinarski et al. 2014). Very few records exist; reported from West Island, east Arnhem Land, Coburg Peninsula, Kakadu, Litchfield and the Tiwi Islands. In the last 10 years only recorded from Kakadu, Coburg Peninsula and the Tiwi Islands, despite many extensive wildlife surveys across regions of the Top End during that time (Woinarski et al. 2014).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>Marginally-suitable woodland habitat (species preference is for taller forest).</li> <li>Range contraction to Arnhem Land (on the mainland) means unlikely to occur in the area.</li> </ul>
<p>Rhind, S.G. (1998). <i>Ecology of the brush-tailed phascogale in jarrah forest of south-western Australia</i>. PhD thesis, Murdoch University, Perth, Western Australia.</p> <p>Rhind, S.G., Woinarski, J. and Aplin, K.P. (2008). Brush-tailed Phascogale. In: Van Dyck, S. and Strahan, R. (eds). <i>The Mammals of Australia</i>. Reed New Holland, Chatswood, NSW.</p> <p>Woinarski, J., Burbidge, A. and Harrison, P. (2014). <i>The Action Plan for Australian Mammals 2012</i>. CSIRO Publishing: pp. 125-127.</p>				
<b>Arnhem Leaf-nosed Bat</b> <i>Hipposideros inornatus</i>	EN	VU	<p><b>Habitat:</b> Caves or abandoned mine sites in cool draughty areas, close to water (Churchill 1998; Corbett &amp; Richards 2002). Reported as foraging in riparian areas and in Eucalypt tall open forests (Woinarski &amp; Milne 2015).</p> <p><b>Distribution:</b> Restricted to the NT and only known to occur on the western Arnhem Land sandstone massif (Deaf Adder Gorge and upper South Alligator River area) and from one site – Tolmer Falls – in Litchfield National Park (McKean &amp; Hertog 1979) where population appears to be disappearing (Woinarski &amp; Milne 2015).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>Distribution restricted to western Arnhem Land and Tolmer Falls</li> </ul>
<p>Churchill, S. (1998). <i>Australian Bats</i>. Reed New Holland, Sydney.</p> <p>Corbett, L. and Richards, G. (2002). <i>Bat survey: Gunlom land trust area</i>. Report to Parks Australia North, EWL Sciences, Darwin.</p>				

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			<p>McKean, J.L. and Hertog, A.L. (1979). Extension of range in the horseshoe bat. <i>Northern Territory Naturalist</i>, Vol. 1, p. 5.</p> <p>Woinarski, D. and Milne, D. (2015). <i>Threatened Species of the Northern Territory – Arnhem Leaf-nosed Bat – Hipposideros inornata</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0018/205524/arnhem-leaf-nosed-bat.pdf">https://nt.gov.au/_data/assets/pdf_file/0018/205524/arnhem-leaf-nosed-bat.pdf</a> [Accessed 1 May 2018].</p>	
<p><b>Northern Leaf-nosed Bat</b> <i>Hipposideros stenotis</i></p>	-	VU	<p><b>Habitat:</b> Prefers rocky outcrops. Often found in shallow caves, boulder piles and old mine sites. It is an obligate cave rooster, most caves being small, shallow overhangs or splits in sandstone cliffs (Churchill 2008). Forages in a wide range of habitats including monsoon vine thickets, woodlands and open grasslands (Milne 2012).</p> <p><b>Distribution:</b> In the NT – recorded in few locations. Often associated with and found in close proximity to rocky outcrops and escarpment country (Milne et al. 2005). Recorded throughout parts of the Kimberley, WA and in the Mt Isa region of north-western Qld. (Woinarski et al. 2014).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• No suitable high sandstone escarpment habitat.</li> <li>• No proximate records.</li> </ul>
			<p>Churchill, S. (2008) <i>Australian Bats</i>. 2nd edition. Allen &amp; Unwin, Crows Nest NSW.</p> <p>Milne, D. (2012). <i>Threatened Species of the Northern Territory - Northern Leaf-nosed Bat - Hipposideros stenotis</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0016/205513/northern-leaf-nosed-bat.pdf">https://nt.gov.au/_data/assets/pdf_file/0016/205513/northern-leaf-nosed-bat.pdf</a> [Accessed 1 May 2018].</p> <p>Milne, D.J., Armstrong, M., Fisher, A., Flores, T. and Pavey, C.R. (2005) Structure and environmental relationships of insectivorous bat assemblages in tropical Australian savannas. <i>Austral Ecology</i>, Vol. 30, pp. 906-919.</p> <p>Woinarski, J., Burbidge, A. and Harrison, P. (2014). <i>The Action Plan for Australian Mammals 2012</i>. CSIRO Publishing, pp. 501-503.</p>	
<p><b>Ghost Bat</b> <i>Macroderma gigas</i></p>	VU	-	<p><b>Habitat:</b> Ranging from the arid Pilbara of WA to tropical savanna woodlands and north Qld. rainforests (TSSC 2016). Permanent roost sites are generally deep natural caves or disused mines (TSSC 2016).</p> <p>Move between a number of caves seasonally or as dictated by weather conditions, and require a range of cave sites (Hutson et al. 2001). Most breeding sites are caves with multiple entrances (TSSC 2016).</p> <p><b>Distribution:</b> Geographically-disjunct colonies occur in the Pilbara and Kimberley in WA, NT north of approximately 17° latitude (including Elcho Island and Groote Eylandt), the Gulf of Carpentaria, eastern Qld from Cape York to near Rockhampton, and western Qld (including Riversleigh and Camooweal districts) (TSSC 2016). Distribution likely influenced by the availability of suitable caves and mines for roost sites (Ward &amp; Milne 2016). Only 14 breeding sites known (Worthington Wilmer 2012). Disperse widely when not breeding (TSSC 2016). In arid Australia, including southern NT until the early 1960's (Ward &amp; Milne 2016).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• No deep cave/abandoned mine habitat for permanent roost sites within the Holtze site.</li> <li>• Few regional records – may occur as a vagrant in the greater Darwin region.</li> </ul>
			<p>Hutson, A. M., Mickleburgh, S. P. &amp; Racey, P. A. (2001) Microchiropteran Bats - Global Status Survey and Conservation Action Plan. IUCN/SSC Chiroptera Specialist Group, Gland, Switzerland and Cambridge, U.K.</p> <p>Milne, D. and Ward, S. (2016). <i>Threatened Species of the Northern Territory – Ghost Bat - Macroderma gigas</i>. Northern Territory Department of Environment and Natural Resource. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0010/376138/ghost-bat.pdf">https://nt.gov.au/_data/assets/pdf_file/0010/376138/ghost-bat.pdf</a> [Accessed 1 May 2018].</p> <p>Threatened Species Scientific Committee (2016). <i>Approved Conservation Advice for Macroderma gigas (ghost bat)</i>. Canberra: Department of the Environment. Available at: <a href="http://www.environment.gov.au/biodiversity/threatened/species/pubs/174-conservation-advice-05052016.pdf">http://www.environment.gov.au/biodiversity/threatened/species/pubs/174-conservation-advice-05052016.pdf</a> [Accessed 1 May 2018].</p> <p>Worthington Wilmer, J. (2012). Ghost Bat <i>Macroderma gigas</i>. In: Curtis et al. (eds.). <i>Queensland's Threatened Animals</i>. CSIRO, Canberra: pp. 382-383.</p>	

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>Bare-rumped Sheathtail Bat</b> <i>Saccolaimus saccolaimus (nudicluniatus)</i>	VU	-	<p><b>Habitat:</b> In the NT, specimens have been collected from Pandanus woodland fringing the sedgelands of the South Alligator River and Eucalypt tall open forests (Friend &amp; Braithwaite 1986; Churchill 1998) with more recent records from Howard Springs (Milne et al 2009). Most records occur within near-coastal habitats with one recent exception (Jasper Gorge) 150 km inland (Woinarski et al. 2014).</p> <p><b>Distribution:</b> Widely distributed from India through south-east Asia to the Solomon Islands including north-eastern Qld and the NT. The north-eastern Australian population is described as the subspecies <i>S. s. nudicluniatus</i>, although it is not clear whether this should be applied to NT populations (Milne &amp; Woinarski 2006).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Suitable woodland habitat.</li> <li>• Not recorded during 2020 field survey</li> <li>• Records on the outskirts of Darwin/Palmerston (most recent 2011).</li> </ul>
<p>Churchill, S. (1998). <i>Australian Bats</i>. Reed New Holland, Sydney.</p> <p>Friend, G.R. and Braithwaite, R.W. (1986). Bat fauna of Kakadu National Park, Northern Territory. <i>Australian Mammalogy</i>, Vol. 9, pp. 43-52.</p> <p>Milne, D.J., Jackling, F.C., Sidhu, M., and Appleton, B.R. (2009). Shedding new light on old species identifications: morphological and genetic evidence suggest a need for conservation status review of the critically endangered bat, <i>Saccolaimus saccolaimus</i>. <i>Wildlife Research</i> 36: 496–508.</p> <p>Milne, D. and Woinarski, J. (2006). <i>Threatened Species of the Northern Territory - Bare-rumped Sheathtail Bat - Saccolaimus saccolaimus</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0007/376117/bare-rumped-sheathtail-bat.pdf">https://nt.gov.au/_data/assets/pdf_file/0007/376117/bare-rumped-sheathtail-bat.pdf</a> [Accessed 1 May 2018].</p> <p>Woinarski, J., Burbidge, A. and Harrison, P. (2014). <i>The Action Plan for Australian Mammals 2012</i>. CSIRO Publishing: pp. 511-514.</p>				
<b>Brush-tailed Rabbit-Rat</b> <i>Conilurus penicillatus</i>	VU	EN	<p><b>Habitat:</b> Largely restricted to mixed <i>Eucalypt</i> open forest and woodland, or on dunes with <i>Casuarina</i> – seeming to prefer habitats that are not burnt annually, that have an understorey of predominantly perennial grasses and a sparse-to-moderate middle storey (Firth et al. 2006; Firth 2007; Kemper &amp; Firth 2008).</p> <p><b>Distribution:</b> Formerly widespread across northern Australia, but has declined extensively from Qld and lower rainfall areas of the Kimberley in WA and the Top End in the NT. No recent records from much of the historically-recorded NT range between near the mouth of Victoria River (in the west) and Sir Edward Pellew island group (in east). Most recently known from Cobourg Peninsula, Tiwi Islands, Groote Eylandt and a small area within Kakadu National Park (Woinarski &amp; Hill 2012).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• Species is considered locally extinct.</li> </ul>
<p>Firth, R.S.C. (2007). <i>Ecology and conservation status of the brush-tailed rabbit-rat Conilurus penicillatus</i>. PhD thesis, Charles Darwin University, Darwin, Northern Territory.</p> <p>Firth, R.S.C., Woinarski, J.C.Z. and Noske, R.A. (2006). Home range and den characteristics of the brush-tailed rabbit-rat <i>Conilurus penicillatus</i> in the monsoonal tropics of the Northern Territory, Australia. <i>Wildlife Research</i>, Vol. 33, pp. 397-408.</p> <p>Kemper, C.M. and Firth, R.S.C. (2008). Brush-tailed Rabbit-rat. In: Van Dyck, S. and Strahan, R. (eds). <i>The Mammals of Australia</i>. Reed New Holland, Chatswood, NSW.</p> <p>Woinarski, J.C.Z. and Hill, B. (2012). <i>Threatened Species of the Northern Territory - Brush-tailed rabbit-rat, Brush-tailed tree-rat - Conilurus penicillatus</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0016/205504/brush-tailed-rabbit-rat.pdf">https://nt.gov.au/_data/assets/pdf_file/0016/205504/brush-tailed-rabbit-rat.pdf</a> [Accessed 1 May 2018].</p>				
<b>Black-footed Tree-rat (Kimberley and mainland NT)</b>	EN	VU	<p><b>Habitat:</b> Woodlands and open forests with large trees and a moderately diverse mid-storey in near-coastal areas. Generally, require fruit and seed resources including <i>Pandanus</i> fruits, and fruiting trees and shrubs (Rankmore 2006). Shelters in tree hollows and occasionally <i>Pandanus</i> (Hill</p>	<p><b>HIGH</b></p> <ul style="list-style-type: none"> <li>• Preferred suitable woodland habitat</li> <li>• Recorded during 2020 field survey</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>subspecies)</b> <i>Mesembriomys gouldii gouldii</i>			2012). Thought to be more prevalent in woodlands with infrequent and low intensity fires (Price et al. 2005). <b>Distribution:</b> Top End of NT, Kimberley region of WA and Cape York Peninsula south to Townsville in Qld. (Hill 2012). Has remained relatively abundant in the Darwin rural area and there are some recent records from Gunn Point (Price et al. 2005), the Lee Point Area and Middle Arm.	<ul style="list-style-type: none"> <li>Recent records (2017 and 2019) ~1 km to the south in Johnston and ~4 km to the north-east.</li> </ul>
<p>Hill, B. (2012). <i>Threatened Species of the Northern Territory- Black-footed Tree-rat - Mesembriomys gouldii</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0018/205515/black-footed-tree-rat.pdf">https://nt.gov.au/_data/assets/pdf_file/0018/205515/black-footed-tree-rat.pdf</a> [Accessed 1 May 2018].</p> <p>Price, O., Rankmore, B., Milne, D.J., Brock, C., Tynan, C., Kean, L. and Roger, L. (2005). Regional patterns of mammal abundance and their relationships to landscape variables in eucalypt woodlands near Darwin, northern Australia. <i>Wildlife Research</i>, Vol. 32, pp. 435-446.</p> <p>Rankmore, B.R. 2006. <i>Impacts of Habitat Fragmentation on the Vertebrate Fauna of the Tropical Savannas of Northern Australia; with Special Reference to Medium-sized Mammals</i>. PhD Thesis, Charles Darwin University, Darwin.</p>				
<b>Nabarlek (Top End subspecies)</b> <i>Petrogale concinna canescens</i>	CR	EN	<b>Habitat:</b> Isolated and rocky areas consisting of both sandstone and granite escarpments (Churchill 1997; Telfer et al. 2008). Shelters in caves and crevices during the day (Churchill 1997) and may move from these to forage in adjacent flat areas (Sanson et al. 1985). <b>Distribution:</b> Restricted to the Top End of the NT in scattered populations from sandstone cliffs bordering the Arafura Swamp (Arnhem Land) in the east, to the Daly River catchment in the west (Ward & Woinarski 2012).	<b>NONE</b> <ul style="list-style-type: none"> <li>No suitable rocky sandstone and granite habitat.</li> </ul>
<p>Churchill, S. (1997). Habitat use, distribution and conservation status of the Nabarlek, <i>Petrogale concinna</i>, and sympatric rock-dwelling mammals, in the Northern Territory. <i>Australian Mammalogy</i>, Vol. 19, pp. 297-308.</p> <p>Sanson, G.D., Nelson, J. and Fell, P. (1985). Ecology of <i>Peradorcas concinna</i> in Arnhem Land in a wet and a dry season. <i>Proceedings of the Ecological Society of Australia</i>, Vol. 13, pp. 65-72.</p> <p>Telfer, W.R., Griffiths, A.D. and Bowman, D.M.J.S. (2008). The habitat requirements of four sympatric rock-dwelling macropods of the Australian monsoon tropics. <i>Austral Ecology</i>, Vol. 33, pp. 1033-1044.</p> <p>Ward, S. and Woinarski, J. (2012). <i>Threatened Species of the Northern Territory - Nabarlek - Petrogale concinna</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0017/205523/nabarlek.pdf">https://nt.gov.au/_data/assets/pdf_file/0017/205523/nabarlek.pdf</a> [Accessed 1 May 2018].</p>				
<b>Pale Field-rat</b> <i>Rattus tunneyi</i>	-	VU	<b>Habitat:</b> Historically occurred in a wide range of habitats, but now primarily in dense vegetation along creeks (Aplin et al. 2008). Fire regime seems to have little effect on population numbers; instead, the level of groundwater irrigating the riparian system and, to a lesser extent, current rainfall have a much stronger influence (Braithwaite & Griffiths 1996). <b>Distribution:</b> Higher rainfall areas of northern Australia, extending from Kimberley in WA to south-eastern Qld, including the Top End of the NT (Cole & Woinarski 2002, Braithwaite & Griffiths 1996). Previously widespread and patchily abundant, particularly in the north-west of the Top End, the Pale Field-rat appears to have declined in lower rainfall areas (Woinarski 2000).	<b>LOW</b> <ul style="list-style-type: none"> <li>Marginally-suitable habitat, but no dense riparian habitat is.</li> <li>Closest record (2001) ~13 km south-east of Holtze site.</li> <li>Few recent records for the greater Darwin region.</li> </ul>
<p>Aplin, K., Braithwaite, R. and Baverstock, P. (2008). Pale Field-rat: <i>Rattus tunneyi</i>. In: Van Dyck, S. and Strahan, R. (eds.). <i>The Mammals of Australia (3rd Edition)</i>. Reed New Holland, Sydney, NSW.</p> <p>Braithwaite, R. and Griffiths, A. (1996). The paradox of <i>Rattus tunneyi</i>: endangerment of a native pest. <i>Wildlife Research</i>, Vol. 23, pp. 1-21.</p> <p>Cole, J. and Woinarski, J. (2002). <i>Field Guide to the Rodents and Dasyurids of the Northern Territory</i>. Surrey Beatty &amp; Sons, Chipping Norton, NSW.</p> <p>Woinarski, J.C.Z. (2000). The conservation status of rodents in the monsoonal tropics of the Northern Territory. <i>Wildlife Research</i>, Vol. 27, pp. 421-435.</p>				

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>False Water rat</b> <i>Xeromys myoides</i>	VU	-	<p><b>Habitat:</b> Utilises both intertidal and freshwater habitats, with most records from mangrove forests, saltmarsh, sedgeland, clay pans and freshwater Melaleuca wetlands. In the NT, few records in the Darwin Coastal bioregion (DoE 2017).</p> <p><b>Distribution:</b> Three regions of coastal Australia: the NT, central south Qld and south-east Qld (DoE 2017). In the NT, known only from coastal Top End with ten records at six sites – South Alligator River in 1903, Daly River floodplain in 1972, two sites on the Tomkinson River in 1975, Melville Island in 1975 and Glyde River floodplain in 1998 and 1999 ( Cole &amp; Woinarski 2002, Woinarski 2006).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>No suitable habitat</li> </ul>
<p>Cole, J. and Woinarski, J. (2002). Field Guide to the Rodents and Dasyurids of the Northern Territory. Surrey Beatty &amp; Sons, Chipping Norton, NSW.</p> <p>Department of the Environment (2017). <i>Xeromys myoides</i> - Water Mouse, False Water Rat, Yirrkoo. Species Profile and Threats Database, Department of the Environment, Canberra. Available at: <a href="http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66">http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66</a> .</p> <p>Woinarski, J.C.Z. (2006). Threatened Species of the Northern Territory - False water-rat, Water mouse - <i>Xeromys myoides</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0008/376136/false-water-rat.pdf">https://nt.gov.au/_data/assets/pdf_file/0008/376136/false-water-rat.pdf</a> .</p>				
<b>Arnhem Rock-rat</b> <i>Zyzomys maini</i>	VU	VU	<p><b>Habitat:</b> Rugged sandstone environments, typically where there are many caves, crevices or boulders. Occupies environments in association with monsoonal rainforest, typically those areas which are floristically-rich and provide the fleshy fruits and seeds that form its principal food item (Begg et al. 1980).</p> <p><b>Distribution:</b> Endemic to the sandstone massif of western Arnhem Land in the NT (Woinarski 2004). Commonly found throughout parts of Kakadu National Park and Warddeken Indigenous protected area (Woinarski et al. 2014).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>Restricted to sandstone massif of western Arnhem Land.</li> </ul>
<p>Begg, R.J. and Dunlop, C.R. (1980). Security eating, and diet in the large rock-rat, <i>Zyzomys woodwardi</i> (Rodentia: Muridae). <i>Australian Wildlife Research</i>, Vol. 7, pp. 63-70.</p> <p>Woinarski, J., Burbidge, A. and Harrison, P. (2014). <i>The Action Plan for Australian Mammals 2012</i>. CSIRO Publishing: pp. 652-654.</p> <p>Woinarski, J.C.Z. (2004). <i>Threatened plants and animals in Kakadu National Park: a review and recommendations for management</i>. Darwin, Northern Territory DIPE.</p>				
<b>REPTILES</b>				
<b>Plains Death Adder</b> <i>Acanthophis hawkei</i>	VU	VU	<p><b>Habitat:</b> Floodplains in the Top End and cracking soil plains inland (Webb et al. 2002).</p> <p><b>Distribution:</b> Habitat mapping suggests the potential geographic range extends from western Qld, across the sub-coastal north of the NT to the north-eastern Kimberley of WA. Fragmented populations occur in the Mitchell Grass Downs of western Qld, the Barkly Tablelands on the NT/Qld border and east of Darwin (Fogg Dam) in the NT (TSSC 2012; Wuster et al. 2005). Susceptible to ingesting toxic Cane Toads (Phillips et al. 2009).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>No suitable cracking clay habitat.</li> <li>No nearby records.</li> </ul>
<p>Phillips, B.L., Greenlees, M.J., Brown, G.P. and Shine R (2010). Predator behaviour and morphology mediates the impact of an invasive species: cane toads and death adders in Australia. <i>Animal Conservation</i>, Vol. 13, pp. 53-59.</p>				

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			<p>Webb, J.K., Christian, K.A. and Fisher, P. (2002). Fast growth and early maturation in a viviparous sit-and-wait predator, the northern death adder (<i>Acanthophis praelongus</i>) from tropical Australia. <i>Journal of Herpetology</i>, Vol. 36, no. 3, pp. 505-509.</p> <p>Wuster, W., Dumbrell, A.J., Hay, C., Pook, C.E., Williams, D.J. and Fry, B.G. (2005). Snakes across the Strait: trans-Torresian phylogeographic relationships in three genera of Australasian snakes (Serpentes: Elapidae: <i>Acanthophis</i>, <i>Oxyuranus</i>, and <i>Pseudechis</i>). <i>Molecular Phylogenetics and Evolution</i>, Vol. 34. pp. 1-14.</p> <p>Threatened Species Scientific Committee (2015). <i>Approved Conservation Advice – Acanthophis hawkei – Plains Death Adder</i>. Canberra: Department of the Environment. [online] Available at: <a href="http://www.environment.gov.au/biodiversity/threatened/species/pubs/83821-conservation-advice.pdf">http://www.environment.gov.au/biodiversity/threatened/species/pubs/83821-conservation-advice.pdf</a> [Accessed 1 May 2018].</p>	
<b>Arnhem Land Skink</b> <i>Bellatorias obiri</i>	EN	EN	<p><b>Habitat:</b> Prefers sandstone outcrops, typically with extensive fissures and cave systems (Sadlier 1990).</p> <p><b>Distribution:</b> Restricted to the Western Arnhem Land plateau and outliers (e.g. Jabiluka), where it is patchily distributed (Armstrong &amp; Dudley 2004).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• Confined to western Arnhem Land Plateau.</li> </ul>
			<p>Armstrong, M. and Dudley, A. (2004). <i>The Arnhem Land Egernia Egernia obiri in Kakadu National Park</i>. Report to Parks Australia North, NT Department of Infrastructure Planning and Environment, Darwin.</p> <p>Sadlier, R.A. (1990). A new species of scincid lizard from western Arnhem Land, Northern Territory. <i>The Beagle</i>, Vol. 7, pp. 29-33.</p>	
<b>Yellow-snouted Gecko</b> <i>Lucasium occultum</i>	EN	VU	<p><b>Habitat:</b> Prefers areas with well-developed leaf litter and grasses (King et al. 1982; Johansen 2006) in open forests dominated by <i>Eucalyptus miniata</i> and <i>E. tetradonta</i>. Commonly found in sandy red-loam substrates. Has been recorded in areas consisting of moderate to sparse Gamba grass (Beggs et al. 2012).</p> <p><b>Distribution:</b> Endemic to the NT with known populations from north-west of Kakadu National Park and Wildman Reserve (King et al. 1982).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• Restricted to Kakadu and Wildman Reserve</li> </ul>
			<p>Beggs, K., Armstrong, M., Woinarski, J. and Ward, S. (2012). <i>Threatened Species of the Northern Territory - Yellow-Snouted Gecko - Lucasium occultum</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0007/206458/yellow-snouted-gecko.pdf">https://nt.gov.au/_data/assets/pdf_file/0007/206458/yellow-snouted-gecko.pdf</a> [Accessed 1 May 2018].</p> <p>Johansen, T. (2006). <i>The yellow-snouted gecko (Diplodactylus occultus), a little known endemic species of northern Australia</i>. Report to NT Department of Natural Resources Environment and the Arts.</p> <p>King, M., Braithwaite, R.W. and Wombey, J.C. (1982). A new species of <i>Diplodactylus</i> (Reptilia: Gekkonidae) from the Alligator Rivers region - Northern Territory. <i>Transactions of the Royal Society of South Australia</i>, Vol. 106, pp. 15-18.</p>	
<b>Oenpelli Python</b> <i>Simalia (Morelia) oenpelliensis</i>	-	VU	<p><b>Habitat:</b> Shelters in cracks, caves and crevices of rugged sandstone escarpments and gorges; or in large shady trees. Within this environment, reported from monsoon rainforest patches, riparian areas, woodlands, open heathlands and bare rock pavements (Woinarski &amp; Ward 2012).</p> <p><b>Distribution:</b> Restricted to the sandstone massif of Western Arnhem Land in the NT. Reported in the upper catchments of the Cadell, also in the South and East Alligator River systems (Woinarski &amp; Ward 2012).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable sandstone escarpment or gorge habitat within Holtze site.</li> <li>• Species restricted to west Arnhem Land.</li> </ul>
			<p>Woinarski, J. and Ward, S. (2012). <i>Threatened Species of the Northern Territory - Oenpelli Python - Morelia oenpelliensis</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0008/206459/oenpelli-python.pdf">https://nt.gov.au/_data/assets/pdf_file/0008/206459/oenpelli-python.pdf</a> [Accessed 1 May 2018].</p>	
<b>Mertens' Water Monitor</b> <i>Varanus mertensi</i>	-	VU	<p><b>Habitat:</b> Semi-aquatic, occupying edges of freshwater watercourses and lagoons, but seldom seen far from water (Christian 2004).</p> <p><b>Distribution:</b> Across far northern Australia from the western Cape York Peninsula in Qld to the Kimberley in WA (Christian 2004). Widespread in the NT, occupying all of the Top End river systems (Ward et al. 2006). Susceptible to ingesting toxic Cane Toads resulting in reduced abundance</p>	<p><b>MEDIUM</b></p> <ul style="list-style-type: none"> <li>• Upper reaches of Mitchell Creek may provide suitable wet season habitat</li> <li>• Recent record from Mitchell Creek</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			(Griffiths & McKay 2007)..	
			<p>Christian, K. (2004). <i>Varanus mertensi</i>. In: Pianka et al. (eds.). <i>Varanoid lizards of the world</i>. Indiana University Press, Bloomington, Indianapolis.</p> <p>Griffiths, A.D. and McKay (2007). Cane toads reduce the abundance and site occupancy of Merten's water monitor (<i>Varanus mertensi</i>). <i>Wildlife Research</i>, Vol. 34, pp. 609-615.</p> <p>Ward, S., Woinarski, J., Griffiths, T. and McKay, L. (2006). <i>Threatened Species of the Northern Territory - Mertens Water Monitor - Varanus mertensi</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0018/206460/mertens-water-monitor.pdf">https://nt.gov.au/_data/assets/pdf_file/0018/206460/mertens-water-monitor.pdf</a> [Accessed 1 May 2018].</p>	
<b>Mitchell's Water Monitor</b> <i>Varanus mitchelli</i>	-	VU	<p><b>Habitat:</b> Semi-aquatic and often arboreal, inhabiting margins of freshwater watercourses, swamps and lagoons (Shine 1986).</p> <p><b>Distribution:</b> Top End of the NT and Kimberley in WA (Schultz &amp; Doody 2004). In the NT, recorded in most catchments flowing into the Timor Sea, Arafura Sea and the Gulf of Carpentaria (Ward 2012).</p> <p>Susceptible to ingesting toxic Cane Toads resulting in reduced abundance (Doody et al. 2009).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Upper reaches of Mitchell Creek may provide suitable wet season habitat</li> <li>• No records for Mitchell Creek catchment</li> </ul>
			<p>Doody, J.S., Green, B., Rhind, D., Castellano, C., Sims, R. and Robinson, T. (2009). Population-level declines in Australian predators caused by an invasive species. <i>Animal Conservation</i>, Vol. 12, pp. 46-53.</p> <p>Schultz, T. and Doody, S. (2004). <i>Varanus mitchelli</i>. In: Pianka et al. (eds.). <i>Varanoid lizards of the world</i>. Indiana University Press, Bloomington, Indianapolis.</p> <p>Shine, R. 1986. Food habits, habitats and reproductive biology of four sympatric species of varanid lizards in tropical Australia. <i>Herpetologica</i>, Vol. 42, pp. 346-360.</p> <p>Ward, S. (2012). <i>Threatened Species of the Northern Territory - Mitchell's Water Monitor - Varanus mitchelli</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0019/206461/mitchells-water-monitor.pdf">https://nt.gov.au/_data/assets/pdf_file/0019/206461/mitchells-water-monitor.pdf</a> [Accessed 1 May 2018].</p>	
<b>Floodplain Monitor</b> <i>Varanus panoptes</i>	-	VU	<p><b>Habitat:</b> Broad range of habitats from coastal beaches to savannah woodlands (Christian 2004). Also common throughout floodplains grasslands and a variety of native woodlands (Ward et al. 2012).</p> <p><b>Distribution:</b> Across northern Australia from the Kimberley in WA to Cape York Peninsula, and southwards through most of Qld. In the NT, recorded across most of the Top End and the Gulf Region (Christian 2004). Highly susceptible to cane toad poisoning (Ujvari &amp; Madsen 2009), and has experienced significant declines (Doody et al. 2009).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Suitable woodland habitat</li> <li>• Significant decline within the region due to Cane Toads, such that the species is rarely seen in the Darwin region away from the coast.</li> </ul>
			<p>Christian, K. (2004). <i>Varanus panoptes</i>. In: Pianka et al. (eds.). <i>Varanoid lizards of the world</i>. Indiana University Press, Bloomington, Indianapolis.</p> <p>Doody, J.S., Green, B., Rhind, D., Castellano, C., Sims, R. and Robinson, T. (2009). Population-level declines in Australian predators caused by an invasive species. <i>Animal Conservation</i>, Vol. 12, pp. 46-53.</p> <p>Ujvari, B. &amp; Madsen, T. (2009). Increased mortality of naive varanid lizards after the invasion of non-native cane toads (<i>Bufo marinus</i>). <i>Herpetological Conservation and Biology</i>, Vol. 4, pp. 248-251.</p> <p>Ward, S., Woinarski, J., Griffiths, T. &amp; McKay, L. (2012). <i>Threatened Species of the Northern Territory - Yellow Spotted Monitor, Northern Sand Goanna, Floodplain Monitor - Varanus panoptes</i>. Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0006/206466/floodplain-monitor.pdf">https://nt.gov.au/_data/assets/pdf_file/0006/206466/floodplain-monitor.pdf</a> [Accessed 1 May 2018].</p>	
<b>FISH</b>				
<b>Northern River Shark</b> <i>Glyphis garricki</i>	EN	EN	<p><b>Habitat:</b> Little is known of the ecology, probably restricted to shallow, brackish reaches of large rivers (Ward &amp; Larson 2012).</p> <p><b>Distribution:</b> In Australia, there are few records, including in the NT from the Adelaide, East and South Alligator River systems. Also known from the Kimberley coast and King Sound in WA (Thorburn &amp; Morgan 2004; Compagno</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable marine or freshwater estuarine habitat.</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			et al. 2008). NT distribution does not extend into the Gulf of Carpentaria.	
			Compagno, L.J.V., White, W.T. and Last, P.R. (2008). Glyphis garricki sp. nov., a new species of river shark (Carcharhiniformes: Carcharhinidae) from northern Australia and Papua New Guinea, with a redescription of Glyphis glyphis (Müller & Henle, 1839). In: Last et al. (eds.). Descriptions of New Australian Chondrichthyans. CSIRO Marine and Atmospheric Research Paper, 022: pp. 203-226. Thorburn, D.C. and Morgan, D.L. (2004). The northern river shark, Glyphis sp. C (Carcharhinidae) discovered in Western Australia. Zootaxa, Vol. 685, pp. 1-8. Ward, S. and Larson, H. (2012). Threatened Species of the Northern Territory – Northern River Shark – Glyphis garricki. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0005/206384/northernr-river-shark.pdf">https://nt.gov.au/_data/assets/pdf_file/0005/206384/northernr-river-shark.pdf</a> .	
<b>Speartooth Shark</b> <i>Glyphis glyphis</i>	CR	VU	<b>Habitat:</b> Tropical freshwater and marine environments (Bradshaw et al. 2008). May be restricted to low salinity environments such as freshwater or brackish areas of rivers (DoE 2017). <b>Distribution:</b> Papua New Guinea and Northern Australia. Considered to be very rare in Australia as few specimens have been collected (Cavanagh et al. 2003). Three distinct geographical locations in the NT and northern Qld (DoE 2017). In the NT, recorded in the Alligator River region across to Adelaide River, and the Bizant River (Ward and Larson 2012).	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable marine or freshwater estuarine habitat.</li> </ul>
			Bradshaw, C.J.A., Fitzpatrick, B.M., Steinberg, C.C., Brook, B.W. and Meekan, M.G. (2008). Decline in whale shark size and abundance at Ningaloo Reef over the past decade: the world's largest fish is getting smaller. Biological Conservation, Vol. 141, pp. 1894–1905. Cavanagh, R., Kyne, P., Fowler, S., Musick, J. and Bennett, M. (eds.) (2003). The Conservation Status of Australian Chondrichthyans. Report of the IUCN Shark Specialist Group Australia and Oceania Red List Workshop. The University of Queensland, School of Biomedical Sciences, Brisbane, Australia. Department of the Environment (2017). Glyphis glyphis - Speartooth Shark. Species Profile and Threats Database, Department of the Environment, Canberra. <a href="http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82453">http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82453</a> . Ward, S. and Larson, H. (2012). Threatened Species of the Northern Territory - Speartooth Shark - Glyphis glyphis. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0009/206388/speartooth-shark.pdf">https://nt.gov.au/_data/assets/pdf_file/0009/206388/speartooth-shark.pdf</a> .	
<b>Lorentz Grunter</b> <i>Gingalla Lorentzi</i>	-	VU	<b>Habitat:</b> Small and large pools with rock and sand substrates, usually in open unshaded sections of streams and in water temperatures between 25°C and 30°C (Allen et al. 2002). <b>Distribution:</b> Rare in Australia, more widespread in PNG. In the NT only known from the Finnis River near Rum Jungle (Stirrat et al. 2006).	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable marine or freshwater estuarine habitat.</li> <li>• Restricted to the Finnis River, which is outside the Holtze site.</li> </ul>
			Allen, G.R., Midgley, S.H. and Allen, M. (2002). Field Guide to Freshwater Fishes of Australia. Western Australian Museum, Perth. Stirrat, S., Woinarski, J.C.Z. and Larson, H. (2006). Threatened Species of the Northern Territory – Lorentz Grunter - <i>Pingalla lorentzi</i> . Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0020/206390/lorentz-grunter.pdf">https://nt.gov.au/_data/assets/pdf_file/0020/206390/lorentz-grunter.pdf</a> [Accessed 26 April 2017].	
<b>Dwarf Sawfish</b> <i>Pristis clavata</i>	VU	VU	<b>Habitat:</b> Tropical marine and estuarine habitats, entering estuarine or fresh waters to breed during the wet season and moving into marine waters following the wet season (Peeverell 2005). <b>Distribution:</b> Indonesia, South-East Asia and northern Australia (Cavanagh et al. 2003). In the NT, known to occur around Darwin (including Buffalo Creek and Rapid Creek), in Kakadu National Park (Alligator River), Keep River and Victoria River (Thorburn et al. 2003).	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable marine or freshwater estuarine habitat.</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			<p>Cavanagh, R., Kyne, P., Fowler, S., Musick, J. and Bennett, M. (eds.) (2003). The Conservation Status of Australian Chondrichthyans. Report of the IUCN Shark Specialist Group Australia and Oceania Red List Workshop. The University of Queensland, School of Biomedical Sciences, Brisbane, Australia.</p> <p>Peverell, S.C. (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on their ecology. Environmental Biology of Fishes, Vol. 73, pp. 391 - 402.</p> <p>Thorburn, D.C., Peverell, S., Stevens, S., Last, J.D. and Rowland, A.J. (2003). Status of freshwater and estuarine elasmobranchs in Northern Australia. Report to Natural Heritage Trust, Canberra.</p>	
<b>Largetooth Sawfish</b> <i>Pristis pristis</i>	VU	VU	<p><b>Habitat:</b> Tropical marine and estuarine habitats, entering estuarine or fresh waters to breed during the wet season and moving into marine waters following the wet season (Peverell 2005). Of the four <i>Pristis</i> species reported to occur in Australia, is the one most often associated with freshwater, and has been recorded several hundred kilometres upstream (Thorburn et al. 2003).</p> <p><b>Distribution:</b> Circumtropical, with distinct populations in the eastern Atlantic, western Atlantic, eastern Pacific and Indo-West Pacific – including northern Australia (TSSC 2014). In the NT, reported in Adelaide, Victoria, Daly, East and South Alligator, Goomadeer, Roper, McArthur, Wearyan and Robinson Rivers (TSSC 2014). May potentially occur in all large rivers of northern Australia from the Fitzroy River, WA, to the western side of Cape York Peninsula, Qld (DoE 2018).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable marine or freshwater estuarine habitat.</li> </ul>
			<p>Department of the Environment (DoE) (2018). <i>Pristis pristis</i> in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: <a href="http://www.environment.gov.au/sprat">http://www.environment.gov.au/sprat</a>.</p> <p>Peverell, S.C. (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on their ecology. Environmental Biology of Fishes, Vol. 73, pp. 391 - 402.</p> <p>Threatened Species Scientific Committee (2014). Approved Conservation Advice - <i>Pristis pristis</i> (largetooth sawfish). Canberra: Department of the Environment. In effect under the EPBC Act from 11-April-2014. <a href="http://www.environment.gov.au/biodiversity/threatened/species/pubs/60756-conservation-advice.pdf">http://www.environment.gov.au/biodiversity/threatened/species/pubs/60756-conservation-advice.pdf</a>.</p>	
<b>Green Sawfish</b> <i>Pristis zijsron</i>	VU	VU	<p><b>Habitat:</b> Tropical waters – including marine inshore waters, river mouths, estuaries and lagoons – but not freshwater (Thorburn et al. 2003). Enters estuarine to breed during the wet season and moves back into marine waters following the wet season (Peverell 2005).</p> <p><b>Distribution:</b> Northern Australia, South-East Asia and the Indian Ocean (Cavenagh et al. 2003). Most frequently encountered of the sawfish species in Australian waters (Last &amp; Stevens 1994). Most commonly known from the Gulf of Carpentaria (Stevens et al. 2005). In the NT specimens have only been collected from Buffalo Creek in Darwin (Stirrat et al. 2006).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable marine or freshwater estuarine habitat.</li> </ul>
			<p>Cavanagh, R., Kyne, P., Fowler, S., Musick, J. and Bennett, M. (eds.) (2003). The Conservation Status of Australian Chondrichthyans. Report of the IUCN Shark Specialist Group Australia and Oceania Red List Workshop. The University of Queensland, School of Biomedical Sciences, Brisbane, Australia.</p> <p>Last, P.R. and Stevens, J.D. (1994). Sharks and Rays of Australia. CSIRO, Melbourne.</p> <p>Peverell, S.C. (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on their ecology. Environmental Biology of Fishes, Vol. 73, pp. 391 - 402</p> <p>Stirrat, S., Larson, H. and Woinarski, J. (2006). Threatened Species of the Northern Territory - Green Sawfish - <i>Pristis zijsron</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/__data/assets/pdf_file/0006/206394/green-sawfish.pdf">https://nt.gov.au/__data/assets/pdf_file/0006/206394/green-sawfish.pdf</a>.</p>	

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
Thorburn, D.C., Peverell, S., Stevens, S., Last, J.D. and Rowland, A.J. (2003). Status of freshwater and estuarine elasmobranchs in Northern Australia. Report to Natural Heritage Trust, Canberra.				
<b>AMPHIBIANS</b>				
<b>Howard Springs Toadlet</b> <i>Uperoleia daviesae</i>	-	VU	<p><b>Habitat:</b> Appears to be confined to seasonally inundated, low relief sandsheet heathland associated with drainage systems. Suitable habitat consists of shallowly inundated seepage areas with sedges and herbs on sandy substrates (Ward et al. 2012). Habitat may be reliant on a perched aquifer overlying a lateritic or clay layer, which is influenced by rainfall inputs and localised drainage.</p> <p><b>Distribution:</b> Endemic to the Darwin region in the northern NT. Confined to sandsheet heathlands in the Howard and Elizabeth River catchments (Ward et al. 2012).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable sandsheet heath habitat.</li> </ul>
Ward, S., Young, S. and Hill, B. (2012). <i>Threatened Species of the Northern Territory - Howard River Toadlet – Uperoleia daviesae</i> . Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0003/205527/howard-river-toadlet.PDF">https://nt.gov.au/_data/assets/pdf_file/0003/205527/howard-river-toadlet.PDF</a> [Accessed 1 May 2018].				
<b>INVERTEBRATES</b>				
<b>Atlas Moth</b> <i>Attacus wardi</i>	-	VU	<p><b>Habitat:</b> Coastal monsoon vine forest, where the larval stages feed on the plant <i>Croton habrophyllus</i> at the edges of the forest (Lane et al. 2010).</p> <p><b>Distribution:</b> The Top End of the NT, with records from Tiwi and Melville Islands, Darwin, Black Point and Cobourg Peninsula. Also records from Lesuer Island in WA (Braby &amp; Nielsen 2011).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable coastal monsoon vine forest.</li> </ul>
Braby, M.F. and Nielsen, J. (2011). Review of the conservation status of the Atlas Moth, <i>Attacus wardi</i> Rothschild, 1910 (Lepidoptera: Saturniidae) from Australia. <i>Journal of Insect Conservation</i> , Vol. 15, pp. 603-608.				
Lane, D., Martin, G. and Weir, R.P. (2010). The life history of <i>Attacus wardi</i> Rothschild (Lepidoptera: Saturniidae) from the Northern Territory, Australia. <i>Australian Entomology</i> , Vol. 37, pp. 115-127.				
<b>FLORA</b>				
<b>a shrub</b> <i>Atalaya brevialata</i>	CR	-	<p><b>Habitat:</b> Restricted to foot-slope sites with more open vegetation on deeper, coarser sandy soils, mostly along a specific, distinct geological boundary (Cowie 2014).</p> <p><b>Distribution:</b> Endemic to the NT; found south of Darwin, near Elizabeth River at Virginia, and its tributary – Amy’s Creek (Cowie 2014). Few targeted survey and there is uncertainty as to the taxonomic distinctness of the species. Extent of occurrence is 7.6 km<sup>2</sup>, with a high degree of confidence as it occurs within one of the most heavily-surveyed areas in the NT (Cowie 2014).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Restricted range which is outside the Holtze site.</li> </ul>
Cowie, I. (2014). <i>Threatened Species of the Northern Territory - Atalaya brevialata</i> . Northern Territory Department of Environment and Natural Resources. [online] Available at: <a href="https://nt.gov.au/_data/assets/pdf_file/0008/376262/atalaya-brevialata.pdf">https://nt.gov.au/_data/assets/pdf_file/0008/376262/atalaya-brevialata.pdf</a> [Accessed 1 May 2018].				
<b>a herb</b> <i>Cleome insolata</i>	-	VU	<p><b>Habitat:</b> Inundated sedge land growing on silty loam with coverage of laterite gravels in close proximity to a river catchment (Short 2010).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			<p><b>Distribution:</b> Endemic to the NT, known from a population located near Humpty Doo and three populations in Lloyd Creek in the Darwin rural area (Westaway &amp; Cowie 2012; EcOz records). A species-specific survey has not been carried out (Westaway &amp; Cowie 2012).</p>	<ul style="list-style-type: none"> <li>• Restricted range which is outside the Holtze site.</li> </ul>
<p>Short, P.S. (2010). New species of <i>Cleome</i> L. (Cleomaceae) from the Northern Territory, Australia. <i>The Beagle</i>, Records of the Museum and Art Galleries of the Northern Territory, 2010, Vol. 26, pp. 1–12. [online] Available at: <a href="https://dtc.nt.gov.au/_data/assets/pdf_file/0011/254954/Short.pdf">https://dtc.nt.gov.au/_data/assets/pdf_file/0011/254954/Short.pdf</a> [Accessed 1 May 2018].</p> <p>Westaway, J. and Cowie, I. (2012). Threatened Species of the Northern Territory - <i>Cleome insolata</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0006/208428/cleome-insolata.pdf">https://nt.gov.au/_data/assets/pdf_file/0006/208428/cleome-insolata.pdf</a> [Accessed 1 May 2018].</p>				
<p><b>an orchid</b> <i>Crepidium marsupichila</i></p>	-	VU	<p><b>Habitat:</b> Prefers protected shady areas and moist soils rich in leaf litter along the margins of monsoon rainforest and littoral rainforest (Kerrigan &amp; Cowie 2006).</p> <p><b>Distribution:</b> An Australian endemic with known populations from north-eastern Qld and the NT. In the NT, only known from one locality, Gunn Point (Kerrigan &amp; Cowie 2006). Limited amount of recent survey in the area, though extensive surveys in the 1980's of rainforest areas failed to find the species (Kerrigan &amp; Cowie 2006).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Highly restricted range which is outside the Holtze site.</li> </ul>
<p>Kerrigan, R. and Cowie, I. (2006). <i>Threatened Species of the Northern Territory - Malaxis marsupichila</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0007/208690/malaxis-marsupichila.pdf">https://nt.gov.au/_data/assets/pdf_file/0007/208690/malaxis-marsupichila.pdf</a> [Accessed 1 May 2018].</p>				
<p><b>Darwin Cycad</b> <i>Cycas armstrongii</i></p>	-	VU	<p><b>Habitat:</b> Open grassy woodland where adequate drainage appears to be a limiting factor (Kerrigan et al. 2006). Prime habitat has deep loamy soil (Liddle 2009). Separate male and female plants, with male microsporophylls flowering in August, and female megasporophylls from March-Nov (Holmes et al. 2007)</p> <p><b>Distribution:</b> Restricted to the Top End of the NT – from Gunn Point to Hayes Creek, west to within 50km of the coastline and east to the Wildman River catchment (Kerrigan et al. 2006). Also on the Tiwi Islands and Cobourgh Peninsula.</p>	<p><b>HIGH</b></p> <ul style="list-style-type: none"> <li>• Suitable open grassy woodland habitat within the Holtze site.</li> <li>• Records within the Holtze site.</li> </ul>
<p>Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). <i>A Guide to the Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory</i>. WWF-Australia, Darwin.</p> <p>Kerrigan, R., Cowie, I. and Liddle, D. (2006). <i>Threatened Species of the Northern Territory - Cycas armstrongii</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0017/208430/cycas-armstrongii.pdf">https://nt.gov.au/_data/assets/pdf_file/0017/208430/cycas-armstrongii.pdf</a> [Accessed 1 May 2018].</p> <p>Liddle, D.T. (2009). Management Program for Cycads in the Northern Territory of Australia 2009-2014. Northern Territory Department of Natural Resources, Environment, the Arts and Sport, Darwin. <a href="http://www.territorystories.nt.gov.au/jspui/bitstream/10070/265358/1/Management%20program%20for%20cycads%20in%20the%20Northern%20Territory%20of%20Australia%202009%20to%202014.pdf">http://www.territorystories.nt.gov.au/jspui/bitstream/10070/265358/1/Management%20program%20for%20cycads%20in%20the%20Northern%20Territory%20of%20Australia%202009%20to%202014.pdf</a> [Accessed 1 May 2018].</p>				
<p><b>a ground orchid</b> <i>Dienia montana</i></p>	-	VU	<p><b>Habitat:</b> Wet (spring-fed) rainforest (Kerrigan et al. 2013).</p> <p><b>Distribution:</b> Northern Qld, and one population in the NT, near Munmarlary in Kakadu National Park. A targeted search in 2003 failed to record any plants at this locality (Kerrigan et al. 2013).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Restricted range which is outside the Holtze site.</li> </ul>
<p>Kerrigan, R., Cowie, I. and Ward S. (2013). <i>Threatened Species of the Northern Territory - Dienia montana</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0007/208474/dienia-montana-malaxis-latifolia.pdf">https://nt.gov.au/_data/assets/pdf_file/0007/208474/dienia-montana-malaxis-latifolia.pdf</a> [Accessed 1 May 2018].</p>				

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>Native Walnut</b> <i>Endiandra limnophila</i>	-	VU	<b>Habitat:</b> Well-developed spring-fed rainforests on swampy or very wet substrates along creek margins (Kerrigan & Cowie 2006). <b>Distribution:</b> Endemic to Australia – far north of Cape York Peninsula in Qld, and the Tiwi Islands and Channel point in the NT (Kerrigan & Cowie 2006). In the NT, recorded at approximately 22 locations with no more than 6 individuals at any one locality (Liddle et al. 1994). Extensive survey of the Tiwi Islands in 2000-02 yielded no further populations (Woinarski et al. 2003).	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Restricted range which is outside the Holtze site.</li> </ul>
			Kerrigan, R. and Cowie, I. (2006). <i>Threatened Species of the Northern Territory - Endiandra limnophila</i> . Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0003/208434/endiandra-limnophila.pdf">https://nt.gov.au/_data/assets/pdf_file/0003/208434/endiandra-limnophila.pdf</a> [Accessed 1 May 2018]. Liddle, D.T., Russell-Smith, J., Brock, J., Leach, G.J. and Connors, G.T. (1994). <i>Atlas of the vascular rainforest plants of the Northern Territory</i> . Flora of Australia Supplementary Series No. 3, Australian Biological Resources Study, Canberra. Woinarski, J., Brennan, K., Cowie, I., Kerrigan, R., and Hempel, C. (2003). <i>Biodiversity conservation on the Tiwi islands, Northern Territory. Part 1. Plants and environments</i> . Department of Infrastructure Planning and Environment, Darwin.	
<b>Narrow-leaf Climbing Pandan</b> <i>Freycinetia excelsa</i>	-	VU	<b>Habitat:</b> Wet lowland rainforest and spring-fed rainforests in sandstone gullies (Kerrigan & Cowie 2006). <b>Distribution:</b> Known from Papua New Guinea, coastal Qld, and in the NT from seven locations between Bathurst Island and the Arafura Swamp (Kerrigan & Cowie 2006).	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Restricted range which is outside the Holtze site.</li> </ul>
			Kerrigan, R. and Cowie, I. (2006). <i>Threatened Species of the Northern Territory - Freycinetia excelsa</i> . Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0018/208440/freycinetia-excelsa.pdf">https://nt.gov.au/_data/assets/pdf_file/0018/208440/freycinetia-excelsa.pdf</a> [Accessed 1 May 2018].	
<b>a ground orchid</b> <i>Habenaria rumphii</i>	-	EN	<b>Habitat:</b> In the NT, collected on sand-plains adjacent to spring-fed rainforests (Kerrigan & Cowie 2006). Flowers and fruits have both occur in February (Holmes et al. 2007). <b>Distribution:</b> Known from the northern parts of Australia, Papua New Guinea, and South-East Asia. In the NT, only known from a single locality, the Howard River sand-plain (upper Howard River catchment) (Kerrigan & Cowie 2006) despite considerable survey effort in potentially-suitable habitat.	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable sand plains habitat.</li> <li>• Single known occurrence well outside Holtze site.</li> </ul>
			Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). <i>A Guide to the Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory</i> . WWF-Australia, Darwin. Kerrigan, R. and Cowie, I. (2006). <i>Threatened species of the Northern Territory - Habenaria rumphii</i> . Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0004/208444/habenaria-rumphii.pdf">https://nt.gov.au/_data/assets/pdf_file/0004/208444/habenaria-rumphii.pdf</a> [Accessed 1 May 2018].	
<b>a shrub</b> <i>Hibiscus brennanii</i>	VU	VU	<b>Habitat:</b> Sandstone cliffs, in gullies and on broken sandstone (Kerrigan & Cowie 2006). <b>Distribution:</b> Endemic to the NT, with restricted population in the Mt Brockman area to the west of Arnhem Land (Kerrigan & Cowie 2006). Considered adequately surveyed (Kerrigan & Cowie 2006).	<b>NONE</b> <ul style="list-style-type: none"> <li>• No suitable sandstone cliff habitat.</li> </ul>
			Kerrigan, R. and Cowie, I. (2006). <i>Threatened Species of the Northern Territory - Hibiscus brennanii</i> . Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0003/208452/hibiscus-brennanii.pdf">https://nt.gov.au/_data/assets/pdf_file/0003/208452/hibiscus-brennanii.pdf</a> [Accessed 1 May 2018].	
<b>Luisia Orchid</b>			<b>Habitat:</b> An epiphyte that commonly grows on trees with scaly bark and	<b>NONE</b>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<i>Luisia corrugata</i>	-	VU	<p>prefers the areas of bright light (non-shaded area). Within the NT, collected from the margins of monsoon rainforests. Elsewhere, more common in coastal and near coastal habitats (Kerrigan &amp; Cowie 2012).</p> <p><b>Distribution:</b> Appears to be endemic to the NT with known populations from Melville Island and the mainland (Bankers Jungle and Crocodile Creek in Black Jungle Conservation Reserve) (Kerrigan &amp; Cowie 2012). It is likely that the existing collections accurately reflect the abundance and distribution of this species (Kerrigan &amp; Cowie 2012).</p>	<ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Restricted range which is outside the Holtze site.</li> </ul>
<p>Kerrigan, R. and Cowie, I. (2012). <i>Threatened Species of the Northern Territory - Luisia corrugata</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0005/208472/luisia-corrugata.pdf">https://nt.gov.au/_data/assets/pdf_file/0005/208472/luisia-corrugata.pdf</a> [Accessed 1 May 2018].</p>				
<b>Arrowleaf Monochoria</b> <i>Monochoria hastata</i>	-	VU	<p><b>Habitat:</b> Grows in floating mat vegetation in permanent to near-permanent back-swamps, drainage channels and billabongs (Kerrigan &amp; Cowie 2006). Inflorescence of 25-60 flowers occurs from March-June, and capsule fruits from April-June (Holmes et al. 2007).</p> <p><b>Distribution:</b> New Guinea, India, Sri Lanka, South-East Asia. In Australia, only found in the NT on the floodplains of the Finnis, Reynolds and Wildman Rivers (Kerrigan &amp; Cowie 2006). There is a negative collection bias associated with the swampy habitat in which this species occurs. However, extensive coverage of floodplains in the Kakadu region detected this species at only one location in that region (Wildman River). Furthermore, it is considered that the extensive surveys of the Top End floodplain communities (Wilson et al. 1991) during the 1990s would have detected this species more often had it been more common or widespread (Kerrigan &amp; Cowie 2006).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat.</li> <li>• Restricted range which is outside the Holtze site.</li> </ul>
<p>Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). <i>A Guide to the Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory</i>. WWF-Australia, Darwin.</p> <p>Kerrigan, R. and Cowie, I. (2006). <i>Threatened Species of the Northern Territory - Monochoria hastata</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0003/208479/monochoria-hastata.pdf">https://nt.gov.au/_data/assets/pdf_file/0003/208479/monochoria-hastata.pdf</a> [Accessed 1 May 2018].</p> <p>Wilson, B.A., Brocklehurst, P.S. and Whitehead, P.J. (1991). <i>Classification, distribution and environmental relationships of coastal floodplain vegetation, Northern Territory, Australia</i>. Technical Report 91/2. Conservation Commission of the Northern Territory, Darwin.</p>				
<b>Darwin Palm</b> <i>Ptychosperma macarthurii</i>	-	EN	<p><b>Habitat:</b> Dense rainforests fed from lowland springs at the edges of tropical riverine floodplains. Common in deep organic loamy clay substrates without humus development (Liddle et al. 2006). Flowers occur in branched inflorescence from May-Dec, and red fleshy drupe fruits from Aug-Sept and Nov-Dec (Holmes et al. 2007).</p> <p><b>Distribution:</b> Known from the NT, Cape York Peninsula and Papua New Guinea. Within the NT, known from eight locations on the western margin of the Adelaide River Floodplain (Liddle et al. 2006). Survey effort is not documented.</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable dense rainforest habitat within the Holtze site.</li> </ul>
<p>Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). <i>A Guide to the Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory</i>. WWF-Australia, Darwin.</p> <p>Liddle, D.T., Brook, B., Matthews, J., Taylor, S.M. and Caley, P. (2006). <i>Threat and response: A decade of decline in a regionally endangered rainforest palm affected by fire and introduced animals</i>.</p>				

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<i>Biological Conservation</i> , Vol. 132, pp. 362-375.				
<b>a trigger plant</b> <i>Stylidium ensatum</i>	EN	EN	<p><b>Habitat:</b> Margins of drainage areas in damp heavy clay or peaty soil (Cowie &amp; Westaway 2012).</p> <p><b>Distribution:</b> Known from three localities – Shoal Bay, Girraween Rd, Hayes Creek. Other historical collections recorded; however, the exact locality for these collections is unknown. Populations at Girraween Rd. and Hayes Creek still exist based on NT Herbarium surveys in recent years. Only additional subpopulation has been located on Koolpinyah Station near Gunn Point Rd., despite several flora and biodiversity surveys in the Darwin region over the last ten years (but no systematic survey of potentially suitable habitat at an appropriate time of year). Substantial areas of potentially-suitable habitat south from Darwin towards Hayes Creek that are relatively poorly surveyed and it is likely that additional subpopulations exist (Cowie &amp; Westaway 2012).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• Drainage areas within the Holtze site are ephemeral and only marginal habitat.</li> <li>• DENR habitat modelling indicate no high likelihood habitat.</li> <li>• Closest known record is ~8 km south-east of the Holtze site.</li> </ul>
<p>Cowie, I. and Westaway, J. (2012). <i>Threatened species of the Northern Territory - Stylidium ensatum</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0009/208494/stylidium-ensatum.pdf">https://nt.gov.au/_data/assets/pdf_file/0009/208494/stylidium-ensatum.pdf</a> [Accessed 1 May 2018].</p> <p>Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). <i>A Guide to Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory</i>. WWF-Australia, Darwin.</p> <p>Threatened Species Scientific Committee. 2016. Conservation Advice. <i>Stylidium ensatum</i>. Department of the Environment, Canberra.</p>				
<b>a herb</b> <i>Typhonium praetermissum</i>	-	VU	<p><b>Habitat:</b> Open woodland including relatively unshaded areas in red brown clay and shallow or gravelly lateritic soil (Cowie &amp; Westaway 2012).</p> <p><b>Distribution:</b> Endemic to the NT. Previous recorded at six locations in the Darwin/Litchfield area – Virginia, Karama, the Palmerston escarpment, Mandorah and Humpty Doo (Cowie &amp; Westaway 2012). Two new sub-populations recorded in Lloyd Creek (EcOz records). Low number of fertile collections thought to be due to the species seasonality rather than its abundance. Targeted survey of potential habitat in the Darwin region is a priority for this species (Cowie &amp; Westaway 2012). Targeted survey have been undertaken in the Darwin region in 2016 and additional sub-populations have been identified at both Gunn Point and the southern extent of Cox Peninsular (Green, Cuff 2016)</p>	<p><b>HIGH</b></p> <ul style="list-style-type: none"> <li>• Suitable habitat.</li> <li>• Known records within the Holtze site.</li> </ul>
<p>Cowie, I. and Westaway, J. (2012). <i>Threatened species of the Northern Territory - Typhonium praetermissum</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0017/208502/typhonium-praetermissum.pdf">https://nt.gov.au/_data/assets/pdf_file/0017/208502/typhonium-praetermissum.pdf</a> [Accessed 1 May 2018].</p> <p>Green, C. and Cuff, N. Threatened Species Distribution in the Greater Darwin Region – <i>Typhonium praetermissum</i> Population Status of <i>Typhonium praetermissum</i>, November 2015</p>				
<b>a herb</b> <i>Typhonium taylori</i>	EN	EN	<p><b>Habitat:</b> Seasonally-saturated sandy substrate in nutrient-deficient grass/sedge land (Kerrigan &amp; Cowie 2006).</p> <p><b>Distribution:</b> Endemic to the NT, with the only known population from the edge of the Howard River floodplain (Kerrigan &amp; Cowie 2006). Targeted survey for this species in the Howard River Floodplain as part of a biodiversity assessment survey (Cowie 2002) did not relocate or uncover any</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat</li> <li>• Outside restricted range</li> </ul>

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
			additional populations of this species. Considered adequately surveyed, based on the strong survey effort in the area and the high profile of this genus amongst collectors. While more populations may exist, the paucity of collections of this species is considered to accurately reflect its very restricted distribution and abundance (Kerrigan & Cowie 2006).	
<p>Cowie, I. D. (2002). <i>Preliminary report on a survey of Utricularia (Lentibulariaceae) in the Howard River – Shoal Bay area</i>. NT Department of Infrastructure Planning and Environment, Darwin.</p> <p>Kerrigan, R. and Cowie, I. (2006). <i>Threatened species of the Northern Territory - Typhonium taylori</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0019/208504/typhonium-taylori.pdf">https://nt.gov.au/_data/assets/pdf_file/0019/208504/typhonium-taylori.pdf</a> [Accessed 1 May 2018].</p>				
<b>a bladderwort</b> <i>Utricularia dunstaniae</i>	-	VU	<p><b>Habitat:</b> 'Sandsheet heath' type habitats with wet sand, often in shallow water, in paperbark (<i>Melaleuca nervosa</i>) woodland or Feather-flower (<i>Verticordia</i>) shrub land. Occurs in slightly wetter micro-habitats than other sympatric <i>Utricularia</i> species, frequently where water is percolating from the ground (Kerrigan &amp; Cowie 2012).</p> <p><b>Distribution:</b> Endemic to Australia, known from WA and the NT – where known from nine locations. Locations near Darwin are Noonamah, Howard Springs and the Howard River floodplain. Other sub-populations on the Cobourg Peninsula, near Murgarella and near Finnis River (Kerrigan &amp; Cowie 2012). As apparently suitable habitat within the extent of occurrence remains unsurveyed, it is likely that additional, undiscovered subpopulations exist (Kerrigan &amp; Cowie 2012).</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat</li> </ul>
<p>Kerrigan, R. and Cowie, I. (2012). <i>Threatened Species of the Northern Territory - Utricularia dunstaniae</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0020/208505/utricularia-dunstaniae.pdf">https://nt.gov.au/_data/assets/pdf_file/0020/208505/utricularia-dunstaniae.pdf</a> [Accessed 1 May 2018].</p>				
<b>a bladderwort</b> <i>Utricularia singeriana</i>	-	VU	<p><b>Habitat:</b> Borders of seasonally-inundated grassland (Cowie &amp; Kerrigan 2012) and low open woodland (Holmes et al. 2005). Dominant associated plants include Eriachne burkittii, Sorghum spp., Pseudopogonatherum spp. and sedges (Cowie &amp; Kerrigan 2012). Also recorded growing near granite outcrops (Holmes et al. 2005). Often in shallow water (to 2 cm deep) on moist sandy or sandy loamy substrates (Holmes et al. 2005). Flowering between March and May, and fruiting begin in May (Cowie &amp; Kerrigan 2012).</p> <p><b>Distribution:</b> Endemic to the NT with known populations from five locations between Darwin and Katherine – the nearest Darwin being Finn Rd in Weddell. Other sites are the Edith River area, near the Finnis River, and the Marrawal Plateau east of Pine Creek. Port Darwin population (early 1900's record) no longer in existence (Kerrigan &amp; Cowie 2012). As much apparently suitable habitat within the extent of occurrence remains unsurveyed, it is likely that additional undiscovered sub-populations exist (Kerrigan &amp; Cowie 2012).</p>	<p><b>LOW</b></p> <ul style="list-style-type: none"> <li>• No suitable habitat</li> </ul>
<p>Cowie, I. and Kerrigan, R. (2012). <i>Threatened Species of the Northern Territory - Utricularia singeriana</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0003/208506/utricularia-singeriana.pdf">https://nt.gov.au/_data/assets/pdf_file/0003/208506/utricularia-singeriana.pdf</a> [Accessed 1 May 2018].</p>				

Name	Status		Ecology	Likelihood of occurrence
	Cth	NT		
<b>a ground orchid</b> <i>Zeuxine oblonga</i>	-	VU	<p><b>Habitat:</b> Grows in clusters in dark and moist situations in wet rainforest or in wet peaty areas near streams (Jones 1988).</p> <p><b>Distribution:</b> Qld, NSW and in the NT, where known from five widely-spaced locations south and south-west of Darwin, from Keep River near the WA border to south-west of Adelaide River (Liddle et al. 1994). Not collected since 1992, despite efforts to relocate the Keep River population in 2000 and 2001 (Kerrigan &amp; Cowie 2006). There is a negative collection bias associated with this species due to its ephemeral nature.</p>	<p><b>NONE</b></p> <ul style="list-style-type: none"> <li>• No suitable rainforest habitat.</li> </ul>
<p>Jones, D.L. (1988). <i>Native Orchids of Australia</i>. Reed, Sydney.</p> <p>Kerrigan, R. and Cowie, I. (2006). <i>Threatened Species of the Northern Territory – Zeuxine oblonga</i>. Northern Territory Department of Environment and Natural Resources. <a href="https://nt.gov.au/_data/assets/pdf_file/0008/208691/zeuxine-oblonga.pdf">https://nt.gov.au/_data/assets/pdf_file/0008/208691/zeuxine-oblonga.pdf</a> [Accessed 1 May 2018].</p> <p>Liddle, D.T., Russell-Smith, J., Brock, J., Leach, G.J. and Connors, G.T. (1994). Atlas of the vascular rainforest plants of the Northern Territory. <i>Flora of Australia Supplementary Series No. 3</i>, Australian Biological Resources Study, Canberra.</p>				

## APPENDIX C PMST REPORT



# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/05/20 09:57:06

[Summary](#)

[Details](#)

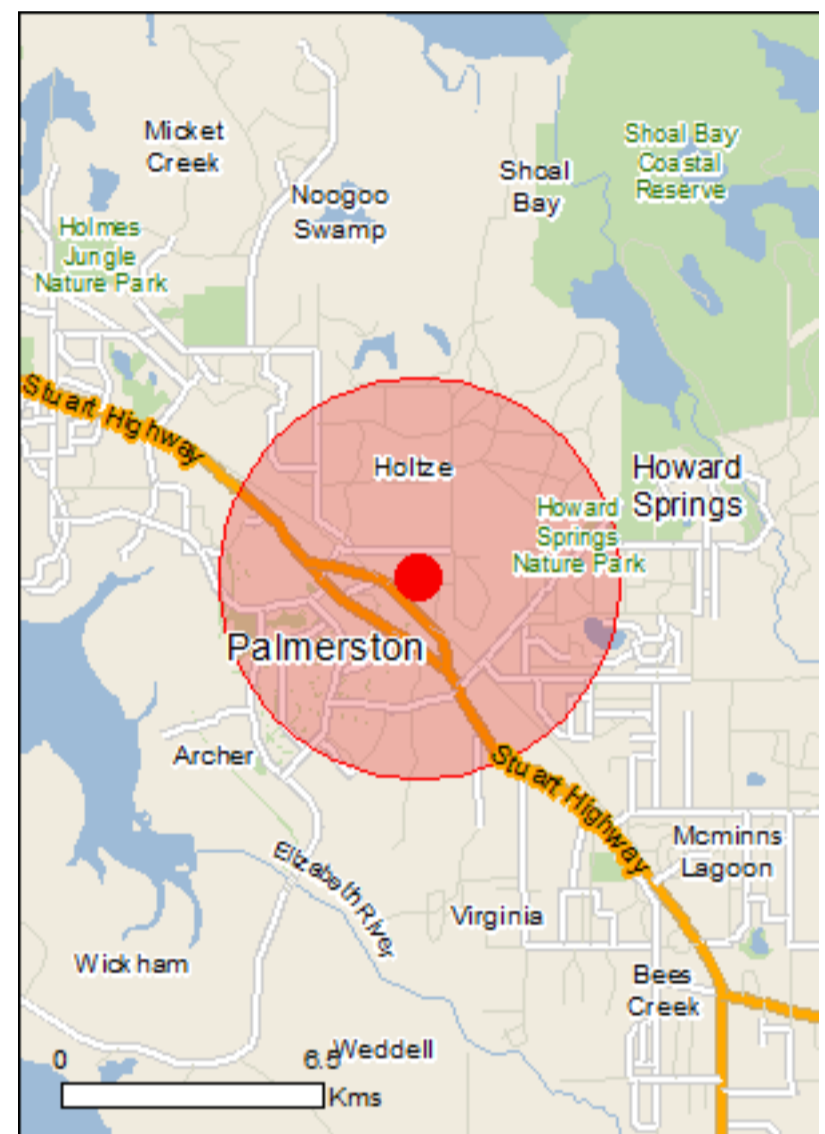
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 5.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	None
<a href="#">Listed Threatened Species:</a>	21
<a href="#">Listed Migratory Species:</a>	20

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Land:</a>	3
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	53
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Australian Marine Parks:</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">State and Territory Reserves:</a>	1
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	31
<a href="#">Nationally Important Wetlands:</a>	1
<a href="#">Key Ecological Features (Marine)</a>	None

# Details

## Matters of National Environmental Significance

Listed Threatened Species		[ Resource Information ]
Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Calidris canutus</a> Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Erythrotriorchis radiatus</a> Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Erythrura gouldiae</a> Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
<a href="#">Geophaps smithii smithii</a> Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
<a href="#">Tyto novaehollandiae kimberli</a> Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
<b>Mammals</b>		
<a href="#">Antechinus bellus</a> Fawn Antechinus [344]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Conilurus penicillatus</a> Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area
<a href="#">Dasyurus hallucatus</a> Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
<a href="#">Macroderma gigas</a> Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
<a href="#">Mesembriomys gouldii gouldii</a> Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat known to occur within area
<a href="#">Petrogale concinna canescens</a> Nabarlek (Top End) [87606]	Endangered	Species or species habitat may occur within area
<a href="#">Phascogale pirata</a> Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Saccolaimus saccolaimus nudicluniatus</a> Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Xeromys myoides</a> Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area

#### Plants

<a href="#">Stylidium ensatum</a> a triggerplant [86366]	Endangered	Species or species habitat may occur within area
<a href="#">Typhonium taylori</a> a herb [65904]	Endangered	Species or species habitat likely to occur within area

#### Reptiles

<a href="#">Acanthophis hawkei</a> Plains Death Adder [83821]	Vulnerable	Species or species habitat known to occur within area
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#### Sharks

<a href="#">Pristis pristis</a> Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area
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#### Listed Migratory Species

[ [Resource Information](#) ]

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
<b>Migratory Marine Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area

#### Migratory Marine Species

<a href="#">Crocodylus porosus</a> Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
<a href="#">Pristis pristis</a> Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area

#### Migratory Terrestrial Species

<a href="#">Cecropis daurica</a> Red-rumped Swallow [80610]		Species or species habitat known to occur within area
<a href="#">Cuculus optatus</a> Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
<a href="#">Hirundo rustica</a> Barn Swallow [662]		Species or species habitat likely to occur within area
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species

Name	Threatened	Type of Presence
<a href="#">Motacilla flava</a> Yellow Wagtail [644]		habitat known to occur within area  Species or species habitat known to occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat known to occur within area
<b>Migratory Wetlands Species</b>		
<a href="#">Acrocephalus orientalis</a> Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat known to occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
<a href="#">Calidris canutus</a> Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
<a href="#">Charadrius veredus</a> Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
<a href="#">Glareola maldivarum</a> Oriental Pratincole [840]		Species or species habitat may occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Pandion haliaetus</a> Osprey [952]		Species or species habitat may occur within area
<a href="#">Tringa nebularia</a> Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

## Other Matters Protected by the EPBC Act

### Commonwealth Land [\[ Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Director of Property Services Defence Estate Defence - KOWANDI NORTH COMMUNICATION STATION Defence - ROBERTSON BARRACKS (Waler Barracks)

## Listed Marine Species

[\[ Resource Information \]](#)

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Acrocephalus orientalis</a> Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat known to occur within area
<a href="#">Anseranas semipalmata</a> Magpie Goose [978]		Species or species habitat may occur within area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat known to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
<a href="#">Calidris canutus</a> Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
<a href="#">Charadrius veredus</a> Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
<a href="#">Chrysococcyx osculans</a> Black-eared Cuckoo [705]		Species or species habitat known to occur within area
<a href="#">Glareola maldivarum</a> Oriental Pratincole [840]		Species or species habitat may occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
<a href="#">Hirundo daurica</a> Red-rumped Swallow [59480]		Species or species habitat known to occur within area
<a href="#">Hirundo rustica</a> Barn Swallow [662]		Species or species habitat likely to occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat known to occur within area
<a href="#">Motacilla flava</a> Yellow Wagtail [644]		Species or species habitat known to occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Pandion haliaetus</a> Osprey [952]		Species or species habitat may occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat known to occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
<a href="#">Tringa nebularia</a> Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
<b>Fish</b>		
<a href="#">Campichthys tricarinatus</a> Three-keel Pipefish [66192]		Species or species habitat may occur within area
<a href="#">Choeroichthys brachysoma</a> Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
<a href="#">Choeroichthys suillus</a> Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
<a href="#">Corythoichthys amplexus</a> Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
<a href="#">Corythoichthys flavofasciatus</a> Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
<a href="#">Corythoichthys haematopterus</a> Reef-top Pipefish [66201]		Species or species habitat may occur within area
<a href="#">Doryrhamphus excisus</a> Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
<a href="#">Doryrhamphus janssi</a> Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
<a href="#">Festucalex cinctus</a> Girdled Pipefish [66214]		Species or species habitat may occur within area
<a href="#">Halicampus brocki</a> Brock's Pipefish [66219]		Species or species habitat may occur within area
<a href="#">Halicampus grayi</a> Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
<a href="#">Halicampus spirostris</a> Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
<a href="#">Haliichthys taeniophorus</a> Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
<a href="#">Hippichthys cyanospilos</a> Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
<a href="#">Hippichthys parvicarinatus</a> Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area
<a href="#">Hippichthys penicillus</a> Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
<a href="#">Hippocampus histrix</a> Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
<a href="#">Hippocampus kuda</a> Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
<a href="#">Hippocampus planifrons</a> Flat-face Seahorse [66238]		Species or species habitat may occur within area
<a href="#">Hippocampus spinosissimus</a> Hedgehog Seahorse [66239]		Species or species habitat may occur within area
<a href="#">Micrognathus micronotopterus</a> Tidepool Pipefish [66255]		Species or species habitat may occur within area
<a href="#">Solegnathus hardwickii</a> Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
<a href="#">Solegnathus lettiensis</a> Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
<a href="#">Solenostomus cyanopterus</a> Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
<a href="#">Syngnathoides biaculeatus</a> Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
<a href="#">Trachyrhamphus bicoarctatus</a> Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
<a href="#">Trachyrhamphus longirostris</a> Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
<b>Reptiles</b>		
<a href="#">Crocodylus johnstoni</a> Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area
<a href="#">Crocodylus porosus</a> Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

## Extra Information

### State and Territory Reserves [\[ Resource Information \]](#)

Name	State
Howard Springs	NT

### Invasive Species [\[ Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
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#### Birds

Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
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Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
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Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
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Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
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Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
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#### Frogs

Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
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#### Mammals

Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
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Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
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Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
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Name	Status	Type of Presence
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
<b>Plants</b>		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311]		Species or species habitat may occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra Mimosa, Giant Mimosa, Giant Sensitive Plant, Thorny Sensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pennisetum polystachyon Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather		Species or species habitat likely to occur

Name	Status	Type of Presence
Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194] Salvinia molesta		within area
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

### Reptiles

Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lepidodactylus lugubris Mourning Gecko [1712]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat known to occur within area

### Nationally Important Wetlands

[ Resource Information ]

Name	State
<a href="#">Port Darwin</a>	NT

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-12.47344 131.00591

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

# **APPENDIX D    BARE-RUMPED SHEATH-TAILED BAT IDENTIFICATION REPORT**

# Acoustic analysis and bat call identification from Palmerston, Northern Territory

Prepared for **EcOz Environmental**

Version **4 May 2020**

SZ project reference **SZ526**

Prepared by **Dr Kyle Armstrong and Yuki Konishi**

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This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2020). Acoustic analysis and bat call identification from Palmerston, Northern Territory. Unpublished report by Specialised Zoological for EcOz Environmental, 4 May 2020, project reference SZ526.

## Summary

Bat identifications from acoustic recordings are provided from Palmerston, Northern Territory. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics. At least six species of bat were identified as being present (**Tables 1** and **2**). There was no evidence of the presence of the Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus*. Representative echolocation calls for each identification are illustrated (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006). Further details are available should verification be required.

## Methods

The data provided were recorded in full spectrum WAV format with Wildlife Acoustics Song Meter SM2BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong and Aplin 2014; Armstrong et al. 2016) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language script that performed three tasks: 1. undertook a Discriminant Function Analysis on training data from representative calls from northern Australia; 2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over confidence regions for the defined call types; and 3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition CS6 version 5.0.2.

Species were identified based on information in Milne (2002) and the author's own unpublished material; and nomenclature follows Jackson and Groves (2015).

## Comments on ambiguous identifications

Some call types have more than one possibility for their source. Calls with a characteristic frequency at c. 40 kHz could have been derived from the Hoary Wattled Bat *Chalinolobus nigrogriseus*, Little Broad-nosed Bat *Scotorepens greyii* or the Northern Broad-nosed Bat *Scotorepens sanborni*.

Likewise, it is difficult to distinguish amongst the calls of long-eared bats *Nyctophilus* spp., and here call sequences with minimum frequencies of c. 45 kHz could have been derived from the Arnhem Long-eared Bat *Nyctophilus arnhemensis*, Pallid Long-eared Bat *N. daedalus* or the Lesser Long-eared Bat *N. geoffroyi*.

## Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological (though SET files were provided). The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.

## References

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- Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.
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**Table 1.** Species identified in the present survey from all sites combined.

<b>EMBALLONURIDAE</b>	
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>
<b>VESPERTILIONIDAE</b>	
Northern Pipistrelle	<i>Pipistrellus westralis</i>
<b>Ambiguous identifications</b>	
Hoary Wattled Bat/ and/or Little Broad-nosed Bat / and/or Northern Broad-nosed Bat	<i>Chalinolobus nigrogriseus</i> / and/or <i>Scotorepens greyii</i> / and/or <i>Scotorepens sanborni</i>
Unidentified long-eared bat	<i>Nyctophilus</i> sp.
<b>MOLOSSIDAE</b>	
Greater Northern Free-tailed Bat	<i>Chaerephon jobensis</i>
Northern Coastal Free-tailed Bat	<i>Ozimops cobourgianus</i>

**Table 2.** Species identifications, with the degree of confidence indicated by a code. Date and recording unit number correlates with site; see *Table 1* for full species names.

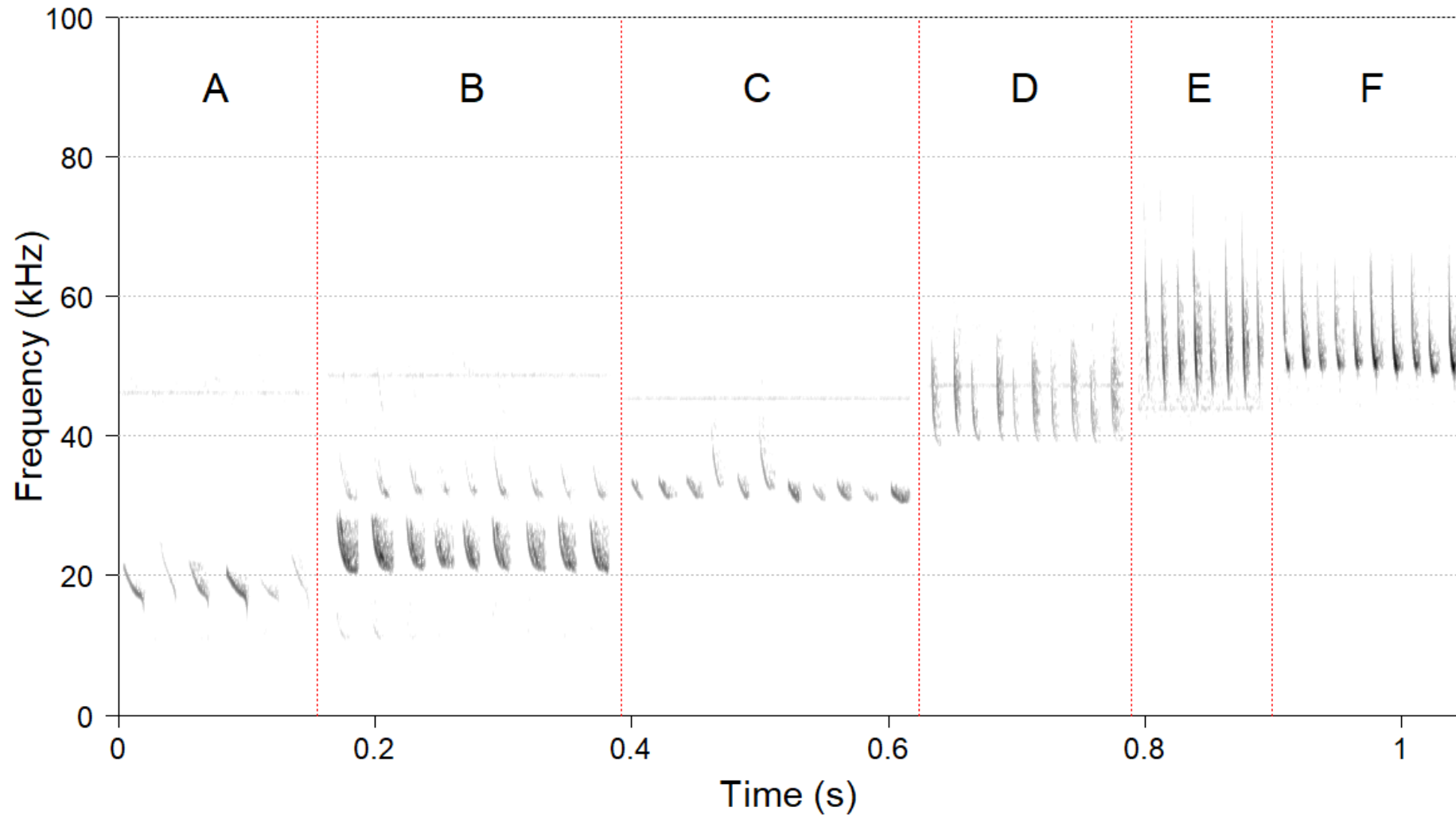
	<i>C. jobensis</i>	<i>C. nigrogriseus</i> / <i>S. greyii</i> / <i>S. sanborni</i>	<i>O. cobourgianus</i>	<i>Nyctophilus</i> sp.	<i>P. westralis</i>	<i>S. flaviventris</i>
<b>SM2BAT 11085</b>						
23/03/2020	—	NC	—	NC	◆	—
24/03/2020	◆	NC	—	NC	◆	—
<b>SM2BAT 11363</b>						
23/03/2020	—	NC	◆	—	◆	—
24/03/2020	◆	NC	—	—	◆	◆
25/03/2020	◆	NC	◆	NC	—	◆

**Definition of confidence level codes**

— Not detected.

◆ Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

**NC Needs Confirmation.** Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the *Comments on identifications* section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.



**Figure 1.** Representative echolocation call sequence portions of the species identified (**A:** *Chaerephon jobensis*; **B:** *Saccolaimus flaviventris*; **C:** *Ozimops cobourgianus*; **D:** *Chalinolobus nigrogriseus* / *Scotorepens greyii* / *Scotorepens sanborni*; **E:** *Nyctophilus* sp.; **F:** *Pipistrellus westralis*; time between pulses has been compressed).



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