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SHEFFIELD RESOURCES LTD
THUNDERBIRD MINERAL SANDS PROJECT
FLORA AND FAUNA SURVEY
SCOPING S¢UDY REPORT

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SHEFFIELD RESOURCES LTD.
THUNDERBIRD MINERAL SAND PROJECT
FLORA AND FAUNA SURVEY
SCOPING STUDY REPORT

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ACRONYMS

ARRP Act	*Agriculture and Related Resources Protection Act 1976*
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BOM	Bureau of Meteorology
DEC	Department of Environment and Conservation (now DPaW)
DEFL	The DEC's Threatened (Declared Rare) Flora Database
DPaW	Department of Parks and Wildlife (formerly DEC)
DRF	Declared Rare Flora
ESA	Environmentally Sensitive Area
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographic Regionalisation for Australia
PEC	Priority Ecological Community
SRE	Short-range Endemic
TEC	Threatened Ecological Community
WAHERB	Western Australian Herbarium
WC Act	*Wildlife Conservation Act 1950*
WAOL	Western Australian Organism List

EXECUTIVE SUMMARY

Sheffield Resources Limited has commissioned *ecologia* Environment (*ecologia*) to undertake a Level 2 Flora and Fauna Survey of its Thunderbird Project, located 70 km west of Derby on the Dampier Peninsula. A Level 2 flora and vegetation and a Level 1 fauna survey was completed by *ecologia* in the area in 2012. In 2013, the study area was expanded and Level 2 surveys completed (i.e. the second phase of the Level 2 flora and vegetation assessment and the first phase of the Level 2 fauna assessment). This report outlines the key issues identified from those surveys with a full report to follow in September 2013.

Flora

During the two-phase flora survey, 284 species were recorded from 71 quadrats surveyed over 36 person days. One species collected from two sites to the north of the study area, *Cyperus* sp. (AIC 1501-0149), is potentially a new taxon.

Six Priority taxa were recorded in the study area:

- *Fuirena nudiflora* (Priority 1);
- *Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946) (Priority 3);
- *Fuirena incrassata* (Priority 3);
- *Pterocaulon intermedium* (Priority 3);
- *Tephrosia valleculata* (Priority 3); and
- *Triodia caelestialis* (Priority 3).

Seven introduced species were recorded within the study area:

- *Cynodon dactylon*;
- *Digitaria ciliaris*;
- *Echinochloa colona*;
- *Sida acuta* (declared pest);
- *Stylosanthes hamata*;
- *Stylosanthes scabra*; and
- *Tridax procumbens*.

Vegetation unit *EtMvSi* (*Eucalyptus tectifica* and *Melaleuca viridiflora* open woodland, over dense tussock grassland) closely resembles vegetation associated with a Priority Ecological Community (PEC) at Lolly Well Springs, 40 km to the north-west. The impact to the vegetation units *EtMvSi* from an altered water table could be significant.

Fauna

During the first phase of the Level 2 fauna survey, conducted over 54 person days, 124 terrestrial vertebrate fauna species were recorded. In addition, 124 invertebrate fauna specimens from six taxonomic groups were collected. Four conservation significant vertebrate species, all birds, were recorded:

- Australian Bustard (*Ardeotis australis*: Priority 4);
- Bush Stone-curlew (*Burhinus grallarius*: Priority 4);
- Fork-tailed Swift (*Apus pacificus*: Migratory, Schedule 3); and
- Rainbow Bee-eater (*Merops ornatus*: Migratory, Schedule 3).

To date, seven confirmed or potential Short-range Endemic (SRE) fauna species have been identified. These include two snails:

- *Rhagada bulgana* (confirmed SRE); and
- *Quistrachia leptogramma* (Potential SRE).

Two isopods (crustaceans):

- *Buddelundia* '74' (potential SRE); and

- Buddelundiinae 'NE Broome' (potential SRE).

Three scorpions:

- *Lychas* 'broome' (potential SRE);
- *Urodacus* 'kraepelini' (potential SRE); and
- *Urodacus* sp. indet. (potential SRE).

All four of the conservation significant bird species are abundant and widespread, and the development of the Thunderbird area is not expected to have a significant impact on these species or their habitats.

Distribution and habitat data suggest that impacts on the two SRE snail species may not be significant. *ecologia* is currently awaiting taxonomic reports from the Western Australian Museum (WAM) for four reptile species, as well as for the mygalomorph, opilionid, pseudoscorpion and selenopid invertebrate specimens which have been submitted for species confirmation. These reports may identify further SRE species. Further assessments may be required to identify the presence or absence of the potential SRE species in the region surrounding the study area. Habitat potentially suitable for the Greater Bilby (*Macrotis lagotis*: Vulnerable, Schedule 1) may exist within the study area.

Implications

The presence of conservation significant flora, fauna and vegetation communities within the vicinity of the Thunderbird Mineral Sands project may affect the design and pathway of the project. Biological factors identified as being of conservation significance and that may have an impact on the project are assessed in the following table. In addition to addressing species of conservation significance confirmed to be present in the study area during the preceding surveys, the assessment in the table below is based on four assumptions:

- *Cyperus* sp. (AIC 1501-0149) is confirmed to be a new species.
- The potential PEC is confirmed to be a new PEC.
- Troglofauna and stygofauna are recorded within the study area.
- Conservation significant fauna with the potential to occur are found to be present.

Assuming that the project is formally assessed by the Environmental Protection Authority (EPA), the likely implications for Sheffield are:

- Further assessment is currently in process for Greater Bilby and Gouldian Finch as part of the Level 2 survey. If suitable habitat is found in the study area for either of these species a referral under the EPBC Act would be required. If deemed to be a controlled action and impacts cannot be avoided or mitigated, offsets may be required. Offsets can include any or all of the following:
    - Purchase and legal protection of land of equivalent habitat;
    - DPaW financial contribution for management or research;
    - Fencing of the protected land;
    - Monitoring of the protected land; and/or
    - Feral animal control within the protected land.
- Monitoring of conservation significant flora (Priority 1 flora) which may be directly or indirectly impacted by the project.
- Monitoring of the potential PEC which may be directly or indirectly impacted by the project.
- 'Licence to take' to be acquired for any clearing of Priority 3 flora and flora representing range extensions.

- Avoidance and utilisation of buffer zones applied to conservation significant flora and the potential PEC. The default direct impact buffer used by DPaW for a Priority Flora species is 50 m.

Although this project is likely to attract Ministerial conditions that will affect the project and (to some degree) the project schedule, no biological issues identified are foreseen to prevent the commencement of the Thunderbird Mineral Sands project.

Assessment of biological results against project feasability

Environmental Factor	Likelihood of Occurrence	Likely action required	Predicted conditions on the project (as set by the EPA)	Potential effect on project
EPBC listed fauna (Bilby and/or Gouldian Finch)	Based on regional records, Bilby has a high likelihood of occurrence Suitable habitat for the Gouldian Finch is present, but this species has not been recorded close to the impact area	• Targeted survey (currently in process as a component of the Level 2 survey) to assist with determining the likelihood of occurrence within and outside of the impact area • An EPBC referral to the Minister of Sustainability, Environment, Water, Population and Communities for the approval of an action that could impact the Bilby and/or Gouldian Finch. Included in the referral is the preparation of a Fauna Management Plan for the Bilby and/or Gouldian Finch, to reduce the likelihood of further assessment	• Monitoring of the Bilby and/or Gouldian Finch for the duration of time impacting the species • Potential offsets package may include funding futher research of the Bilby and/or Gouldian Finch, or purchasing available habitat equivalent to the area and quality of habitat being impacted	• Financial o An approximate cost of $25,000 to prepare a referral application per EPBC listed species, if required o Additional costs in preparing a Fauna Management Plan for the Bilby and/or Gouldian Finch o Cost involved in (annual) monitoring surveys for the Bilby and/or Gouldian Finch, if required o Cost involved in offsets, based on the size of area and significance of of impact to the Bilby and/or Gouldian Finch
Troglofauna – subterranean cave-dwelling fauna	Not previously recorded in region, but EPA Environmental Assessment Guideline No. 12 suggests a high likelihood of occurrence within the region	• If troglofauna are recorded during the pilot, further sampling required to determine species presence outside of the impact area • Geological studies to show that voids occupied by troglofauna extend outside of the impact area	• Second phase of troglofauna surveying • Monitoring of troglofauna for the duration of the mining operations	• Financial o Cost involved in second phase of surveying o Cost involved in monitoring surveys for the duration of the mining operations
Stygofauna – subterranean aquatic fauna	Not previously recorded in region, but EPA Environmental	• If stygofauna are recorded during the pilot study, further sampling required to determine species presence outside of the impact area	• Second phase of stygofauna surveying • Monitoring of stygofauna for	• Financial o Cost involved in second phase of surveying

Environmental Factor	Likelihood of Occurrence	Likely action required	Predicted conditions on the project (as set by the EPA)	Potential effect on project
	Assessment Guideline No. 12 suggests a high likelihood of occurrence within the region	• Hydrological studies to determine the impact area of of the operations on the water table and also until the draw down cone has restored to its original levels after mining operations	the duration of operations, • Modelling of drawdown impact area	o Cost involved in monitoring surveys until the draw down cone is restored to original levels o Cost of hydrological modelling and reporting
Priority 1 flora species, *Fuirena nudiflora*	100% (recorded)	• Targeted survey to ensure this species had a wider regional distribution • Hydrological studies if the project is impacting the flow of water downstream to a degree that could cause flooding upstream where this species is located	• Buffer or 'no impact' zones placed around known locations of this species • Monitoring to ensure this species is not being affected • Licence to take required	• Financial o Cost involved in additional surveys and approvals o Cost of licence and licence preparation • Delay o If left to the late stages of the project, the increased survey effort could cause delays
Cyperus sp. (AIC 1501-0149) – Potential new species	100% (recorded)	• Targeted survey to ensure this species had a wider regional distribution • Hydrological studies if the project is impacting the flow of water downstream to a degree that could cause flooding upstream where this species is located	• Buffer or 'no impact' zones placed around known locations of this species • Monitoring to ensure this species is not being affected • Hydrological study	• Financial o Cost involved in additional surveys and approvals o Cost of licence and licence preparation • Delay o If left to the late stages of the project, the increased survey effort could cause delays
Priority 3 flora species	100% (recorded)	• Targeted survey to confirmation that these species are present outside of the study area	• Licence to take required	• Financial o Cost involved in additional surveys and approvals • Delay

Environmental Factor	Likelihood of Occurrence	Likely action required	Predicted conditions on the project (as set by the EPA)	Potential effect on project
				o If left to the late stages of the project, the increased survey effort could cause delays
Potential Priority 3 Priority Ecological Community	Potential PEC community recorded, PEC status not confirmed	• Hydrological studies to determine if the project will have an impact on the potential PEC • Determination of whether or not this is in fact a PEC by submission to DPaW	• Buffer or 'no impact' zones placed around the potential PEC • Hydrological • Monitoring to ensure the PEC is not being affected	• Financial o Cost involved in additional surveys and approvals • Delay o If left to the late stages of the project, the increased survey effort could cause delays
Flora taxa representing range extensions	100% (recorded)	• Desktop assessment of regional distribution (in this report) • Targeted regional survey if any taxa are identified to be poorly repesented	• Licence to take required • Monitoring of high importance range extensions	• Financial o Cost involved in additional surveys and approvals o Cost of licence and licence preparation • Delay o If left to the late stages of the project, the increased survey effort could cause delays

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Sheffield Resources Limited (Sheffield) is an exploration company with significant mineral sands and additional nickel, talc and iron assets, all located within the state of Western Australia. Sheffield is exploring the Thunderbird mineral sands deposit, which is located in the Canning basin.

Sheffield has commissioned *ecologia* Environment (*ecologia*) to undertake a Level 2 Flora Survey of the Thunderbird Project, located 70 km west of Derby on the Dampier Peninsula (Figure 1.1). Sheffield seeks to gain an understanding of the flora and fauna of the Thunderbird area (study area) and identify the environmental assessment implications that may apply to developing a mineral sands mining operation.

1.2 SURVEY EFFORT

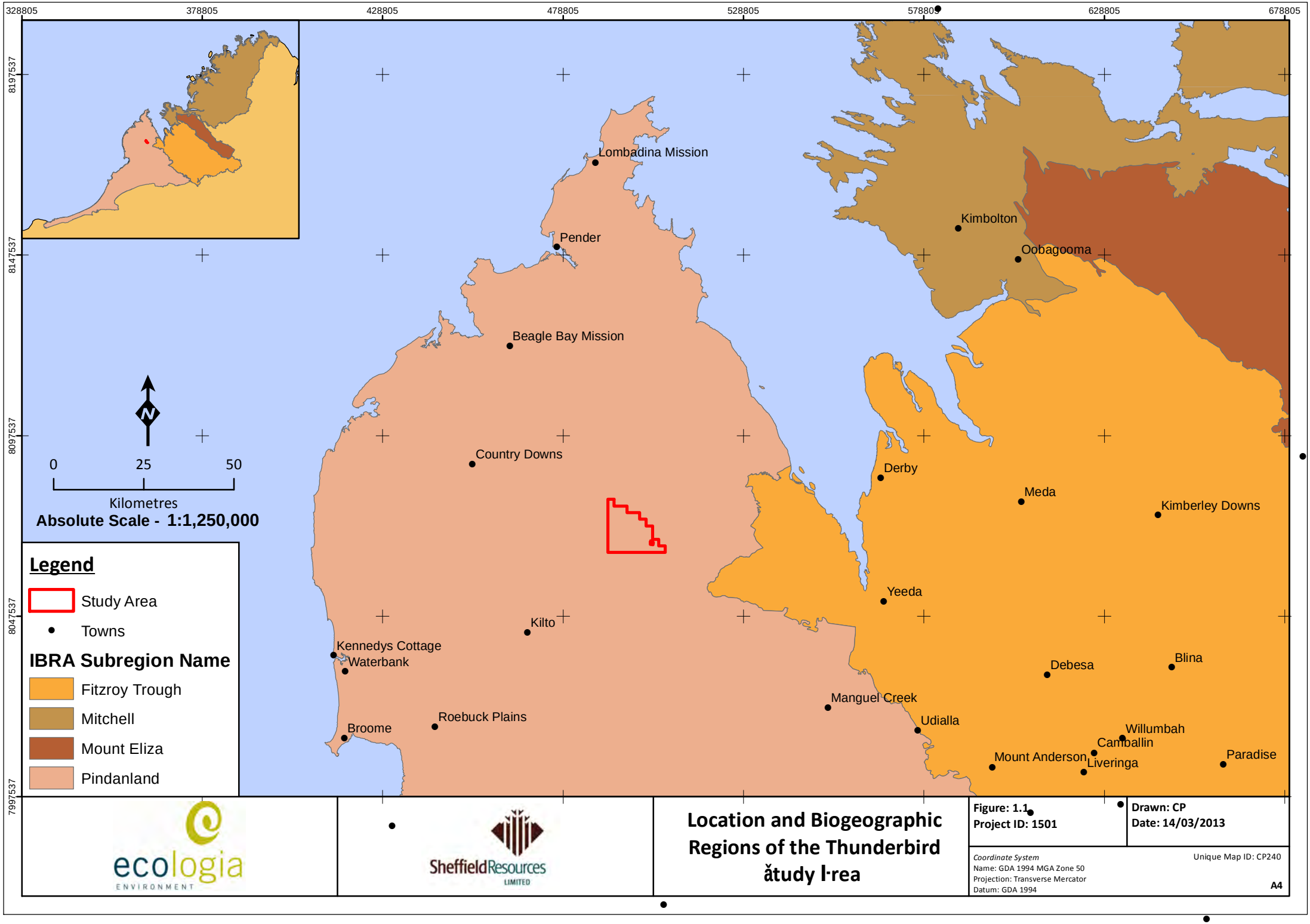
The two-phase flora survey involved a combination of sampling within 71 bounded quadrats (Appendix A, Figure 1.2) each 2,500 m^2 in area, in accordance with Guidance Statement 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (Environmental Protection Authority 2004), supplemented by a series of linked field traverses. Linked traverses assisted in maximising the floristic inventory and thus increasing the probability of recording flora of potential significance.

The flora and vegetation of the study area was surveyed in two phases over two separate trips in conjunction with fauna surveys. The flora surveys totalled 36 person days, and the fauna survey 60 days. Six person days of the phase 2 flora survey were spent assisting with vertebrate fauna trap site installation. The timing of the surveys was as follows:

- Survey 1; 21 to 26 June 2012 (6 person days each for flora and fauna); and
- Survey 2; 4 to 15 April 2013, (30 person days for flora, 54 for fauna).

The first fauna survey carried out was in accordance with a Level 1 assessment, and the second a Level 2 assessment. These surveys were conducted in accordance with Environmental Protection Authority (EPA) Guidance Statement No. 20: *Sampling of Short-range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA 2009), Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004), and the principles outlined in EPA Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002).

During the first phase of the Level 2 survey, seven vertebrate fauna trap sites were installed along with six Short-range Endemic (SRE) dry pit-fall trapping sites. Survey methods also involved diurnal and nocturnal opportunistic searches for vertebrates and SREs, as well as the deployment of motion cameras and SM2BAT bat call recording devices.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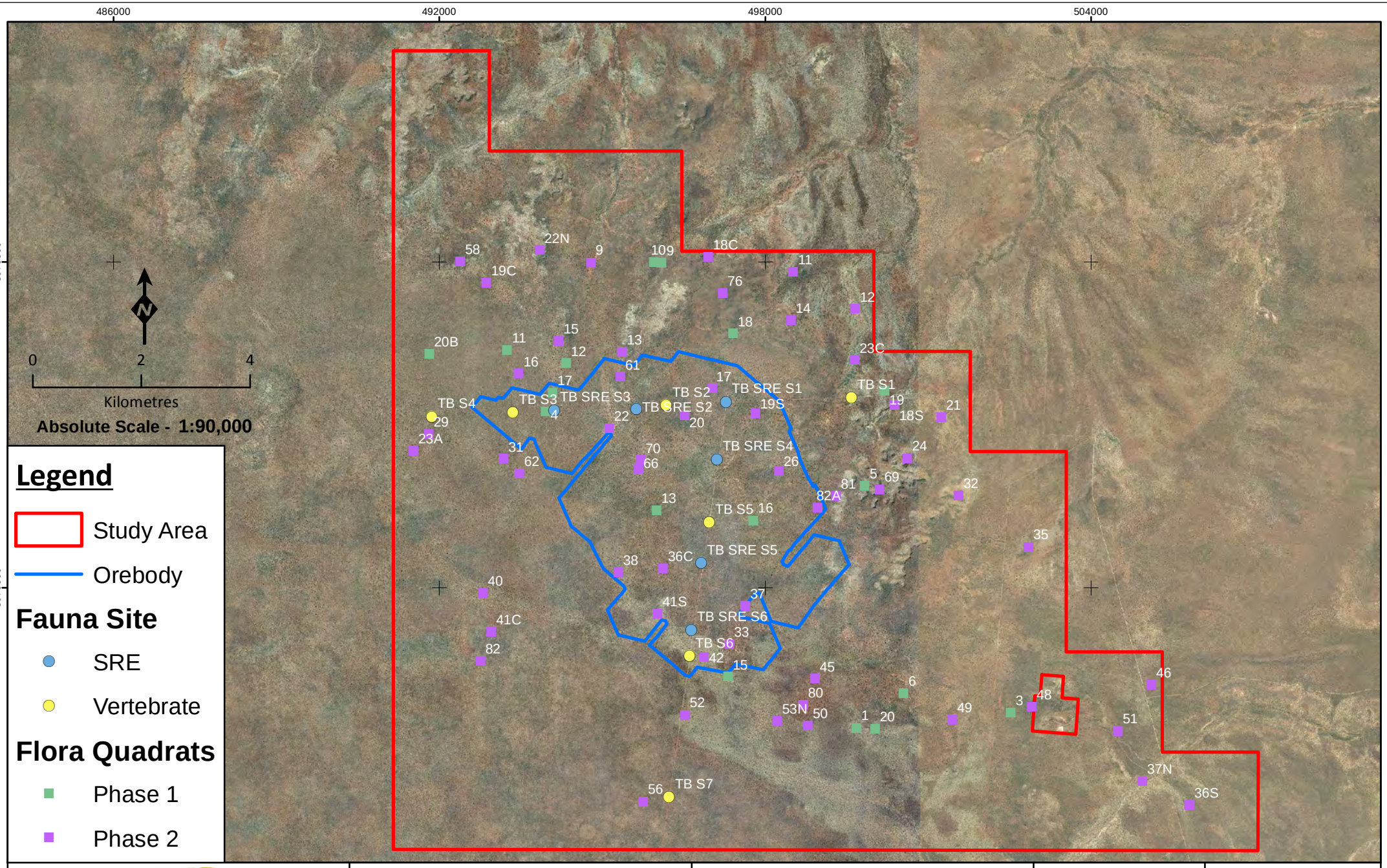

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Flora, Fauna and SRE site locations within the study area

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2 RESULTS

2.1 FLORA

2.1.1 Species richness

A total of 284 flora taxa, including subspecies, varieties and hybrids, were recorded during the phase one and two field assessments of the study area (Table 2.1). Thirty aditional taxa were not fully identified due to lack of reproductive material and are likely to be duplicates of taxa already listed. These taxa were excluded from the data, resulting in the 284 species total. The total diversity of the flora (excluding those not fully identified) is summarised in Table 2.2. A complete list of the flora recorded in the study area is included as Appendix B.

Table 2.1 – Diversity of the flora of the study area

Number of Taxa Recorded	Number of Families	Number of Genera	Number of Families Represented by a Single Taxon	Number of Genera Represented by a Single Taxon
284	54	151	21	93

The families and genera represented by the greatest number of taxa and the most frequently recorded species in the study area are listed in Table 2.2. There is a high presence of the predominantly annual families; Poaceae, Cyperaceae, Amaranthaceae and Euphorbiaceae. This indicates that the two field surveys occurring in the wet and the dry season were effective in recording a high proportion of species present within the study area under different seasonal conditions.

Table 2.2 – Most represented families and genera in the study area

Most Common Families	Most Common Genera	Most Frequently Recorded Taxa
Poaceae (49 taxa) Fabaceae (43 taxa) Cyperaceae (30 taxa) Malvaceae (18 taxa) Amaranthaceae (10 taxa) Euphorbiaceae (10 taxa) Myrtaceae (10 taxa)	*Fimbristylis* (13 taxa) *Acacia* (9 taxa) *Euphorbia* (9 taxa) *Cyperus* (8 taxa) *Tephrosia* (8 taxa)	*Brachychiton diversifolius* subsp. *diversifolius* (65 quadrats) *Triodia caelestialis* (54 quadrats) *Spermacoce occidentalis* (52 quadrats) *Corymbia greeniana* (49 quadrats) *Acacia tumida* var. *tumida* (48 quadrats) *Eriachne obtusa* (42 quadrats) *Grevillea refracta* subsp. *refracta* (42 quadrats) *Sorghum timorense* (42 quadrats) *Terminalia canescens* (41 quadrats)

2.1.2 Sampling adequacy

Flora sampling adequacy was estimated using SAC analysis (Colwell 2009) and extrapolation of the curve to the asymptote using Michaelis-Menten modelling (Figure 2.1). Using this analysis, the incidence-based coverage estimators of species richness; ICE Mean and Chao 2 Mean were determined as 325 and 335, respectively. The total number of taxa collected in the study area quadrats (excluding opportunistic collections) was 273 if all potential duplicates not fully identified to subspecies level (and therefore possibly repeats of other taxa) are also excluded. Thus it is estimated that between 81.5% and 84% of the taxa present in the study area were recorded.

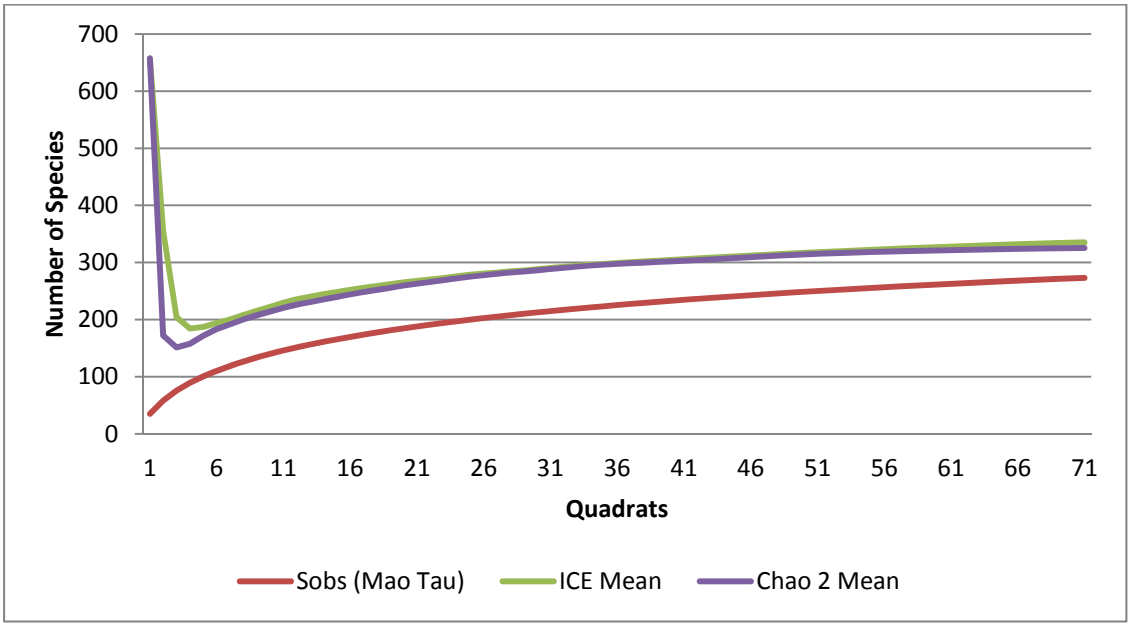


Figure 2.1 – Average randomised species accumulation curve for the study area

2.1.3 Threatened and priority flora recorded within the Thunderbird study area

No EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*) or WC Act (*Wildlife Conservation Act 1950*) listed Threatened flora were recorded in the study area.

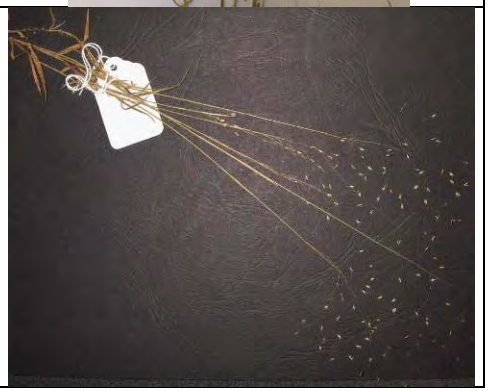
Six Priority taxa were recorded in the study area during both phases of surveying:

- Fuirena *nudiflora* (P1);
- *Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946) (P3);
- *Fuirena incrassata* (P3);
- *Pterocaulon intermedium* (P3);
- *Tephrosia valleculata* (P3); and
- *Triodia caelestialis* (P3).

Further details of Priority Flora collected are summarised in Table 2.3. The distribution of records within the study area is illustrated in Figure 2.2 and coordinates of records are provided in Appendix C, with an explanation of the conservation codes in Appendix D.

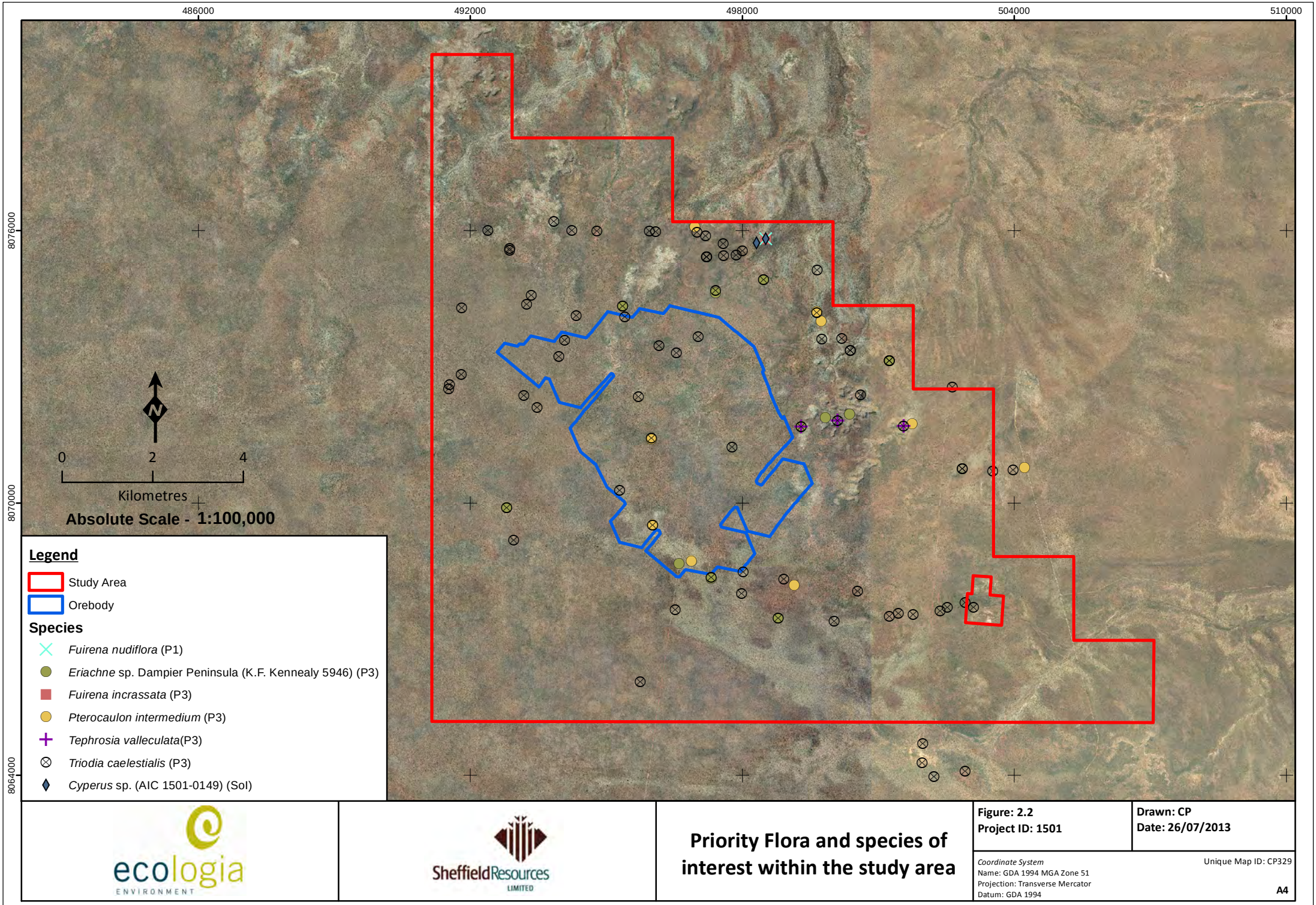
The Priority 1 taxon, *Fuirena nudiflora* was recorded from a single location within the study area. It also represents the only location on the Dampier Peninsula, 600 km from the next nearest location as per the WA herbarium records (Western Australian Herbarium 1998-2013).

Table 2.3 – Priority Flora recorded within the Thunderbird study area

Conservation Status	Taxon, Family and Description	No. of localities (individuals) within study area	Habitat (WA Herbarium 2013)	Distribution	Flower Period	Photograph (*ecologia* 2013)
P1	*Fuirena nudiflora*	1 (30)	Sandy swamps, creek beds	Ngaanyatjarraku, Wyndham-East Kimberley	Apr – May or July	
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	12 (140)	Plain. Red-brown sandy loam. Pindan Sands	Scattered on Dampierland and in the Fitzroy Trough	-	

Conservation Status	Taxon, Family and Description	No. of localities (individuals) within study area	Habitat (WA Herbarium 2013)	Distribution	Flower Period	Photograph (*ecologia* 2013)
P3	*Fuirena incrassata*	1 (30)	Sand or sandy clay. Swamps, creek beds, claypans and semi-saline lakes	Broome, East Pilbara, Wyndham-East Kimberley.	May - Aug	
P3	*Pterocaulon intermedium*	9 (75)	Flat areas on red sand - loam	Broome, Derby-West Kimberley, Port Hedland, Wyndham-East Kimberley	-	

Conservation Status	Taxon, Family and Description	No. of localities (individuals) within study area	Habitat (WA Herbarium 2013)	Distribution	Flower Period	Photograph (*ecologia* 2013)
P3	*Tephrosia valleculata*	3 (45)	Sandy, often shallow, soil around sandstone and rock outcrops	Broome, Wyndham-East Kimberley	Apr - Sept	
P3	*Triodia caelestialis*	79 (11320)	Red-brown sand-silt-clay on low plains	Broome, Derby-West Kimberley.	-	



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Priority Flora and species of interest within the study area

Figure: 2.2
Project ID: 1501

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Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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2.1.4 Introduced flora

No Weeds of National Significance were recorded in the study area.

Data from the Western Australian Herbarium's database (Western Australian Herbarium 1998-2013) indicates that as at July 2013 there are 165 introduced species within the Dampierland bioregion. Of these, seven species have been recorded within the study area. These species and their legal status under the Western Australian Organism List (WAOL) (DAFWA 2013) are presented in Table 2.4. Of these species, *Sida acuta* is rated as a declared pest on the WAOL (DAFWA 2013) (Table 2.4). This means that this species is prohibited from being imported or kept by any person. The C3 management category means that it is desirable to manage this species in order to limit its damage. Control measures are recommended and can prevent this pest from increasing in population size or density, or moving from an area in which it is established into an area which currently is free of that pest (DAFWA 2013).

The locations at which these species were recorded are listed in Appendix E and mapped in Figure 2.3. The characteristics and broad distributions of these species are summarised in Table 2.5 and Table 2.6.

Table 2.4 – Introduced species recorded in the study area

Taxon	Legal status (DAFWA 2013)	Control Categories
**Cynodon dactylon*	Permitted (s11)	N/A
**Digitaria ciliaris*	Permitted (s11)	N/A
**Echinochloa colona*	Permitted (s11)	N/A
**Sida acuta*	Declared Pest (s22)	C3 Management
**Stylosanthes hamata*	Permitted (s11)	N/A
**Stylosanthes scabra*	Permitted (s11)	N/A
**Tridax procumbens*	Permitted (s11)	N/A

* Introduced species.

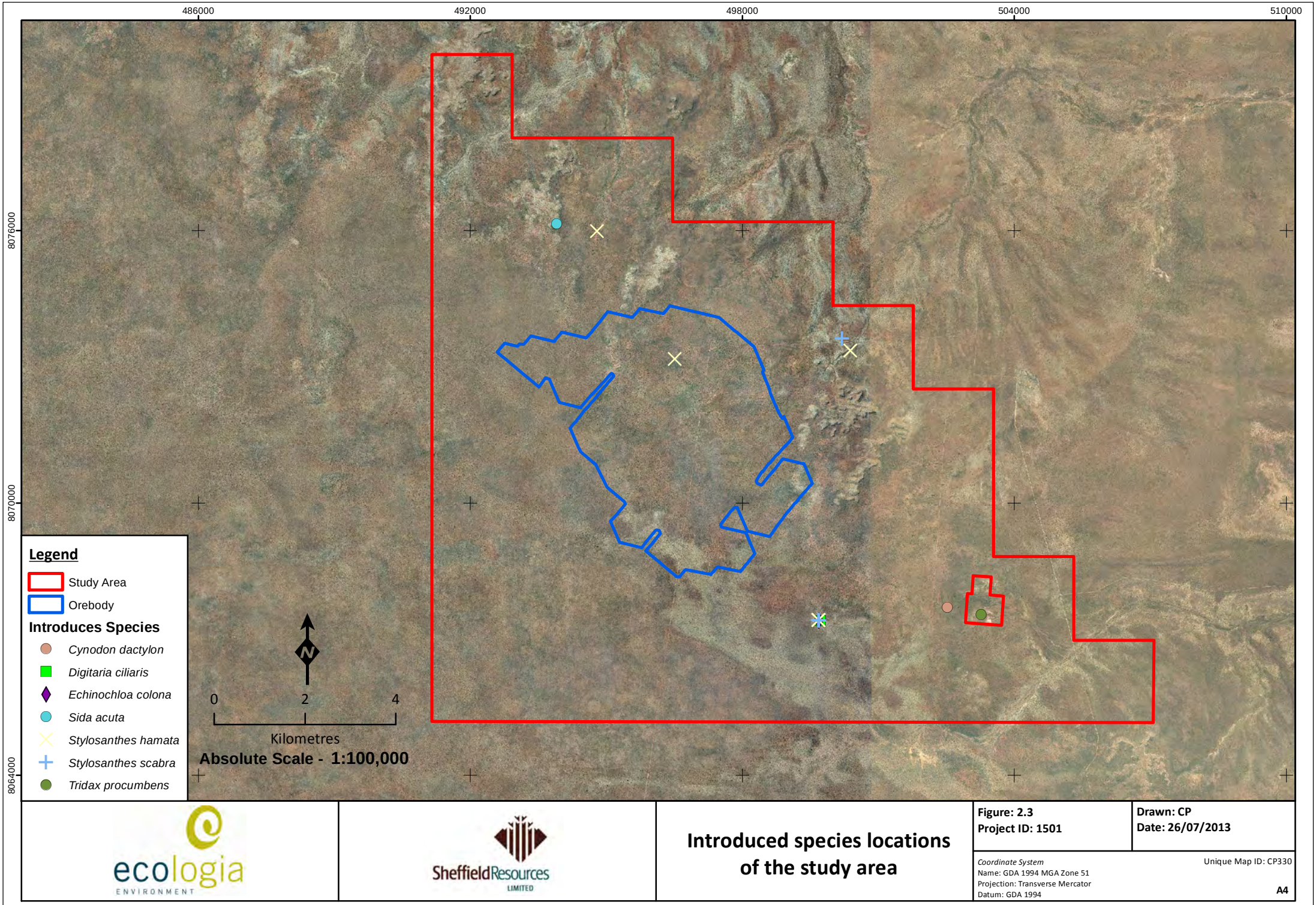
Table 2.5 – Environmental status of introduced species recorded in the study area

Taxa	DEC Environmental Threat Assessment within the Kimberley (Department of Environment and Conservation 2012)							Number of Observations in Study Area
	Current Distribution	Abundance	Ecological Impact	Invasiveness	Feasibility of Control	General Trend	Status	
Cynodon dactylon	-	-	-	-	-	-	-	1
Digitaria ciliaris	Moderate	Occasional	Low	Unknown	Low	Increasing	Established	1
Echinochloa colona	High	Occasional	Unknown	Rapid	Low	Unknown	Established	1
Sida acuta	Moderate	Common	Unknown	Moderate	Low	Increasing	Established	1
Stylosanthes hamata	Extensive	Common	Moderate	Rapid	Low	Increasing	Established	5
Stylosanthes scabra	Extensive	Common	Moderate	Rapid	Low	Increasing	Established	3
Tridax procumbens	Low	Common	Unknown	Slow	Low	Increasing	Established	1

Table 2.6 – Introduced flora recorded in the study area

Taxa	Description	Photograph
Cynodon dactylon Poaceae (Couch grass)	*Cynodon dactylon* is a rhizomatous or stoliniferous prostrate perennial, 5 to 30 cm high (Western Australian Herbarium 1998-2013). It invades wetlands and river edges and has been found in virtually all parts of Western Australia (Hussey *et al.* 2007). Native to the Kimberley and the tropics worldwide (Hussey *et al.* 2007).	 WAHERB (2013)
Digitaria ciliaris Poaceae (Summer Grass)	*Digitaria ciliaris* is a decumbent, tufted annual, grass-like or herb, 0.02–1 m high with green flowers, occurring between November and June (Western Australian Herbarium 1998-2013). It commonly grows in sand, clay, alluvium and sandstone (Western Australian Herbarium 1998-2013). Native to the tropics, *D. ciliaris* is now a weed of crops and disturbed areas (Hussey *et al.* 2007).	 www.shirleydenton.com
Echinochloa colona Poaceae (Awnless Barnyard Grass)	*Echinochloa colona* is a tufted annual, grass-like or herb, 0.2–0.6 m high. Flowers are green or purple, occurring between February and July (Western Australian Herbarium 1998-2013). It commonly grows in black sand or black clay, near watercourses and swamps (Western Australian Herbarium 1998-2013) and is a widespread weed of creeks and irrigated crops (Hussey *et al.* 2007). Native to Africa and Asia (Hussey *et al.* 2007).	 WAHERB (2013)
Sida acuta Malvaceae (Spinyhead sida)	*Sida acuta* is a slender, erect perennial, herb or shrub growing to 1 m high. From March to September it possesses a yellow flower (Western Australian Herbarium 1998-2013). *Sida acuta* is a common weed throughout the Kimberley, preferring to grow in creeks and riverine vine thickets (Hussey *et al.* 2007). This is a pantropical species that is native to tropical America and Africa (Hussey *et al.* 2007).	 WAHERB (2013)

Taxa	Description	Photograph
Stylosanthes hamata Fabaceae (Verano Stylo)	*Stylosanthes hamata* is an erect or decumbent herb or shrub up to 70 cm high with yellow flowers (Western Australian Herbarium 1998-2013). It can be found in seepage areas, creek banks, pool edges, lawn and disturbed vegetation (Western Australian Herbarium 1998-2013). Native to Central and South America (Hussey *et al.* 2007).	 WAHERB (2013)
Stylosanthes scabra Fabaceae (Stylo)	*Stylosanthes scabra* is an erect shrub ranging from 0.3 to 2 metres in height with yellow flowers (Western Australian Herbarium 1998-2013). It can be observed in levees adjacent to major rivers, flood prove areas, well-watered cultivated grounds and road verges (Western Australian Herbarium 1998-2013). Native to the Caribbean and South America (Hussey *et al.* 2007).	 www.hear.org (2013)
Tridax procumbens Fabaceae (Coat buttons)	*Tridax procumbens* is a prostrate to erect perennial herb, growing to 0.4 m high. It possesses a white and yellow flower from Jan to Dec (Western Australian Herbarium 1998-2013). It can be found in seepage areas, on wet and disturbed ground (Western Australian Herbarium 1998-2013). Native to Central America (Hussey *et al.* 2007).	No Image



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Introduced species locations of the study area

Figure: 2.3
Project ID: 1501

Drawn: CP
Date: 26/07/2013

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP330

A4

2.1.5 Flora representing range extensions

Twenty six records from the surveys represent range extensions of more than 100 km to the taxon's previously known distribution (Table 2.7), based on current records on Florabase (Western Australian Herbarium 1998-2013) and on the Australian Virtual Herbarium (The Council of Heads of Australasian Herbaria 2013). In some instances, range extensions can represent poorly collected taxa particularly given the relative paucity of records due to the lack of survey effort on the Dampier Peninsula. The paucity of records in the area is evident in that 221 species recorded from both phases (77%) have not previously been recorded within 40 km of the study area. Specimens from these taxa will be lodged with the Western Australian Herbarium.

There are taxa that are relatively well recorded and unlikely to be exhibiting a range extension due to paucity of records, and therefore expected to actually represent significant range extensions, these species being: *Alysicarpus muelleri, Cenchrus elymoides, Fimbristylis simulans, Lophostemon grandiflorus* subsp. *riparius, Polygala galeocephala, Pterocaulon tricholobum* and *Stemodia lythrifolia*.

Table 2.7 – Taxa with range extensions greater than 100 km

Species	Approximate distance and direction of extension	Bioregions in which species is known to occur	Number of records on WAHERB (2013)
Acacia drepanocarpa subsp. *latifolia*	128 km NW of south eastern record	CK, DL, GSD, OVP, PIL	19
Alysicarpus muelleri	188 km W of Northern Kimberley population	CK, CAR, DL, NK, OVP, PIL, TAN, VB	84
Aphyllodium biarticulatum	500 km SW of Northern Kimberley population	NK, VB	6
Cenchrus elymoides	120 km SW of known population	CK, NK, VB	59
Cenchrus elymoides var. *elymoides*	115 km SW of Northern Kimberley population	CK, NK	18
Cheilanthes ?*nudiuscula*	265 km WSW of Northern Kimberley population	CK, NK, OVP	3
Cyperus latzii	111 km S of Kimberley population	CK, DL, NK, VB	5
Fimbristylis macrantha	400 km SW nearest record	NK, VB	3
Fimbristylis simulans	118 km NW of known Northern Province records	CK, DL,NK,OVP, PIL, TAN	30
Fimbristylis trigastrocarya	154 km S of known population	NK, VB	13
Fuirena nudiflora (P1)	635 km W of known Kimberley population	CR, VB	2
Gomphrena lanata	135 km NW of western population	DL, GSD, OVP, PL, SKI	23
Heliotropium dichotomum	135 km W of eastern population	DL NK OVP VP	13
Lophostemon grandiflorus subsp. *riparius*	110 km W of known population	CK, DL, NK, OVP, VB	81
Polygala galeocephala	100 km W of known population	CK, DL, GSD, NK, OVP, TAN, VB	37
Pterocaulon tricholobum	112 km SSW of known population	CK, DL, NK, OVP, VB	43
Rotala occultiflora	200km WSW of known population	CK, CR, DL, NK, OVP, VB	27
Sida acuta	112 km SSW of known population	CK, DL, OVP, P, VP	26
Stemodia lythrifolia	653 km SW of known records	CK, DL, NK, OVP, VB	46
Tephrosia forrestiana	417 km W of known population	CK, OVP, VB	9
Tephrosia valleculata	115 km SSW of known population	DL, NK	9
Thaumastochloa pubescens	100 km E of known population	DL	2
Tribulopis pentandra	100 km W of known population	CK, DL, NK, OVP, VB	24

Species	Approximate distance and direction of extension	Bioregions in which species is known to occur	Number of records on WAHERB (2013)
Trichodesma zeylanicum var. *zeylanicum*	Bridging extension 192 km W of eastern population and 523 km NE of Pilbara population	CAR, CK, DL, GAS, GD, GVD, LSD, NK, OVP, PIL, YAL	28
Triodia caelestialis	197 km W of known population	CK, DL, NK	3
Triodia intermedia	152 km W of eastern population and 220 km NE of south-western record	CK, DL, GAS, GSD, OVP, PIL	26

Bioregion codes:
Northern: Central Kimberley (CK), Dampierland (DL), Northern Kimberley (NK), Ord-Victoria Plains (OVP) and Victoria Bonaparte (VB).
Eremaean: Carnarvon (CAR), Central Ranges (CR), Coolgardie (COO), Gascoyne (GAS), Gibson Desert (GD), Great Sandy Desert (GSD), Great Victoria Desert (GVD), Hampton (HAM), Little Sandy Desert (LSD), Murchison (MUR), Nullarbor (NUL) Pilbara (PIL), Tanami (TAN) and Yalgoo (YAL). **South-west**: Avon Wheatbelt (AW), Esperance Plains (ESP), Geraldton Sandplains (GS), Jarrah Forest (JF), Mallee (MAL), Swan Coastal Plain (SWA), Warren (WAR).

2.1.6 Species of Interest

Cyperus sp. (AIC 1501-0149) is a tall grey-green to green, apparently non-rhizomatous, perennial sedge to ca. 50 cm high (Figure 2.4). This specimen was unable to be assigned to a known species due to its unusual inflorescence, glume structure and fully formed nuts and with anthers that are apparently absent (M. Hislop, *pers. comm*.); it is awaiting further examination by *Cyperus* specialists. This potentially new taxon was collected at two sites in the north of the study area (Figure 2.2), occurring on dark sandy-loam soils together with species including *Acacia tumida* var. *tumida*, *Acacia platycarpa*, *Melaleuca alsophila*, *Crotalaria crispata*, *Sorghum timorense* and *Triodia caelestialis*.

Figure 2.4 – *Cyperus* sp. (AIC 1501-0149)

2.2 VEGETATION

2.2.1 Priority Ecological Communities (PECs)

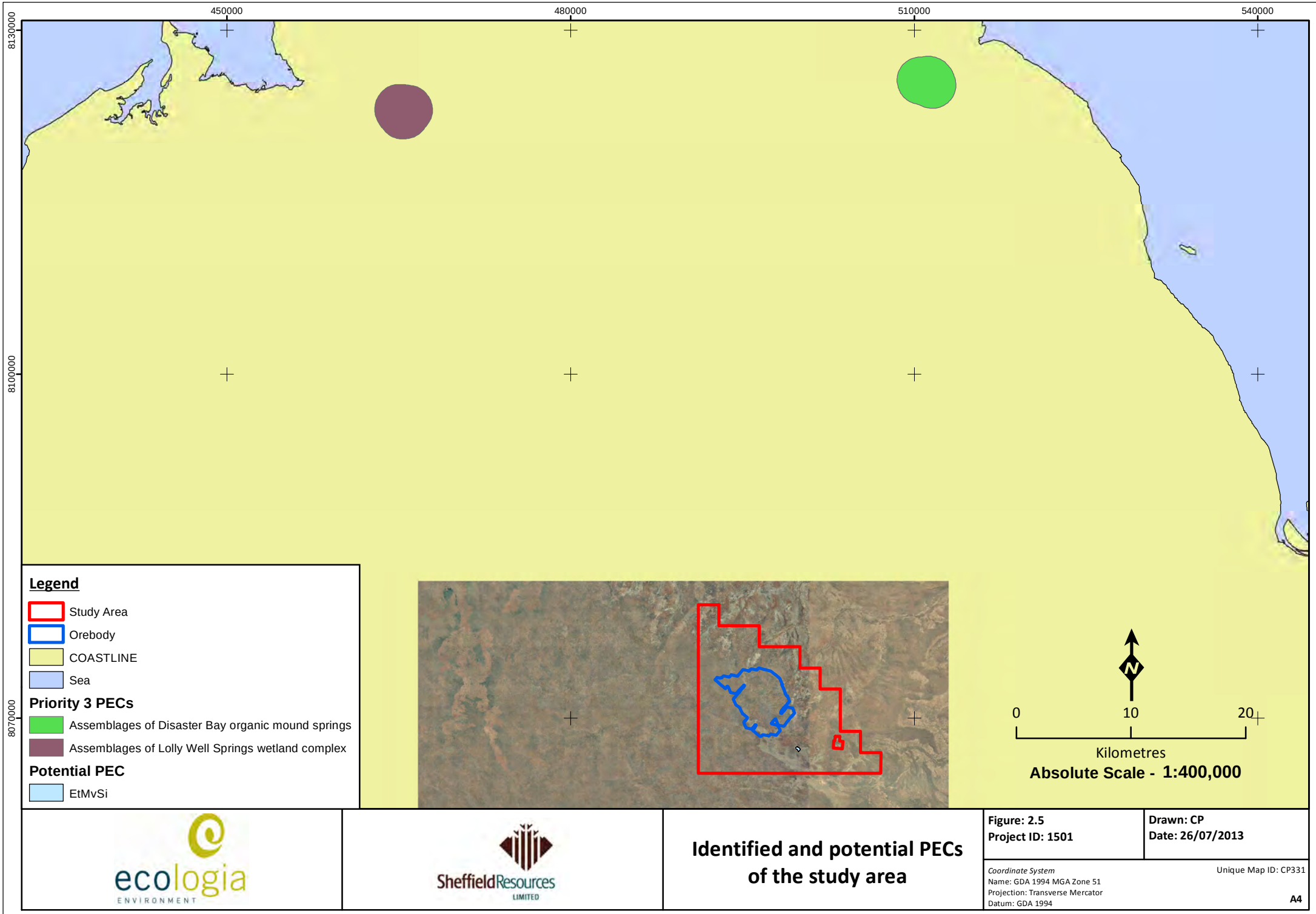
Two Priority 3 PECs are recorded within 50 km of the study area, both located approximately 40 km north east of the study area (Figure 2.5). These PECs are:

- Assemblages of Disaster Bay organic mound springs; and
- Assemblages of Lolly Well Springs wetland complex.

Assemblages of Disaster Bay organic mound springs (P3) are found on a tidal flat with *Melaleuca acacioides, Timonius timon, Pandanus spiralis, Melaleuca viridiflora, Acacia neurocarpa* and *Lumnitzera racemosa* (mangrove) woodland with *Typha domingensis* and sedges, including *Schoenoplectus litoralis*. Threats to this PEC include soil compaction by cattle and potential changes in sea level due to climate change (Department of Environment and Conservation 2013).

Assemblages of Lolly Well Springs wetland complex (P3) contain numerous low organic mound springs with moats. *Melaleuca cajuputi* and/or *Timonius timon*, and *Eleocharis dulcis* are indicative of these types of wetlands. Threats to this PEC include recreational use, potential tourism developments, weed invasion, rubbish dumping, grazing and trampling (cattle) (Department of Environment and Conservation 2013).

Vegetation unit EtMvSi (*Eucalyptus tectifica* and *Melaleuca viridiflora* open woodland, over dense tussock grassland) mapped in the first phase shows similarities with the Lolly Well Springs wetland complex Priority 3 PEC assemblage (Figure 2.5). This comparison can be made because the landform of this vegetation unit also presents an area of what can be described as a low, large organic mound spring with moats. The presence of *Melaleuca viridiflora* and Cyperaceae species also present in the Lolly Well Springs wetland complex incicate that this vegetation unit may constitute a potential PEC.



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Identified and potential PECs of the study area

Figure: 2.5
Project ID: 1501

Drawn: CP
Date: 26/07/2013

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP331

A4

2.3 FAUNA

2.3.1 Conservation significant fauna recorded within the Thunderbird study area

During the first phase of the survey, four vertebrate species of conservation significance were recorded, all of them birds. These were the Australian Bustard (*Ardeotis australis*; WC Act Priority 4), Bush Stone-curlew (*Burhinus grallarius*; WC Act Priority 4), Fork-tailed Swift (*Apus pacificus*; EPBC Act Migratory, WC Act Schedule 3) and Rainbow Bee-eater (*Merops ornatus*; EPBC Act Migratory, WC Act Schedule 3). The details of these records are shown in Table 2.8 and Figure 2.6 below.

Table 2.8 – Conservation significant fauna recorded during the survey

Species	Number recorded	Location		
		Site	Easting	Northing
Australian Bustard (*Ardeotis australis)*	2	Opportunistic	493689	8073231
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	495867	8063689
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	498080	8073444
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	501623	8073615
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	503137	8073511
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	498858	8073480
Australian Bustard (*Ardeotis australis)*	2	Opportunistic	497167	8073401
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	499925	8073532
Australian Bustard (*Ardeotis australis)*	1	Opportunistic	498892	8073487
Bush Stone-curlew (*Burhinus grallarius*)	1	Opportunistic	504998	8067975
Fork-tailed Swift (*Apus pacificus*)	2	Opportunistic	503460	8067419
Rainbow Bee-eater (*Merops ornatus*)	3	TBS1	499584	8073492
Rainbow Bee-eater (*Merops ornatus*)	3	TBS3	493352	8073219
Rainbow Bee-eater (*Merops ornatus*)	2	TBS4	491858	8073144
Rainbow Bee-eater (*Merops ornatus*)	9	TBS5	496965	8071200
Rainbow Bee-eater (*Merops ornatus*)	13	TBS6	496603	8068741
Rainbow Bee-eater (*Merops ornatus*)	3	TBS7	496226	8066143
Rainbow Bee-eater (*Merops ornatus*)	2	Opportunistic	499712	8067404
Rainbow Bee-eater (*Merops ornatus*)	10	Opportunistic	504152	8072770

Zone: 51K
Datum: GDA 94

A desktop study of conservation significant invertebrate fauna potentially found within the Thunderbird study area produced few records due to the paucity of prior survey effort in the area. Searches of the Department of Parks and Wildlife (DPaW) and Western Australian Museum (WAM) databases detected five terrestrial snails that are either confirmed SREs or potential SREs that could occur within the study area (Table 2.9).

Table 2.9 – Potential SRE fauna relevant to the Thunderbird study area

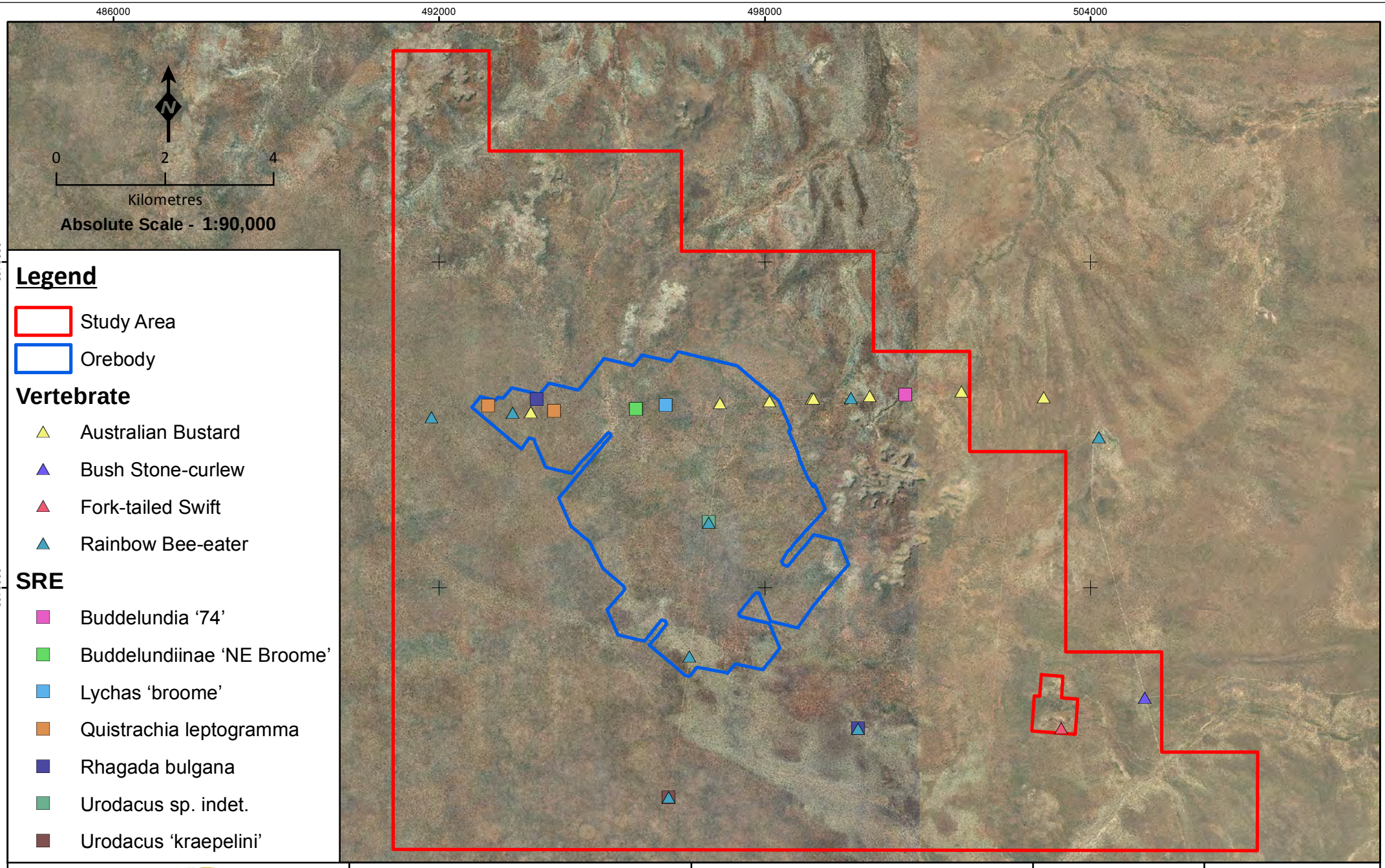
Species	SRE status
Rhagada bulgana	SRE (Confirmed)
Quistrachia leptogramma	SRE (Confirmed); distribution nearing 10000km2
Quistrachia sp.	Unidentified species; Potential SRE (taxonomically poorly resolved)
Rhagada sp.	Unidentified species; Potential SRE (taxonomically poorly resolved)
Magilaoma sp. *nov.*	Probable new species; Potential SRE (taxonomically poorly resolved)

To date, only the taxonomic results for snails, scorpions and isopods have been returned to *ecologia* from WAM. The snail report states that of the four species identified, one (*Rhagada bulgana)* is a confirmed SRE, another (*Quistrachia leptogramma*) is a potential SRE, whilst the remaining two (*Eremopeas interioris* and *Pupoides pacificus*) are widespread species and therefore are not SREs (Whisson 2013). The combined scorpion and isopod report states that three of the five scorpions identified are potential SREs, as are both of the isopods (Framenau 2013). Details of these confirmed and potential SREs are shown in Table 2.10 below.

Table 2.10 – SRE specimens recorded during the survey

Taxon	SRE status	Number	Easting	Northing	WAM Reg. No.	ecologia ref.
CAMAENIDAE						
Rhagada bulgana	Confirmed	1	8073471	493791	81704	1501;13:2742
Rhagada bulgana	Confirmed	1	8067404	499712	81705	1501;13:2739
Quistrachia leptogramma	Potential (A,E)*	1	8073259	494110	81702	1501;13:2788
Quistrachia leptogramma	Potential (A,E)*	6	8073259	494110	81702	1501;13:2741
Quistrachia leptogramma	Potential (A,E)*	1	8073352	492897	81703	1501;13:2742
SCORPIONES						
Lychas 'broome'	Potential (A,E)*	1	8073359	496173	Pending	1501,13:2744
Lychas 'broome'	Potential (A,E)*	3	8073359	496173	Pending	1501,13:2757
Urodacus 'kraepelini'	Potential (A,E)*	1	8066143	496226	Pending	1501,13:2740
Urodacus sp. indet.	Potential (A,E)*	1	8073290	495622	Pending	1501,13:1304
Urodacus sp. indet.	Potential (A,E)*	1	8071200	496965	Pending	1501,13:2749
ISOPODA						
Buddelundia '74'	Potential (A,E)*	9	8073560	500580	Pending	1501,13:2772
Buddelundia '74'	Potential (A,E)*	7	8073560	500580	Pending	1501,13:2773
Buddelundiinae 'NE Broome'	Potential (A,E)*	4	8073290	495622	Pending	1501,13:2774
Buddelundiinae 'NE Broome'	Potential (A,E)*	1	8073290	495622	Pending	1501,13:2775

Zone: 51K
Datum: GDA 94
*Details of these codes are provided in Appendix D



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Conservation significant fauna recorded during the survey

Figure: 2.6
Project ID: 1501

Drawn: JFH
Date: 29/07/2013

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: JFH018

A4

2.3.2 Fauna representing range extensions

One of the species recorded during the survey may represent a range extension. The nearest NatureMap (a database maintained by DPaW) record for the gecko, *Gehyra nana* is approximately 100 km away. However, two other surveys have previously recorded this species on the Dampier Peninsula (*ecologia* 2004c; ENV 2008). This disparity is likely due to the low frequency in which the NatureMap database is updated, as well as the paucity of survey data in the region.

Although it may not represent a range extension, the record of the skink *Lerista greeri* is notable in that it has only been recorded on the Dampier Peninsula once before (ENV 2008), and the nearest NatureMap record is around 60 km away. Similarly, the record of the Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*) is also noteworthy since there is only one prior NatureMap record and one *ecologia* (2004c) record of this species on the Dampier Peninsula.

As suspected by WAM experts, the record of the snail *Rhagada bulgana* has been identified as a range extension (Slack-Smith and Whisson 2011). Current distribution records for this species are limited to the area between Quondong Point and the northern tip of the Dampier Peninsula. In addition, molecular taxonomy suggests that the species is synonymous with *R. cygna* in the north and *R. reigna* in the south of the peninsula (Johnson *et al.* 2004). Similarly, *Quistrachia leptogramma* has been found from Broome northwards to Cape Leveque, and other scattered records of it are known (Slack-Smith and Whisson 2011).

2.3.3 Other conservation significant fauna

Based upon consultation with staff at the WAM during the survey, specimens of three vertebrate species were vouchered. This included a specimen of the Short-tailed Monitor (*Varanus* affin. *brevicauda*), which may in future be split into a new species in the Kimberley region. Also submitted were two specimens of the skinks *Morethia storri*, and one of *Ctenotus colletti*. Two specimens of a third skink, tentatively identified as *Proablepharus tenuis*, were also submitted. *ecologia* is currently awaiting taxonomic reports from WAM regarding these reptiles, as well as for the mygalomorph, opilionid, pseudoscorpion and selenopid invertebrate specimens which have been submitted.

2.3.4 Species recorded

During the survey, 124 terrestrial vertebrate species were recorded. This included 13 mammal (including three introduced), 73 bird, 31 reptile and seven amphibian species, shown in Table 2.3 below.

Table 2.11 – Vertebrate species recorded during the survey

Taxon	Common name
Mammals	
DASYURIDAE	
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart
MACROPODIDAE	
Macropus agilis	Agile Wallaby
VESPERTILIONIDAE	
Chalinolobus gouldii	Gould's Wattled Bat
Chalinolobus nigrogriseus	Hoary Wattled Bat
Myotis macropus	Large-footed Myotis
Nyctophilus geoffroyi	Lesser Long-eared Bat
Scotorepens greyii	Little Broad-nosed Bat
MOLOSSIDAE	
Chaerophon jobensis	Northern Freetail Bat
MURIDAE	
Pseudomys delicatulus	Delicate Mouse
Pseudomys nanus	Western Chestnut Mouse
INTRODUCED MAMMALS	
**Canis lupus*	Dog/Dingo
**Felis catus*	Cat
**Bos taurus*	Cow
Birds	
PHASIANIDAE	
Coturnix ypsilophora	Brown Quail
ANSERANATIDAE	
Anseranas semipalmata	Magpie Goose
ANATIDAE	
Dendrocygna eytoni	Plumed Whistling-Duck
Anas superciliosa	Pacific Black Duck
PODICIPEDIDAE	
Tachybaptus novaehollandiae	Australasian Grebe
COLUMBIDAE	
Ocyphaps lophotes	Crested Pigeon
Geopelia cuneata	Diamond Dove
Geopelia striata	Peaceful Dove
PODARGIDAE	

Taxon	Common name
Podargus strigoides	Tawny Frogmouth
EUROSTOPODIDAE	
Eurostopodus argus	Spotted Nightjar
AEGOTHELIDAE	
Aegotheles cristatus	Australian Owlet-nightjar
APODIDAE	
Apus pacificus	Fork-tailed Swift
ARDEIDAE	
Ardea pacifica	White-necked Heron
THRESKIORNITHIDAE	
Threskiornis spinicollis	Straw-necked Ibis
ACCIPITRIDAE	
Milvus migrans	Black Kite
Accipiter fasciatus	Brown Goshawk
Accipiter cirrocephalus	Collared Sparrowhawk
Circus assimilis	Spotted Harrier
Aquila audax	Wedge-tailed Eagle
FALCONIDAE	
Falco cenchroides	Nankeen Kestrel
Falco berigora	Brown Falcon
OTIDIDAE	
Ardeotis australis	Australian Bustard
BURHINIDAE	
Burhinus grallarius	Bush Stone-curlew
TURNICIDAE	
Turnix pyrrhothorax	Red-chested Button-quail
Turnix velox	Little Button-quail
CACATUIDAE	
Eolophus roseicapillus	Galah
Nymphicus hollandicus	Cockatiel
PSITTACIDAE	
Trichoglossus haematodus rubritorquis	Red-collared Lorikeet
Aprosmictus erythropterus	Red-winged Parrot
Melopsittacus undulatus	Budgerigar
CUCULIDAE	
Centropus phasianinus	Pheasant Coucal
Chalcites basalis	Horsfield's Bronze-Cuckoo
STRIGIDAE	
Ninox novaeseelandiae	Southern Boobook
HALCYONIDAE	
Dacelo leachii	Blue-winged Kookaburra

Taxon	Common name
Todiramphus pyrrhopygius	Red-backed Kingfisher
Todiramphus sanctus	Sacred Kingfisher
MEROPIDAE	
Merops ornatus	Rainbow Bee-eater
CORACIIDAE	
Eurystomus orientalis	Dollarbird
CLIMACTERIDAE	
Climacteris melanura	Black-tailed Treecreeper
MALURIDAE	
Malurus melanocephalus	Red-backed Fairy-wren
ACANTHIZIDAE	
Smicrornis brevirostris	Weebill
Gerygone albogularis	White-throated Gerygone
PARDALOTIDAE	
Pardalotus rubricatus	Red-browed Pardalote
Pardalotus striatus	Striated Pardalote
MELIPHAGIDAE	
Lichenostomus virescens	Singing Honeyeater
Lichenostomus flavescens	Yellow-tinted Honeyeater
Conopophila rufogularis	Rufous-throated Honeyeater
Sugomel niger	Black Honeyeater
Lichmera indistincta	Brown Honeyeater
Melithreptus gularis	Black-chinned Honeyeater
Melithreptus albogularis	White-throated Honeyeater
Philemon citreogularis	Little Friarbird
POMATOSTOMIDAE	
Pomatostomus temporalis	Grey-crowned Babbler
NEOSITTIDAE	
Daphoenositta chrysoptera	Varied Sittella
CAMPEPHAGIDAE	
Coracina novaehollandiae	Black-faced Cuckoo-shrike
Lalage sueurii	White-winged Triller
PACHYCEPHALIDAE	
Pachycephala rufiventris	Rufous Whistler
Colluricincla harmonica	Grey Shrike-thrush
ARTAMIDAE	
Artamus personatus	Masked Woodswallow
Artamus cinereus	Black-faced Woodswallow
Artamus minor	Little Woodswallow
Cracticus nigrogularis	Pied Butcherbird
RHIPIDURIDAE	

Taxon	Common name
Rhipidura leucophrys	Willie Wagtail
CORVIDAE	
Corvus orru	Torresian Crow
MONARCHIDAE	
Myiagra nana	Paperbarck Flycatcher
Grallina cyanoleuca	Magpie-lark
PETROICIDAE	
Microeca fascinans	Jacky Winter
Melanodryas cucullata	Hooded Robin
MEGALURIDAE	
Cincloramphus mathewsi	Rufous Songlark
HIRUNDINIDAE	
Petrochelidon nigricans	Tree Martin
NECTARINIIDAE	
Dicaeum hirundinaceum	Mistletoebird
ESTRILDIDAE	
Taeniopygia guttata	Zebra Finch
Poephila acuticauda	Long-tailed Finch
Reptiles	
AGAMIDAE	
Chlamydosaurus kingii	Frill-necked Lizard
Diporiphora magna	
Diporiphora pindan	
Pogona minor	Dwarf Bearded Dragon
DIPLODACTYLIDAE	
Diplodactylus conspicillatus	Fat-tailed Gecko
Lucasium stenodactylum	
Strophurus ciliaris	
GEKKONIDAE	
Gehyra nana	
Gehyra pilbara	
Heteronotia binoei	Bynoe's Gecko
PYGOPODIDAE	
Delma tincta	
Lialis burtonis	
SCINCIDAE	
Carlia munda	
Carlia rufilatus	
Ctenotus colletti	
Ctenotus inornatus	

Taxon	Common name
Ctenotus pantherinus	
Ctenotus robustus	
Ctenotus serventyi	
Eremiascincus isolepis	
Lerista greeri	
Morethia storri	
Proablepharus tenuis	
Tiliqua scincoides	Eastern Blue-tongue
VARANIDAE	
Varanus acanthurus	Spiny-tailed Monitor
Varanus brevicauda	Short-tailed Pygmy Monitor
Varanus tristis tristis	Racehorse Monitor
BOIDAE	
Antaresia stimsoni	Stimson's Python
ELAPIDAE	
Brachyurophis roperi	
Demansia angusticeps	
Suta punctata	Spotted Snake
Amphibians	
HYLIDAE	
Cyclorana australis	Giant Frog
Cyclorana longipes	Long-footed Frog
Litoria caerulea	Green Tree Frog
Litoria rubella	Little Red Tree Frog
LIMNODYNASTIDAE	
Notaden nichollsi	Desert Spadefoot
Platyplectrum ornatum	Ornate Burrowing Frog
MYOBATRACHIDAE	
Uperoleia talpa	Mole Toadlet

*Introduced species

A total of 124 invertebrate fauna were recorded including 22 isopods, nine mygalomorphs, four opilionids (harvestmen), 15 pseudoscorpions, 58 scorpions and 16 snails. Taxonomic information for the mygalomorph, opilionid, selenopid and pseudoscorpion samples are pending relevant identification reports from WAM.

3 DISCUSSION

3.1 FLORA

3.1.1 Regional distribution of conservation significant flora

The conservation significance of Threatened and Priority Flora is greater if the taxa is poorly recorded or restricted to a particular area or region. The table below summarises the distribution of the Priority flora recorded within the study area in Western Australia, according to specimens lodged at the Western Australian Herbarium (Western Australian Herbarium 1998-2013).

Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946) (P3), is relatively well represented in the Herbarium's database with 22 records distributed regionally outside of the study area. However, records suggest that this species is entirely restricted to the Dampierland bioregion.

Fuirena incrassata (P3), *Pterocaulon intermedium* (P3), *Tephrosia valleculate* (P3) and *Triodia caelestialis* (P3) are less well represented within the Herbarium's database with seven, 17, nine and 16 regional records each, respectively. However, these species have a wide distribution throughout northern Australia.

Fuirena nudiflora (P1) has two populations recorded in the Herbarium's database from the Central Ranges and Victoria Bonaparte bioregions. The specimen collected during the current survey represents the first record in the Dampierland bioregion increasing the significance of the presence of this species in the study area.

All Priority flora recorded in the study area are poorly represented within conservation reserves managed by DPaW (formerly DEC). *Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946), *Pterocaulon intermedium* and *Triodia caelestialis* are the only species known to be represented within the conservation estate, by a single record each. The remainder of the species recorded during the survey are not known to be present within a conservation reserve.

Table 3.1 – Distribution of Priority Flora recorded in the study area within Western Australia

Priority Status	Taxon	No. of Locations within the Study Area	Locations within the Conservation Estate	Locations in Florabase (WAHerb)
P1	*Fuirena nudiflora*	1	0	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	12	1	22
P3	*Fuirena incrassata*	1	0	7
P3	*Pterocaulon intermedium*	9	1	17
P3	*Tephrosia valleculata*	3	0	9
P3	*Triodia caelestialis*	79	1	16

3.1.2 Comparison with nearby surveys

Results from the current survey were compared to six surveys within 100 km of the study area, as discussed below.

Biota Environmental Services (Biota) conducted two phases of the James Price Point, Browse LNG Vegetation Monitoring Program – Phase 1 and 2 Surveys (Biota 2011a, b), approximately 60 km north north-east of Broome in 2011. Four taxa of conservation significance were recorded during this survey; *Gomphrena pusilla* (P2), *Eriachne* sp. Dampier Peninsula (K.F. Kennealy 5946) (P3), *Lophostemon grandiflorus* subsp. *grandiflorus* (P3) and *Pittosporum moluccanum* (P4).

In 2011, *ecologia* conducted a flora and vegetation survey titled 'James Price Point: Light Industrial Area, Workers' Accommodation and Southern Pipeline Sites Vegetation and Flora Survey'. The survey, conducted approximately 60 km north north-east of Broome, (*ecologia* 2011a) identified two Priority Flora taxa; *Eriachne* sp. Dampier Peninsula (K.F. Kennealy 5946) (P3) and *Pittosporum moluccanum* (P4).

Biota conducted a Vegetation and Flora Survey of James Price Point: Wet Season 2009 (Biota 2010b). Four currently listed priority flora species were observed; *Gomphrena pusilla* (P2), *Eriachne semiciliata* (P3), *Polymeria distigma* (P3) and *Pittosporum moluccanum* (P4).

MBS Environmental are conducting a progressive rehabilitation plan of the Ellendale 4 Diamond Project for the Kimberley Diamond Company (MBS 2010) situated *ca* 100 km south south-east of the Thunderbird study area. Six Priority Flora taxa were recorded during this survey; *Goodenia byrnesii, Aphyllodium glossocarpum, Euphorbia stevenii, Goodenia sepalosa* var. *glandulosa* and *Phyllanthus aridus*.

In 2004, *ecologia* conducted two vegetation and flora surveys of the Beagle Bay Big Tree Country Timber Plantation lease, approximately 48 km north of the study area (*ecologia* 2004a, b). Six currently listed priority species were recorded within the study areas; *Gomphrena pusilla* (P2), *Nymphoides beaglensis* (P2), *Aphyllodium glossocarpum* (P3), *Phyllanthus aridus* (P3), *Stylidium costulatum* (P3) and *Triodia acutispicula* (P3).

Eriachne sp. Dampier Peninsula (K.F. Kennealy 5946) was the only Priority flora taxa recorded within the Thunderbird study area, as well as in additional regional reports. This species appears to have a wide distribution on the Dampier Peninsuila (Table 3.2).

Table 3.2 – Priority Flora present within nearby surveys

Taxon	*ecologia* (2011)	Biota (2011a)	Biota (2011b)	*Ecologia* (2011)
Eriachne sp. Dampier Peninsula (K.F. Kennealy 5946) (P3)	3 locations	5 locations	19 locations	12 locations

3.2 VEGETATION

3.2.1 TECs and PECs

No TECs have been identified within the study area. Although no PECs have been identified within the study area, vegetation unit *EtMvSi*, mapped in the first phase is similar in both species composition and landform to the Priority 3 PEC, Assemblages of Lolly Well Springs wetland complex (Figure 2.5). This assemblige is also associated with the ephemeral pool or spring. Vegetation unit *EtMvSi*, is dominated by *Eucalyptus tectifica* and *Melaleuca viridiflora* open woodland, over dense tussock grassland (*Sacciolepis indica*, *Sorghum plumosum* and *Fuirena ciliaris*) and covers 9.39 ha of the study area. *EtMvSi* appears to be localised to and supported by the ephemeral pool. This vegetation unit is highly dependent on the water present around the ephemeral pool and would be highly susceptible to changes in the level of the water table.

If this vegetation unit is subsequently considered to be a PEC, then potential impacts should be minimised or avoided entirely. The impact to the vegetation unit *EtMvSi* from an altered water table if the Thunderbird project is developed could be assessed through a separate hydrological assessment.

3.3 FAUNA

3.3.1 Regional distribution of conservation significant fauna

All four of the conservation significant birds which were recorded (Australian Bustard, Bush Stone-curlew, Fork-tailed Swift and Rainbow Bee-eater) are both abundant and widespread throughout

WA, occurring from the south-west to the Kimberley. There are many NatureMap records of all four species on the Dampier Peninsula, and they have also been recorded there on prior fauna surveys.

The two confirmed/potential SRE snail species found on this survey were previously known mainly from the west coast of the Dampier Peninsula; therefore the range extension represented by these records indicates that their distribution is not limited to these areas and may cover a reasonably large area. The same applies to the two identifiable SRE scorpion species, which were previously only known from the area around Broome (Framenau 2013). The two isopod morphospecies are currently only known from this survey and may represent new species altogether.

3.3.2 Impact on conservation significant fauna

The development of the Thunderbird resource is expected to have a minimal impact on the conservation significant fauna species recorded therein. The spring located near the centre of the study area may be a locally significant water source, but none of the four conservation significant bird species are particularly water-dependent. Habitat analysis completed after the second phase of the survey will enhance understanding of the potential amount of nesting habitat for these species present in the study area. However, since the rest of the habitat within the study area appears to be regionally extensive, it is expected that these four species are capable of avoiding impacts from development works.

Samples of both of the confirmed/potential SRE snail species have previously been collected at James Price Point in habitat similar to that found in the study area. Although SRE fauna are restricted to small home ranges, the habitat found in the study area is widespread across the Dampier Peninsula. This indicates that potentially only a small proportion of their populations inhabit the study area and therefore, any impact on them may only be minimal. However, very little is known about the potential SRE scorpion and isopod species, so at this stage it is difficult to assess the level of impact any future development may have.

3.3.3 Comparison with nearby surveys

A comparison of vertebrate species richness with other surveys conducted on the Dampier Peninsula indicates that the numbers of mammal, bird, reptile and amphibian species recorded is similar if not slightly higher than average. Due to seasonal variation, it is likely that still more species will be recorded during the second phase of the survey, indicating that species richness in the area may be relatively high. However, most of the prior surveys conducted on the Dampier Peninsula were located near the coast; therefore results of comparisons of the various fauna assemblages may not necessarily be entirely compariable and should consider this fact.

The nearest invertebrate regional surveys were located at James Price Point, where a combined total of 31 confirmed or potential SRE species were identified (Biota 2009, 2010a; *ecologia* 2011b, c). These species were collected from three habitat types (Pindan Shrubland, Open Forest and Monsoon Vine Thicket), and included the two snail species found on this survey (*R.bulgana* and *Q. leptogramma*). The Pindan Shrubland and Open Forest habitats are similar to or the same as that found in the study area, indicating that a comparable number of SRE species may be identified pending delivery of the remaining taxonomic reports.

3.3.4 Habitat potentially supporting conservation significant fauna

On-site observation of the habitat in the study area indicates that the area may be at least sporadically inhabited by the Greater Bilby (*Macrotis lagotis*; EPBC Act Vulnerable, WC Act Schedule 1). This is supported by the fact that there are numerous NatureMap records within 50 km, and several old burrows were found in the study area which may be attributed to Bilbies. A full habitat analysis complemented by more information collected during the second phase of the survey will allow an assessment of the likelihood of occurrence of this protected species in the study area.

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3.4 ASSESSMENT OF BIOLOGICAL RESULTS AGAINST PROJECT PATHWAY

The presence of conservation significant flora, fauna and vegetation communities within the vicinity of the Thunderbird Mineral Sands project may affect the design and pathway of the project. Biological factors identified as being of conservation significance and that may have an impact on the project are assessed in Table 3.1.

In addition to addressing species of conservation significance confirmed to be present in the study area during the preceding surveys, the assessment in Table 3.1 is based on four assumptions:

- *Cyperus* sp. (AIC 1501-0149) is confirmed to be a new species.
- The potential PEC is confirmed to be a new PEC.
- Troglofauna and stygofauna are recorded within the study area.
- Conservation significant fauna with the potential to occur are found to be present.

Assuming that the project is formally assessed by the Environmental Protection Authority (EPA), the likely implications for Sheffield are:

- Further assessment is currently in process for Greater Bilby and Gouldian Finch as part of the Level 2 survey. If suitable habitat is found in the study area for either of these species a referral under the EPBC Act would be required. If deemed to be a controlled action and impacts cannot be avoided or mitigated, offsets may be required. Offsets can include any or all of the following:
    - Purchase and legal protection of land of equivalent habitat;
    - CALM/DEPaW financial contribution for management or research;
    - Fencing of the protected land;
    - Monitoring of the protected land; and/or
    - Feral animal control within the protected land.
- Monitoring of conservation significant flora (Priority 1 flora) which may be directly or indirectly impacted by the project.
- Monitoring of the potential PEC which may be directly or indirectly impacted by the project.
- 'Licence to take' to be acquired for any clearing of Priority 3 flora and flora representing range extensions.
- Avoidance and utilisation of buffer zones applied to conservation significant flora and the potential PEC. The default direct impact buffer used by DPaW for a Priority Flora species is 50 m.

Although this project is likely to attract Ministerial conditions that will affect the project and (to some degree) the project schedule, no biological issues identified (Table 3.1) are foreseen to prevent the commencement of the Thunderbird Mineral Sands project.

Table 3.1 – Assessment of biological results against project feasibility

Environmental Factor	Likelihood of Occurrence	Likely action required	Predicted conditions on the project (as set by the EPA)	Potential effect on project
EPBC listed fauna (Bilby and/or Gouldian Finch)	Based on regional records, Bilby has a high likelihood of occurrence Suitable habitat for the Gouldian Finch is present, but this species has not been recorded close to the impact area	• Targeted survey (currently in process as a component of the Level 2 survey) to assist with determining the likelihood of occurrence within and outside of the impact area • An EPBC referral to the Minister of Sustainability, Environment, Water, Population and Communities for the approval of an action that could impact the Bilby and/or Gouldian Finch. Included in the referral is the preparation of a Fauna Management Plan for the Bilby and/or Gouldian Finch, to reduce the likelihood of further assessment	• Monitoring of the Bilby and/or Gouldian Finch for the duration of time impacting the species • Potential offsets package may include funding futher research of the Bilby and/or Gouldian Finch, or purchasing available habitat equivalent to the area and quality of habitat being impacted	• Financial o An approximate cost of $25,000 to prepare a referral application per EPBC listed species, if required o Additional costs in preparing a Fauna Management Plan for the Bilby and/or Gouldian Finch o Cost involved in (annual) monitoring surveys for the Bilby and/or Gouldian Finch, if required o Cost involved in offsets, based on the size of area and significance of of impact to the Bilby and/or Gouldian Finch
Troglofauna – subterranean cave-dwelling fauna	Not previously recorded in region, but EPA Environmental Assessment Guideline No. 12 suggests a high likelihood of occurrence within the region	• If troglofauna are recorded during the pilot, further sampling required to determine species presence outside of the impact area • Geological studies to show that voids occupied by troglofauna extend outside of the impact area	• Second phase of troglofauna surveying • Monitoring of troglofauna for the duration of the mining operations	• Financial o Cost involved in second phase of surveying o Cost involved in monitoring surveys for the duration of the mining operations
Stygofauna – subterranean aquatic fauna	Not previously recorded in region, but EPA Environmental	• If stygofauna are recorded during the pilot study, further sampling required to determine species presence outside of the impact area	• Second phase of stygofauna surveying • Monitoring of stygofauna for	• Financial o Cost involved in second phase of surveying

Environmental Factor	Likelihood of Occurrence	Likely action required	Predicted conditions on the project (as set by the EPA)	Potential effect on project
	Assessment Guideline No. 12 suggests a high likelihood of occurrence within the region	• Hydrological studies to determine the impact area of of the operations on the water table and also until the draw down cone has restored to its original levels after mining operations	the duration of operations, • Modelling of drawdown impact area	o Cost involved in monitoring surveys until the draw down cone is restored to original levels o Cost of hydrological modelling and reporting
Priority 1 flora species, *Fuirena nudiflora*	100% (recorded)	• Targeted survey to ensure this species had a wider regional distribution • Hydrological studies if the project is impacting the flow of water downstream to a degree that could cause flooding upstream where this species is located	• Buffer or 'no impact' zones placed around known locations of this species • Monitoring to ensure this species is not being affected • Licence to take required	• Financial o Cost involved in additional surveys and approvals o Cost of licence and licence preparation • Delay o If left to the late stages of the project, the increased survey effort could cause delays
Cyperus sp. (AIC 1501-0149) – Potential new species	100% (recorded)	• Targeted survey to ensure this species had a wider regional distribution • Hydrological studies if the project is impacting the flow of water downstream to a degree that could cause flooding upstream where this species is located	• Buffer or 'no impact' zones placed around known locations of this species • Monitoring to ensure this species is not being affected • Hydrological study	• Financial o Cost involved in additional surveys and approvals o Cost of licence and licence preparation • Delay o If left to the late stages of the project, the increased survey effort could cause delays
Priority 3 flora species	100% (recorded)	• Targeted survey to confirmation that these species are present outside of the study area	• Licence to take required	• Financial o Cost involved in additional surveys and approvals • Delay

Environmental Factor	Likelihood of Occurrence	Likely action required	Predicted conditions on the project (as set by the EPA)	Potential effect on project
				o If left to the late stages of the project, the increased survey effort could cause delays
Potential Priority 3 Priority Ecological Community	Potential PEC community recorded, PEC status not confirmed	• Hydrological studies to determine if the project will have an impact on the potential PEC • Determination of whether or not this is in fact a PEC by submission to DPaW	• Buffer or 'no impact' zones placed around the potential PEC • Hydrological • Monitoring to ensure the PEC is not being affected	• Financial o Cost involved in additional surveys and approvals • Delay o If left to the late stages of the project, the increased survey effort could cause delays
Flora taxa representing range extensions	100% (recorded)	• Desktop assessment of regional distribution (in this report) • Targeted regional survey if any taxa are identified to be poorly repesented	• Licence to take required • Monitoring of high importance range extensions	• Financial o Cost involved in additional surveys and approvals o Cost of licence and licence preparation • Delay o If left to the late stages of the project, the increased survey effort could cause delays

4 CONCLUSION AND RECOMMENDATIONS

4.1 FLORA AND VEGETATION

Two-hundred and eighty-four species were recorded with a high presence of families: Poaceae, Fabaceae, Cyperaceae, Amaranthaceae and Euphorbiaceae. One species collected from two sites to the north of the study area, *Cyperus* sp. (AIC 1501-0149), is potentially a new taxon. If this taxon is confirmed to be a new species, buffers should be established around these locations and targeted surveys may be appropriate to confirm the extent of this species' range.

Six Priority taxa were recorded in the study area, consisting of one Priority 1 taxaon; *Fuirena nudiflora*, and five Priority 3 taxa; *Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946), *Fuirena incrassata*, *Pterocaulon, intermedium*, *Tephrosia valleculata* and *Triodia caelestialis*. The Priority 1 taxon, *Fuirena nudiflora* was recorded from a single location within the study area. It also currently represents the only recorded location on the Dampier Peninsula, 600 km from the next nearest location.

Seven introduced species were recorded within the study area; *Cynodon dactylon*, *Digitaria ciliaris*, *Echinochloa colona*, *Sida acuta*, *Stylosanthes hamata*, *Stylosanthes scabra* and *Tridax procumbens*. Of these species, *Sida acuta* is rated as a declared pest which, according to the WAOL falls under the management category and limits the keeping and distribution of the species.

Vegetation unit *EtMvSi* closely resembles a known PEC 40 km to the north east of the study area and should be investigated further. The impacts on this vegetation unit, if found to be a PEC, from an altered water table may appropriately be assessed via a separate hydrological assessment.

4.2 VERTEBRATE FAUNA

There is expected to be minimal impact on the conservation significant vertebrate fauna species recorded during the first phase of the survey. Species richness appears to be high in the study area, and it is possible that more conservation significant fauna species may be recorded during the second phase.

One of the phase one gecko records may represent a range extension, although this could be a product of a delay in the NatureMap database being updated. There is also the potential that the Greater Bilby utilises the study area, as suitable habitat may be present, although the likelihood of this has not yet been fully assessed. This assessment is dependent on habitat mapping, which will be finalised after the second phase. If it is deemed likely to occur in the study area, an additional targeted survey focussing on this species may be appropriate.

4.3 INVERTEBRATE FAUNA

The two confirmed or potential SRE snail species identified to occur within the study area will potentially only be minimally affected by development works, as additional regional records indicate that these species may be widely distributed across the Dampier Peninsula. There is currently insufficient information to indicate the level of impact on the potential SRE scorpion and isopod morphospecies identified. Comparison with prior surveys suggests there may be numerous SRE species occurring in the study area. However, without having received taxonomic identification reports on four of the taxonomic groups from which samples were collected, the potential impact on these species cannot yet be assessed. In order to evaluate the potential impact of future development on the confirmed or potential SRE species identified, an additional survey assessing the presence of these species outside the study area, to obtain regional context, will likely be required.

4.4 RECOMMENDATIONS

Recommendations include:

- Potential impacts on vegetation unit *EtMvSi* should be minimised or avoided entirely. If the Thunderbird project is developed, impacts on this unit could be assessed / predicted through a separate hydrological assessment; and
- If *Cyperus* sp. (AIC 1501-0149) is confirmed to be a new species, a targeted search should be carried out to accurately map the local populaitons and buffers should be established around these to avoid impacts where possible.
- Habitat analysis will not be finalised until after the second phase of the Level 2 fauna survey. If this analysis indicates likelihood for the Greater Bilby to inhabit the study area, an additional targeted survey focussing on this species may be appropriate.
- This report is updated and revised on receipt of a full report in September 2013.

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APPENDIX A FLORA QUADRAT LOCATIONS

Quadrat	Botanist	Date	Quadrat Size	Phase	Easting	Northing
9	AIC	9/04/2013	50 x 50 m	2	494789	8075984
11	AIC	12/04/2013	50 x 50 m	2	498514	8075814
12	CWP	9/04/2013	50 x 50 m	2	499653	8075125
13	CWP	7/04/2013	50 x 50 m	2	495361	8074331
14	CWP	12/04/2013	50 x 50 m	2	498468	8074919
15	SAJ	10/04/2013	50 x 50 m	2	494196	8074533
16	SAJ	10/04/2013	50 x 50 m	2	493457	8073934
17	CWP	8/04/2013	50 x 50 m	2	497025	8073662
18S	SAJ	9/04/2013	50 x 50 m	2	500378	8073356
18C	CWP	14/04/2013	25 x 100 m	2	496949	8076082
19S	SAJ	8/04/2013	50 x 50 m	2	497817	8073207
19C	CWP	10/04/2013	50 x 50 m	2	492866	8075609
20	AIC	7/04/2013	50 x 50 m	2	496513	8073167
21	SAJ	9/04/2013	50 x 50 m	2	501241	8073130
22	SAJ	10/04/2013	50 x 50 m	2	495127	8072932
23A	AIC	7/04/2013	50 x 50 m	2	491519	8072514
23C	CWP	9/04/2013	50 x 50 m	2	499646	8074187
24	AIC	8/04/2013	50 x 50 m	2	500611	8072377
26	SAJ	11/04/2013	50 x 50 m	2	498247	8072138
29	SAJ	7/04/2013	50 x 50 m	2	491802	8072821
31	CWP	7/04/2013	50 x 50 m	2	493181	8072364
32	AIC	14/04/2013	50 x 50 m	2	501560	8071692
33	SAJ	11/04/2013	50 x 50 m	2	497338	8068954
35	SAJ	14/04/2013	50 x 50 m	2	502849	8070745
36C	CWP	8/04/2013	50 x 50 m	2	496114	8070344
37	SAJ	11/04/2013	50 x 50 m	2	497635	8069657
38	AIC	7/04/2013	50 x 50 m	2	495293	8070278
40	AIC	12/04/2013	50 x 50 m	2	492804	8069895
41S	SAJ	8/04/2013	50 x 50 m	2	496015	8069515
41C	CWP	12/04/2013	50 x 50 m	2	492955	8069182
42	AIC	7/04/2013	50 x 50 m	2	496875	8068718
45	CWP	11/04/2013	50 x 50 m	2	498914	8068318
46	CWP	13/04/2013	50 x 50 m	2	505109	8068209
48	CWP	13/04/2013	50 x 50 m	2	502909	8067801
49	CWP	13/04/2013	50 x 50 m	2	501442	8067568
50	AIC	11/04/2013	50 x 50 m	2	498784	8067453
51	CWP	9/04/2013	50 x 50 m	2	504491	8067353
52	CWP	8/04/2013	50 x 50 m	2	496522	8067652
56	SAJ	8/04/2013	50 x 50 m	2	495748	8066057
58	CWP	10/04/2013	50 x 50 m	2	492382	8076000
61	AIC	7/04/2013	50 x 50 m	2	495331	8073876
62	AIC	7/04/2013	50 x 50 m	2	493471	8072099
66	CWP	10/04/2013	50 x 50 m	2	495669	8072175
69	AIC	8/04/2013	50 x 50 m	2	500103	8071806
70	AIC	10/04/2013	50 x 50 m	2	495707	8072341
76	SAJ	12/04/2013	50 x 50 m	2	497215	8075413
80	CWP	11/04/2013	50 x 50 m	2	498699	8067837
81	CWP	11/04/2013	50 x 50 m	2	499300	8071680
82	SAJ	12/04/2013	50 x 50 m	2	492755	8068650
22N	AIC	9/04/2013	50 x 50 m	2	493844	8076206
36S	SAJ	9/04/2013	50 x 50 m	2	505809	8065995
37N	AIC	8/04/2013	50 x 50 m	2	504944	8066433
53N	AIC	11/04/2013	50 x 50 m	2	498219	8067535
82A	AIC	11/04/2013	50 x 50 m	2	498961	8071463
1	RY	21/03/2012	50 x 50 m	1	499677	8067413
3	RY	23/06/2012	50 x 50 m	1	502523	8067699
4	RY	22/06/2012	50 x 50 m	1	493955	8073234
5	RY	25/06/2012	50 x 50 m	1	499829	8071874
6	RY	11/04/2013	50 x 50 m	1	500545	8068053

Quadrat	Botanist	Date	Quadrat Size	Phase	Easting	Northing
9	RY	24/06/2012	25 x 100 m	1	496085	8075978
10	RY	21/03/2012	50 x 50 m	1	495950	8075987
11	RY	21/06/2012	50 x 50 m	1	493242	8074375
12	RY	22/06/2012	50 x 50 m	1	494332	8074125
13	RY	25/06/2012	50 x 50 m	1	495997	8071422
15	RY	24/06/2012	50 x 50 m	1	497314	8068357
16	RY	25/06/2012	50 x 50 m	1	497776	8071234
17	RY	15/06/2012	50 x 50 m	1	494080	8073582
18	RY	21/03/2012	10 x 250 m	1	497409	8074676
19	RY	25/06/2012	50 x 50 m	1	500192	8073619
20	RY	21/06/2012	50 x 50 m	1	500022	8067396
20B	RY	21/03/2012	50 x 50 m	1	491807	8074300

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APPENDIX B FLORA SPECIES LIST RECORDED IN THE STUDY AREA

Family	Taxon	Status	Phase 1	Phase 2
Acanthaceae	*Dicliptera armata*		X	X
Aizoaceae	*Trianthema oxycalyptra* var. *oxycalyptra*			X
Aizoaceae	*Trianthema pilosa*		X	X
Amaranthaceae	*Achyranthes aspera*			X
Amaranthaceae	*Amaranthus undulatus*			X
Amaranthaceae	*Gomphrena canescens* subsp. *canescens*		X	X
Amaranthaceae	*Gomphrena flaccida*		X	X
Amaranthaceae	*Gomphrena lanata*			X
Amaranthaceae	*Gomphrena leptoclada* subsp. *leptoclada*			X
Amaranthaceae	*Ptilotus corymbosus*		X	X
Amaranthaceae	*Ptilotus fusiformis*			X
Amaranthaceae	*Ptilotus lanatus*			X
Amaranthaceae	*Ptilotus polystachyus*			X
Amaranthaceae	*Ptilotus sp*			
Amaryllidaceae	*Crinum* sp.			X
Apocynaceae	*Apocynaceae* sp.			X
Apocynaceae	*Carissa lanceolata*		X	X
Apocynaceae	*Ichnocarpus frutescens*			X
Apocynaceae	*Marsdenia angustata*			X
Apocynaceae	*Marsdenia viridiflora* subsp. *tropica*		X	X
Apocynaceae	*Wrightia saligna*		X	X
Araliaceae	*Trachymene microcephala*		X	X
Asparagaceae	*Thysanotus chinensis*		X	X
Asteraceae	*Asteraceae* sp.		X	
Asteraceae	*Blumea integrifolia*		X	
Asteraceae	*Blumea tenella*		X	
Asteraceae	*Cyanthillium cinereum*			X
Asteraceae	*Pterocaulon intermedium*	P3	X	X
Asteraceae	*Pterocaulon paradoxum*			X
Asteraceae	*Pterocaulon serrulatum* var. *velutinum*		X	X
Asteraceae	*Pterocaulon sphacelatum*		X	X
Asteraceae	*Pterocaulon tricholobum*			X
Asteraceae	*Tridax procumbens*	Introduced		X
Bignoniaceae	*Dolichandrone heterophylla*		X	X
Boraginaceae	*Ehretia saligna* var. *saligna*		X	X
Boraginaceae	*Heliotropium cunninghamii*		X	X
Boraginaceae	*Heliotropium dichotomum*		X	
Boraginaceae	*Heliotropium foliatum*			X
Boraginaceae	*Heliotropium glabellum*			X
Boraginaceae	*Heliotropium leptaleum*			X
Boraginaceae	*Trichodesma zeylanicum*			X
Boraginaceae	*Trichodesma zeylanicum* var. *zeylanicum*		X	X
Byblidaceae	*Byblis filifolia*		X	X
Byblidaceae	*Byblis rorida*		X	
Caryophyllaceae	*Polycarpaea corymbosa*		X	X
Caryophyllaceae	*Polycarpaea holtzei*		X	
Caryophyllaceae	*Polycarpaea longiflora*		X	X
Celastraceae	*Stackhousia intermedia*		X	X
Cleomaceae	*Cleome tetrandra* var. *tetrandra*			X
Cleomaceae	*Cleome viscosa*			X
Combretaceae	*Terminalia canescens*		X	X
Combretaceae	*Terminalia ferdinandiana*			X
Combretaceae	*Terminalia* sp.		X	X
Commelinaceae	*Murdannia graminea*			X
Convolvulaceae	*Bonamia linearis*		X	X
Convolvulaceae	*Evolvulus alsinoides*		X	X
Convolvulaceae	*Evolvulus alsinoides* var. *decumbens*		X	X
Convolvulaceae	*Ipomoea coptica*			X
Convolvulaceae	*Jacquemontia paniculata*			X

Family	Taxon	Status	Phase 1	Phase 2
Convolvulaceae	*Polymeria ambigua*		X	X
Convolvulaceae	*Xenostegia tridentata*		X	X
Cyperaceae	*Abildgaardia schoenoides*			X
Cyperaceae	*Bulbostylis barbata*		X	X
Cyperaceae	*Crosslandia setifolia*			X
Cyperaceae	*Cyperaceae* sp 2 ENE		X	
Cyperaceae	*Cyperus ? conicus*		X	
Cyperaceae	*Cyperus conicus*			X
Cyperaceae	*Cyperus latzii*			X
Cyperaceae	*Cyperus microcephalus*		X	
Cyperaceae	*Cyperus microcephalus* subsp. *microcephalus*			X
Cyperaceae	*Cyperus nervulosus*			X
Cyperaceae	*Cyperus pulchellus*			X
Cyperaceae	*Cyperus* sp. (AIC 1501-0149)			X
Cyperaceae	*Cyperus squarrosus*			X
Cyperaceae	*Cyperus tenuispica*			X
Cyperaceae	*Eleocharis geniculata*		X	
Cyperaceae	*Fimbristylis ammobia*			X
Cyperaceae	*Fimbristylis caespitosa*			X
Cyperaceae	*Fimbristylis dichotoma*		X	
Cyperaceae	*Fimbristylis littoralis*			X
Cyperaceae	*Fimbristylis macrantha*			X
Cyperaceae	*Fimbristylis microcarya*			X
Cyperaceae	*Fimbristylis neilsonii*			X
Cyperaceae	*Fimbristylis nuda*			X
Cyperaceae	*Fimbristylis punctata*			X
Cyperaceae	*Fimbristylis rara*			X
Cyperaceae	*Fimbristylis simulans*		X	X
Cyperaceae	*Fimbristylis tetragona*			X
Cyperaceae	*Fimbristylis trigastrocarya*			X
Cyperaceae	*Fuirena ciliaris*		X	X
Cyperaceae	*Fuirena incrassata*	P3		X
Cyperaceae	*Fuirena nudiflora*	P1		X
Cyperaceae	*Lipocarpha microcephala*		X	X
Cyperaceae	*Scleria brownii*		X	X
Droseraceae	*Drosera broomensis*			X
Droseraceae	*Drosera derbyensis*		X	X
Droseraceae	*Drosera indica*		X	X
Euphorbiaceae	*Euphorbia ?australis*		X	
Euphorbiaceae	*Euphorbia hassallii*			X
Euphorbiaceae	*Euphorbia mitchelliana*			X
Euphorbiaceae	*Euphorbia myrtoides*		X	
Euphorbiaceae	*Euphorbia psilosperma*			X
Euphorbiaceae	*Euphorbia schultzii*			X
Euphorbiaceae	*Euphorbia schultzii* var. *comans*			X
Euphorbiaceae	*Euphorbia* sp.		X	
Euphorbiaceae	*Euphorbia trigonosperma*			X
Euphorbiaceae	*Euphorbia vicina*			X
Euphorbiaceae	*Microstachys chamelea*		X	X
Fabaceae	*Acacia colei* var. *colei*		X	X
Fabaceae	*Acacia drepanocarpa* subsp. *latifolia*		X	
Fabaceae	*Acacia eriopoda*			X
Fabaceae	*Acacia hippuroides*		X	X
Fabaceae	*Acacia monticola*		X	X
Fabaceae	*Acacia platycarpa*		X	X
Fabaceae	*Acacia* sp.			X
Fabaceae	*Acacia stigmatophylla*			X
Fabaceae	*Acacia stipuligera*		X	
Fabaceae	*Acacia tumida* var. *tumida*		X	X

Family	Taxon	Status	Phase 1	Phase 2
Fabaceae	*Alysicarpus muelleri*			X
Fabaceae	*Aphyllodium biarticulatum*			X
Fabaceae	*Bauhinia cunninghamii*		X	X
Fabaceae	*Cajanus cinereus*			X
Fabaceae	*Cajanus marmoratus*			X
Fabaceae	*Chamaecrista mimosoides*		X	X
Fabaceae	*Chamaecrista symonii*		X	X
Fabaceae	*Crotalaria brevis*		X	X
Fabaceae	*Crotalaria crispata*		X	X
Fabaceae	*Crotalaria medicaginea* var. *neglecta*		X	X
Fabaceae	*Desmodium filiforme*		X	X
Fabaceae	*Erythrophleum chlorostachys*		X	X
Fabaceae	*Galactia tenuiflora*		X	X
Fabaceae	*Glycine tomentella*		X	X
Fabaceae	*Indigofera colutea*			X
Fabaceae	*Indigofera haplophylla*		X	X
Fabaceae	*Indigofera hirsuta*			X
Fabaceae	*Indigofera linifolia*		X	X
Fabaceae	*Senna costata*			X
Fabaceae	*Senna oligoclada*		X	X
Fabaceae	*Stylosanthes hamata*	Introduced	X	X
Fabaceae	*Stylosanthes scabra*	Introduced	X	X
Fabaceae	*Tephrosia brachyodon* var. *longifolia*			X
Fabaceae	*Tephrosia crocea*			X
Fabaceae	*Tephrosia forrestiana*		X	
Fabaceae	*Tephrosia leptoclada*		X	X
Fabaceae	*Tephrosia remotiflora*		X	X
Fabaceae	*Tephrosia simplicifolia*		X	X
Fabaceae	*Tephrosia* sp. *D Kimberley Flora (R.D. Royce 1848)*			X
Fabaceae	*Tephrosia valleculata*	P3		X
Fabaceae	*Uraria lagopodioides*			X
Fabaceae	*Vigna lanceolata*			X
Fabaceae	*Vigna lanceolata* var. *filiformis*		X	X
Fabaceae	*Zornia chaetophora*			X
Fabaceae	*Zornia prostrata*		X	
Fabaceae	*Zornia prostrata* var. *prostrata*		X	X
Goodeniaceae	*Goodenia armitiana*			X
Goodeniaceae	*Goodenia scaevolina*		X	X
Goodeniaceae	*Goodenia sepalosa*			X
Goodeniaceae	*Goodenia sepalosa* var. *sepalosa*		X	X
Goodeniaceae	*Velleia panduriformis*		X	X
Gyrostemonaceae	*Codonocarpus cotinifolius*		X	
Hernandiaceae	*Gyrocarpus americanus* subsp. *pachyphyllus*			X
Lamiaceae	*Clerodendrum floribundum* var. *ovatum*			X
Lamiaceae	*Premna acuminata*		X	X
Lauraceae	*Cassytha capillaris*			X
Lentibulariaceae	*Utricularia kimberleyensis*			X
Loganiaceae	*Mitrasacme connata*			X
Loganiaceae	*Mitrasacme exserta*			X
Loganiaceae	*Mitrasacme hispida*			X
Loganiaceae	*Mitrasacme lutea*			X
Loganiaceae	*Mitrasacme* sp.			X
Lythraceae	*Rotala occultiflora*		X	
Malvaceae	*Abutilon hannii*			X
Malvaceae	*Abutilon otocarpum*			X
Malvaceae	*Brachychiton diversifolius*		X	
Malvaceae	*Brachychiton diversifolius* subsp. *diversifolius*		X	X
Malvaceae	*Corchorus aestuans*			X
Malvaceae	*Corchorus sidoides* subsp. *vermicularis*		X	X

Family	Taxon	Status	Phase 1	Phase 2
Malvaceae	*Corchorus tridens*			X
Malvaceae	*Gossypium australe*		X	X
Malvaceae	*Hibiscus geranioides*		X	X
Malvaceae	*Hibiscus* sp.			X
Malvaceae	*Melhania oblongifolia*		X	
Malvaceae	*Melochia corchorifolia*		X	X
Malvaceae	*Sida acuta*	Introduced		X
Malvaceae	*Sida hackettiana*		X	X
Malvaceae	*Sida rohlenae* subsp. *occidentalis*			X
Malvaceae	*Sida spinosa*		X	
Malvaceae	*Triumfetta albida*			X
Malvaceae	*Triumfetta breviaculeata*		X	
Malvaceae	*Triumfetta plumigera*		X	X
Malvaceae	*Triumfetta* sp.		X	
Malvaceae	*Waltheria indica*		X	X
Menispermaceae	*Tinospora smilacina*		X	X
Moraceae	*Ficus aculeata* var. *indecora*		X	
Moraceae	*Ficus platypoda*		X	X
Myrtaceae	*Calytrix exstipulata*		X	X
Myrtaceae	*Corymbia dendromerinx*		X	X
Myrtaceae	*Corymbia flavescens*			X
Myrtaceae	*Corymbia greeniana*		X	X
Myrtaceae	*Corymbia zygophylla*		X	X
Myrtaceae	*Eucalyptus tectifica*		X	X
Myrtaceae	*Lophostemon grandiflorus*		X	
Myrtaceae	*Lophostemon grandiflorus* subsp. *riparius*			X
Myrtaceae	*Melaleuca alsophila*			X
Myrtaceae	*Melaleuca nervosa*		X	X
Myrtaceae	*Melaleuca viridiflora*		X	X
Nyctaginaceae	*Boerhavia coccinea*			X
Nyctaginaceae	*Boerhavia gardneri*			X
Oleaceae	*Jasminum molle*		X	X
Onagraceae	*Ludwigia perennis*		X	X
Opiliaceae	*Opilia amentacea*			X
Orobanchaceae	*Buchnera asperata*		X	X
Orobanchaceae	*Buchnera linearis*		X	
Orobanchaceae	*Striga curviflora*			X
Phrymaceae	*Mimulus uvedaliae* var. *lutea*		X	X
Phyllanthaceae	*Breynia cernua*			X
Phyllanthaceae	*Bridelia tomentosa*		X	
Phyllanthaceae	*Flueggea virosa* subsp. *melanthesoides*		X	X
Phyllanthaceae	*Phyllanthus exilis*			X
Phyllanthaceae	*Phyllanthus maderaspatensis*			X
Phyllanthaceae	*Phyllanthus virgatus*		X	X
Phyllanthaceae	*Sauropus trachyspermus*			X
Plantaginaceae	*Bacopa floribunda*		X	
Plantaginaceae	*Stemodia lathraia*		X	X
Plantaginaceae	*Stemodia lythrifolia*		X	X
Poaceae	*Aristida holathera*			X
Poaceae	*Aristida holathera* var. *holathera*		X	X
Poaceae	*Aristida holathera* var. *latifolia*		X	X
Poaceae	*Aristida hygrometrica*		X	X
Poaceae	*Aristida inaequiglumis*		X	X
Poaceae	*Cenchrus elymoides*		X	X
Poaceae	*Cenchrus elymoides* var. *elymoides*			X
Poaceae	*Chloris lobata*			X
Poaceae	*Chrysopogon pallidus*			X
Poaceae	*Chrysopogon* sp.		X	
Poaceae	*Cymbopogon bombycinus*		X	

Family	Taxon	Status	Phase 1	Phase 2
Poaceae	*Cymbopogon procerus*		X	X
Poaceae	*Cynodon dactylon*	Introduced	X	
Poaceae	*Dactyloctenium radulans*			X
Poaceae	*Digitaria bicornis*		X	
Poaceae	*Digitaria brownii*			X
Poaceae	*Digitaria ciliaris*	Introduced		X
Poaceae	*Echinochloa colona*	Introduced		X
Poaceae	*Ectrosia schultzii*		X	
Poaceae	*Ectrosia schultzii* var. *schultzii*			X
Poaceae	*Eragrostis ?eriopoda*		X	
Poaceae	*Eragrostis cumingii*		X	X
Poaceae	*Eragrostis eriopoda*			X
Poaceae	*Eragrostis exigua*			X
Poaceae	*Eragrostis* sp.			
Poaceae	*Eriachne ciliata*		X	X
Poaceae	*Eriachne melicacea*		X	X
Poaceae	*Eriachne obtusa*		X	X
Poaceae	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	P3	X	X
Poaceae	*Eriachne sulcata*		X	X
Poaceae	*Heteropogon contortus*		X	X
Poaceae	*Mnesithea formosa*			X
Poaceae	*Paspalidium rarum*		X	X
Poaceae	*Perotis rara*			X
Poaceae	*Sacciolepis indica*		X	
Poaceae	*Schizachyrium fragile*			X
Poaceae	*Sehima nervosum*			X
Poaceae	*Setaria apiculata*		X	X
Poaceae	*Setaria surgens*			X
Poaceae	*Sorghum plumosum*		X	X
Poaceae	*Sorghum timorense*			X
Poaceae	*Sporobolus australasicus*		X	
Poaceae	*Thaumastochloa major*			X
Poaceae	*Thaumastochloa pubescens*			X
Poaceae	*Triodia caelestialis*	P3	X	X
Poaceae	*Triodia intermedia*		X	
Poaceae	*Triodia schinzii*			X
Poaceae	*Triodia* sp.			X
Poaceae	*Urochloa praetervisa*			X
Poaceae	*Xerochloa laniflora*			X
Poaceae	*Yakirra australiensis*			X
Poaceae	*Yakirra australiensis* var. *australiensis*			X
Poaceae	*Yakirra australiensis* var. *intermedia*		X	X
Poaceae	*Yakirra pauciflora*			X
Poaceae	*Yakirra pauciflora*			X
Polygalaceae	*Polygala galeocephala*			X
Polygalaceae	*Polygala tepperi*		X	X
Portulacaceae	*Calandrinia strophiolata*		X	X
Portulacaceae	*Portulaca aff. filifolia*			X
Portulacaceae	*Portulaca bicolor*			X
Proteaceae	*Grevillea pyramidalis*			X
Proteaceae	*Grevillea pyramidalis* subsp. *pyramidalis*		X	X
Proteaceae	*Grevillea refracta* subsp. *refracta*		X	X
Proteaceae	*Grevillea striata*			X
Proteaceae	*Hakea arborescens*		X	X
Proteaceae	*Hakea macrocarpa*			X
Proteaceae	*Persoonia falcata*		X	X
Proteaceae	*Synaphea* sp.			X
Pteridaceae	*Cheilanthes ?nudiuscula*			X
Pteridaceae	*Cheilanthes brownii*			X

Family	Taxon	Status	Phase 1	Phase 2
Rhamnaceae	*Ventilago viminalis*		X	X
Rubiaceae	*Dentella misera*			X
Rubiaceae	*Gardenia pyriformis* subsp. *keartlandii*		X	X
Rubiaceae	*Oldenlandia galioides*		X	X
Rubiaceae	*Oldenlandia mitrasacmoides*			X
Rubiaceae	*Oldenlandia mitrasacmoides* subsp. *mitrasacmoides*		X	
Rubiaceae	*Spermacoce occidentalis*		X	X
Rubiaceae	*Synaptantha scleranthoides*			X
Santalaceae	*Santalum lanceolatum*		X	X
Sapindaceae	*Atalaya hemiglauca*		X	X
Sapindaceae	*Atalaya variifolia*		X	X
Sapindaceae	*Dodonaea hispidula* var. *arida*		X	X
Solanaceae	*Solanum cunninghamii*		X	X
Thymelaeaceae	*Thecanthes punicea*			X
Violaceae	*Hybanthus aurantiacus*		X	X
Violaceae	*Hybanthus enneaspermus* subsp. *enneaspermus*			X
Xyridaceae	*Xyris complanata*		X	X
Zygophyllaceae	*Tribulopis angustifolia*			X
Zygophyllaceae	*Tribulopis pentandra*			X

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APPENDIX C LOCATIONS OF PRIORITY FLORA RECORDED IN THE STUDY AREA

Table B.1 – Locations of Priority Flora

Priority Status	Taxon	Easting	Northing	Phase of survey
P1	*Fuirena nudiflora*	498513	8075814	2
P3	*Eriachne* sp. *Dampier Peninsula (K.F. Kennealy 5946)*	500362	8071952	2
P3	*Eriachne* sp. *Dampier Peninsula (K.F. Kennealy 5946)*	499829	8071874	1
P3	*Eriachne* sp. *Dampier Peninsula (K.F. Kennealy 5946)*	497314	8068337	1
P3	*Eriachne* sp. *Dampier Peninsula (K.F. Kennealy 5946)*	497409	8074626	1
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	495360	8074330	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	498468	8074919	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	501241	8073130	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	492804	8069895	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	498783	8067452	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	499300	8071679	2
P3	*Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)	496600	8068656	2
P3	*Fuirena incrassata*	498513	8075814	2
P3	*Pterocaulon intermedium*	496948	8076082	2
P3	*Pterocaulon intermedium*	496014	8069515	2
P3	*Pterocaulon intermedium*	496874	8068718	2
P3	*Pterocaulon intermedium*	501746	8071736	2
P3	*Pterocaulon intermedium*	499645	8074211	2
P3	*Pterocaulon intermedium*	499736	8074001	2
P3	*Pterocaulon intermedium*	499143	8068184	2
P3	*Pterocaulon intermedium*	504227	8070776	2
P3	*Tephrosia valleculata*	501559	8071691	2
P3	*Tephrosia valleculata*	500103	8071806	2
P3	*Tephrosia valleculata*	499300	8071679	2
P3	*Triodia caelestialis*	494788	8075983	2
P3	*Triodia caelestialis*	499653	8075125	2
P3	*Triodia caelestialis*	495360	8074330	2
P3	*Triodia caelestialis*	498468	8074919	2
P3	*Triodia caelestialis*	497024	8073661	2
P3	*Triodia caelestialis*	500377	8073356	2
P3	*Triodia caelestialis*	500377	8073356	2
P3	*Triodia caelestialis*	492865	8075608	2
P3	*Triodia caelestialis*	501241	8073130	2
P3	*Triodia caelestialis*	501241	8073130	2
P3	*Triodia caelestialis*	493844	8076206	2
P3	*Triodia caelestialis*	491518	8072513	2
P3	*Triodia caelestialis*	499645	8074186	2
P3	*Triodia caelestialis*	500610	8072377	2
P3	*Triodia caelestialis*	491802	8072820	2
P3	*Triodia caelestialis*	493180	8072364	2
P3	*Triodia caelestialis*	501559	8071691	2
P3	*Triodia caelestialis*	502849	8070745	2
P3	*Triodia caelestialis*	502849	8070745	2
P3	*Triodia caelestialis*	495292	8070277	2
P3	*Triodia caelestialis*	492804	8069895	2
P3	*Triodia caelestialis*	492954	8069182	2
P3	*Triodia caelestialis*	496014	8069515	2
P3	*Triodia caelestialis*	502909	8067801	2
P3	*Triodia caelestialis*	501441	8067567	2
P3	*Triodia caelestialis*	498783	8067452	2
P3	*Triodia caelestialis*	496522	8067652	2
P3	*Triodia caelestialis*	495748	8066057	2
P3	*Triodia caelestialis*	492382	8076000	2
P3	*Triodia caelestialis*	493471	8072099	2
P3	*Triodia caelestialis*	500103	8071806	2
P3	*Triodia caelestialis*	495707	8072341	2

Priority Status	Taxon	Easting	Northing	Phase of survey
P3	*Triodia caelestialis*	497215	8075412	2
P3	*Triodia caelestialis*	497215	8075412	2
P3	*Triodia caelestialis*	497215	8075412	2
P3	*Triodia caelestialis*	499300	8071679	2
P3	*Triodia caelestialis*	496547	8073307	2
P3	*Triodia caelestialis*	494237	8076007	2
P3	*Triodia caelestialis*	502361	8067614	2
P3	*Triodia caelestialis*	501977	8064692	2
P3	*Triodia caelestialis*	502224	8063975	2
P3	*Triodia caelestialis*	496166	8073465	2
P3	*Triodia caelestialis*	495405	8074098	2
P3	*Triodia caelestialis*	499749	8073601	2
P3	*Triodia caelestialis*	492865	8075563	2
P3	*Triodia caelestialis*	498021	8068475	2
P3	*Triodia caelestialis*	498914	8068318	2
P3	*Triodia caelestialis*	497584	8075440	2
P3	*Triodia caelestialis*	503967	8070730	2
P3	*Triodia caelestialis*	503519	8070695	2
P3	*Triodia caelestialis*	497574	8075714	2
P3	*Triodia caelestialis*	497004	8075953	2
P3	*Triodia caelestialis*	497183	8075890	2
P3	*Triodia caelestialis*	493341	8074570	2
P3	*Triodia caelestialis*	491539	8072602	2
P3	*Triodia caelestialis*	497985	8068005	2
P3	*Triodia caelestialis*	497865	8075466	2
P3	*Triodia caelestialis*	498001	8075549	2
P3	*Triodia caelestialis*	503097	8067697	2
P3	*Triodia caelestialis*	501772	8067538	2
P3	*Triodia caelestialis*	501241	8067496	2
P3	*Triodia caelestialis*	501960	8064274	2
P3	*Triodia caelestialis*	502916	8064085	2
P3	*Triodia caelestialis*	502636	8072555	2
P3	*Triodia caelestialis*	502523	8067699	1
P3	*Triodia caelestialis*	493955	8073234	1
P3	*Triodia caelestialis*	500545	8068053	1
P3	*Triodia caelestialis*	496085	8075978	1
P3	*Triodia caelestialis*	495950	8075987	1
P3	*Triodia caelestialis*	493242	8074375	1
P3	*Triodia caelestialis*	494332	8074125	1
P3	*Triodia caelestialis*	495997	8071422	1
P3	*Triodia caelestialis*	497314	8068357	1
P3	*Triodia caelestialis*	497776	8071234	1
P3	*Triodia caelestialis*	494080	8073582	1
P3	*Triodia caelestialis*	497409	8074676	1
P3	*Triodia caelestialis*	500192	8073619	1
P3	*Triodia caelestialis*	491807	8074300	1
P3	*Triodia caelestialis*	500022	8067396	1
P3	*Pterocaulon intermedium*	495997	8071402	1

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APPENDIX D CONSERVATION CODES FOR THREATENED AND PRIORITY FLORA AND FAUNA SPECIES AND ECOLOGICAL COMMUNITIES

Table D.1 – Definition of codes for Threatened and Priority Flora (DPaW)

Code	Definition
T	**Threatened Flora – (Declared Rare Flora – Extant)** Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*).
X	**Presumed Extinct Flora (Declared Rare Flora - Extinct)** Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such Schedule 2 under the *Wildlife Conservation Act 1950*).
P1	**Priority One – Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four – Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	**Priority Five - Conservation Dependent species** Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Table D.2 – Definition of codes for Commonwealth Listed Threatened Flora

Code	Definition
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, the species is the focus of a specific conservation programme, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Table D.3 – Definition of codes for Threatened Ecological Communities

Code	Definition
PD: Presumed Totally Destroyed	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant
CR: Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
EN: Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future.
VU: Vulnerable	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

Table D.4 – Definition of codes for Priority Ecological Communities

Code	Definition
P1: Priority One	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or Pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: Priority Three	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four	Ecological communities that are adequately known, Rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years. P5: Priority Five Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.
P5: Priority Five	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table D.5 – Definition of codes for Threatened Fauna (WC Act)

Code	Definition
T (Schedule 1)	Fauna that is rare or likely to become extinct Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction or otherwise in need of special protection, and have been gazetted as such. Further categorised as: o CR Critically Endangered – considered to be facing an extremely high risk of extinction in the wild o EN Endangered – considered to be facing a very high risk of extinction in the wild o VU Vulnerable – considered to be facing a high risk of extinction in the wild.
X (Schedule 2)	Presumed Extinct Fauna Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
IA (Schedule 3)	Birds protected under an international agreement. Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction are declared to be fauna that is in need of special protection.
S (Schedule 4)	Other specially protected fauna Fauna that is in need of special protection, otherwise than for the reasons mentioned [in Schedule 1 – 3].]

Table D.6 – Definition of codes for Priority Fauna (WC Act)

Code	Definition
P1	Priority One Taxa with few, poorly known populations on threatened lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
P2	Priority Two Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
P3	Priority Three Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
P4	Priority Four Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
P5	Priority Five Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Table D.7 – Definition of codes for Threatened Fauna (EPBC Act)

Code	Definition
Ex	Extinct Taxa not definitely located in the wild during the past 50 years
ExW	Extinct in the Wild Taxa known to survive only in captivity
CE	Critically Endangered Taxa facing an extremely high risk of extinction in the wild in the immediate future
E	Endangered Taxa facing a very high risk of extinction in the wild in the near future
V	Vulnerable Taxa facing a high risk of extinction in the wild in the medium-term
NT	Near Threatened Taxa that risk becoming Vulnerable in the wild
CD	Conservation Dependent Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
DD	Data Deficient (Insufficiently Known) Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
M	Migratory Taxa listed under one or more of the following International Conventions: • Japan-Australia Migratory Bird Agreement (JAMBA) • China-Australia Migratory Bird Agreement (CAMBA) • Convention on the Conservation of Migratory Species of Wild Animals - (Bonn Convention)

Table D.8 – Definition of codes for potential SRE species

Code	Definition
A	Extinct • There is insufficient data available to determine SRE status. • Factors that fall under this category include: - Lack of geographic information. - Lack of taxonomic information. - The group may be poorly represented in collections. - The individuals sampled (e.g. juveniles) may prevent identification to species level.
B	Habitat Indicators • It is becoming increasingly clear that habitat data can elucidate SRE status. • Where habitat is known to be associated with SRE taxa and vice versa, it will be noted here.
C	Morphology Indicators • A suite of morphological characters are characteristic of SRE taxa. • Where morphological characters are known to be associated with SRE taxa and vice-versa, it will be noted here.
D	Molecular Evidence • If molecular work has been done on this taxon (or a close relative), it may reveal patterns congruent or incongruent with SRE status.
E	Research and Expertise • Previous research and/ or WAM expertise elucidates taxon SRE status. • This category takes into account the expert knowledge held within the WAM.

APPENDIX E LOCATION OF INTRODUCED SPECIES RECORDED WITHIN THE STUDY AREA

Family	Taxon	Easting	Northing	Phase of Survey
Acteraceae	*Tridax procumbens*	503271	8067541	2
Fabaceae	*Stylosanthes hamata*	500377	8073356	2
Fabaceae	*Stylosanthes hamata*	494788	8075983	2
Fabaceae	*Stylosanthes hamata*	496513	8073167	2
Fabaceae	*Stylosanthes hamata*	499687	8067416	2
Fabaceae	*Stylosanthes hamata*	499677	8067413	1
Fabaceae	*Stylosanthes scabra*	499696	8067407	2
Fabaceae	*Stylosanthes scabra*	499677	8067413	1
Fabaceae	*Stylosanthes scabra*	500192	8073619	1
Malvaceae	*Sida acuta*	493898	8076151	2
Poaceae	*Cynodon dactylon*	502523	8067699	2
Poaceae	*Digitaria ciliaris*	499720	8067399	1
Poaceae	*Echinochloa colona*	499687	8067416	2