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AUSTRALIA

TROPICANA GOLD PROJECT

PUTATIVE SHORT-RANGE ENDEMIC INVERTEBRATE SURVEY REPORT

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PUTATIVE SHORT-RANGE ENDEMIC INVERTEBRATE SURVEY REPORT

Tropicana Joint Venture

ANGLOGOLD ASHANTI AUSTRALIA

INDEPENDENCE GROUP NL

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EXECUTIVE SUMMARY

The Tropicana JV (TJV) is currently undertaking a pre-feasibility study on the viability of establishing the Tropicana Gold Project (TGP), which is centred on the Tropicana and Havana gold prospects. The proposed TGP is located approximately 330 km east north-east of Kalgoorlie, and 15 km west of the Plumridge Lakes Nature Reserve, on the western edge of the Great Victoria Desert (GVD) biogeographic region of Western Australia (Figure 1). The Tropicana and Havana prospects represent the first gold resource discovered in this remote portion of Western Australia.

Ecologia Environment (*ecologia* hereafter) was contracted to conduct a literature review of short-range endemism in Western Australia, and to undertake surveys for short-range endemic invertebrates (SRE) in the proposed operational area. SRE species are recognised from mostly flightless arthropod groups such as arachnids (i.e. trap door spiders, scorpions, pseudoscorpions), myriapods (i.e. specific millipedes and centipedes) and snails. This report documents the findings of the literature review and field surveys.

A conventional trapping and foraging programme was conducted over 30 days between September and October 2006 (one phase) and over five months (five phases) between April and September in 2008. Twenty two pitfall sites were selected in and around the proposed mining and infrastructure footprint in 2006. Twenty five pitfall sites were selected outside the proposed mining and infrastructure footprint during 2008. Site selection was designed to include as wide a range of habitats as possible, focusing on areas where SRE species were most likely to occur. After retrieval, specimens were sorted in *ecologia's* invertebrate laboratory and SRE species were provided to experts for taxonomic identification.

Fourty six species from potential SRE groups were collected from within the TJV operational area, of which 19 species (41%) were of conservation significance. Of the 19 species of conservation significance, three species of mygalomorph spiders, *Aganippe* sp.1, *Aganippe* sp. 4 and Kwonkan sp. 2, are currently fully impacted by the TGP mining and infrastructure footprint. These species were collected in 2006 from single locations within the operational footprint and have not been collected since. Ten of the 19 species were recorded from both within and outside of the proposed mining and infrastructure footprint, thus being partially impacted by the TGP. These were the mygalomorph spiders *Synothele* 'megaspiral', *Aganipe* sp. 3, *Anidiops mastridgei*, *Aname* sp. 2 and *Kwonkan* sp. 1, and the isopod *Pseudoareola*, the millipedes *Antichiropus* sp.1, sp.2, the millipede from the order Polyzoniida., and the Chernetidae pseudoscorpion. Six of the 19 species were recorded exclusively outside of the proposed mining and infrastructure footprint. These included the mygalomorph spiders *Aganippe* sp. 5, *Aganippe* sp. 6, *Aganippe* sp. 8 and two new species from two unknown genera of Nemesidae, and the scorpion from the genus *Cercophonius*.

The survey results indicate that the operational area is located in a region unexpectedly rich in invertebrate biodiversity. The presence of the wet karri-forest species, such as the millipede from the order Polyzoniida, the scorpion from the genus *Cercophonius* and the isopod from the genus *Pseudolaureola,* suggests that relictual habitats originating from much wetter climate periods still exist in the area. In addition, the high diversity of Mygalomorph spiders, particularly the arid adapted species such as *Aganippe*, suggests that several historical events including mygalomorph radiation / adaptation must have also occurred in the area. Nevertheless, given that none of the species were associated with a highly localised landscape unit (i.e. range) and the features of the landscape are known to extend well beyond the survey sampling areas, it is highly likely that both the historical and the current ecological / evolutionary processes have been occurring on a much larger scale.

In conclusion, the TGP will have a small impact upon the majority of species of conservation significance recorded within the operational area. However, to minimise the impact on the mygalomorph spiders *Aganippe* sp. 1 and *Aganippe* sp. 4 and Kwonkan sp. 2 (currently recorded exclusively within the proposed impact areas), all efforts should be made to locate them outside of the proposed mining and infrastructure footprint. In addition, as the TGP is an area of extremely high biodiversity, it is recommended that TJV take a precautionary and preventative approach to mining and that the management recommendations outlined in this report are strictly adhered to.

1.0 INTRODUCTION

1.1 Project Background

The Tropicana JV (TJV) is currently undertaking a pre-feasibility study on the viability of establishing the Tropicana Gold Project (TGP), which is centred on the Tropicana and Havana gold prospects. The proposed TGP is located approximately 330 km east north-east of Kalgoorlie, and 15 km west of the Plumridge Lakes Nature Reserve, on the western edge of the Great Victoria Desert (GVD) biogeographic region of Western Australia (Figure 1). The Tropicana and Havana prospects represent the first gold resource discovered in this remote portion of Western Australia. Drilling to date suggests that the resource represents a multi-million ounce discovery within a new Greenfields gold province. The Project is a joint venture between AngloGold Ashanti Australia Limited (70% stakeholder and Manager) and the Independence Group NL (30% stakeholder).

The TGP consists of three main components (Figure 1):

- operational area - this area contains the mine, processing plant, aerodrome, village and other associated infrastructure;

- water supply area - two basins have been investigated, the Minigwal Trough and Officer Basin; and

- infrastructure corridor - two options are under consideration (Cable Haul and Pinjin Road options).

Ecologia Environment (*ecologia* hereafter) was contracted to conduct a literature review to provide an overview of the short-range endemism in Western Australia, and to conduct surveys for short-range endemic invertebrates (SRE) in the proposed operational area.

1.2 Survey Objectives

The objectives of the Environmental Protection Authority (EPA) with regards to invertebrate fauna management are to:

- maintain the abundance, species diversity and geographical distribution of Short-range endemic terrestrial invertebrate fauna; and

- protect Specially Protected (Threatened) fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*

Hence, the purpose of this survey was to provide sufficient information to allow the EPA to assess the impact of the TGP located within the operational area on the local invertebrate fauna, thereby ensuring that these objectives are upheld.

Specifically, the objectives of this survey were to undertake a survey that satisfies the requirements documented in EPA's Guidance Statement 56 and Position Statement No. 3, thus providing:

- a review of background information (including literature and database searches);

- an inventory of Short-range endemic (SRE) fauna species occurring in the study area, incorporating recent published and unpublished records;

- an inventory of species of biological and conservation significance recorded or likely to occur within the operational area and surrounds;
- a review of regional and biogeographical significance, including the conservation status of species recorded in the operational area; and
- a risk assessment to determine likely impacts of threatening processes on short-range endemic fauna within the study area.

The legislative framework governing this report is outlined in Appendix 1.

1.3 Report Objectives

During 2006 the TJV commissioned *ecologia* to undertake a baseline biological survey of the SRE invertebrate fauna of the TGP operational area as part of the environmental impact assessment (EIA) for the project. Results from this survey highlighted the need for an additional, longer term survey to fulfil the requirements of the EPA which was subsequently conducted throughout 2008.

Results from the original survey conducted in 2006 concluded that almost fifty percent of the taxa recovered from the pitfall traps and foraging activities were considered by taxonomic experts to be of conservation concern. Two potential causes for such conclusion were taken into consideration:

1. that the Great Victorian Desert in which the operational area lies is an area of high local endemism; or
2. the high number of species new to science recorded from the area was an artefact of a lack of invertebrate sampling undertaken in that part of Western Australia to date.

In order to distinguish between the two causes, additional invertebrate sampling across a large area in the vicinity of the operational area was undertaken throughout 2008.

This report focuses on the findings of the 2006 survey and the results to date for the 2008 survey. Further taxonomic identifications and advice should become available in March 2009 and will be attached to this report as a results addendum at a later date.

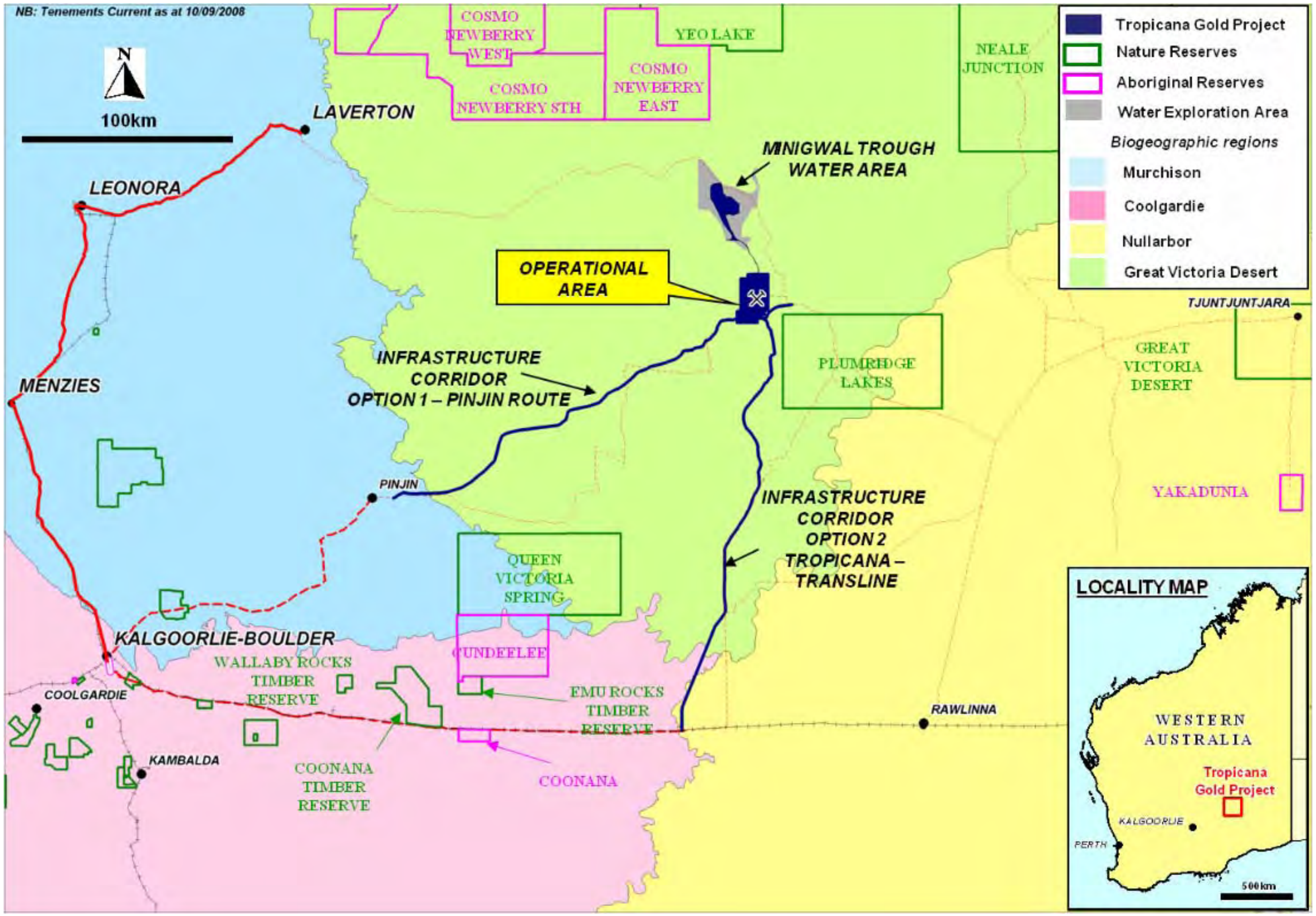

Figure 1 General Location Plan of Tropicana Joint Venture Operational Area in Western Australia

2.0 LITERATURE REVIEW

2.1 Review of Short-range Endemism in Western Australia

Short-range endemic (SRE) invertebrates are rare invertebrates with highly restrictive and/or specialised habitat utilisation and frequently represent ancient lineages that were widespread as long ago as Cretaceous (*ca* 65 million years ago). Short-range endemism refers to endemic species with a restricted range, which in Western Australia (WA) is currently defined as less than 10,000 km^2 (100 km x 100 km) (Harvey 2002a). Such taxa are usually invertebrates, as they are more likely to display poor dispersal abilities and defined or restrictive biology that promotes their isolation and eventual speciation. It is important to note that the potential SRE groups listed in this review are not exhaustive, and that invertebrates are historically understudied and in many cases lack formal descriptions. It is in relatively recent times that reliable taxonomic evaluation of these species has been undertaken and thus the availability of literature relevant to SREs is limited.

Currently recognised SRE invertebrate groups in WA include (but are not limited to):

- trap-door spiders (Mygalomorphae);
- scorpions (Scorpiones: Urodacus);
- pseudoscorpions (Pseudoscorpiones);
- millipedes (Diplopoda);
- non-marine land snails (Mollusca);
- isopods (Isopoda);
- worms (Megascolecidae);
- schizomids (Schizomida);
- freshwater crayfish (Engaewa); and
- centipedes (Chilopoda).

2.2 Processes Promoting Short-range Endemism

Short-range endemism is influenced by numerous processes which generally contribute to the isolation of the species. A number of factors including life history, physiology, habitat requirements, habitat availability, the ability and opportunity to disperse, biotic and abiotic interactions and historical conditions influence not only the distribution of a taxon, but also the tendency for differentiation and speciation (Ponder and Colgan 2002).

Isolated populations of both plants and animals tend to differentiate morphologically and genetically as they are influenced by different selective pressures over time. Additionally, a combination of novel mutations and genetic drift can result in genetic differences between isolated populations. Conversely, the maintenance of genetic similarity is promoted by a lack of isolation through migration between populations, repeated mutation and balancing selection (Wright 1943). The level of differentiation and speciation between populations will be determined by the relative magnitude of these factors, with migration generally being the strongest determinant. Migration is hindered by poor dispersal ability of the taxon as well as by geographical barriers. Consequently, taxa that exhibit short-range endemism are generally characterised by poor dispersal, low growth rates, low fecundity and reliance on habitat types that are discontinuous (Harvey 2002a).

In Australia, a number of habitats contain SREs as a result of surrounding geographic barriers. Islands are a classic example, where terrestrial fauna are surrounded by a marine environment which impedes migration and thus gene flow. Similarly, habitats such as mountains, aquifers, lakes and caves are essentially islands exhibiting unique environmental conditions in comparison to the surrounding landscape. The historical connections of habitats are also important in determining species distributions and often explain patterns that are otherwise inexplicable by current conditions. Many SREs are considered to be relictual taxa (remnants of species that are extinct elsewhere) and are confined to certain habitats, and in some cases to single geographic areas (Main 1996). Relictual taxa include species from Gondwanan periods (180-65 million years ago), with a very restrictive biology.

In Western Australia, relictual taxa generally occur in fragmented populations, from lineages reaching back to historically wetter periods. For example, during the Miocene period (from 25 million to 13 million years ago), the aridification of Australia resulted in the contraction of many areas of moist habitat and the fragmentation of faunal populations occurring in these areas (Hill 1994). With the onset of progressively dryer and more seasonal climatic conditions since this time, suitable habitats have become increasingly fragmented. Relictual species now generally persist in habitats characterised by permanent moisture and shade. These conditions may be maintained by high rainfall and/or prevalence of fog, whether induced by topography or coastal proximity; areas associated with freshwater courses (e.g. swamps or swampy headwater of river systems); caves, microhabitats associated with southern slopes of hills and ranges; rocky outcrops; deep litter beds or combinations of each of these features (Main 1996, 1999). As a result, these habitats support only small, spatially isolated populations, which are further restricted by the low dispersal powers typical for all SRE species.

3.0 BIOPHYSICAL ENVIRONMENT

3.1 Climate

The operational area is located 330 km east-north-east of Kalgoorlie and 220 km east of Laverton. Average weather conditions in the area can be interpreted from data collected at weather stations in Laverton (to the north-west) and Balgair (to the south-east). A summary of the data is provided in Table 1 and Figure 2, Figure 3, Figure 4 and Figure 5)

The climate is described as arid, with summer and winter rain averaging 100 –180 mm (Barton and Cowan 2001b, a). The majority of rainfall occurs during the summer months between January and April and is generally associated with cyclonic rainfall extending inland. Conversely, the region can experience almost no rainfall for the majority of the year with the lowest amount of rainfall received in a year being 65.6 mm at Laverton (1928) and 140.7 mm at Balgair (1991).

Temperatures vary greatly in the region, with the highest maxima at Laverton and Balgair being 46.1 °C (1957) and 47.6 °C (1991), respectively. Lowest minima extend into negative values during the winter months, with the lowest minimum reaching -2.4 °C at Laverton (1969) and -5.0 °C at Balgair (2006).

During the initial survey in September and October 2006, average monthly rainfall varied from 8-16 mm whilst temperatures ranged from the mid to high twenties.

During the subsequent survey in 2008, rainfall was heaviest in February and June while minimum rainfall was received during March, May and August. Average temperature was the highest during January (34.5°C) and the lowest in July (5.7°C).

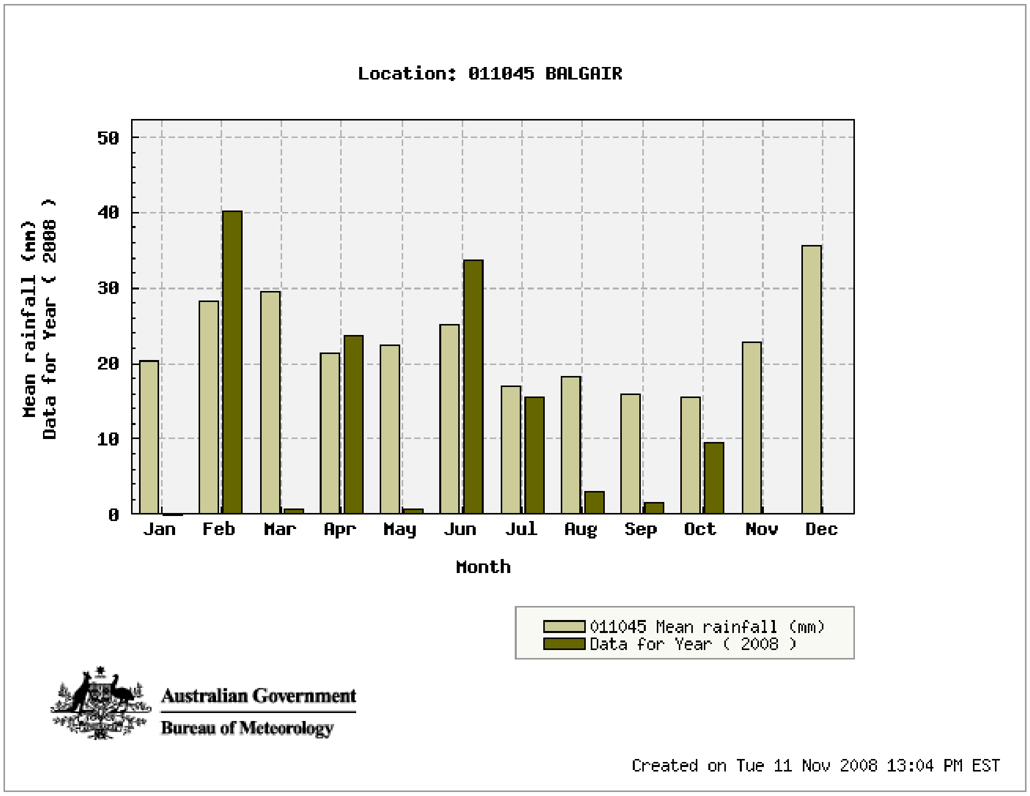

Figure 2 Mean Rainfall (mm) for Balgair from 1983 – 2008

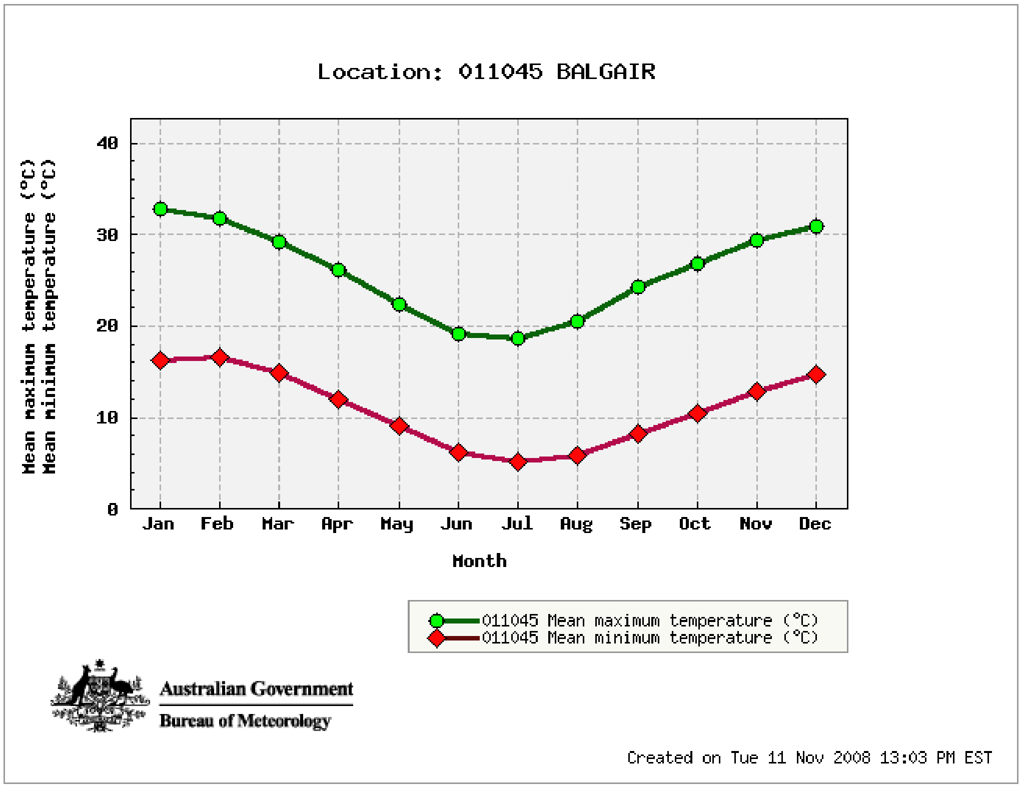

Figure 3 Mean Annual Maximum and Minimum Temperature for Balgair from 1983 – 2008

Table 1 Climatic Statistics for Balgair*
(http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Monthly Records 1983 - 2008												
Rainfall (mm)	20.3	28.2	29.6	21.4	22.5	25.1	17.0	18.3	16.0	15.8	22.8	35.6
Temp. Max.	32.8	31.8	29.2	26.2	22.4	19.1	18.6	20.5	24.2	26.8	29.3	30.9
Temp. Min.	16.3	16.6	14.8	11.9	9.0	6.2	5.1	5.9	8.2	10.5	12.8	14.7
Records for 2008												
Total Rainfall (mm)	0.0	40.2	0.6	23.6	0.6	33.8	15.6	3.0	1.6	9.4	50.7	51.0
Average daily Temp. Max.	34.5	28.4	32.7	27.0	24.9	20.1	18.7	18.6	26.3	28.3	25.7	No data
Average daily Temp. Min.	17.0	15.2	15.4	12.8	9.5	6.7	5.7	4.9	8.5	10.9	12.7	No data

***Latitude:** 31.09 °S **Longitude:** 125.66 °E
* not quality controlled

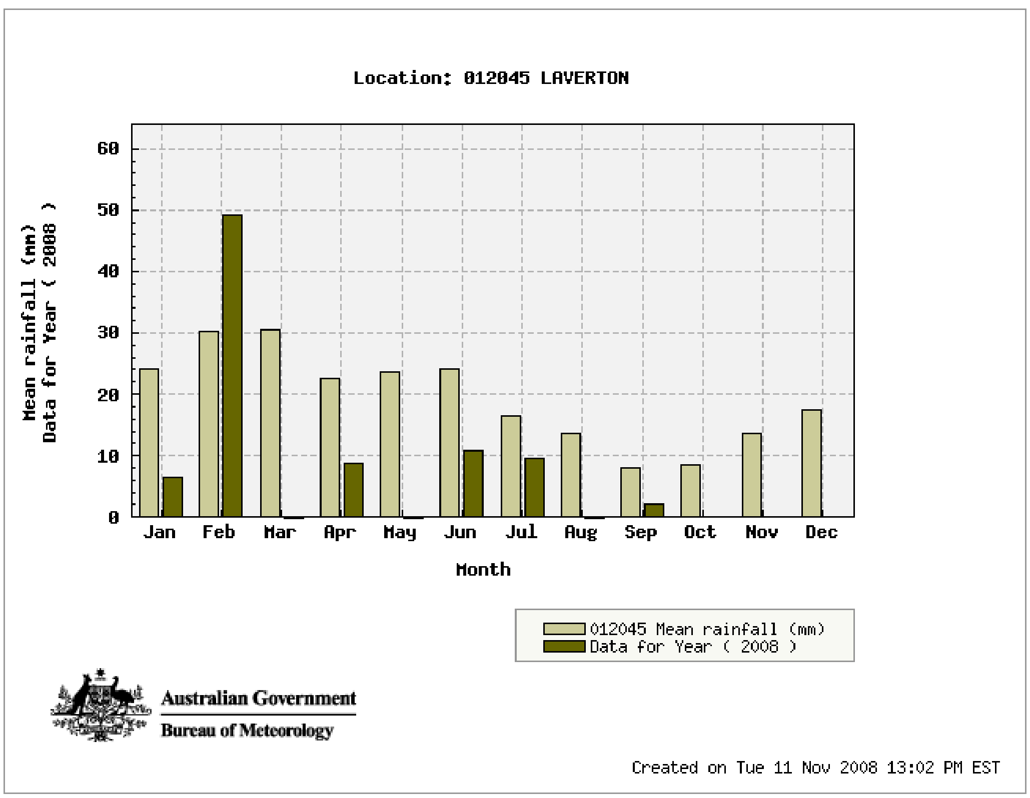

Figure 4 Mean Rainfall for Laverton 1899 – 2008

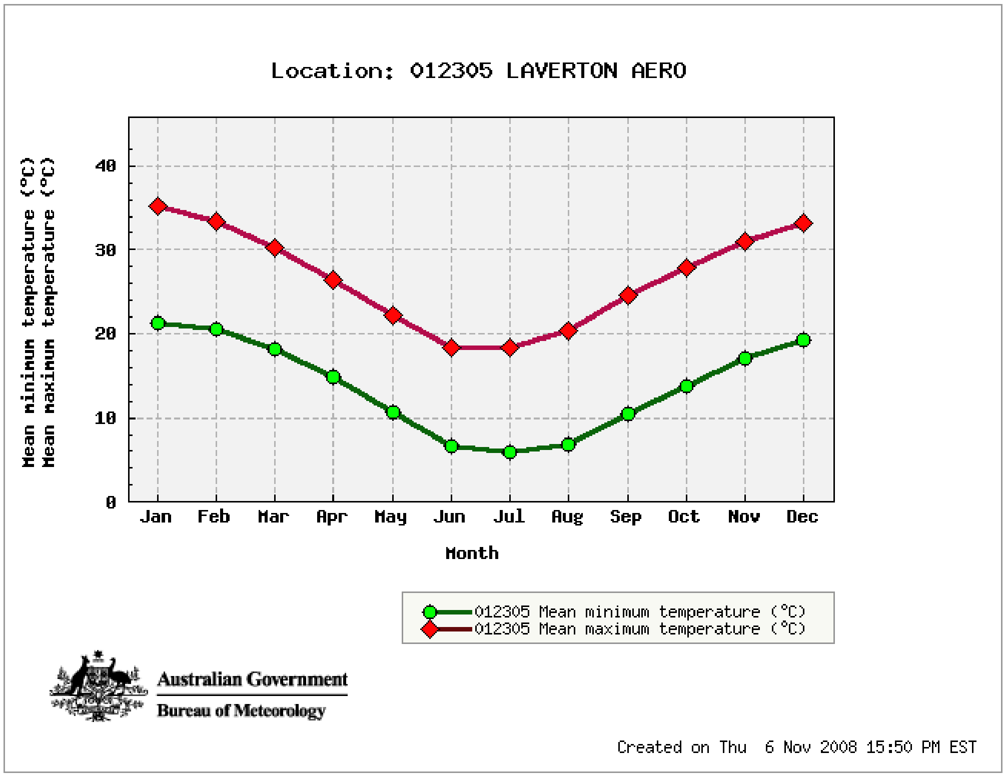

Figure 5 Mean Maximum and Minimum Temperature for Laverton Aero (2.5kms from Laverton) 1991 – 2008

Table 2 Climatic Statistics for Laverton*(where data unavailable, Laverton Aero data has been used – 2.5 km from Laverton)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Monthly Records 1899 - 2008												
Rainfall (mm)	24.1	30.2	30.4	22.5	23.7	24.0	16.4	13.5	8.1	8.4	13.6	17.5
Average Monthly Records 1900 - 1971												
Temp. Max.	35.8	34.8	31.9	27.2	22.1	18.5	17.8	20.0	24.5	28.0	32.1	34.9
Temp. Min.	20.5	20.0	18.0	13.9	9.5	6.6	5.2	6.4	9.5	12.8	16.6	19.3
Records for 2008												
Total Rainfall (mm)*	6.4	49.2	0.0	8.8	0.0	10.8	9.4	0.0	2.2	0.4	77.0	22.8
Average daily Temp. Max.	38.2	30.8	33.9	27.9	25.6	19.2	19.2	18.9	25.2	30.1	27.2	No data
Average daily Temp. Min.	22.8	18.7	20.0	15.2	11.9	8.1	6.7	5.6	10.7	16.0	14.9	No data

*** Latitude:** 28.63 °S **Longitude:** 122.41 °E
* not quality controlled
* Laverton Aero data (2.5 km from Laverton)

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3.2 Biogeography

The operational area of the TGP is located within the Great Victoria Desert bioregion, as defined by Thackway and Cresswell in the Interim Biogeographic Regionalisation of Australia (IBRA) Version 6.1 (Department of Environment and Water Resources, 2007). On a finer scale, it is located on the northern border of the Central and Shield sub-regions of the Great Victoria Desert.

The Central region of the Great Victoria Desert is described as an:

> *"arid active sand-ridge desert with extensive dune fields of deep Quaternary aeolian sands overlying Permian strata of the Gunbarrel Basin. Landforms consist of salt lakes and major valley floors with lake derived dunes. Sand plains with extensive seif dunes running east west, occasional outcropping (breakaways) and quartzite hills provide minor relief"* (Barton and Cowan 2001a).

The subregion covers an area of 14,286,995 ha, of which 9.11 % is vested in conservation estates.

3.3 Flora and Vegetation

The operational area is situated in the Helms Botanical District, near the border of the Great Victoria Desert and the Nullarbor Plain, within the Eremaean Botanical Province. At a broad scale, Beard (1975) described three distinct vegetation units within close proximity to and including the Tropicana Gold Exploration Area:

1. *Acacia aneura* (mulga) low woodland between sand ridges;
2. Tree (*Eucalyptus gongylocarpa, E. youngiana*) and shrub steppe between sand hills with hummock grassland (*Triodia basedowii*); and
3. *Acacia aneura / Casuarina cristata* (*C. pauper*) woodland (Mulga and sheoak).

The survey area is primarily located within the Mulga between sandhill complexes with longitudinal sand ridges.

4.0 METHODS

The survey methods adopted by *ecologia* have been developed in consultation with senior Western Australian Museum (WAM) staff and other local experts. The Environmental Protection Authority's Guidance Statement No. 56 (EPA 2004a) and Position Statement 3 (EPA 2002) currently provide no specific instructions on the expected design of SRE surveys.

4.1 Survey Timing

The 2006 survey was conducted in spring between September and October. The survey involved a 30-day wet-pitfall-trapping program in conjunction with extensive foraging to record species that are usually not collected using pitfall traps alone (e.g. pseudoscorpions and female trapdoor spiders).

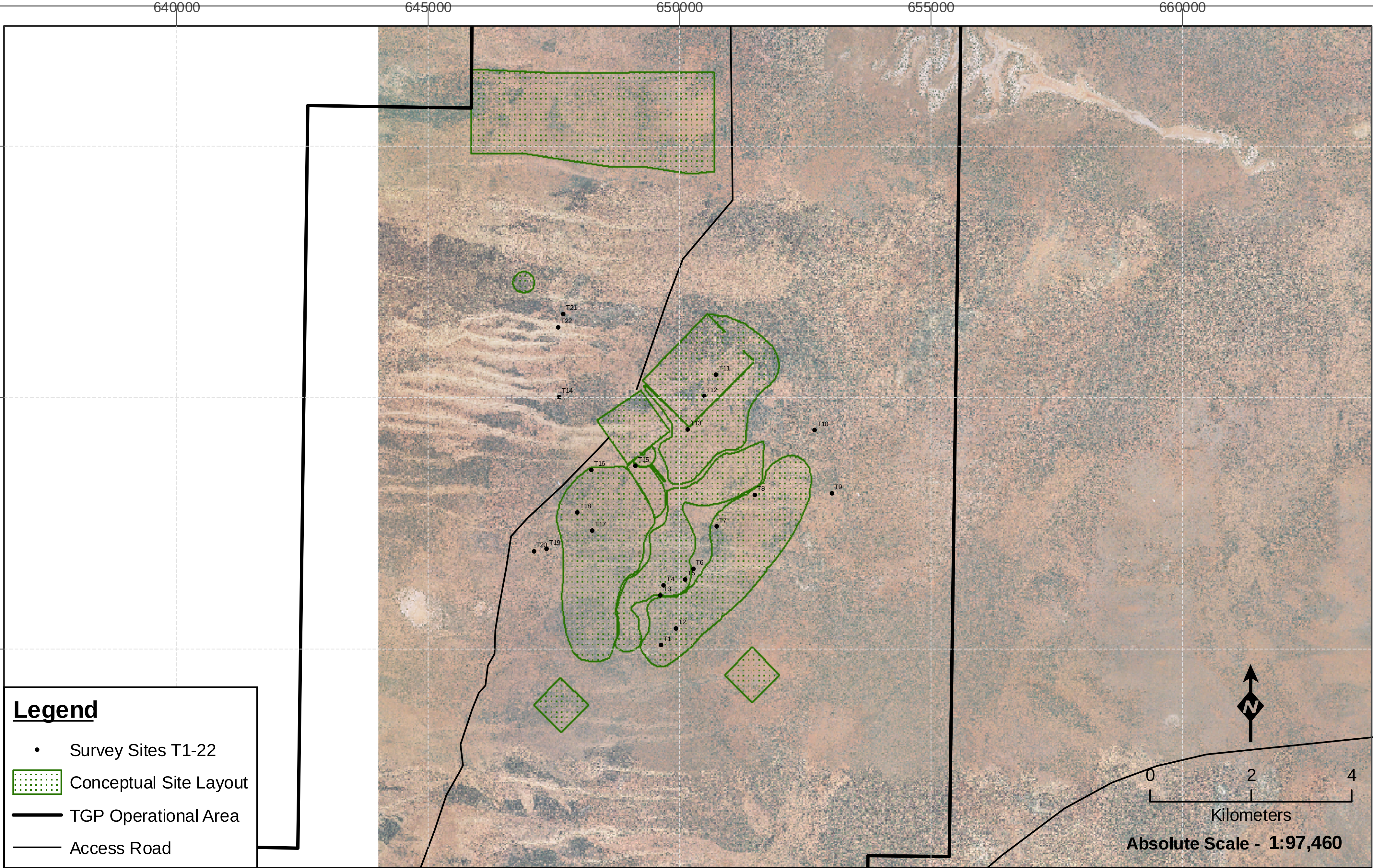
The 2008 additional survey consisted of wet pitfall-trapping for a total period of five months. Traps were established at the end of April 2008 and cleared and maintained by AGAA field assistants every 30 days. Each month (May through September) represented a different phase of the survey with May being phase one and September being phase five.

4.2 Site Selection

SRE invertebrates are generally found in cooler, moister, isolated habitats, such as south facing hill slopes, areas of deep leaf accumulation, and isolated patches of dense vegetation and river gullies. Within these habitats, SREs are often further adapted to utilise specific microhabitats such as areas of permanent shade, under the bark of trees and inside decaying logs. In order to determine suitable sampling locations aerial photographs were inspected to identify southern facing slopes, gullies and permanent water bodies. On-site personnel with intimate knowledge of the area were also involved in locating potential survey sites. Survey site locations are displayed in Figure 6, Figure 7 and Figure 8. Additionally, site descriptions are provided in Appendices 2-5.

The majority of sites selected during the 2006 survey were located inside the proposed mining and infrastructure footprint. Sites T19 and T20 were located outside but situated beside the road. They have therefore been classified as 'inside' the TGP impact footprint as any potential short-range endemic species occurring in this area may be indirectly impacted through activities on the road. Sites T10, 14, 21 and 22 were located outside of the proposed mining and infrastructure footprint and are unlikely to be impacted by TGP.

The majority of sites selected during the 2008 survey were located outside the proposed mining and infrastructure footprint. Sites T26 and T27 were located at the airstrip and beside the road. As SRE's at these sites may be indirectly impacted by the TGP activities, they have been classified as 'inside' the TGP impact footprint.



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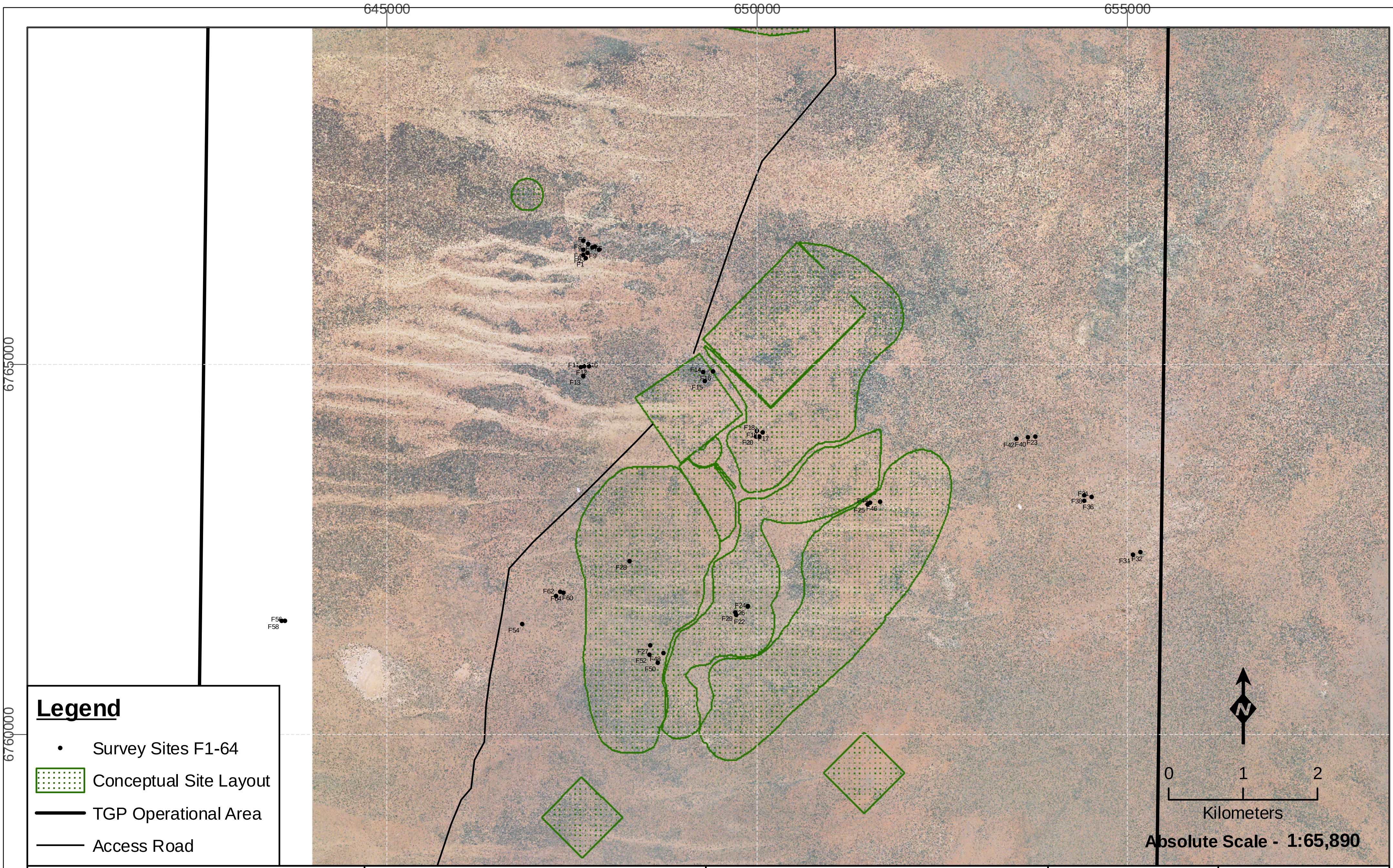
Tropicana 2006
SRE Survey Sites

Figure: 6
Project ID: 716

Drawn: SG
Date: 10/03/09

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

A4



Tropicana 2006
SRE Foraging Sites

Figure: 7
Project ID: 716

Drawn: SG
Date: 10/03/09

Coordinate System
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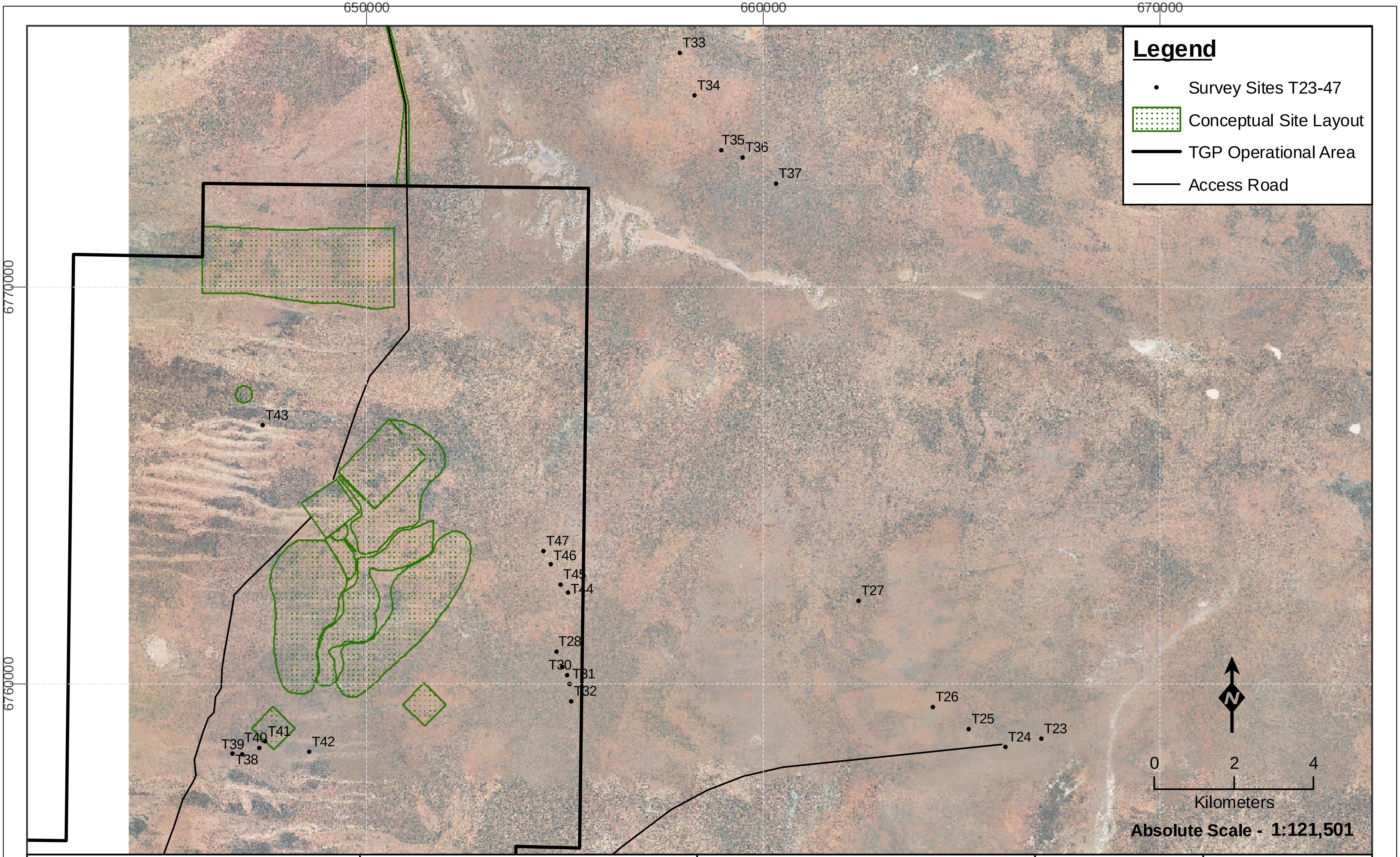

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Tropicana 2008
SRE Survey Sites

Figure: 8
Project ID: 716

Drawn: SG
Date: 10/03/09

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

A4

4.3 Analysis of data

The data was analysed using species accumulation curves to plot the cumulative number of new species collected over unit effort (number of collection stations). To estimate the total number of species three different non-parametric approaches were applied and compared: a) Chao 1, b) first-order Jack-knife and c) bootstrap. In addition, and since some rare and/or localized species may have been missed, a Michaelis-Menten enzyme kinetic curve (Colwell & Coddington 1994) approach was also used to estimate the species richness in the community. To eliminate features caused by random or periodic temporal variation, the sample order was randomised 29 times. All estimators applied to the data set were performed with the Species Diversity and Richness program (SDR) (Henderson 2001).

4.4 Sampling Methods

4.4.1 Systematic Sampling: Pitfall Trapping

The survey used systematic (pitfall trapping) techniques. Systematic sampling refers to data methodically collected over a fixed time period in a discrete habitat type, using an equal or standardised sampling effort. Pitfall traps were located across the range of geographically defined habitats and vegetation communities. Each trap consisted of a two-litre container (16cm x 16cm x 9.5cm), containing 1 L of trapping solution (ethylene glycol 30 %: Formaldehyde *ca* 4 %). This solution euthanizes collected animals and fixes tissues. To minimise the chance of vertebrate by-catch, each trap is roofed with a plastic lid positioned 3 cm above the soil surface and weighed down with rocks and/or branches.

Twenty two sites comprising ten pitfall traps each were set up during 2006. The traps were left in place for one month between September and October 2006. In 2008, twenty five sites comprising ten pitfall traps each were set up by *ecologia* zoologists. These were left in place for five months from April to August 2008, with AGAA field assistants clearing the traps and maintaining the fluid levels on a monthly basis after their initial installation. Each trap was placed in a suitable microhabitat, which generally consisted of areas under shade-bearing shrubs, against the shady side of larger rocks and boulders, on river banks or on southern hill slopes and hill tops.

Once collected, the samples were dispatched to *ecologia* for sorting and identification on a monthly basis and any potential short-range endemic specimens sent to experts for taxonomic and SRE status identification.

A summary of survey effort is shown in Table 3.

4.4.2 Opportunistic Data: Hand foraging and Sifting

Opportunistic sampling was conducted at 46 sites during the 2006 survey. In 2008, opportunistic sampling was conducted at and around the pitfall trap sites during the trap installation phase only.

The opportunistic sampling involved the following techniques:

- inspecting and foraging around and under rocks and logs, targeting mygalomorph spiders, scorpions, pseudoscorpions and snails; and

- sifting leaf litter and sand at the base of large shade-bearing trees and rock faces, targeting millipedes, snails, pseudoscorpions and small mygalomorph spiders.

A total of 46 person hours was spent foraging during the 2006 survey and 24 person hours during the 2008 survey.

A summary of survey effort is shown in Table 3.

Table 3 Summary of Survey Effort

Technique	Number of Pits Per Site / Foraging Time (Hrs) per site	Number of Sites	Total Sample Size (hrs or traps)	Phases
Invertebrate Pitfall Traps 2006	10	22	220 traps	1
Invertebrate Pitfall Traps 2008	10	24	240 traps	5
TOTAL	**-**	**46**	**460**	**6**
Foraging 2006	1.0 person hrs	46	46.0 person hours	-
Foraging 2008	1.0 person hrs	24	24.0 person hours	-
TOTAL	-	70	70 person hours	-

4.5 Survey Team

The *ecologia* staff involved in planning, coordination and execution of the AGAA Tropicana SRE surveys are listed in Table 4.

Table 4 Ecologia Staff involved with Survey Effort

Name	Qualifications	Position
Magdalena Davis (Zofkova)	PhD (Zoology)	Manager Invertebrate Sciences
Nicki Thompson	BSc. Hons (Zoo + Marine Biol.)	Invertebrate Zoologist
Gilbert Whyte	BSc. Hons (Biological Sciences)	Invertebrate Zoologist
Jarrad Clark	BSc. (Env. Management)	Senior Invertebrate Zoologist

4.6 External Support

A number of local and interstate expert taxonomists were involved in identifications of collected specimens. Their names, associations and area of expertise are listed in Table 5.

Table 5 Taxonomic Experts used for Specimen Identification

Group	Person	Institution
Mygalomorphae (trapdoor) spiders (*Nemesiidae*, *Dipluridae* and *Idiopidae*)	Prof. Barbara York Main	The University of Western Australia
Mygalomorphae (trapdoor) spiders (*Barychelidae*)	Dr Robert Raven	Queensland Museum
Scorpions (*Scorpiones*)	Dr Erich S Volschenk	*ecologia* Environment
Pseudoscorpions	Dr Mark S Harvey	WA Museum
Millipedes (*Diplopoda*)	Dr Mark S Harvey	WA Museum
Land Snails (*Mollusca*)	Dr Shirley Slack-Smith, Corey Whisson	WA Museum
Isopods (slaters)	Dr Simon Judd	Edith Cowan University

5.0 RESULTS

5.1 Overview

A total of 46 potential SRE species were collected during the entire survey (2006 and 2008), of which 19 species were of conservation significance (Table 6 and Table 7). These were represented predominantly by mygalomorph spiders: however, other groups were also represented, including three species of millipede, an isopod and a pseudoscorpion.

5.2 Taxonomy

5.2.1 Arachnids (Phylum Arthropoda, Subclass Arachnida)

5.2.1.1 Trapdoor spiders (Order Araneae, Infraorder Mygalomorphae)

Twenty seven species of trapdoor spiders from five families (Barychelidae, Actinopodidae, Dipluridae, Idiopidae and Nemesiidae) were recorded.

Barychelidae (Simon, 1982)

***Mandjelia humphreysi* (Raven and Churchill, 1994)**

Specimens were recorded at sites 5 and 13 inside the mining and infrastructure footprint. Named after Bill Humphreys of the Western Australian Museum (WAM), the species was known from Gimlet woodland in Woodline and Buningonia springs areas (110 km apart) in the W.A. Goldfields. The species record from the TGP operational area represented an extension of the known distribution of the species. However, it is likely that the existing record of this species distribution is an artefact of limited collections rather than short-range endemism and thus this species is **not considered to be a SRE** (R. Raven, pers. comm.).

***Synothele meadhunteri* (Raven, 1994)**

Synothele meadhunteri was described from a male collected at Queen Victoria Springs (WA: 30°26'S, 123°34'E) and since then has been collected only from the Olympic Dam at Roxby Downs in South Australia (30°42'S 136°46'E). The specimens from TGP were collected from sites 4, 13, 34, both inside and outside the mining and infrastructure footprint, and these records extend the known distribution of the species. The species is **not considered to be a SRE** (R. Raven, pers. comm.).

***Synothele* 'megaspiral'**

Three male specimens were collected from sites 6, 18 and 37, both inside and outside the mining and infrastructure footprint. This is a new species of *Synothele* characterised by a large spiral-shaped embolus on the male palp. The embolus is a distinct character unique to each species and thus the designation as a new species by Dr Robert Raven (world Barychelidae expert) is unequivocal. The specimens present the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (R. Raven, pers. comm.).

***Synothele* 'procacis'**

Synothele 'procacis' was recorded from site 33 outside the mining and infrastructure footprint. The species is **not considered to be a SRE (**V. Framenau, pers. comm.)**.**

Actinopodidae (Simon, 1892)

***Missulena insignis* (Cambridge, 1977)**

Specimens were collected from sites 1, 9, 25, 36, both inside and outside the mining and infrastructure footprint. This species possibly represents a species complex, however it is widespread and it is one of the few mygalomorph species where males wander in search of females during the day time and throughout the year. Spiderlings disperse by ballooning, a technique that is rare in mygalomorphs. This explains the relatively wide distribution of Red-headed Mouse Spiders compared to other mygalomorph species. The species is **not considered to be a SRE** (Main 1953).

Dipluridae (Simon, 1889)

***Cethegus ischnotheloide* (Raven, 1985)**

Specimens were recorded from sites 16 and 28, both inside and outside the mining and infrastructure footprint. The family Dipluridae contains 30 extant species which are all commonly referred to as Curtain-web spiders. The genus *Cethegus* contains thirteen described species, two of which *C. ischnoltheloides* and *C. fugax* are known from the southern half of Western Australia. The majority of members of this genus are known from tropical regions of Australia.

Specimens of *Cethegus ischnotheloides* (Figure 9 and Figure 10) were recorded from sites 16 and 28, both inside and outside the mining and infrastructure footprint. *Cethegus ischnotheloides* was described from a single specimen collected from Commonwealth Hill in South Australia and it is **not considered to be a SRE species at present**.

Professor Barbara York Main (University of Western Australia) initially indicated that *C. ischnoltheloides* could be a species of conservation concern for the operational area. However, after 12 months of observations of live specimens in the laboratory and in the field, *ecologia* reached a conclusion that this species may not be at risk to the same extent as other mygalomorph species. This is because *Cethegus* spiderlings have limited aerial dispersal capabilities (probably up to 10 m) and adult spiders commonly move and rebuild their nest after indirect disturbance (*ecologia*, unpublished data). Therefore, *Cethegus* is capable of coping with indirect disturbance to a much larger extent than most mygalomorph groups, making it more robust to potential impacts from the proposed TGP.

Figure 9 The Distinctive Curtain-web of *Cethegus ischnotheloides*

Figure 10 *Cethegus ischnoltheloides* Coaxed from its Web

Idiopidae (Simon, 1889)

Aganippe sp. 1

A single male was collected at site 5 inside the mining and infrastructure footprint. This was an aberrant specimen or possibly a rare adaptive morpho-type not occurring widely. The specimen found is the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 2

Male specimens were collected from sites 4, 13, 34, 35, 37, 47, both inside and outside the mining and infrastructure footprint. This species is likely a representative of the eastern form of the “Twig lining” race (Main 1957a) and it is **not considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 3

Male specimens were recorded from sites 13 and 42, inside and outside the mining and infrastructure footprint. The specimens present the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 4

Two male specimens were recorded from site 16 inside the mining and infrastructure footprint. The specimens present the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 5

Two male specimens were collected from Site 34 and a single, unidentifiable juvenile possibly belonging to the same species was collected from Site 47, both outside the mining and infrastructure footprint. The specimens present the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 6

A single female specimen was collected during 2008 from site 34. With a different eye structure to the males from sites 34 and 42 it cannot be attributed to either of these species; however, it may belong to one of the species 1 – 5. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 7

Four female specimens were collected from sites 33, 43, 45, 47 located outside the mining and infrastructure footprint area. Further taxonomic verification is being conducted as the specimens may belong to one of the species 1 – 5. At this stage the species is **not considered to be a SRE** (B.Y. Main, pers. comm.).

Aganippe sp. 8

Three female specimens were recorded from site 30 and a single male at site 47 outside of the mining and infrastructure footprint. One female was with a brood of spiderlings. The species is anomalous. The posterior abdominal sigilla are very small and indistinct. The spiders have a dense band of tiny spines on the mid dorsal region of the abdomen plus diffusely scattered spines dorso-laterally. Such spination has been observed in some undescribed *Aganippe* species from localities in the Wheatbelt but which otherwise are not similar morphologically (e.g. eye arrangement) as these specimens. As TPG is the only locality from which these specimens have been collected this species is **considered to be a SRE** (B.Y.Main, pers.comms.).

Figure 11 *Aganippe* sp. 1

Anidiops manstridgei (Pocock, 1897)

The specimens were collected at sites 2, 3, 13, 33, 34, 36, both inside and outside of the mining and infrastructure footprint and they closely resembled specimens from WA Museum (#T 79173 male) from Morgan Range. If this were the case then this recording would be an extension of range (type locality Lawlers, S.A.). Some confusion exists, however, concerning the true identity of this species, as some specimens identified by Rainbow and Pulleine in the literature, were probably not *A. manstridgei* (B.Y. Main, pers. comm.). This species is currently **considered to be a SRE** (B.Y. Main, pers. comm.).

Eucyrtops sp.

A single female or immature male specimen was recorded at site 34 outside the mining and infrastructure footprint**.** Prof. Barbara Y. Main was unable to further identify the taxonomic identity of the specimen.

Nemesiidae (Simon, 1892)

Aname sp. 1

Specimens were collected at site 13 and in camp, inside the mining and infrastructure footprint. The species is similar to *A. armigera*, which is widespread and unlikely to be of conservation significance. This species is **not considered to be a SRE** (B.Y. Main, pers. comm.).

Aname sp. 2

Specimens were collected at sites 3, 13, 14, F3, F13 and Havana Bore (Figure 12). This species had been recorded previously from Queen Victoria Springs and it is currently **considered to be a SRE** (B.Y. Main, pers. comm.).

Aname sp. 3

Specimens were collected at sites 13, 15 and 19, all located inside the mining and infrastructure footprint. The identity of this species is uncertain. This species is currently **not considered to be a SRE** (B.Y. Main, pers. comm.).

Aname sp. 4

A single male specimen was collected at site 5 inside the mining and infrastructure footprint. The identity of this species is uncertain, however it is currently **not considered to be a SRE** (B.Y. Main, pers. comm.).

Figure 12 *Aname* sp. 2

Kwonkan (Main, 1983)

sp. 1

Specimens were collected at sites 3, 5, 10, 14, 15, 16 and 22, both inside and outside the mining and infrastructure footprint. The specimens present the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

sp. 2

Four males and three juveniles were collected at site 4 inside the mining and infrastructure footprint. The specimens present the first record of this species, and more sampling and research needs to be conducted in order to understand the distribution and biology of this species. At this stage the species is **considered to be a SRE** (B.Y. Main, pers. comm.).

Figure 13 *Kwonkan* sp. 2

Nemesiidae new. genus 1

Males were recorded from sites 23, 28, 37 and 44, a juvenile was recorded from site 36, and a female (tentatively attributed to taxon) was recorded from site 36, all outside the mining and infrastructure footprint. The males were extremely small (known as "midget" males) and thus might be difficult to collect using other methods apart from pitfall trapping. Although the Nemesiidae new genus is known from elsewhere (single record from Morgan Range to the north east) and has some morphological modifications similar to an unnamed genus/species collected during the Carnarvon Basin Survey (Woodleigh station) some years ago, it appears to be unique, probably adapted to sandy/desert habitats. The extent of its range is currently unknown and it is **considered to be a SRE** (B.Y. Main, pers. comm.).

***Nemesiidae* new. genus 2**

Two adult male specimens were recorded from sites 25 and 46 outside the mining and infrastructure footprint. The specimens were very small, with carapace lengths 2.5 mm and 2.8 mm (“midget” males) and present a new record of this genus/species. The genus/species has some similarities with both *Kwonkan* and some species of *Aname*, but it does not fit readily into either genus. Due to the extremely small size of the males (which is often the case with some arid inhabiting nemesiids), female specimens are required for a positive identification. This species is **considered to be a SRE** (B.Y. Main, pers. comm.).

***Teyl* sp. 1**

Specimens were collected from sites 2, 3, 14, 15, both inside and outside the mining and infrastructure footprint. This species was possibly thought to be close to an undescribed species found from a single previous collection (eastern central WA). Morphologically, some features (e.g. spines on palp tarsus) were unusual and found elsewhere only in a western desert species in Victoria. Prof. Barbara York Main indicated this species may be of special interest but it is currently **not considered to be a SRE** (B.Y. Main, pers. comm.).

***Chenistonia tepperi* (Hogg, 1901)**

Specimens were collected at sites 1 and 2 inside the mining and infrastructure footprint. This species is relatively common and widespread in the south half of Western Australia and *ecologia* has previously recorded the species from coastal heathland near the town of Wellstead, 100 km east of Albany. The species is **not considered to be a SRE.**

5.2.1.2 Scorpions (Class Arachnida, Order Scorpiones)

Six species from three families (Bothriuridae, Buthidae and Urodacidae) were recorded.

Bothriuridae (Simon, 1880)

***Cercophonius* sp.**

A total of four specimens of *Cercophonius* were recorded from site 38 (Figure 14) outside the mining and infrastructure footprint. The body length, including the tail, ranges from 25–40 mm, and the body pattern is variegated, consisting of patches of different shades of brown on a lighter background. *Cercophonius* is the only genus in the family Bothriuridae and species belonging to the genus have been recorded only from wet areas such as Karri forests and they are SRE species. The record from the Great Victoria Desert is thus of significance and it is **considered to be a SRE** (E. Volschenk, pers. comm.).

Figure 14 Scorpion from the Genus *Cercophonius*

Buthidae (Koch, 1837)

Lychas 'annulatus'

Specimens were collected at sites 6, 12, 15 10, 24, 25, 33 and 47, both inside and outside the mining and infrastructure footprint. This species is widespread in the southern half of Western Australia, extending through South Australia and western Victoria. *Lychas* 'annulatus' does **not represent a SRE species** (E. Volschenk, pers. comm.).

Lychas 'adonis'

Specimens were collected from sites 1-11, 13, 15, 17-19, 20, 24, 37 and 45, both inside and outside the mining and infrastructure footprint. This species is widespread across much of semi-arid Western Australia and it is **not a SRE species** (E. Volschenk, pers. comm.).

Isometroides sp. unknown

Specimens were collected at sites 34 and 42 outside the mining and infrastructure footprint. The genus *Isometroides* is endemic to Australia where it inhabits semi-arid to arid habitats. Presently only two species are recognized, *I. vescus* and *I. angusticaudus*; however, there are a number of undescribed species which are poorly understood. Most appear to be fairly wide ranging and none are currently considered to be a SRE species (E. Volschenk, pers. comm.).

Urodacidae (Pocock, 1893)

Urodacus yaschenkoi

Specimens were collected at sites 4, 6, 10, 13, 14, 15 and 46, both inside and outside the mining and infrastructure footprint. This species is found over much of arid Australia (Koch 1977), where it constructs deep burrows in red sand dunes (Koch 1978). **It is not a SRE species** (E. Volschenk, pers. comm.).

Urodacus sp.

A single specimen was recorded at site 43 outside the mining and infrastructure footprint, with features indicative of a sand specialist. *Urodacus* species are found over much of arid Australia (Koch 1977) and due to the widespread nature of its preferred habitat it is **not considered to be a SRE species** (E. Volschenk, pers. comm.).

5.2.1.3 Pseudoscorpions (Class Arachnida, Order Pseudoscorpiones)

Chernetidae (Menge, 1855)

Genus. new sp. new

Specimens of a potential new genus were collected at sites 1, 3 and 31, inside and outside the mining and infrastructure footprint. A further four specimens were collected from sites 25, 27 and 35 (located outside the mining and infrastructure footprint) but could not be identified beyond family level. The family occurs elsewhere in Western Australia, where it has been most commonly collected amongst *Xanthorrhea* fronds in the south-west. The lack of certainty regarding the genus / species distribution makes the **assessment of short-range endemism very difficult.** However, pseudoscorpions of the family Chernetidae are known to use 'phoretic' dispersal which is a passive mechanism whereby the pseudoscorpion attaches itself to a flying invertebrate or mammal (Szymokowiak 2007) (Figure 15). This allows the animal to colonise new areas in times when resources may be scarce (e.g. overcrowding, lack of food source etc).

Olpiidae (Banks, 1895)

Beierolpium sp. (8/3)

Over 20 specimens of *Beierolpium* were collected at numerous sites, both inside and outside the mining and infrastructure footprint. The genus is very diverse in Australia, with two described species (Harvey 1991) and many undescribed species. These specimens appeared to represent a distinct species based upon the presence of eight trichobothria on the fixed chelal finger and three on the movable chelal finger. It was not possible to firmly establish the identity of the species until a complete systematic revision of the Western Australian species of *Beierolpium* is undertaken. Consequently, the **assessment of short-range endemicity is extremely difficult at this stage** (M. S. Harvey, pers. comms.).

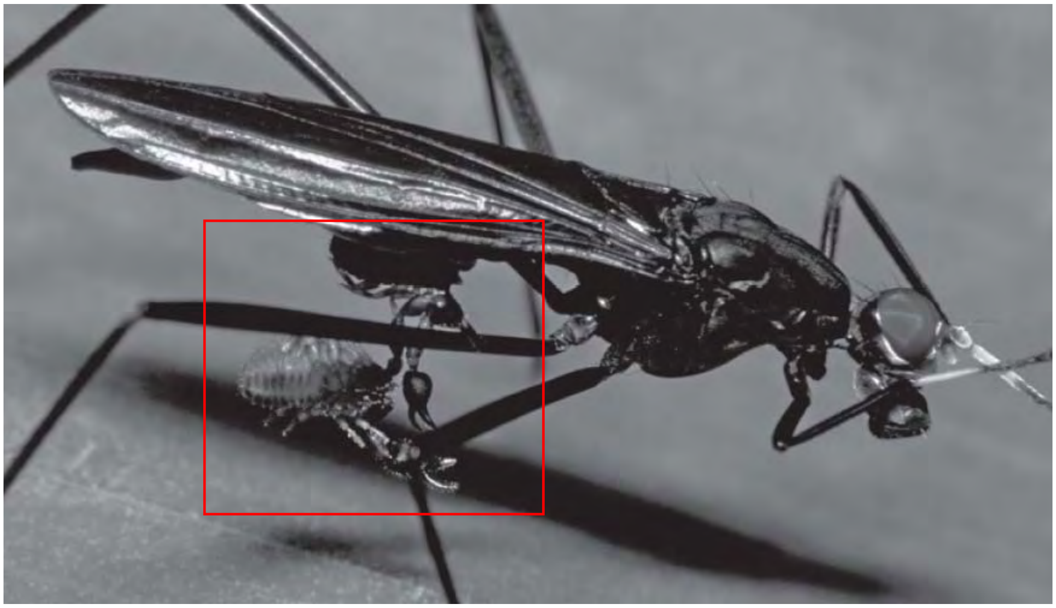

Figure 15 Passive Dispersal of Chernetid Pseudoscorpions Using a Fly Host (Szymkowiak *et al.* 2007)

Austrohorus sp.

Four specimens *Austrohorus* sp. were collected from sites 25, 27 and 44, all located outside the mining and infrastructure footprint. The genus is very diverse in Australia, with many undescribed species. The lack of certainty regarding the identification of individual species and their distributions makes the **assessment of short-range endemism very difficult at this stage** (M. S. Harvey, pers. comms.).

Euryolpium sp.

Two *Euryolpium* specimens were recorded at site 47 outside the mining and infrastructure footprint. Species of *Euryolpium* are commonly found under bark and under rocks throughout northern Australia. They can be locally abundant, and at least one species is quite widespread across northern Australia. This species is **not a SRE species** (M.S. Harvey, pers. comm.).

Indolpium sp.

Single specimens of *Indolpium* were collected from sites 25, 27, 35 and 28, located both inside and outside the mining and infrastructure footprint. The specimens probably comprise more than one species and similar specimens have been collected from other regions of Western Australia, suggesting that each species is relatively widespread. Based on our current levels of knowledge, it appears that these species are **not short-range endemic species.**

5.2.2 Crustaceans (Phylum Arthropoda, Subphylum Crustacea)

5.2.2.1 Isopods (Class: Malacostraca, Order Isopoda)

Armadillidae (Brandt, 1831)

***Pseudolaureola* (Kwon, Ferrara & Taiti, 1992)**

sp.new

A new species of *Pseudolaureola* (Figure 16) was collected from sites 3, 4, 6, 8, 9, 13 14, 19, 20 and 22, both inside and outside the mining and infrastructure footprint. This genus is widespread in wetter parts of the south-west of Australia, particularly in the karri forest, and is composed of SRE species, therefore the species **is considered to be a SRE.** This was a significant find and a revision of a number of biogeography theories will be required (S. Judd, pers. comm.).

Figure 16 Isopod from the Genus *Pseudolaureola*

***Buddelundia* (Michaelsen, 1912)**

sp. unknown

New species of the genus was collected from sites 1, 3, 9, 10, 15, 16, 18 and 19, both inside and outside the mining and infrastructure footprint. The species closely resembled *Buddelundia cinerascens* which is found north of Perth in sandy limestone soils: however, it is probably not *B. cinerascens* but rather a close relative. The species is physically robust and locally widespread within its range, particularly in coastal and arid areas. **This is not a SRE species** (S. Judd, pers. comm.).

***Platyarthridae* (Vandel, 1946)**

sp. new

A new species from this family was collected from sites 4, 9, 10, 11 and 12, both inside and outside the mining and infrastructure footprint. To date, only one species, *Trichorhina australiensis*, has been described from this family in Western Australia, and it does not match the characteristics of the specimens collected from the operational area. These are small, cryptic and primitive species but they are widespread and thus **not a SRE species** (S. Judd, pers. comm.).

5.2.3 Myriapods (Phylum Arthropoda, Subphylum Myriapoda)

5.2.3.1 Millipedes (Subphylum Myriapoda, Class Diplopoda)

Paradoxosomatidae (Daday, 1889)

***Antichiropus* (Attems, 1911)**

sp. 1, sp. 2 and 'sp. juv'

Two new, undescribed species from the genus *Antichiropus* were recorded. *Antichiropus* sp. 1 was collected from sites 2, 11, 14, 17 and 20, both inside and outside the mining and infrastructure footprint. *Antichiropus* sp. 2 was collected from sites 13 and 31, located inside and outside the mining and infrastructure footprint. An unidentifiable, juvenile specimen was also recorded from site 32 located outside the mining and infrastructure footprint. This genus was first named in 1911 for seven species (Attems 1911), and additional species were added by Jeekel (1982) and Shear (1992). As the result of large field surveys and taxonomic work at the Western Australian Museum, the genus is now known to consist of over 100 species, ranging as far north as Cape Range and Barlee Range, and extending onto the Nullarbor Plain and the Eyre Peninsula in South Australia (M. Harvey, pers. comm.).

With the exception of *Antichiropus variabilis*, which inhabits the jarrah forests of south-western WA, all recorded species of the genus are known to be SREs, and many are known from areas of only a few hundred square kilometres (Harvey *et al.* 2000; Harvey 2002b). However, the vast majority of *Antichiropus* species are currently undescribed. Dr Mark Harvey has spent the past decade comparing different species of the genus and assigning temporary codes to each of the species. The distinction between species is largely based upon differences in the male reproductive structure (gonopods). These are modified legs on the seventh abdominal segment that are used to store sperm prior to mating. The shape of the gonopod of each *Antichiropus* species is different, making the identification of individual species a relatively simple task. These differences in gonopod morphology have been used in millipede taxonomy for 150 years, and have been shown to be good indicators of valid biological species.

Antichiropus have a seasonal lifecycle with limited dispersal. They are only active on the surface of soil and leaf litter after rainfall, usually during the winter months. When the ground has been moistened they emerge from underground to mate. The specimens were recorded during June 2008 after relatively heavy rainfall was recorded at nearby locations (approx 34 mm in Balgair).

It is highly likely that the collected specimens are SRE species (M. Harvey, pers. comm.).

Polyzoniida (Hoffman, 1980)

Family/genus/sp. unknown

Nine specimens from the order Polyzoniida (Figure 17) were recorded at sites 27, 38 and 47 located both inside and outside the mining and infrastructure footprint. This is the first time this species has been observed outside of wet habitats (i.e. Karri forest) and it is therefore **likely to be a SRE species** (E. Volschenk, pers. comm.).

Polyxenida

***Synexidae* (Sylvestri, 1923)**

sp. unknown

A single specimen was recorded at site 33 outside the mining and infrastructure footprint. The taxonomy of the Australian Polyxenid fauna is very poorly understood and the status of the specimen from TGP is uncertain: however, it **is unlikely to represent a SRE species** (M.S. Harvey, pers. comm.).

Figure 17 Millipede from the Order Polyzoniida

5.2.4 Molluscs (Mollusca)

5.2.4.1 Snails (Phylum Mollusca, Class Gastropoda)

Pupillidae (Gabriel, 1930)

Gastrocopta bannertonensis

Two small specimens (height 2.95 - 3.19 mm) were collected at site 46 outside the mining and infrastructure footprint. The shells exhibit characters consistent with those of the dextral species *Gastrocopta bannertonensis* (Gabriel 1930), which has a wide geographic distribution in southern Australia, having been recorded from the southern regions of Western Australia, South Australia and New South Wales. There is also an isolated record from an area to the north-west of Alice Springs in the Northern Territory (Pokryszko 1996).

Another similarly dextral species, *Gastrocopta margaretae* (Cox 1868), is often found to occur sympatrically with *G. bannertonensis*, but differs slightly in shell aperture characters.

This species also has a wide geographic distribution, being found along the western and southern coastal areas of Western Australia, the southern regions of South Australia and the area near Alice Springs in the Northern Territory. There is also an isolated record from the King Leopold Ranges in the north of Western Australia (Pokryszko 1996).

This is not a SRE species (S. Slack-Smith, pers. comm.).

Table 6 Summary of All Species Collected Inside and Outside the Mining and Infrastructure Footprint (species of conservation significance highlight in red)

Taxa	Species Located Inside	Site	Species Located Outside	Site
Mygalomorphae spiders	*Aganippe* sp.1	T5	-	-
	Aganippe sp.2	T4, 13	*Aganippe* sp.2	T34, 35, 37, 47
	Aganippe sp.3.	T13	*Aganippe* sp.3	T42
	Aganippe sp.4	T16	-	-
	-	-	*Aganippe* sp.5	T34,47
	-	-	*Aganippe* sp.6	T34
	-	-	*Aganippe* sp.7	T33, 43, 45, 47
	-	-	*Aganippe* sp.8	T30,47
	Aname sp.1	T13, camp	-	-
	Aname sp.2.	Havana Bore, T3,13	*Aname* sp.2	T14, F3 and F13
	Aname sp.3	T13, 15, 19	-	-
	Aname sp.4	T5	-	-
	Anidiops manstridgei	T2, 3, 13	*Anidiops manstridgei*	T33, 34, 36
	Cethegus ischnotheloides	T16	*Cethegus ischnotheloides*	T28
	Chenistonia tepperi	T1, 2	-	-
	-	-	*Eucyrtops* sp.	T34
	Kwonkan sp.1	T3, 5, 15, 16	*Kwonkan* sp.1	T10, 14, 22
	Kwonkan sp.2	T4	-	-
	Mandjelia humphreysi	T5, 13	-	-
	Missulena insignis	T1, 9	*Missulena insignis*	T25, 36
	-	-	*Nemesiidae* new. genus 1	T23, 28, 36, 37, 44
	-	-	*Nemesiidae* new. genus 2	T25, 46
	Synothele meadhunteri	T4, 13	*Synothele meadhunteri*	T34
	-	-	*Synothele* \`*procacis*\`	T33
	Synothele 'megaspiral'	T6, 18	*Synothele* 'megaspiral'	T37
	Teyl sp.1	2, 3, 15	*Teyl* sp.1	T14

Table 6 Cont.

Taxa	Species Located Inside	Site	Species Located Outside	Site
Scorpions	-	-	*Cercophonius* sp.	T38
	Lychas 'adonis'	T1, 2, 3, 4, 5, 6, 8, 9, 11, 13, 15, 17, 18, 19, 20	*Lychas* 'adonis'	T10, 37, 24, 45
	Lychas 'annulatus'	T6, 12, 15	*Lychas* 'annulatus'	T10, 25, 47, 33, 24
	Urodacus yaschenkoi	T4, 6, 13, 15	*Urodacus yaschenkoi*	T10, 14, 46
	-	-	*Urodacus* sp.	T43
	-	-	*Isometroides* sp. unknown	T34, 42
Pseudoscorpions	*Austrohorus* sp.	T27	*Austrohorus* sp.	T25, 44
	Beierolpium sp. (8/3)	T9, 17, 11, 18, 23, 27, 41	*Beierolpium* sp. (8/3)	T10, 25, 28, 29, 30, 31, 32, 33, 34, 35, 37, 39, 44, 46, 47
	Chernetidae genus new sp.new	T1, 3, 27	Chernetidae genus new sp.new	T25, 35, 31
	-	-	*Euryolpium* sp.	T47
	Indolpium sp.	T27	*Indolpium* sp.	T25, 28, 35
Isopods	*Buddelundia* sp.unknown	T1, 3, 9, 15, 16, 18, 19	*Buddelundia* sp.unknown	T10
	Platyarthridae sp.new	T4, 9, 11, 12	Platyarthridae sp.new	T10
	Pseudolaureola sp. new	T3, 4, 6, 8, 9, 13, 19, 20	*Pseudolaureola* sp. new	T14, 22, F4
Millipedes	*Antichiropus* sp.1	T2, 11, 17, 20	*Antichiropus* sp.1	T14
	Antichiropus sp.2	T13	*Antichiropus* sp.2	31
	-	-	*Antichiropus* 'sp.juv'	32
	Polyzoniida (Fam.gen.sp. unknown)	T27	*Polyzoniida* (Fam.gen.sp.unknown)	T38, 47
	-	-	*Polyxeniida* (Fam.gen.sp.unknown)	T33
Snails	-	-	*Gastrocopta bannertonensis*	T46
Total Number of Species	**28**		**39**	

Table 7 Species of Conservation Interest Collected within the Operational Area (2006 / 2008). Species not impacted by TGP are in Black; species partially impacted by TGP are in Red; species fully impacted by the TGP are highlighted in Red.

Class	Order	Family	Genus	Species	inside 2006	outside 2006	inside 2008	outside 2008
Arachnida	Mygalomorphae	Barychellidae	*Synothele*	'megaspiral'	T6, 18		*	T37
Arachnida	Mygalomorphae	Idiopidae	*Aganippe*	species 1	T5	*	*	*
Arachnida	Mygalomorphae	Idiopidae	*Aganippe*	species 3	T13	*	*	T42
Arachnida	Mygalomorphae	Idiopidae	*Aganippe*	species 4	T16	*	*	*
Arachnida	Mygalomorphae	Idiopidae	*Aganippe*	species 5	*	*	*	T34, 47
Arachnida	Mygalomorphae	Idiopidae	*Aganippe*	species 6	*	*	*	T34
Arachnida	Mygalomorphae	Idiopidae	*Aganippe*	species 8	*	*	*	T30, 47
Arachnida	Mygalomorphae	Idiopidae	*Anidiops*	*manstridgei*	T2, 3, T13	*	*	T34, 36
Arachnida	Mygalomorphae	Nemesidiae	*Aname*	species 2	Havana bore, T3, 13	T14, F3 & F13	*	*
Arachnida	Mygalomorphae	Nemesidiae	*Kwonkan*	species 1	T3, 5, 15, 16	T10, 14, 22	*	*
Arachnida	Mygalomorphae	Nemesidiae	*Kwonkan*	species 2	T4	*	*	*
Arachnida	Mygalomorphae	Nemesidiae	new	new 1	*	*	*	T23, 28, 36, 37, 44
Arachnida	Mygalomorphae	Nemesidiae	new	new 2	*	*	*	T25, 46
Arachnida	Pseudoscorpionida	Chernetidae	new	new	T1, T3	*	T27	T25, 31, 35
Arachnida	Scorpiones	Bothriuridae	*Cercophonius*	new	*	*	*	T38
Crustacea	Isopoda	Armadillidae	*Pseudolaureola*	new	T3, 4, 6, 8, 9, 13, 19, 20	T 14, 22, F4	*	*
Diplopoda	Polydesmida	Paradoxosomatidae	*Antichiropus*	species 1	T2, 11, 17, 20	T14	*	*
Diplopoda	Polydesmida	Paradoxosomatidae	*Antichiropus*	species 2	T13	*	*	T31
Diplopoda	Polyzoniida	Polyzoniidae	unknown	unknown	*	*	T27	T38, 47

5.3 Completeness of Survey Set

The taxonomic and morphological species of all potential SREs and sample locations of each sampling point was entered into a database and analysed separately for areas to be impacted by the operational area (inside the mining and infrastructure footprint) and areas not to be impacted (outside the mining and infrastructure footprint). Sample order was randomised to obtain mean species accumulation curves in order to determine the degree of sampling completeness. The results show that the curves in both areas reach plateau, therefore the sampling effort has been adequate (Figure 19 and Figure 20). However, the rarefaction method showed that there is a significant difference in species diversity (abundance and composition) between the 'inside' and 'outside' areas (T= -4.34, p=0.000; Figure 18) and thus further characterisation of habitat and microhabitats in the 'inside' area will need to be conducted and matched to habitats in the 'outside' areas in order to locate all the species of conservation significance outside the proposed mining and infrastructure footprint.

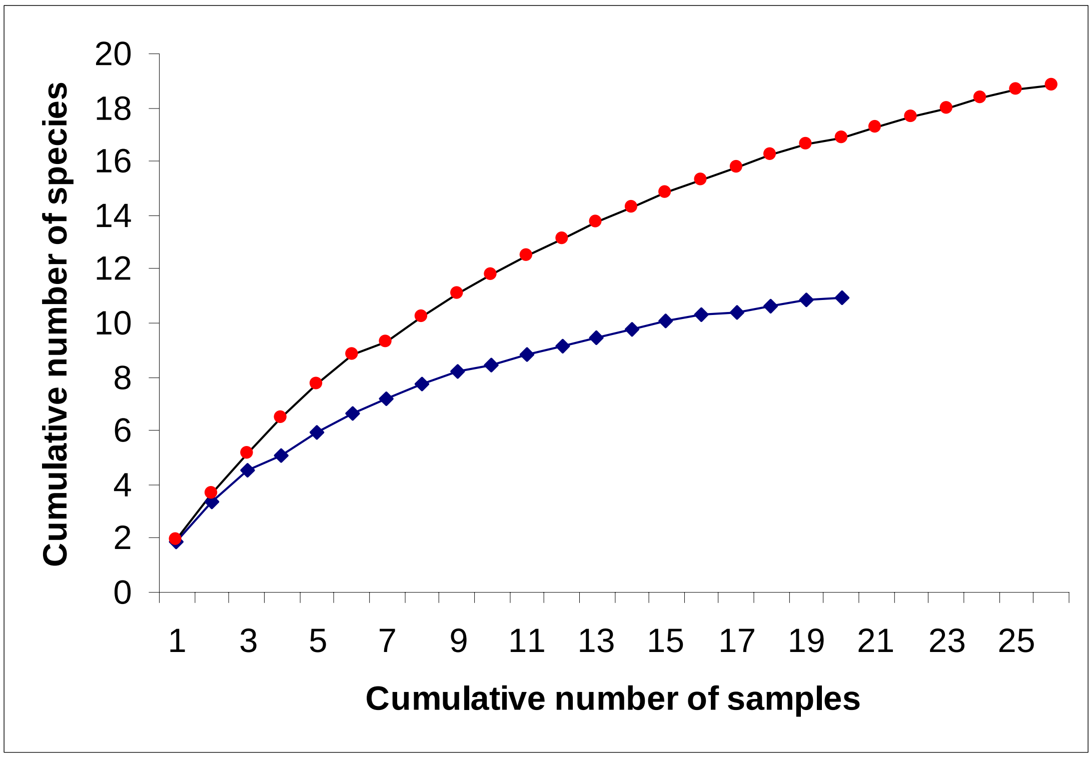

Figure 18 Rarefaction Curves of Species Diversity; Blue – Inside, Red – Outside

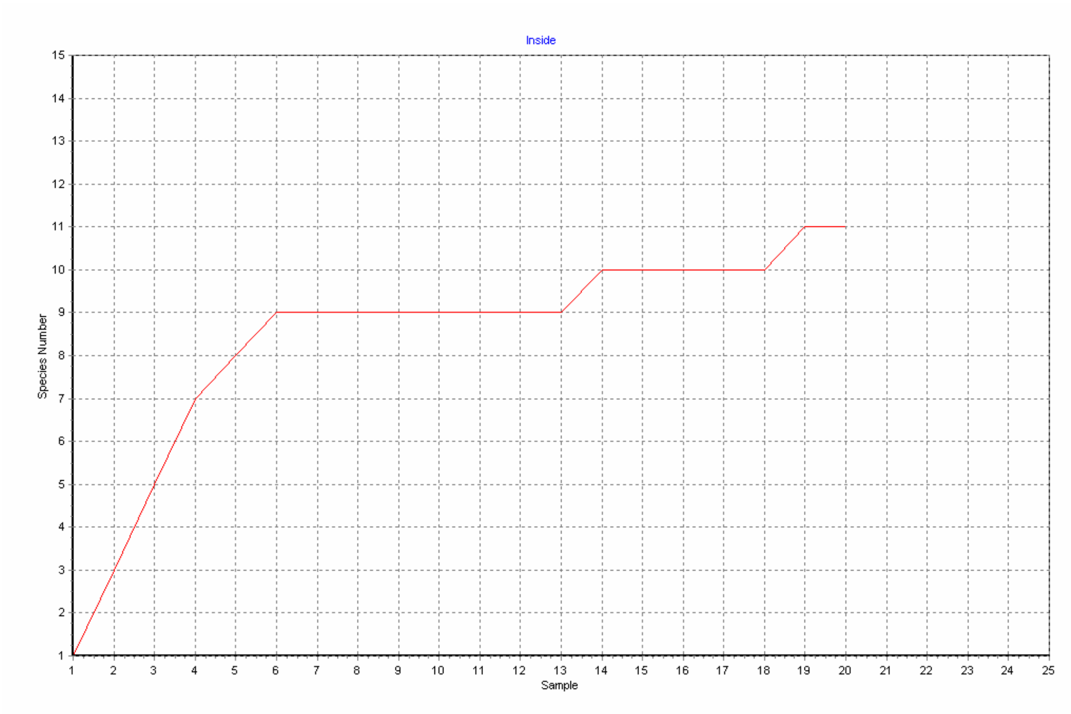

Figure 19 Species Accumulation Curve for 'Inside' Area

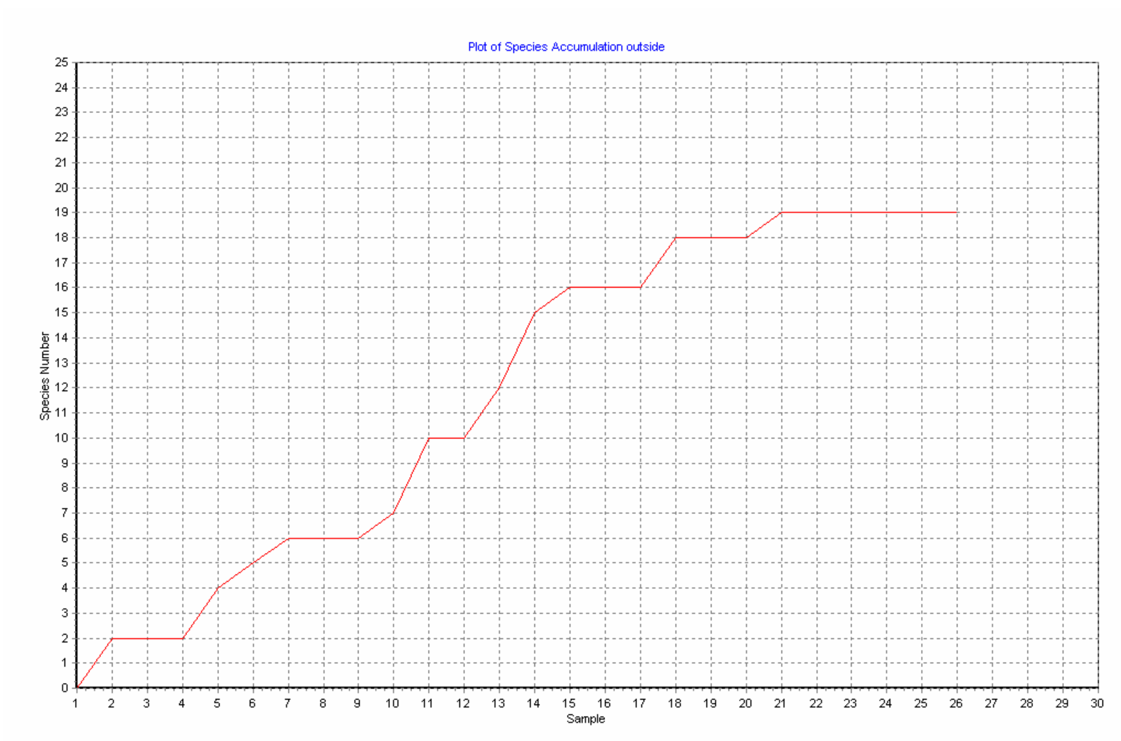

Figure 20 Species Accumulation Curve for 'Outside' Area

6.0 DISCUSSION

Unlike most deserts, the area around the TGP operational area is unexpectedly rich in invertebrate biodiversity. The presence of the wet karri-forest species, such as the millipede from the order Polyzoniida, the scorpion from the genus *Cercophonius* and the isopod from the genus *Pseudolaureola,* suggests that relictual habitats originating from much wetter climate periods persist in the area (Main 1987). In addition, the high diversity of mygalomorph spiders, particularly from the arid adapted genera such as *Aganippe*, suggests that historical events including multiple radiations/adaptations must have occurred in the area (Main 1982; Main 2001). Nevertheless, given that none of the species were associated with highly localised landscape units (i.e. ranges) and the features of the landscape are known to extend well beyond the proposed operational footprint and the survey sampling areas, it is highly likely that both the historical and the current ecological/evolutionary processes have been occurring on a much larger scale.

After combining the survey data recorded from the 2006 and 2008 SRE surveys, the results show a total of 46 different species were collected from within the TGP operational area (Table 6). From the taxa recorded, 41% (19 species) were of conservation interest. These species are not currently listed as protected fauna: however, all are new to science and/ or belong to genera composed predominantly of SRE species and are thus considered to be of conservation significance.

Of the 19 species of conservation significance, three species of mygalomorph spiders, *Aganippe* sp.1, *Aganippe* sp. 4 and Kwonkan sp. 2, are currently fully impacted by the TGP mining and infrastructure footprint. These species were collected in 2006 from single locations within the operational footprint and have not been re-collected since.

Ten of the 19 species were recorded from both within and outside of the proposed mining and infrastructure footprint, thus being partially impacted by the TGP. These were the mygalomorph spiders *Synothele* 'megaspiral', *Aganipe* sp. 3, *Anidiops mastridgei*, *Aname* sp. 2 and *Kwonkan* sp. 1, and the isopod *Pseudolaureola,* the millipedes *Antichiropus* sp.1, sp.2, the millipede from the order Polyzoniidae, and the Chernetidae pseudoscorpion. Some of these species have been collected elsewhere in Australia, i.e. *Anidiops mastridgei* at Lawlers (Main 1957b), *Aname* sp. 2 at Queen Victoria Springs (B.Y. Main, pers. comm.).

Six of the 19 species were recorded exclusively outside of the proposed mining and infrastructure footprint. These included the mygalomorph spiders *Aganippe* sp. 5, *Aganippe* sp. 6, *Aganippe* sp. 8 and two new species from two unknown genera of Nemesiidae, and the scorpion from the genus *Cercophonius*.

In conclusion, the TGP will have a small impact upon the majority of species of conservation significance recorded within the operational area. However, to minimise the impact on the mygalomorph spiders *Aganippe* sp.1 and *Aganippe* sp.4 and Kwonkan sp. 2 (currently recorded exclusively within the proposed impact areas), all efforts should be made to locate them outside of the proposed mining and infrastructure footprint. In addition, as the TGP is an area of extremely high biodiversity, it is recommended that AGAA take a precautionary and preventative approach to mining and that the management recommendations outlined in this report are strictly adhered to.

7.0 MANAGEMENT RECOMMENDATIONS

Four risk issues were identified in the course of conducting the risk assessment for the TJV's Tropicana Gold Project. These included vegetation clearing, vibrations and ground disturbance, dust and fire. The following management recommendations may mitigate potential risks on SRE species:

1. Clearing should be restricted to that which is necessary. Clearing boundaries should be defined in the field. As some of the species recorded outside the impact were still very close to the mining and infrastructure footprint, additional clearing could have direct negative impacts on these species and thus should be avoided.
2. Areas likely to contain potential SRE species such as drainage lines and densely vegetated areas with high moisture retention should not be cleared of vegetation or be disturbed by machinery if possible.
3. Cleared areas should be rehabilitated as soon as practical.
4. Dust suppression measures should be implemented, including management of road speed on unsealed roads.
5. A fire prevention strategy should be implemented.
6. Suitable fire fighting equipment should be available onsite at all times

A risk assessment was undertaken to determine potential impacts arising from the development on invertebrate fauna and the residual impacts following the implementation of management strategies identified in this document. The level of risks is classified as either "High" (site/issue specific management programmes required, advice/approval from regulators required), "Medium" (specific management and procedures must be specified) or "Low" (managed by routine procedures) (Appendix 6).

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Appendix 1

Legislative Framework

Legislative Framework

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

- *The Precautionary Principle*

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

- *The Principles of Intergenerational Equity*

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

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

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

Projects undertaken as part of the Environmental Impact Assessment (EIA) process are required to address guidelines produced by the EPA, in this case Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact in Western Australia (EPA 2004b), and principles outlined in the EPA's Position Statement No. 3 Terrestrial Biological Surveys as an element of Biodiversity Protection (EPA 2002).

Native fauna in Western Australia are protected at a Federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a State level under the *Wildlife Conservation Act 1950* (WC Act).

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

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all fauna and flora within Western Australia are protected; however, the Minister may, via a notice published in the *Government Gazette*, declare a list of fauna taxa identified as likely to become extinct, or is rare, or otherwise in need of special protection.

Appendix 2

2006 Survey Pitfall Trap and Hand Foraging Sites

2006 Survey Pitfall Trap Sites (WGS84 UTM)

Site ID	GPS Co-ordinates			Location
	Zone	Easting	Northing	Inside/Outside
TROP1	51 J	649639	6760082	Inside
TROP2	51 J	649930	6760407	Inside
TROP3	51 J	649626	6761074	Inside
TROP4	51 J	649697	6761269	Inside
TROP5	51 J	650120	6761389	Inside
TROP6	51 J	650279	6761596	Inside
TROP7	51 J	650741	6762445	Inside
TROP8	51 J	651501	6763065	Inside
TROP9	51 J	653039	6763098	Inside (very close to road)
TROP10	51 J	652701	6764349	outside
TROP11	51 J	650737	6765456	Inside
TROP12	51 J	650495	6765027	Inside
TROP13	51 J	650174	6764377	Inside
TROP14	51 J	647611	6765013	outside
TROP15	51 J	649126	6763652	Inside
TROP16	51 J	648259	6763567	Inside
TROP17	51 J	648273	6762350	Inside
TROP18	51 J	647973	6762721	Inside
TROP19	51 J	647358	6761987	outside
TROP20	51 J	647108	6761949	outside
TROP21	51 J	647692	6766663	outside
TROP22	51 J	647590	6766406	outside

2006 Survey Hand Foraging Sites (WGS84 UTM)

Site ID	GPS Co-ordinates			Location
	Zone	Easting	Northing	Inside/Outside
FRG001	51 J	647699	6766447	outside
FRG002	51 J	647665	6766488	outside
FRG003	51 J	647713	6766514	outside
FRG004	51 J	647663	6766560	outside
FRG005	51 J	647780	6766591	outside
FRG006	51 J	647722	6766635	outside
FRG007	51 J	647815	6766606	outside
FRG008	51 J	647661	6766679	outside
FRG009	51 J	647869	6766556	outside
FRG010	51 J	647672	6764985	outside
FRG011	51 J	647632	6764968	outside
FRG012	51 J	647743	6764985	outside
FRG013	51 J	647660	6764852	outside
FRG014	51 J	649283	6764899	Inside (v.close to road)
FRG015	51 J	649307	6764785	Inside (v.close to road)
FRG016	51 J	649416	6764912	Inside (v.close to road)
FRG017	51 J	650088	6764090	Inside
FRG018	51 J	650010	6764108	Inside
FRG019	51 J	650044	6764036	Inside
FRG020	51 J	649994	6764034	Inside
FRG021	51 J	654523	6763221	outside
FRG022	51 J	649731	6761616	inside
FRG023	51 J	653772	6764033	outside
FRG024	51 J	649885	6761743	Inside
FRG025	51 J	651499	6763119	Inside
FRG026	51 J	649881	6761736	Inside
FRG027	51 J	648568	6761208	Inside
FRG028	51 J	648281	6762350	inside
FRG030	51 J	649717	6761657	outside
FRG032	51 J	655188	6762465	outside
FRG034	51 J	655085	6762437	outside
FRG036	51 J	654429	6763162	outside
FRG038	51 J	654429	6763243	outside
FRG040	51 J	653663	6764019	outside
FRG042	51 J	653516	6763998	outside
FRG044	51 J	651537	6763140	Inside

Site ID	GPS Co-ordinates			Location
	Zone	Easting	Northing	Inside/Outside
FRG046	51 J	651666	6763148	Inside
FRG048	51 J	648741	6761112	inside
FRG050	51 J	648668	6760974	inside
FRG052	51 J	648551	6761086	outside
FRG054	51 J	646835	6761500	outside
FRG056	51 J	643625	6761541	outside
FRG058	51 J	643584	6761542	outside
FRG060	51 J	647346	6761939	outside
FRG062	51 J	647296	6761882	outside
FRG064	51 J	647397	6761925	outside

Appendix 3

2006 Site Descriptions (Pitfall Traps and Hand Foraging Sites)

2006 Site Descriptions (Pitfall Traps and Hand Foraging Sites)

Pitfall Site 1.

Eucalyptus gongylocarpa open low woodland, over open to moderately dense *Callitris columellaris* tall shrubs, over open mixed shrubs *Triodia* sp. hummock grass.

Plentiful leaf litter, mainly under shrubs and sparse wood litter

Red-orange sand

Pitfall Sites 2, 3, 4.

Eucalyptus gongylocarpa open low woodland, over *Eucalyptus trivalvis* sparse mallee, over open low shrubs and *Triodia basedowii* moderately dense hummock grassland.

Moderate leaf litter, mainly under trees and sparse wood litter

Orange sand

Pitfall Sites 5, 6.

Eucalyptus trivalvis open medium mallee, over *Acacia jamesiana* sparse medium shrubs, over *Triodia basedowii*

Sparse leaf litter, mainly under shrubs and sparse wood litter

Red-orange sandy loam

Pitfall Site 7.

Eucalyptus gongylocarpa open low woodland, over open mixed shrubs, over open *Triodia basedowii* hummock grass.

Sparse leaf litter, mainly under shrubs and sparse wood litter

Red-orange sand

Pitfall Site 8.

Codonocarpus cotinifolius sparse to low trees, over *Thryptomene biseriata*, over open medium shrubs, over *Anthotroche pannosa* and *Dicrastylis nicholasii* low shrubs.

Sparse Leaf litter mainly under shrubs, sparse wood litter

Red-orange sand

Pitfall Site 9.

Casuarina pauper (sheoak) open medium woodland, over *Acacia aneura var. argentea* trees-shrubs, over open mixed shrubs dominantly *Eremophila scoparia* and *Scaevola spinescens.*

Moderate leaf litter mainly under shrubs

Red-orange clay loam

Pitfall Site 10.

Casuarina pauper (sheoak) open medium woodland, over sparse *Eucalyptus concinna* mallee, over open *Senna artemisioides* subsp. *petiolaris* medium shrubs

Undulating Plain. Moderate leaf litter, mainly under shrubs and sparse wood litter

Red sandy clay, Calcrete bedrock

Pitfall Sites 11, 12.

Acacia aneura var. *aneura* (mulga) m*oderately dense* tall shrubland, over very isolated medium shrubs, over isolated *Eragrostis eriopoda* and *Monachather paradoxus* tussock grasses.

Flat Plain. Sparse leaf litter, mainly under shrubs and moderate wood litter

Red loamy sand

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Pitfall Sites 13, 15.

Open post-fire regrowth of *Eucalyptus gongylocarpa*, over regrowth shrubs of *Duboisia hopwoodii* and low *Aluta maisonneuvei* subsp. *auriculata* , over *Triodia baseodowii* hummock grass.

Plain. Sparse leaf litter, mainly under shrubs and sparse wood litter

Red-orange sand

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Pitfall Site 14.

Post-fire: *Eucalyptus ewartiana* open medium mallee, over *Codonocarpus cotinifolius* and *Callitris preissii* trees-shrubs, over other shrubs such as *Aluta maisonneuvei* subsp. *auriculata* and *Solanum plicatile*, with *Amphipogon caricinus* and *Triodia basedowii* grasses.

Inter-dune swale. Red sand

Post-fire: *Acacia acanthoclada* subsp. *acanthoclada* and other mixed sparse to scattered low or dwarf shrubs and grasses.

Linear dune crest and slope.

Yellow sand

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Pitfall Sites 16,18. *Callitris columellaris* scattered trees, over *Eucalyptus youngiana* sparse mallee, over *Anthotroche pannosa* / *Pityrodia loricata* open low shrubland, over *Triodia desertorum* open hummock grass. Dune Crest. Sparse leaf litter, mainly under shrubs and sparse wood litter. Burnt a long time ago Red-orange fine sand	
Pitfall Site 17. *Casuarina pauper* (sheoak) open medium woodland, over *Acacia aneura* var. *argentea* trees, over open mixed shrubs of *Senna, Maireana* and *Eremophila* spp. Moderate leaf litter mainly under shrubs Red-orange clay loam	
Pitfall Sites 19, 20. *Eucalyptus gongylocarpa* low woodland, over *Callitris* ?*collumellaris* moderately dense tall shrubland, over open *Triodia desertorum* hummock grass. Plain flat. Red-orange sand	

Pitfall Sites 21, 22. Mixed *Acacia aneura* (mulga) mid-dense low woodland, over mid-dense tall shrubs of dominantly *Eremophila latrobei* subsp. *latrobei* / *Dodonaea rigida*, over *Triodia basedowii* hummock grass. Rocky sandstone slope. Sparse leaf litter, mainly under shrubs and sparse wood litter Pale orange sandy clay.	

2006 Hand Foraging Sites

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FG Sites 1 to 13

Mixed *Acacia aneura* (mulga) mid-dense low woodland, over mid-dense tall shrubs of dominantly *Eremophila latrobei* subsp. *latrobei* / *Dodonaea rigida*, over *Triodia basedowii* hummock grass.

Rocky sandstone slope. Sparse leaf litter, mainly under shrubs and sparse wood litter

Pale orange sandy clay.

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FG Sites 14 to 20

Open post-fire regrowth of *Eucalyptus gongylocarpa*, over shrub regrowth of *Duboisia hopwoodii* / low *Aluta maisonneuvei* subsp. *auriculata* shrubs, over *Triodia basedowii* hummock grass.

Plain. Sparse leaf litter, mainly under shrubs and sparse wood litter

Red-orange sand

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FG Sites 21, 32, 33 Mixed Mulga (*Acacia aneura*) sparse low woodland or emergent trees, over *Senna artemisioides* subsp. *petiolaris* Solanum spp., chenopods and mixed tussock grassland. Plain / flat. Sparse leaf litter, mainly under shrubs and sparse wood litter Red sandy clay, calcrete and quartz	
FG Sites 22, 24, 26, 29 *Eucalyptus trivalvis* open medium mallee, over *Acacia jamesiana* sparse medium shrubs, over *Triodia basedowii* hummock grassland-steppe. Sparse leaf litter, mainly under shrubs and sparse wood litter Red-orange sandy loam	

FG Sites 25, 36, 37

Codonocarpus cotinifolius sparse to low trees, over *Thryptomene biseriata*, over open medium shrubs, over *Anthotroche pannosa* and *Dicrastylis nicholasii* low shrubs

Sparse Leaf litter mainly under shrubs, sparse wood litter

Red-orange sand

FG Sites 30, 31

Eucalyptus concinna sparse tall mallee, over mixed Mulga (*Acacia aneura*) open tall shrubland, over Senna *artemisioides* subsp. *petiolaris* medium shrubs and *Triodia basedowii* open hummock grass.

Undulating plain Moderate leaf litter, mainly under shrubs and sparse wood litter. Loose soil and surface crust

Red-orange sandy clay

FG Sites 23, 34, 35

Eucalyptus low woodland, over *Callitris* - moderately dense tall shrubland, over open Triodia desertorum hummock grass.

Flat plain.

Leaf litter under shrubs with sparse wood litter.

Red-orange sand

NO IMAGE AVAILABLE

FG Sites 27, 38, 39, 40

Dune Crest. *Callitris columellaris* scattered trees, over *Eucalyptus youngiana* sparse mallee, over *Anthotroche pannosa* / *Pityrodia loricata* open low shrubland, over *Triodia desertorum* open

hummock grass. Sparse leaf litter, mainly under shrubs and sparse wood litter. Burnt a long time ago Red-orange fine sand	
FG Sites 41 *Eucalyptus gongylocarpa* low woodland, over *Callitris ?collumellaris* moderately dense tall shrubland, over open Triodia desertorum hummock grass. Plain-flat. Red-orange sand leaf litter under shrubs and sparse wood litter	

FG Sites 42, 43 *Eucalyptus horistes* open medium mallee, over *Acacia eremophila* var. *variabilis* / *Halgania cyanea* var. Allambi Stn (B.W. Strong 676) dwarf shrubs, over *Triodoa* sp. moderately dense hummock grass. Undulating plain, Loose soil, surface crust, Moderate leaf litter, mainly under shrubs and sparse wood litter Orange sand	
FG Sites 44, 45, 46 *Eucalyptus gongylocarpa* low woodland, over *Callitris ?collumellaris* moderately dense tall shrubland, over open Triodia desertorum hummock grass. Plain-flat. Red-orange sand leaf litter under shrubs and sparse wood litter	

Appendix 4

2008 Location and GPS Coordinates of Pitfall Trap Sites

Location and GPS Coordinates of Pitfall Trap Sites 2008

Site ID	GPS Co-ordinates			Location
	Zone	Easting	Northing	Inside/Outside
TROP23	51 J	667167	6758770	outside
TROP24	51 J	666251	6758559	outside
TROP25	51 J	665319	6759012	outside
TROP26	51 J	664421	6759575	Inside
TROP27	51 J	662540	6762247	Inside
TROP28	51 J	654920	6760980	outside
TROP29	51 J	655066	6760587	outside
TROP30	51 J	655201	6760390	outside
TROP31	51 J	655261	6760146	outside
TROP32	51 J	655292	6759713	outside
TROP33	51 J	658039	6776068	outside
TROP34	51 J	658405	6774998	outside
TROP35	51 J	659090	6773612	outside
TROP36	51 J	659626	6773424	outside
TROP37	51 J	660461	6772778	outside
TROP38	51 J	646756	6758396	outside
TROP39	51 J	647009	6758378	outside
TROP40	51 J	647429	6758539	Not installed
TROP41	51 J	647582	6758711	outside
TROP42	51 J	648696	6758439	outside
TROP43	51 J	647512	6766689	outside
TROP44	51 J	655223	6762450	outside
TROP45	51 J	655026	6762675	outside
TROP46	51 J	654786	6763172	outside
TROP47	51 J	654598	6763516	outside

Appendix 5

2008 Vegetation Descriptions of Pitfall Trap Sites

<table>
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Pitfall Site 23

Eucalypt and *Acacia* dominated to 3 m over grasses,sand and small shrubs.

Leaf litter with lots of twig and stick debris.

Red-orange sand

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Pitfall Site 24

Open grassland under hop bush. Very sparse *Acacia* sp to 2m.

Some fine leaf litter with bare patches (open sand) in between.

Many scorpion burrows visible.

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Pitfall Sites 25

Large, white *Eucalyps* and *Acacia*, dense thicket. Some Spinifex but mostly grasses and other low shrubs. Lots of leaves and debris under trees with around 30% bare earth outside of tree cover.

Plentiful leaf litter.

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Pitfall Site 26

Open grassland with clumps of Acacia sp. to 1m. 50% Bare earth.

Little leaf litter.

Pitfall Site 27

Acacia aneura woodland overlain by grasses and shrubs to 1.5m.

Plentiful leaf litter under Acacia with bare earth in between trees.

Pitfall Sites 28 to 32

Eucalyp sp. woodland with some *Acacia*. Mature Spinifex.

Thick leaf litter under Eucalyps.

Patches of bare earth with gravely soil at survace. Sediment cemented.

Pitfall Site 33, 34

Acacia aneura – sparse woodland. Grass under-storey with mixed shrubs.

Aganippe spider dug from burrow at this site.

Pitfall Site 35

Acacia aneura open woodland with blue bush Maireana (?) sp. understorey and grasses.

Pitfall Sites 36

Weeping, small '*Calistomen*' and large *Eucalyp* to 6m – white/salmon bark.

Variety of shrub understorey and grasses 70%.

Bare earth between trees.

100% leaf litter and debris under trees.

Course sands suggesting ancient river channel.

Pitfall Site 37 Dominated by mature Spinifex – 50%. Bare sand overstorey, large *Acacia* sp with accumulated leaf litter beneath. Red sand and a few mature *Eucalyptus*.	
Pitfall Site 38 East-west facing dune. Eucalypts present mid to peak. Eucalypts have large nuts. Diverse understorey of shrubs to 1.5m. Spinifex mature and sand very soft. Leaf litter thick under *Eucalyptus* and *Acacia.*	
Pitfall Site 39 More exposed dune that site 38. Lower rise south face with less diverse shrubs. Minimal Eucalyptus with many dead. Spinifex less mature but more healthy looking. Fire scared – long ago	

Pitfall Site 40 Broad flat-top dune crest. *Acacia aneura* with shrubs of various species all over. *Eucalyps* mallee form with large strips of bark peeling off trunk – salmon coloured bark.	
Pitfall Site 41 North facing, gently sloping dune base. *Acacia* over sparse shrubs and Triodia. Lots of stick and log debris. Evidence of fire.	
Pitfall site 42 Inter dune to 6m. *Acacia* sp woodland. 40% total shade. Thick shrub cover to 2m. Spinifex understorey. Thick leaf litter layers under trees with lots of stick/log debris. Areas of bare earth.	

Pitfall site 43 *Acacia* and *Eucalyp* woodland. Little understorey. Lots of leaf litter – 100% cover Spinifex in patches Between dune and salty dog breakaway. Soil more compact and crusty in patches with lichen and moss present.	
Pitfall site 44, 45 She-oak open woodland with diverse understorey. No Spinifex Lots of bare earth and calcrete	
Pitfall site 46 She-oak woodland on calcrete. Similar to site 44 + 45 but with Spinifex starting to appear	

	
Pitfall site 47 Similar to 44 to 46 but more open. No Spinifex. Heavy leaf litter under trees Bare earth between trees and shrubs.	

Appendix 6

Biological Environmental Impact Risk Assessment for Short-range Endemics at TJV's Tropicana Gold Project

The Definitions used in the Determination of the Biological Impact Risk Assessment

Likelihood:

Value	Description	Criteria
5	Almost Certain	Environmental issue will occur, is currently a problem or is expected to occur in most circumstances.
4	Likely	Environmental issue has been a common problem in the past and there is a high probability that it will occur in most circumstances.
3	Possible	Environmental issue may have arisen in the past and there is a high probability that it could occur at some time.
2	Unlikely	Environmental issue may have occurred in the past and there is a moderate probability that it could occur at some time but not expected.
1	Rare	Environmental issue has not occurred in the past and there is a very low probability that it may occur in exceptional circumstances.

Consequence:

Value	Description	Criteria
5	Catastrophic	Significant impact to fauna species of conservation significance or regional biodiversity
4	Major	Impact to fauna species of conservation significance in operational area.
3	Moderate	Loss of fauna biodiversity in operational area.
2	Minor	Short term or localised impact to fauna biodiversity.
1	Insignificant	No impact to fauna of conservation significance or biodiversity.

Biological Environmental Impact Risk Assessment

Project: AGAA Tropicana		*Location: Great Victoria Desert*					*Date: 5/3/09*				
			Inherent Risk					**Residual Risk**			
Risk Issue	**Aspect (Event)**	**Impact**	**Likelihood**	**Consequence**	**Risk Level**	**Significance**	**Controls**	**Likelihood**	**Consequence**	**Risk Level**	**Significance**
Mine Site: Tropicana Gold Project											
Mining Operations	Construction of Tropicana / Havana pits	Removal of SREs and habitat	5	4	20	**High**	No controls are available for pit construction; however further sampling outside the mining and infrastructure footprint should be conducted to locate species in areas not impacted by TGP and thus reduce the full impact to some species to partial impact.	3	3	9	**Med**
Mining Operations	Expansion of Tropicana / Havana pits	Removal of SREs and habitat	3	4	12	**High**	Ground disturbance should be restricted to that which is outlined within this report. Boundaries should be clearly defined in the field. Cleared areas should be rehabilitated. Areas likely to contain SREs should be avoided.	2	3	6	**Med**
Mining and vehicle operations	Vibration	Disturbance to SREs	3	3	9	**Med**	Equipment maintenance and correct storage controls to be in place. Disturbance should be restricted to that which is necessary and outlined within this report. Boundaries should be clearly defined in the field	1	3	3	**Low**
Mining and vehicle operations	Dust	Destruction of habitat and disturbance to SREs	3	3	9	**Med**	Dust suppression measures should be implemented, including management of road speed on unsealed roads.	1	3	3	**Low**
Fire	Bush Fire	Destruction of SREs and habitat	2	4	8	**Med**	A fire prevention strategy should be implemented. All vehicles should be fitted with fire extinguishers & all personnel trained in their use.	1	4	4	**Low**

Risk Matrix:

		LIKELIHOOD				
	Risk Assessment Rating	5 ALMOST CERTAIN Is expected to occur in most circumstance	4 LIKELY Will probably occur in most circumstance	3 POSSIBLE Could occur	2 UNLIKELY Could occur but not expected	1 RARE Occurs in exceptional circumstances
CONSEQUENCES	5 - CATASTROPHIC Significant impact to fauna species of conservation significance or regional biodiversity	25	20	15	10	5
	4 - MAJOR Impact to fauna species of conservation significance in project area.	20	16	12	8	4
	3 - MODERATE Loss of fauna biodiversity in project area.	15	12	9	6	3
	2 - MINOR Short term or localised impact to fauna biodiversity.	10	8	6	4	2
	1 - INSIGNIFICANT No impact to fauna of conservation significance or biodiversity.	5	4	3	2	1

12-25	High risk, site/issue specific management programmes required, advice/approval from regulators required.
6 – 10	Medium risk, specific management and procedures must be specified.
1 – 5	Low risk, managed by routine procedures.