Iron Ore Holdings Ltd – Iron Valley Project

Targeted Terrestrial Short-Range Endemic Invertebrate Fauna Survey

Prepared for URS Australia Pty Ltd

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Dalcon Environmental Pty Ltd
3 Yeeda Way, Malaga, WA 6090, Australia

Phone: (08) 9271 6776 (Int. +61 8 9271 6776)
Fax: (08) 9248 9120 (Int. +61 8 9248 9120)
Email: contact@dalconenvironmental.com.au
Webpage: http://www.dalconenvironmental.com.au

dalcon environmental

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Author: Mark Heath, Ross Gordon
Dalcon Environmental Pty Ltd
3 Yeeda Way, MALAGA WA 6090
Phone: +61 (0)8 9271 6776
Fax: +61 (0)8 9248 9120
Email: contact@dalconenvironmental.com.au
Website: www.dalconenvironmental.com.au

Cover Images

Top Left: Mygalomorph trapdoor spider *Missulena* “MYG045”.
Mid Left: Scorpion *Urodacus* “megamastigus short” fluorescing under ultraviolet light.
Bottom Left: Male Mygalomorph trapdoor spider *Aganippe* “MYG086”, rearing up in a typical aggressive posture.

Images courtesy of Ross Gordon, Dalcon Environmental Pty Ltd

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Executive Summary

Dalcon Environmental, on behalf of URS Australia Pty Ltd (URS), undertook a targeted Short Range Endemic (SRE) invertebrate fauna survey of the Iron Valley Project (Iron Ore Holdings Ltd) in June 2011, specifically targeting the Mygalomorph trapdoor spider genus *Aganippe* and scorpion genus *Urodacus* at the request of the Department of Environment and Conservation (DEC). This target survey was subsequent to an extensive SRE survey undertaken by Dalcon Environmental in 2010 (Dalcon Environmental 2011).

Iron Ore Holdings Ltd proposes to develop an iron ore mine on its Iron Valley tenement in the Eastern Pilbara Region of Western Australia (WA). Two associated surveys were conducted initially during May and June 2010 (Dalcon Environmental 2011), with this third targeted SRE survey occurring in June 2011. The targeted SRE survey in June 2011 was conducted within Iron Ore Holdings Ltd tenement M47/1439 and adjoining Rio Tinto Iron Ore's tenement M274/SA for the purpose of obtaining more specimens of potential SRE fauna collected in the previous surveys, in the expectation that the taxonomy of these species can be further resolved and their SRE status determined.

Methods appropriate to the targeted collection of SRE invertebrates were employed, including dry pitfall traps with drift net fences, leaf litter collection, hand foraging, night surveys and burrow excavation.

Six specimens of the Mygalomorph spider previously identified from the 2010 surveys as *Aganippe* "sp. (fem)" (Dalcon Environmental 2011) were collected. Five out of the six specimens were identified to species level as *Aganippe* 'MYG086'; the sixth specimen was a juvenile but is considered to belong to the same species as the other five specimens. Three of the *Aganippe* "MYG086" specimens were each recorded at survey sites IOH Site 01 and RIO Site 02. *Aganippe* "MYG086" is only known from the three surveys of the Iron Valley Project as well as a survey at Roy Hill Station, ca. 80 km southeast of Iron Valley. As these two recorded occurrences of *Aganippe* "MYG086" fall within the currently accepted SRE definition of fauna exhibiting home ranges less than 100,000 km^2 (Harvey 2002), it is reasonable to consider *Aganippe* "MYG086" as potentially SRE fauna.

The target *Urodacus* sp. found in the previous survey of the area was discovered to be *Urodacus* 'megamastigus short' which is not an SRE (Volschenk 2010).

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1. INTRODUCTION

In May 2010 Dalcon Environmental was commissioned by URS Australia Pty Ltd (URS) on behalf of Iron Ore Holdings Ltd (IOH) to undertake a Short Range Endemic (SRE) invertebrate fauna survey at the Iron Valley Project (the Project) in the Pilbara Region of Western Australia. As a result of this survey (Dalcon Environmental 2011), two potential SRE taxa were recorded but neither could be identified to species level and hence their SRE status could not be determined. These potential SRE taxa were a species of scorpion, *Urodachus* sp. juv, and a Mygalomorph (trapdoor) spider, *Aganippe* sp. (fem).

Only a single juvenile specimen of the *Urodachus* was found in the 2010 survey (in a wet pitfall trap on the gravel plains of the "long transect" (Figure 1), and adults are required for identification to species level. Eleven female *Aganippe* trapdoor spiders were excavated from burrows also on the gravel plains of the "long transect" (Figure 1) in the 2010 survey, and male spiders are required for identification to species level and subsequent determination of SRE status.

This report documents the Project background and the methods and results of a targeted survey for the Mygalomorph trapdoor spider genus *Aganippe* and scorpion genus *Urodacus*, which was undertaken during June 2011.

1.1. Project Background

IOH proposes to develop an iron ore mine on its Iron Valley tenement in the Eastern Pilbara Region of Western Australia (WA), for the Iron Valley Project (Figure 2). The Iron Valley deposit lies within Mining Lease M47/1439.

Initial drilling has been undertaken at the Iron Valley deposit since 2008. The Project Area has been previously undisturbed by mining, and has been used by the Marillana Station pastoralists for cattle grazing.

The Project Area is located approximately 90 km north-west of Newman and 150km east of Tom Price and located in close proximity to a number of operating iron ore mines including Rio Tinto Iron Ore's (RTIO) Yandicoogina operation, BHP Billiton Iron Ore's (BHPBIO) Yandi operation and Fortescue Metals Group (FMG) Cloudbreak operation.

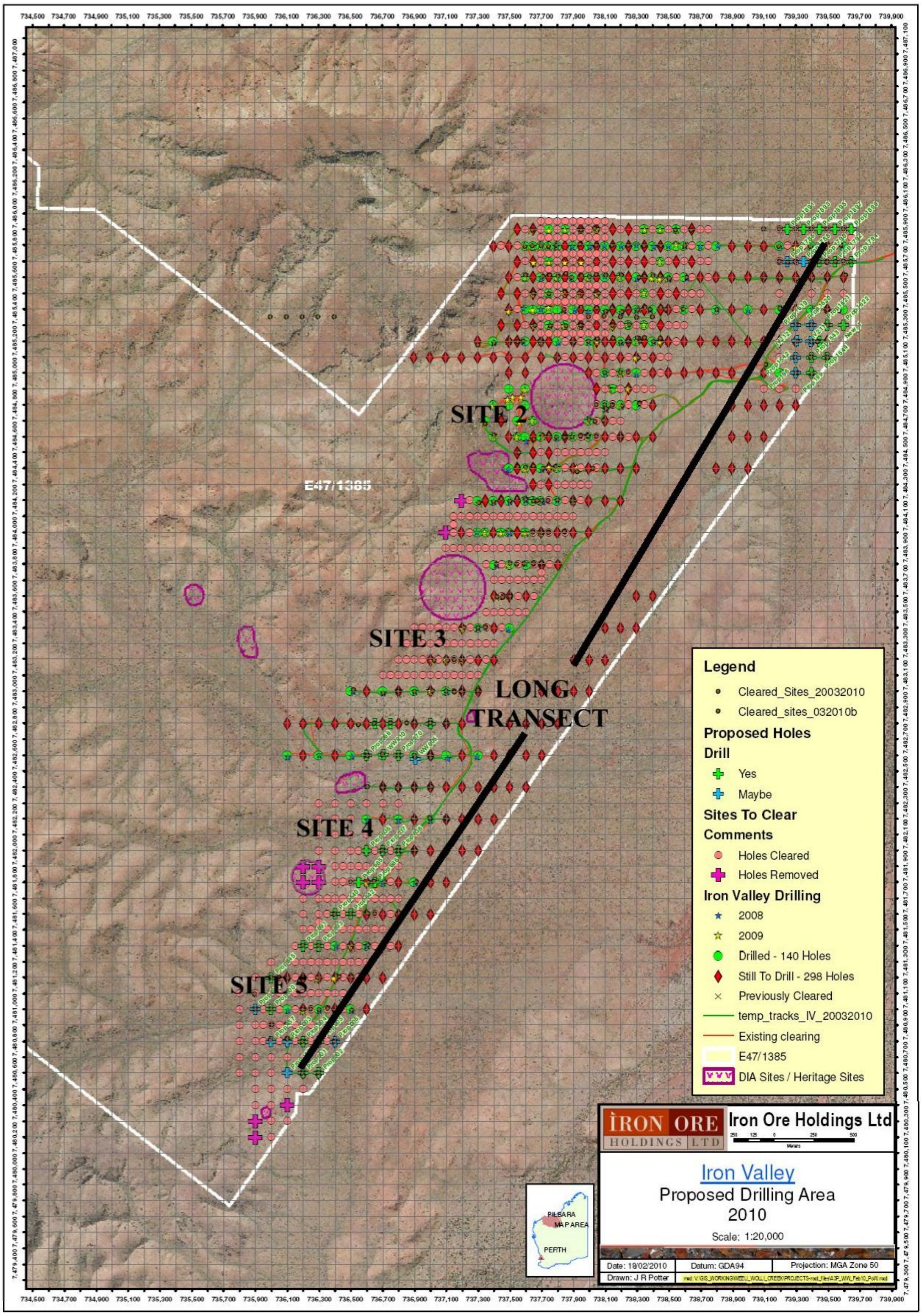

Figure 1: *Long transect line from the Dalcon Environmental 2010 SRE Survey at IOH.*

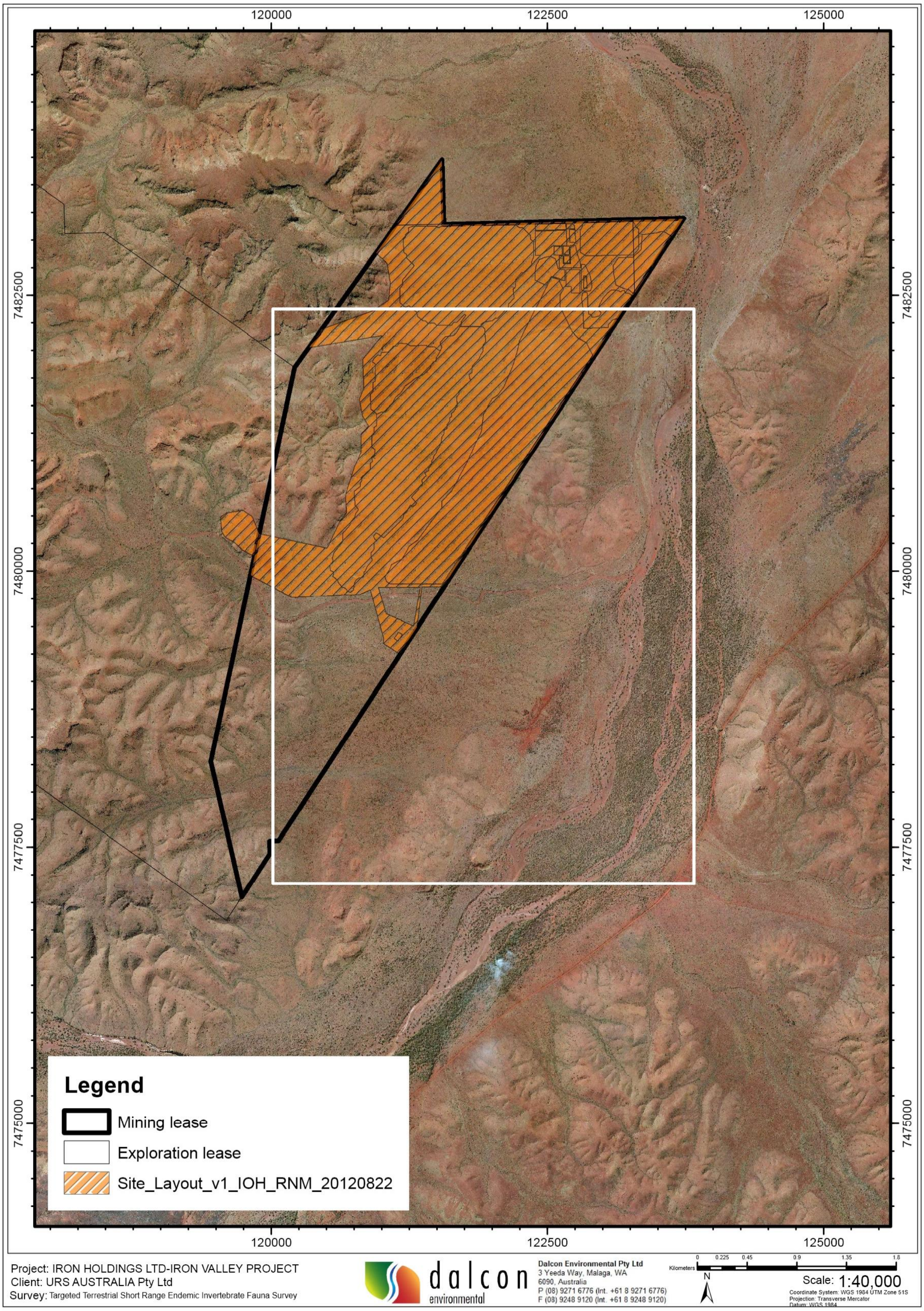

Figure 2: *Key mining components and activities of the proposed Project. White rectangle indicates area depicted in Figure 5.*

1.2. Objectives

This targeted survey was undertaken as a result of discussions with the Department of Environment and Conservation (DEC) in regards to the findings of the 2010 SRE survey (Dalcon Environmental, 2011), which highlighted the taxonomic uncertainty of the potential SRE taxa *Aganippe* sp. (fem) and *Urodachus* sp. (juv). The response from the DEC outlined the need to obtain mature male specimens for both these taxa so that their SRE status could be determined along with specific habitat information. The collection of male specimens would provide much greater taxonomic certainty and combined with habitat information, should help to address the uncertainty regarding the risk to these taxa from the Project, by demonstrating that these species are found in habitat that is widespread.

The DEC recommended that a targeted survey be undertaken using active searching techniques (such as hand foraging, burrow inspections and excavations, collection of leaf litter and night surveys) and dry pitfall trapping. The targeted survey should be undertaken at locations within the Project Area where these species are known to occur (based on the previous survey) as well where known to occur (based on the previous survey) in areas of similar habitat beyond the Project (impact) Area (Figure 5, 7, 8, 18), with the objective of capturing male specimens of the taxa listed above. In addition to this, habitat descriptions should be recorded of the locations where the targeted taxa are found, which can then be used to provide some risk based assessment. This combined approach should provide adequate data for the DEC to further assess the Project's impact on invertebrate/SRE fauna, as advised by the DEC.

The objectives of this survey therefore are:

1) Undertake a targeted survey for male specimens of the trapdoor spider *Aganippe* sp. (fem) at sites recorded in the 2010 survey and from similar habitat within and beyond the Project Area;
2) Describe the preferred habitat in which the burrows of the trapdoor spider *Aganippe* sp. (fem) as recorded in the 2010 survey occur;
3) Extrapolate the extent of preferred *Aganippe* sp. (fem) habitat throughout the Project Area to the best extent possible in order to estimate distribution and locate new *Aganippe* sp. populations;

4) Undertake a targeted survey for male specimens of the scorpion *Urodachus* sp. (juv) at sites recorded in the 2010 survey and from similar habitat within and beyond the Project Area;
5) Describe the habitat in which the burrows of the scorpion *Urodachus* sp. (juv) as recorded in the 2010 survey occur;
6) Extrapolate the extent of this preferred *Urodachus* sp. (juv) habitat throughout the Project Area.

This survey was conducted as a targeted SRE survey as per the EPA's Guidance Statement No. 20, Sampling of SRE Invertebrate Fauna for Environmental Impact Assessment in WA (EPA, 2009) and the DEC recommendations (Durant B 2011, pers. comm., 15 April) focusing on:

1. Identifying areas in which vegetation is under threat of being cleared or irrevocably damaged in a way which would directly affect SRE fauna habitat.
2. Identifying areas sensitive to and likely subjected to changes in hydrology, fire regimes, introduction of weed or soil pathogens which would directly affect SRE fauna habitat.
3. Identify any other potential impacts which would directly affect SRE fauna habitat.

Permission was granted for Dalcon Environmental to conduct sampling and vegetation surveys in the adjacent Rio Tinto tenement (Best D 2011, pers. comm., 29 May) to find areas similar to IOH sites containing the targeted SRE in the hopes of finding target SRE fauna outside IOH tenement.

2. PROJECT AREA

2.1. Regional Setting

The Project is situated within the Pilbara Region of WA within the Hamersley Range. It lies within the Weeli Wolli Catchment which drains into the Fortescue River Basin (known as the Fortescue Marsh). The Hamersley Range contains large deposits of iron ore and is a source of a high percentage of the iron ore mined in Australia (Department of the Environment, Water, Heritage and the Arts 2001 – now known as Department of Sustainability, Environmental, Water, Population and Communities). It is a mountainous area of Proterozoic (545-2500 million years ago) sedimentary ranges and plateaux, reaching an elevation of 1250 m above sea level (Durrant *et al*., 2010).

The Project is within the Pilbara Bioregion which consists of mountainous ranges and plateaus with cliffs and deep gorges, alluvial/granite/basalt plains with an arid subtropical climate, mild winters and summer rain. The Pilbara Bioregion is dominated by hummock grasslands (spinifex) with some Acacia shrub land. The region is extensively grazed by cattle (Department of the Environment, Water, Heritage and the Arts, 2001).

Cyclones and local thunderstorms cause major flows in river systems almost every year between December and April. These rivers are generally dry between August and November with only occasional flows (Department of the Environment, Water, Heritage and the Arts, 2001).

2.2. Regional Climate

Climate for the region was collected from the Bureau of Meteorology (BOM) Newman Aerodrome weather station, approximately 90 km north-west of the Project Area. A weather station is present at Marillana Station, however, it is only equipped to record temperature and data is inconsistent (Bureau of Meteorology, 2011b).

The Project Area experiences an arid tropical climate characterised by hot wet summers and mild dry winters. Annual average rainfall of 309.6 mm (200 – 350 mm) occurs between December and June (Figure 3) but can vary widely (Department of the Environment, Water, Heritage and the Arts, 2001). Highest average temperature of 37 °C occurs between November to February, declining to median temperature of 25 °C during winter months (Figure 3) (Department of the Environment, Water, Heritage and the Arts, 2001). Effect of climate upon potential short-range endemic invertebrate yields is discussed in Section 4.1 and Section 4.2.

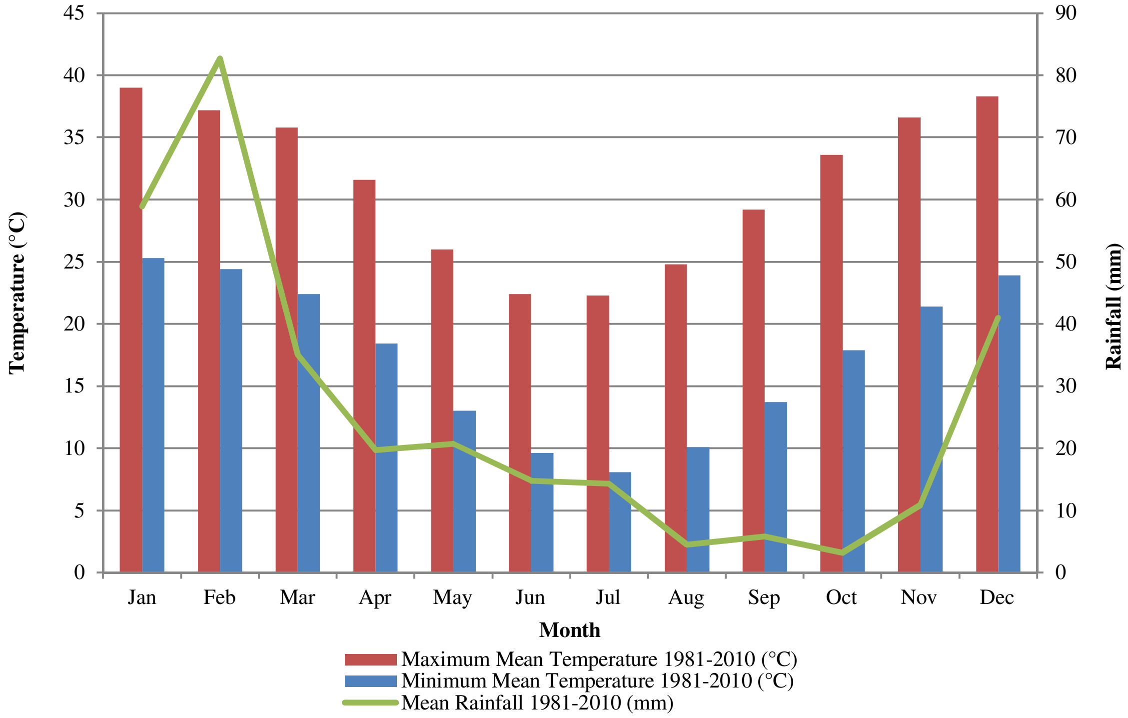

Figure 3: *Average Temperature and Rainfall 1981 – 2010 from Newman Airport weather station (Station ID: 001176) (Bureau of Meteorology, 2011a).*

2.3.Project Setting

IOH proposes to clear up to 674 ha of vegetation for the Project (excluding any future transport corridors). The Project Area has historically been used for pastoral activities and in the past several years, mineral exploration has also been undertaken within the Project Area. Dalcon observed that a recent fire had occurred within the Project Area, in early 2009.

The Project Area occurs within the Hamersley Plateau Botanical District, which is grouped within the Eremaean Botanical Province (Beard, 1979). The vegetation condition and assemblage, including the presence of any weed species within the Project Area, has been assessed during the flora and vegetation assessments undertaken as part of the EIA for the Project.

The Project is located within the Eastern Pilbara Region and is dominated by the Hamersley Plateau (Van Vreeswyk *et al.,* 2004). The geology in the region comprises lower Proterozoic shale, chert, mudstone, sandstone and dolomite (Van Vreeswyk *et al.,* 2004). The Project Area is located within the Boolgeeda and Newman Land systems which is not prone to soil erosion, or land degradation (Van Vreeswyk *et al.,* 2004). This land system comprises of hills, ridges, plateaux remnants and breakaways of meta-sedimentary and sedimentary rocks, supporting hard Spinifex and predominantly supports hard Spinifex vegetation. The soils generally encountered within the McKay land system comprise stony soils, red deep loamy duplex with minor shallow loams and red loamy earths with river bed soil in channels (Van Vreeswyk *et al.,* 2004). Although not favoured by livestock (Van Vreeswyk *et al.,* 2004), the Project Area has historically been used for pastoral use, and is currently a pastoral station (Marillana Station).

It was evident that the southern part of the tenement had recently been subject to wildfire, with the wildfire occurring in early 2009. The area burnt was south of the creek line (a tributary of Weeli Wolli Creek) which runs in an east-west direction across the southern part of the tenement. This burning had altered the structure of the vegetation community and removed all of the Spinifex and most of the ground cover and litter. The effect this has had on the invertebrate community is largely unknown (see Section 3) and beyond the scope of this survey. Different invertebrate groups respond differently to fire, however there were some differences in the invertebrate communities observed in this burnt region and these will be discussed in Section 6.2, and Section 6.4.

2.4. Legislative Framework

The *Environmental Protection Act 1986* (EP Act) was developed to provide for the formation of an EPA. The Act allows the EPA to carry out measures "for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing". The object and principles of the EP Act are outlined in Section 4a of the Act. This section of the Act lists five principles that are necessary to ensure that the objectives of the Act are maintained. Three of these principles relate to native fauna and flora:

1) 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.

In the application of the precautionary principle, decisions should be guided by:

a) Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and
b) An assessment of the risk-weighted consequences of various options.

2) The Principles of Intergeneration 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.

3) The Principle of the Conservation of Biological Diversity and Ecological Integrity

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

Environmental Impact Assessment projects require the assessor(s) to follow EPA guidelines. With regards to this Project there are three applicable guidelines:

- Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact in Western Australia (EPA, 2004); and
- Position Statement No. 3: Terrestrial Biological Surveys as an element of Biodiversity Protection (EPA, 2002) ; and
- Position Statement No. 20: Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (EPA, 2009).

In relation to SRE Fauna, EPA Guidance Statement No. 56 states:

> "*Comprehensive systematic reviews of different faunal groups often reveal the presence of short-range endemic species (Harvey, 2002). Among the terrestrial fauna there are numerous regions that possess short-range endemics. Mountainous terrains and freshwater habitats often harbour short-range endemics, but the widespread aridification and forest contraction that has occurred since the Miocene has resulted in the fragmentation of populations and the evolution of many new species. Particular attention should be given to these types of species in environmental impact assessment because habitat loss and degradation will further decrease their prospects for long-term survival.*
>
> *Harvey (2002) considered that although there were occasional short-range endemics among the vertebrates and insects, there were much higher numbers among the molluscs, earthworms, some spider groups (especially the mygalomorphs), millipedes, and some groups of crustaceans. Short-range endemics generally possessed similar ecological and life history characteristics, especially poor powers of dispersal, confinement to discontinuous habitats, slow growth and low fecundity.*
>
> *Some better known short-range endemic species have been listed as threatened or endangered under State or Commonwealth legislation but the majority have not. Often the lack of knowledge about these species precludes their consideration for listing as threatened or endangered. Listing under legislation should therefore not be the only conservation consideration in environmental impact assessment. The State is committed to the principles and objectives for the protection of biodiversity as outlined in* The National Strategy for the Conservation of Australia's Biological Diversity *(Commonwealth of Australia, 1996). The EPA expects that environmental impact assessment will consider impacts on conservation of short-range endemics in accordance with these principles and objectives*."

Western Australian native fauna are currently protected under Federal and State Acts, the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the WA *Wildlife Conservation Act 1950* (WC Act) respectively.

The EPBC Act was created to protect native species, to prevent extinction and promote recovery of threatened species, and aid in the conservation of migratory species. Section 3 of the EPBC Act lists a number of key objectives in order to achieve this, some of which include:

- Provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance;
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;
- Promote the conservation of biodiversity; and
- Provide for the protection and conservation of heritage.

Section 3a of the EPBC Act states "decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations" in addition to the ecologically sustainable development principles listed in Section 4a of the EP Act.

The WC Act is applicable to Western Australian wildlife only, and states that all native flora and fauna and migratory species are to be protected at all times.

This survey was undertaken in accordance with all of the principles and objectives detailed above.

3. SHORT RANGE ENDEMIC FAUNA - BACKGROUND

Previously the use of invertebrates in biodiversity surveys has been regarded as problematic due to the high numbers of species involved (Harvey, 2002). In response to this problem Main (1996) suggested that research be conducted specifically on relict species assemblages to determine their habitat requirements. The concept of recognising the major groups which contained a high number of narrow range relictual species was proposed by Harvey (2002), who called these relictual species SREs. An SRE species is defined as having a naturally small distribution of less than 10 000 km^2 (100 km x 100 km) (Harvey, 2002). SREs were found to display certain ecological and life history traits:

- Poor dispersal ability (e.g. most spiders can disperse by ballooning, but trapdoors [Mygalomorphs] do not use this method and many are SREs);
- Confinement to discontinuous habitats;
- Highly seasonal activity patterns, often only active during cooler and moister periods, which, typically based on rain variations, can be restricted to certain periods; and
- Lower ability to reproduce offspring, or offspring produced in lower numbers.

The existence of SREs is a result of climatic and vegetation changes that have occurred over geological time. Australia used to be part of a super land mass called Gondwanaland and was thickly vegetated with tropical rainforest. The fragmentation of Australia from Gondwana, and its drift northwards, resulted in a decrease in rainfall, resulting in aridification (Main, 1996; 1997). Invertebrate species that used to be common while the land was covered with rainforest found themselves squeezed into the reduced rainforest areas, and today these relictual species are only found in moist and shaded areas. These areas typically include habitats that are isolated by geographical barriers which impedes dispersal and gene flow. A classic example is islands, where the terrestrial environment is surrounded by a marine environment which prevents dispersal to other islands. In this respect, caves and mesas are like islands, possessing environmental conditions that are totally different to the surrounding landscape. Large landform features, like the Devonian Reef system in the Kimberley Region, host a large number of SREs because they act as a barrier, resulting in speciation as a result of fragmentation of populations.

Typical habits that often contain SRE species include:

- Vine thickets and rainforest patches (usually in the Kimberley and tropics);
- Areas of high rainfall with short summer drought;
- Boulder and rock piles especially if water is shed from rocks;
- Isolated hills and mesas especially if subject to frequent mist, cloud or drizzle;
- Areas where vegetation can harvest water from fog or cloud;
- Vegetated gullies with deep leaf litter;
- Permanent freshwater pools, rivers and wetlands; swamps; springs;
- Areas of impeded groundwater flow;
- South facing slopes of hills and ranges which are sheltered from summer heat;
- Mouths of caves, inside of caves;
- Mountainous terrain and gorges;
- Islands;
- Granite outcrops (Main, 1997);
- Ridges that create a barrier (e.g. Devonian Reef in the Kimberley); and
- Palaeodrainage channels (Raven, 2008).

Each of these habitats would support a small and spatially isolated population, which would be further restricted due to SRE low dispersal power (Main, 1996; Harvey, 2002).

The process of aridification and rainforest reduction has resulted in the fragmentation of invertebrate populations and a tendency for the evolution of new species with small distribution (EPA, 2009). Due to SREs being restricted to specialized microhabitats they are very vulnerable to anthropogenic disturbances and will often be unable to recover from disturbance and thus face the prospect of extinction. These disturbances can be due to agriculture, mineral extraction, roading and housing developments. Fire can also be a threat because an entire population may be restricted to a single microhabitat (EPA, 2009).

Not all taxa are characterised by a large number of SREs. Although there are insects which could be described as SRE, no insect Orders have a high percentage of SRE. This is mainly because insects are winged and usually highly mobile. Some flightless insects could be considered SREs as their range is limited, but no Order is made up of a high percentage of flightless individuals (Yeates *et al.*, 2002).

Harvey (2002) has identified certain taxa that contain a high proportion of SREs in Australia, these are:

- Mollusca - Gastropoda (land snails);
- Annelida - Oligochaeta (earthworms);
- Onychophora (velvet worms);
- Arachnida - Scorpionida (scorpions);
- Arachnida - Araneae (mostly Mygalomorphae [trapdoor] spiders);
- Arachnida – Pseudoscorpionida (pseudoscorpions);
- Arachnida – Schizomida (schizomids);
- Malacostraca – Isopoda (slaters/woodlice); and
- Diplopoda – Chordeumatida (millipedes).

It should be noted that the identification of known SREs in WA is based on the identification provided by the WA Museum. Due to the poor current state of knowledge of the taxonomy of groups like Isopods (woodlice) they are currently mostly identified to morphospecies level, and as a result SRE identification cannot be achieved. For this reason it is possible that SRE species do occur at a project site but taxonomic difficulties make their complete identification impossible.

From the Iron Valley survey in the Pilbara, it is unlikely that Velvet worms (Onychophora) would be recorded as they are usually found in the moister south-west of WA, avoiding the arid areas of the state (Monge-Najera, 1994). Schizomids are true troglobites found in deep crevices of mesas and are unlikely to be found in the Project Area because of the lack of sufficiently deep caves. Earthworms (Annelida – Oligochaeta) could occur but currently there is no standard acceptable method to survey them. Consequently the groups to be surveyed at the Iron Valley site were landsnails, trapdoor spider, pseudoscorpions, slaters/woodlice and millipedes (Gastropoda, Scorpionida, Mygalomorphae, Pseudoscorpionida, Isopoda and Diplopoda).

It is important to recognise that the potential SRE groups listed above are not exhaustive, and that invertebrates generally are understudied and poorly understood with most species lacking a formal description. Reliable taxonomic evaluation of many species has only recently been commenced and thus there is very little literature relevant to SREs in peer reviewed journals. Bearing these facts in mind, it is important to adhere to the precautionary principle, as adopted by the EPA/DEC under section 4a of the EP Act.

3.1. Potential Threats to Short Range Endemic Populations

A small distribution range of a particular species may be completely natural and stable, or it may represent a historical fragmentation of range or loss of habitat due to past or continuing threats. It is therefore essential to carefully interpret the range patterns of any species and determine any causes for the restricted range before any conservation management is carried out (New and Sands, 2002).

Issues that need to be considered are dispersal ability, habitat preferences, life history attributes, physiological attributes, habitat availability and biotic/abiotic interactions. Due to their relictual nature, any loss or fragmentation of habitat can cause the extinction of a local SRE (Ponder and Colgan, 2002). Threats to habitats suitable to SREs include (Australian Biological Resource Assessment, 2002):

- Clearing of native vegetation;
- Inappropriate and changed fire regimes (altered fire regimes may act to promote premature drying of mesic refuge habitats for SREs);
- Mineral extraction;
- Road and housing development;
- Grazing; and
- Changed hydrology.

SREs are especially vulnerable to anthropogenic activity due to limited dispersal ability and specific habitat requirements (Eberhard *et.al.*, 2009). Their limited dispersal capabilities make any land degradation likely to fragment their habitat and results in a decrease in population numbers, inbreeding and loss of genetic fitness. Thus if a loss of habitat occurs in only a part of their range this could be highly significant due to fragmentation and the consequent inability to exchange genes between the fragments.

4. METHODS

4.1. Survey Timing

The targeted survey was conducted between the 31st May 2011 and 10th June 2011 with dry pitfall traps deployed and additional invertebrate sampling conducted between the 3rd and 8th of June 2011. The timing of the survey was just outside the preferred timing stated in EPA Guidance Statement No. 20 (EPA, 2009), as this Guidance Statement recommends that terrestrial invertebrate fauna (particularly SRE) surveys in the Pilbara should be conducted from November to April (coinciding with the cyclone season as many SRE species are only found during this wet season). During discussions with the DEC in early 2011 (Durant B 2011, pers. comm., 15 April), the DEC recommended that the survey commence sooner rather than later, and that the proposed timing of late May-June was acceptable (Durant B 2011, pers. comm., 15 April) Fortunately, out of season rainfall between the 4th and 10th June 2011 which significantly increased the yield of SRE Mygalomorph spiders in the targeted survey areas.

4.2. Weather During the Survey Period

Data from the Newman Aerodrome weather station (Station ID 001176, located approximately 90 km south east of the Project Area) indicates that temperature during the survey period ranged from 0.3 ºC minimum to 28.6 ºC maximum. The monthly rainfall total of 9.4 mm was recorded from 5th to 8th June, with the majority, 8.2 mm falling on the 7th June. (BOM, 2011). However, it was noted by the field team that the survey area experienced continuous drizzle to rain for the majority of the survey period with numerous heavy rain events, so it is likely that the rainfall for the survey area was greater than that recorded from the Newman Airport weather station.

Daily maximum and minimum temperatures, as well as rainfall, recorded from the Newman Airport weather station during the targeted survey month of June 2011 are presented in Figure 4.

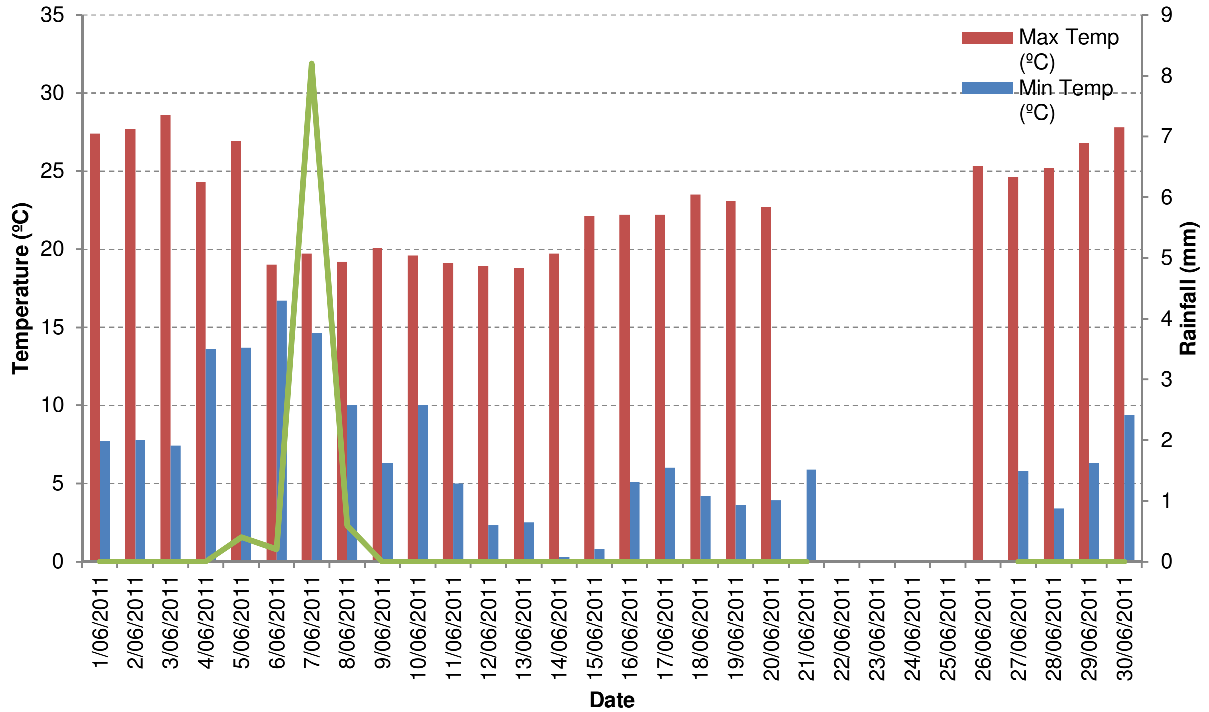

Figure 4: *Daily minimum and maximum temperature and rainfall from the Newman Airport weather (Station ID 001176) in June 2011 (BOM, 2011).*

4.3. Site Selection

Due to the targeted nature of the current survey, site selection was based upon data collected during previous surveys. Sites were allocated at and around GPS waypoints of previous sites which had recorded instances of the Mygalomorph spider *Aganippe* sp. and scorpions *Urodachus* sp. on the flat plains, around drilling pads and the proposed pit areas (Figure 5). At these targeted sites a grid pattern deployment was utilized to ensure the most comprehensive sampling of the habitat.

As requested by the DEC, sites beyond the Project impact area (the Iron Valley tenement boundary) were also surveyed. Approval was granted to locate sites on Rio Tinto Iron Ore's North Billard tenure (Best D 2011, pers. comm., 29 May) with similar habitats found in the Iron Valley tenement area that is known to contain *Aganippe* and *Urodachus* burrows (Figure 5, 7 and 8).

Rio Tinto survey sites were selected by examining aerial photographs and selecting areas of vegetation exhibiting either: 1) similarities to the Iron Valley Project sites where SRE fauna had been collected previously in the 2010 survey (Dalcon Environmental, 2011), or 2) vegetation complexes with high probability of containing SRE fauna based on previous Dalcon Environmental surveys and unpublished data, extensive literature review and correspondence with short-range endemic specialists (Harvey, 2002). These potential sites were then verified via ground reconnaissance prior to commencing the surveying (Figure 5, 6, 7 and 8).

Figure 5 displays a distribution overview all site locations associated with the targeted SRE survey. Red icons indicate survey points within the IOH tenement and are expanded upon in Figure 6. Green icons indicate survey points within the adjacent Rio Tinto tenement and are expanded upon in Figure 7 and Figure 8

Figure 6 displays a distribution overview of all sampling sites within the IOH tenement. Two sampling sites, IOH tenement Site 01 (IOHS01 – Figure 6) and IOH tenement Site 02 (IOHS02 – Figure 6) are present. IOHS01 contained 20 dry pitfall traps (Section 4.4.1) in a five-by-four sampling grid matrix. IOHS02, adjacent to IOHS01 contained 10 dry pitfall traps (Section 4.4.1) in a three-by-three sampling grid matrix with one trap positioned at the end of the final sampling row in suitable potential SRE habitat.

Rio Tinto tenement Site 01 (RIOS01 – Figure 7) and Rio Tinto tenement Site 02 (RIOS02 – Figure 8) contained 15 dry pitfall traps (Section 4.4.1) in a five-by-three sampling grid matrix each to standardise sampling methodology.

Total of 60 dry pitfall traps (Section 4.4.1.) were deployed during the targeted survey.

Four vegetation and habitat assessment sites (RIOVEG 01 to 02) were selected in Rio Tinto tenement in areas considered to best represent the vegetation complexes along the tenement boundary line as well as provide suitable habitat for potential SRE fauna (Figure 5).

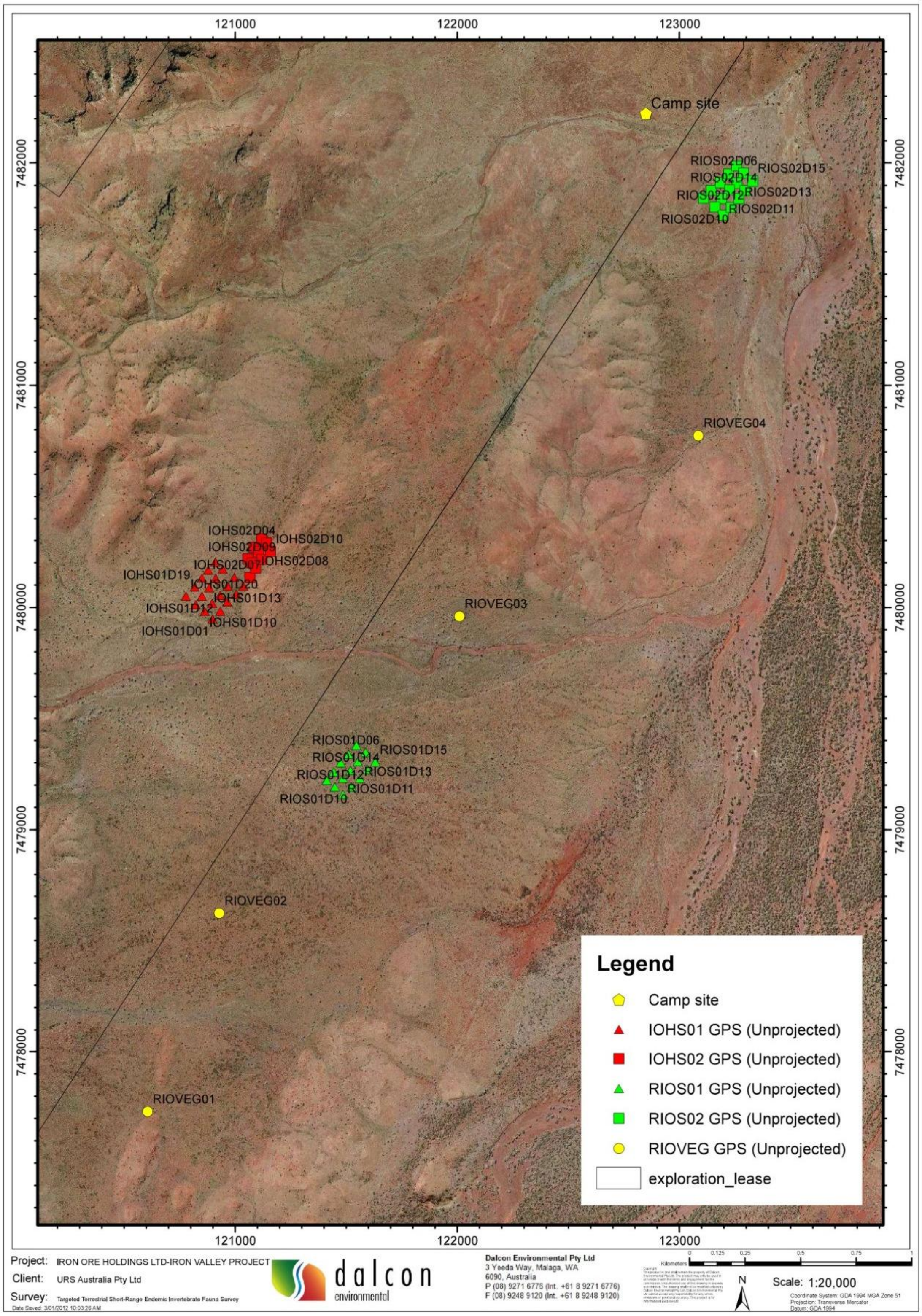

Figure 5: *Site locations within the Iron Valley (IOH – left side of tenement boundary) and Rio Tinto (RIO – right side of tenement boundary) for the targeted SRE survey.*

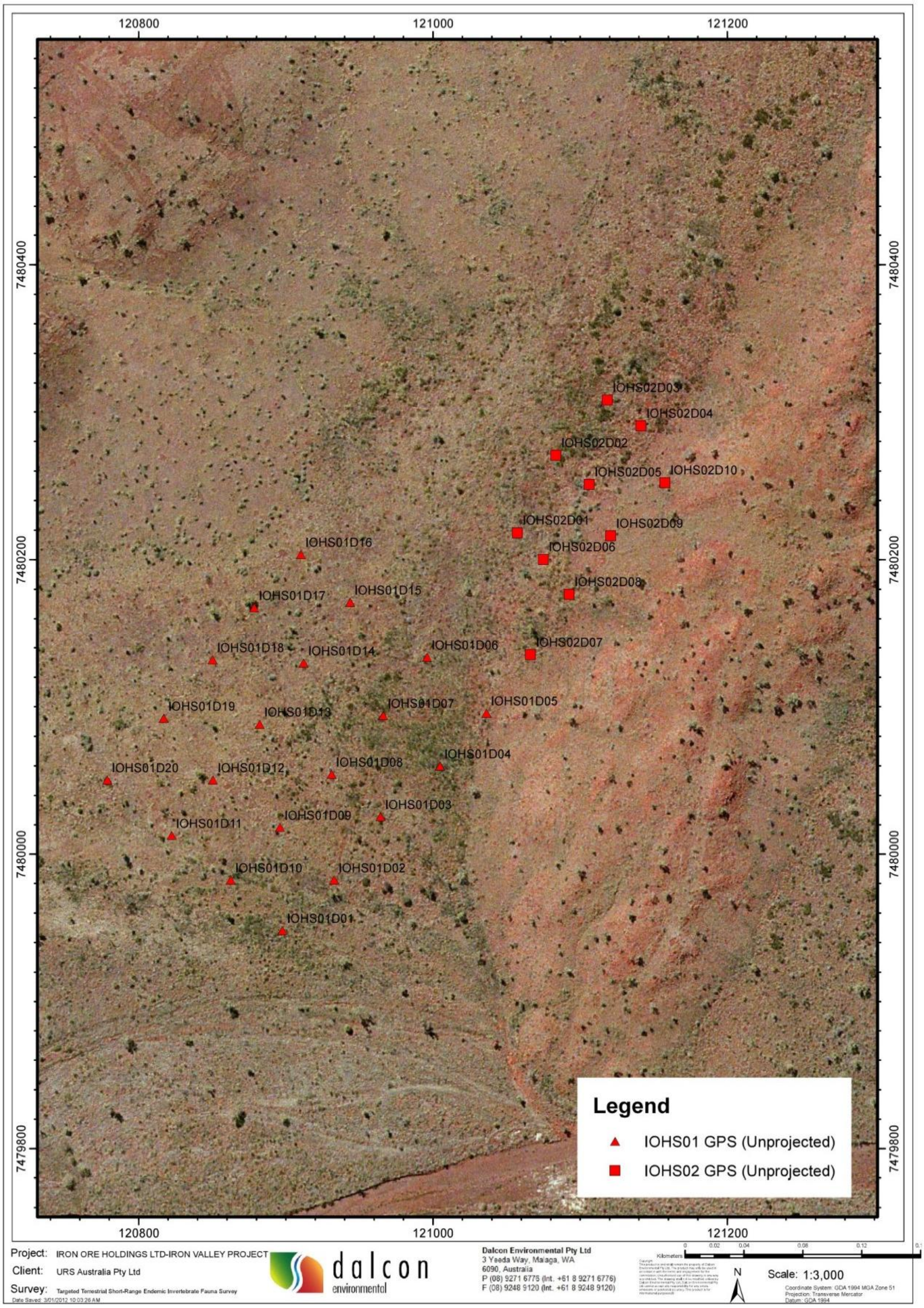

***Figure 6:** Sites One and Two within the Iron Valley tenement (IOHS01 & IOHS02) for the targeted SRE survey.*

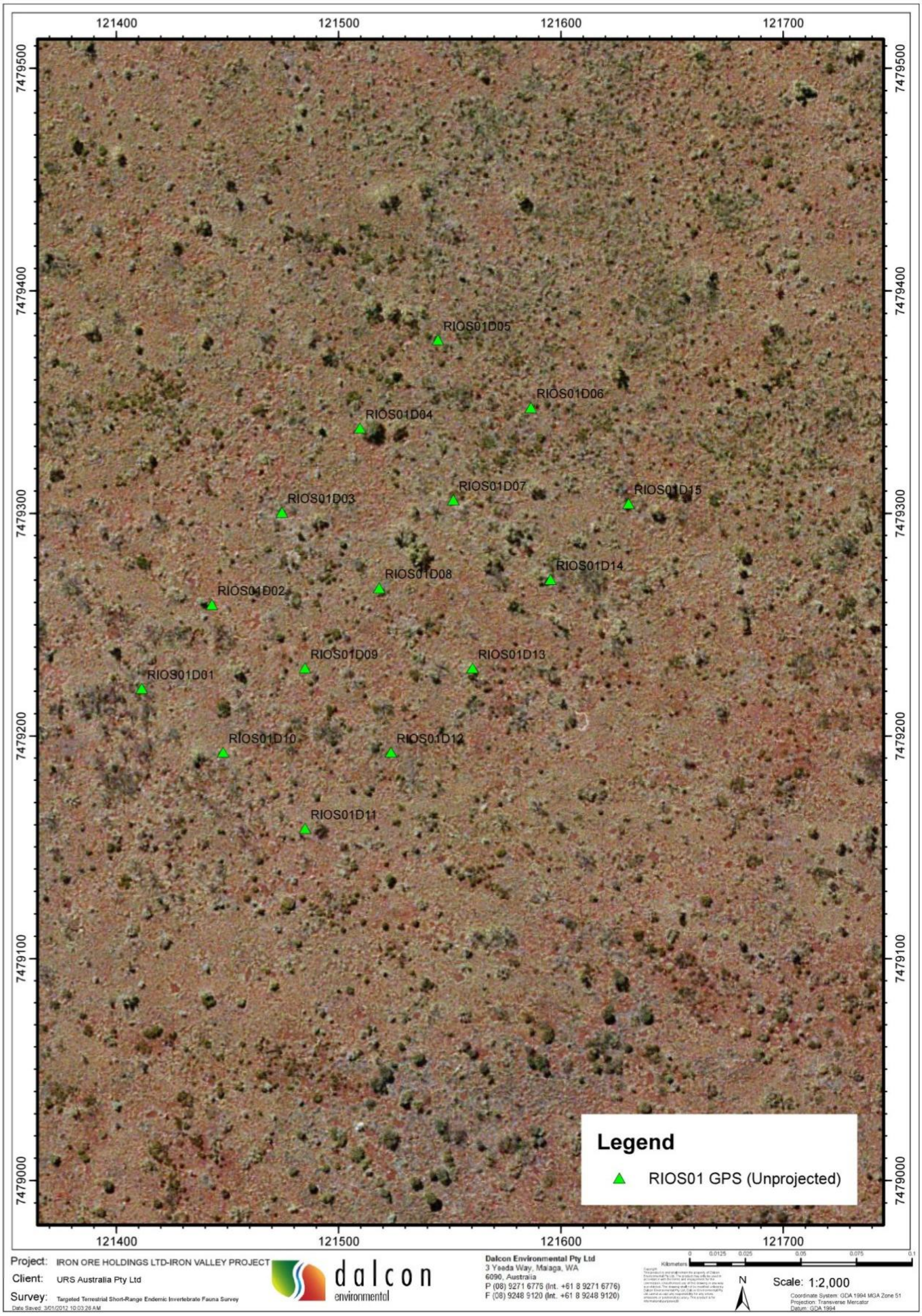

Figure 7: *Rio Tinto Site One locations within the Rio Tinto Iron Ore's tenement (RIOS01).*

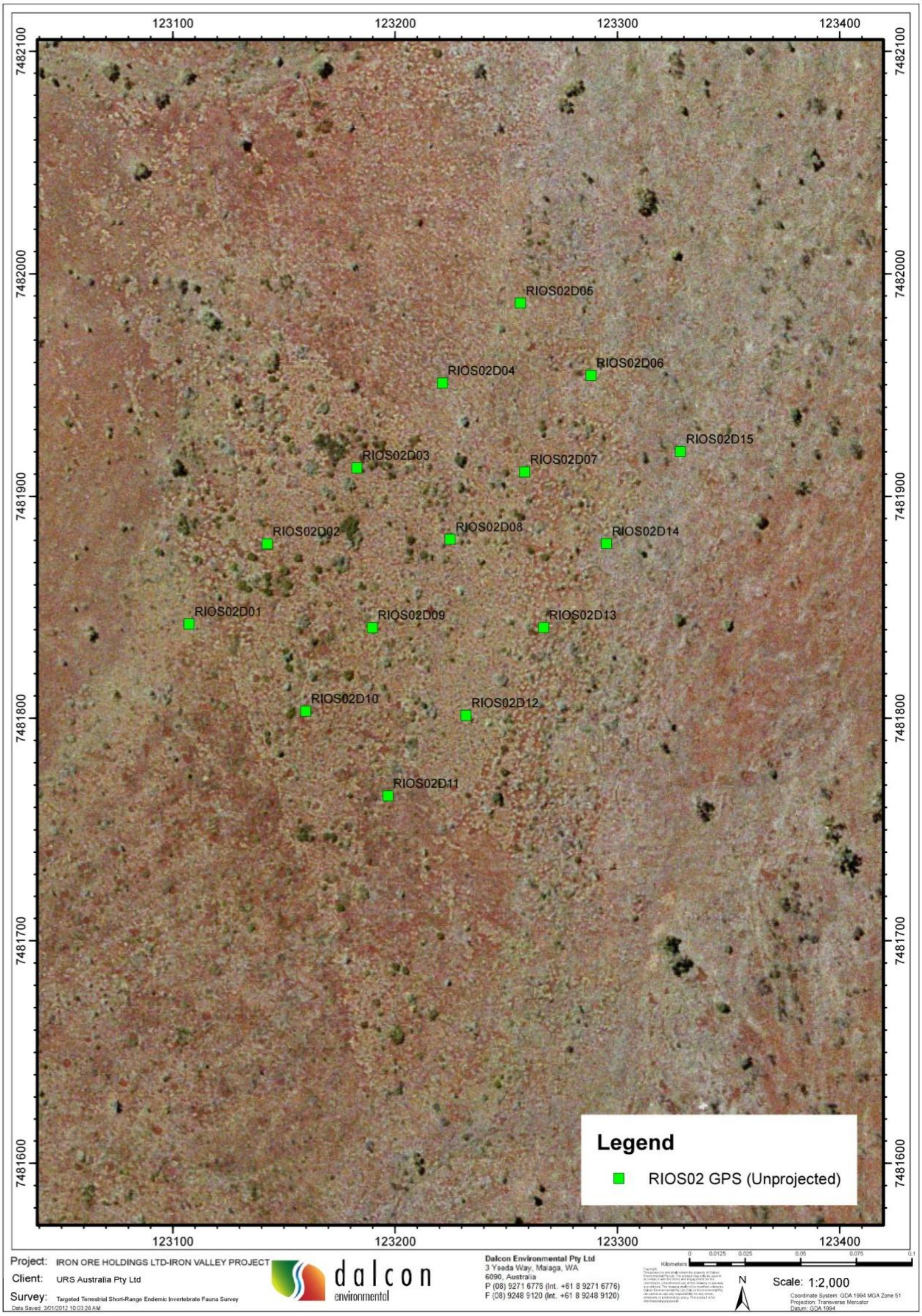

Figure 8: *Rio Tinto Site Two locations within the Rio Tinto Iron Ore's tenement (RIOS02).*

4.4. Sampling Methodology

Several sampling methodologies were employed for this targeted survey based on the principles outlined in EPA Guidance Statement No. 20: *Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA, 2009). This survey focussed on several foraging methodologies (discussed in the following sections) intended to target SRE taxa. Dalcon Environmental presented the DEC with a complete proposed methodology prior to applying for a Regulation 17 License to take (i.e. capture, collect, disturb, study) fauna for scientific purposes (Bradley D 2011, pers. comm., 15 April). These methods were accepted and consequently a Regulation 17 License was awarded to Dalcon Environmental prior to the survey commencing (License No. SF007419).

4.4.1. Dry Pitfall Traps with Drift Net Fencing

Total of 60 dry pitfall traps were deployed during this survey. Dry pitfall traps comprised of a two litre bucket (160 mm diameter, 145 mm depth) dug flush into the ground. To increase sampling efficiency, three drift net fences (metal fly screen, 2 m length, 30 cm height) extending out in a 'Y' configuration (120 degrees apart) each side of the bucket were dug into the ground and ends secured using stakes (Figure 9). Lids were fashioned from the bucket lids and secured by metal pegs to 30 mm above ground level to reduce large vertebrate by catch.

Dry pitfall traps were checked every morning for six days. Potential SRE taxa were collected and vertebrate by-catch carefully released nearby. Dry pitfall traps were constructed in accordance to the regulations imposed by Environmental Protection Authority (2009).

Although recognised that dry pitfall traps have limited success sampling SRE fauna in comparison to other collection methods, their ability to capture fauna live reducing vertebrate by-catch mortality is extremely attractive (Environmental Protection Authority, 2009). Dry pitfall traps have proven very successful in sampling scorpion and mygalomorph fauna during favourable weather conditions (Harvey, 2002).

Figure 9: *A typical dry pitfall Trap without a lid and with two drift net fences.*

4.4.2. Scorpion Trapping

Targeted scorpion trapping was deployed at each site using plastic cups as small dry pitfall traps, located in close proximity to verified scorpion burrows. Close proximity was standardised by setting the small dry pitfall trap directly in front of and 30 cm away from the scorpion burrow exit. If vegetation or other factors prevented deployment directly in front of the burrow, the trap was deployed 30 cm away from the burrow exit and offset 45 degrees from it. It was the aim of these traps to directly intercept scorpion fauna entering and exiting the burrows for foraging outside of their burrow.

4.4.3. Hand Foraging

Foraging was undertaken by a three person team at all sites for a minimum of three hours each. Hand foraging included turning over rocks, looking under bark and sifting through leaf litter targeting: Araneae (spiders), Scorpiones (scorpions), Pseudoscorpiones (pseudoscorpions), Gastropoda (snails), Isopoda (woodlice) and Diplopoda (millipedes). An organised search pattern following the layout of the trapping regimen at the site and targeted searches under areas of interest (ie. ideal areas of potential SRE habitat) was utilised.

Any specimens collected were carefully picked up and transferred to plastic jars containing 100% ethanol for preservation. A waterproof label was placed in the jar indicating the site location and collection method.

4.4.4. Collection of Leaf Litter

Leaf litter was sparse over much of the Project Area and therefore could not be collected quantitatively. Where available, leaf litter was collected and “double bagged” into large plastic garbage bags. A waterproof label was placed into each bag indicating the site the leaf litter was collected from. These bags were kept in a dark cool place in order to prevent desiccation, and then transported back to the laboratory. Upon arrival at the laboratory, each litter sample was placed into a Tullgren Funnel to extract the invertebrates. Tullgren Funnels are a widely used technique (Upton, 1991) to separate the invertebrates from the leaf litter collected. Leaf litter is placed into a large funnel underneath a heat and light source (in this case a 100W incandescent light globe) for a set duration, commonly two weeks. As the invertebrates move downward through the litter to avoid the heat they eventually fall out of the funnel into a jar containing 100% Glycol to preserve specimens. These jars were then sorted and specimens collected, labelled and preserved in vials containing 100% ethanol pending analysis.

4.4.5. **Burrow Excavation**

The ground at all sites was examined visually for the presence of Mygalomorph spider burrows. When these were located, the burrows were documented, photographed and Mygalomorph spider presence and sex verified by using a milliscope. Female spiders rearing young were left undisturbed, however, if no other burrows were found within the site, a singular spider would be excavated for identification purposes. A limited number of females and males were excavated from each site (depending on occurrence) so as to avoid causing unrecoverable damage of the local Mygalomorph population, with the preference to collect male spiders for accurate identification purposes. A representative of each species present would be collected if possible. Excavated spiders were collected, labelled and preserved in vials containing 100% ethanol. Figure 10 illustrates the locating and excavation of a Mygalomorph trap door spider burrow.

Burrow descriptions and photographs of the Mygalomorph specimens collected are presented in Section 5.1.

4.4.6. **Night Surveys**

Night surveys were conducted using a large ultra violet (UV) blacklight lamp. Scorpions fluoresce under UV light and this method is an excellent technique to find them, as many species of scorpion are nocturnal. This is a standard technique for surveying scorpions (Lowe *et al*., 2003). Scorpions located were carefully picked up and transferred to labelled jars containing 100% ethanol.

4.5.**Laboratory Methods**

Upon return to the laboratory, each sample collected during the surveys was entered into Dalcon Environmental's proprietary job track and sample analysis software to record where each sample was collected and a unique numeric sample ID was allocated. An adhesive label was printed out with the sample ID and stuck to the outside of each sample jar.

Samples were processed at varying magnifications under an Olympus SZX7 Zoom Stereo Microscope. Potential SRE taxa were placed into individual vials each labelled with the sample ID.

Figure 10: *Locating and excavating spider burrows. The scale bar below the "lids" of the Mygalomorph spider burrow = 2.5 cm, the silk-lined tunnels of the excavated burrows extended to a depth of about 30 – 40 cm (May/June 2010 survey).*

These samples were passed on to the WA Museum (and other agencies where required) for taxonomic verification together with a database of information including (for each unique sample ID) the date of collection, the site codes, GPS coordinates and the name of the collector(s).

4.6. Habitat Assessment Methodology

Habitat assessment (see Section 6) involved recording at each site:

- Broad SRE habitat type;
- Landscape position;
- Broad vegetation type (including vegetation indicative of suitable SRE habitat);
- Presence of rocky outcrops;
- Suitable soil substrate;
- Leaf litter coverage;
- Presence of SRE fauna;
- Habitat disturbance;
- Habitat physical connectivity.

Dominant vegetation present at each site was labelled and identified by a botanist for vegetation complex comparison. Short-range endemic habitat assessment sheets for all sites are found in Appendix 3.

4.7. Curation and Species Identification

As stated above, taxa belonging to invertebrate groups known to contain SRE species (see Section 3) were forwarded to people from various agencies that have the relevant expertise to identify them to the lowest taxonomic level. The level of taxonomic resolution is dependent upon both the current state of knowledge on a particular taxon and the level of expertise currently available. The experts used for taxonomic verification are presented in Table 1.

Table 1: *List of expertise used for taxonomic verification of potential SRE taxa found throughout the survey.*

Taxon	Expert	Institution
Aganippe trapdoor spider	Barbara Main	University of Western Australia
Mygalomorph spiders	Volker Framenau	WA Museum
Scorpions	Erich Volshenk	Scorpion ID

5. RESULTS AND DISCUSSION

As per the targeted nature of this survey, invertebrates representing two groups known to contain potential SRE taxa were collected:

- Araneae (mostly Mygalomorphae [trapdoor] spiders);
- Scorpionida (scorpions);

A list of the potential SRE taxa recorded, SRE significance and location collected is presented in Table 2. Results for each of the potential SRE invertebrate groups are discussed in results and discussion.

Table 2: *List of the potential SRE taxa recorded for the targeted SRE survey, SRE significance and which site location they were found.*

TAXON	Genus/Species	Significance	Site	Total
ARACHNIDA				
Araneae				
Idiopidae	*Aganippe* sp.	Juvenile	RIO Site 02	**1**
	Aganippe 'MYG086'	Potentially SRE	IOH Site 01	**3**
	Aganippe 'MYG086'	Potentially SRE	RIO Site 02	**2**
			Total	**6**

5.1. Arachnida

5.1.1. Araneae, Mygalomorphae (Mygalomorph Spiders)

5.1.1.1. Overview

Mygalomorphae are an important group of spiders, many of which are SRE. These spiders have become a focus group in environmental assessment surveys, particularly in recent SRE surveys (Durrant *et al*., 2010). Their high conservation status is demonstrated by the listing of several mygalomorphs on Schedule 1 (fauna likely to become extinct) of the Wildlife Conservation (Specially Protected Fauna) Notice 2010 by the Western Australian Government. The WA Mygalomorph fauna has impressive biodiversity and is still taxonomically poorly understood with many families and many new species being regularly collected (Durrant *et al*., 2010).

Spiders can be divided into two groups: the aerially active spiders; and those that live and disperse on the ground. The aerially active spiders use ballooning to disperse their young in the air, and are typically short lived (usually survive one year). They are highly invasive and recolonise quickly after habitat disturbance. Due to their practice of ballooning they tend to be widespread and of no significance regarding SRE. In contrast the Araenomorphae (ground hunters) and Mygalomorphae (trapdoor and funnel-web spiders) are limited to earth bound activity and the young disperse by walking. As a result populations often tend to be very clumped and entire populations can be missed due to the logistical and ethical constraints of wet pitfall trapping programs which limit the number of traps placed (Raven, 2008). Mygalomorphae generally live much longer, up to 20 years old, and are very habitat specific not moving very far from their habitat even if it is under threat. Mygalomorphs are therefore also a useful indicator of the history of disturbance in an area (Raven, 2008).

Raven (2008) has argued that in the Pilbara, Mygalomorph spiders are found where palaeodrainage basins occur, rather than on south facing slopes as suggested by Harvey (2002). Raven bases this argument on the fact that the Pilbara is part of the Western Shield which developed during the Precambrian (600-400 million years ago), has the oldest land surface in the world, and has never been glaciated or submerged. Calcrete channels formed during the Eocene and Oligocene (37-30 million years ago) when the rivers stopping flowing as a result of the dryer conditions, leaving behind the palaeodrainage channels (Karonovic, 2007). For this reason Mygalomorph spiders have had over 200 million years to evolve and adapt to the harsh conditions of the Pilbara. Their main adaptation is the use of burrows, which can extend to a depth of 700 mm (Main, 1982). This Project (and many other iron ore operations in the Pilbara Region) is situated on a Channel Iron Deposit (CID [Iron Ore Holdings Ltd, 2010]). These CIDs are iron-rich fluvial sedimentary deposits which occupy the meandering palaeochannels of the region dating back to the Early to Mid-Tertiary period.

Raven further argues that in the very open country of the Pilbara the gullies are dry and hot by 8am, even in mid-winter and, as a result, may not provide suitable habitat for Mygalomorph spiders. He argues that Mygalomorph spiders will tend to be more common on the flatter areas with more soil, especially those areas associated with palaeodrainage basins. Both Harvey and Raven present valid arguments, and Dalcon Environmental is not in a position to validate one or the other as our experience indicates that both arguments have merit depending upon the nature of the site being surveyed.

Harvey's argument can be considered to refer to SREs in general, which do prefer habitats where they are sheltered from the heat of the day (such as south facing slopes) whereas the argument of Raven is specific to Mygalomorph spiders.

The argument presented by Raven, particularly with respect to Mygalomorph spiders being more common on the flatter areas with more soil in areas associated with palaeodrainage basins (as is the case for this Project), appears to have been confirmed in this survey with Mygalomorph burrows only being located on the flat ground on the 'long transect' (Figure 1). Mygalomorph burrows are cryptic, however and may have not been present but not observed in the rockier terrain throughout the Project during the initial 2010 short-range endemic and 2011 targeted short-range endemic surveys.

Seven Mygalomorph spiders were collected over the duration of the targeted survey. Six of these belong to the genus *Aganippe* and one to genus *Missulena*. Twelve *Aganippe* sp. (fem) specimens were collected during the 2010 short-range endemic IOH survey, however, no similarity can be drawn between 2011 targeted survey yields and the initial 2010 survey as the original 2010 survey specimens were unidentifiable due to incorrect sex (absent sufficient taxonomic features for species identification. The singular *Misulena* specimen collected during the targeted survey (2011) was not previously found during the initial 2010 short-range endemic IOH survey.

5.1.1.2. *Aganippe* 'MYG086' - (Family Idiopidae)

The Mygalomorph family Idiopidae are common throughout Australia and are considered 'typical' trapdoor spiders; spiders that close their burrow with a hinged door. The genus *Aganippe* is common throughout Western Australia with fourteen species described in Australia and many new species awaiting descriptions (Main, 1985). Six specimens of *Aganippe* were collected during the targeted survey, with five of the six specimens accurately identified as *Aganippe* 'MYG086' and one as an unidentifiable juvenile. Three specimens were recorded at IOH Site 01 and two specimens, as well as the juvenile *Aganippe* sp. (which is believed to be the same species as *Aganippe* 'MYG086'), at RIO Site 02. Figure 11 shows a typical example of ideal *Aganippe* Mygalomorph trapdoor spider habitat: open soil area in spinifex grasslands under stands of Acacia which provide leaf litter for trap door construction.

Aganippe 'MYG086' (Figures 12 and 13) is only known from two locations, the two surveys of the Iron Valley Project (May/June 2010 and June 2011) and from Roy Hill Station, approximately 80 km southeast of the Iron Valley Project. As these two recorded occurrences of *Aganippe* 'MYG086' fall within the currently accepted SRE definition of fauna exhibiting home ranges less than 10,000 km^2, it is reasonable to consider *Aganippe* 'MYG086' as potentially SRE fauna.

Figure 11: *Habitat of RIO Site 02, showing the location of an excavated Aganippe 'MYG086' burrow.*

Due to the diversity of *Aganippe* species known throughout Western Australia, it is difficult to generalise the characteristics of the burrows and trapdoors of the genus. However, *Aganippe* 'MYG086' found throughout the survey exhibited a preference to burrowing in open patches of soil under Acacia stands with only a moderate amount of leaf litter around the base (Figure 11). This enables the *Aganippe* 'MYG086' to use the leaf litter to construct an extremely cryptic door (Figure 14 and 15), while exploiting the increase in open area to better ambush prey. *Aganippe* 'MYG086' burrows excavated during the survey were typically 2 to 3 cm in diameter and 30 to 60 cm deep.

Figure 12: *Aganippe 'MYG086' in a typical Mygalomorph aggressive posture (front).*

Figure 13: *Aganippe 'MYG086' in a typical Mygalomorph aggressive posture (dorsal).*

Figure 14: *Aganippe 'MYG086' trapdoor burrow (closed).*

Figure 15: *Aganippe 'MYG086' trapdoor burrow (open).*

5.1.1.3. *Missulena* ‘MYG045’ - (Family Actinopodidae)

A single specimen of *Missulena* ‘MYG045’ (Figures 16 and 17) was collected in a dry trap within the Rio Tinto Iron Ore tenement Site 02 (See Appendix 1 for coordinates). *Missulena* are commonly referred to as ‘Mouse Spiders’ with *M.* ‘MYG045’ being widely distributed throughout the Hamersley subregion of the Pilbara and possibly further south according to the WA Museum database collections (Durrant *et al.* 2010). Because of this it is not considered a SRE. No burrow was found in the location of the dry trap where the *Missulena* ‘MYG045’ was collected during hand foraging due to mygalomorph burrows being cryptic in nature; therefore, no burrow description or images are available.

Figure 16: *Missulena ‘MYG045’ (lateral).*

Figure 17: *Missulena 'MYG045' (front).*

5.1.2. **Scorpiones (Scorpions)**

5.1.2.1. **Overview**

Scorpions are found throughout Australia but are particularly common in arid areas. These species excavate deep spiral burrows from which they emerge at night to catch prey. Scorpions are often found under logs and rocks (Harvey and Yen, 1989). Scorpions are represented in WA by two families, Buthidae and Urodacidae.

The family Buthidae is the most widespread of all scorpion families, and in WA are represented by the genera *Isometrus*, *Isometroides* and *Lychas*. The taxonomy of the species making up these genera is problematic as each genus contains numerous undescribed species, this is especially true for *Lychas*. Most Australian Buthidae appear to have wide distributions, however, few taxa have confirmed SRE distributions (Volschenk, 2010).

The family Urodacidae is endemic to Australia where it is represented by the genera *Urodachus* and *Aops*. The greatest issue confronting *Urodachus* taxonomy is the large number of undescribed species being recognised as a result of current ongoing research on the group. At present there are 22 species of *Urodachus*, but this may represent only 20% of the real diversity in Australia. *Urodachus* is most diverse in WA and only a few species are recorded east of the Great Dividing Range in eastern Australia (Volschenk, 2010).

Two species of scorpion were recorded during the targeted SRE survey totalling four specimens collected. Specimens from both the Buthidae and Urodacidae families were collected. One specimen of Lychas "multipunctatus" (from the Buthidae family) was recorded at IOH site 01. Two specimens of *Urodacus* "megamastigus short" (from the Urodacidae family) were recorded at IOH Site 01 and a singular specimen at RIO Site 01. The only specimen of *Lychas* "multipunctatus" was recorded at IHO Site 01.

5.1.2.2. *Lychas* 'multipunctatus' - (Family Buthidae)

The genus *Lychas* is widespread throughout Australia and suffers from a lack of taxonomic work. While also represented in Africa, India and eastern Asia, all known Australian taxa are considered endemic. While *Lychas* have wide distributions, however, a small number are known to be SRE.

One specimen of *Lychas* 'multipunctatus' was found during the targeted SRE survey at IOH Site 01. This undescribed species is one of the most common and widely distributed scorpions throughout the Western Australia Pilbara region. The species *Lychas* 'multipunctatus' is considered non-SRE (Volschenk, 2011). (Note: Lychas 'multipunctatus' is a well-defined and clearly identified unpublished morphospecies[1]).

5.1.2.3. *Urodacus* 'megamastigus short' - (Family Urodacidae)

Urodacus is the most diverse scorpion genus in Western Australia and contains both widespread and SRE species. Three specimens of *Urodacus* 'megamastigus short' were collected during the survey, two at IOH Site 01 and one at RIO Site 02. This undefined species as been recorded throughout the greater Pilbara bioregion and all subregions, and therefore is considered non-SRE. (Volschenk, 2011).

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[1] Morphospecies: A taxonomic species based wholly on morphological differences from related species (Merriam-Webster 2012a)

It is believed that the unidentifiable *Urodacus* sp. collected in the previous survey (May/June 2010) is conspecific with *Urodacus* 'megamastigus short' and therefore considered to be non-SRE.

5.2. Results Summary

A list of all invertebrates recorded and numbers found for each sampling method is presented in Table 3, with SREs found only in the Mygalomorph family Idiopidae, species *Aganippe* 'MYG086'. The majority of taxa listed here are non-SRE taxa but have been included as additional information.

Table 3: *Table of all invertebrate groups and individuals collected during the targeted SRE survey.*

TAXON	Genus/Species	Significance	Site	Method	Total
ARACHNIDA					
Araneae					
Actinopodidae	*Missulena* 'MYG045'	Not SRE, Widespread	RIO Site 02	Dry Pitfall	**1**
Idiopidae	*Aganippe* sp.	Juvenile	RIO Site 02	Excavation	**1**
	Aganippe 'MYG086'	Potentially SRE	IOH Site 01	Dry Pitfall	**3**
	Aganippe 'MYG086'	Potentially SRE	RIO Site 02	Dry Pitfall	**2**
ARACHNIDA					
Scorpiones					
Urodacidae	*Urodacus* 'megamastigus short'	Not SRE, Widespread	IOH Site 01	UV Lamp	**2**
	Urodacus 'megamastigus short'	Not SRE, Widespread	RIO Site 01	UV Lamp	**1**
Buthidae	Lychas 'multipunctatus'	Not SRE, Widespread	IOH Site 01	UV Lamp	**1**

Total	**11**

6. VEGETATION ASSESSMENT

6.1. Vegetation Assessment and Collection Methods

As requested by the DEC for the Targeted SRE survey, a habitat assessment of major flora was undertaken at each site (Durrant B 2011, pers. comm. 15 April). This was undertaken to enable comparison between different survey areas in order to better determine the likelihood of target SRE fauna being present.

The habitat assessment consisted of observing the sites and recording

- Broad habitat type
- Specialised habitat type
- Vegetation complex assemblage
- Substrate analysis
- Presence of geological and topographic points of interest suitable as SRE habitat
- Leaf litter cover and composition
- Level and type of habitat disturbance
- Area physical connectivity and extent
- Visual confirmation during site hand foraging (Section 4.4.3.) of the presence or absence of Mygalomorph trap door spider and scorpion fauna burrows.

The vegetation assemblage at IOH Site 01 and 02 are considered 'floristic control sites' to compare the other site vegetation assemblages recorded during the study as these sites already contain target SRE fauna from the previous IOH survey collections (Dalcon Environmental 2011). A comprehensive flora assessment was conducted at IOH Site 01 and 02, however, due to the increased thoroughness (more samples collected) of the vegetation assessment conducted, it is difficult to directly compare vegetation complexes directly due the non-standardised sampling methodology used at the other sites. Vegetation present at each site was collected, labelled and pressed to be identified by a flora taxonomic specialist.

The vegetation boundaries and types indicated on the vegetation map (Figure 18) are drawn using visual differences in perceived vegetation assemblages while in the field and using high resolution aerial photography in the laboratory, not data collected from the vegetation assessment. This map is for reference only and should by no means be considered an official map of the vegetation complexes occurring within the site.

The objective of vegetation mapping was to provide further certainty 'that neither species is at risk from the Project. To address this uncertainty more specific habitat information should be provided illustrating that the species are found in habitat that is widespread and not conductive to SREs' (Durrant B 2010, pers. comm. 15 April). However this habitat information, while indicating that the risk to the species is potentially low, there is however, a risk that it won't (Durrant B 2010, pers. comm. 15 April).

Although it is confirmed that potential SRE taxa are in habitat that is located in the adjacent Rio Tinto tenement, these taxa still fall within the 10,000 km^2 restricted population distribution which defines the taxa as a potential SRE (Harvey 2002). As Dalcon Environmental cannot confirm the long term security of SRE populations on the Rio Tinto tenement, these taxa are potentially still at risk.

Vegetation map creation was aided by the vegetation map produced by Astron Environmental Services vegetation and flora survey report (Astron Environmental Services 2011).

Vegetation type 1 is indicative of rocky hillocks and crests containing low *Eucalyptus leucophloia* subsp. *leucophloia* trees with *Grevillea wickhamii* subsp. *hispidula* and *Acacia bivenoso* shrubs over *Triodia* sp. hummock grassland.

Vegetation type 2 is indicative of creek and drainage lines predominated by *Grevillea wickhamii* subsp. *hispidula* over wide and open *Triodia* sp. hummock grassland.

Vegetation type 3 is indicative of family Malvaceae flora including numerous *Corchorus* species, *Hibiscus coatesii* and *Sida* species collected. Vegetation type 3 is also characterised by *Triodia* sp. open grassland, however, there are scattered stands of *Aristida holathera* var. *holathera* and the weed grass *Cenchrus cillaris*.

Vegetation type 4 is indicative of vegetation adjacent creek and drainage areas by *Grevillea wickhamii* subsp. *hispidula* over open *Triodia* sp. hummock grassland with scattered *Indigofera monophylla* and *Senna* species. This vegetation type is a mix between Vegetation type 2 and Vegetation type 3 although is different enough in assemblage and age to warrant its own vegetation type allocation.

Vegetation type 5 is indicative of scattered *Hakea lorea* subsp. *lorea* over *Petalostylis labicheoides* over open *Triodia* species grassland.

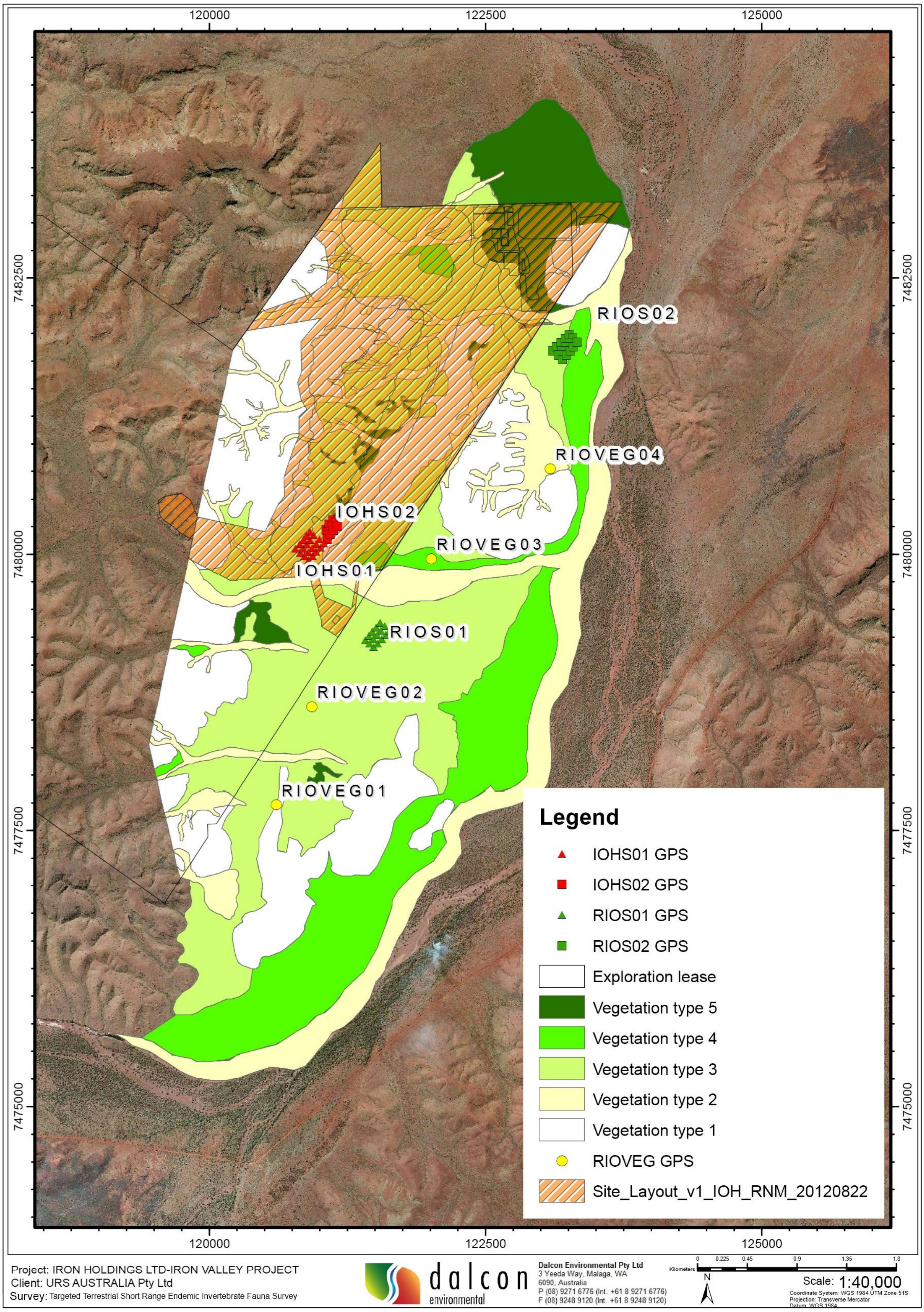

Figure 18: *Representational vegetation map of the survey area using visual differences in vegetation assemblages to distinguish perceived floral borders.*

6.2. Results of Habitat Assessment – IOH Sites

Due to their close proximity and identical biology and geography, IOH Site 01 (IOH-S01) and IOH Site 02 (IOH-S02) were combined for the vegetation assessment. These two sites were surveyed due to the likelihood of containing the SRE fauna the survey was specifically targeting.

The two IOH sites are broadly characterised as spinifex grassland with open ground scattered Eucalyptus over-storey and Acacia under-storey, transitioning to open grasslands towards the elevated terrain to the west (Figure 19). The substrate is suitable for Mygalomorph spiders and scorpions as it consists of loosely compacted red soil with scattered rocks and pebbles (35% coverage) with spinifex clumps providing shelter and microhabitat. Leaf litter coverage was minimal within both sites. However, in the south west corner of IOH Site 02, young vegetation recovering from previous fires formed thick stands with up to 60 % leaf litter coverage. The north east corner of IOH Site 02 exhibits a transition area in geography, with ground substrate consisting of 15 % small pebbles, 85 % large rocks as the site progressed into a nearby rocky ridgeline. This impenetrable rocky habitat is unsuitable for the burrow dwelling Mygalomorph trapdoor spiders and scorpion fauna. This vegetation type is broadly represented in Figure 18 as Vegetation Type 3, however, IOH Site 02 also passes briefly into Vegetation type 5.

IOH Site 01 and IOH Site 02 are located within the proposed disturbance area for the project, with drill lines, drill pads and severe soil disturbance already present throughout the sites. The IOH sites are also heavily eroded in areas by artificial drainage lines created from exploration disturbances. Evidence of cattle grazing, anthropogenic disturbances and weed invasion are also present (Astron Environmental Services 2011).

A total of 54 flora species were collected during the vegetation assessment at both IOH sites (see Appendix 2).

Figure 19: *IOH Site 01 and 02 - Typical vegetation complex.*

6.3. Results of Habitat Assessment - RIO Sites

6.3.1. RIO Site 01

Rio Tinto Iron Ore Site 01 (RIO-S01) is characterised by spinifex grassland with open soil patches and sparse Eucalyptus over-storey (Table 5, Appendix 3). Soil substrate is suitable for Mygalomorph trapdoor and scorpion fauna to burrow in, although slightly more compacted then the IOH sites. Overall leaf litter coverage throughout the site is minimal, however, a moderate to high amount of leaf litter was present under localised Acacia stands which are ideal for Mygalomorph trapdoor spiders as they commonly use leaf litter in the construction of burrow doors. This vegetation type is broadly represented in Figure 18 as Vegetation Type 3. Mygalomorph trapdoor spiders and scorpions were present at the site (refer to SRE fauna collected in Table 2).

Fire is the dominant disturbance observed at RIO-S01 and is likely responsible for the age and composition of the vegetation assemblage present. Minor signs of cattle grazing and runoff erosion are also present. Twenty two representative flora species were collected at RIO-S01, exhibiting the highest percentage similarity in comparison to both the IOH sites at 41 %. Only two species of RIO-S01 are unique to the site.

6.3.2. **RIO Site 02**

Rio Tinto Iron Ore Site 02 (RIO-S02) is a flat plain situated adjacent land subjected to inundation associated with the seasonal flow of Weeli Wolli Creek. Vegetation complex is characterised by spinifex grassland with a mixed Acacia woodland over-storey (Table 5, Appendix 3). The open areas of this site have medium compacted soil between clumps of spinifex which are ideal for SRE Mygalomorph trapdoor spiders and scorpion fauna. The medium to high concentrations (60 – 100 %) of leaf litter under Acacia stands are also ideal for SRE Mygalomorph trapdoor spiders and scorpion fauna, despite overall leaf litter coverage of the site being insignificant. This vegetation type is broadly represented in Figure 18 as Vegetation Type 3 and Vegetation Type 4. Mygalomorph trapdoor spiders were present in RIO-S02 under the Acacia stands, however, no scorpion burrows were found.

Eleven flora species dominated the vegetation complex present at Rio Tinto Iron Ore Site 02 (Table 5). Of these eleven species, three percent were unique to the site: *Acacia colei* var. ileocarpa and *Velleia connata*. The site, however, exhibits a 16 % similarity in species composition with IOH Sites 01 and 02.

6.4. **IOH and RIO Vegetation Assessment Site Comparisons**

Due to their close proximity and identical flora complex and geography, IOH Site 01 (IOH-S01) and IOH Site 02 (IOH-S02) were combined for the vegetation assessment. In contrast, the Rio Tinto Iron Ore vegetation assessment sites were sufficiently isolated by distance and contain unique floristic complexes that they are discussed separately here.

Only six species were present in all four Rio Tinto tenement vegetation assessment sites (Table 4). It is important to note that no SRE fauna sampling regimen was deployed at the RIO vegetation assessment sites

Table 4: *The six flora species present in all RIO Vegetation Assessment Sites.*

Name	Family
Corchorus lasiocarpus subsp. *lasiocarpus*	Malvaceae
Corchorus sidoides subsp. *sidoides*	Malvaceae
Petalostylis labichieoides	Fabaceae
Ptilotus exaltatus	Amaranthaceae
Ptilotus helipteroides	Amaranthaceae
Senna artemisioides subsp. *helmsii*	Fabaceae

On average, the RIO vegetation survey sites exhibit 18 % to 27 % floristic uniqueness in comparison to both the IOH survey sites. An average of 18 species were collected to represent the dominant vegetation complexes present per site, however, there is only 25 – 43% species composition similarity between the four vegetation assessment sites.

Flora species composition and similarities between the IOH and the four RIO vegetation survey sites is displayed in Table 5.

***Table 5:** Flora species present at IOH and Rio Tinto Iron Ore vegetation assessment sites.*

Name	Site				
	IOH	RIOVEG-1	RIOVEG-2	RIOVEG-3	RIOVEG-4
Acacia adoxa var. a*doxa*	X	X			
Acacia ancistrocarpa	X				X
Acacia colei var. *ileocarpa*		X			
Acacia dictyophleba					X
Acacia hilliana	X	X			X
Acacia inaequilatera	X		X	X	
Acacia pachyachra	X		X	X	X
Acacia pruinocarpa	X			X	
Acacia pyriformis				X	
Acacia spondylophylla				X	
Acacia tumida var. *pilbarensis*	X	X		X	X
Aristida holathera var. *holathera*	X			X	
**Cenchrus ciliaris*	X			X	X
Corchorus lasiocarpus subsp. *lasiocarpus*		X	X	X	X
Corchorus sidoides subsp. *sidoides*	X	X	X	X	X
Corymbia hamersleyana	X				X
Dicrastylis cordifolia		X	X	X	
Eragrostis setifolia		X		X	
Eucalyptus gamophylla	X			X	
Gomphrena cunninghamii				X	
Goodenia microptera	X	X			
Gossypium robinsonii	X	X			X
Grevillea wickhamii subsp. hispidula	X		X	X	
Hakea chordopylla			X	X	X
Hakea lorea subsp lorea	X		X	X	X
Paraneurachne muellerii	X	X			
Petalostylis labichieoides	X	X	X	X	X
Ptilotus calostachyus	X	X	X		
Ptilotus exaltatus	X	X	X	X	X
Ptilotus helipteroides	X	X	X	X	X
Ptilotus obovatus	X			X	
Salsola austrlalis				X	
Scaevola parvifolia					X
Senna artemisioides subsp. *helmsii*		X	X	X	X
Sida echinocarpa	X	X	X	X	
Solanum phlomoides	X	X			
Trianthema pilosa	X				X

* indicates weed species

6.4.1. RIO Vegetation Assessment Site 01

Vegetation of RIO vegetation assessment Site 01 (RIOVEG-1, Figure 18) consisted entirely of herbaceous species with no discernable living over-storey due to previous fire. A total of 18 dominant flora species were collected during the survey (Table 5). Only nine percent of the species collected are shared with the IOH tenement sites, with 44 % being unique to the site (see Appendix 2).

RIOVEG-1 is a plain landscape, sparse in features with few undulations and hillocks. Rocky outcrops may be suitable for harbouring SRE Gastropods (snails), and while being absent from the site, may be substituted by the presence of the rocky hillocks which in some cases can provide suitable habitat. Soil substrate is ideal for burrowing SRE fauna, however, the evidence of fire having removed all leaf litter has reduced the potential areas of refuge, habitat and construction materials for Mygalomorph trapdoors. This vegetation type is broadly represented in Figure 18 as Vegetation Type 1 flanked either side by Vegetation Type 2.

No scorpion or trapdoor spider burrows were found and no specimens collected during the site visual assessment. No sampling regime was deployed at RIOVEG-1.

6.4.2. RIO Vegetation Assessment Site 02

RIO Site 02 (RIOVEG-2, Figure 18) vegetation consists entirely of herbaceous species due to previous fire, as all previous over-storey vegetation is deceased. Fourteen species were collected, 57% of which are unique to RIOVEG-2 (see Table 5, Appendix 2). Four of the total fourteen species are shared with the IOH sites (7 % similarity).

RIOVEG-2 is a plain flanked by small ranges on either side. Soil substrate is suitable for Mygalomorph spider and scorpion fauna, however, presence of either is unconfirmed. Leaf litter is absent from the site due to pervious fire. This vegetation type is broadly represented in Figure 18 as the broad Vegetation Type 3; however, the site does cross into Vegetation Type 5. No scorpion or trapdoor spider burrows were found and no specimens collected during the site visual assessment. No sampling regime was deployed at RIOVEG-2.

6.4.3. **RIO Vegetation Assessment Site 03**

RIO vegetation Site 03 (RIOVEG-3, Figure 18) is characterised by spinifex grasslands with scattered herbs and Eucalyptus over-storey. The spinifex grasslands transitions to general grasslands and towards a creek line which flows near the site (Figure 18). The soil substrate is suitable for SRE fauna, however, no evidence of Mygalomorph trapdoor spider or scorpion burrows or species were found. This may be contributed to some extent by the lack of over-storey and leaf litter throughout the site. This vegetation type is broadly represented in Figure 18 as Vegetation Type 4.

Twenty four species were collected during the vegetation assessment, the greatest diversity exhibited by any of the RIO vegetation assessment sites. Thirty three percent of the 24 flora species collected are unique to RIOVEG-3, only nine species are shared with the IOH sites (16 %) (see Appendix 2).

No scorpion or trapdoor spider burrows were found and no specimens collected during the site visual assessment. No sampling regime was deployed at RIOVEG-3.

6.4.4. **RIO Vegetation Assessment Site 04**

The vegetation of RIO vegetation Site 03 (RIOVEG-4, Figure 18) is characterised by spinifex grassland with Acacia shrub level over-storey with areas of open soil and scattered Eucalyptus (Table 5, Appendix 3). While rocky outcrops are ideal for SRE Gastropods (snails), this species was absent within the survey area, although they were present in the surrounding rocky hills. Substrate was suitable for SRE trapdoor spider and scorpion burrow building, especially between grass and spinifex clumps present under Eucalyptus and Acacia stands where elevated levels (40 – 60 %) of leaf litter coverage provides ample habitat construction materials and camouflage. Overall, however, there was minimal leaf litter covering the site. Although no evidence of Mygalomorph trapdoor spider or scorpion burrows or species were found, it is highly likely that they are present within the area. Existing disturbances are localised with depressions and drainage lines running throughout the survey site accompanied by evidence of seasonal or periodic inundation and heavy runoff into the nearby Weeli Wolli Creek catchment area.

Visually, RIOVEG-4 is very similar to RIO Site 01. This vegetation type is broadly represented in Figure 18 as the broad Vegetation Type 1 and differs however from RIO Site 01 due to be restricted to areas of increased soil moisture, inundation and drainage.

A total of 18 species were collected at RIOVEG-4 during the vegetation (see Appendix 2). Fourteen of the 18 species collected (24 %) are present at both RIOVEG-4 and the IOH sites, with only five species (9 %) being unique to the site. These results of similarity and uniqueness are identical to that of RIO vegetation assessment site 01. Both sites (RIOVEG-1 and RIOVEG-4) vegetation complexes are represented by 18 species, of which over 55 % (10 species) are common.

No scorpion or trapdoor spider burrows were found and no specimens collected during the site visual assessment. No sampling regime was deployed at RIOVEG-4.

7. SURVEY ADEQUACY AND LIMITATIONS

The main potential limitation of this survey was that the timing was later in the year than optimal, as stated in EPA Guidance Statement No. 20, which recommends that SRE surveys in the Pilbara region be conducted during the wet season (November – April) (EPA, 2009). However, Department of Environment and Conservation advised that the May and June survey period was acceptable (Durrant B 2011, pers. comm., 15 April).

Durant *et al.* (2010) has stated that Pilbara rainfall is very unreliable and highly variable, with these rainfall events largely driving the activity of the local fauna. Extended periods of dry conditions and inappropriate rainfall can induce torpor[2], however, SRE assemblages respond very quickly to appropriate isolated rainfall events. The 12 month period prior to the survey had less than average rainfall and although there was good rainfall recorded on site during April immediately before this survey (Bureau of Meteorology 2011a), rainfall during the survey periods themselves (May and June) was below average (Table 6). This would have potentially effected specimen yields as SREs, specifically mygalomorphs, which known to be active immediately prior to, during and after rainfall events (Main BY 2011, pers. comm., July).

Ultimately, the precise rainfall requirements which are most favourable for sampling SRE taxa (and their subsequent capture) are not known and there are many mitigating circumstances which affect the suitability of these rain events (i.e. soil type, topography, vegetation, SRE species). Because of this it cannot be said categorically that the lower than average rainfall in the 12 months prior to the survey and the months of the survey itself resulted in reduced SRE mobility and capture but it must be considered herein as a potential limitation to the survey.

Marillana station weather station is not equipped with rainfall measuring equipment (Bureau of Meteorology 2011b), therefore, although rain was present during the survey it is unable to be locally quantified and weather data at Newman Airport is the most accurate rainfall data available.

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[2] Torpor: A state of physiological lowered activity typically characterized by reduced metabolism, heart rate, respiration, and body temperature that occurs in varying degrees especially in hibernating and estivating animals (Merriam-Webster 2012b).

Table 6: *Newman Aerodrome weather station monthly average rainfall (mm) over the period 1981 – 2010, running monthly total for 2011 and monthly differences.*

	Duration		**Difference**
	1981-2010	**2011**	**2011**
Month	**Mean for 30 yrs**	**Monthly**	**Monthly**
January	58.9	59	0.1
February	82.7	145.8	63.1
March	35	26	-9
April	19.7	31.4	11.7
May	20.7	5.6	-15.1
June	14.8	9.4	-5.4
July	14.3	32.2	17.9
August	4.5	0	-4.5
September	5.8	-	-
October	3.2	-	-
November	10.9	-	-
December	41	-	-
TOTAL	**311.5**	**309.4**	

Lack of habitat diversity per site during the targeted SRE survey is not considered a limitation of this study as the targeted nature of the survey restricted sampling sites to areas which SRE specimens had been collected in the previous SRE survey in the Iron Valley Project and similar habitats where the target fauna may occur.

Although part of the survey area had been burnt (refer Section 2.3), Dalcon Environmental does not consider this to have been a limitation to the survey as it does not seem to have affected the abundance of any of the SRE taxa recorded when compared to unburnt sites. This is due to collections of the Mygalomorphae trap door spider *Aganippe* 'MYG086' and the scorpion *Urodacus* 'megamastigus short' from both IOH and RIO survey areas (Table 3).

As discussed in Section 6.1 the comprehensive floristic assessment conducted at IOH sites 01 and 02 in comparison to the Rio Tinto Iron Ore sites makes a direct floral comparison between sites difficult due to the non-standardised sampling methodology used at all sites. Future flora assessments should have methodology to ensure similar sampling regimes between sites. It is possible with an identical scope of flora surveying at RIO sites as was conducted at the IOH sites, an increased number of flora samples may have been identified and vegetation complexes between sites increase or decrease in similarity in respect to the values presented in this report. However, considering that the objective of the flora assessment was to define SRE habitat as the basis of a risk assessment, rather than make direct floristic comparisons between sites (see Section 8), Dalcon Environmental considers the assessment to be adequate.

8. CONCLUSIONS

The targeted short-range endemic invertebrate survey conducted in June 2011, consisted of a total of four sampling sites within the Iron Ore Holdings Ltd Iron Valley M47/1439 mining lease and the adjacent Rio Tinto M274/SA tenement. Total of 60 dry pitfall traps were deployed in the project area: 30 dry pitfall traps within between two IOH tenement sampling sites and 30 dry pitfall traps between two RIO tenement sampling sites. Extensive hand foraging was also conducted at each sampling site as well as UV night surveys specifically to sample for scorpion fauna. Four vegetation and habitat assessment sites were situated along the length of the adjacent Rio Tinto M274/SA tenement boundary to access the extent of potentially suitable SRE habitat outside the IOH project area.

Recommendations made by the Department of Environment and Conservation (Durrant B 2011, pers. comm. 15 April) and the Environmental Protection Authority guidance statement 20 (Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia; EPA, 2009) were used as a guideline in determining the most appropriate sampling regime to selectively sample the target short-range endemic invertebrates. The deployment of dry pitfall traps (EPA, 2009) was deemed the best survey method over time to survey in conjunction with extensive hand foraging (Durrant B 2011, pers. comm. 15 April; EPA 2009) for target burrows of mygalomorphs and scorpions. Due to the range of area in the Rio Tinto tenement, vegetation assessments were conducted at regular intervals to determine the extent of suitable SRE habitat and composition similarity to IOH sites (Durrant B 2011, pers. comm. 15 April; EPA, 2009).

A total of 11 specimens were yielded over five species, with a single potential SRE identified (Table 3).

A singe *Aganippe* species, *Aganippe* ‘MYG086’ was collected within the project area (Table 3). *Aganippe* ‘MYG086’ is considered to be a potential SRE (Section 5.1.1.2). *Aganippe* ‘MYG086’ is only known from the Iron Valley Project (May/June 2010 and June 2011) and from Roy Hill Station, approximately 80 km southeast of the Project area.

Aganippe ‘MYG086’ is present within the Iron Valley tenement (IOH Site 01) and the adjoining Rio Tinto Iron Ore tenement (RIO Site 02). This may indicate a larger population of *Aganippe* ‘MYG086’ in the area which may be unlikely to be adversely impacted upon by Iron Valley infrastructure development. This conclusion is dependent upon the long term security of habitats in the adjacent Rio Tinto Iron Ore.

Although these two *Aganippe* 'MYG086' populations may be unrelated and may experience no interconnectivity (i.e. due to topographical and habitat barriers, lack of population dispersal) due to the definition of SRE fauna stating that populations range less than 10 000 km^2, the significance of these localised populations is still relevant. Based on the current known distribution of this species (only known at the Project and 80 km southeast), Dalcon Environmental cannot assume that this species is widespread, but can infer that at least within the region of the IOH/RIO tenements, that it may be present within areas that have been defined as suitable habitat (see Section 5.1.1, Section 6, Figure 18). This is only verifiable by further targeted surveys conducted throughout the two tenements and is complicated by the vegetation condition of the RIO Site 02.

The vegetation complex currently present at RIO Site 02 has been directly influenced by a recent fire event. There is evidence surrounding the burnt area at RIO Site 02 that suggests that a different vegetation type once existed within the site than was present during the survey.

As the area recovers from the fire event (date unknown, possibly in early 2009) the surrounding vegetation complex will recolonise the area with its assemblage making it less synonymous with the vegetation present at IOH Site 01 and 02. While it is inevitable that RIO Site 02 will share some flora species present at IOH sites, between the two sites there are currently differences in:

- Flora composition complexity (primarily of understory species);
- Flora age;
- Flora stability (flora composition will continue to change while colonising species die off and are replaced over time with more permanent species);
- Soil dynamics and burrowing suitability;
- Leaf litter composition and percent coverage;
- Percent open bare soil;
- Food sources.

SRE fauna experience difficulty dispersing (Harvey 2002) rendering them vulnerable to rapid re-colonisation of damaged and disturbed areas by flora and habitat changes. For example, Mygalomorph trap door spiders will burrow and inhabit only one burrow for the entirety of their life, rendering them extremely susceptible to habitat changes over time (Main BY 2011, pers. comm., July). Locally restricted species tend to have a high conservation status because they are more vulnerable to extinction following habitat destruction and environmental change (Eberhard *et al*., 2009; Ponder and Colgan, 2002). SRE migration from the older stable IOH habitat to the burnt transitional habitat at RIO Site 2 is extremely unlikely.

A single *Urodacus* species, *Urodacus* 'megamastigus short', was collected during UV night survey's at IOH Site 01 and RIO Site 02 (Table 3). *Urodacus* 'megamastigus short' is widespread and not a SRE (Section 5.1.2.3) (Volschenk, 2010, 2011).

It is important to note concerning possible SRE distributions and populations within the potential suitable habitat zones within the IOH and adjacent RIO tenements, as per Figure 18 that without a survey to physically confirm population presence that the known populations in the IOH tenement may still be at risk. This is because the IOH tenement populations are known where the extent of possible RIO tenement populations is not. Any future plans to develop the RIO tenement is unknown by Dalcon Environmental casting uncertainty about the future of potential SRE populations present and increasing the importance of SRE populations found within the IOH project area.

9. RECOMMENDATIONS

9.1. General recommendations

In order to limit the impacts on *Aganippe* 'MYG086' present within the Project area, Dalcon recommends that:

- Clearing of native vegetation should be kept to a minimum. This applies particularly to any spinifex grasslands.
- Habitat that is likely to contain *Aganippe* 'MYG086', such as spinifex grasslands with acacia over-storeys, should not be disturbed if possible. It is apparent that much of the *Aganippe* 'MYG086' habitat on the IOH tenement occurs within areas that are proposed to be disturbed as a result of the Project. Whilst suitable *Aganippe* 'MYG086' habitat was found on the adjacent Rio Tinto Iron Ore tenement, this habitat was in a state of flux as a result of previous fire with the vegetation community which is likely to change over time, and as a result, may become less conducive habitat for *Aganippe* 'MYG086'. Any possible future development within this tenement is unknown.
- Any areas that will be cleared should be rehabilitated by plants endemic to the area as immediately after use to encourage SRE (and general) floral and faunal recolonisation.
- To minimise the danger of increased fire frequency as a result of the Project, a fire prevention strategy should be implemented. Fire is a recognised threat to spinifex grasslands (Kendrick, 2001).
- Every effort is taken to ensure vehicles do not introduce or spread any weeds (i.e. implement a weed management strategy) or soil pathogens which will impact potential SRE habitat.

10.STUDY TEAM

The Iron Valley Project Targeted Short Range Endemic Invertebrate Fauna Survey detailed in this document was planned, coordinated and executed by Dalcon Environmental Pty Ltd in close consultation with URS Australia Pty Ltd and Iron Ore Holdings Pty Ltd.

The Project team, their responsibilities and qualifications were as follows:

Stuart Helleren BSc (Hon), MSc

Principal Scientist/Director/Project Management

Phillip Mark Heath BSc (Hon)

Senior Environmental Scientist/Invertebrate Zoologist/Field Program

Sabrina Arkile BSc (Hon)

Senior Environmental Scientist/Field Program

Ray Mielens BSc

Environmental Scientist/Field Program

Mitchel Ranger BSc

Environmental Scientist/Field Program

Ross Gordon BSc (Hon)

Environmental Scientist/Invertebrate Zoologist/Field Program

We would also like to thank the taxonomic experts listed in Table 1 for the identification of potential SRE taxa.

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12. Appendix 1 – GPS Coordinates

12.1. IOH Site 01 GPS Coordinates

IOH Site 01	Position (WSG 84)		
Trap Number	**Lat/Long**	**UTM**	**Notes**
IOHS01D01	S22 44 43.1 E119 18 34.1	50 K 737165 7482824	
IOHS01D02	S22 44 42.1 E119 18 35.3	50 K 737201 7482857	
IOHS01D03	S22 44 40.7 E119 18 36.5	50 K 737234 7482899	
IOHS01D04	S22 44 39.6 E119 18 37.9	50 K 737276 7482932	
IOHS01D05	S22 44 38.5 E119 18 39.1	50 K 737309 7482966	
IOHS01D06	S22 44 37.2 E119 18 37.7	50 K 737270 7483006	
IOHS01D07	S22 44 38.5 E119 18 36.6	50 K 737239 7482967	
IOHS01D08	S22 44 39.7 E119 18 35.3	50 K 737202 7482929	
IOHS01D09	S22 44 40.9 E119 18 34.1	50 K 737166 7482895	
IOHS01D10	S22 44 42.0 E119 18 32.9	50 K 737131 7482860	
IOHS01D11	S22 44 41.0 E119 18 31.5	50 K 737092 7482892	
IOHS01D12	S22 44 39.8 E119 18 32.5	50 K 737122 7482928	
IOHS01D13	S22 44 38.6 E119 18 33.7	50 K 737155 7482965	
IOHS01D14	S22 44 37.3 E119 18 34.7	50 K 737186 7483005	
IOHS01D15	S22 44 35.9 E119 18 35.9	50 K 737220 7483045	
IOHS01D16	S22 44 34.9 E119 18 34.7	50 K 737188 7483079	
IOHS01D17	S22 44 36.0 E119 18 33.6	50 K 737154 7483044	
IOHS01D18	S22 44 37.1 E119 18 32.6	50 K 737125 7483010	
IOHS01D19	S22 44 38.4 E119 18 31.4	50 K 737090 7482971	
IOHS01D20	S22 44 39.7 E119 18 30.0	50 K 737050 7482931	
IOHS01S01	S22 44 41.2 E119 18 35.7	50 K 737212 7482885	Scorpion Burrow
IOHS01S02	S22 44 41.1 E119 18 35.6	50 K 737210 7482886	Scorpion Burrow
IOHS01S03	S22 44 40.7 E119 18 35.9	50 K 737219 7482897	Scorpion Burrow
IOHS01S04	S22 44 40.4 E119 18 36.8	50 K 737243 7482908	Scorpion Burrow
IOHS01S05	S22 44 38.5 E119 18 37.9	50 K 737275 7482967	Scorpion Burrow
IOHS01S06	S22 44 38.3 E119 18 37.6	50 K 737268 7482971	Scorpion Burrow
IOHS01S07	S22 44 38.3 E119 18 37.7	50 K 737271 7482972	Scorpion Burrow
IOHS01S08	S22 44 39.7 E119 18 35.3	50 K 737202 7482929	Scorpion Burrow
IOHS01S09	S22 44 37.7 E119 18 37.0	50 K 737251 7482989	Scorpion Burrow
IOHS01S10	S22 44 38.6 E119 18 36.6	50 K 737239 7482962	Scorpion Burrow
IOHS01S11	S22 44 38.8 E119 18 36.4	50 K 737232 7482958	Scorpion Burrow
IOHS01S12	S22 44 39.7 E119 18 35.6	50 K 737211 7482931	Scorpion Burrow
IOHS01S13	S22 44 40.1 E119 18 35.3	50 K 737200 7482918	Scorpion Burrow
IOHS01TD01	S22 44 39.5 E119 18 37.7	50 K 737269 7482935	Trapdoor
IOHS01TD02-03	S22 44 38.3 E119 18 33.5	50 K 737152 7482974	Trapdoor 02 and 03 close together

Note: 'IOH' indicates site location within the Iron Valley Project (IOH tenement). '$S0_X$' indicates site number. 'D_{XX}' indicated dry pitfall Trap number. 'S_{XX}' indicates Scorpion burrow number found on site. '$TD0_X$' indicates trapdoor number found on site.

12.2. IOH Site 02 GPS Coordinates

IOH Site 02	Position (WSG 84)		
Trap Number	**Lat/Long**	**UTM**	**Notes**
IOHS02D01	S22 44 34.5 E119 18 39.9	50 K 737335 7483088	
IOHS02D02	S22 44 32.8 E119 18 40.9	50 K 737363 7483139	
IOHS02D03	S22 44 31.6 E119 18 42.1	50 K 737400 7483175	
IOHS02D04	S22 44 32.2 E119 18 42.9	50 K 737422 7483156	
IOHS02D05	S22 44 33.5 E119 18 41.6	50 K 737385 7483118	
IOHS02D06	S22 44 35.1 E119 18 40.5	50 K 737352 7483069	
IOHS02D07	S22 44 37.2 E119 18 40.1	50 K 737340 7483004	
IOHS02D08	S22 44 35.9 E119 18 41.1	50 K 737369 7483045	
IOHS02D09	S22 44 34.6 E119 18 42.1	50 K 737398 7483083	
IOHS02D10	S22 44 33.5 E119 18 43.4	50 K 737436 7483117	
IOHS02S01	S22 44 34.9 E119 18 39.1	50 K 737312 7483077	Scorpion Burrow

Note: ‘IOH’ indicates site location within the Iron Valley Project (IOH tenement). ‘$S0_X$’ indicates site number. ‘D_{XX}’ indicated dry pitfall Trap number. ‘S_{XX}’ indicates Scorpion burrow number found on site.

12.3. RIO Site 01 GPS Coordinates

RIO Site 01	Position (WSG 84)		
Trap Number	Lat/Long	UTM	Notes
RIOS01D01	S22 45 07.1 E119 18 51.4	50 K 737648 7482078	
RIOS01D02	S22 45 05.9 E119 18 52.6	50 K 737681 7482115	
RIOS01D03	S22 45 04.6 E119 18 53.7	50 K 737714 7482155	
RIOS01D04	S22 45 03.4 E119 18 55.0	50 K 737751 7482191	
RIOS01D05	S22 45 02.2 E119 18 56.2	50 K 737787 7482229	
RIOS01D06	S22 45 03.2 E119 18 57.7	50 K 737828 7482197	
RIOS01D07	S22 45 04.5 E119 18 56.4	50 K 737791 7482157	
RIOS01D08	S22 45 05.8 E119 18 55.2	50 K 737757 7482119	
RIOS01D09	S22 45 06.9 E119 18 54.0	50 K 737722 7482085	
RIOS01D10	S22 45 08.1 E119 18 52.7	50 K 737683 7482048	
RIOS01D11	S22 45 09.2 E119 18 53.9	50 K 737719 7482013	
RIOS01D12	S22 45 08.2 E119 18 55.3	50 K 737759 7482045	
RIOS01D13	S22 45 07.0 E119 18 56.6	50 K 737797 7482081	
RIOS01D14	S22 45 05.7 E119 18 57.9	50 K 737834 7482120	
RIOS01D15	S22 45 04.6 E119 18 59.2	50 K 737870 7482152	
RIOS01S01	S22 45 05.3 E119 18 53.6	50 K 737712 7482133	Scorpion Burrow
RIOS01S02	S22 45 05.0 E119 18 53.8	50 K 737716 7482142	Scorpion Burrow
RIOS01S03	S22 45 04.3 E119 18 54.1	50 K 737726 7482164	Scorpion Burrow
RIOS01S04	S22 45 06.5 E119 18 54.1	50 K 737724 7482097	Scorpion Burrow
RIOS01S05	S22 45 06.2 E119 18 53.3	50 K 737702 7482107	Scorpion Burrow
RIOS01S06-07	S22 45 06.5 E119 18 55.1	50 K 737754 7482097	Scorpion Burrow
RIOS01S08	S22 45 06.7 E119 18 55.2	50 K 737756 7482090	Scorpion Burrow
RIOS01S09	S22 45 06.9 E119 18 56.6	50 K 737797 7482083	Scorpion Burrow
RIOS01S10	S22 45 07.4 E119 18 54.8	50 K 737744 7482068	Scorpion Burrow
RIOS01S11	S22 45 06.7 E119 18 48.9	50 K 737576 7482094	Scorpion Burrow
RIOS01TD01	S22 45 08.9 E119 18 52.9	50 K 737688 7482024	Trapdoor
RIOS01TD02	S22 45 10.4 E119 18 52.9	50 K 737689 7481976	Trapdoor
RIOS01TD03	S22 45 10.1 E119 18 55.0	50 K 737749 7481986	Trapdoor

Note: 'RIO' indicates site location within Rio Tinto Iron Ore's tenement (adjacent to the Iron Valley Project). '$S0_X$' indicates site number. 'D_{XX}' indicated dry pitfall trap number. 'S_{XX}' indicates Scorpion burrow number found on site. '$TD0_X$' indicates trapdoor number found on site.

12.4. **RIO Site 02 GPS Coordinates**

RIO Site 02	Position (WSG 84)		
Trap Number	**Lat/Long**	**UTM**	**Notes**
RIOS02D01	S22 43 43.4 E119 19 53.0	50 K 739447 7484626	
RIOS02D02	S22 43 42.3 E119 19 54.3	50 K 739483 7484660	
RIOS02D03	S22 43 41.2 E119 19 55.7	50 K 739525 7484693	
RIOS02D04	S22 43 40.0 E119 19 57.1	50 K 739565 7484729	
RIOS02D05	S22 43 38.9 E119 19 58.4	50 K 739601 7484764	
RIOS02D06	S22 43 40.0 E119 19 59.5	50 K 739632 7484730	
RIOS02D07	S22 43 41.3 E119 19 58.4	50 K 739600 7484688	
RIOS02D08	S22 43 42.3 E119 19 57.2	50 K 739566 7484659	
RIOS02D09	S22 43 43.6 E119 19 55.9	50 K 739529 7484621	
RIOS02D10	S22 43 44.8 E119 19 54.8	50 K 739498 7484584	
RIOS02D11	S22 43 46.0 E119 19 56.1	50 K 739533 7484545	
RIOS02D12	S22 43 44.9 E119 19 57.4	50 K 739569 7484580	
RIOS02D13	S22 43 43.6 E119 19 58.6	50 K 739606 7484618	
RIOS02D14	S22 43 42.4 E119 19 59.6	50 K 739636 7484654	
RIOS02D15	S22 43 41.1 E119 20 00.8	50 K 739671 7484694	
RIOS02S01	S22 43 43.8 E119 19 52.5	50 K 739431 7484615	Scorpion Burrow
RIOS02S02	S22 43 43.3 E119 19 53.3	50 K 739454 7484631	Scorpion Burrow
RIOS02S03	S22 43 39.2 E119 19 57.5	50 K 739577 7484753	Scorpion Burrow
RIOS02S04	S22 43 38.7 E119 19 58.7	50 K 739610 7484769	Scorpion Burrow
RIOS02TD01	S22 43 44.9 E119 19 55.0	50 K 739501 7484579	Trapdoor
RIOS02TD02	S22 43 43.5 E119 19 53.9	50 K 739473 7484624	Trapdoor
RIOS02TD03	S22 43 45.1 E119 19 54.2	50 K 739479 7484576	Trapdoor

Note: 'RIO' indicates site location within Rio Tinto Iron Ore's tenement (adjacent to the Iron Valley Project). '$S0_X$' indicates site number. 'D_{XX}' indicated dry pitfall trap number. 'S_{XX}' indicates Scorpion burrow number found on site. '$TD0_X$' indicates trapdoor spider number found on site.

12.5. RIO Site 02 GPS Coordinates

	Position (WSG 84)		
Trap Number	Lat/Long	UTM	Notes
RIOVEG01	S22 45 54.8 E119 18 21.9	50 K 736783 7480624	Vegetation Assessment point
RIOVEG02	S22 45 26.2 E119 18 34.0	50 K 737141 7481501	Vegetation Assessment point
RIOVEG03	S22 44 43.6 E119 19 13.0	50 K 738274 7482792	Vegetation Assessment point
RIOVEG04	S22 44 18.1 E119 19 51.3	50 K 739380 7483560	Vegetation Assessment point

Note: 'RIO' indicates site location within Rio Tinto Iron Ore's tenement (adjacent to the Iron Valley Project). '$S0_X$' indicates site number. 'D_{XX}' indicated dry pitfall trap number. 'S_{XX}' indicates Scorpion burrow number found on site. '$TD0_X$' indicates trapdoor spider number found on site.

13.Appendix 2 – Vegetation Survey Results

	Site						
Name	IOH	RIO-S01	RIO-S02	RIOVEG-1	RIOVEG-2	RIOVEG-3	RIOVEG-4
Acacia adoxa var. *adoxa*	X			X			
Acacia ancistrocarpa	X		X				X
Acacia bivenosa	X		X				
Acacia colei var. *ileocarpa*			X	X			
Acacia dictyophleba							X
Acacia hilliana	X			X			X
Acacia inaequilatera	X	X			X	X	
Acacia pachyachra	X				X	X	X
Acacia pruinocarpa	X					X	
Acacia pteraneura	X	X					
Acacia pyriformis						X	
Acacia spondylophylla						X	
Acacia tumida var. *pilbarensis*	X			X		X	X
Aristida holathera var. *holathera*	X	X				X	
**Cenchrus ciliaris*	X	X	X			X	X
Cleome viscosa	X	X	X				
Corchorus lasiocarpus subsp. *lasiocarpus*		X		X	X	X	X
Corchorus sidoides subsp. *sidoides*	X	X		X	X	X	X
Corymbia hamersleyana	X						X
Cucumis maderaspatanus	X						
Dicrastylis cordifolia				X	X	X	
Dysphania kalparri	X						
Eragrostis setifolia				X		X	

Eremophila forrestii subsp. *forrestii*	X	X					
Eremophila longifolia	X						
Eucalyptus gamophylla	X		X			X	
Eucalyptus ?leucophloia subsp. *leucophloia*	X						
Euphorbia australis	X	X					
Gomphrena cunninghamii						X	
Goodenia microptera	X			X			
Gossypium robinsonii	X			X			X
Grevillea wickhamii subsp. hispidula	X		X		X	X	
Hakea chordopylla		X			X	X	X
Hakea lorea subsp lorea	X	X			X	X	X
Heliotropium pachyphyllum	X						
Hibiscus coatesii	X	X					
Indigofera monophylla	X	X					
Oldenlandia crouchiana	X						
Paraneurachne muellerii	X	X		X			
Petalostylis labichieoides	X		X	X	X	X	X
Phyllanthus erwinii	X						
Polycarpea corymbosa	X						
Portulaca oleracea	X						
Ptilotus astrolasius	X						
Ptilotus auriculifolius	X						
Ptilotus calostachyus	X	X		X	X		
Ptilotus exaltatus	X	X		X	X	X	X
Ptilotus helipteroides	X	X		X	X	X	X
Ptilotus macrocephalus	X	X					
Ptilotus obovatus	X					X	
Salsola austrlalis						X	

Scaevola parvifolia							X
Senna artemisioides subsp. *helmsii*				X	X	X	X
Senna ferraria	X	X	X				
Senna glutinosa subsp.x *luerssenii*	X	X					
Senna glutinosa subsp.pruinosa	X	X					
Sida echinocarpa	X	X		X	X	X	
Sida fibulifera	X						
Sida Spiciform Panicles (E. Leyland s.n. 14/8/90)	X						
Solanum phlomoides	X			X			
Solanum sturtianum	X	X					
Trianthema pilosa	X	X					X
Trichodesma zeylanicum var. *zeylanicum*	X		X				
Triodia pungens	X						
Triodia sp.	X						
Velleia connata			X				
Yakirra australiensis	X						

14. Appendix 3 – Habitat Assessment Sheets

14.1. IOH Site 01 and 02 – Habitat Assessment Sheet

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location	IOHS01 & IOHS02
Date	2-Jun-11
Surveyor	Heath.M
GPS (Easting/Northing)	50K 737165 7482824
Site #	S01 & S02
Photo #	
Broad SRE Habitat Type	Spinifex grassland w/h open ground. Transitional grassland
Landscape Position	Plain between ridges

VEGETATION

Broad Vegetation Type: Spinifex, grass, scattered Eucalyptus spp. & Acacia spp.

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [X] Absent [ ]

Spinifex Grassland

SUBSTRATE

Rock outcrop which may harbour land snails — Present [ ] Absent [X]

-

Substrate suitable for Mygalomorph spiders or scorpions — Present [X] Absent [ ]

Loose compacted soil w/h scattered rock & spinifex clumps. Open bare ground.

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

-

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [X] Absent [ ]

Trapdoor burrows present. Scorpion burrows present.

HABITAT

Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [X] Absent [ ]

Drilling lines, road, minimal cattle sign (inc. grazing), drainage lines, disturbance specialist pioneer vegetation present.

Phyisical Connectivity	Continuous vegetation type throughout plain between ridges.
Extent of Habitat	Similar habitat for +4 km as per walked during previous year survey.
Other Comments	Final transect of IOHS02 (D07-10) in rocky area at foot of hill - Rock cover 80-100%

14.2. RIO Site 01 – Habitat Assessment Sheet

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location	RIOS01	Date	3-Jun-11	Surveyor	Mark.H
GPS (Easting/Northing)	50K 737648 7482078	Site #	RIOS01		
		Photo #			
Broad SRE Habitat Type	Spinifex grassland w/h open soil patches	Landscape Position	v.large open plain between two ranges		

VEGETATION

Broad Vegetation Type: Spinifex grassland w/h sparse Eucalpytus spp. overstorey

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [ ] Absent [X]

-

SUBSTRATE

Rock outcrop which may harbour land snails — Present [X] Absent [ ]

There are patches of rocky cobble possibly suitable - v.unlikely however.

Substrate suitable for Mygalomorph spiders or scorpions — Present [X] Absent [ ]

Open sandy areas between spinifex clumps - soil burrowable. Good Myg habitat under scattered Acacia spp. stands w/h leaf litter.

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

Mainly under overstorey vegetation & shurbs. No loose litter.

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [X] Absent [ ]

Scorpion & Myg burrows present & excavated. Scorpion & myg's collected.

HABITAT — Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [X] Absent [ ]

Fire, v.minor drainage erosion, major cattle sign

Phyisical Connectivity:

Extent of Habitat:

Other Comments:

14.3. RIO Site 02 – Habitat Assessment Sheet

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location	RIOS02	Date	3-Jun-11	Surveyor	Mark.H
GPS (Easting/Northing)	50K 739447 7484626	Site #	RIOS02		
		Photo #			
Broad SRE Habitat Type	Spinifex grassland w/h mixed Acacia spp. woodland overstorey	Landscape Position	Plain adjacent creekline		

VEGETATION

Broad Vegetation Type: Spnifex grassland w/h mixed Acacia spp. woodland overstorey

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [ ] Absent [X]

V.suitable under/around Acacia spp. stands

SUBSTRATE

Rock outcrop which may harbour land snails — Present [ ] Absent [X]

-

Substrate suitable for Mygalomorph spiders or scorpions — Present [X] Absent [ ]

Open soil patches between Spinifex. Perfect under Acacaia spp. stands in Leaf.L

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

Overall low, however, moderate-high under Acacia spp. stands

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [X] Absent [ ]

Scorpion burrows absent. Myg PRESENT, found under Acacia spp. stands.

HABITAT

Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [ ] Absent [X]

-

Phyisical Connectivity	Plain. fringes adjoining creek land vegetation and flooding area of Weeli Wollie Creek
Extent of Habitat	
Other Comments	

14.4. RIO Vegetation Assessment Site 01 – Habitat Assessment Sheet

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location	RIOVEG01	Date	8-Jun-11	Surveyor	Mark.H
GPS (Easting/Northing)	50K 736783 7480624	Site #	RIOVEG01		
		Photo #			
Broad SRE Habitat Type	Herbs and open areas fire affected	Landscape Position	Plain - Minor undulations & Hillocks		

VEGETATION

Broad Vegetation Type: Herbs

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [ ] Absent [X]

-

SUBSTRATE

Rock outcrop which may harbour land snails — Present [ ] Absent [X]

Rocky hillocks possibly suitable

Substrate suitable for Mygalomorph spiders or scorpions — Present [X] Absent [ ]

Easily burrowable

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

Evidence of fire which would have burnt leaf litter off

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [ ] Absent [X]

-not checked, vegetation assessment only-

HABITAT

Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [X] Absent [ ]

Fire, minor cattle sign

Phyisical Connectivity: Plain runing between two ranges running length of transect.

Extent of Habitat:

Other Comments:

14.5. RIO Vegetation Assessment Site 02 – Habitat Assessment Sheet

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location: RIOVEG02
Date: 8-Jun-11
Surveyor: Mark.H
GPS (Easting/Northing): 50K 737141 7481501
Site #: RIOVEG02
Photo #:
Broad SRE Habitat Type: Open herb plain
Landscape Position: Plain between two ranges

VEGETATION

Broad Vegetation Type: Herbs - Less flowering that RIOVEG01 & less species

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [ ] Absent [X]

-

SUBSTRATE

Rock outcrop which may harbour land snails — Present [ ] Absent [X]

-

Substrate suitable for Mygalomorph spiders or scorpions — Present [ ] Absent [ ]

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

Fire would have burnt leaf litter off. Herbs not contributing to litter cover.

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [ ] Absent [X]

-not checked, vegetation assessment only-

HABITAT

Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [X] Absent [ ]

Fire, minor cattle signs

Phyisical Connectivity:

Extent of Habitat:

Other Comments:

14.6. **RIO Vegetation Assessment Site 03 – Habitat Assessment Sheet**

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location	RIOVEG03	Date	8-Jun-11	Surveyor	Mark.H
GPS (Easting/Northing)	50K 738274 748297	Site #	RIOVEG03		
		Photo #			
Broad SRE Habitat Type	Spinifex grassland	Landscape Position	Open drainage area near creek surrounded by hills		

VEGETATION

Broad Vegetation Type: Spinifex grassland with herbs & Eucalyptus spp

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [ ] Absent [X]

-

SUBSTRATE

Rock outcrop which may harbour land snails — Present [ ] Absent [X]

Substrate suitable for Mygalomorph spiders or scorpions — Present [X] Absent [ ]

Soil is suitable

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [ ] Absent [X]

None observed

HABITAT

Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [ ] Absent [X]

None observed

Phyisical Connectivity: Part of plain running EW between ranges

Extent of Habitat:

Other Comments:

14.7. RIO Vegetation Assessment Site 04 – Habitat Assessment Sheet

SHORT-RANGE ENDEMIC ASSESSMENT - HABITAT ASSESSMENT SHEET

GENERAL INFORMATION

Location: RIOVEG04 | Date: 9-Jun-11 | Surveyor: Mark.H

GPS (Easting/Northing): 50K 739380 7483560 | Site #: RIOVEG04 | Photo #:

Broad SRE Habitat Type: Spinifex & Acacia spp. w/h Open Soil Patches | Landscape Position: Transitional zone between 2 hills & riverbed

VEGETATION

Broad Vegetation Type: Spinifex & Grassland with Acacia spp. & Eucalpytus spp. overstorey

Vegetation indicative of SRE habitat (eg. Ficus, ferns) — Present [ ] Absent [X]

-

SUBSTRATE

Rock outcrop which may harbour land snails — Present [ ] Absent [X]

Not in area sampled - POSIBILITY in surrounding rocky hills

Substrate suitable for Mygalomorph spiders or scorpions — Present [X] Absent [ ]

Soil Suitable for burrowing, open areas of soil between trees & grass/spinifex clumps

Litter Cover — Low (0-40%) [X] Moderate (40-60%) [ ] High (60-100%) [ ]

Mainly below overstorey flora

EVIDENCE OF TARGET SRE GROUPS

Presence of Mygalomorph spider/scorpion burrows — Present [ ] Absent [X]

No visual confirmation. Low/Med posibility of Myg/Scorpions. Looks good though…

HABITAT

Area of Habitat (based on aerial photographs):

Existing Disturbance — Present [X] Absent [ ]

Drainage lines, v.minor cattle sign, areas (small) of depressions w/h evidence of seasonal/periodical inundation

Phyisical Connectivity: -See landscape position above- Catchment area flowing into nearby Weeli Wollie Creek

Extent of Habitat:

Other Comments: Looks v.similar to RIOS01 - Potential for Mygs