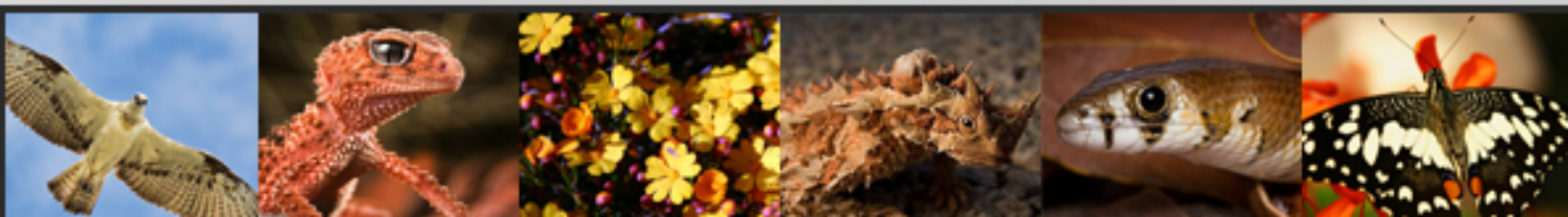
biologic

Christmas Creek Short-range Endemic Invertebrate Survey Report: Fortescue Marsh Samphire

Fortescue Metals Group

August 2012



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List of Acronyms and Abbreviations

aff. : species with affinity to, or close to…

ALA : Australian Living Atlas

BOM : Bureau of Meteorology

cf. : confer/compare with…

DEC : Western Australian Department of Environment and Conservation

EPA : Western Australian Office of the Environmental Protection Authority

FMG : Fortescue Metals Group

IBRA : Interim Biogeographical Regionalisation of Australia

OZCAM : Online Zoological Collections of the Australian Museum

sp. : species

sp. **indet** : species indeterminate, an unknown species

sp. **nov**. : a newly described species

SRE : short-range endemic

WAM : Western Australian Museum

EXECUTIVE SUMMARY

Biologic Environmental Survey was commissioned by Fortescue Metals Group to undertake an additional, targeted short-range endemic (SRE) survey at the Christmas Creek life of mine survey area, specifically targeting the samphire habitats (hereafter referred to as the Study Area). The Christmas Creek mine is located in the Pilbara region of Western Australia, approximately 110 km north-west of the town of Newman.

While there has been several habitat and SRE studies conducted in the surrounding area, none of them have surveyed within the samphire habitat and, as such no SRE fauna have been recorded from this habitat type in the area.

Twenty one sites were chosen in the Study Area, 20 sites within the samphire habitat and one reference site within a small, isolated Mulga grove.

Of the six taxa recorded in the Study Area none are considered SREs. Four are aquatic snails, which are not likely to be restricted to the Study Area, and the other two species (the land snail *Pupoides beltianus* and the isopod *Buddelundia* sp. nov. 14) are both found outside of the Study Area, and outside of the samphire habitat.

The habitat characteristics most likely to influence SRE fauna distribution, appear to be consistent throughout the samphire within the Study Area (vegetation structure), or are associated with spatially and temporally unpredictable events, such as flooding (availability of detrital material, such as logs).

Provision of protected microhabitat by samphire species, such as *Muellerolium salicorniaceum,* is recognised to be an important SRE habitat characteristic in the Pilbara. Likewise, logs and vegetative debris appear to be important for the presence of isopods in the samphire. Both these characteristics are consistent throughout the Study Area, although the latter is more randomly distributed due to the influence of flooding events.

Conversely, areas of inhospitable habitat, either because of inundation or lack of protection, are less common but are still consistent throughout the Study Area and are unlikely to impact significantly on species distributions along the Fortescue Marsh.

While samphire vegetation is not a prospective SRE habitat, the Fortescue Marsh is an isolated feature in the landscape and is recognised as a significant ecological

community. The survey work has indicated it is unlikely that there are any terrestrial SRE taxa restricted to the samphire habitat. Likewise, the habitat assessments show that, despite seven recognised samphire vegetation communities in the Study Area, the habitat characteristics that are most likely to influence terrestrial SRE fauna distributions are consistent throughout the samphire. Therefore, any terrestrial SRE fauna that may be present are unlikely to be restricted to any particular part of the samphire within the Study Area, and are likely to be present in the samphire of the surrounding Fortescue Marsh.

1. INTRODUCTION

1.1 Background

Biologic Environmental Survey (Biologic) was commissioned by Fortescue Metals Group (Fortescue) to undertake an additional, targeted short-range endemic (SRE) survey at the Christmas Creek life of mine survey area, specifically targeting the samphire habitats (hereafter referred to as the Study Area). These habitats were not sampled during the original SRE survey work, conducted by Subterranean Ecology, as access was restricted by flooding.

The Christmas Creek mine is located in the Pilbara region of Western Australia, approximately 110 km north-west of the town of Newman (Figure 1.1).

The objective of this survey was to:

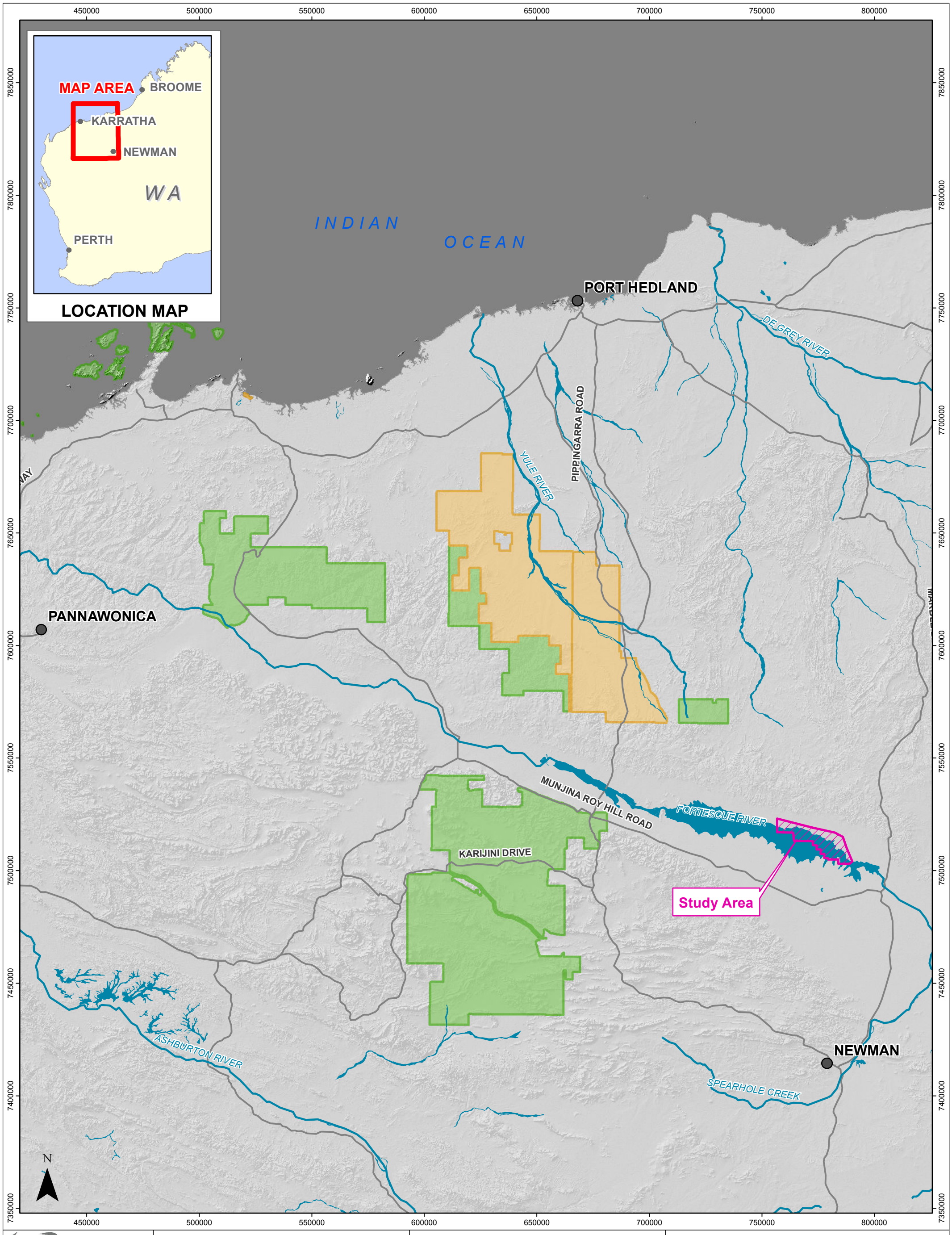
- Conduct a SRE invertebrate fauna and habitat desktop assessment of the Study Area (Figure 1.2); and
- Undertake a SRE invertebrate fauna survey and habitat assessment in the samphire habitat within the Study Area.

1.2 Biogeography

The Study Area is located in the Fortescue subregion of the Pilbara IBRA (Interim Biogeographic Regionalisation for Australia) region (Thackway and Cresswell 1995), within the upper reaches of the Fortescue Marsh.

The Fortescue Marsh is a broad valley, or small plain, consisting primarily of samphire marsh, lying between the Chichester and Hamersley Ranges, with a western (lower) section running for approximately 100 km, 2-3 km wide, and an eastern section (upper) running for a similar length but 5-10 km wide. The Fortescue Marsh is episodically inundated and it is likely only extreme weather events allow water to flow from the upper to the lower sections (Kendrick 2001).

The Fortescue Marsh is listed on the Australian Heritage Commission Register of the National Estate as an “Indicative Place”, and in the Directory of the Important Wetlands in Australia (Environment Australia 2001).



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Fortescue Metals Group

REGIONAL LOCATION MAP

FIGURE 1.1

0 12.5 25 50 75 100
Kilometers

1:1,500,000

Datum: GDA94
Projection: MGA Zone 50

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FIGURE:	1.1	Date:	25/06/12
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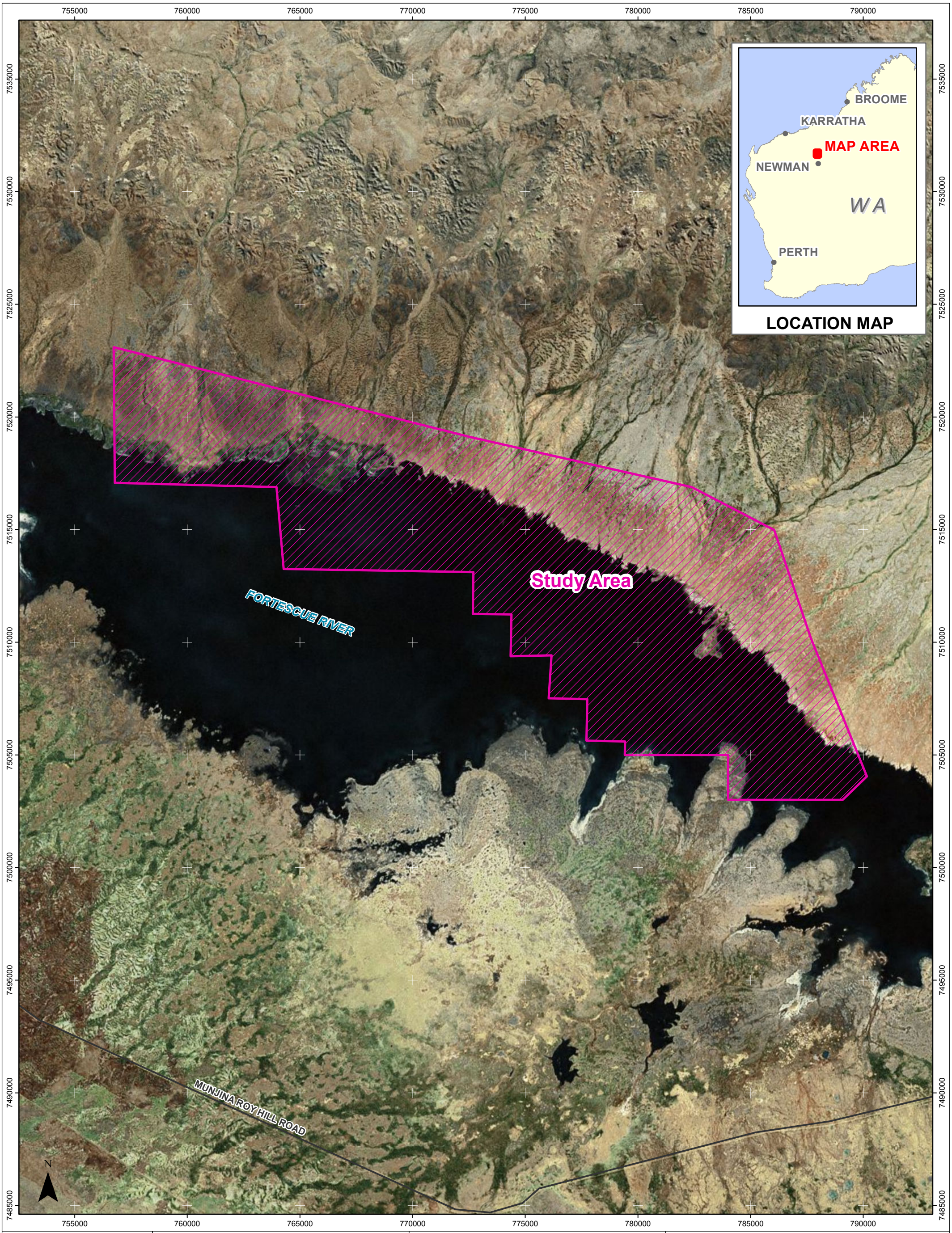
Legend

- Study Area
- **Roads**

Reserves

- IndigenousReserve
- NatureConservationReserve



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STUDY AREA LOCATION MAP

FIGURE 1.2

0 1 2 4 6 8
Kilometers

1:150,000

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Projection: MGA Zone 50

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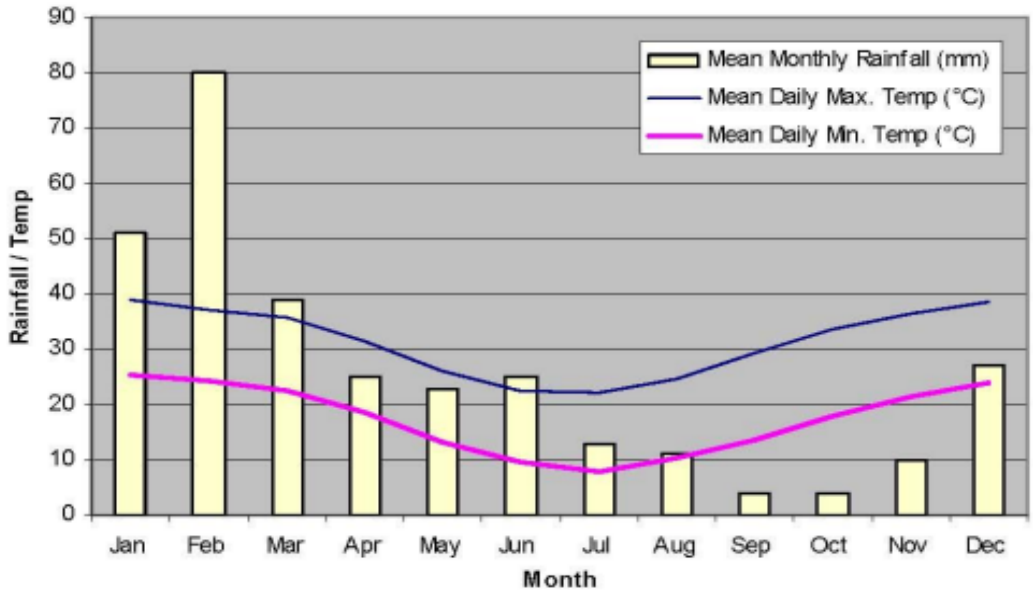
Legend

Study Area

1.3 Climate

The Study Area lies within the eastern Pilbara, a semi-tropical, arid climate with hot, humid summers (maxima between 35°C and 40°C) and mild, dry winters (maxima between 22°C and 30°C) (BOM 2012). Rainfall in the Pilbara is largely influenced by tropical cyclone systems, that predominately occur between January and March. The long term average annual rainfall in Newman (110 km south of the Study Area) is 312 mm.

Figure 1.3: Climatic graph for Newman (BOM 2012)



1.4 Land Systems

Land systems represent broad-scale characteristic land types that incorporate landforms, soils, vegetation types, and drainage patterns (van Vreeswyk *et al.* 2004). Within the Pilbara bioregion, 102 land systems have been identified and amalgamated into 20 land types (van Vreeswyk *et al.* 2004). There are nine land systems represented within the Study Area; Newman, McKay, Boolgeeda, Jamindie, Turee, Cowra, Warri, Calcrete and Marsh. Six of these systems are well represented within the Pilbara, with less than 1% of their distribution falling within the Study Area. The remaining three (Turee, Cowra and Marsh) have in comparison large proportions (14.8, 22.8 and 12.8 % respectively) of their Pilbara distribution falling within the Study Area, as they occur only

within the vicinity of the Fortescue Marsh. Cowra and Marsh are both classified as Land Type 15 (Alluvial plains with snakewood shrublands), whilst Turee is classified as Land Type 14 (Alluvial plain with tussock grasslands) (van Vreeswyk *et al.* 2004).

1.5 Geology

The Study Area represents a wide variety of geological characteristics. Eight geological units are represented within the Study Area; Jeerinah Formation (pelite, chert, and thin-bedded meta sandstone), Alluvium (unconsolidated silt, sand and gravel in drainage channels and floodplains), Alluvium and Colluvium (red-brown sandy and clayey soil on slopes and sheetwash areas), Colluvium (unconsolidated quartz and rock fragments in soil), Marra Mamba Formation (Chert, banded ironstone formation), Hematite (goethite deposits on banded iron-formation and adjacent scree deposits), Calcrete (sheet carbonates along major drainage lines), and Colluvium (partly consolidated quartz in silt in old valley-fill deposits) (Myers & Hockey 1998).

1.6 Soil

Two major soil units occur within the Study Area; the Fortescue Valley and Chichester Range, both contained within the Fortescue Province Zone (Tille 2006). The Fortescue Valley is characterised by alluvial plains, hardpan wash plains and sandplains, where the soils are described as red deep sands, red loamy earths and red/brown non-cracking clays with some red shallow loams and hard cracking clays (Tille 2006). The Chichester Range is characterized by hills and dissected plateau on basalt and sedimentary rocks of the Hamersley Basin, where the soils are described as stony with some red shallow loams and hard cracking clays (Tille 2006)

1.7 Hydrology

The Upper Fortescue River Catchment is approximately 31,000 km^2, with numerous creeks discharging from the northern and southern flanks of the Fortescue Valley into the Fortescue Marsh. Runoff events generally create isolated pools on the Fortescue Marsh, opposite the main drainage outlets, but larger runoff events may flood the whole of the Fortescue Marsh area (FMG 2009). The Goodiadarrie Hills restricts the flow of water from the Upper Fortescue to the Lower Fortescue, except during extreme flooding events.

1.8 Vegetation

Vegetation and flora work conducted by ENV Australia (ENV 2010) identified four broad floristic formations corresponding to landforms:

- Creeks and Drainage lines (vegetation types 1, 2 and 8);
- Ranges, Hills and Hill Slopes (vegetation types 16 and 17);
- Flats and Broad Plains (vegetation types 3, 4, 10 and 30); and
- Fringes of Samphire Flats (vegetation types 13, 22, 26, 31, 32, 34 and 35).

The Study Area consists primarily of vegetation of the Samphire Flats but also vegetation of the Flats and Broad Plains landform (Figures 1.3 and 1.4). The vegetation of the Samphire Flats form part of the Fortescue March (Priority 1) Priority Ecological Community, recognised as significant both locally and federally due to the unique and locally restricted vegetation types (ENV 2010). Some of the vegetation types also contain Priority Flora species and it was suggested that some Samphire and Creek line communities potentially represent groundwater-dependent ecosystems (ENV 2010).

1.9 Short-range endemic fauna

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale, the latter being commonly referred to as short-range endemism (Allen *et al.* 2002). Short-range endemism is influenced by several factors including life history, physiology, habitat requirements and availability, dispersal capabilities and opportunities, biotic and abiotic interactions and historical conditions which, not only influence the distribution of a species, but also the tendency for differentiation and speciation (Ponder and Colgan 2002).

In recent years a number of taxonomic groups of invertebrates have been highlighted as comprising a high proportion of species likely to be regarded as SREs, including mygalomorph spiders, pseudoscorpions, land and freshwater snails and millipedes (Harvey 2002; Ponder and Colgan 2002; Johnson *et al.* 2004; and Main *et al.* 2000). This identification of restricted taxonomic groups has led to SRE invertebrate fauna becoming an important component of the environmental impact assessment process, as it has provided a focal point for survey work aimed at protecting species of high conservation value.

760000 765000 770000 775000 780000 785000 790000 795000 800000

7530000 7525000 7520000 7515000 7510000 7505000

FORTESCUE RIVER

LOCATION MAP

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Kilometers

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Datum: GDA94

Projection: MGA Zone 50

Fortescue Metals Group

VEGETATION MAPPING (ENV 2010)

FIGURE 1.4

Legend

Study Area

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Legend

Vegetation Mapping

Label - Vegetation Description

- 1 - Open Woodland of *Eucalyptus victrix, E. camaldulensis* with pockets of *Acacia coriacea* subsp. *pendens* over *Grevillea wickhamii* subsp. *aprica, Petalostylis labicheoides* and *A. tumida* over *Triodia longiceps, Chrysopogon fallax, Themeda triandra and Aristid**
- 2 - Low Woodland to Low Open Forest of *Acacia aneura var. aneura, A. citrinoviridis, A. pruinocarpa* over *A. tetragonophylla* and *Psydrax latifolia over Chrysopogon fallax, Stemodia viscosa, Blumea tenella, Themeda triandra* and *Triodia* and *Aristida* species
- 3 - Low Woodland to Low Open Forest of *Acacia aneura var. aneura, A. pruinocarpa, A. tetragonophylla, A. tenuissima, Grevillea wickhamii* subsp. *aprica, Psydrax latifolia* over *Dodonaea petiolaris* and *Triodia* and *Aristida* species
- 4 - Low Open Woodland of *Acacia aneura var. aneura, Acacia pruinocarpa, Acacia xiphophylla, Acacia victoriae* over *A. tetragonophylla, Psydrax latifolia* and *Psydrax suaveolens* over *Ptilotus obovatus* and mixed *Maireana* and *Sclerolaena* species
- 8 - Closed Scrub to Tall Shrubland of *Acacia pruinocarpa, A. tumida, A. ancistrocarpa, A. maitlandii, A. kempeana, A. tetragonophylla* with occasional *E. gamophylla* and *Corymbia spp.* over *Triodia epactia, Themeda triandra* and *Aristida* species
- 9 - Closed Scrub to Shrubland of *Acacia ancistrocarpa* , *A. maitlandii, A. kempeana, A. monticola, occasional E. gamophylla* and *Corymbia deserticola* over *Senna* species, *Triodia basedowii* and *Aristida* species.
- 10 - Low Open Woodland of *Acacia xiphophylla, Acacia victoriae, Acacia aneura var. aneura* over *Acacia tetragonophylla, Ptilotus obovatus* and mixed *Senna, Maireana and Sclerolaena* species
- 10b - Low Open Woodland of *Acacia xiphophylla, Acacia aneura, Eremophila platycalyx subsp. pardalota* over Low Open Shrubland of *E. cuneifolia, Maireana pyramidata, Senna artemisioides subsp. oligophylla* over sparse tussock grassland of mixed species
- 13 - Low Halophytic Shrubland of *Tecticornia auriculata, T. indica subsp. leiostachya, T. halocnemoides subsp. tenuis* with patches of *Frankenia* species
- 16 - Hummock Grassland of *Triodia basedowii* with pockets of *Triodia epactia* and *Triodia lanigera*with emergent patches of *Eucalyptus leucophloia, Corymbia deserticola* over *Acacia ancistrocarpa, Acacia hilliana, Acacia acradenia, Acacia pyrifolia, Hakea lorea**
- 17 - Hummock Grassland of *Triodia basedowii* with pockets of *Triodia epactia* and *Triodia lanigera* with emergent patches of *Eucalyptus leucophloia, Corymbia deserticola* over *Acacia ancistrocarpa, A. pyrifolia, Hakea lorea subsp. lorea* over *Goodenia stobbsiana* *
- 22 - Low Shrubland of *Tecticornia indica subsp. bidens* and *Nicotiana occidentalis* over grasses with occasional stands of *Sesbania cannabina* and *Cullen cinereum*
- 26 - Low Shrubland of *Muellerolimon salicorniaceum* and *Tecticornia indica subsp. bidens*
- 30 - High open Shrubland of *Acacia synchronicia* with *Senna glaucifolia (Sclerolaena spp.* and other *halophytes)* over *Aristida* species.
- 30+10 - Mosaic of VT 30 and VT10, patches of vegetation were too small to map separately
- 30+13 - Mosaic of VT30 and VT13, patches of vegetation were too small to map separately
- 30+4 - Mosaic of VT30 and VT4, patches of vegetation were too small to map separately
- 31 - Low Shrubland of *Tecticornia indica subsp. biden, T. auriculata and T. indica subsp. leiostachya with T. sp.* Christmas Creek*
- 32 - Low Shrubland of *Muellerolimon salicorniaceum* over *Tecticornia indica subsp. bidens* and *T.indica subsp. leiostachya* with T. sp. Christmas Creek*
- 34 - Low Shrubland of *Muellerolimon salicorniaceum* over *Tecticornia indica subsp. bidens and T. auriculata* with *Heliotropium curassavicum and Atriplex flabelliformis*
- 35 - Low Shrubland of *Muellerolimon salicorniaceum* over *Tecticornia auriculata, T. sp. Christmas Creek**
- 36 - Bare ground or very sparsely vegetated ground within Fortescue Marsh
- Infrastructure

biologic

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VEGETATION MAPPING (ENV 2010)

FIGURE 1.5

LEGEND

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2. ASSESSMENT METHODOLOGY

2.1 Desktop assessment

Two online databases and two WA Museum (WAM) databases were searched for terrestrial SRE records:

- Department of Environment and Conservation's (DEC) NatureMap (accessed 16/04/2012);
- Atlas of Living Australia (ALA) (accessed 16/04/2012);
- WAM Arachnid database (accessed 17/04/2012); and the
- WAM Mollusc database (accessed 17/04/2012).

DEC's NatureMap allows a maximum of a 40 km radius around a precise centroid, defined as above. For the ALA a 50 km radius around a centroid (Mt Gould: 25.803159^{o}S 117.339858^{o}E) was used. ALA allows access to the biodiversity records of the Online Zoological Collections of the Australian Museum (OZCAM), which accesses collection data from the following institutions:

- Museum of Victoria;
- Museum and Art Gallery of the Northern Territory;
- South Australian Museum;
- Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- Australian National Wildlife Collection;
- Western Australian Museum;
- Queen Victoria Museum and Art Gallery;
- Tasmanian Museum and Art Gallery; and
- Queensland Museum.

The WAM arachnid and mollusc databases was searched using a bounding box 100km x 100km. This search differs from the ALA search in that OZCAM does not have access to the entire WAM database.

2.2 Review of previous studies

While there has been several habitat and SRE studies conducted in the surrounding area, only one has surveyed within the samphire habitat (Ecologia 2011), with two sample sites on the fringe of the Fortescue Marsh, but still within the halophytic shrubland. The lack of survey is largely due to samphire habitat not being regarded as prospective for SRE fauna because of the lack of protective qualities and habitat complexity, or accessibility has been an issue. However, within the context of the Upper Fortescue Marsh, it can be regarded as an isolated habitat, which is partly why it is recognised as a significant habitat for the region.

2.3 Field survey methods

2.3.1 Site selection

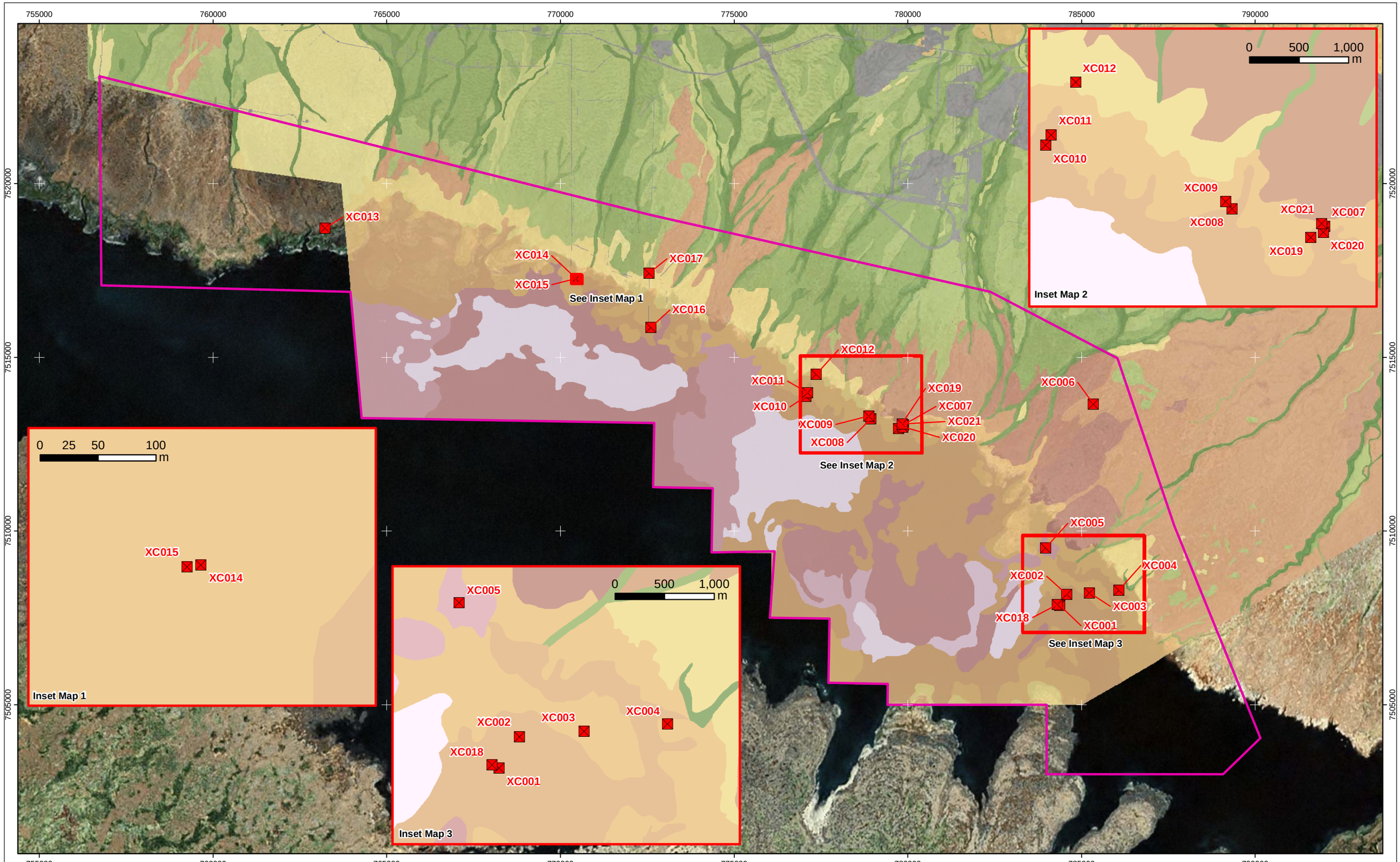
The focus of this survey was the samphire habitat and, to a lesser extent, the vegetation fringing the samphire. The sampling was conducted from the 10th to the 12th of May, 2012. Twenty one sites (Appendix A) were selected to capture the variety of vegetation types within the samphire habitat, based on the vegetation mapping by ENV (2010) (Figure 1.3). Each site was searched within a five meter radius. Large parts of the samphire habitat were inundated, with sites XC01, XC13, XC16 and XC18 being within several meters of the waterline of the Fortescue River. Only one non-samphire site was surveyed, a small, isolated Mulga grove within the samphire. While it was originally planned to survey more of the non-samphire vegetation, as reference sites, it was decided on site that it was more important to focus more heavily on the samphire habitat, due to the very low level of fauna activity. This maximised the chance of collecting fauna from the focus habitat of the samphire itself, rather than habitat types previously surveyed.

2.3.2 Sampling methodology

The sampling methodology adopted was carried out in accordance with the following documents:

- Environmental Protection Authority (EPA) Position Statement No. 3 ‘Terrestrial Biological Surveys as an Element of Biodiversity Protection’ (EPA 2002);

- Environmental Protection Authority (EPA) Guidance Statement No. 56 'Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia' (EPA 2004); and
- Environmental Protection Authority (EPA) Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna for Environmental Impact Assessment in Western Australia' No. 20. (EPA 2009).



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Legend

- Xmas Creek Study Sites
- Study Area

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Active foraging was undertaken at each site (five meter radius) for one person hour. Areas underneath vegetation were targeted for searching, as they provided the greatest amount of protection for SRE taxa. Soil around the base and the roots of the samphire vegetation, as well as within the vegetation itself, was of specifically targeted. Any detrital material was also searched, in particular logs and leaf litter. The following techniques were used, where applicable:

- Detrital searching: Leaf litter was placed in a leaf litter reducer (leaf litter sieve) at the site and agitated so that any small species fall through onto a sheet, or a tray, for collection. Logs were actively searched. This targets most SRE species but particularly pseudoscorpions, millipedes, snails and scorpions.
- Soil searching: Soil is collected from the base of large, and or, significant trees and vegetation. Soil up to 30 cm deep is put through a soil sieve and specimens collected. This technique primarily targets aestivating snails and millipedes.

2.3.3 Identification of Specimens

All specimens were lodged with the WAM. The land snails were identified by Corey Whisson (WAM land snail expert) and the isopods by Dr Simon Judd (private consultant and terrestrial isopod expert). No other specimens required identification.

2.3.4 Habitat Assessment

Biologic carried out a habitat assessment at each of the 21 survey sites. These assessments differed from that carried out during a standard SRE invertebrate survey in that the target habitat is not a prospective SRE habitat, but is chosen because of its regional isolation. As such, the habitat assessment is aimed at determining if there are changes to habitat characteristics that can influence SRE invertebrate fauna presence within the samphire habitat, or whether these features are consistent throughout.

2.3.5 Limitations

2.3.5.1 General limitations

The EPA (2009) identified several key limitations with respect to the assessment of SRE invertebrates, including:

- Lack of a complete taxonomic framework for many groups, which directly affects the determination of whether a taxa can be regarded as an SRE or not. Within this report five types of SRE taxa are recognised, so as to clearly identify those that have these taxonomic limitations. Of these five, only the first three (Known SRE, Potential SRE and Indet. SRE) are regarded as significant, with Unknown SREs and Non-SREs not considered further:
    - **Known SRE**: a taxon that is known to be a SRE;
    - **Possible SRE**: a taxon or specimen that is not a Known SRE but belongs to a higher taxonomic group (e.g. genus or family) that indicates it may have a restricted distribution;
        - **Potential SRE**: a taxon that can be identified to species level and belongs to a higher taxonomic group that indicates it may have a restricted distribution, but lacks distributional data to state clearly whether it is or not;
        - **Indeterminate SRE (Indet. SRE)**: a specimen that cannot be placed to species level, usually due to the specimen not having the required morphological state for species determination (i.e. a female or a juvenile), but belongs to a higher taxonomic group that indicates it may have a restricted distribution;
    - **Unknown SRE**: a taxon or specimen that belongs to a SRE group, is not known to occur outside of the Study Area, but it is not possible to determine its SRE status based on species, genus or family level identification; and
    - **Non-SRE**: a taxon that is either known to occur widely or is determined as unlikely to have a restricted distribution.
- Lack of sufficient taxonomic expertise to provide identifications for many groups within the timeframe required by project proposals. This is not regarded as a limitation for this survey.
- Difficulty sampling many taxa, which can be exacerbated by the lack of experience and knowledge of survey personnel. These difficulties usually result in sampling data that has severe limitations in its use, particularly with respect to quantitative analysis, but also with respect to assessing the likelihood of a taxon

occurring in sites where it wasn't recorded. Any weight placed on the absence of a species at a site needs to be placed in this context. This is not regarded as a limitation for this survey. and

- Ecological and habitat knowledge of most taxa is incomplete, or based on broad assumptions.

2.3.5.2 Limitations specific to this survey

- Access to many lower lying areas was limited by the presence of water, the lack of passable tracks and the presence of cattle. This likely only limited the even spacing of survey sites, and not the outcomes of the survey or the conclusions.

3. RESULTS

3.1 Desktop Review

The desktop review found no SRE species have been recorded from samphire habitat within, or adjacent to, the Study Area. However, there has been very limited sampling for SRE fauna within these habitats, with only one SRE survey sampling two sites within the habitat (Ecologia 2011) at the nearby Cloudbreak survey area (Table 3.1).

3.2 Field Survey

Seventy specimens of SRE taxa were collected from 21 survey sites in the Study Area, 57 specimens of non-marine snail and 13 specimens of isopod (Appendix B).

3.2.1 Non-marine Snails

Fifty seven specimens of non-marine snail were recorded in the Study Area, comprising five species from five genera and four families (Figure 3.1). Only one specimen was a live record, with the other 56 specimens comprising empty snail shells. Only one species was a terrestrial snail, with the others confirmed as aquatic.

3.2.1.1 Gabbia aff. *smithii* (Tate, 1882) (Bithyniidae)

Gabbia aff. *smithii* was recorded at six sites with 30 empty shells collected. This taxa is an aquatic mollusc and is regarded as most likely a new species by the WAM (2012). It is considered conspecific with specimens from Cloudbreak, Karratha and Whim Creek. This species is a **Non-SRE**.

3.2.1.2 Austropeplea cf. *lessoni* (Deshayes, 1830) (Lymnaeidae)

Austropeplea cf. *lessoni* was recorded at three sites with six empty shells collected. This taxa is an aquatic mollusc and is known to be widespread. This species is a **Non-SRE**.

3.2.1.3 Gyraulus sp. (Planorbidae)

Gyraulus sp. was recorded at six sites with 14 empty shells collected. This taxa is an aquatic mollusc and is regarded as highly unlikely to have a restricted distribution. A *Gyraulus* sp. was also collected during the Subterranean Ecology SRE Survey (2011) on floodplain and is highly likely to be the same species. This species is a **Non-SRE**.

Table 3.1: Previous SRE studies within, and adjacent to, the Study Area

Study	Author	Timing	Habitats Sampled	SRE Species Recorded	SRE Group
Christmas Creek Life of Mine SRE Invertebrate Survey	Subterranean Ecology 2011	March/April	Drainage lines; Floodplains; Alluvial/colluvial plains; Vegetation groves; Rocky hills and gullies; Gorges	*Beierolpium* sp. indet. XC *Buddelundia* sp. nov. 20 *Karaops* sp. indet. XC Paradoxosomatidae sp. indet.	Pseudoscorpion Isopod Selenopid spider Millipede
Cloudbreak SRE Invertebrate Survey	Ecologia 2011	November	Creek lines; Spinifex hills; Mulga woodland; Hummock grassland; Halophytic shrubland	*Aname* 'MYG001 group' *Conothele* sp. *Urodacus* sp. *Austrohorus* sp. *Beierolpium* sp 8/2 *Linnaeolpium* sp. *Antichiropus* 'Cloudbreak'	Mygalomorph spider Mygalomorph spider Scorpion Pseudoscorpion Pseudoscorpion Pseudoscorpion Millipede

Study	Author	Timing	Habitats Sampled	SRE Species Recorded	SRE Group
FMG Stage B Fauna Survey	Biota 2005	April	Spinifex hills and slopes; Spinifex plains; Drainage lines; Mulga woodland; Tussock grassland; Colluvial plains	*Aganippe* sp. *Synothele* sp.	Mygalomorph spider Mygalomorph spider
Roy Hill Iron Ore Mine SRE Surveys	Ecologia 2006; 2008	June and October	Drainage lines; Southern slopes; Mulga plains	*Conothele* sp.	Mygalomorph spider

3.2.1.4 Isidorella cf. *egregia* (Preston, 1906) (Planorbidae)

Isidorella cf. egregia was recorded at four sites with six empty shells collected. This taxa is an aquatic mollusc and is regarded as highly likely to be widespread. This species is a **Non-SRE**.

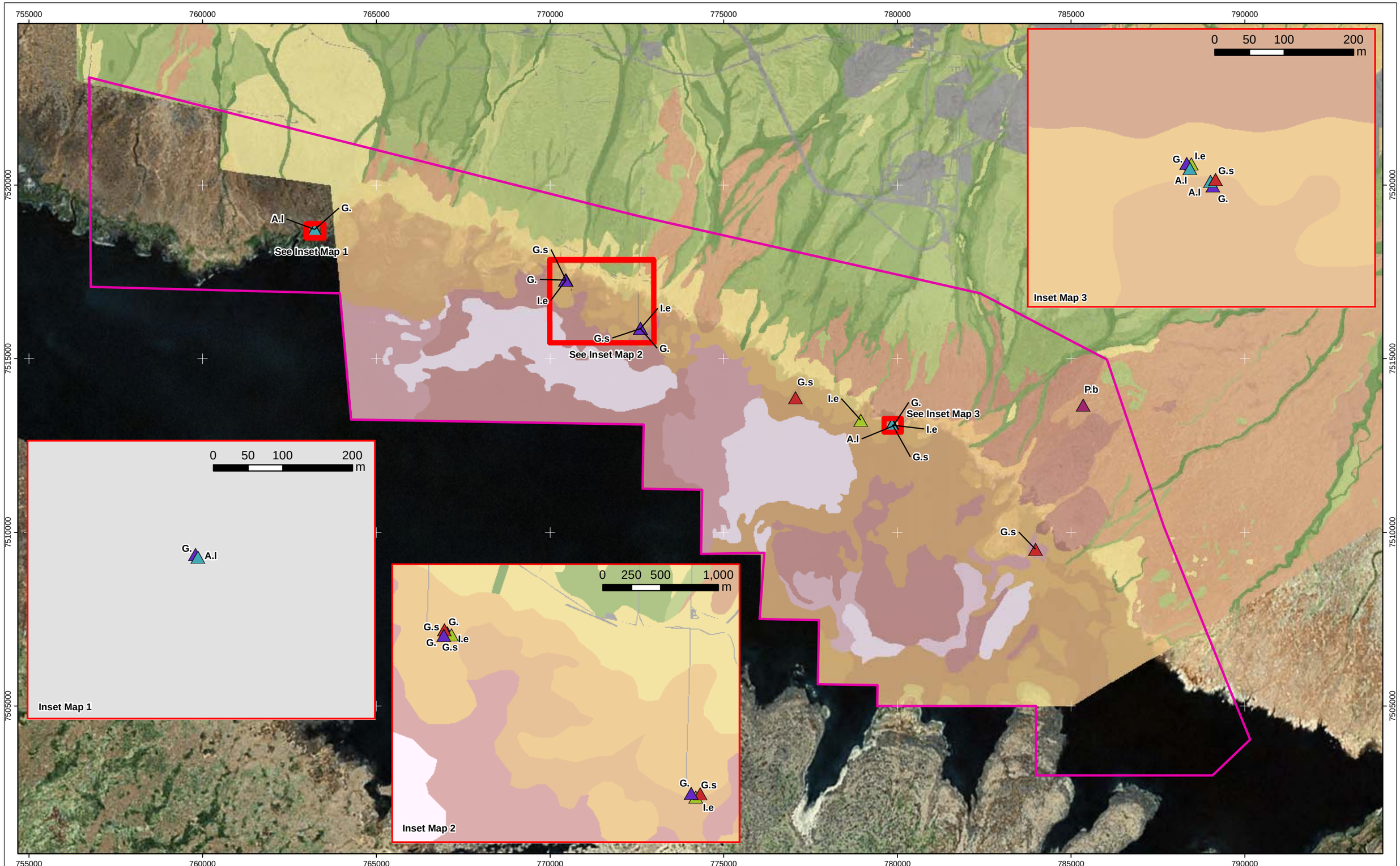
3.2.1.5 Pupoides beltianus (Tate, 1894) (Pupillidae)

Pupoides beltianus was recorded at one site with one live specimen. This species is widespread and, as such, a **Non-SRE**.

3.2.2 Isopods

3.2.2.1 Buddelundia sp. nov. 14 (Armadillidae)

Buddelundia sp. nov. 14 was recorded at six sites with 13 specimens collected (four males, seven females and two juveniles). This species was recorded outside of the samphire habitat at Christmas Creek (Subterranean Ecology 2011) and is regarded as very likely to be widespread and, as such, is a **Non-SRE**.



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Fortescue Metals Group

MOLLUSC LOCATIONS

FIGURE 3.1

Legend

Study Area

Mollusc Locations

Species

- *Austropeplea cf. lessoni*
- *Gabbia aff. smithii*
- *Gyraulus sp.*
- *Isidorella cf. egregia*
- *Pupoides beltianus*

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XC015
XC014
XC016
XC011
XC020
XC018

FORTESCUE RIVER

LOCATION MAP

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ISOPOD LOCATIONS

FIGURE 3.2

Legend

Study Area

Ispod Locations

Buddelundia sp. nov. 14

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3.3 Habitat Assessment

The habitat assessment showed that there is some variation in certain habitat characteristics throughout the Study Area, with the potential to influence terrestrial SRE distribution. Some of this variation is associated with changes in vegetation communities and some with, unpredictable changes associated with water movement and flooding events. These characteristics are discussed below, with a description of the variation through the samphire habitat.

3.3.1 Protection/cover

Some vegetation types provide more protection from exposure (solar) and predators than others. This is a very important characteristic for most SRE taxa in the hot, arid Pilbara region. The amount of protection and cover was influenced by the vegetation types and density of the vegetation present. *Muellerolium salicorniaceum* (Plate 3.1) provided the greatest amount of cover in the samphire, forming large, thick shrubs. This species was common throughout the Study Area (present at 12 survey sites), and is dominant in four of the seven samphire vegetation types (26, 32, 34 and 35), of which the first two are very common and cover much of the Study Area. Seven survey sites (XC10, XC12, XC13, XC14, XC16, XC17 and XC21) were very lightly vegetated (Plate 3.2) and one survey site (XC09) had large areas of open ground (Plate 3.3).

3.3.2 Logs/debris

All the isopod specimens were recorded within dead vegetation and logs throughout the samphire habitat. The vegetation types where isopods were collected (and therefore where these microhabitats were present) varied, indicating that the presence of logs/debris is not closely associated with vegetation type. The deposition of logs and debris is most likely associated with water movement and can therefore be regarded as unpredictable with respect to vegetation type, and likely to occur throughout the samphire in the Study Area.

Plate 3.1: *Muellerolium salicorniaceum* (XC01)

Plate 3.2: Lightly vegetated survey site (XC12)

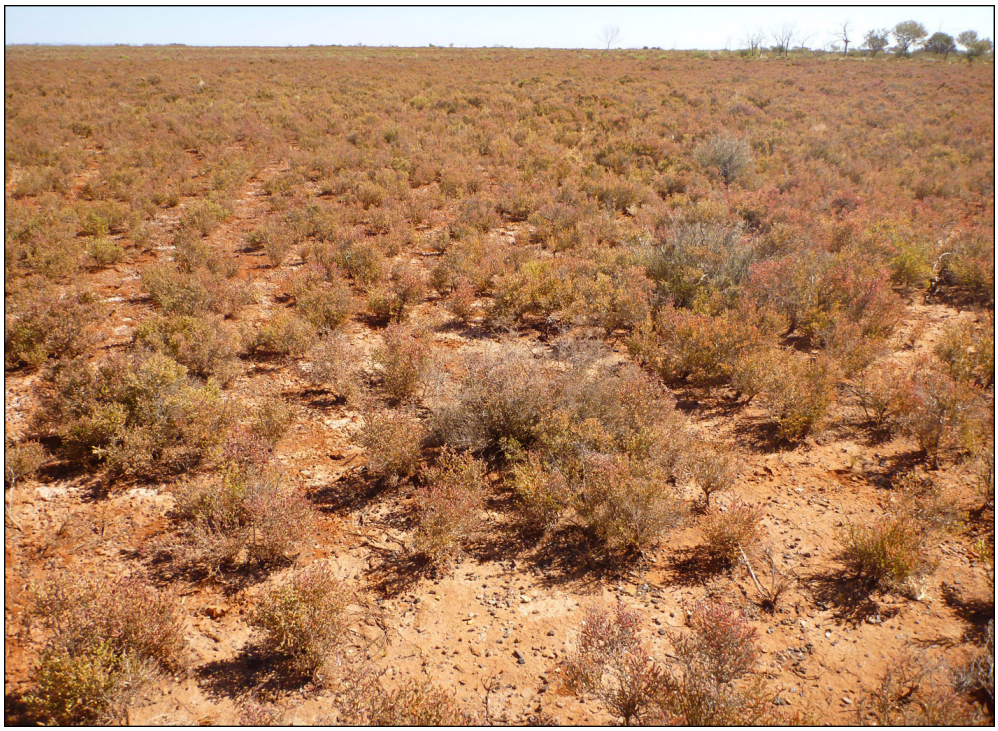

Plate 3.3: Open ground survey site (XC09)

3.3.3 Habitat complexity and species richness

As a general rule, species richness in a habitat will be driven by its complexity or heterogeneity; the more complex the architecture of the habitat the greater the diversity of species (Hatley and McMahon 1980). While the samphire is not particularly heterogenous, there are some vegetation types, and survey sites, where the habitat complexity was extremely low (i.e. very homogenous). When viewed within the context of habitat characteristics like protection and prey availability, these habitats are likely to be inhospitable environments for many species, and therefore can be regarded as having the potential to restrict distributions and movement of SRE fauna. Only five survey sites (XC009, XC012, XC013, XC016 and XC021) can be regarded as having such restrictive characteristics and, as such, it does not appear to occur often enough so as to significantly affect species distributions.

3.3.4 Soil/water

Soil characteristics can play a significant role in the presence of many SRE taxa, especially for species that burrow (trapdoor spiders and scorpions), soil-aestivating species (land snails and millipedes) and detritivores (isopods and millipedes). In samphire habitat, however, it is likely the presence of water within the soil and salinity levels have the greatest influence on the presence of terrestrial SRE fauna. The presence of water in the samphire is influenced by rain events, and the subsequent movement of water from the surrounding catchment area and from the Fortescue River itself. The extent of samphire vegetation can be used as a surrogate for the extent of flooding and salinity levels of the Fortescue Marsh, as it is the inundation and waterlogging of the soils that allow the persistence of these vegetation types. As such, given that the samphire vegetation types are consistent throughout the Upper Fortescue Marsh, it is unlikely that these habitat characteristics will impact on species distributions within the marsh itself.

4. CONCLUSION

Of the six taxa recorded in the Study Area none are considered SREs. Four are aquatic snails, which are not likely to be restricted to the Study Area, and the other two species (the land snail *Pupoides beltianus* and the isopod *Buddelundia* sp. nov. 14) are both found outside of the Study Area, and outside of the samphire habitat.

There was very little invertebrate fauna activity in the samphire habitat, which is largely a result of the inhospitable nature of the habitat. The habitat characteristics associated with the samphire, such as vegetation type, soil type and salinity, which are most likely to influence SRE fauna distribution, appear to be consistent throughout the samphire within the Study Area, or are associated with the stochastic nature of certain events (i.e. flooding).

Provision of protected microhabitats by samphire species, such as *Muellerolium salicorniaceum,* is likely to be important and is a standard SRE habitat characteristic in the Pilbara. This species is common to four of the seven samphire vegetation types, including two of the most dominant vegetation types that occur throughout the Study Area.

Similarly, homogenous areas of inhospitable habitat, either because of inundation frequency, lack of shade or high salinity, are less common but also consistent throughout the Study Area and are unlikely to impact significantly on species distributions along the Fortescue Marsh.

Logs and vegetative debris appear to be important for the presence of isopods in the samphire. However, all isopod specimens recorded were from a widespread species, and the presence of this microhabitat is influenced by water movement and likely to be stochastic with respect to other habitat variables throughout the Study Area.

While samphire vegetation is not a prospective SRE habitat, the Fortescue Marsh is an isolated feature in the landscape and is recognised as a significant ecological community. The survey work has indicated it is unlikely that there are any terrestrial SRE taxa restricted to the samphire habitat. Likewise, the habitat assessments show that, despite seven currently recognised samphire vegetation communities in the Study Area,

 the habitat characteristics that are most likely to influence terrestrial SRE fauna distributions are consistent throughout the samphire. Therefore, any terrestrial SRE fauna that may be present are unlikely to be restricted to any particular part of the samphire within the Study Area, and are likely to be present in the samphire of the surrounding Fortescue Marsh.

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Appendix A: Survey Sites

SITE	LAT	LONG	VEG. TYPE (ENV 2010)
XC001	22°30'43.74"S	119°45'51.72"E	26
XC002	22°30'33.30"S	119°45'58.62"E	26
XC003	22°30'31.20"S	119°46'21.42"E	22
XC004	22°30'28.32"S	119°46'50.76"E	22
XC005	22°29'49.92"S	119°45'36.48"E	32
XC006	22°27'34.50"S	119°46'21.72"E	30
XC007	22°27'57.30"S	119°43'10.98"E	26
XC008	22°27'52.14"S	119°42'38.16"E	22
XC009	22°27'49.68"S	119°42'35.94"E	26
XC010	22°27'32.40"S	119°41'32.22"E	26
XC011	22°27'28.92"S	119°41'34.02"E	26
XC012	22°27'11.58"S	119°41'42.36"E	13
XC013	22°25'02.82"S	119°33'25.38"E	22
XC014	22°25'46.14"S	119°37'39.18"E	22
XC015	22°25'46.20"S	119°37'38.76"E	22
XC016	22°26'30.36"S	119°38'55.08"E	26
XC017	22°25'39.72"S	119°38'52.50"E	13
XC018	22°30'42.78"S	119°45'49.20"E	26
XC019	22°28'01.02"S	119°43'06.12"E	22
XC020	22°27'59.22"S	119°43'10.56"E	26
XC021	22°27'56.46"S	119°43'09.90"E	26

Appendix B: Survey Data

SRE GROUP	SPECIES	SITE	VEG. TYPE (ENV 2010)
Non-marine Snail	*Austropeplea* cf. *lessoni*	XC007	26
Non-marine Snail	*Austropeplea* cf. *lessoni*	XC013	22
Non-marine Snail	*Austropeplea* cf. *lessoni*	XC021	26
Non-marine Snail	*Gabbia* aff. *smithii*	XC005	32
Non-marine Snail	*Gabbia* aff. *smithii*	XC007	26
Non-marine Snail	*Gabbia* aff. *smithii*	XC010	26
Non-marine Snail	*Gabbia* aff. *smithii*	XC014	22
Non-marine Snail	*Gabbia* aff. *smithii*	XC015	22
Non-marine Snail	*Gabbia* aff. *smithii*	XC016	26
Non-marine Snail	*Gyraulus* sp.	XC007	26
Non-marine Snail	*Gyraulus* sp.	XC013	22
Non-marine Snail	*Gyraulus* sp.	XC014	22
Non-marine Snail	*Gyraulus* sp.	XC015	22
Non-marine Snail	*Gyraulus* sp.	XC016	26
Non-marine Snail	*Gyraulus* sp.	XC021	26
Non-marine Snail	*Isidorella* cf. *egregia*	XC008	22
Non-marine Snail	*Isidorella* cf. *egregia*	XC014	22
Non-marine Snail	*Isidorella* cf. *egregia*	XC016	26
Non-marine Snail	*Isidorella* cf. *egregia*	XC021	26
Non-marine Snail	*Pupoides beltianus*	XC006	30
Isopod	*Buddelundia* sp. nov. 14	XC011	26
Isopod	*Buddelundia* sp. nov. 14	XC014	22
Isopod	*Buddelundia* sp. nov. 14	XC015	22
Isopod	*Buddelundia* sp. nov. 14	XC016	26
Isopod	*Buddelundia* sp. nov. 14	XC018	26
Isopod	*Buddelundia* sp. nov. 14	XC020	26