

Our Ref: SO-EN-0177

Dr Paul Vogel
Chairman
Environmental Protection Authority
Locked Bag 33, Cloisters Square
PERTH WA 6850

16 July 2014

Office of the Environmental Protection Authority	
File:	
22 JUL 2014	
A:	<input type="checkbox"/> For Information
fa:	<input type="checkbox"/> For Discussion
Officer:	<input type="checkbox"/> For Action
<input type="checkbox"/> Dir. AC	Response please:
<input type="checkbox"/> Dir. Bus Ops	<input type="checkbox"/> GM Signature
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Dear Dr. Vogel

SOLOMON IRON ORE PROJECT EXPANSION - REFERRAL OF PROPOSAL

Under Section 38 of the *Environmental Protection Act 1986*, Fortescue Metals Group Limited (Fortescue) wishes to refer a Proposal to increase the footprint of the Solomon Iron Ore Project.

The Proposal consists of expanding mining operations and rail infrastructure beyond the current footprint. Fortescue is also seeking approval for an external borefield to provide an additional water supply to support the expansion.

The extent of proposed ground disturbance is approximately:

- 11,322 ha for the mine expansion within a development envelope of 33,520 ha
- 700 ha for an additional external borefield within an development envelope of 33,712 ha
- 476 ha for additional permanent rail infrastructure within the 29,257 ha rail corridor envelope (includes spur).

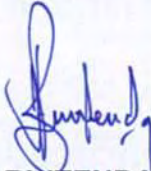
The combined disturbance extent is approximately 12,498 ha. This is in addition to the 6,297 ha of disturbance approved under Ministerial Statement 862 and results in a total disturbance footprint of 18,795 ha.

Please find enclosed the completed EPA Referral Form and supporting document for the Solomon Expansion Project for your consideration.

If you have any queries regarding the enclosed information, please do not hesitate to contact Amy Barker, Fortescue's Senior Environmental Advisor for the Solomon Project on 08 6218 8364 or abarker@fmgl.com.au.

Yours sincerely

FORTESCUE METALS GROUP



ISAK BUITENDAG

Director, External Relations

Enc.

Attachment 1	EPA Referral Form – Proponent
Attachment 2	EPA Referral Form Supporting Document



Environmental Protection Authority

EPA REFERRAL
FORM
PROPONENT

Referral of a Proposal by the Proponent to the Environmental Protection Authority under Section 38(1) of the *Environmental Protection Act 1986*.

PURPOSE OF THIS FORM

Section 38(1) of the *Environmental Protection Act 1986* (EP Act) provides that where a development proposal is likely to have a significant effect on the environment, a proponent may refer the proposal to the Environmental Protection Authority (EPA) for a decision on whether or not it requires assessment under the EP Act. This form sets out the information requirements for the referral of a proposal by a proponent.

Proponents are encouraged to familiarise themselves with the EPA's *General Guide on Referral of Proposals* [see Environmental Impact Assessment/Referral of Proposals and Schemes] before completing this form.

A referral under section 38(1) of the EP Act by a proponent to the EPA must be made on this form. A request to the EPA for a declaration under section 39B (derived proposal) must be made on this form. This form will be treated as a referral provided all information required by Part A has been included and all information requested by Part B has been provided to the extent that it is pertinent to the proposal being referred. Referral documents are to be submitted in two formats – hard copy and electronic copy. The electronic copy of the referral will be provided for public comment for a period of 7 days, prior to the EPA making its decision on whether or not to assess the proposal.

CHECKLIST

Before you submit this form, please check that you have:

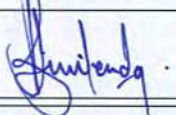
	Yes	No
Completed all the questions in Part A (essential).	✓	
Completed all applicable questions in Part B.	✓	
Included Attachment 1 – location maps.	✓	
Included Attachment 2 – additional document(s) the proponent wishes to provide (if applicable).	✓	
Included Attachment 3 – confidential information (if applicable).		✓
Enclosed an electronic copy of all referral information, including spatial data and contextual mapping but excluding confidential information.	✓	

Following a review of the information presented in this form, please consider the following question (a response is optional).

Do you consider the proposal requires formal environmental impact assessment?		
<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Not sure
If yes, what level of assessment?		
<input type="checkbox"/> Assessment on Proponent Information	<input checked="" type="checkbox"/> Public Environmental Review	

PROPONENT DECLARATION (to be completed by the proponent)

I... ISAK BUITENDAG....., (full name) declare that I am authorised on behalf of FORTESCUE METALS GROUP..... (being the person responsible for the proposal) to submit this form and further declare that the information contained in this form is true and not misleading.

Signature 	Name: Isak Buitendag
Position : Director, Health Safety, Environment & Security	Company: Fortescue Metals Group Limited
Date : 16/07/2014	

PART A - PROPONENT AND PROPOSAL INFORMATION

(All fields of Part A must be completed for this document to be treated as a referral)

1 PROPONENT AND PROPOSAL INFORMATION**1.1 Proponent**

Name	Fortescue Metals Group Limited (Fortescue)
Joint Venture parties (if applicable)	Not Applicable
Australian Company Number (if applicable)	ABN: 57 002 594 872
Postal Address (where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State)	Level 2, 87 Adelaide Terrace East Perth Western Australia 6004
Key proponent contact for the proposal: <ul style="list-style-type: none"> • name • address • phone • email 	Sean McGunnigle Level 2, 87 Adelaide Terrace East Perth WA 6004 Ph:08 6218 8415 smcgunnigle@fmgl.com.au
Consultant for the proposal (if applicable): <ul style="list-style-type: none"> • name • address • phone • email 	NA

1.2 Proposal

Title	Solomon Iron Ore Project Expansion
Description	This proposal is to expand the mining life and footprint of the Solomon Iron Ore Project (the Project) and associated railway, located 60 km north of the town of Tom Price WA (Figure 1), including the construction and maintenance of associated mine infrastructure (such as, but not limited to, waste dumps, tailings storage facilities, processing facilities, borefields, stockpile areas, crushers, overland conveyors and roads), and the addition of a borefield located east-northeast of Firetail mining area. See Section 2 in the supporting document for more information.
Extent (area) of proposed ground	The extent of proposed ground disturbance

disturbance.	<p>(Figure 2) is approximately:</p> <ul style="list-style-type: none"> • 11,322 ha for the mine expansion • 700 ha for a new external borefield • 476 ha for additional permanent infrastructure in the rail corridor. <p>The combined extent is approximately 12,498 ha. This is in addition to the approved footprint of 6,297 ha for mining and rail operations.</p>
Timeframe in which the activity or development is proposed to occur (including start and finish dates where applicable).	Commencing in July 2016 and continuing for 30 years (commencing in 2016)
Details of any staging of the proposal.	No Staging
Is the proposal a strategic proposal?	No
Is the proponent requesting a declaration that the proposal is a derived proposal?	Not a derived proposal
Please indicate whether, and in what way, the proposal is related to other proposals in the region.	<p>The Proposal will be an expansion of the existing Solomon mine and rail (Solomon Iron Ore Project - Ministerial Statement 862).</p> <p>The Solomon Mine is connected to the Christmas Creek Mine and Cloud Break Mine by the Hamersley Railway and the north-south railway which also connects to Fortescue Port facilities.</p> <p>The following details Fortescue's current approvals:</p> <ul style="list-style-type: none"> • Stage A Project: Port and a north-south railway from Port Hedland to the Chichester Ranges in the Eastern Pilbara to Port Hedland (Ministerial Statement 690) • Stage B Project: Christmas Creek and Mindy Mindy mines and an east-west rail spur (Ministerial Statement 707) • Port Facility Upgrade: Anderson Point Port Hedland, Dredging and Wharf Construction, Third Berth (Ministerial Statement 771). • Solomon Iron Ore Project (Ministerial Statement 862) • Christmas Creek Water Management Scheme (Ministerial Statement 871) • Cloudbreak Life of Mine (Ministerial Statements 899 & 962).
Does the proponent own the land on	Fortescue does not own the land, but has

which the proposal is to be established? If not, what other arrangements have been established to access the land?

tenure and licence to mine the land. Fortescue will apply for miscellaneous licences for the borefields once bore locations have been confirmed.

The Project is situated within Unallocated Crown Land (UCL), Native Title claim areas and active pastoral leases (Mt Florance, Hooley, Hamersley and Mulga Downs stations) and the following tenements (Figure 3):

E47/1011	E47/1532	M47/1466	L47/293	L47/367
E47/1016	M47/1409	M47/1474	L47/294	L47/381
E47/1319	M47/1410	P47/1279	L47/296	L47/382
E47/1333	M47/1411	P47/1286	L47/301	L47/391
E47/1334	M47/1413	P47/1287	L47/351	L47/392
E47/1398	M47/1431	P47/1304	L47/360	L47/397
E47/1399	M47/1433	P47/1305	L47/361	L47/471
E47/1436	M47/1434	P47/1468	L47/362	L47/696
E47/1447	M47/1453	L1SA	L47/363	L47/697

Native Title claim areas are as follows:

- Yindjibarndi # 1 Native Title Claim - WC2003/003
- Eastern Guruma Native Title Determination - WCD2007/001
- Banjima People Native Title Determination - WCD2014/001
- Kariyarra People Native Title Claim - WC1999/003
- Palyku Native Title Claim - WC1999/016

What is the current land use on the property, and the extent (area in hectares) of the property?

The land use is currently mining, pastoral and vacant crown land.

The extent of proposed ground disturbance is approximately:

- 11,322 ha for the mine expansion within a development envelope of 33,520 ha.
- 700 ha for a new external borefield within an envelope of 33,712 ha
- 476 ha for additional permanent infrastructure within the 29,257 ha rail corridor envelope (includes spur).

The combined extent is approximately 12,498 ha. This is additional to the approved footprint of 6,297 ha for mining and rail operations and results in a total disturbance footprint of 18,795 ha.

1.3 Location

Name of the Shire in which the proposal is located.	The Solomon Mine and the western portion of the Solomon rail corridor falls within the Shire of Ashburton. The eastern extent of the rail corridor extends into the Town of Port Hedland and Shire of East Pilbara.
For urban areas: <ul style="list-style-type: none"> • street address; • lot number; • suburb; and • nearest road intersection. 	
For remote localities: <ul style="list-style-type: none"> • nearest town; and • distance and direction from that town to the proposal site. 	The Solomon Iron Ore Project and associated railway is located 60 km north of the town of Tom Price in the Pilbara region of Western Australia.
Electronic copy of spatial data - GIS or CAD, geo-referenced and conforming to the following parameters: <ul style="list-style-type: none"> • GIS: polygons representing all activities and named; • CAD: simple closed polygons representing all activities and named; • datum: GDA94; • projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA); • format: Arcview shapefile, Arcinfo coverages, Microstation or AutoCAD. 	Enclosed: Yes

1.4 Confidential Information

Does the proponent wish to request the EPA to allow any part of the referral information to be treated as confidential?	No
If yes, is confidential information attached as a separate document in hard copy?	NA

1.5 Government Approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.	No
Is approval required from any Commonwealth or State Government agency or Local Authority for any part of the proposal?	Yes

Solomon Project Expansion - EPA Referral Form

SO-RP-EN-0078

If yes, please complete the table below.			
Agency/Authority	Approval required	Application lodged Yes / No	Agency/Local Authority contact(s) for proposal
Department of the Environment (DoE)	Referral/approval under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> .	Will be lodged concurrently with the <i>Environmental Protection Act 1986</i> (EP Act) referral	TBC
Shire of Ashburton, Shire of East Pilbara and Town of Port Hedland	Development Approval	Existing approval	
Department of Environment Regulation (DER)	Works Approval and Licences,	Existing prescribed premise	Alana Kidd
Department of Aboriginal Affairs (DAA)	Approval under Section 18 of the <i>Aboriginal Heritage Act 1972</i>	Will be lodged as and if required	TBC
Department of Water (DoW)	Groundwater investigation and abstraction licenses (26D and 5C) under the <i>Rights in Water and Irrigation Act 1914</i>	26D licences sought to construct bores along the proposed rail corridor and 5C licences for groundwater abstraction.	Kevin Hopkinson and Gary Humphreys
Department of Mines and Petroleum (DMP)	Mining Proposal and Mine Closure Plans in accordance with the <i>Mining Act 1978</i>	Will be lodged as required	Danielle Risbey

PART B - ENVIRONMENTAL IMPACTS AND PROPOSED MANAGEMENT

2. ENVIRONMENTAL IMPACTS

Describe the impacts of the proposal on the following elements of the environment, by answering the questions contained in Sections 2.1-2.11:

- 2.1 flora and vegetation;
- 2.2 fauna;
- 2.3 rivers, creeks, wetlands and estuaries;
- 2.4 significant areas and/ or land features;
- 2.5 coastal zone areas;
- 2.6 marine areas and biota;
- 2.7 water supply and drainage catchments;
- 2.8 pollution;
- 2.9 greenhouse gas emissions;
- 2.10 contamination; and
- 2.11 social surroundings.

These features should be shown on the site plan, where appropriate.

For all information, please indicate:

- (a) the source of the information; and
- (b) the currency of the information.

2.1 Flora and Vegetation

2.1.1 Do you propose to clear any native flora and vegetation as a part of this proposal?

[A proposal to clear native vegetation may require a clearing permit under Part V of the EP Act (Environmental Protection (Clearing of Native Vegetation) Regulations 2004)]. Please contact the Department of Environment and Conservation (DEC) for more information.

(please tick) ☒ Yes If yes, complete the rest of this section.

☐ No If no, go to the next section

2.1.2 How much vegetation are you proposing to clear (in hectares)?

Approximately 12,498 ha of vegetated areas are proposed to be disturbed as part of this proposal.

2.1.3 Have you submitted an application to clear native vegetation to the DEC (unless you are exempt from such a requirement)?

☒ No Managed under Part IV of the EP Act.

2.1.4 Are you aware of any recent flora surveys carried out over the area to be disturbed by this proposal?

✓ Yes

A recent flora and vegetation survey has been undertaken over the project area to address any gaps not previously surveyed within the proposed mining footprint and the surrounding environment. This survey report is due to be completed in September 2014 and the preliminary findings are detailed in:

- Solomon Flora and Vegetation Survey Summary (Ecologia 2014d)

Additional flora and vegetation surveys undertaken for the Solomon Project include:

- Flora and Vegetation Assessment, Solomon Project and Investigator (Coffey Environments 2010)
- Solomon Project: Kings Flora and Vegetation Assessment (ENV 2010).
- Level Two Flora and Vegetation Assessment, Firetail Mining Area (Ecoscape 2010a)
- Solomon Project – Airstrip and Rail Re-Alignment Flora, Vegetation and Fauna Assessment (Ecoscape 2010b)
- Robe Pisolite Assessment and Targeted *Gompholobium Karijini* (P2) Survey, Solomon Mine Project (Coffey Environments 2011)

2.1.5 Has a search of DEC records for known occurrences of rare or priority flora or threatened ecological communities been conducted for the site?

✓ Yes

2.1.6 Are there any known occurrences of rare or priority flora or threatened ecological communities on the site?

✓ Yes

The following priority species have been identified within the proposal footprint (See section 4.3 of supporting document for additional information):

- *Aristida jerichoensis* var. *subspinulifera* - Priority 1
- *Paspalidium retiglume* - Priority 2
- *Gompholobium Karijini* - Priority 2
- *Eremophila magnifica* subsp. *Magnifica* - Priority 3
- *Acacia effusa* - Priority 3
- *Bulbostylis burbridgeae* - Priority 4

- *Goodenia nuda* - Priority 4
- *Ptilotus mollis* - Priority 4
- *Rhynchosia bungarensis* - Priority 4.

One Threatened Ecological Community (TEC) Themeda Grasslands on Cracking Clays, and one Priority Ecological Community (PEC) Brockman Iron Cracking Clay, were also identified within the southern portion of the Solomon Project Area.

- 2.1.7 If located within the Perth Metropolitan Region, is the proposed development within or adjacent to a listed Bush Forever Site? (You will need to contact the Bush Forever Office, at the Department for Planning and Infrastructure)

✓ No

- 2.1.8 What is the condition of the vegetation at the site?

Vegetation condition within the areas is generally considered to be in good to very good condition. However some localised areas, particularly along creeklines and adjacent to cleared areas, have been significantly degraded by weed invasion (Buffel Grass **Cenchrus ciliaris*) and grazing and are considered to be in poor to degraded condition (Coffey, 2010a).

Some areas of Mulga in the rail corridor have been subjected to grazing and consequently these areas were found to be in poor to very poor condition. The low stony hills in the rail corridor were considered to be in good to very good condition. Three introduced species were recorded; *Bidens bipinnata*, *Cenchrus ciliaris* and *Cucumis melo* subsp. *agrestis*. Of these, only *Cenchrus ciliaris* (Buffel Grass) is rated under the Environmental Weed Strategy of Western Australia, as high risk. *Cenchrus ciliaris* was found on valley floors and is associated with cattle grazing.

2.2 Fauna

- 2.2.1 Do you expect that any fauna or fauna habitat will be impacted by the proposal?

✓ Yes See Section 4.4 in the Supporting document

- 2.2.2 Describe the nature and extent of the expected impact.

The most significant impacts arising from the proposal are associated with the clearing of native vegetation and consequential loss and alteration of fauna habitat. Potential impacts include:

- Removal of fauna habitat
- Fragmentation of habitat linkages and corridors
- Alteration of vegetation composition and introduction of weed species resulting in altered feeding and breeding patterns
- Potential increase in feral fauna
- Altered groundwater levels, potentially impacting on subterranean (stygo fauna) fauna

- Alteration of existing surface water drainage patterns
- Removal of geological strata potentially impacting on subterranean fauna habitat
- Altered fire regimes.

2.2.3 Are you aware of any recent fauna surveys carried out over the area to be disturbed by this proposal?

✓Yes

A recent terrestrial fauna survey has been undertaken over the project area to address any gaps not previously surveyed within the proposed footprint and the surrounding environment. This survey report is due to be completed in September 2014 and the preliminary findings are detailed in:

- Solomon Vertebrate and SRE Fauna Survey – Summary Report (Ecologia 2014c).

Additional fauna surveys and investigations undertaken for the Solomon Project Area are as follows:

- Level 2 Terrestrial Vertebrate Fauna Assessment for the Solomon Project (Coffey Environments 2008)
- Vertebrate Fauna and Fauna Habitat Assessment for the Firetail Project (Ecoscape 2010b)
- Level 1 Vertebrate Fauna Assessment – Solomon Rail Project (Coffey Environments 2010b)
- Solomon Project: Kings Area Vertebrate Fauna Assessment (Valley of the Kings, Valley of the Queens, Trinity and Zion) (Ecologia 2010)
- Solomon Project – Firetail, Short-Range Endemic Invertebrate and Habitat Assessment (Ecologia 2010a)
- Short Range Endemic Invertebrate Survey of Solomon Project: Kings Area and Reference Sites (Phoenix Environmental Sciences 2010)
- Targeted Surveys – Northern Quolls, Mulgara and Pilbara Olive Pythons, Solomon Rail Project (Coffey Environments 2011)
- Solomon Project – Airstrip Fauna Assessment (Ecoscape 2010c)
- Targeted Surveys – Northern Quolls and Pilbara Leaf-Nosed Bats (Coffey 2011a)
- Solomon Mine Annual Conservation Significant Fauna Monitoring Report 2012 (Ecologia 2013a)
- Solomon Rail Annual Conservation Significant Fauna Monitoring Report 2012 (Ecologia 2013b)

- Solomon Mine Annual Conservation Significant Fauna Monitoring Report 2013 (in draft) (Ecologia 2014a)
- Solomon Rail Annual Conservation Significant Fauna Monitoring Report 2013 (in draft) (Ecologia 2014b)

Subterranean and short-range endemic (SRE) invertebrate fauna within the Solomon Project Area have been assessed within reports listed below (and in Section 4.5 in of the supporting document):

- Solomon Project: Kings Deposits Subterranean Fauna Survey and Assessment (Subterranean Ecology Pty Ltd 2011)
- Troglifauna Assessment for the Solomon Project: Firetail Deposits (Bennelongia Pty Ltd 2010)
- Solomon Iron Ore Project: 30 Month Troglifauna Report at Kings Mine (Bennelongia Pty Ltd 2013)
- Solomon Life of Mine: Troglifauna Assessment (Bennelongia Pty Ltd 2014)
- Stygofauna Assessment for the Solomon Project (in prep) (Bennelongia Pty Ltd 2014)

2.2.4 Has a search of DEC records for known occurrences of Specially Protected (threatened) fauna been conducted for the site?

✓Yes

2.2.5 Are there any known occurrences of Specially Protected (threatened) fauna on the site?

✓Yes

The following species of Specially Protected (Threatened) fauna have been recorded within the Proposal area:

- Pilbara Olive Python (*Liasis olivaceus barroni*) – EPBC Act (Vulnerable); Wildlife Conservation Act -Schedule 1
- Northern Quoll (*Dasyurus hallucatus*) – EPBC Act (Endangered); Wildlife Conservation Act - Schedule 1
- Pilbara Leaf-nosed Bat (*Rhinonictis aurantia*) - EPBC Act (Vulnerable); Wildlife Conservation Act - Schedule 1
- Australian Bustard (*Ardeotis australis*) – Priority 4
- Barking Gecko (*Underwoodisaurus seorsus*) Priority 1
- Blind Snake (*Ramphotyphlops ganei*) – Priority 1
- Brush-tailed Mulgara (*Dasycercus blythi*) - Priority 4
- Bush Stone-curlew (*Burhinus grallarius*) - Priority 4
- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (Migratory).

- Ghost Bat (*Macroderma gigas*) – Priority 4
- Rainbow Bee-eater (*Merops ornatus*) – EPBC Act (Migratory)
- Peregrine Falcon – (*Falco peregrinus*) - Schedule 4
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4

2.3 Rivers, Creeks, Wetlands and Estuaries

2.3.1 Will the development occur within 200 metres of a river, creek, wetland or estuary?

✓ Yes See Section 4.2 in the Supporting Document

The Project is located at the headwaters of the Millstream Catchment and is primarily associated with three separate surface water drainage systems:

- Zalamea (Zion, South East Flow) – this drainage line flows from the middle and eastern part of the Kings deposit back to the east then through the ranges to the north before discharging into the Fortescue Valley.
- Kangeenarina (Kings, Central Flow) – this drainage line flows from the central portion of the Kings deposit to the west and also from the eastern part of the Queens deposit draining to the east joining in a confluence to flow to the north through Kangeenarina Gorge and discharging into the Fortescue Valley.
- Queens Flow System (West Flow) – this drainage line flows from a portion of the Queens deposit to the west to join Weelumurra Creek near Rio Tinto's Hamersley rail line before flowing to the north to discharge into the Fortescue Valley.

2.3.2 Will the development result in the clearing of vegetation within the 200 metre zone?

✓ Yes

The Zalamea Creek and groundwater-fed pools are now located within a proposed pit boundary and will be mined.

2.3.3 Will the development result in the filling or excavation of a river, creek, wetland or estuary?

✓ Yes

The Zalamea groundwater fed pool is now located within a proposed pit boundary and will be mined.

Some parts of other drainage lines within the mine footprint may also be excavated or blocked by infrastructure during mining.

Fortescue intends to divert surface water flows around pits to maintain surface water flows as much as possible. In some areas however, surface water flows may not be able to be reinstated due to changes in elevation.

- 2.3.4 Will the development result in the impoundment of a river, creek, wetland or estuary?

✓ Yes

Fortescue intends to divert surface water flows around pits to maintain surface water flows as much as possible. In some areas however, surface water flows may not be able to be reinstated due to changes in elevation.

- 2.3.5 Will the development result in draining to a river, creek, wetland or estuary?

✓ No

- 2.3.6 Are you aware if the proposal will impact on a river, creek, wetland or estuary (or its buffer) within one of the following categories? (please tick)

Conservation Category Wetland	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
<i>Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998</i>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Perth's Bush Forever site	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
<i>Environmental Protection (Swan & Canning Rivers) Policy 1998</i>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
The management area as defined in s4(1) of the <i>Swan River Trust Act 1988</i>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Which is subject to an international agreement, because of the importance of the wetland for waterbirds and waterbird habitats (e.g. Ramsar, JAMBA, CAMBA)	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure

2.4 Significant Areas and/ or Land Features

- 2.4.1 Is the proposed development located within or adjacent to an existing or proposed National Park or Nature Reserve?

✓ Yes No

The Proposal boundary is located 450 m from the north western corner of Karijini National Park.

- 2.4.2 Are you aware of any Environmentally Sensitive Areas (as declared by the Minister under section 51B of the EP Act) that will be impacted by the proposed development?

Yes ✓ No

- 2.4.3 Are you aware of any significant natural land features (e.g. caves, ranges etc) that will be impacted by the proposed development?

✓ Yes

The proposed mining areas are situated within the Hamersley Range, while the previously approved rail corridor traverses the Fortescue Valley and Chichester Range.

A number of caves exist within the hill sides of valleys where mining is proposed. Some of these caves will be impacted by waste dumps.

2.5 Coastal Zone Areas (Coastal Dunes and Beaches)

2.5.1 Will the development occur within 300 metres of a coastal area?

✓ No

2.6 Marine Areas and Biota

2.6.1 Is the development likely to impact on an area of sensitive benthic communities, such as seagrasses, coral reefs or mangroves?

✓ No

2.7 Water Supply and Drainage Catchments

2.7.1 Are you in a proclaimed or proposed groundwater or surface water protection area?

(You may need to contact the Department of Water (DoW) for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

✓ Yes

The Project is located within the Pilbara Groundwater Area (Ashburton sub-area) and Pilbara Surface Water Area proclaimed under the *Rights in Water and Irrigation Act 1914*. Fortescue have liaised with DoW on this issue.

2.7.2 Are you in an existing or proposed Underground Water Supply and Pollution Control area?

(You may need to contact the DoW for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

✓ No

2.7.3 Are you in a Public Drinking Water Supply Area (PDWSA)?

(You may need to contact the DoW for more information or refer to the DoW website. A proposal to clear vegetation within a PDWSA requires approval from DoW.)

✓ Yes

Based on the extent of the Millstream surface water catchment, the western portion of the Kings mining area is situated within the Millstream Water Reserve, which is a Priority 2 Public Drinking Water Source Area. According to the Department of Water's Water Quality Protection Note on Land Use Compatibility in Public Drinking Water Source Areas, mining

is compatible (with conditions) in P2 areas (Department of Environment, 2004). Tailings dams are also acceptable with DoW approval (in application).

2.7.4 Is there sufficient water available for the proposal?

✓ Yes

Fortescue has investigated options for additional mine water supply. This proposal includes:

- a new borefield located to the northeast of the Firetail mining area
- a minor expansion of the borefield to the south of the airport.

2.7.5 Will the proposal require drainage of the land?

✓ No

2.7.6 Is there a water requirement for the construction and/ or operation of this proposal?

(please tick) ✓ Yes If yes, complete the rest of this section.

2.7.7 What is the water requirement for the construction and operation of this proposal, in kilolitres per year?

The estimated water requirement for the construction and operation of the Solomon Project is in the order of 35 GL/a.

2.7.8 What is the proposed source of water for the proposal? (e.g. dam, bore, surface water etc.)

Water will be sourced from groundwater via borefield(s) and dewatering of the proposed Mining area.

Dewatering across the mine area is not expected to significantly change from the original proposal and dewatering will be undertaken in accordance with the approved 25 GL/a required for the Kings mining areas (Queens, Trinity, Zion and Castle Valley).

In addition to the 25 GL/a provided by dewatering, Fortescue requires an average of 35 GL/a to meet peak water demands. The southern and lower borefield's are proposed to meet the additional operating water requirements

This proposal includes an expansion of the external borefield to the south of the airport which is expected to yield approximately 14 GL/a. A new borefield is also proposed northeast of Firetail mining area and is anticipated to supply up to 10 GL/a to the Solomon mining operations.

2.8 Pollution

2.8.1 Is there likely to be any discharge of pollutants from this development, such as noise, vibration, gaseous emissions, dust, liquid effluent, solid waste or other pollutants?

(please tick) ✓ Yes If yes, complete the rest of this section.

2.8.2 Is the proposal a prescribed premise, under the *Environmental Protection Regulations 1987*?

(Refer to the EPA's *General Guide for Referral of Proposals to the EPA under section 38(1) of the EP Act 1986* for more information)

✓ Yes

The Solomon Mine currently operates in accordance with a Part V *Environmental Protection Act 1986* Licence - L8464/2010, which includes the following:

- Category 5: Processing or beneficiation of metallic or non-metallic ore
- Category 54: Sewage facility
- Category 64: Class II or III putrescible landfill site (pending)
- Category 73: Bulk storage chemicals.

2.8.3 Will the proposal result in gaseous emissions to air?

✓ Yes

The Proposal will result in minor volumes of gaseous emissions as a result of blasting, vehicle and mobile machinery use. However, these emissions will not be significantly greater than those of current operations. Gaseous emissions associated with the Proposal will not have a significant impact on air quality.

2.8.4 Have you done any modelling or analysis to demonstrate that air quality standards will be met, including consideration of cumulative impacts from other emission sources?

✓ No

As the Proposal is a continuation of existing approved operations, emissions will not be significantly greater than that already approved and as such it was considered it was unnecessary to undertake additional modelling. Potential impacts can be managed under Part V of the EP Act (Environmental Licence to Operate), the *Clean Energy Act 2011* (Cth) and the *National Greenhouse and Energy Reporting Act 2007* (Cth).

2.8.5 Will the proposal result in liquid effluent discharge?

✓ No

At this stage, no additional liquid effluent discharge is proposed as a part of this proposal. If additional wastewater treatment plants are required, they can be managed under Part V of the EP Act (Environmental Licence to Operate).

2.8.6 If there is likely to be discharges to a watercourse or marine environment, has any analysis been done to demonstrate that the State Water Quality Management Strategy or other appropriate standards will be able to be met?

✓ Yes

Fortescue's Licence under Part V of the EP Act (L8464/2010/1, Condition 1.25) permits stormwater to be discharged from the Premises as long as it is treated prior to release and does not cause contamination.

2.8.7 Will the proposal produce or result in solid wastes?

✓ Yes

The Project will result in the production of solid waste including:

- Construction wastes
- Tailings
- Overburden and low grade ore
- Putrescible waste associated with the accommodation village and administrative buildings
- Hydrocarbon wastes from maintenance facilities.

2.8.8 Will the proposal result in significant off-site noise emissions?

✓ Yes

Noise will be generated throughout operations. During operations, blasting is likely to be the most significant noise source.

There are few sensitive receptors in the vicinity of the Project area, and as a consequence noise is not considered likely to be a significant factor.

2.8.9 Will the development be subject to the Environmental Protection (Noise) Regulations 1997?

✓ Yes ☐ No Please attach the analysis.

Noise modelling was undertaken for the Original Project assessment. Given that the project is, in general terms, a wider footprint of the original footprint modelled, no significant additional noise is expected to impact sensitive receptors.

2.8.10 Does the proposal have the potential to generate off-site, air quality impacts, dust, odour or another pollutant that may affect the amenity of residents and other "sensitive premises" such as schools and hospitals (proposals in this category may include intensive agriculture, aquaculture, marinas, mines and quarries etc.)?

✓ No

2.8.11 If the proposal has a residential component or involves "sensitive premises", is it located near a land use that may discharge a pollutant?

✓ N/A

2.9 Greenhouse Gas Emissions

2.9.1 Is this proposal likely to result in substantial greenhouse gas emissions (greater than 100 000 tonnes per annum of carbon dioxide equivalent emissions)?

✓ Yes

Greenhouse gas emissions are anticipated to be more than 100,000 tonnes per annum of carbon dioxide equivalent (CO₂-e) emissions produced annually.

- 2.9.2 Further, if yes, please describe proposed measures to minimise emissions, and any sink enhancement actions proposed to offset emissions.

Emissions management and mitigation will be addressed during engineering design.

In particular a new pipeline has been designed to supply gas to the Solomon Project. The conversion from diesel to gas has the potential to reduce greenhouse gas emissions in the order of 25%.

2.10 Contamination

- 2.10.1 Has the property on which the proposal is to be located been used in the past for activities which may have caused soil or groundwater contamination?

✓No

- 2.10.2 Has any assessment been done for soil or groundwater contamination on the site?

✓Yes

If yes, please describe.

Fortescue is implementing an ongoing acid and metalliferous drainage sampling program which encompasses sampling groundwater in operating and future mine areas.

- 2.10.3 Has the site been registered as a contaminated site under the *Contaminated Sites Act 2003*? (on finalisation of the CS Regulations and proclamation of the CS Act)

✓No

2.11 Social Surroundings

- 2.11.1 Is the proposal on a property which contains or is near a site of Aboriginal ethnographic or archaeological significance that may be disturbed?

✓ Yes

Fortescue has archaeologically and ethnographically surveyed the majority of the Proposal footprint and is currently undertaking additional surveys to ensure all proposed impact areas are surveyed. Numerous heritage sites have been identified within the Proposal footprint, including some which Fortescue intend to disturb in the future. Fortescue will continue to consult with the relevant Native Title Groups and seek approval under Section 18 of the Aboriginal Heritage Act, prior to doing so.

- 2.11.2 Is the proposal on a property which contains or is near a site of high public interest (e.g. a major recreation area or natural scenic feature)?

✓Yes

The Proposal boundary is located 450 m from the northwest corner of Karijini National Park.

2.11.3 Will the proposal result in or require substantial transport of goods, which may affect the amenity of the local area?

✓ Yes

The Original Proposal was assessed for an increase in train movements on Fortescue's north-south rail line by 6 trains per day. It is likely there will also be an increase in truck movements and other transport along Nanutarra-Wittenoom and Munjina-Wittenoom roads during the extended operations phases of the Project.

3. PROPOSED MANAGEMENT

3.1 Principles of Environmental Protection

3.1.1 Have you considered how your project gives attention to the following Principles, as set out in section 4A of the EP Act? (See Section 6.0 in the Supporting document)

- | | |
|--|------|
| 1. The precautionary principle. | ✓Yes |
| 2. The principle of intergenerational equity. | ✓Yes |
| 3. The principle of the conservation of biological diversity and ecological integrity. | ✓Yes |
| 4. Principles relating to improved valuation, pricing and incentive mechanisms. | ✓Yes |
| 5. The principle of waste minimisation. | ✓Yes |

3.1.2 Is the proposal consistent with the EPA's Environmental Protection Bulletins/Position Statements and Environmental Assessment Guidelines/Guidance Statements (available on the EPA website)?

✓Yes

Surveys and investigations have been undertaken consistent with EPA guidelines.

The supporting document includes an assessment of the Proposal using:

- EAG 1, Defining Key Characteristics of a Proposal
- EAG 8, Environmental factors and objectives
- EAG 9, Application of a significance framework in the environmental impact assessment process – Focusing on the key environmental factors.

3.2 Consultation

3.2.1 Has public consultation taken place (such as with other government agencies, community groups or neighbours), or is it intended that consultation shall take place?

✓Yes

Detailed list of consulted stakeholders, issues and responses are in Section 3.5 of the Supporting document.

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Figure 1

Solomon Mine - Regional Location

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LOCATION MAP



LEGEND

- FMG Mines
- Towns
- Principal Road
- Secondary Road
- Railways
- Watercourses
- Fortescue Marsh
- National Park



0 20 40 60 80
Kilometres

SOLOMON MINE REGIONAL LOCATION

Requested By: Amy Barker
Drawn By: Sacha Fielden
Revised By: sfielden
Approved By: Undraa George
Scale: 1:2,000,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: SO_MP_EN_0294.001r2

Date: 30/06/2014
Size: A4P
Revision: 2
Confidentiality: 1

Data Source(s):
Landsat 2005 Imagery, Topography, Geoscience Australia, 2013
National Parks, Landgate, 2014

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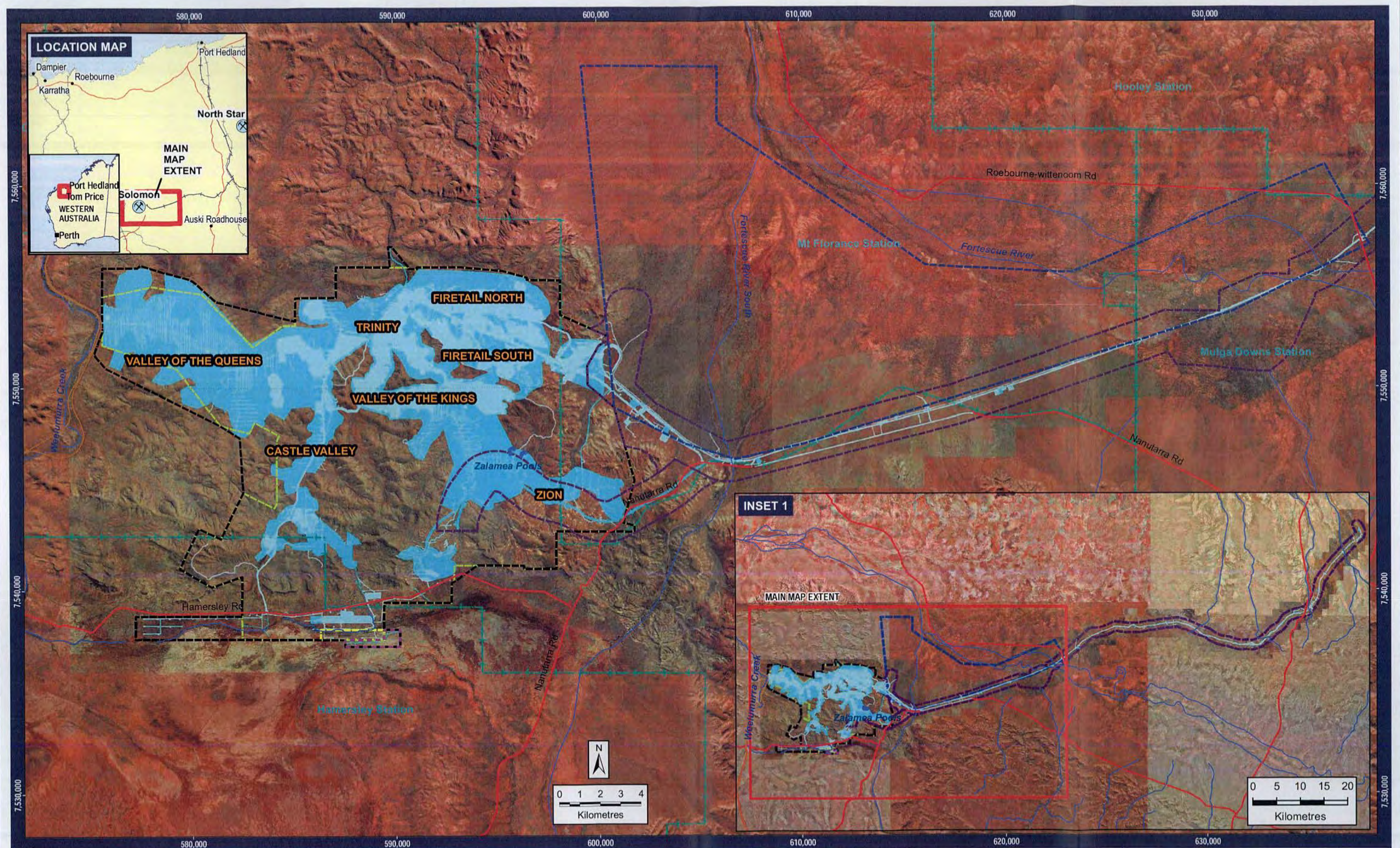
Fortescue Metals Group Ltd
The New Force in Iron Ore

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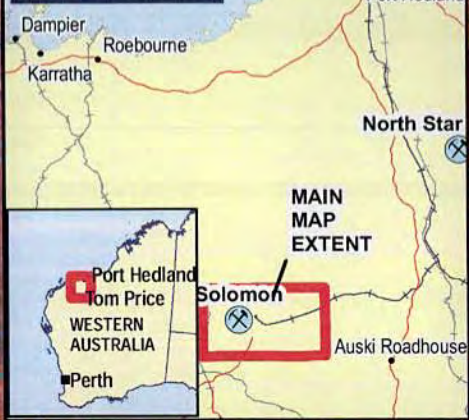
Figure 2

Solomon Mine – Indicative Layout of the Proposal Area

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LOCATION MAP



INSET 1



LEGEND

- Roads
- 3rd Party Rail
- Major Drainage
- Zalamea Pools
- Current and Approved Disturbance to June 2016
- Pastoral Leases (Excluding Easements)
- Proposed Project Development Envelope 1
- Proposed Project Development Envelope 2 Extension
- Proposed Project Development Envelope 3
- Indicative Mine and Rail Footprint
- Project Development Envelope 1
- Project Development Envelope 2
- Rail and Rail Spur Corridor

Data Source(s):

Topography, Geoscience Australia, 2013. Pastoral Lease Boundary, Landgate, 2014. Imagery, FMG and Landgate, 2014. All other data, FMG, 2014.

Requested By: Amy Barker
Drawn By: Sacha Fielden
Revised By: ugeorge

Date: 7/07/2014
Size: A3L
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Coordinate System: GDA 1994 MGA Zone 50
Document Name: SO_MP_EN_0294.002r6

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SOLOMON MINE LAYOUT OF THE PROPOSAL AREA (Indicative)

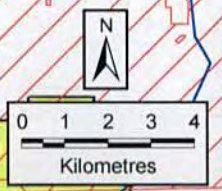
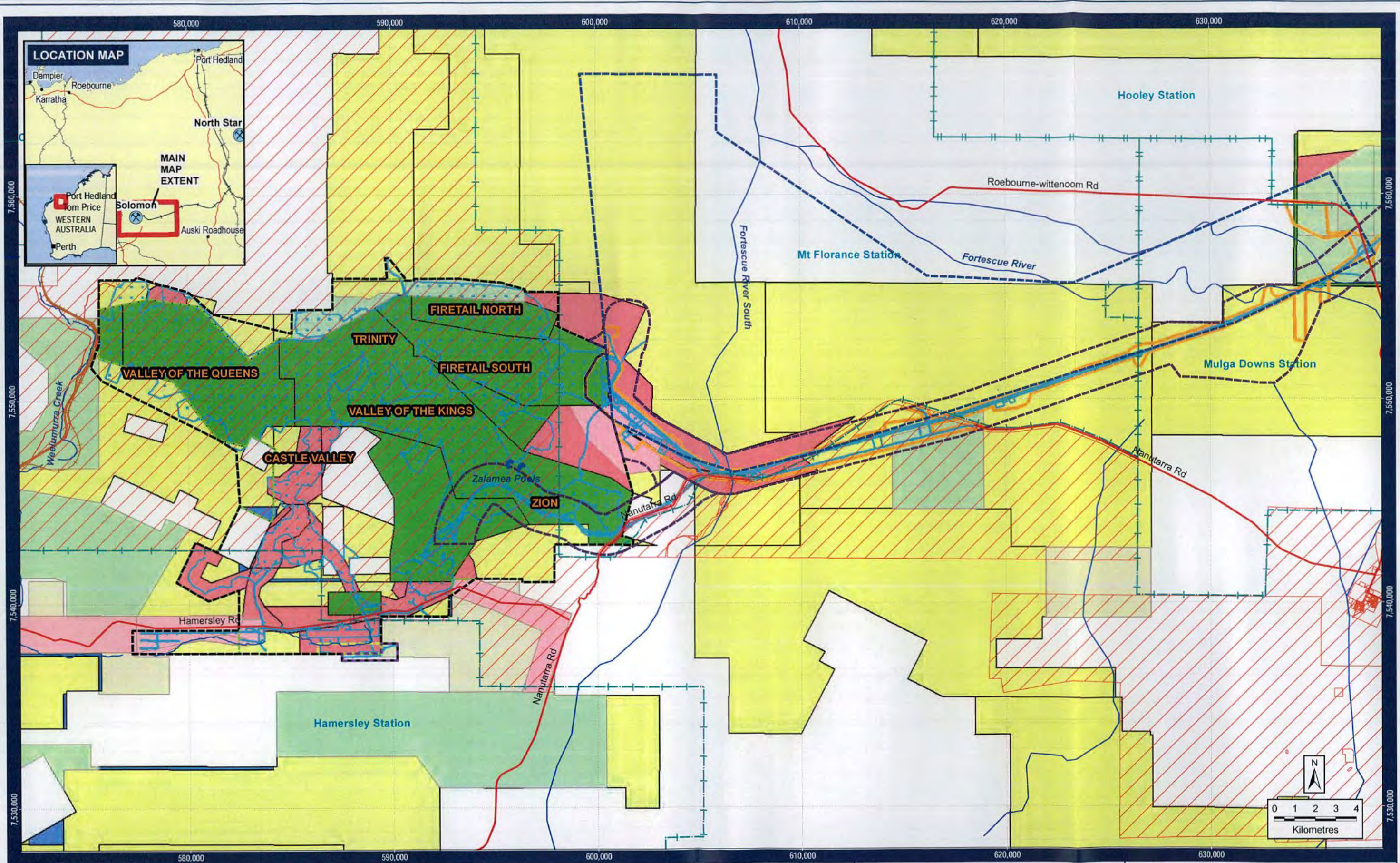


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Figure 3

Solomon – Tenure and Land Use

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LEGEND			
Roads	Project Development Envelope 1	FMG Live M Tenement	FMG Live Prospecting Tenement
3rd Party Rail	Project Development Envelope 2	FMG Live L Tenement	FMG Pending M Tenement
Major Drainage	Proposed Project Development Envelope 1	FMG Live SRL Tenement	FMG Pending L Tenement
Zalamea Pools	Proposed Project Development Envelope 2 Extension	FMG Live Exploration Tenement	FMG Pending E Tenement
Pastoral Leases (Excluding Easements)	Proposed Project Development Envelope 3		
Unallocated Crown Land	Rail and Rail Spur Corridor		
	Indicative Mine and Rail Footprint		

Data Source(s):
 Topography, Geoscience Australia, 2013. Tenure, Landgate, 2014.
 Imagery, FMG and Landgate, 2014. All other data, FMG, 2014.

Requested By: Amy Barker
 Drawn By: Sacha Fielden
 Revised By: sfielden
 Date: 4/07/2014
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SOLOMON MINE TENURE AND LAND USE



Report

EPA Referral Supporting Document

Solomon Iron Ore Project Expansion

Solomon Iron Ore Project




**16 July 2014
SO-RP-EN-0079**



Fortescue
The New Force in Iron Ore

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L. Kirchner	A. Barker	Sean McGunnigle	0	IFU	16/7/14

EXECUTIVE SUMMARY

Fortescue Metals Group Limited (Fortescue) is seeking approval to expand mining operations and rail infrastructure beyond the current footprint at the Solomon Iron Ore Mine (the Proposal). To support the expansion, Fortescue is also seeking approval for an external borefield to provide an additional water supply.

Fortescue commenced construction and operations at the Solomon Mine in 2011. Exploration and orebody definition has continued since commencement and has resulted in new mining areas and additional associated infrastructure, and now requires an increased footprint beyond the previously approved footprint. This Proposal provides the area required to continue mining operations at the Solomon Mine.

This Supporting Document provides information to the Environmental Protection Authority (EPA) in order to determine the level of assessment. This document provides information about the existing environment, existing approvals in place, potential impacts arising from implementation of the Proposal, and proposed management measures to address potential impacts for each of the EPA's environmental factors. Numerous specialist studies have been undertaken to support this and previous government impact assessment submissions, or as part of ongoing management of the site.

In accordance with the EPA Environmental Assessment Guideline No. 8 for Environmental Factors and Objectives (EPA 2013a), Fortescue has reviewed the preliminary environmental factors and identified the following as potentially being key environmental factors:

- hydrological processes
- inland waters environmental quality
- flora and vegetation (Priority Flora and Priority Ecological Community (PEC))
- terrestrial fauna (Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat)
- subterranean fauna
- rehabilitation and closure
- Offsets.

Through the preparation of the assessment of environmental factors, the significance of the implementation of the Proposal on the environmental factors was assessed, in line with the EPA Environmental Assessment Guideline No. 9 for Application of a Significance Framework in the environmental impact assessment process (EPA 2013b). Fortescue has concluded that the potential key environmental factors will not have a significant residual environmental impact (Table ES).

The information and assessment presented in this supporting document is considered to have adequately identified and addressed environmental aspects and issues relevant to the Proposal, and is adequate to enable the EPA to consider the Proposal and determine the

level of assessment. The Proposal is unlikely to result in significant impacts to the environment beyond the Proposal area, and appropriate management practices have been identified to minimise impacts under existing Management Plans or through implementation of the Mine Closure Plan.

Table ES - Evaluation of Potential Impact Summary

Aspect/Factor	Evaluation of Potential Impact Summary	Conclusion
Hydrological Processes and Inland Water Quality	<ul style="list-style-type: none"> - New borefield in Lower Fortescue River catchment (Lower Borefield) with abstraction up to 10 GL/a - Additional 5 bores added to Southern Borefield with increase abstraction up to 14 GL/a - Removal of Zalamea groundwater-fed pool - In pit tailing storage above and below the water table - Modification of peak water flows via surface water control measures - Modification of drainage and surface water flows may remain at closure due to changes in elevation. 	<p>Groundwater studies undertaken to date indicate the impact on groundwater levels will be localised and there will be no significant impacts on regional groundwater and no impacts on key environmental receptors outside of the proposal footprint.</p> <p>Rainfall and catchment studies undertaken to date indicate the impact on surface water flow will be localised (due to small catchment areas) and there will be no significant impacts on downstream environmental receptors.</p> <p>Monitoring has indicated that Zalamea groundwater-fed pools are unlikely to be permanent pools and only persist in periods of high rainfall.</p> <p>Can be managed under the <i>Rights in Water and Irrigation Act 1914</i> (RIWI Act) (5C and 26D Licence) and Part V of the EP Act.</p>
Flora and Vegetation	<ul style="list-style-type: none"> - Disturbance of 12,498 ha within the mine areas and rail corridor - Clearing of Priority Flora - Minor disturbance (5.3 ha) within the PEC (Brockman Iron Cracking Clays) - Increase in disturbance to Robe Pisolite vegetation units - Increase in disturbance of locally or regionally significant vegetation - Increase in weed risks. 	<p>The proposal will result in minor clearing of small areas of Priority Flora and with the PEC. Other clearing of well represented vegetation associations will be undertaken.</p> <p>Could be assessed and managed under Part V of the <i>Environmental Protection Act 1986</i> (EP Act) Native Vegetation Clearing Permit.</p> <p>Rehabilitation of cleared areas will be managed under the Mine Closure Plan.</p>
Terrestrial Fauna	<ul style="list-style-type: none"> - Loss of up to 12,498 ha of fauna habitat - Low potential impact on 11 priority fauna species - Potential impact on three species of conservation significance (Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat) 	<p>The proposal could be considered to have a minor impact on the habitat of Matters of National Environmental Significance (MNES). This could be managed under existing MNES management plans.</p>
Subterranean Fauna	<ul style="list-style-type: none"> - Removal of additional subterranean invertebrate habitat through mining and dewatering activities 	<p>The Proposal is considered to have minimal impact on stygofauna and troglafauna species persistence, irrespective of any habitat changes that may occur, due to likely habitat connectivity extending beyond the Proposal area, indicating that species and communities may be interconnected and not limited to the Proposal area.</p>

Aspect/Factor	Evaluation of Potential Impact Summary	Conclusion
Closure and rehabilitation	- Additional areas of disturbance requiring rehabilitation at end of mine life	The Solomon Iron Ore Project has a comprehensive and current Mine Closure Plan (MCP) that will be updated to include the expansion. This MCP can adequately manage rehabilitation and closure.
Offsets	- Compensation for residual adverse impacts	Offsets for this Proposal will be determined using EPA and Australian Government guidance.

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Appendix D	Solomon Life of Mine: Troglofauna Assessment

1. INTRODUCTION

1.1 Proposal Overview and Location

Fortescue Metals Group Limited (Fortescue) is the proponent for the Solomon Iron Ore Project (Solomon) located approximately 60 kilometres (km) north of Tom Price in the Pilbara region of Western Australia (Figure 1).

Solomon currently consists of the Firetail and Kings (including Queens, Zion and Trinity) mining areas and processing hubs with associated support infrastructure. The Hamersley Rail is approximately 125 km in length and was constructed as a part of the Original Proposal (Figure 1). The rail extends from the east of the Firetail deposit, connecting to Fortescue's North-South Railway (Stage A).

The Firetail deposit consists mainly of a blend of Bedded Iron Deposits (BID) and Detrital Iron Deposits (DID) while the Kings deposits comprise mostly Channel Iron Deposits (CID), with some BID and DID.

The current project also includes a water supply from pit dewatering and a borefield located to the south of the mine, known as the Southern Borefield.

The estimate of the footprint for the Original Proposal was 6,297 hectares (ha) (4,400 ha for mining operations and 1,897 ha for rail infrastructure) and was based upon feasibility study factors, many of which have been refined through the completion of more detailed studies. As the geological resource drilling, mine planning and construction phases progressed, the understanding of resource, site conditions and requirements for infrastructure placement have improved, as well as the identification of additional resource areas, allowing for a more accurate footprint definition.

The Proposal is for the subsequent revision to the Original Proposal layout, with an overall increase of 12,498 ha to the footprint required for the Firetail, Kings, Queens, Trinity, Zion mining areas, and the rail corridor, and the addition of the Castle Valley mining and infrastructure area and proposed borefields.

1.2 Purpose of Document

This document has been prepared to provide supporting information for the referral of the Proposal to the Environmental Protection Authority (EPA) under Section 38 (Part IV) of the *Environmental Protection Act 1986* (EP Act). The document is based on project and study information available at the time of writing.

1.3 Proponent Details

Fortescue Metals Group Limited
ABN: 57 002 594 872
Level 2, 87 Adelaide Terrace
East Perth
Western Australia 6004

Key Contact:
Sean McGunnigle
Level 2, 87 Adelaide Terrace
East Perth WA 6004
Ph: 08 6218 8415
smcgunnigle@fmgl.com.au

2. PROPOSAL INFORMATION

2.1 Proposal Description

The Proposal is for the revision to the Original Proposal layout, with a mine footprint increase of 11,322 ha to the footprint required to mine and process the Firetail, Kings, Queens, Trinity, Zion deposits and include the addition of Castle Valley mining and infrastructure areas (Table 1). The majority of the expanded mining footprint remains within the Project Development Envelope that was previously assessed and is shown in the current Ministerial Statement 862 (MS 862), and that the change in footprint generally involves the expansion or widening of previously approved mining and infrastructure areas (Figure 2).

Mining activities and infrastructure previously approved such as, but not limited to, ore processing facilities, waste dumps, tailings storage facilities, workshops, water infrastructure, overland conveyors, crushing facilities, and stockpile areas will continue to be implemented across the expanded footprint. Additional tailings storage options such as in-pit below water table storage are also being considered for the expanded footprint.

Fortescue is also proposing to increase the permanent footprint within the Part IV rail corridor. The Hamersley Rail requires ongoing maintenance to keep the rail functioning at an optimum level. In order to maintain the rail, Fortescue requires additional borrow pit areas for ongoing maintenance material. As a part of the expanding mine footprint Fortescue is also proposing additional mining and rail infrastructure within the Part IV rail corridor near the rail loop. The total increase in area required within the rail corridor is detailed in Table 1.

To support the proposed mine expansion an external borefield is proposed to be located northeast of the Solomon mine area within the Lower Fortescue River valley (Lower Borefield). Fortescue is proposing a series of paired monitoring bores, and abstraction bores, to be developed within the "Project Development Envelope 3", shown in Figure 2. The proposed clearing required is anticipated to be approximately 700 ha within a 33,712 ha development envelope. It is anticipated that this borefield will include approximately 20 abstraction bores and will supply approximately 10 Ggalitres per annum (GL/a) of groundwater for the Solomon Project.

An additional five bores are also proposed within the Southern Borefield. This borefield is located within the Brockman Iron Cracking Clays Priority Ecological Community (PEC). These bores will be constructed and operated in accordance with the *Southern Borefield TEC/PEC Management and Monitoring Plan – Operation – Solomon Project (SO-PL-EN-0011)*, which was developed and implemented for the previous three bores located in the PEC. The clearing required for the additional bores is approximately 5.3 ha. This will increase the clearing within the PEC to a maximum of 10.3 ha and will increase the Southern Borefield supply to approximately 14 GL/a of groundwater for the Solomon mining operations.

Table 1 Disturbance Footprint

Component	Approved disturbance (ha)	This Proposal disturbance (ha)	Combined disturbance (ha)
Mining areas and associated infrastructure	4,400	11,322 (including not more than 5.3 ha disturbance of the Brockman Iron Ore Cracking Clay Communities within a 132 ha Project Development Envelope 2)	15,722 (including not more than 10.3 ha disturbance of the Brockman Iron Ore Cracking Clay Communities within a 285 ha Project Development Envelope 2)
Lower Borefield area	-	700	700
Rail corridor and infrastructure	1,897 total disturbance 764 permanent disturbance 1133 rehabilitation	476	2373 total disturbance 1240 permanent disturbance 1133 rehabilitation
Total disturbance	6,297	12,498	18,795

2.2 Key Characteristics of the Proposal

The total disturbance estimate is based on information from the completion of a detailed mine plan that takes into consideration the life of the known resources for Solomon as well as a reasonable reflection of the potential for additional development based on exploration results. Table 2 provides a summary of the Proposal.

Table 2 Summary of the Proposal

Proposal title	Solomon Iron Ore Project
Proponent name	Fortescue Metals Group Limited
Short description	This proposal is to expand the mining life and area of the Solomon Iron Ore Mine and Hamersley railway corridor, located 60 km north of the town of Tom Price WA, including the construction and maintenance of associated mine infrastructure (waste dumps, tailings storage facilities, borefields, stockpile areas and roads etc.) and the addition of a borefield located northeast of Firetail mining area.

Physical Elements

Progression of resource drilling, detailed design, construction and early mining activities has increased the data certainty of mine resource and waste volumes and it has become apparent

that further land will be required for mining and the placement of additional infrastructure including but not limited to:

- The increased definition or expansion of mining areas in the Firetail, Kings, Queens, Zion and Trinity areas and the addition of Castle Valley mining area. This includes new exploration results and further opportunities likely to be exploited in the life of the mine at Solomon
- Definition of waste rock dumps as a result of detailed scheduling and sequencing providing visibility of footprints required for storage
- An expansion of the water supply infrastructure
- Expansions to the previously defined mining pit areas as a result of addition resource drilling
- Expansion to the footprint of disturbance for tailings storage as a result of more detailed mine planning and tailings volumes
- Inclusion of expanded footprints for key infrastructure to allow for fire breaks and asset protection/management
- Inclusion of expanded footprints for single use roads, separating light vehicle, automated heavy vehicle and manned heavy vehicle,
- Increased footprint of disturbance to support the operation and maintenance of the rail infrastructure
- Topographic and terrain constraints encountered during construction and early mining activities have required Fortescue to reallocate some of the existing approved clearing budget
- The pit boundary now encompasses the Zalamea Groundwater fed pool (excluded from previous impacts by condition 11-1 and 11-2 of MS862 (EPA 2013c).

Table 3 details the Proposal extent and Appendix A includes the shapes files showing the indicative location of the Proposal extent.

Table 3 Physical elements

Element	Location	Propose extent
Mine areas Associated infrastructure including access roads, overland conveyors, stockpile areas, offices etc. Processing and crushing facilities Tailings storage facilities (TSF) Waste rock landforms (WRL) Borefields	Figure 2	Clearing no more than 11,322 ha (in addition to 4,400 ha) within a 33,520 ha Project Development Envelope 1
Borefield	Figure 2	Clearing no more than 700 ha within a 33,712 ha Project Development Envelope 3
Rail Corridor	Figure 2	Clearing no more than 2,373 ha within a 29,257 ha development envelope – (combined) Railway Corridor and Rail Spur Corridor

Operational Elements

Operational elements of this proposal include Table 4:

- An increase to the mine life from 20 years to 35 years (30 years from 2016).
- Additional borefield to supply increased requirements (up to 10 GL/a).
- Additional 5 water bores for the Southern Borefield, increasing the borefield's abstraction to 14 GL/a.

Table 4 Operational Elements

Element	Location	Proposed Extent
Ore processing	Tailing storage facility	Disposal of 7.7 Mm ³ per annum
Water supply	Lower Borefield Error! Reference source not found. Additional bores in Southern Borefield	Abstraction of: <ul style="list-style-type: none"> • up to 10 GL/a in Lower Borefield • increase abstraction in Southern Borefield up to 14 GL/a
Pit depths	Pits	Up to 100 m below ground level (mbgl)

2.3 Timeframe

The Solomon Mine is an operating mine site and will need access to the increased disturbance area by 30 June 2016 to maintain tonnage throughput.

The previous expected operating life was 20 years, which has now extended to 35 years due to the increase in resources discovered.

The Solomon Mine is not a staged proposal and is not a strategic proposal or a derived proposal.

2.4 Approval History

Solomon was referred to the EPA under Part IV of the *Environmental Protection Act 1986* (EP Act) on 19 July 2010 (the Original Proposal). On 16 August 2010, the EPA set a Public Environmental Review (PER) level of assessment.

The EPA completed its assessment of the Original Proposal and released its report and recommendations in March 2011. State Ministerial approval for the Original Proposal was granted in April 2011, via the release of MS 862 (EPA 2011).

A number of changes to the Original Proposal have subsequently been approved including the following:

- under s45C of the EP Act - increased the clearing footprint of the railway component from 1,100 ha to 1,897 ha (13 December 2011)
- under s45C of the EP Act – clearing 5 ha of the PEC ‘Brockman Iron Cracking Clay Communities’ within a 153 ha Project Development Area 2 (21 November 2013).

The amendments in accordance with s45C of the EP Act and other minor amendments (Table 5) are captured in Attachment 1 to MS 862.

Table 5 Previously Approved Project Characteristics

Element	Previously Approved (including amendments)	This Proposal
Total Disturbance - Mines	Up to 4400 ha within the 29818 ha Project Development Area 1, including not more than 5 ha disturbance of the PEC ‘Brockman Iron Cracking Clay Communities’ within the 153 ha Project Development Area 2.	Up to 15722 ha within the 33520 ha Project Development Envelope 1, including not more than 10.3 ha disturbance of the PEC ‘Brockman Iron Cracking Clay Communities’ within the 285 ha Project Development Envelope 2.
Mine pit area	Firetail and Kings – not more than 3630 ha within the 29818 ha Project Development Area 1.	Additional pits included in disturbance figures above.
Total Disturbance - Lower Borefield		Up to 700 ha of disturbance within 33712 ha Project Development Envelope 3
Total Disturbance - Railway	Not more than 1897 ha total disturbance within the 26945 ha (combined) Railway Corridor and Rail Spur Corridor. Of the total disturbance area for the railway, not more than 764 ha is to be permanent disturbance and all other disturbed areas are to be rehabilitated.	Not more than 2373 ha total disturbance within the 29257ha (combined) Railway Corridor and Rail Spur Corridor. Of the total disturbance area for the railway, not more than 1240 ha is to be permanent disturbance and all other disturbed areas are to be rehabilitated.
Dewatering	Up to 25 gegalitres per annum	As approved
Waste rock disposal	• 373 million tonnes disposal to external waste dumps, remainder to in-pit backfilling	Additional waste volumes to be developed.
Final Landform	Backfilling pits	As approved
Tailings storage facility	Tailings disposal in constructed valley pits located near the Kings and Firetail processing facilities.	Tailings disposal in constructed valley pits and in pit storage below the water table
Dewater disposal	• Processing and operational water supply requirements; and • Managed aquifer recharge.	As approved

The Original Proposal was assessed by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). SEWPaC (now Department of the Environment (DoE)) determined the Original Proposal (EPBC 2010/5567) to be a Controlled Action, and that the bilateral agreement between the Commonwealth and Western Australia would apply to the assessment of the Original Proposal. SEWPaC granted approval for the Original Proposal in April 2011.

The Project is also subject to regulation by the Department of Environment Regulation (DER) through Part V of the EP Act, and holds Works Approvals and Licences for the site.

Construction of the mine and associated mine infrastructure has also been the subject of assessment and approval by way of Mining Proposals as required under section 82A(2) of the *Mining Act 1978* (Mining Act). The Mining Act is administered by the Department of Mines and Petroleum (DMP).

Additionally, any increases and changes to dewatering volumes or borefield requirements for the Original Proposal has been addressed through a Section 5C and 26D of the RIWI Act administered by the Department of Water.

Bilateral Agreement

The Bilateral Agreement between the Commonwealth and the State of Western Australia has resulted from the Commonwealth's endorsement of the State's environmental impact assessment (EIA) process. This agreement minimises the duplication of EIA processes for projects that require assessment by both the State and the Commonwealth.

An EPBC referral will be submitted concurrently with this EPA referral to enable the environmental impacts on Matters of National Significance (MNES) to be assessed under the bilateral agreement if appropriate.

3. ASSESSMENT PROCESS

3.1 WA State Environmental Assessment

The referral and environmental impact assessment (EIA) of a project that is likely to have a significant effect on the environment is regulated under Part IV of the EP Act.

The EPA published the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012 to establish the principles and practices of EIA, specifically:

- 1) the referral of a significant proposal or strategic proposal
- 2) the setting of the level of assessment of a significant proposal or strategic proposal
- 3) environmental review and consultation
- 4) EIA of a significant proposal or strategic proposal.

In addition to these administrative procedures, the EPA produces Environmental Assessment Guidelines (EAGs), Post Assessment Guidelines and Environmental Protection Bulletins, to provide more detailed and specific guidance.

The EPA released two EAGs in June 2013, relating to the application of EIA Administrative Procedures:

- EAG No. 8 Environmental Factors and Objectives
- EAG No. 9 Application of a Significance Framework in the environmental impact assessment process.

3.2 Identification of Relevant Factors and Objectives - EAG 8

Environmental Assessment Guideline 8 describes an environmental factor as the part of the environment that may be impacted upon by an aspect of the Project. There are 14 environmental factors that have been selected to be relevant and practical to the EIA process. In addition, there are two integrating factors – rehabilitation and closure and offsets, which are important considerations in determining the environmental acceptability of proposals.

Based on the scale and nature of the Proposal, Table 6 identifies the key environmental factors which may be relevant to the Proposal.

Table 6 Environmental Factors and Objectives – EPA EAG 8

Factor	Objective	Relevance to Proposal
Sea		
Benthic Communities and Habitat	To maintain the structure, function, diversity, distribution and viability of benthic communities and habitats at local and regional scales.	Not relevant – No proximity to marine or coastal environments.
Coastal Processes	To maintain the morphology of the subtidal, intertidal and supratidal zones and the local geophysical processes that shape them.	
Marine Environmental Quality	To maintain the quality of water, sediment and biota so that the environmental values, both ecological and social, are protected.	
Marine Fauna	To maintain the diversity, geographic distribution and viability of fauna at the species and population levels.	
Land		
Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.	Relevant – Section 4.3
Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.	Relevant – Section 4.2
Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	Relevant – Section 4.5
Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.	Minor Relevance – Proposal will not result in any significant impact
Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	Relevant – 4.4
Water		
Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	Relevant – Section 4.2
Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.	Relevant – Section 4.2
Air		
Air Quality	To maintain air quality for the protection of the environment and human health and amenity.	Minor relevance – Proposal will not result in any significant air or dust emissions.
People		
Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable.	Minor relevance – Proposal will not result in any significant impacts or managed under other relevant legislation
Heritage	To ensure that historical and cultural associations are not adversely affected.	
Human Health	To ensure that human health is not adversely affected.	
Integrating Factors		
Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	Relevant – Significant residual impact Section

Factor	Objective	Relevance to Proposal
		4.7.
Rehabilitation and Closure	To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State.	Relevant – Proposal has closure plan for pre-approved project. Needs to be extended to include expansion – Section 4.6

3.3 Significance Framework – EAG 9

In EAG 9, the OEPA detail that it only intends to assess projects with impacts on key environmental factors. Key environmental factors are those where the EPA's objectives may be met, but there is a lack of confidence, data or conditions related to implementation. If there is early confidence that none of the factors are key factors or that another regulatory process can ensure that the EPA objective can be met then that factor will receive no further consideration by the EPA. The proponent is only required to carry out further necessary studies for the preliminary key environmental factors. Refer to Section 5.

3.4 EPBC Act MNES Significant Impact Guidelines

The DoE published the MNES Significant Impact Guidelines 1.1 in 2013.

The purpose of the Significant Impact Guidelines 1.1 is to assist proponents to determine whether their project (referred to as the action) has a significant impact on MNES. This will enable the proponent to decide whether to refer the project to DoE for a decision on whether the project is a 'controlled action' and requires approval by the Australian Government Environment Minister under the EPBC Act. The Significant Impact Guidelines 1.1 outline detailed criteria for which to assess the action against to determine whether or not referral may be required.

A 'significant impact' is defined as:

an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

In determining whether the project will have a significant impact on MNES, all adverse impacts are expected to be considered including both indirect and offsite impacts.

3.5 Stakeholder Consultation

Fortescue has undertaken ongoing stakeholder consultation for the planning, construction and implementation of the Original Proposal, including discussions with the following Western Australian regulatory groups:

- Office of the Environmental Protection Authority (OEPA)

- Department of Environment Regulation (DER, formerly Department of Environment Conservation [DEC])
- Department of Parks and Wildlife (DPaW)
- Department of Mines and Petroleum (DMP)
- Department of Water (DoW).

In relation to this Proposal, Fortescue has spoken directly with the OEPA about its intentions to refer. Feedback provided by OEPA has been considered and, where appropriate, has informed the actions and designs of Fortescue's referral.

The Australian DoE was also consulted for the Original Project and this Proposal. Consultation with the key regulatory agencies will be conducted during the EP Act referral and assessment processes.

Community consultation associated with the Solomon Project has commenced and to date has included the following pastoral lease holders, Native Title Parties and local communities:

- Local authorities (Town of Port Hedland, Shire of Ashburton, Shire of East Pilbara)
- Pilbara Development Commission
- Martu Idja Banyjima (MIB) People Native Title Claimants
- Kariyarra Native Title Claimants
- Eastern Guruma Native Title Claimants
- Palyku Native Title Claimants
- Yindjibarni Native Title Claimants
- Pastoralists (Mulga Downs, Hooley, Hamersley and Mt. Florance stations)
- Community (Paraburdoo, Karratha, Tom Price and South Hedland).

4. PRELIMINARY ASSESSMENT OF FACTORS

4.1 Summary of Environmental Aspects and Impacts

Table 7 summarises the potential environmental aspects and impacts of the Proposal. Those aspects that may be significantly impacted are addressed in more detail below.

Table 7 Summary of Environmental Aspects and Impacts

Aspect/Factor	Evaluation of Potential Impacts
Hydrological Processes and Inland Water Quality	<ul style="list-style-type: none"> - New borefield in Lower Fortescue catchment with abstraction up to 10 GL/a - Removal of Zalamea groundwater fed pool - Additional 5 bores added to Southern Borefield - increasing total abstraction up to 14 GL/a - In-pit tailing storage and in-pit below the water table - Modification of peak water flows via surface water control measures - Modification of drainage and surface water flows may remain at closure due to changes in elevation.
Flora and Vegetation	<ul style="list-style-type: none"> - Disturbance of an additional 12,498 ha within the mine areas, proposed borefields and rail corridor - Clearing of Priority Flora - Minor disturbance of PEC (Brockman Iron Cracking Clays) (5.3 ha) - Increase in disturbance to Robe Pisolite vegetation units - Increase in disturbance of locally or regionally significant vegetation - Increase in weed risks
Terrestrial Fauna	<ul style="list-style-type: none"> - Loss of up to 12,498 ha of fauna habitat - Low potential impact of 11 species of conservation significance - Potential impact on three species of conservation significance (Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat)
Subterranean Fauna	<ul style="list-style-type: none"> - Removal of additional subterranean invertebrate habitat through mining and dewatering activities
Terrestrial Environmental Quality	<ul style="list-style-type: none"> - Mine wastes and low grade ore have been classified as non-acid forming therefore potential for Acid Mine Drainage is low
Closure and rehabilitation	<ul style="list-style-type: none"> - Additional areas of disturbance requiring rehabilitation at end of mine life
Offsets	<ul style="list-style-type: none"> - Compensation for residual adverse impacts

4.2 Hydrological Processes and Inland Water Quality

EPA Objective:

To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.

4.2.1 Studies Completed

Previous studies undertaken as part of the Solomon Project include:

- Hydrogeological Assessment of the Solomon Project (MWH 2010a)
- Solomon Project Groundwater Modelling (NTEC Dec 2010)
- Peer Review and Model Appraisal – Hydrogeological Assessment of Solomon Project (Hydroconcept Dec 2010)
- Bore Completion Report – Solomon Construction Water Supply (MWH, June 2011)
- Results of the Baseline Riparian Vegetation Survey of a Portion of the Kangeenarina – Solomon Project Area (Coffey, Oct 2011d)
- Aquatic Assessment of Kangeenarina Creek, Solomon Project (Coffey 2011e)
- Solomon Project Groundwater Modelling Phase 2 - Draft (NTEC 2011)
- Kangeenarina Creek Pools Hydrological and Hydrogeological Assessment (URS 2012a)
- Solomon Project Kangeenarina Pools Supplementation Programme - Construction and - Early Mining Phases - 2012 to 2013 (URS, 2012b)
- Solomon H3 Hydrological Assessment and Groundwater Operating Strategy (Golder 2012a and Golder 2012b)
- Solomon Project Kangeenarina Creek Geomorphology Study (Lesleighter 2012)
- Updating and Re-calibrating Solomon Groundwater Model (Fortescue 2013a).

4.2.2 Hydrology

Stream flows in the Pilbara region are a direct response to rainfall and are highly seasonal and variable. Most runoff occurs during the period from January to March with typically less runoff during December to April. Episodic flow patterns leave rivers and creeks dry for most of the year with occasional persistent pools where springs occur along watercourses. After heavy rains, rivers often flood over the low sloping topography of the floodplain causing water to move as sheet flow rather than in channelised flows.

The Solomon area is characterised by a landscape of steep hills and ridges, incised drainage channels and downstream alluvial fans that form part of the Fortescue River catchment. The mine areas are typically within open valleys approximately 0.5 km to 2 km wide. Major drainage associated with the Proposal includes the Ashburton River to the south, the Fortescue River to the north and Robe River to the west.

The Solomon Project area contributes to the upper watershed formed by the Lower Fortescue River Catchment and is located at the headwaters of the Millstream Catchment. The Project is primarily associated with three separate surface water drainage systems (Figure 3):

- Zalamea (Zion, South East Flow) – this drainage line flows from the middle and eastern part of the Kings deposit back to the east then through the ranges to the north before discharging into the Fortescue Valley.
- Kangeenarina (Kings, Central Flow) – this drainage line flows from the central portion of the Kings deposit to the west and also from the eastern part of the Queens deposit draining to the east joining in a confluence to flow to the north through Kangeenarina Gorge and discharging into the Fortescue Valley.
- Queens Flow System (West Flow) – this drainage line flows from a portion of the Queens deposit to the west to join Weelumurra Creek near Rio Tinto's Hamersley rail line before flowing to the north to discharge into the Fortescue Valley.

Table 8 details the area of the three surface water catchments in the Solomon Mine area.

Table 8: Solomon Surface Water Catchment Areas

Catchment	Area
Fortescue River Catchment	1,859,803 ha
Kangeenarina Creek	
Total catchment area (upstream of Alluvial Fan)	36,680 ha
Intersect with Solomon Project Area	25,570 ha
Solomon Project Area as a Percentage of Receiving Catchment Area (Lower Fortescue River)	1.37 %
Weelumurra Creek	
Total catchment area	229,500 ha
Intersect with Solomon Project Area	7,490 ha
Solomon Project Area as a Percentage of Receiving Catchment Area (Lower Fortescue River)	0.4 %
Zalamea Creek	
Total catchment area	8,330 ha
Intersect with Solomon Project Area	8,330 ha
Solomon Project Area as a Percentage of Receiving Catchment Area (Lower Fortescue River)	0.45 %

The main local surface water drainage systems include the Kangeenarina Creek and Weelumurra Creek, both of which predominantly shed surface water from south to north towards the Lower Fortescue River. A number of permanent groundwater fed pools occur within these creeks.

The western portion of the Project area is situated within the Millstream Water Reserve, which is a Priority 2 Public Drinking Water Source Area. According to the DoW's Water Quality

Protection Note on Land Use Compatibility in Public Drinking Water Source Areas, mining is compatible (with conditions) in P2 areas (Department of Environment 2004). Tailings storage facilities are acceptable with DoW approval (DoW 2010). Fortescue are proposing to construct a tailing storage facility within the Millstream Water Reserve and are currently consulting with DoW regarding this activity.

4.2.3 Hydrogeology

There are numerous geological units within the vicinity of the Solomon Project varying from Archaean to Tertiary in age, however groundwater occurrence in the region is typically associated with palaeovalley units such as:

- Channel iron deposit (main aquifer)
- Unconsolidated sediments comprised of alluvial, colluvial and detrital deposits associated with valley fill.
- Calcrete deposits originating from carbonate precipitation at palaeo water tables. The existence and thickness of the calcrete deposits is variable within the project area.
- The Paraburdoo Member of the Wittenoom Formation or Wittenoom Dolomite underlying the valley fill deposits.

A shallow aquifer is associated with an alluvial/colluvial sequence of valley fills. The alluvial deposits consist of clays, silts, sands, and gravels, whereas the colluvial deposits are comprised of cobble-sized detritals within a clay matrix. Both alluvial and colluvial deposits are variable in their occurrence both vertically and horizontally. The valley fill sediments form the major unconfined or water table aquifers, although the aquifer may be locally confined or semi-confined by sediments of low permeability.

The water table is interpreted to reflect topography with peak elevations generally associated with topographical highs. Groundwater is generally 5 to 30 mbgl and quality is generally fresh to marginal (i.e. 200 to 3,000 mg/L TDS). Bore yields are variable ranging from 50 to 2,500 kL/day, reflecting the interfingering relationship between the alluvium and colluvium (Johnson and Wright 2001).

Calcrete is a chemical deposit that tends to replace the original sediments at and below the water table. The water productivity of the sediments within the calcrete profile can be an order of magnitude higher than the underlying interbedded sand and clay sediments. Groundwater tends to be fresh to brackish and a bore can yield in excess of 1,500 kL/day.

The Wittenoom Dolomite commonly underlies the main valleys in the Hamersley Range. The dolomitic aquifers in the Wittenoom Formation are considered the primary aquifer in the area, especially where it has been previously exposed and subjected to Karst development resulting in the formation of cavernous areas. The Wittenoom Dolomite is highly transmissive and high yielding particularly in karstic areas where bore yields can reach up to 1,600 kL/day.

The Firetail BID and DID are located in the elevated area associated with the outcropping Brockman Iron Formation to the north of the Kings mining area. The BID mineralisation is located above the water table.

The Kings CID is located in an incised valley and is part of a regional aquifer system containing fresh quality groundwater (<500 milligrams per litre (mg/L) total dissolved solids (TDS)). Using estimated porosity values, the calculated groundwater storage at Kings has been estimated to be approximately 115 GL, representing a storage rate of 3.3 GL/km over the 35 km length of the Kings CID.

4.2.4 Nature and Extent of Impact

Hydrology

As the Proposal represents only a small fraction of the Fortescue River valley catchment area, Fortescue considers that impacts related to surface water can still be managed to meet the EPA's objectives for this factor. In particular, this Proposal does not include mining or infrastructure that extends into new catchment areas. The increase in disturbance within the Kangeenarina catchment area is the highest of the three catchments, but will still be less than 2% of the total area. In the remaining catchments the disturbance equates to less than 2.5% of the total catchment area. This Proposal is therefore not expected to have a detrimental effect on surface water catchments or on surface water flow volumes in the area. Changes to surface water flows may remain at closure due to changes in elevation. Fortescue intends to divert surface water flows around pits to maintain surface water flows as much as possible.

Hydrogeology

Fortescue will continue to provide a supplementary water supply to the Northern Kangeenarina Pools in accordance with approved plans. The Zalamea Groundwater-fed Pools, however now falls within the Zion mine footprint and are likely to be mined as a part of the expansion. Monitoring has shown evidence that the Zalamea pools may not be permanent pools and are only sustained in periods of high rainfall.

Dewatering across the mine area is not expected to significantly change from the original proposal and dewatering will be undertaken in accordance with the approved 25 GL/a required for the Kings mining areas (Queens, Trinity, Zion and Castle Valley).

In addition to the 25 GL/a provided by dewatering, Fortescue requires an average of 35 GL/a to meet peak water demands. The southern and lower borefield's are proposed to meet the additional operating water requirements.

Fortescue has an approved borefield located south of the airport (Southern Borefield) to sustain the long-term groundwater supply required for the Project. Fortescue is proposing to install five additional water bores in the Southern Borefield within the Brockman Iron Cracking Clays PEC. It is estimated that this will increase the groundwater abstraction from the Southern Borefield up

to 14 GL/a. These bores will be constructed and operated in accordance *Southern Borefield TEC/PEC Management and Monitoring Plan – Operation – Solomon Project (SO-PL-EN-0011)* developed and implemented for the previous three bores in the PEC. Investigations regarding yield are currently underway; however the aquifer is expected to have a sustainable yield of more than 14 GL/a.

A production borefield is planned for an area within the Lower Fortescue River valley and will consist of approximately 20 abstraction bores with abstraction up to 10 GL/a. The borefield is situated entirely within the Mt. Florance pastoral lease area. Mt. Florance abstracts groundwater from several shallow bores within the pastoral lease for their water supply. Studies are underway to refine the hydrogeological conceptual model of the area to allow for detailed impact assessments to be undertaken. Final abstraction and borefield layout will be determined by the results of stakeholder engagement with the Mt. Florance pastoralists and the impact assessment.

The aquifer targeted for the Lower Borefield is not currently allocated for any other uses and is not within a Public Drinking Water Source Area. Fortescue is in continued consultation with the DoW regarding its plans for the borefield, and will be seeking appropriate approvals from DoW prior to abstraction.

Fortescue expects that the use of the borefield can be appropriately managed under the RIWI Act.

4.3 Flora and Vegetation

The native flora of Western Australia is protected under the provisions of the *Wildlife Conservation Act 1950* (WC Act), making it an offence to remove or harm any native flora species without approval. If a project is not assessed under Part IV of the EP Act then clearing of native vegetation is controlled under Part V and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Where there is a significant impact on threatened flora, threatened ecological communities or large areas of clearing are required, approval under the EP Act and/or EPBC Act may be required.

EPA Objective:

To maintain representation, diversity, viability and ecological function at the species, population and community level.

4.3.1 Surveys completed

Recent flora and vegetation surveys undertaken for this proposal include:

- Solomon Project: Kings Flora and Vegetation Assessment (ENV 2010).

- Flora and Vegetation Assessment, Solomon Project and Investigator (Coffey Environments 2010a)
- Level Two Flora and Vegetation Assessment, Firetail Mining Area (Ecoscape 2010a)
- *Solomon Project – Airstrip and Rail Re-Alignment Flora, Vegetation and Fauna Assessment*, (Ecoscape 2010b)
- Robe Pisolite Assessment and Targeted *Gompholobium Karijini* (P2) Survey, Solomon Mine Project (Coffey Environments 2011)
- Results of the Baseline Riparian Vegetation Survey of a Portion of the Kangeenarina – Solomon Project Area,(Coffey Environments, 2011d)
- Solomon - Level 2 Flora and Vegetation Summary Report (Ecologia Environment [Ecologia] 2014b, Appendix B).

The Project area lies within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard (1975). The vegetation of this province is typically open, and frequently dominated by Spinifex, Acacia's and occasional Eucalypts. The Proposal includes portions of 11 of Beard's mapping units, which are described in Table 9.

The vegetation to be disturbed for the Proposal does not represent areas of remnant vegetation which are significantly depleted from their Pre-European extent.

Table 9 Pre-European Extent of Vegetation Associations (Beard 1979)

Vegetation association	Pre-European extent (ha)	Current Statewide remaining extent (ha)	Current Statewide remaining extent (%)	Current Pilbara IBRA remaining (%)
565 <i>Eucalyptus</i> open woodland/ <i>Triodia</i> open hummock grassland. Hummock Grasslands, low tree steppe, bloodwood over soft Spinifex	143,438.92	143,438.92	100.00	100.00
82 <i>Eucalyptus</i> isolated trees/ <i>Triodia</i> open hummock grassland. Hummock Grasslands, low tree steppe, snappy gum over <i>Triodia wiseana</i>	2,565,901.28	2,565,901.28	100.00	100.00
18 <i>Acacia</i> open shrubland. Low woodland, mulga (<i>Acacia aneura</i>)	19,892,304.84	19,890,275.39	99.99	100.00
175 <i>Aristida</i> tussock grassland. Short bunch grassland – savanna/grassplain (Pilbara)	526,206.13	524,861.08	99.74	99.99
111 <i>Eucalyptus</i> sparse mallee shrubland/ <i>Triodia</i> open hummock grassland. Hummock grasslands, shrub steppe, <i>Eucalyptus gamophylla</i> over	762,963.54	762,963.54	100.00	100.00

Vegetation association	Pre-European extent (ha)	Current Statewide remaining extent (ha)	Current Statewide remaining extent (%)	Current Pilbara IBRA remaining (%)
hard Spinifex				
29 <i>Acacia</i> isolated clumps. Sparse low woodland, mulga, discontinuous in scattered groups	7,903,991.46	7,903,991.46	100.00	100.00
173 <i>Acacia</i> sparse shrubland/ <i>Triodia</i> open hummock grassland. Hummock grasslands, shrub steppe, kanji over soft Spinifex and <i>Triodia wiseana</i> on basalt	1,421,375.74	1,421,375.74	100.00	100.00
93 <i>Triodia</i> open hummock grassland. Hummock grasslands, shrub steppe, kanji over soft Spinifex	3,044,308.21	3,044,249.00	100.00	100.00
619 <i>Eucalyptus</i> woodland. Medium woodland, river gum (<i>Eucalyptus camaldulensis</i>)	119,158.56	119,088.71	99.94	100.00
151 <i>Eucalyptus</i> open woodland/ <i>Triodia</i> open hummock grassland. Sedgeland, sedges with open low trees, coolibah over various sedges	154,352.88	154,273.35	99.95	100.00
562 <i>Acacia</i> woodland. Mosaic. Low woodland, mulga in valleys/Hummock grasslands, open low tree steppe, snappy gum over <i>Triodia wiseana</i>	103,606.82	103,606.82	100.00	100.00

The Project area lies predominantly within the Hamersley subregion, which is described as Mulga low woodland over bunch grasses in valley floors and *Eucalyptus leucopholia* over *Triodia* on the ranges (Ecologia 2010a).

The vegetation within the Solomon Mine footprint has been mapped by Beard (1975) and the majority is described as Vegetation Associations 82.3:

- *Eucalyptus* open woodland / *Senna* mixed sparse shrubland / *Triodia* open hummock grassland.

4.3.2 Threatened and Priority Species and Communities

One Threatened Ecological Community (TEC) Themeda Grasslands on Cracking Clays, and one Priority Ecological Community (PEC) Brockman Iron Cracking Clay, were identified within the southern portion of the Project Area.

The PEC and TEC extend on an east-west alignment to the south of the airport, along the base of a broad valley within the Hamersley Range. The TEC is listed by the DEC as vulnerable, but

is not listed under the EPBC Act. The majority of the TEC occurs within Hamersley Station, and is grazed by livestock. The vegetation condition of the area of the TEC assessed by Ecoscape (2010a) ranged from degraded to very good, with only two relevés assessed as very good.

One area of groundwater dependent vegetation was identified within the Zalamea Gorge within the Zion area of the Proposal.

No Threatened Flora has been recorded within the Study Area.

The following Priority Flora species were identified within the proposed development envelopes (Figure 4) during surveys undertaken prior and subsequent to the assessment of the Original Proposal:

- *Aristida jerichoensis* var. *subspinulifera* (Priority 1)
- *Paspalidium retiglume* (Priority 2)
- *Gompholobium Karijini* (Priority 2)
- *Eremophila magnifica* subsp. *Magnifica* (Priority 3)
- *Acacia effuse* (Priority 3)
- *Bulbostylis burbridgeae* (Priority 4)
- *Goodenia nuda* (Priority 4)
- *Ptilotus mollis* (Priority 4)
- *Rhynchosia bungarensis* (Priority 4)

4.3.3 Nature and extent of impact

Aspects of the proposal that may affect flora and vegetation include:

- Clearing of vegetation for pit expansions, infrastructure, waste rock dumps, water supply infrastructure, tailings dam, roads and access tracks, firebreaks, rail operations and maintenance
- Groundwater drawdown for dewatering for pits and for water supply may affect groundwater dependent vegetation
- Alterations and disruptions to surface water flows may affect vegetation associations dependent on surface water
- Ignition sources such as machinery and generators may increase fire risk
- Vehicle movements, mining and waste rock dumps may generate dust which may smother native vegetation
- Increased vehicle and material movements may increase the spread of weeds.

Priority species have been mapped within and outside the disturbance footprint (Figure 4).

Approximately 5.3 ha of the borefield and connecting tracks are located within the PEC. This will

increase the disturbance within the PEC to 10.3 ha. It is unlikely that their disturbance (Table 10) will alter the conservation status of these species or communities.

Table 10 Impacts on Environmental Values

Values	Nature of Impact	Quantum of impact	Significance
PEC - Brockman Iron Cracking Clay	Five bores and connecting roads	5.3 ha of disturbance of 12,413 ha PEC	0.04%
<i>Gompholobium karjini</i> (P2)	Removal of up to 1,027 individuals	Well represented in the region	Not significant
<i>Goodenia nuda</i> (P4).	Removal of up to 47 individuals	Well represented in the region	Not significant

A level 2 flora and vegetation survey is currently underway which will provide a summary of any areas not previously surveyed and a comprehensive review and compilation of previous surveys undertaken for the Solomon Project.

Groundwater drawdown will occur around the pits and the borefields. The vegetation in these areas is not groundwater dependent (Ecoscape 2010a). Changes to surface water flow regimes will occur as a result of placement of infrastructure, but this will be managed to maintain ecological flows wherever possible to maintain riparian vegetation.

The management of fire, dust and weeds is included in the mine operations Environmental Management plans.

Vegetation Condition

Vegetation condition within the areas is generally considered to be in good to very good condition. However some localised areas, particularly along creeklines and adjacent to cleared areas, have been significantly degraded by weed invasion (Buffel Grass **Cenchrus ciliaris*) and grazing and are considered to be in poor to degraded condition (Coffey 2010a). Some areas of Mulga in the rail corridor have been subjected to grazing and consequently these areas were found to be in poor to very poor condition. The low stony hills in the rail corridor were considered to be in good to very good condition.

Given the large area of disturbance included in the Proposal, there is an increase in the area that may be affected by the spread or introduction of weeds. The spread of weeds is a potential detrimental environmental effect identified by the EPA in their assessment of the Original Proposal. However a large component of weed (particularly *C. ciliaris*) invasion has been as a result of pastoralism and grazing, rather than mining.

Fortescue has developed and implemented appropriate weed management measures (as identified in the Weed Management Plan (45-PL-EN-0013)) to manage this issue and these will continue to be implemented.

4.4 Terrestrial Fauna

All fauna species in Western Australia are protected under the WC Act, making it an offence to remove or harm native fauna species without approval. If a project has the potential to disturb habitat or threaten a population of native fauna, this disturbance may require assessment under the EP Act. Where EPBC Act listed threatened species are present within the proposed disturbance area, referral under the EPBC Act is likely to be required.

The EPA objective for fauna is:

To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

4.4.1 Surveys completed

Recent fauna surveys and investigations within the Solomon Project Area have been assessed within the following reports:

- Level 2 Terrestrial Vertebrate Fauna Assessment for the Solomon Project (Coffey Environments 2008)
- Solomon Project – Firetail, Short-Range Endemic Invertebrate and Habitat Assessment (Ecologia 2010a)
- Short Range Endemic Invertebrate Survey of Solomon Project: Kings Area and Reference Sites (Phoenix Environmental Sciences 2010).
- Solomon Project – Airstrip Fauna Assessment, (Ecoscape 2010c)
- Vertebrate Fauna and Fauna Habitat Assessment for the Firetail Project (Ecoscape 2010d)
- Level 1 Vertebrate Fauna Assessment – Solomon Rail Project (Coffey Environments 2010b)
- Solomon Project: Kings Area Vertebrate Fauna Assessment (Valley of the Kings, Valley of the Queens, Trinity and Zion) (Ecologia 2010b)
- Targeted Surveys – Northern Quolls, Mulgara and Pilbara Olive Pythons, Solomon Rail Project (Coffey Environments 2011a)
- Targeted Surveys – Northern Quolls and Pilbara Leaf-Nosed Bats (Coffey 2011b)
- Solomon Mine Annual Conservation Significant Fauna Monitoring Report 2012 (Ecologia 2013)
- Solomon Iron Ore Project - Rail Conservation Significant Fauna Monitoring 2012, Ecologia Environment (2013a)
- Solomon – Vertebrate and SRE Fauna Survey (Ecologia 2014a)
- Solomon - Vertebrate Fauna and SRE Invertebrate Fauna Survey Summary Report (Ecologia 2014b, Appendix C)
- Solomon Mine Annual Conservation Significant Fauna Monitoring Report (Ecologia 2014c)

4.4.2 Threatened and Priority Species

There is a potential for fourteen species of conservation significance to occur within the Project area.

Two threatened conservation significant vertebrate fauna species have been observed or recorded from secondary evidence within the Project Development Envelopes and identified as occurring within or periodically using the Proposal area (Ecologia 2010a):

- Pilbara Olive Python (*Liasis olivaceus barroni*) – EPBC Act (Vulnerable); Wildlife Conservation Act (Schedule 1)
- Northern Quoll (*Dasyurus hallucatus*) – EPBC Act (Endangered); Wildlife Conservation Act (Schedule 1)

The following Priority Species of fauna were observed or recorded from secondary evidence within the Project Development Envelopes (Figure 5):

- Australian Bustard (*Ardeotis australis*) – Priority 4
- Barking Gecko (*Underwoodisaurus seorsus*) Priority 1
- Blind Snake (*Ramphotyphlops ganei*) – Priority 1
- Brush-tailed Mulgara (*Dasycercus blythi*) - Priority 4
- Bush Stone-curlew (*Burhinus grallarius*) - Priority 4
- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (Migratory).
- Ghost Bat (*Macroderma gigas*) – Priority 4
- Rainbow Bee-eater (*Merops ornatus*) – EPBC Act (Migratory)
- Peregrine Falcon – (*Falco peregrinus*) - Schedule 4
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4

One foraging Pilbara Leaf-nosed Bat was recorded during the 2013 monitoring programme (Ecologia 2014a) from one site located in the Queens mining area and from one control site approximately 10 km south-west of the proposed disturbance area. A foraging call was also recorded from this control site during the 2012 monitoring programme. All of the recorded calls are in proximity (within 5 km) to the Weelumurra Creek which is located to the west of the Solomon Mine. No day or maternal roost cave has been recorded from the site and therefore there are no Pilbara Leaf-nosed Bats inhabiting the proposal area.

Based on a broad landform assessment and subsequent habitat characterisation of the Proposal area, it was estimated that approximately 40,731 ha of suitable habitat (2,574 ha of potential denning habitat and 38, 157 ha of suitable foraging habitat) for the Northern Quoll was present within areas surveyed. Additionally, twenty one Northern Quolls have been identified

during the twelve surveys undertaken over the past five years (eight within or near the mine footprint, and thirteen within or near the rail corridor).

Short-range endemic fauna (SRE) studies have identified five potential SREs in habitats that were characteristic of the surrounding area so populations would not be significantly impacted by the project.

A Level 2 terrestrial vertebrate fauna and SRE survey is currently underway which will provide a summary of any areas not previously surveyed and a comprehensive review and compilation of previous surveys undertaken for the Solomon Project.

4.4.3 Nature and Extent of Impact

The Proposal lies adjacent to areas previously assessed and approved for mining operations and rail infrastructure. The Proposal involves an increase in the current approved area of disturbance within the project disturbance envelopes (shown in Figure 2) from 6,297 ha to 18,795 ha. This area contains fauna habitat, including some habitat that may be utilised by conservation significant fauna. This clearing may result in mortalities of some conservation significant fauna species, and decrease in a faunal assemblage or habitat fragmentation.

Since assessment of the Original Proposal, Fortescue has conducted more detailed habitat mapping for the Northern Quoll (Fortescue 2014a). This has facilitated refinement of the broad landform based habitat categories and ultimately enabled Fortescue to reduce the level of conservatism previously applied to impact assessment for the Northern Quoll.

Based on refined habitat mapping, approximately 40,731 ha of potentially suitable Northern Quoll habitat (approximately 2,574 ha of potential denning habitat and approximately 38,157 ha of suitable foraging habitat) has been identified. This Proposal is likely to result in disturbing approximately 92 ha of potential denning habitat and approximately 2,652 ha of suitable foraging habitat. This is in addition to the Original Proposal approved impact, which has been redefined in recent mapping as approximately 34 ha of potential denning habitat and approximately 3,283 ha of suitable foraging habitat. The proposed disturbance of the Proposal is approximately 12 % of the total mapped Northern Quoll habitat (approximately 3.6 % of potential denning habitat and approximately 7 % of suitable foraging habitat).

Records from the Proposal area, together with a previous record of a Pilbara Olive Python in a similar location in the Kings mining area, suggests that a local population may be supported by the waterholes in the area. The habitats in the Proposal area are similar to habitats at control sites and comprise major creeklines with surface water. Approximately 8,107 ha of potentially suitable foraging habitat for the Olive Python (Pilbara subspecies) has been mapped by Fortescue in the Solomon region. The Proposal is likely to result in the removal of approximately 4.5% of potentially suitable foraging habitat for the Olive Python (Pilbara subspecies).

Observations of the SRE habitat surrounding the Project area and review of aerial imaging suggest that habitats are not unique to the area and that the series of gullies and drainage

channels from deep gorges are characteristic of the whole Hamersley Range. Therefore SRE habitats are unlikely to be restricted to the Project area.

Fortescue has prepared a Conservation Significant Fauna Management Plan (45-PL-EN-0027) (Fortescue 2013) that addresses potential environmental impacts associated with the Proposal. A series of management objectives with respect to mitigating potential environmental impacts on fauna has been developed.

4.5 Subterranean Fauna

EPA Objective:

To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

4.5.1 Surveys completed

Subterranean fauna within the Solomon Project Area have been assessed within reports listed below:

- Solomon Project: Kings Deposits Subterranean Fauna Survey and Assessment (Subterranean Ecology Pty Ltd 2011)
- Troglafauna Assessment for the Solomon Project: Firetail Deposits (Bennelongia Pty Ltd 2010)
- Solomon Iron Ore Project: 30 Month Troglafauna Report at Kings Mine (Bennelongia Pty Ltd 2013)
- Solomon Life of Mine: Troglafauna Assessment (Bennelongia Pty Ltd 2014, Appendix D)
- Stygofauna Assessment for the Solomon Project (in prep) (Bennelongia Pty Ltd 2014).

4.5.2 Threatened and Priority Species

The Firetail deposit is above the water table and was identified to host high troglafauna diversity, with 45 species recorded. Of these, only four are not known from outside the pit area.

The subterranean fauna community within the Kings Mine area is considered to have high diversity and abundance. At the time of assessment, five of the 17 stygofauna recorded had the potential to be restricted to the CID deposit, while 22 of the 27 troglafauna species recorded in the Study Area had the potential to be restricted to the area. The Zion deposits within the Kings mine area were identified as containing a good representation of the subterranean fauna identified in the area.

The Regional Survey sampled seven reference areas situated in similar geological and/or hydrological settings within 25 km of the Kings and Firetail deposits, including Castle Camp, Mt Florance, Sheila Valley East and West, Serenity, Kangeenarina Creek, and Weelumurra Creek.

Twenty-two (22) species of stygofauna and 14 species of troglafauna were collected, of which nine stygofauna and five troglafauna species had been recorded during the 2010 Baseline Survey of Kings. The Regional Survey did not detect any of the troglafauna species recorded during the 2010 Baseline Survey of Firetail (Subterranean Ecology 2011).

In a more recent study (Bennelongia 2013), 81 troglafauna species were collected from the Kings Mine including Zion deposit. Eleven (13%) of them are known only from the mine pits or proposed mine pits, which is typically of the ratio of 'restricted' troglafauna species at approved mine pits and represents a substantial drop in the ratio of restricted species at the time of the Public Environmental Review (68%). The monitoring program has, therefore, both improved knowledge of troglafauna populations in the region and demonstrated that wider habitat connectivity exists.

4.5.3 Nature and Extent of Impact

The proposed extension of the Firetail deposit is not expected to impact stygofauna as the deposit is located above the groundwater table and therefore no dewatering is required,

The remaining mining areas in the Proposal such as Kings, Trinity, Queens, Zion and Castle valley have the potential to directly impact stygofauna in areas that require dewatering. The drawdown effects of dewatering within the Proposal area will be largely restricted to the immediate mining footprint. All of the species recorded within the area of predicted drawdown associated with the Proposal are also known, or considered highly likely, to occur in locations not impacted by mining and associated activities. Additionally, habitat characterisation and regional stygofauna sampling suggest that the stygofauna habitat in the Proposal area is connected with stygofauna habitat in the surrounding area.

No stygofauna information is available for the Lower Borefield. In order to address this, a stygofauna trapping program is underway.

Results of sampling in the proposal area have identified that the proposed mining areas contain populations of troglafauna that will be impacted by habitat removal from mining, but has demonstrated that wider habitat connectivity indicates that these species are not restricted to the areas to be mined.

4.6 Rehabilitation and Closure

EPA Objective:

To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without acceptable liability to the State.

Following closure of the Solomon Project, it is likely the Solomon mining areas will revert to the original land use as Unallocated Crown Land (UCL).

The Original Proposal had approval to disturb approximately 4,400 ha for mining activities and the permanent alteration of some landscapes in the area. Fortescue takes an integrated approach to mine planning to achieve effective and best management practices for progressive mine rehabilitation, decommissioning and closure and to ensure that the areas of mine disturbance are left in a stable, non-polluting and ecologically sustainable form.

In accordance with Condition 14-1 of MS 862, Fortescue has submitted ongoing Mine Closure Plans (MCPs) for the Solomon Project, with the latest being in October 2013 (Fortescue 2013a).

Previous versions of the MCP have addressed the actions to be undertaken in the event of unplanned closure prior to completion of the Project. The latest version of the MCP contains mine pits for Kings and Firetail, but does not include mining at Queens.

This Proposal includes new pits, WRLs, TSFs and other storage dumps, access roads, borefield and associated mining infrastructure. Potential issues during closure include reinstating surface water flows and groundwater systems where possible, maintaining groundwater-fed pools that have not been removed by mining and landforms rehabilitation. Changes to surface water flows may remain at closure due to changes in elevation.

Fortescue considers that closure of the features included in this Proposal can be managed under the MCP, and other than the possibility of changes to surface flows at closure, this proposal does not result in additional complexities in terms of closure that were not already considered to be part of the Original Proposal.

4.7 Offsets

EPA Objective:

To counterbalance any significant environmental impacts or uncertainty through the application of offsets.

Fortescue has prepared a Fauna Management Plan to address Conditions 12.1 and 12.2 of MS862 and Condition 3 of EPBC Act approval 2010/5567, which has been approved by the EPA and SEWPaC (now DoE). Section 4 of the EPBC Act approval states that Fortescue must

not commence operation until the Minister has approved the Threatened Fauna Offset Plan. This plan was approved prior to commencing ore processing activities.

Offsets for this Proposal will be determined using EPA guidance including:

- Environmental Protection Bulletin No. 1: Environmental Offsets – Biodiversity (EPA, 2010)
- Position Statement No. 9: Environmental Offsets (EPA, 2006)
- Guidance Statement No. 19: Environmental Offsets - Biodiversity (EPA, 2008).

5. APPLICATION OF SIGNIFICANCE FRAMEWORK – EAG 9

The EPA uses a 'Significance Framework' to determine the likely significance of a proposal and to make decisions throughout the EIA process – from its decision on whether or not to assess a proposal, through to its recommendations to the Minister for Environment on whether or not a proposal should be implemented, and the recommended implementation conditions.

Where EPA objectives for a factor can be met, then the proposal is considered unlikely to have a significant impact on the environment. Where a proposal may or may not meet one or more of the EPA objectives, then the proposal is likely to have a significant impact on the environment.

As outlined in Section 3.2, the preliminary key environmental factors identified as likely to be impacted by the Proposal are as follows:

- Flora and Vegetation
- Terrestrial Fauna
- Subterranean Fauna
- Hydrological Processes
- Inland Waters Environmental Quality
- Rehabilitation and Closure
- Offsets.

For referred proposals, the OEPA conducts a significance assessment in line with the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012* to determine whether the potential impacts on environmental factors will require formal assessment under the EP Act. The criteria considered in this significance assessment were applied to the Project to determine the need for a referral to the OEPA (Table 11).

Table 11 Assessment of the Significance of the Project against the OEPA significance criteria

EPA Significance Criteria	Assessment of Project
Values, sensitivity and quality of the environment which is likely to be impacted	<ul style="list-style-type: none"> - Vegetation is well represented outside of the Project area - Maximum impact to Beard vegetation associations is only 0.1 % of remaining extent - All Beard vegetation associations have >99.7 % of their pre-European extent remaining - Locally and regionally significant vegetation expected to be similar to other restricted vegetation in the region - Priority Flora are well represented outside of the Project area - Fauna habitats are well represented outside the Project area - Species are generally highly mobile - Subterranean fauna habitat expected to be connected to similar habitat outside of the Project area.
Extent (intensity, duration, magnitude and geographic footprint) of the likely impacts	<p>The Project requires disturbance of 12,498 ha. This includes the following direct impacts on matters of conservation significance:</p> <ul style="list-style-type: none"> - Clearing of Priority Flora - Removal of 92 ha of potential denning habitat and approximately 2,652 ha of suitable foraging habitat for Northern Quoll

EPA Significance Criteria	Assessment of Project
	<ul style="list-style-type: none"> - Clearing will disturb approximately 0.04 % of PEC and activities will not have indirect impacts - Additional disturbance of 1.63 ha of Robe Pisolite vegetation units - Increase in disturbance to Robe Pisolite vegetation units - Groundwater abstraction of up to 10 GL/a, from a borefield in Lower Fortescue catchment.
Consequence of the likely impacts (or change)	Disturbance is not likely to result in any reduction in the local and regional availability of habitat and extent of significance species and vegetation.
Resilience of the environment to cope with the impacts or change	The Proposal area already contains a large working mine with several pits and associated infrastructure. The area is subject to climate and weather extremes and vegetation, flora and fauna are generally well adapted to these environmental extremes.
Cumulative impact with other projects	There is a number of operating Iron Ore mines in the Pilbara to the south of the Fortescue River. The Solomon Mine is located to the west of the majority of these and is the furthest from the Fortescue Marsh and to the north of Karijini National Park. Given its distance from other mines in the region there are not expected to be any cumulative impacts on the environment.
Level of confidence in the prediction of impacts and the success of proposed mitigation	Substantial investigations, studies, modelling and planning have been undertaken by Fortescue to ensure that the required footprint of the Proposal is minimised in areas of conservation significance. Fortescue has experience in iron ore mining in the region and has well established practices around environmental management and mitigation.
Objects of the Act, policies, guidelines, procedures and standards against which a proposal can be assessed	All relevant policies, guidelines, procedures and standards have been considered in the assessment of the environmental value of the area.
Presence of strategic planning policy framework	Not Relevant. The Project is not a Strategic Proposal.
Presence of other statutory decision-making processes which regulate the mitigation of the potential effects on the environment to meet the EPA's objectives and principles for EIA	<p>Aspects of the Project able to be appropriately assessed and managed through the following regulatory mechanisms:</p> <ul style="list-style-type: none"> - Impacts due to Prescribed premises – Part V of the EP Act - Consent for the Impact of Heritage Sites – Section 18 of the AH Act - Impacts of groundwater extraction – RIWI Act - Air Quality – Part V of the EP Act - Human Health – <i>Health Act 1911</i> - Rehabilitation and Closure – Mining Act
Public concern about the likely effect of the proposal, if implemented, on the environment.	Community Stakeholder and Agency consultation was undertaken for the Original Proposal. Community interest was not high regarding the Original Proposal.

6. MANAGEMENT APPROACH

6.1 Environmental Management System

Fortescue operates under an Environmental Management System (EMS) which contains numerous environmental management plans (EMPs) for the management of environmental impacts for each aspect of its operations. Unless otherwise stated, EMPs are reviewed every five years, or as required for environmental approval condition compliance.

Environmental management plans that Fortescue will use to manage this proposal are listed in Table 12:

Table 12 Environmental Management Plans

Environmental Management Plan	Document Number
Borrow Pit Management Plan	45-PL-EN-0018
Chemical and Hydrocarbon Management Plan	45-PL-EN-0011
Conservation Significant Fauna Management Plan	100-PL-EN-0022 (under assessment by the EPA and DoE)
Cultural Heritage Management Plan	45-PL-HE-0002
Exploration Environmental Management Plan	E-PL-EN-0002
Fauna Management Plan	45-PL-EN-0027
Bushfire Management Plan	100-PL-EM-0009
GHG Emissions and Energy Reporting Management Plan	100-PR-GH-0001
Groundwater Management Plan	100-PL-EN-0029
Mine and Rail Dust Management Plan	45-PL-EN-0030
Mine and Rail Noise Management Plan	100-PL-EN-0028
Solomon Rail Project Mulga Management Plan	SO-PL-EN-0001
Rehabilitation and Revegetation Management Plan	100-PL-EN-0023 (under assessment by the EPA)
Significant Flora and Vegetation Management Plan	45-PL-EN-0017
Subterranean Fauna Survey Plan	45-PL-EN-0010
Surface Water Management Plan	100-SW-EN-0020, 45-PL-EN-0024 (under assessment by the EPA)
TEC/PEC Management and Monitoring Plan	SO-PL-EN-0011
Waste Management Plan	45-PL-EN-0014
Weed Management Plan	45-PL-EN-0013

6.2 Principles of Environmental Protection

Table 13 describes how the Principles of Environmental Protection have been addressed in this Proposal.

Table 13 Principles of Environmental Protection

Principle	Consideration given in this Proposal
<p>1. 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: Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment. An assessment of the risk-weighted consequences of various options.</p>	<p>Fortescue has conducted scientific studies to understand the project area and the potential risks to the environment The proposal has sought to avoid, minimise and mitigate environmental impacts Fortescue acknowledges the sensitivity of the Fortescue Valley and is proposing to monitor impacts to avoid and minimise environmental degradation</p>
<p>2. Intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</p>	<p>The Fortescue proposal meets the principle of intergenerational equity by ensuring the health of the environmental values, maintaining ecological functions for future generations, whilst minimising any impacts to the environment</p>
<p>3. Conservation of biological diversity and ecological integrity. Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<p>The conservation of biological diversity and ecological integrity was a fundamental consideration in the assessment of this proposal. Clearing has been avoided or minimised wherever possible and infrastructure sited away from ecologically significant areas.</p>
<p>4. Improved valuation, pricing and incentive mechanisms Environmental factors should be included in the valuation of assets and services. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentives structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.</p>	<p>Environmental factors were considered when evaluating siting of facilities such as the tailings storage facility, waste dump landforms and topsoil storage. Management has been set in place for construction and operations to minimise environmental impacts. Mine planning will take into account progressive rehabilitation and minimisation of release of dust, noise and contamination into the environment.</p>
<p>5. Waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</p>	<p>Waste management is addressed in construction and operations management.</p>

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Figure 1

Solomon Mine - Regional Location



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LOCATION MAP



LEGEND

- FMG Mines
- Towns
- Principal Road
- Secondary Road
- Railways
- Watercourses
- Fortescue Marsh
- National Park



SOLOMON MINE REGIONAL LOCATION

Requested By: Amy Barker
 Drawn By: Sacha Fielden
 Revised By: sfielden
 Approved By: Undraa George
 Scale: 1:2,000,000
 Coordinate System: GDA 1994 MGA Zone 50
 Document Name: SO_MP_EN_0294.001r2

Date: 30/06/2014
 Size: A4P
 Revision: 2
 Confidentiality: 1

Data Source(s):
 Landsat 2005 Imagery, Topography, Geoscience Australia, 2013
 National Parks, Landgate, 2014

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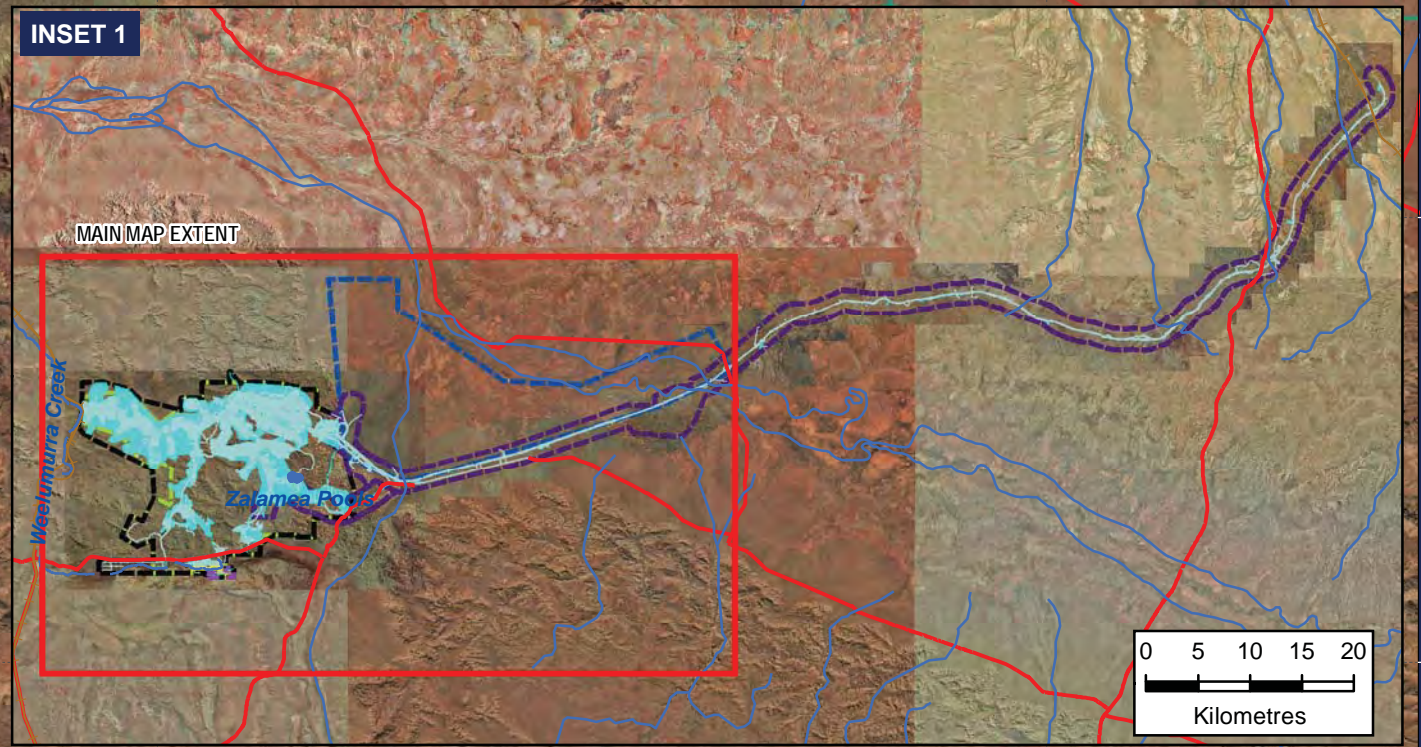
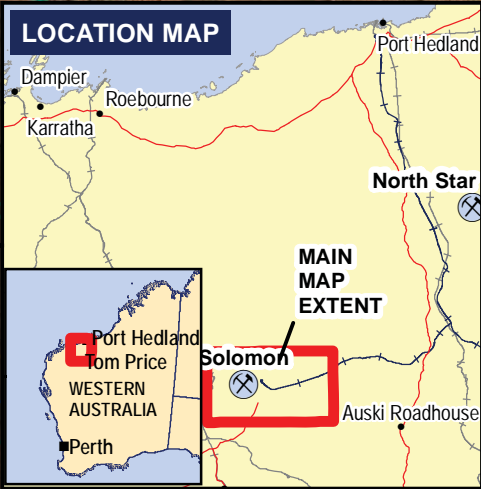
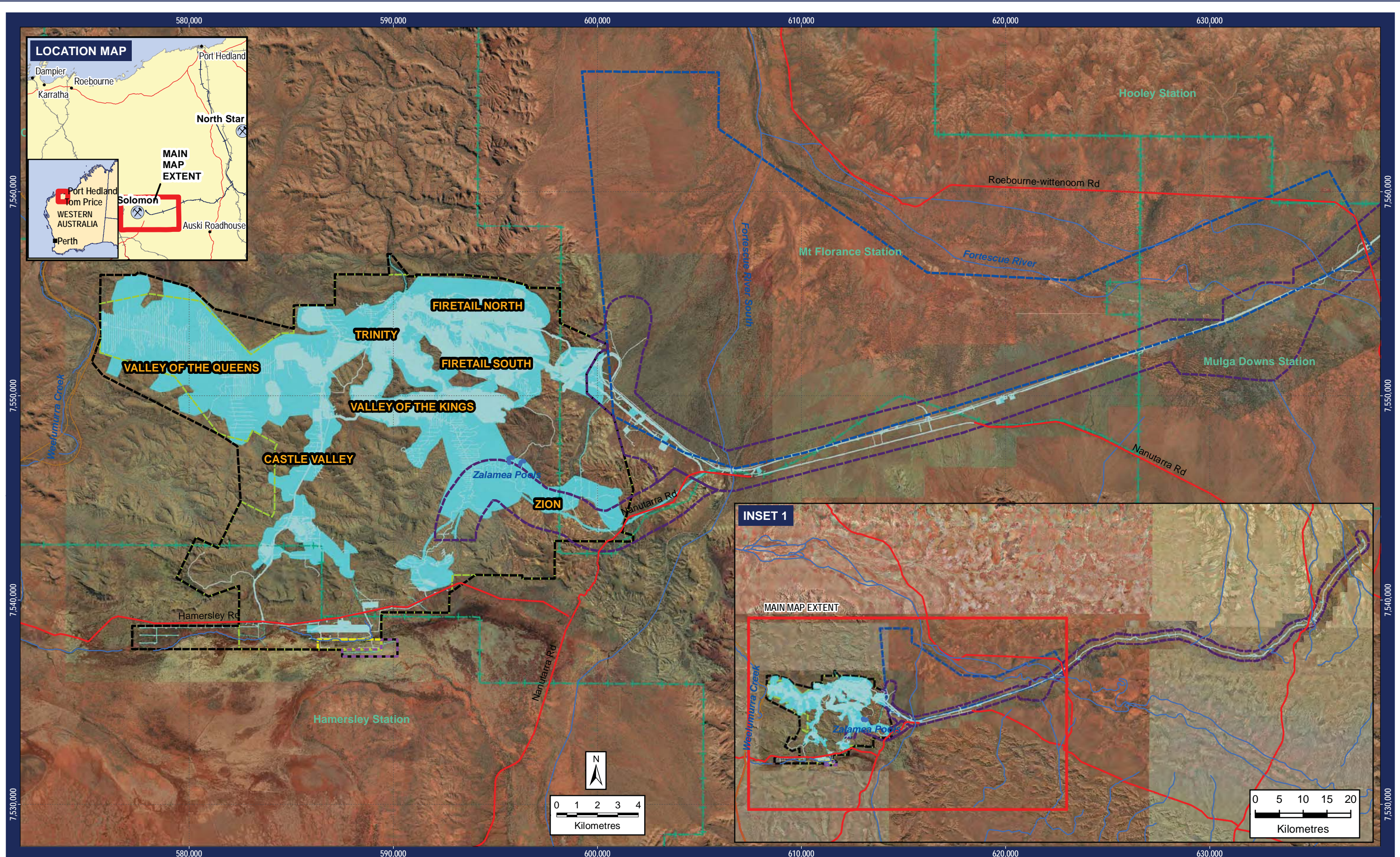
Figure 2

Solomon Mine – Indicative Layout of the Proposal Area



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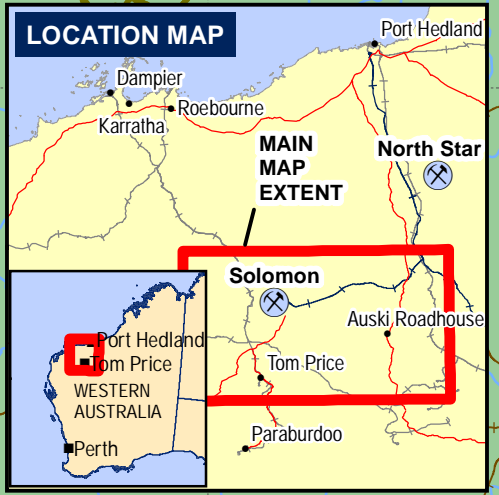
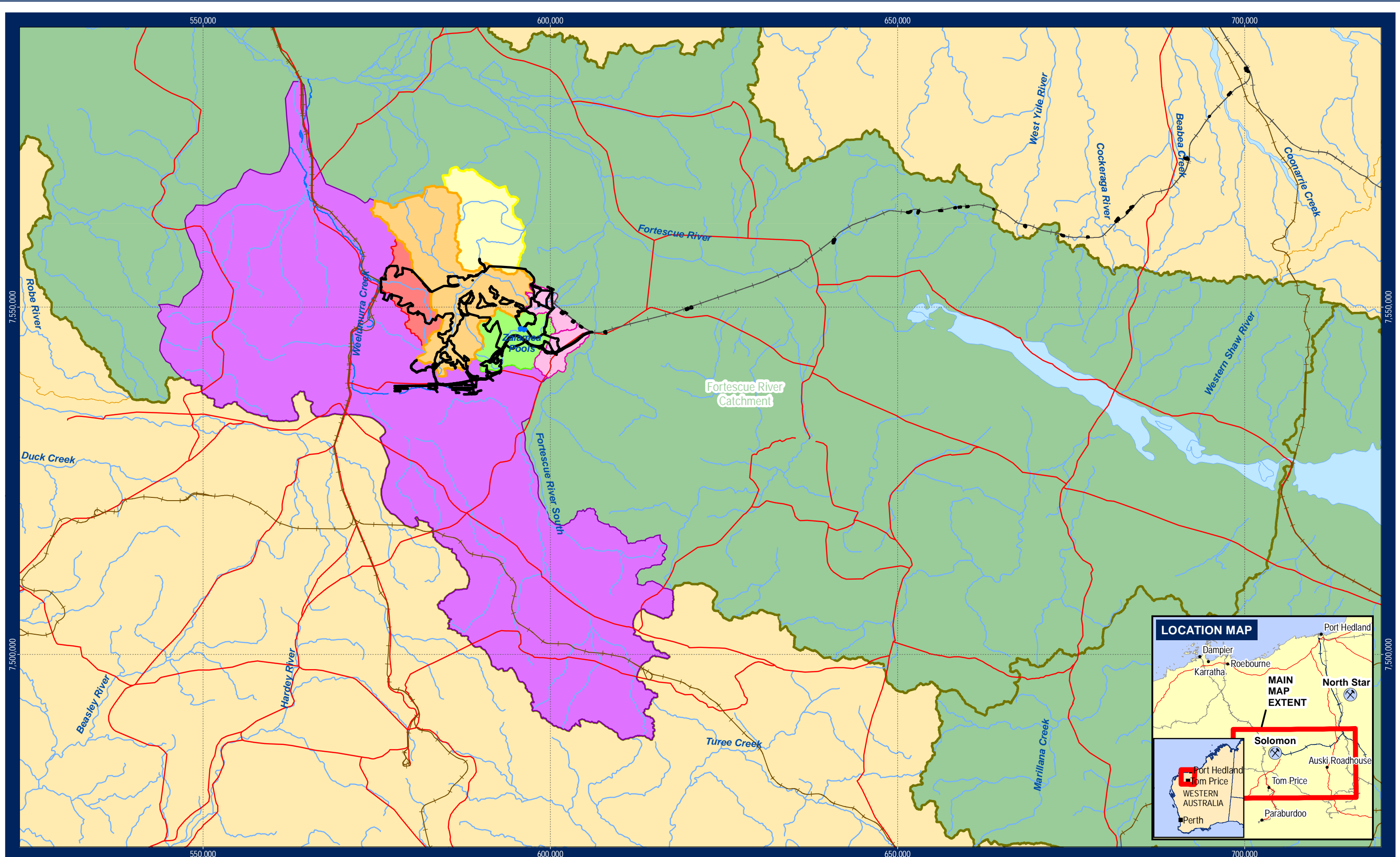


LEGEND <ul style="list-style-type: none">Roads3rd Party RailMajor DrainageZalamea PoolsCurrent and Approved Disturbance to June 2016Pastoral Leases (Excluding Easements)	<ul style="list-style-type: none">Proposed Project Development Envelope 1Proposed Project Development Envelope 2 ExtensionProposed Project Development Envelope 3Indicative Mine and Rail Footprint	<ul style="list-style-type: none">Project Development Envelope 1Project Development Envelope 2Rail and Rail Spur Corridor	<p>Requested By: Amy Barker Drawn By: Sacha Fielden Revised By: ugeorge</p> <p>Scale: 1:170,000 Coordinate System: GDA 1994 MGA Zone 50 Document Name: SO_MP_EN_0294.002r6</p> <p>FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.</p>	<p>Date: 7/07/2014 Size: A3L Revision: 6 Confidentiality: 1</p>	<p>SOLOMON MINE LAYOUT OF THE PROPOSAL AREA (Indicative)</p> <p> Fortescue Metals Group Ltd The New Force in Iron Ore</p>
---	--	---	--	---	---

Figure 3

Surface Water - Catchments

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LEGEND

— FMG Rail Alignment	Indicative Life of Mine Disturbance Footprint	Weelumurra Catchment Boundary
— 3rd Party Rail	Kangeenarina Creek Solomon Catchment	Fortescue River Catchment
— Road	Lower Fortescue River (Upstream of Solomon Rail)	Basin Catchment Boundary
— Water course	Queens Solomon Catchment	
□ Zalamea Pools	Zalamea Creek Solomon Catchment	
□ Water area	Kangeenarina Creek Lower Catchment	

0 5 10 15 20
Kilometres

Data Source(s):
Topography, Geoscience Australia, 2013,
Basins catchments, DoW, 2013. All other data, FMG, 2014.

Requested By: Amy Barker
Drawn By: Sacha Fielden
Revised By: ugeorge

Date: 7/07/2014
Size: A3L
Revision: 5
Confidentiality: 1

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**SOLOMON MINE
SURFACE WATER**

Fortescue Metals Group Ltd
The New Force in Iron Ore

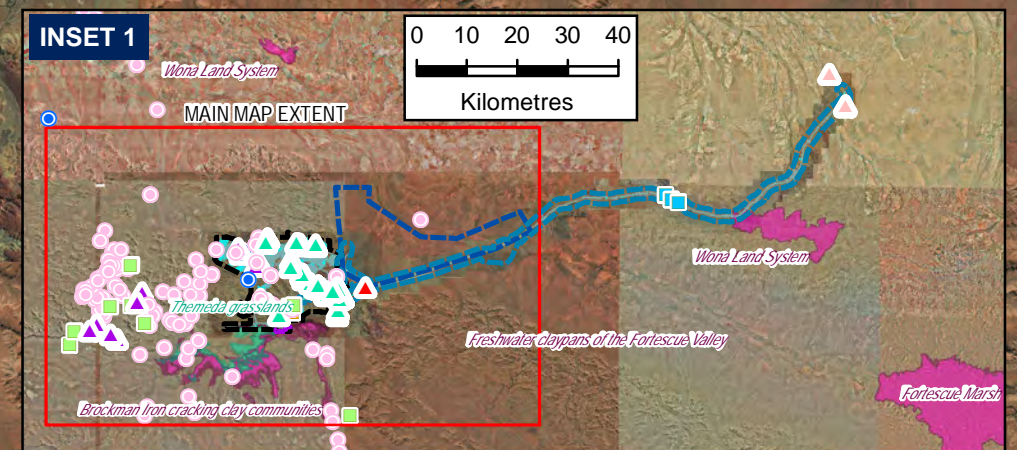
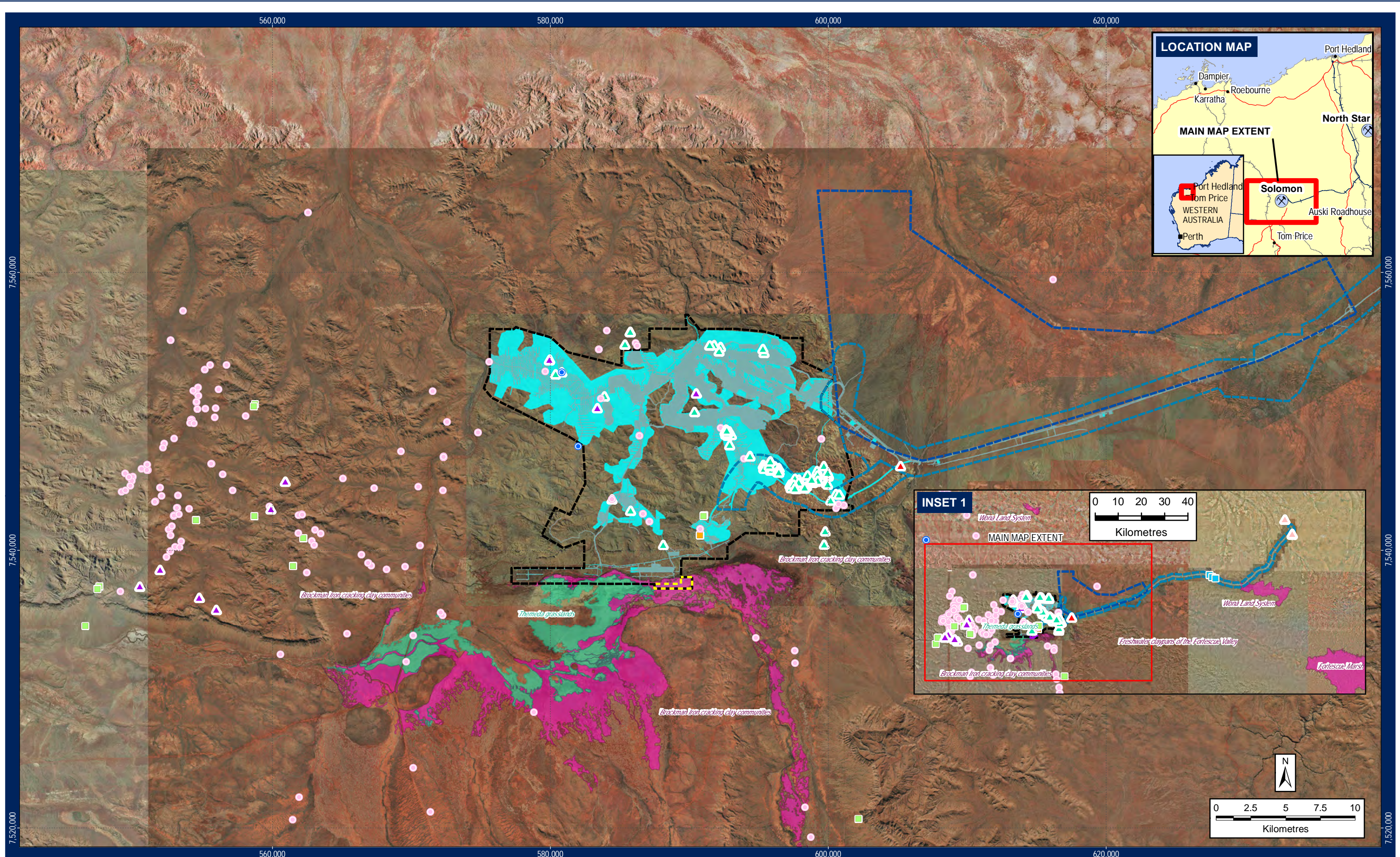
Figure 4

Solomon Mine - Threatened and Priority Ecological
Communities and Priority Flora in the Vicinity of the
Proposal Area



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LEGEND		Conservation Significant Flora	
Proposed Project Development Envelope 1	Indicative Mine and Rail Footprint	Acacia effusa	Gompholobium karrijini
Proposed Project Development Envelope 2 Extension	Threatened Ecological Communities	Aristida jerichoensis var. subspinulifera	Goodenia nuda
Proposed Project Development Envelope 3	Protected Ecological Communities	Bulbostylis burridgeae	Paspalidium retiglume
Rail and Rail Spur Corridor	Current and Proposed Disturbance to June 2016	Eremophila magnifica subsp. magnifica	Ptilotus mollis
			Rhynchosia bungarensis

Data Source(s): Topography, Geoscience Australia, 2013.
Imagery, FMG and Landgate, 2014. TEC and PEC Sites, DPaW, 07/04/2014.
FMG Threatened and Priority Flora, FMG, 26/06/2014. All other data, FMG, 2014.

Requested By: Amy Barker	Date: 14/07/2014
Drawn By: Sacha Fielden	Size: A3L
Revised By: ugeorge	Revision: 8
	Confidentiality: 1

Scale: 1:250,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: SO_MP_EN_0294.004r7

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The New Force in Iron Ore

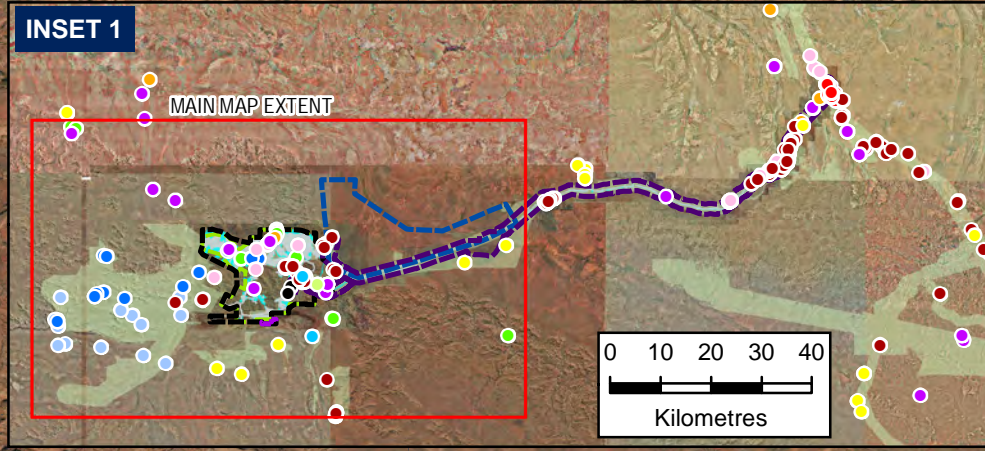
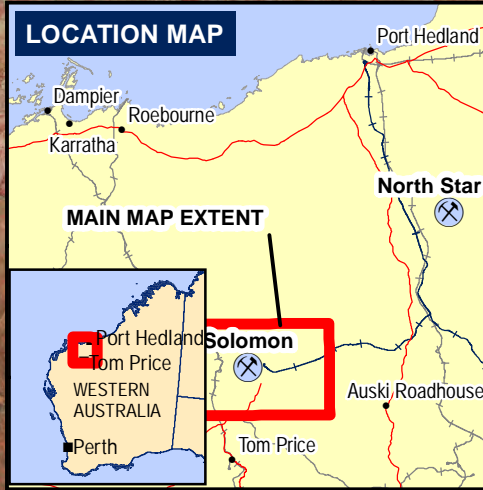
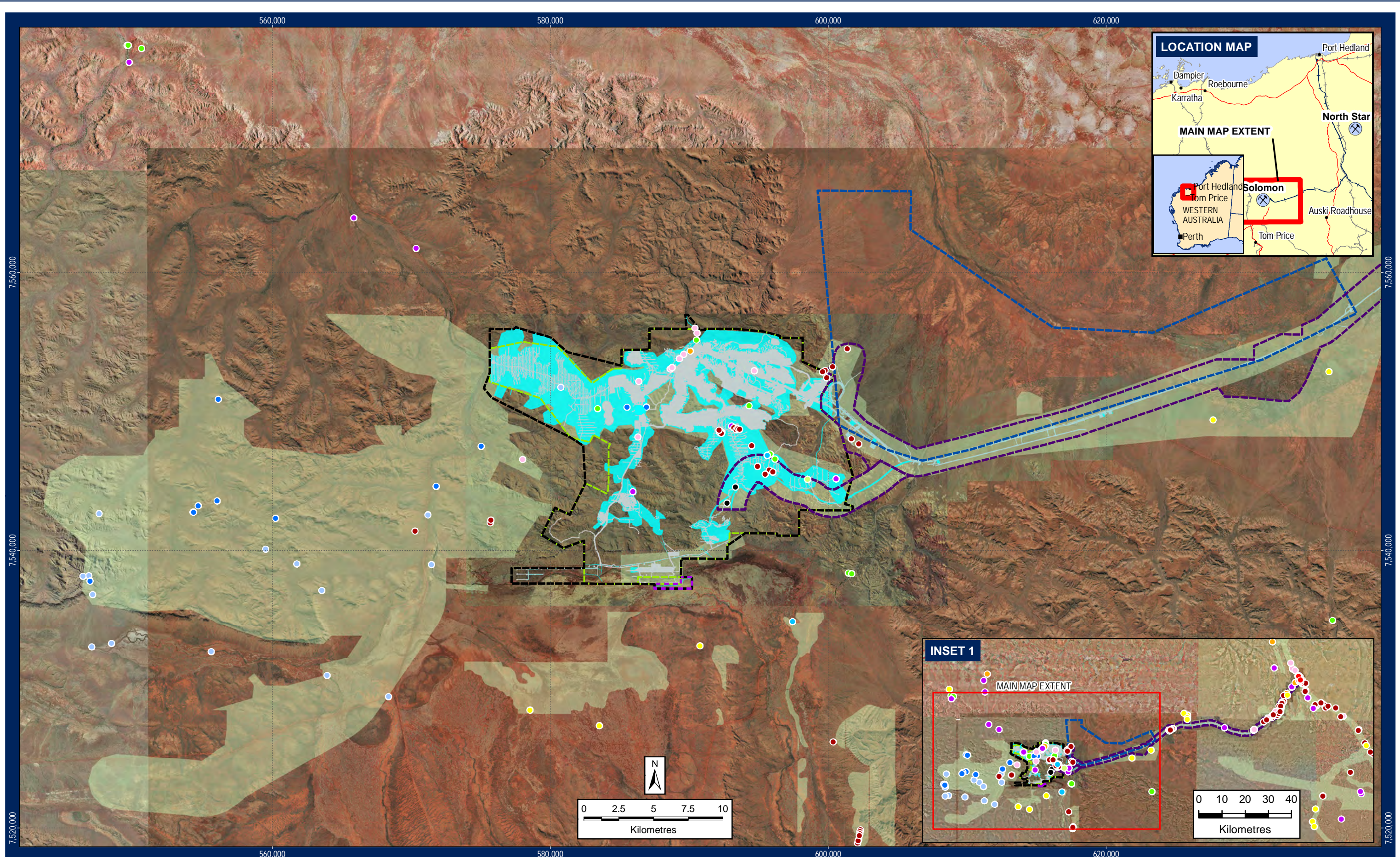
SOLOMON MINE
THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES AND PRIORITY FLORA IN THE VICINITY OF THE PROPOSAL AREA

Figure 5

Solomon Mine - Conservation Significant Fauna Species
in the Vicinity of the Proposal Area



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LEGEND
Fauna Record

- Pilbara Barking Gecko
- Australian Bustard
- Blind Snake
- Brush-tailed Mulgara
- Bush Stone-curlew
- Fork-tailed Swift
- Ghost Bat
- Northern Quoll
- Pilbara Leaf-nosed Bat
- Pilbara Olive Python
- Rainbow Bee-eater
- Western Pebble-Mound Mouse
- Peregrine Falcon

- Current and Approved Disturbance to June 2016
- Project Development Envelope
- Proposed Project Development Envelope 1
- Proposed Project Development Envelope 2 Extension
- Proposed Project Development Envelope 3
- Indicative Mine and Rail Footprint
- Rail and Rail Spur Corridor

- Current Extent of FMG Fauna Habitat Mapping

Data Source(s):
Topography, Geoscience Australia, 2013
Imagery, FMG and Landgate, 2014
All other data, FMG, 2014.

Requested By: Amy Barker
Drawn By: Sacha Fielden
Revised By: ugeorge

Date: 7/07/2014
Size: A3L
Revision: 7
Confidentiality: 1

Scale: 1:250,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: SO_MP_EN_0294.005r7

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SOLOMON MINE
CONSERVATION SIGNIFICANT FAUNA
SPECIES IN THE VICINITY OF
THE PROPOSAL AREA

Fortescue Metals Group Ltd
The New Force in Iron Ore

Appendix A

GIS Data



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Appendix B

Solomon - Vertebrate Fauna and SRE Invertebrate Fauna Survey Summary



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Appendix C

Solomon – Flora and Vegetation Survey Summary Report



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Appendix D

Solomon Life of Mine: Troglifauna Assessment
(Bennelongia Pty Ltd 2014)



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JULY 2014



*Providing sustainable environmental strategies,
management and monitoring solutions
to industry and government.*



**FORTESCUE METALS GROUP
SOLOMON – FLORA AND VEGETATION SURVEY
SUMMARY REPORT**

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**FORTESCUE METALS GROUP
SOLOMON – FLORA AND VEGETATION SURVEY
SUMMARY REPORT**

Document Status						
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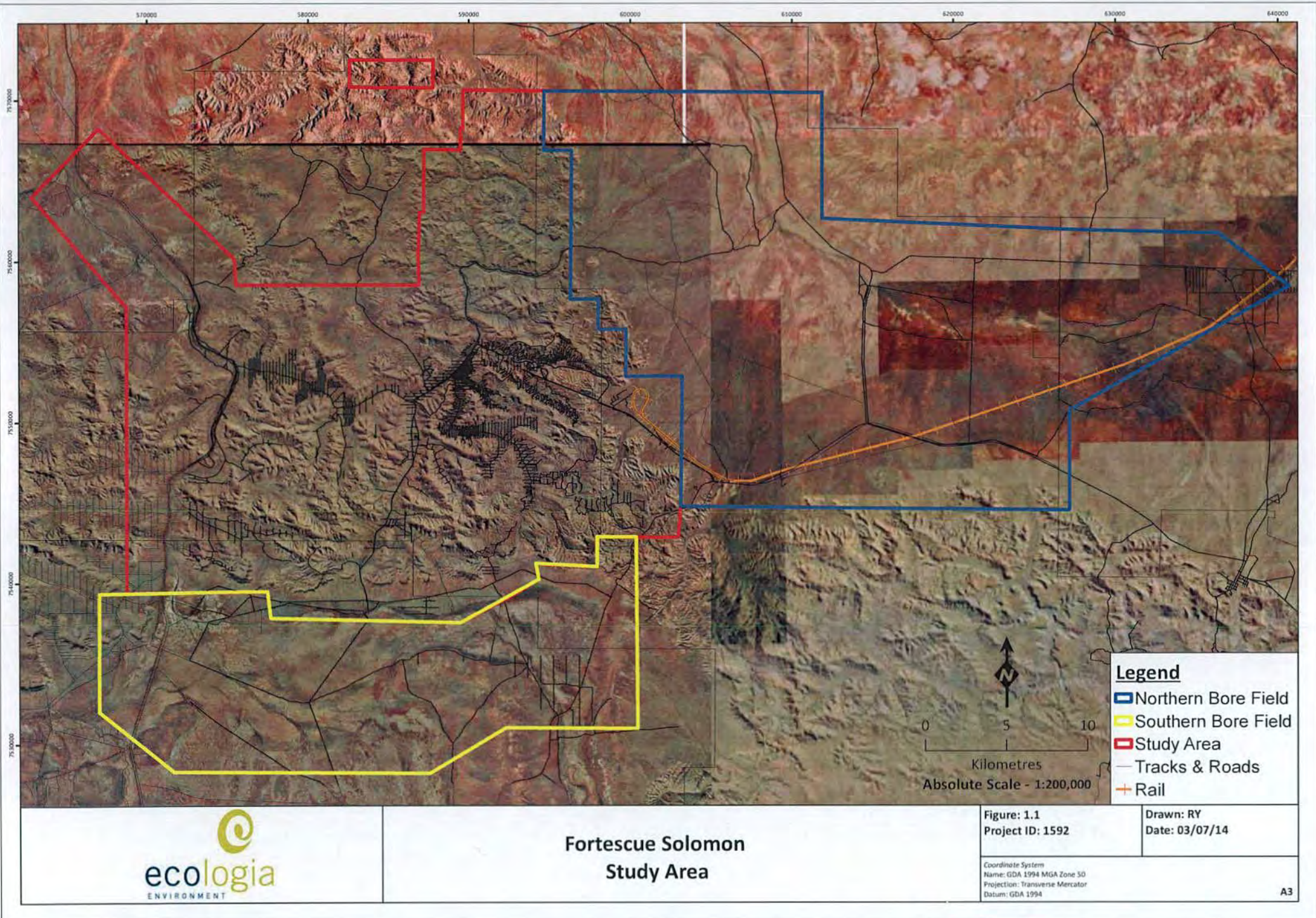
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1 INTRODUCTION

Fortescue Metals Group (Fortescue) is an integrated business comprised of mines (Chichester and Solomon Hub), rail (main line and Hamersley line) and port operations (Port Hedland) based in the Pilbara region of Western Australia, with its head office located in Perth. Fortescue is investigating options to expand the Solomon Hub, including the expansion of the mine footprint, the development of new bore fields and new resources (Figure 1.1). To facilitate approvals for the project, Fortescue has commissioned *ecologia* to complete a Level 2 Flora and Vegetation assessment.

The survey area is approximately 183,200 hectares in size and the survey areas are located on Mt Florance, Coolawanyah and Hamersley Stations, as well as Unallocated Crown Land (UCL). The overarching objective is to prepare a comprehensive and consolidated flora and vegetation assessment report to support primary environmental approvals for the project.

This report details the preliminary results of Phase one of the field survey conducted in April-May 2014. A second phase is planned for July 2014 with full report to follow in September 2014.



1.1 LEGISLATIVE FRAMEWORK

Commonwealth and State legislation applicable to the conservation of native flora and fauna in Western Australia includes, but is not limited to, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the Western Australian *Wildlife Conservation Act 1950* (WC Act) and the *Environmental Protection Act 1986* (EP Act).

Section 4a of the EP Act requires that developments take into account the following principles applicable to native flora and fauna:

- **The Precautionary Principle**

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

- **The Principles of Intergenerational Equity**

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

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

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

Furthermore, floristic surveys undertaken as part of the Environmental Impact Assessment (EIA) process are required to address the following:

- Environmental Protection Authority's (EPA's) Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002); and
- Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004).

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

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all fauna and flora within Western Australia are protected; however, the Minister may, via a notice published in the Government Gazette, declare a list of flora taxa identified as likely to become extinct, or as rare, or otherwise in need of special protection. The current listing was gazetted on 17 September 2013.

1.2 SURVEY OBJECTIVES

The EPA's objectives with regard to the management of native flora and vegetation are to:

- Avoid adverse impacts on biological diversity comprising the different plants and animals and the ecosystems they form, at the levels of genetic, species and ecosystem diversity;
- Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities;
- Protect Threatened Flora (formerly DRF, Declared Rare Flora) consistent with the provisions of the WC Act; and,
- Protect other flora species of conservation significance.

The primary objective of this flora and vegetation survey is to provide sufficient information to the EPA to assess the impact of the proposed development on the flora and vegetation of the study area, thereby ensuring that the EPA objectives will be upheld.

Specifically, this survey was to satisfy the requirements documented in the EPA's Guidance Statement 51 and Position Statement No. 3 and Fortescue's requirements, thus providing:

- A review of background information (including literature and database searches);
- An inventory of vegetation types and flora species occurring in the study area, incorporating recent published and unpublished records;
- An inventory of species of biological and conservation significance recorded or likely to occur within the study area and surrounds;
- A map and detailed description of vegetation types occurring in the study area;
- A map detailing the vegetation condition and discussion on the type of disturbances encountered;
- A map of Sheet Flow Dependent Vegetation and Groundwater Dependent Ecosystems;
- An appraisal of the current knowledge base for the area, including a review of previous surveys conducted in the area relevant to the current study;
- A review of regional and biogeographical significance, including the conservation status of species recorded in the study area;
- A review of the significance of the recorded vegetation types, based on their conservation status as TECs or PECs, as well as their local and regional representation; and
- Discussion on the vegetation units described that may be Groundwater Dependent Ecosystems and/or Sheet Flow Dependent Vegetation.

This report details the key findings to date from the field survey, a full report will follow following the second phase of the field assessment.

2 SURVEY METHODOLOGY

2.1 GUIDING PRINCIPLES

The survey methods adopted by *ecologia* were formulated using:

- Position Statement 3 (Environmental Protection Authority 2002) for terrestrial biological surveys as an element of biodiversity protection;
- Guidance Statement 51 (EPA 2004) for terrestrial flora and vegetation surveys for environmental impact assessment;
- Background research to gather background information on the footprint or target area (i.e. search of literature, data and map-based information); and
- Fortescue's Flora and Vegetation Guidelines.

Guidance Statement 51 recommends the following characteristics for a Level 2 Flora and Vegetation survey which were incorporated into the survey and reporting design:

- One or more visits to the target area in the main flowering season;
- Replication of plots in each vegetation unit to thoroughly sample the flora and characterise the vegetation units over their full extent in the target area;
- Multivariate analysis of the vegetation using, at a minimum, presence/absence data and perennial species;
- Mapping of vegetation at an appropriate scale; and
- Tabulation of the area of each vegetation unit mapped and an assessment of the environmental values including such factors as extent, condition and presence or significant flora.

2.2 DATABASE SEARCHES

A search of the following databases was undertaken in April 2014 prior to the field survey, to determine species and communities of conservation significance previously recorded in the vicinity of the study area:

- DPaW Threatened (Declared Rare) and Priority Flora Database (TPFL);
- DPaW Threatened and Priority Flora List (TPlist);
- DPaW Western Australian Herbarium Specimen Database (WAHERB);
- DPaW Threatened and Priority Ecological Communities Database; and
- DoE EPBC Protected Matters Database.

Searches of the DPaW Threatened and Priority Flora Database (TPFL), Threatened and Priority Flora List and the Western Australian Herbarium specimen database were conducted within 50 km of the Solomon study area (DPaW search 29-0414FL).

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia)

At a Commonwealth level, Threatened taxa are protected under the EPBC Act, which lists species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (see Appendix A for more detail).

Wildlife Conservation Act 1950 (Western Australia)

Taxa which have been adequately searched for and are deemed to either rare, in danger of extinction, or otherwise in need of special protection in the wild, are gazetted as Threatened (Declared Rare) Flora (Schedule 1, WC Act 1950). Threatened Flora further categorised by the DEC (now DPaW) according to their level of threat using IUCN Red List criteria (IUCN 2001):

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild;
- EN: Endangered – considered to be facing a very high risk of extinction in the wild; and
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

These taxa are legally protected and their removal or impact to their surroundings cannot be conducted without Ministerial approval, obtained specifically on each occasion for each population (refer to Appendix A for conservation category definitions).

DPaW maintains a list of Priority Flora, which are considered poorly known, uncommon or under threat but for which there is insufficient justification, based on known distribution and population sizes, for inclusion in Schedule 1 of the WC Act. A Priority taxon is assigned to one of five priority categories (Appendix A).

The likelihood of occurrence of each taxon was assessed based on distribution and known habitat preference, using the criteria shown in Table 2.1.

Table 2.1 – Criteria used to assess likelihood of occurrence of significant flora

Likelihood of Occurrence	Criteria
Recorded	The taxon has been recorded within the study area.
Highly likely	Due to the proximity of previous records (<2 km) and the presence of suitable habitat, the taxon is considered highly likely to occur within the study area.
Likely	Given the presence of suitable habitat and moderate proximity (2-10 km) of previous records, the taxon is considered likely to occur within the study area.
Possible	The habitat specificity of the taxon is broadly defined or undefined and there are records within 50 km of the study area. There is insufficient information available to exclude the possibility of occurrence within the study area.
Unlikely	The habitat specificity of the taxon is well defined from previous records and the habitat is considered unlikely to be present within the study area; or there are no records within 50 km of the study area.

2.2.1 Range Extensions

According to advice received from DPaW (S. van Leeuwen, pers. comm. 2013), range extensions are defined as records at least 100 km from the nearest vouchered Western Australian Herbarium record, or where the taxon has not been previously recorded in the IBRA subregion in which the study area is located (regardless of distance to nearest vouchered record).

Range edge records are denoted where records from this study are at the limit of the distribution based on vouchered records.

2.2.2 Introduced Flora

Weeds of National Significance (WONS)

At a national level, there are 32 weed species listed as Weeds of National Significance (WONS). *The Commonwealth National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2012) describes broad goals and objectives to manage these species. Of these species, three are currently recorded within the Pilbara; mesquite (*Prosopis* spp.), athel pine (*Tamarix aphylla*) and Parkinsonia (*Parkinsonia aculeata*).

Declared Plants

The *Biosecurity and Agriculture Management Act 2007* (BAM Act, DAFWA 2007) seeks to prevent serious animal and plant pests and diseases from entering the State and becoming established, and to minimise the spread and impact of those that are already present. The BAM Act (and associated regulations) replaces the *Agriculture and Related Resources Protection Act 1976* (and associated regulations). The BAM regulations were enacted on 1 May 2013, placing organisms into one of four categories:

- Permitted organism (listed under Section 11) – permitted in Western Australia subject to regulations;
- Prohibited organism (listed under Section 12) – prohibited in Western Australia subject to regulations (i.e. is a Declared Pest for the whole of State);
- Permitted organism: permit required (under regulation 73) – must not be imported unless in accordance with an import permit; and
- Permitted organism: Declared Pests (under Section 22) – can apply to part of or the whole of the State.

The current Western Australian Organism List (WAOL) was published on 1 May 2013 (DAFWA 2014) and lists organisms in each of these categories. Unlisted organisms must not be imported (unless in accordance with an import permit and regulations).

The BAM Act further categorises Declared Pests in one of three control categories (Table 2.2):

- C1 – Exclusion;
- C2 – Eradication; or
- C3 – Management.

Table 2.2 – Control categories for Declared Pests

Declared Plant category	Description
C1 - Exclusion	Pests assigned to this category are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 - Eradication	Pests assigned to this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 - Management	Pests assigned to this category are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

*Source: BAM Act 2007 and WAOL (DAFWA 2014)

Environmental Weeds

A third and much more extensive categorisation of weeds was developed by the DEC, formerly the Department of Conservation and Land Management (CALM, now DPaW) in an Environmental Weed Strategy (CALM 1999). Species considered to adversely affect the communities they invade are evaluated and rated based on the following criteria:

- Invasiveness: Ability to invade bushland in good to excellent condition or ability to invade waterways.
- Distribution: Wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world.
- Environmental impacts: Ability to change the structure, composition and function of ecosystems. In particular an ability to form single-species stands.

To advance the above categorisation, the *Invasive Plant Prioritization Process for DEC* was developed in 2011 by the Department of Environment and Conservation (DEC 2011). The new criteria for weed species categorisation are summarised as follows:

- Potential distribution: Area of potential habitat in the Region that could be occupied or the area at risk of invasion by the weed (limited, moderate, high, extensive, unknown);
- Current distribution: Area of habitat in the Region currently occupied by the weed (limited, moderate, high, extensive, unknown);
- Survey effort: Survey effort of IBRA (nil 0%, some 0-25%, patchy 25-50%, extensive 50-75%, complete 75-100%);
- Abundance: Density class across one or more IBRA regions in the DEC Region (occasional, common, abundant);
- Ecological impact: Impact of species within the region (low, medium, high, unknown);
- Impact attributes: List of known ecological impact attributes;
- Invasiveness: Rate of spread of a weed in native vegetation (slow, moderate, rapid, unknown);
- Feasibility of control: The longer a coordinated program takes to achieve its desired goal, the more expensive and less feasible it become (low, medium, high, unknown);

- General trend: General trend in distribution and abundance across the region (decreasing, increasing, stable, unknown); and
- Status: Define whether the species is outside the regions, emerging, established, or unknown.

2.2.3 Nationally Listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (DEC 2010). At a national level, flora and Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act. An ecological community may be categorised into one of three sub-categories:

- Critically Endangered, if it is facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered, if it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
- Vulnerable, if it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

2.2.4 State Listed Priority and Threatened Ecological Communities

The Western Australian Department of Parks and Wildlife (DPaW, previously DEC) also maintains a list of TECs which are further categorised into three subcategories much like those of the EPBC Act. Within the Western Australian classification, an ecological community will be listed as Vulnerable "when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future". DPaW also maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined.

2.3 VEGETATION AND FLORA ASSESSMENT

In accordance with the methodologies described in EPA Guidance Statement 51 for the Pilbara, the survey was conducted by sampling within bounded quadrats 2500 m² in area, supplemented by targeted Priority flora searches in areas of suitable habitat and opportunistic collections. Collecting opportunistically during field traverses is a more time efficient method of maximising the floristic inventory and thus increasing the probability of locating flora of potential significance than relying solely on records from quadrat sampling. However, standardised quadrats allow the vegetation to be consistently characterised and facilitate multivariate analysis of the vegetation. Both methods in combination contributed to the delineation of fine scale vegetation units and a comprehensive floristic inventory of the study area. Additional targeted searches for Priority flora were undertaken in areas of suitable habitat.

2.3.1 Study Team

The flora and vegetation assessment in this report was planned, coordinated, executed and reported by those summarised below.

Project Staff and Qualifications		
Kellie Bauer-Simpson	B.Sc.	Biological Sciences Manager/Principal Ecologist
Renee Young	PhD (Botany)	Botany Team Leader/Senior Botanist
Matthew Macdonald	PhD (Botany)	Principal Ecologist
Melissa Hay	B.Sc.	Senior Botanist
Christopher Parker	B.Sc.	Botanist
Beiha-Malen Yanez	B.Sc.	Botanist
Andrew Craigie	PhD (Botany)	Taxonomist
Udani Sirisena	PhD (Botany)	Taxonomist
Rachel Omodei	B.Sc.	Botanist
Jessica Stingemore	PhD (Botany)	Botanist

Licences - "Licence to Take Flora for Scientific Purposes"		
The vegetation and flora assessment described in this report was conducted under the authorisation of the following licences issued by the DEC:		
Name	Permit Number	Valid Until
Matthew Macdonald	SL 010 976	30/04/2015
Melissa Hay	SL 010 975	30/04/2015
Beiha-Malen Yanez	SL 010 981	30/04/2015
Andrew Craigie	SL 010 972	30/04/2015
Rachel Omodei	SL 010 980	30/04/2015
Jessica Stingemore	SL 010 982	30/04/2015

2.3.2 Survey Timing

The flora and vegetation of the Solomon study area was surveyed over 76 person days. Phase one of the survey was conducted between 22 April and 4 May 2014.

2.3.3 Quadrat based sampling

Two hundred and twenty-one quadrats were surveyed, distributed throughout the study area as detailed in Figure 2.1 and Table 2.3. Quadrat locations were selected using aerial photography, topographic features and field observations to represent the diversity of vegetation present. Most quadrats were 50 x 50 m; however, the dimensions were modified where necessary to ensure that sampling occurred in homogeneous vegetation. For example, 25 x 100 m or 10 x 250 m quadrats were used to assess vegetation along drainage lines.

For each quadrat, the following were recorded:

- Coordinates of each corner of the quadrat;
- Site features such as topography, soil and lithology;

- Structure of the vegetation, including the height, cover, habit and dominant species within each stratum;
- Height range and percentage foliage cover for each species within the site (including introduced species);
- Vegetation condition (degree of disturbance); and
- Estimated time since fire.

All quadrats were permanently marked at the north-west corner using a galvanised fence dropper.

At least one specimen of each taxon recorded was collected for subsequent verification of identity. Nomenclature and taxonomy follow the conventions currently adopted on FloraBase (Western Australian Herbarium 1998-2013).

2.3.4 Transects

A series of transects were completed to target priority flora species, introduced species and to provide opportunistic collections of taxa not recorded within the quadrats, to supplement the species list.

These transects crossed a number of landforms and vegetation types to maximise the habitat for conservation significant flora of species observed (Figure 2.1). Suitable habitat for priority species was mapped using aerial imagery to target searches and maximise the effort. When additional suitable habitat for priority species was encountered in the field, thorough searches of these habitats were performed.

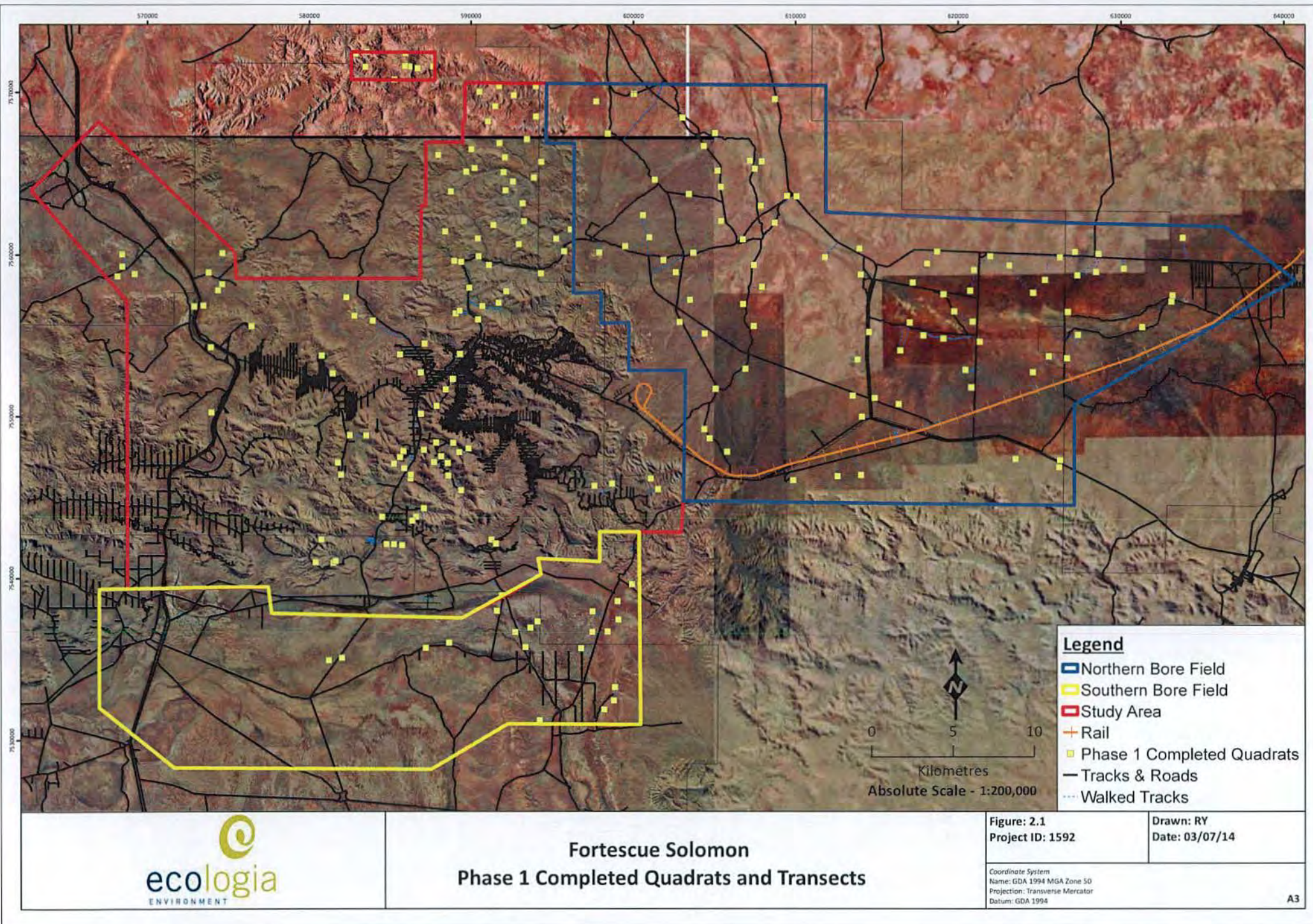


Table 2.3 – Quadrat locations within the Solomon study area

Site	Date	Quadrat Size	Location (GDA94)	Site	Date	Quadrat Size	Location (GDA94)
1	26/04/2014	25 x 100 m	50K 0582844 7572395	33	26/04/2014	50 x 50 m	50K 0585915 7571638
2	26/04/2014	50 x 50 m	50K 0583531 7572518	34	26/04/2014	50 x 50 m	50K 0591462 7569164
3	26/04/2014	10 x 250 m	50K 0585934 7572423	35	26/04/2014	50 x 50 m	50K 0591989 7565093
4	26/04/2014	25 x 100 m	50K 0586185 7571597	36	27/04/2014	50 x 50 m	50K 0589689 7565129
5	26/04/2014	25 x 100 m	50K 0585242 7570804	37	27/04/2014	50 x 50 m	50K 0588741 7563907
6	26/04/2014	50 x 50 m	50K 0591026 7568234	38	27/04/2014	50 x 50 m	50K 0592931 7560659
7	26/04/2014	50 x 50 m	50K 0593987 7568538	39	30/04/2014	50 x 50 m	50K 0595225 7560991
8	27/04/2014	50 x 50 m	50K 0588380 7561435	40	27/04/2014	50 x 50 m	50K 0593155 7563172
9	26/04/2014	50 x 50 m	50K 0590017 7566520	41	30/04/2014	50 x 50 m	50K 0594298 7558848
10	26/04/2014	50 x 50 m	50K 0592077 7566012	42	25/04/2014	50 x 50 m	50K 0590674 7556820
11	26/04/2014	50 x 50 m	50K 0590189 7565349	44	30/04/2014	25 x 100 m	50K 0599483 7560540
12	30/04/2014	50 x 50 m	50K 0597701 7569459	45	30/04/2014	50 x 50 m	50K 0605385 7564194
13	26/04/2014	25 x 100 m	50K 0591745 7566882	46	1/05/2014	50 x 50 m	50K 0608711 7569608
14	26/04/2014	40 x 62.5 m	50K 0593428 7567131	47	1/05/2014	50 x 50 m	50K 0607839 7563026
15	26/04/2014	50 x 50 m	50K 0594311 7565745	48	1/05/2014	50 x 50 m	50K 0607165 7565806
16	26/04/2014	50 x 50 m	50K 0587959 7566158	49	1/05/2014	25 x 100 m	50K 0607916 7565771
17	26/04/2014	50 x 50 m	50K 0592616 7569837	50	1/05/2014	50 x 50 m	50K 0606735 7560957
18	26/04/2014	50 x 50 m	50K 0593240 7562070	51	29/04/2014	50 x 50 m	50K 0601840 7559676
19	27/04/2014	50 x 50 m	50K 0593856 7564766	52	29/04/2014	50 x 50 m	50K 0605768 7547829
20	26/04/2014	50 x 50 m	50K 0590496 7570048	54	1/05/2014	50 x 50 m	50K 0627357 7555054
21	26/04/2014	50 x 50 m	50K 0591708 7570396	55	1/05/2014	50 x 50 m	50K 0625586 7553722
22	27/04/2014	25 x 100 m	50K 0592113 7563972	56	30/04/2014	50 x 50 m	50K 0626747 7556465
23	27/04/2014	25 x 100 m	50K 0590406 7561019	57	30/04/2014	50 x 50 m	50K 0625349 7558450
24	30/04/2014	50 x 50 m	50K 0596119 7561563	58	29/04/2014	50 x 50 m	50K 0620948 7559072
25	26/04/2014	50 x 50 m	50K 0592154 7557740	59	30/04/2014	50 x 50 m	50K 0621334 7554649
26	26/04/2014	50 x 50 m	50K 0593978 7570399	60	29/04/2014	50 x 50 m	50K 0620888 7555887
27	27/04/2014	50 x 50 m	50K 0592561 7564514	61	29/04/2014	50 x 50 m	50K 0617194 7558293
28	26/04/2014	25 x 100 m	50K 0591370 7561849	62	29/04/2014	50 x 50 m	50K 0620741 7557786
29	26/04/2014	50 x 50 m	50K 0587638 7571622	63	29/04/2014	50 x 50 m	50K 0619097 7557572
30	30/04/2014	50 x 50 m	50K 0598404 7567481	64	29/04/2014	50 x 50 m	50K 0619098 7554844
31	26/04/2014	50 x 50 m	50K 0583472 7571577	65	30/04/2014	50 x 50 m	50K 0626206 7546874
32	26/04/2014	50 x 50 m	50K 0586681 7571491	66	28/04/2014	25 x 100 m	50K 0583505 7548835

Site	Date	Quadrat Size	Location (GDA94)
66	28/04/2014	50 x 50 m	50K 0582489 7548852
67	28/04/2014	50 x 50 m	50K 0581421 7552670
68	28/04/2014	50 x 50 m	50K 0586884 7552726
69	28/04/2014	50 x 50 m	50K 0585792 7547860
70	3/05/2014	50 x 50 m	50K 0587063 7547954
71	4/05/2014	50 x 50 m	50K 0580355 7540995
72	28/04/2014	50 x 50 m	50K 0581930 7546412
74	4/05/2014	50 x 50 m	50K 0586594 7543800
75	28/04/2014	50 x 50 m	50K 0586240 7546176
76	4/05/2014	50 x 50 m	50K 0584760 7542129
77	4/05/2014	50 x 50 m	50K 0585730 7542042
79	3/05/2014	50 x 50 m	50K 0591253 7542389
80	3/05/2014	50 x 50 m	50K 0587693 7547194
81	3/05/2014	40 X 62.5 m	50K 0588530 7547127
82	3/05/2014	50 x 50 m	50K 0589255 7547795
83	3/05/2014	50 x 50 m	50K 0589365 7545445
84	28/04/2014	25 x 100 m	50K 0585216 7547083
85	3/05/2014	50 x 50 m	50K 0587823 7548393
86	3/05/2014	50 x 50 m	50K 0588868 7548372
87	28/04/2014	25 x 100 m	50K 0586272 7546408
92	3/05/2014	50 x 50 m	50K 0591514 7542138
93	2/05/2014	50 x 50 m	50K 0596748 7535679
95	25/04/2014	50 x 50 m	50K 0572845 7556806
96	2/05/2014	50 x 50 m	50K 0573411 7556863
97	2/05/2014	50 x 50 m	50K 0573755 7558915
98	30/04/2014	50 x 50 m	50K 0633168 7557494
101	30/04/2014	50 x 50 m	50K 0631308 7555538
102	1/05/2014	50 x 50 m	50K 0609450 7563641
102	1/05/2014	50 x 50 m	50K 0626689 7553605
103	30/04/2014	50 x 50 m	50K 0630174 7559150
105	1/05/2014	50 x 50 m	50K 0603006 7568471
106	1/05/2014	50 x 50 m	50K 0605008 7567522
107	1/05/2014	50 x 50 m	50K 0607477 7565309

Site	Date	Quadrat Size	Location (GDA94)
110	29/04/2014	50 x 50 m	50K 0613903 7560398
111	30/04/2014	50 x 50 m	50K 0626280 7547302
112	2/05/2014	10 x 250 m	50K 0609841 7546067
113	1/05/2014	50 x 50 m	50K 0610041 7563618
114	3/05/2014	50 x 50 m	50K 0588569 7546337
117	25/04/2014	30 x 70	50K 0589032 7556365
118	30/04/2014	50 x 50 m	50K 0595725 7560214
119	29/04/2014	50 x 50 m	50K 0603679 7560129
120	30/04/2014	50 x 50 m	50K 0633107 7557109
121	29/04/2014	50 x 50 m	50K 0621965 7559915
122	28/04/2014	50 x 50 m	50K 0627177 7560181
123	1/05/2014	50 x 50 m	50K 0614862 7551172
124	1/05/2014	50 x 50 m	50K 0614057 7549996
125	29/04/2014	50 x 50 m	50K 0604678 7548660
126	2/05/2014	50 x 50 m	50K 0594186 7531217
127	26/04/2014	25 x 100 m	50K 0590453 7559909
128	30/04/2014	50 x 50 m	50K 0628631 7560065
129	29/04/2014	50 x 50 m	50K 0617855 7555028
130	25/04/2014	50 x 50 m	50K 0613989 7558790
132	1/05/2014	50 x 50 m	50K 0605168 7565201
133	28/04/2014	50 x 50 m	50K 0587105 7554509
135	4/05/2014	50 x 50 m	50K 0584491 7543805
136	3/05/2014	50 x 50 m	50K 0588122 7547540
137	4/05/2014	50 x 50 m	50K 0581461 7540963
138	4/05/2014	40 X 62.5 m	50K 0581590 7541081
139	28/04/2014	50 x 50 m	50K 0585840 7546815
140	4/05/2014	50 x 50 m	50K 0585221 7542102
141	4/05/2014	50 x 50 m	50K 0580718 7542396
142	28/04/2014	25 x 100 m	50K 0585585 7547489
143	28/04/2014	25 x 100 m	50K 0580740 7553783
144	28/04/2014	50 x 50 m	50K 0582774 7556233
145	28/04/2014	50 x 50 m	50K 0583910 7555928
146	28/04/2014	50 x 50 m	50K 0581729 7547162

Site	Date	Quadrat Size	Location (GDA94)
147	25/04/2014	50 x 50 m	50K 0589881 7557963
148	30/04/2014	50 x 50 m	50K 0597886 7560153
149	29/04/2014	50 x 50 m	50K 0618700 7560196
150	30/04/2014	50 x 50 m	50K 0632691 7559120
152	2/05/2014	50 x 50 m	50K 0598765 7532441
153	2/05/2014	50 x 50 m	50K 0598176 7531878
154	2/05/2014	50 x 50 m	50K 0597453 7536696
155	2/05/2014	50 x 50 m	50K 0599909 7539638
159	2/05/2014	50 x 50 m	50K 0574319 7557813
161	2/05/2014	50 x 50 m	50K 0598401 7536702
162	4/05/2014	50 x 50 m	50K 0587064 7544328
164	2/05/2014	50 x 50 m	50K 0581161 7534920
165	1/05/2014	50 x 50 m	50K 0614505 7555229
166	29/04/2014	50 x 50 m	50K 0602593 7558925
167	29/04/2014	50 x 50 m	50K 0607426 7559373
168	30/04/2014	50 x 50 m	50K 0600961 7561087
170	28/04/2014	50 x 50 m	50K 0586886 7550173
171	28/04/2014	50 x 50 m	50K 0587847 7550659
172	28/04/2014	50 x 50 m	50K 0588416 7551684
173	26/04/2014	25 x 100 m	50K 0588854 7552319
174	27/04/2014	50 x 50 m	50K 0588619 7536033
175	27/04/2014	50 x 50 m	50K 0587175 7535692
176	2/05/2014	50 x 50 m	50K 0598841 7533268
177	27/04/2014	50 x 50 m	50K 0591879 7538947
178	27/04/2014	50 x 50 m	50K 0591573 7537992
179	27/04/2014	50 x 50 m	50K 0593332 7535736
180	27/04/2014	50 x 50 m	50K 0593632 7536940
181	2/05/2014	50 x 50 m	50K 0597454 7537953
182	27/04/2014	50 x 50 m	50K 0592703 7536668
183	29/04/2014	25 x 100 m	50K 0606747 7556971
184	1/05/2014	10 x 250 m	50K 0608703 7561970
185	29/04/2014	50 x 50 m	50K 0616427 7554096
186	29/04/2014	50 x 50 m	50K 0603480 7557217

Site	Date	Quadrat Size	Location (GDA94)
187	29/04/2014	25 x 100 m	50K 0604366 7555140
188	29/04/2014	50 x 50 m	50K 0605054 7551723
189	29/04/2014	50 x 50 m	50K 0606890 7552965
190	1/05/2014	50 x 50 m	50K 0613503 7551309
191	30/04/2014	50 x 50 m	50K 0600583 7562450
192	30/04/2014	50 x 50 m	50K 0603407 7563757
193	29/04/2014	50 x 50 m	50K 0607409 7555609
195	30/04/2014	50 x 50 m	50K 0613809 7553546
198	29/04/2014	50 x 50 m	50K 0607921 7558024
200	1/05/2014	50 x 50 m	50K 0620444 7552902
201	29/04/2014	50 x 50 m	50K 0618075 7559471
202	30/04/2014	50 x 50 m	50K 0627324 7558739
204	30/04/2014	50 x 50 m	50K 0623143 7559347
207	30/04/2014	50 x 50 m	50K 0616335 7550787
208	1/05/2014	50 x 50 m	50K 0624600 7552747
211	1/05/2014	50 x 50 m	50K 0620797 7551816
212	30/04/2014	50 x 50 m	50K 0628471 7558946
213	30/04/2014	50 x 50 m	50K 0600025 7569918
214	30/04/2014	50 x 50 m	50K 0601307 7564639
215	29/04/2014	50 x 50 m	50K 0602834 7555837
219	2/05/2014	50 x 50 m	50K 0573895 7550257
220	28/04/2014	50 x 50 m	50K 0589292 7553866
221	25/04/2014	50 x 50 m	50K 0590421 7556002
222	2/05/2014	50 x 50 m	50K 0573880 7554292
225	25/04/2014	50 x 50 m	50K 0591679 7557030
226	27/04/2014	25 x 100 m	50K 0589362 7559552
227	27/04/2014	25 x 100 m	50K 0591073 7559353
228	27/04/2014	50 x 50 m	50K 0588937 7559619
230	3/05/2014	50 x 50 m	50K 0601056 7546179
231	3/05/2014	50 x 50 m	50K 0597582 7545720
235	29/04/2014	50 x 50 m	50K 0617016 7555831
237	29/04/2014	40 x 62.5 m	50K 0611794 7559858
238	28/04/2014	50 x 50 m	50K 0626252 7559842

Site	Date	Quadrat Size	Location (GDA94)
239	29/04/2014	50 x 50 m	50K 0619757 7556508
240	30/04/2014	50 x 50 m	50K 0633800 7561049
242	3/05/2014	25 x 100 m	50K 0601506 7545520
243	3/05/2014	50 x 50 m	50K 0598657 7545849
247	2/05/2014	50 x 50 m	50K 0599057 7537445
248	28/04/2014	50 x 50 m	50K 0585590 7553838
249	25/04/2014	50 x 50 m	50K 0589277 7556534
253	2/05/2014	50 x 50 m	50K 0574588 7560102
254	27/04/2014	50 x 50 m	50K 0594070 7537324
255	28/04/2014	50 x 50 m	50K 0582266 7557371
256	2/05/2014	50 x 50 m	50K 0599008 7538583
257	3/05/2014	50 x 50 m	50K 0589817 7548043
259	4/05/2014	50 x 50 m	50K 0586348 7543560
261	29/04/2014	50 x 50 m	50K 0604362 7549218
262	2/05/2014	40 X 62.5 m	50K 0612567 7546330
263	2/05/2014	50 x 50 m	50K 0614016 7546399
264	30/04/2014	50 x 50 m	50K 0623536 7547379
265	25/04/2014	50 x 50 m	50K 0568114 7558666
266	25/04/2014	50 x 50 m	50K 0568391 7559285
267	25/04/2014	50 x 50 m	50K 0568402 7560035
268	25/04/2014	50 x 50 m	50K 0569166 7558804
269	2/05/2014	50 x 50 m	50K 0576397 7555594
270	2/05/2014	50 x 50 m	50K 0574585 7558183
273	1/05/2014	50 x 50 m	50K 0605381 7562075
870	30/04/2014	50 x 50 m	50K 0624620 7557663

3 PRELIMINARY RESULTS

3.1 RESULTS OF DESKTOP ASSESSMENT

3.1.1 Flora

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia)

Two EPBC listed, Threatened Flora (Declared Rare Flora) have previously been recorded within the database search area: *Lepidium catapycnon* and *Thryptomene wittweri* from the spatial TPFL and Western Australian Herbarium.

Wildlife Conservation Act 1950 (Western Australia)

Three Threatened (Declared Rare) Flora species have previously been recorded in the Pilbara Bioregion: *Aluta quadrata*, *Lepidium catapycnon* and *Thryptomene wittweri*. One of these species have been recorded within 50 km of the study area, *Lepidium catapycnon* (listed as Vulnerable by DPaW).

100 Priority Flora taxa were identified from the multiple searches. Seventy three of these are known from within 50 km of the Solomon study area (DPaW search 29-0414FL); 27 were listed in the name place search but have no coordinate location (DPaW search 29-0414FL).

Their conservation status and likelihood of occurrence within the study area are presented in Table 3.1.

Table 3.1 – Priority flora taxa previously recorded in the vicinity of the Solomon study area

Conservation Status	Likelihood of Occurrence	Number of Taxa	Taxa
T	Possible	1	<i>Lepidium catapycnon</i>
P1	Recorded	3	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> , <i>Euphorbia inappendiculata</i> var. <i>queenslandica</i> , <i>Teucrium pilbaranum</i>
	Highly likely	1	<i>Barbula ehrenbergii</i>
	Possible	8	<i>Brachyscome</i> sp. Wanna Munna Flats (S. van Leeuwen 4662), <i>Calotis squamigera</i> ; <i>Grevillea</i> sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01), <i>Helichrysum oligochaetum</i> , <i>Hibiscus</i> sp. Mt Brockman (E. Thoma ET 1354), <i>Josephinia</i> sp. Marandoo (M.E. Trudgen 1554), <i>Nicotiana heterantha</i> , <i>Sida</i> sp. Hamersley Range (K. Newbey 10692)
	Unlikely	3	<i>Bothriochloa decipiens</i> var. <i>cloncurrensis</i> , <i>Eucalyptus lucens</i> , <i>Goodenia pedicellata</i>
P2	Recorded	2	<i>Gompholobium karjini</i> , <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>
	Highly likely	2	<i>Adiantum capillus-veneris</i> , <i>Dicladanthra glabra</i>
	Likely	1	<i>Vigna</i> sp. central (M.E. Trudgen 1626)
	Possible	7	<i>Aristida lazaridis</i> , <i>Cladium procerum</i> , <i>Euphorbia australis</i> var. <i>glabra</i> ; <i>Indigofera ixocarpa</i> , <i>Paspalidium retiglume</i> , <i>Scaevola</i> sp. Hamersley Range basalts (S. van Leeuwen 3675), <i>Spartothamnella puberula</i>
	Unlikely	3	<i>Isotropis parviflora</i> , <i>Pentalepis trichodesmoides</i> subsp. <i>hispida</i> , <i>Stylidium weeliwolli</i>
P3	Recorded	16	<i>Acacia effusa</i> , <i>Astrebla lappacea</i> , <i>Calotis latiuscula</i> , <i>Eragrostis surreyana</i> , <i>Eremophila magnifica</i> subsp. <i>velutina</i> , <i>Glycine falcata</i> , <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727), <i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869), <i>Iatasperma sessilifolium</i> , <i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479), <i>Rostellularia adscendens</i> var. <i>latifolia</i> , <i>Solanum albotellatum</i> , <i>Stackhousia clementii</i> , <i>Swainsona thompsoniana</i> , <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431), <i>Whiteochloa capillipes</i>
	Highly likely	2	<i>Fimbristylis sieberiana</i> , <i>Polymeria distigma</i>

Conservation Status	Likelihood of Occurrence	Number of Taxa	Taxa
	Likely	4	<i>Dampiera anonyma</i> , <i>Olearia mucronata</i> , <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)
	Possible	14	<i>Acacia dawsoniana</i> , <i>Acacia glaucocarpa</i> , <i>Acacia subtiliformis</i> , <i>Amaranthus centralis</i> , <i>Ampelopteris prolifera</i> , <i>Eucalyptus rowleyi</i> , <i>Euphorbia stevenii</i> , <i>Geijera salicifolia</i> , <i>Gymnanthera cunninghamii</i> , <i>Indigofera</i> sp. Bungaroo Creek (S. van Leeuwen 4301), <i>Nicotiana umbratica</i> , <i>Ptilotus subspinescens</i> , <i>Solanum kentrocaule</i> , <i>Xanthoparmelia nashii</i>
P4	Recorded	4	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> , <i>Goodenia nuda</i> , <i>Ptilotus mollis</i> , <i>Rhynchosia bungarensis</i>
	Possible	1	<i>Acacia bromilowiana</i>
	Unlikely	1	<i>Livistona alfredii</i>

3.1.2 Vegetation

Nationally Listed Threatened Ecological Communities

No Commonwealth listed TECs are known to occur within 50 km of the study area.

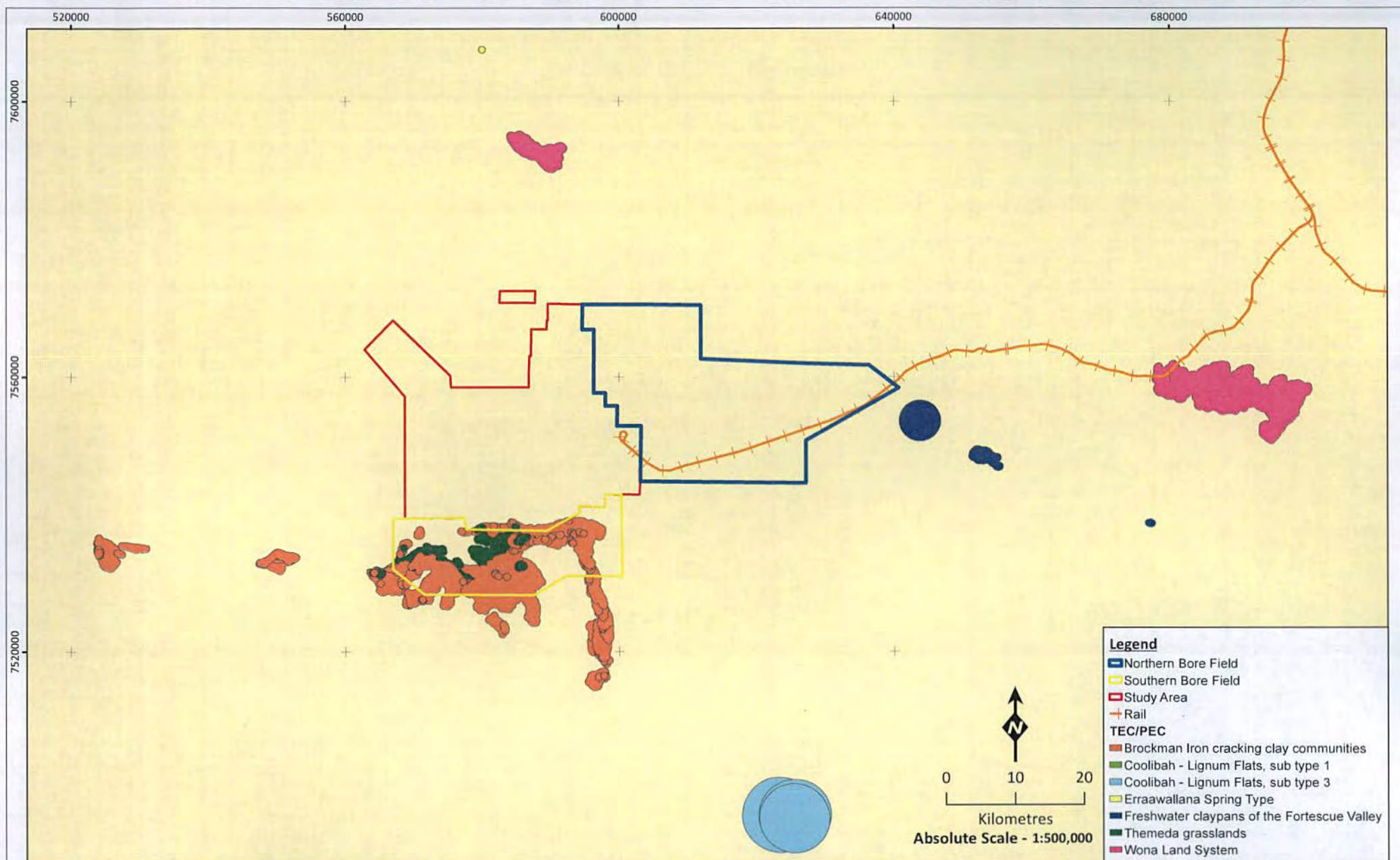
State Listed Threatened and Priority Ecological Communities

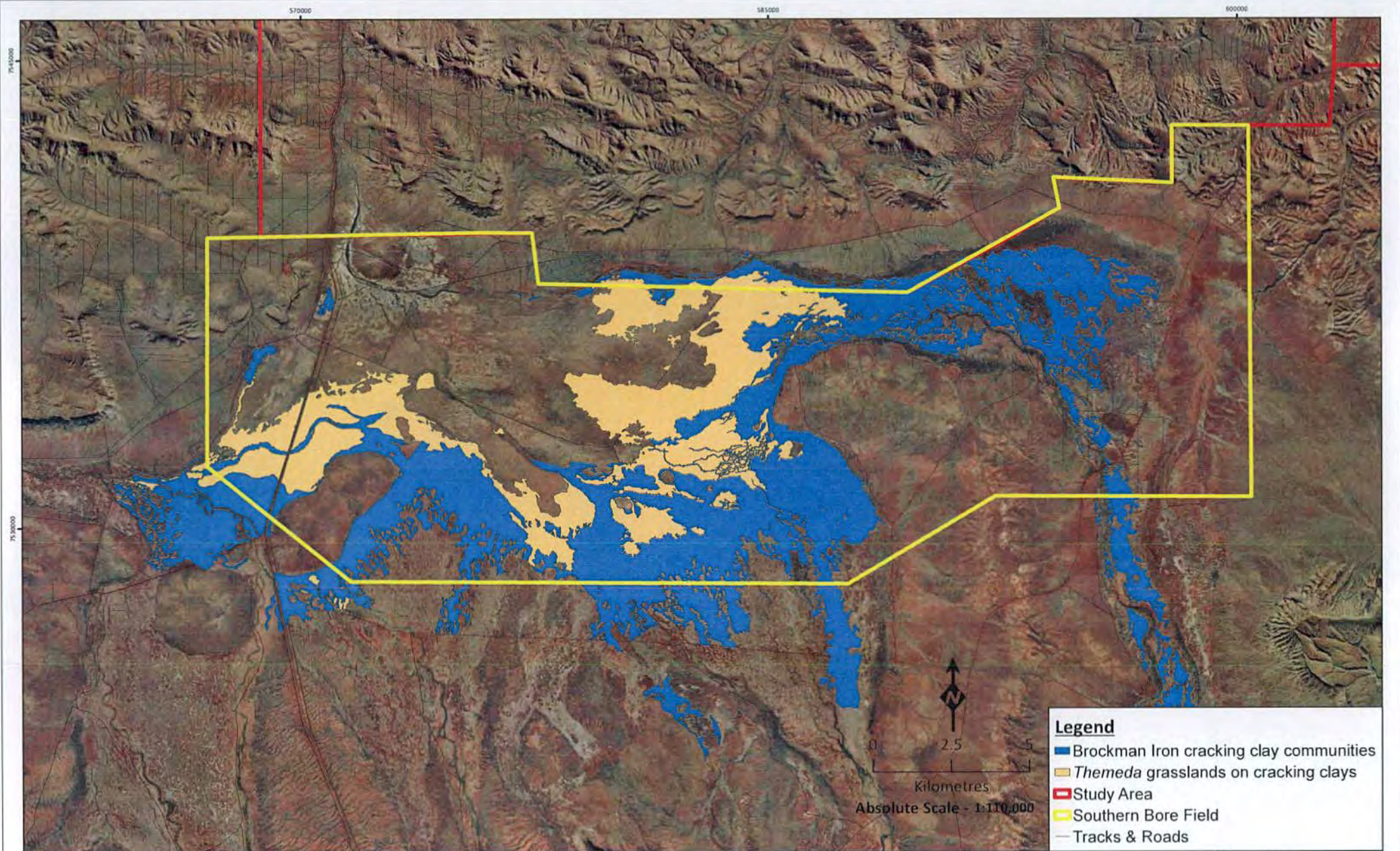
A search of the DPaW database (Reference: 24-0414EC) within 50 km of Solomon study area returned one State listed TEC, *Themeda* grasslands on cracking clays (Hamersley Station, Pilbara) (Vulnerable). The *Themeda* grasslands overlap with the southern portion of the study area.

In addition, the search returned six PECs with buffers within 50 km of Solomon study area (Table 3.2, Figure 3.1). One of the PECs returned, Brockman cracking clays, overlaps with the study area.

Table 3.2 – PECs within 50 km of Solomon study area

PEC description	Status	Distance from Solomon
Brockman Iron cracking clay communities of the Hamersley Range	P1	Overlaps with study area
Coolibah - Lignum Flats: sub type 1. Coolibah woodland over lignum over silky browntop (Mt Bruce flats)	P3	41 km southeast
Coolibah - Lignum Flats: sub type 3. Coolibah woodland over lignum over silky browntop (Mt Bruce flats)	P1	36 km southeast
Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range')	P1	19 km north 36 km east
Freshwater claypans downstream of the Fortescue Marsh - Goodiadarrie Hills on Mulga Downs Station	P1	3 km east
Invertebrate assemblages (Errawallana Spring type) Coolawanya Station	P4	35 km north





3.2 RESULTS OF FIELD SURVEY

As of 15 May 2014 approximately 70% of specimens collected have been formally identified. The preliminary results presented here are based only on completed identifications.

3.2.1 Flora

Flora of conservation significance

Seven confirmed and one unconfirmed priority taxa were recorded during phase one of the survey, including:

- *Aristida jerichoensis* var. *subspinulifera* (P1);
- *Teucrium pilbaranum* (P1);
- *Gompholobium karijini* (P2);
- *Glycine falcata* (P3);
- *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (P3);
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3);
- *Goodenia ?nuda* (P4); and
- *Rhynchosia bungarensis*(P4).

The locations of each of these records are presented in Table 3.3 and Figure 3.3.

Additional priority species may be added on completion of the specimen identification.

No EPBC Act Listed plant species were recorded in the study area.

3.2.2 Range extensions

No specimens currently identified are considered to be range extensions.

3.2.3 Introduced species

Nine introduced species were recorded within the study area: **Aerva javanica* (Kapok bush), **Argemone ochroleuca* (Mexican poppy), **Bidens bipinnata* (Bipinnate beggartick), **Cenchrus ciliaris* (Buffel grass), **Cenchrus setiger* (Birdwood grass), **Cyperus polystachyos* (Bunchy sedge), **Malvastrum americanum* (Spiked malvastrum), **Sonchus oleraceus* (Common sowthistle), and **Vachellia farnesiana* (Mimosa bush).



No Weeds of National Significance (WONS) were recorded during the survey.




3.2.4 Vegetation



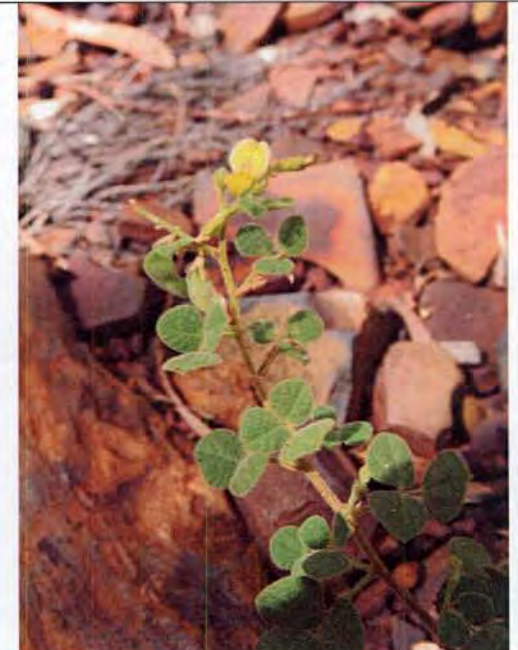
Threatened and priority ecological communities

Definitive mapping of the *Themeda* grasslands on cracking clays (Hamersley Station, Pilbara) and the Brockman Iron cracking clay communities of the Hamersley Range within the vicinity of the study area is presented in Figure 3.2. The boundaries of these communities is being reviewed and accurately delineated by *ecologia*.

Table 3.3 – Flora of conservation significance recorded in the study area

Taxon	Picture
<p><i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P1) POACEAE</p> <p>Tufted annual grass to ca. 60 cm high; leaves usually coiled at maturity; inflorescence loosely contracted and narrow; glumes equal or slightly unequal; lemmas without a columns, distinct pseudoarticulation absent (although an indistinct pseudoarticulation may be present on mature fruit), the lemma body < 7 mm long.</p> <p>Recorded from low-lying areas, often in mulga woodland.</p> <p>IBRA subregions: Carnegie, Hamersley LGA distribution: Ashburton, East Pilbara, Wiluna</p>	
<p><i>Teucrium pilbaranum</i> (P1) LAMIACEAE</p> <p>Erect multi-stemmed subshrub to ca. 30 cm high; leaves near stem-clasping and tripartite; flowers appearing solitary in the axils, minute, petals whitish.</p> <p>Recorded from crabhole plains dominated by <i>Eucalyptus victrix</i> and from calcrete tables dominated by grasses.</p> <p>IBRA subregions: Chichester, Fortescue, Hamersley LGA distribution: Ashburton, East Pilbara</p>	

Taxon	Picture
<p><i>Gompholobium karijini</i> (P2) FABACEAE</p> <p>Glabrous or near glabrous shrub to ca. 50 cm; leaves compound with ca. 5-21 sub-opposite leaflets; flowers yellow.</p> <p>Recorded from skeletal soils on the edges of deep ravines or plateaus on banded ironstone.</p> <p>IBRA subregions: Fortescue, Hamersley LGA distribution: Ashburton</p>	
<p><i>Glycine falcata</i> (P3) FABACEAE</p> <p>Perennial, usually sprawling herb; leaves digitately tri-foliolate (the apical leaflet subsessile); flowers blue to purple; pods curved.</p> <p>Recorded from stony loam or cracking clays, typically in grassland in low lying areas.</p> <p>IBRA subregions: Fortescue, Hamersley, Ord, Ord-Victoria Plains P1, Pentecost, Roebourne LGA distribution: Ashburton, Derby-West Kimberley, Halls Creek, Roebourne</p>	 <p>(Image: Western Australian Herbarium)</p>
<p><i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869) (P3) FABACEAE</p> <p>Sparsely branched shrub; leaves compound with ca. 12 leaflets; leaf rachis with conspicuous clumps of reddish glandular hairs between the leaflets; stipules persistent and recurved.</p> <p>Recorded from open shrub mallee, usually high in the landscape on skeletal soils overlaying massive ironstones of the Brockman Iron Formation.</p> <p>IBRA subregions: Eastern Murchison, Hamersley, Mann-Musgrave Block, Tanami LGA distribution: Ashburton, East Pilbara, Halls Creek, Meekatharra, Ngaanyatjaraku</p>	

Taxon	Picture
<p><i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) POACEAE</p> <p>Robust perennial tussock grass, 1-2 m high with grey-green leaves.</p> <p>Recorded from red clay in clay pans and grass plains.</p> <p>IBRA subregions: Chichester, Fortescue, Hamersley, Roebourne LGA distribution: Ashburton, East Pilbara, Roebourne</p>	
<p><i>Goodenia nuda</i> (P4) GOODENIACEAE</p> <p>Glabrous or sparsely hairy herb, pale green, often glaucous; flowers yellow, the abaxial corolla lobes with equal wings, bracteoles absent.</p> <p>Mostly recorded from seasonally inundated clay soils and drainage lines, often in mulga. Also recorded from sand in scoured river beds and from hill sides.</p> <p>IBRA subregions: Carnegie, Chichester, Fortescue, Hamersley, Roebourne LGA distribution: Ashburton, East Pilbara, Port Hedland, Roebourne, Wiluna</p>	
<p><i>Rhynchosia bungarensis</i> (P4) FABACEAE</p> <p>Prostrate shrub covered with sticky glandular hairs; leave trifoliolate, the leaflets broad-elliptic or rhomboid; flowers yellow.</p> <p>Recorded from rock piles, gorges, river beds and alluvial soils in shrubland or gallery woodland.</p> <p>IBRA subregions: Ashburton, Cape Range, Chichester, Hamersley, Roebourne LGA distribution: Ashburton, East Pilbara, Exmouth, Roebourne</p>	

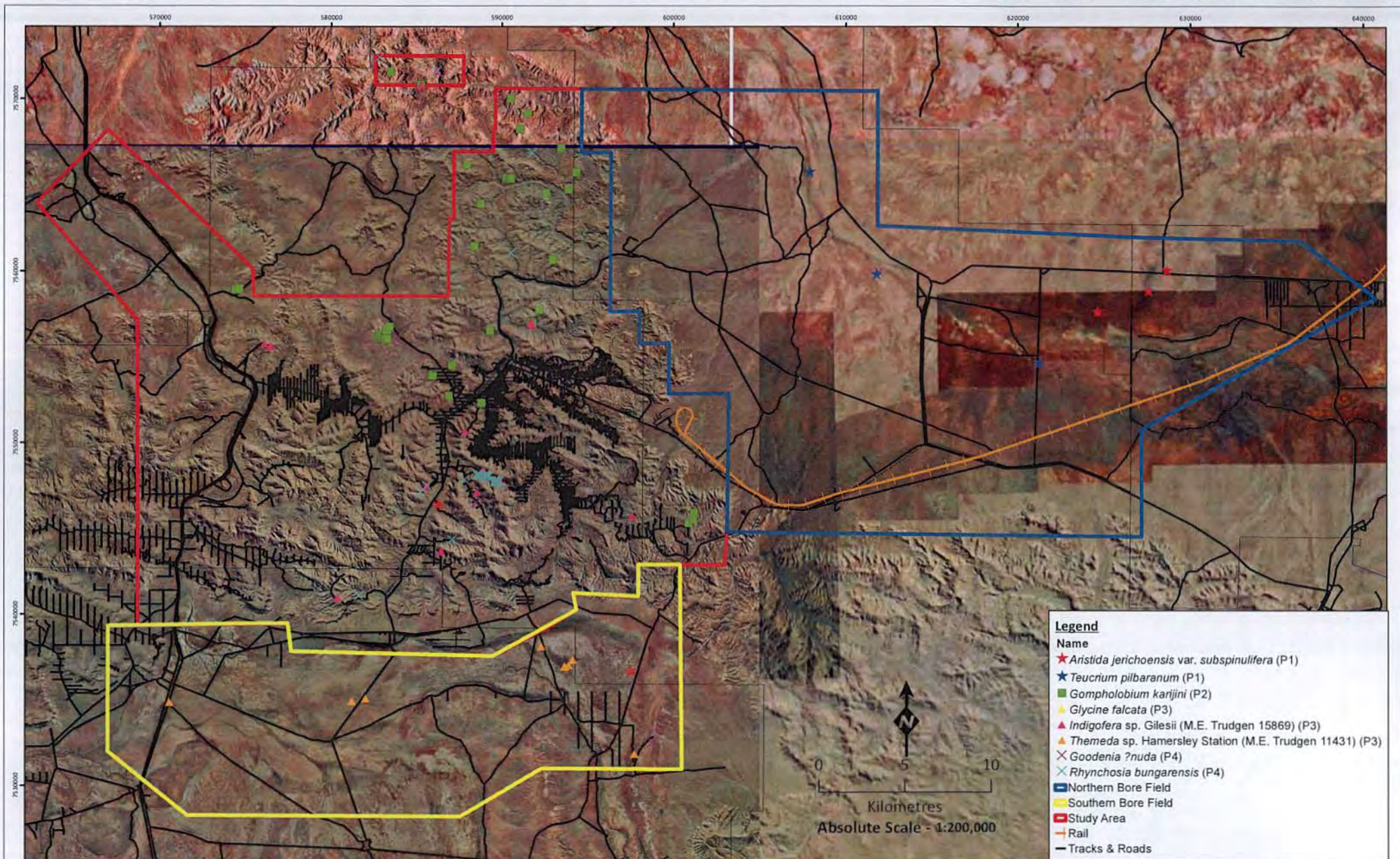


Table 3.4 – Coordinates of Priority flora species and number of plants recorded

Status	Taxon	Date	Number of plants	Zone	Easting	Northing
P1	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	30-Apr-14	1	50K	628626.6	7560063.9
		02-May-14	1	50K	597458.6	7536694.3
		30-Apr-14	10	50K	627553.7	7558872.1
	<i>Teucrium pilbaranum</i>	01-May-14	1000	50K	621227.2	7554641.5
P2	<i>Gompholobium karjini</i>	26-Apr-14	1	50K	585242.8	7570805.9
		26-Apr-14	1	50K	593426.1	7567129.6
		26-Apr-14	10	50K	596109.1	7561515.9
		26-Apr-14	1	50K	583474.0	7571576.9
		26-Apr-14	2	50K	591476.5	7569166.8
		25-Apr-14	1	50K	591667.3	7557031.3
		25-Apr-14	1	50K	589275.1	7556534.3
		25-Apr-14	5	50K	591739.2	7556895.1
		25-Apr-14	1	50K	591744.0	7556914.0
		25-Apr-14	2	50K	591702.0	7556960.0
		28-Apr-14	5	50K	588730.0	7552244.0
		28-Apr-14	4	50K	588682.0	7552231.0
		28-Apr-14	13	50K	588652.0	7552178.0
		28-Apr-14	15	50K	588620.0	7552132.0
		28-Apr-14	10	50K	588599.0	7552045.0
		03-May-14	1	50K	601161.6	7545880.1
		03-May-14	5	50K	601104.1	7545486.3
		03-May-14	200	50K	600841.4	7545292.7
		26-Apr-14	5	50K	590203.0	7565404.0
P3	<i>Glycine falcata</i>	02-May-14	1	50K	581988.0	7535085.0
	<i>Indigofera</i> sp. <i>Gilesii</i> (M.E. Trudgen 15869)	26-Apr-14	5	50K	585242.8	7570805.9
		28-Apr-14	1	50K	587847.1	7550663.0
		25-Apr-14	1	50K	591667.3	7557031.3
		03-May-14	1	50K	597539.6	7545727.4
		02-May-14	1	50K	576396.3	7555597.0
		25-Apr-14	2	50K	591726.0	7556810.6
		25-Apr-14	10	50K	591732.0	7556831.0
		25-Apr-14	5	50K	591750.0	7556912.0

Status	Taxon	Date	Number of plants	Zone	Easting	Northing
P3	<i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869)	25-Apr-14	10	50K	591704.0	7556948.0
		04-May-14	3	50K	586411.0	7543653.0
		26-Apr-14	2	50K	590438.0	7565408.0
	<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	02-May-14	1000	50K	581988.0	7535085.0
		02-May-14	60	50K	581161.0	7534924.0
		27-Apr-14	1	50K	593632.4	7536938.9
		27-Apr-14	1	50K	594072.3	7537325.5
		24-Apr-14	100000+	50K	570523.4	7534872.3
		02-May-14	1000	50K	597659.7	7531849.4
		27-Apr-14	100	50K	592234.7	7538103.7
		27-Apr-14	100	50K	592237.0	7538105.0
		27-Apr-14	2	50K	593582.2	7536926.0
		27-Apr-14	100	50K	593844.9	7537014.1
P4	<i>Goodenia</i> ?nuda	02-May-14	1	50K	598841.0	7533268.0
		02-May-14	3	50K	598707.4	7532515.3
	<i>Rhynchosia</i> bungarensis	27-Apr-14	5	50K	590527.1	7561083.1
		28-Apr-14	1	50K	585213.4	7547086.1
		04-May-14	3	50K	581590.8	7541081.8
		04-May-14	1	50K	587063.1	7544327.4
		03-May-14	1	50K	587813.9	7547858.6

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JULY 2014



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**FORTESCUE METALS GROUP
SOLOMON - VERTEBRATE FAUNA AND SRE INVERTEBRATE
FAUNA SURVEY
SUMMARY REPORT**

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FORTESCUE METALS GROUP
SOLOMON - VERTEBRATE FAUNA AND SRE INVERTEBRATE
FAUNA SURVEY
SUMMARY REPORT

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1 PROJECT BACKGROUND AND SCOPE

Fortescue Metals Group (Fortescue) is an integrated business comprised of mines (Chichester and Solomon Hub), rail (main line and Hamersley line) and port operations (Port Hedland) based in the Pilbara region of Western Australia, with its head office located in Perth. Fortescue is investigating options to expand the Solomon Hub, including the expansion of the mine footprint, the development of new bore fields and new resources ('the project'). To facilitate approvals, Fortescue has commissioned *ecologia* to complete a Level 2 Vertebrate fauna and SRE assessment.

The survey area is approximately 183,200 hectares in size and comprises 4 survey areas- a Northern exploration area; Southern bore field; Northern bore field and power line corridor (Figure 2.1). The survey area is located on Mt Florance, Coolawanyah and Hamersley Stations, as well as Unallocated Crown Land (UCL). The overarching objective is to prepare a comprehensive and consolidated terrestrial vertebrate fauna and fauna habitat assessment report to support primary environmental approvals for the project.

The survey was conducted to determine the impacts of the development on native fauna and habitat, in particular those species of conservation significance. This report details the preliminary results of the survey conducted in April-May 2014.

The Pilbara region supports a number of rare species which may be impacted by the development. The key aims of the survey were:

- Compliment previous survey effort to determine the faunal assemblages present within the proposed impact areas of the project;
- Determine the suitability of habitat to support species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (including Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat), and where suitable habitat exists, undertake a search for secondary evidence;
- Determine the suitability of the habitat to support any other rare fauna potentially impacted by the project as determined through literature reviews and consultation with the DPaW.

2 SURVEY METHODS

The survey methods adopted by *ecologia* are aligned with the EPA's Guidance Statement No. 56 (EPA 2004b), Position Statement No. 3 (EPA 2002), *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010) and EPA guidance Statement No. 20 – *Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia*. In addition, Fortescue's *Terrestrial Vertebrate Fauna Assessment Guidelines* (100-GU-EN-0006) and Fortescue's *Short Range Endemic Invertebrate Fauna Assessment Guidelines* (100-GU-EN-0007) were considered when the survey program was designed.

Surveying was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (NHMRC 2004). In all cases, vertebrate fauna were identified in the field and released at the point of capture.

2.1 SURVEY TIMING

The Level 2 vertebrate fauna assessment was conducted in autumn (22nd April to 3rd May 2014). The survey timing was determined as per guidelines (DEWHA 2010; DSEWPac 2011a, b, c; EPA 2004a; EPA and DEC 2010; FMG 2011). A team of ten zoologists opened the first sites on the 23rd April. The last of the sixteen sites was opened on the 26th April. All sites remained open for seven nights, with the first being closed on the 30th April and the last closed on the 3rd May.

Eight zoologists were present for the majority of the program, each working 11-13 days on site (including travel time). Two additional zoologists worked for 8 days each on the site. A total of 108 person days was invested in the survey.

Table 2.1 – Survey Team and qualifications

Survey Team	Qualifications	Specialization	Experience
Damien Cancilla	BSc. (Hon)	Mammology	9 years
Astrid Heidrich	MSc.	Herpetology/Mammology	7 years
Sean White	BSc. (Hon)	Invertebrates	7 years
Jordan Vos	-	Herpetology/Ornithology	5 years
Leigh Smith	Cert. of Vet Nursing	Herpetology	4 years
John Graff	BSc.	Ornithology	4 years
Paul Anderson	-	Zoology	1 year
Farhan Bokhari	BSc.	Invertebrates	5 years
Kellie McMaster	PhD, BSc.	Flora/Zoology	6 years/1 year
Plaxy Barratt	BSc.	Ornithology	3 years

2.2 SITE SELECTION

As part of the survey planning, all previous vertebrate fauna studies (Coffey 2010; Outback Ecology 2014), sampling and habitat mapping within the study area (Rapallo (2011), *ecologia* (ecologia 2010, 2011, 2013a, b) and Ecoscape (2013)) were consolidated which allowed the identification of survey gaps. Previous survey information, land system mapping, pre-European vegetation mapping (Shepherd *et al.* 2002) and aerial photography information were then utilised to identify fauna habitats that are expected to occur within the study area. In addition, the number of previous survey sites located in each habitat type was determined to allow further identification of survey gaps (Table 1).

The locations of the previous vertebrate fauna systematic surveys have focused on the Hamersley range and proposed impact areas of the Solomon mine site. Very limited survey effort has been expended in the alluvial floodplains associated with the Fortescue River valley and some gaps existed near the Solomon mine that were previously outside of the current proposed impact areas.

Preliminary habitat mapping has shown that a total of eleven broad scale habitat types occur in the study area (including both Borefield areas). Substantial survey effort had previously been expended in the most common habitat type (Plain (Stony gibber) which includes hillslopes) with additional survey effort focused in common habitat types such as Cracking Clay Plains, Drainage Lines, Hummock grassland and Woodlands. Therefore, where inadequate assessments have been carried out, additional trap sites were established. In areas adequately surveyed during previous assessments, less survey effort was required. The gap analysis indicated that habitats associated with the Fortescue river valley (Floodplain/alluvial plain, Shrubland and tussock grassland) had not been adequately surveyed. Geographically, several additional areas within the study area had not been systematically surveyed, even though habitat types that occur in these areas have been previously assessed. For this reason, additional trap sites were established within these areas during this survey.

Table 2.2 – Habitat types and survey sites

Habitat	Percent of survey area (preliminary)	Previous trap sites		Current trap sites	
		Solomon area	Bore field (south and east)	Solomon area	Bore field (south and east)
Drainage line/River/Creek (Major)	2	10	3	1	1
Plain (stony gibber) and hillslopes (includes lower slopes and midslopes)	45	43	1	3	2
Plain (Cracking clay)	10	n/a	6		3
Hummock grassland	6	9	-		1
Plain (alluvial/floodplain) with open mulga woodland	11	n/a	12	-	1
Shrubland (Open)	5	-	2	1	
Hills/ranges/plateaux	13	7	n/a	1	
Gorges/Gullies	1	2	n/a		
Woodland (Open Eucalypt)	3	n/a	2		
Plain (stony calcrete)	3	n/a	4		2
Tussock grassland (on loam/clay)	<1				
Total	100	71	30	6	10

Three creeklines exist within the Solomon study area: Kangeenarina creek, Weelumurra creek and Zalamea creek. Of these, two creeklines (Kangeenarina creek and Zalamea creek) had been sampled during previous Level 2 fauna assessments. During this survey, one trap site was set up at the remaining creekline (Weelumurra creek) and previous sampling effort was complimented with targeted searches along all three creeklines.

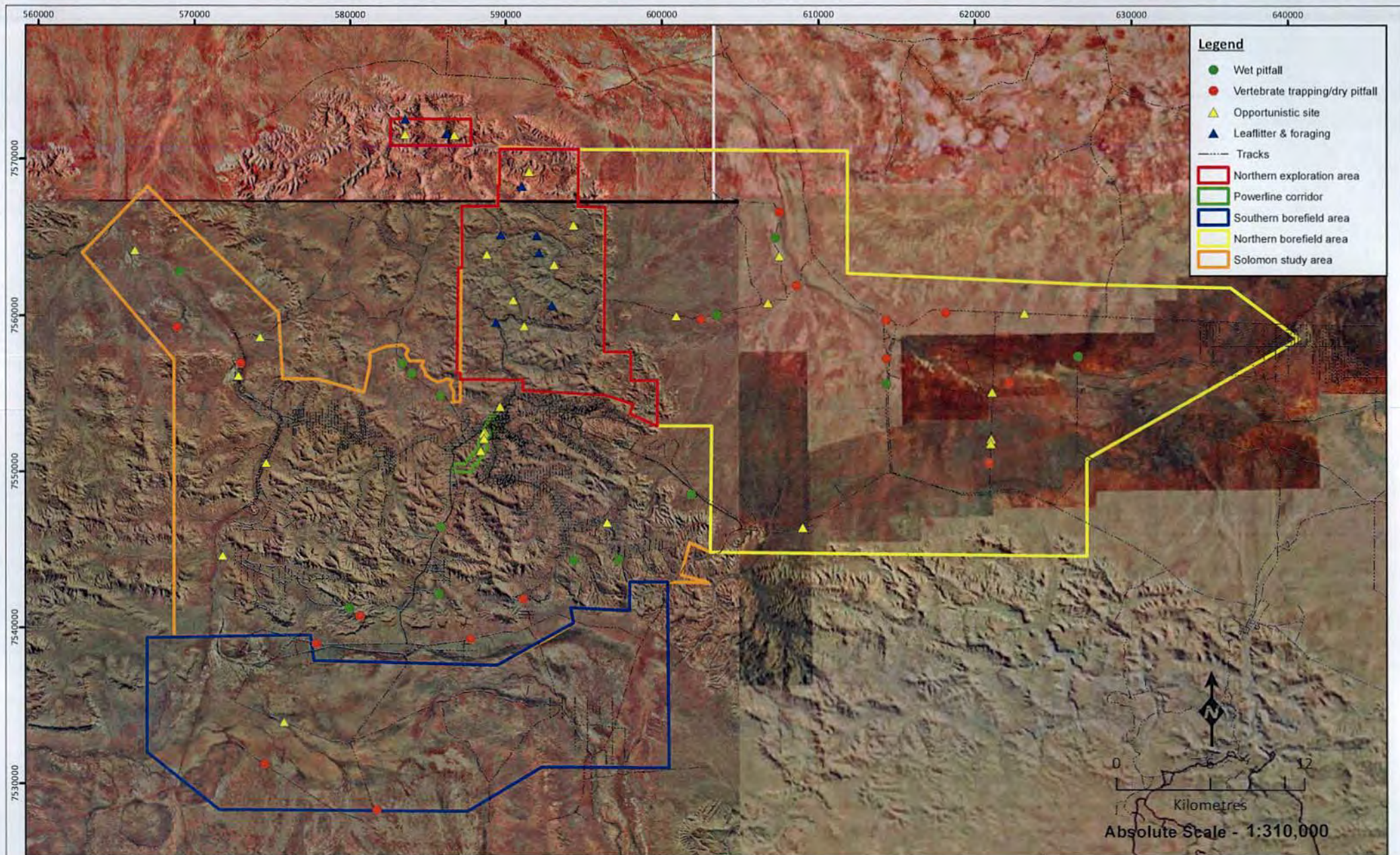
In addition to trapping, targeted searches were undertaken of potentially sensitive habitats and habitat supporting conservation significant species. A total of 38 motion cameras were set up across the Solomon study area. Of these, 20 motion cameras were located within the Northern exploration tenements (across 8 sites). All motion cameras were set-up and will be collected during the targeted survey resulting in cameras established for up three months.

SM2 Bat recorders were set up at 22 locations to compliment the previous analysis of the existing bat assemblage within the study area.

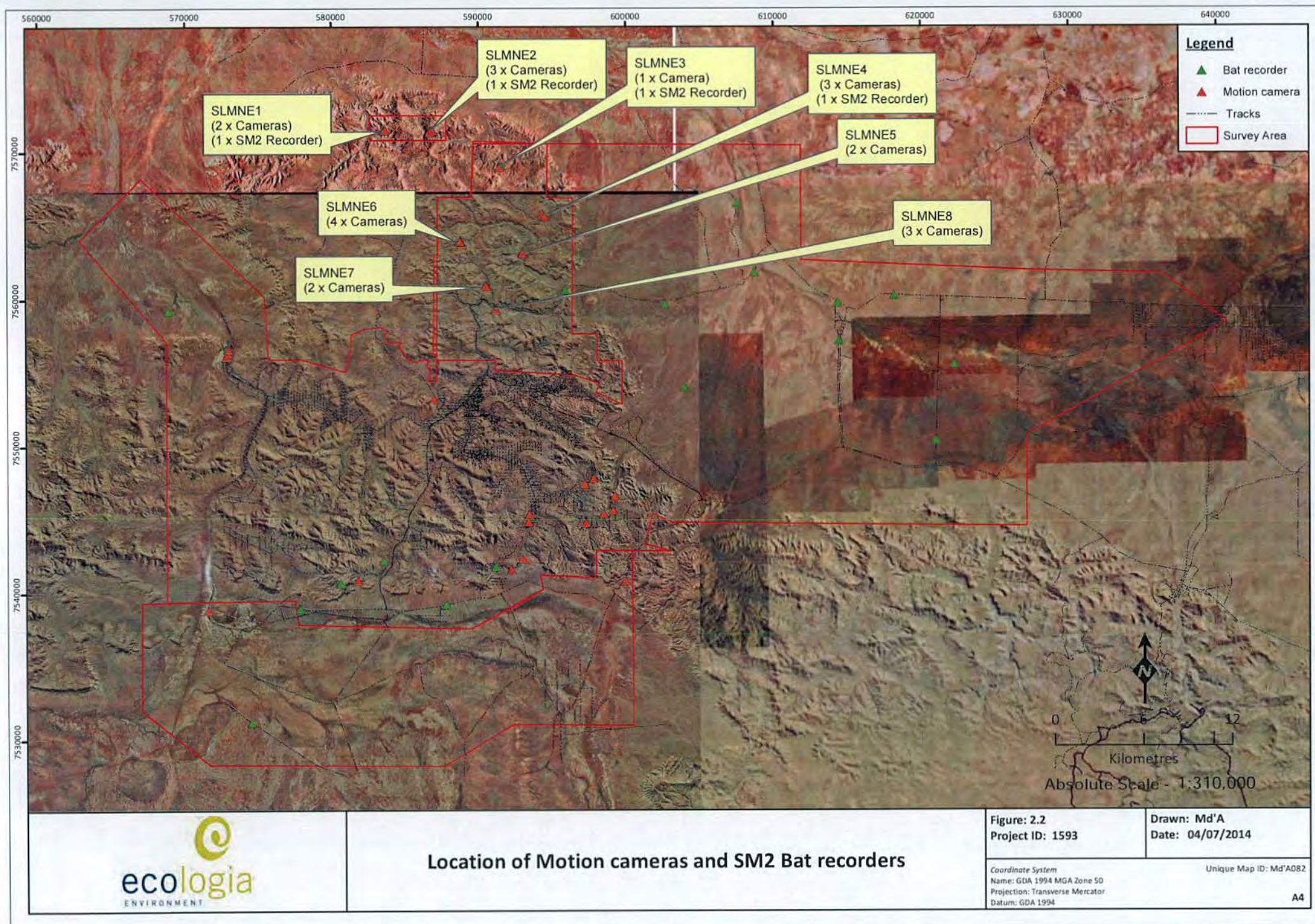
The set-up of the trap sites was spread over six Land Systems within the study area. Five of the 16 trap sites were installed within the Boolgeeda Land System, four trap sites were established within Coolibah Land System, two trap sites were located within Newman Land System, one site was set up within River Land System, two sites were installed within Hooley Land System and the remaining two trap sites were set up within the Urandy Land System.

SRE Wet pitfall sites were established in areas not previously surveyed, in particular within the eastern and southern Borefield (Figure 2.1). A total of 14 wet pitfall sites were set up across the study area. In addition, leaf litter samples were taken from eight sites within the Northern exploration tenements and foraging searches were undertaken at 28 locations.

Locations and details of all survey sites sampled and searched during the survey are presented in Appendix A and mapped in Figure 2.1 and Figure 2.2 (below). Site photographs and descriptions of all trap sites are presented in Appendix B and Appendix C.



- Legend**
- Wet pitfall
 - Vertebrate trapping/dry pitfall
 - ▲ Opportunistic site
 - ▲ Leaf litter & foraging
 - Tracks
 - Northern exploration area
 - Powerline corridor
 - Southern borefield area
 - Northern borefield area
 - Solomon study area



2.3 SAMPLING EFFORT

The survey was undertaken using a range of sampling techniques including systematic, opportunistic and targeted sampling. Systematic sampling refers to data methodically collected over a fixed time period in a discrete habitat type, using an equal or standardised sampling effort. The resulting information can be analysed statistically, facilitating comparisons between habitats. Opportunistic sampling includes data collected non-systematically from both fixed sampling sites and as opportunistic records from chance encounters with fauna, and targeted sampling includes data collected from specific habitats identified as potentially suitable for conservation significant species known from the area (i.e. Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat, Ghost Bat, Bush Stone-curlews, Western Pebble-mound Mouse etc).

Vertebrate fauna survey effort expended within the study area included the following:

- trapping grids were open for 4,704 trapnights;
- approximately 36.1 hours were spent surveying for birds;
- 15.5 hours were spent on opportunistic diurnal searching;
- 14 hours were spent on opportunistic nocturnal searching;
- 8.5 hours were spent searching for Northern Quoll within potential foraging and denning habitat;
- 8.5 hours were spent searching for Pilbara Olive Python along rocky gorges and major drainage lines;
- trapping grids were open for 588 trapnights targeting the Short-tailed Mouse within cracking clay habitats;
- 17.6 hours were spent searching for Western Pebble-mound Mouse within suitable habitat;
- 14 hours were spent on nocturnal searches for Bush Stone-curlews, including play-back calls;
- two hours were spent on searches targeting the Fortescue Grunter, including the set up of fish traps;
- 228 hours of recordings were analysed to determine bat assemblage and distribution.
- A total of 38 motion cameras have been deployed across the study area and will be collected during the targeted survey.

Total survey effort for vertebrate fauna per site is presented in Table 2.3.

Invertebrate SRE fauna survey effort expended within the study area included the following:

- 14 wet pitfall sites (with five pitfalls each) were deployed across the study area;
- 16 dry pitfall sites were set up over seven nights of trapping, totalling 3,360 trapnights;
- 66 leaf litter collections were taken from 22 locations across the study area;
- 35.5 hours were spent on foraging for terrestrial invertebrate fauna;

Total survey effort for invertebrate fauna per site is presented in Table 2.4.

Table 2.3 – Survey Effort (vertebrate fauna)

Site	Pit Traps (trap nights)	Funnels (trap nights)	Elliotts (trap nights)	Cages (trap nights)	Bird Survey (min)	Diurnal Opp. Search (min)	Bat Recording (hours)	Nocturnal Opp. Search (min)
SLM 1	70	140	70	14	120	-	12	-
SLM 2	70	140	70	14	120	120	12	-
SLM 3	70	140	70	14	120	-	12	-
SLM 4	70	140	70	14	120	-	12	-
SLM 5	70	140	70	14	120	-	24	-
SLM 6	70	140	70	14	120	-	24	-
SLM 7	70	140	70	14	120	-	12	-
SLM 8	70	140	70	14	120	-	-	-
SLM 9	70	140	70	14	120	-	12	-
SLM 10	70	140	70	14	90	-	12	-
SLM 11	70	140	70	14	120	-	12	-
SLM 12	70	140	70	14	90	-	12	-
SLM 13	70	140	70	14	90	-	-	-
SLM 14	70	140	70	14	90	-	-	-
SLM 15	70	140	70	14	120	-	-	-
SLM 16	70	140	70	14	160	-	12	-
Opportunistic	-	-	-	-	330	930	60	840
Total	1,120	2,240	1,120	224	2,170	930	228	840

Table 2.4 – Survey Effort (SRE invertebrate fauna)

Site	Wet pitfall Traps (trap nights)	Leaf litter collection (no.)	Foraging (min)	Dry pitfalls including funnels (trap nights)
SRE 1	-	3	60	-
SRE 2	-	3	60	-
SRE 3	-	3	60	-
SRE 4	-	3	60	-
SRE 5	-	3	60	-
SRE 6	-	3	60	-
SRE 7	-	3	60	-
SRE 8	-	3	60	-
SRE A	ongoing	3	60	-
SRE B	ongoing	3	60	-
SRE C	ongoing	3	60	-
SRE D	ongoing	3	60	-
SRE E	ongoing	3	60	-
SRE F	ongoing	3	60	-
SRE G	ongoing	3	60	-
SRE H	ongoing	3	60	-
SRE I	ongoing	3	60	-
SRE J	ongoing	3	60	-
SRE K	ongoing	3	60	-
SRE L	ongoing	3	60	-
SRE M	ongoing	3	60	-
SRE N	ongoing	3	60	-
SLM S1	-	-	-	210
SLM S2	-	-	-	210
SLM S3	-	-	-	210
SLM S4	-	-	-	210
SLM S5	-	-	-	210
SLM S6	-	-	-	210
SLM S7	-	-	-	210
SLM S8	-	-	-	210

Site	Wet pitfall Traps (trap nights)	Leaf litter collection (no.)	Foraging (min)	Dry pitfalls including funnels (trap nights)
SLM S9	-	-	-	210
SLM S10	-	-	-	210
SLM S11	-	-	-	210
SLM S12	-	-	-	210
SLM S13	-	-	-	210
SLM S14	-	-	-	210
SLM S15	-	-	-	210
SLM S16	-	-	-	210
Opportunistic sites	-	-	810	-
Total	14 sites	66	2,130	3,360

3 RESULTS

3.1 FAUNA HABITATS

A total of 11 broad fauna habitats were recorded from the study area:

- Drainage line/River/Creek (Major)
- Plain (stony gibber) (includes lower slopes and midslopes)
- Plain (Cracking clay)
- Hummock grassland
- Plain (Alluvial)
- Shrubland (Open)
- Hills/Ranges/plateaux
- Gorges/Gullies
- Woodland (Open Eucalypt)
- Plain (stony calcrete)
- Tussock grassland (on loam/clay)

All 11 broad habitat types were present within and outside the study area and are not unique to the study area.

Of these, the Gullies/Gorges habitat type is considered as suitable habitat for:

- Northern Quoll (critical denning habitat)
- Pilbara Olive Python,

The Drainage line/River/Creek (Major) is considered as suitable habitat for:

- Northern Quoll (dispersal)
- Pilbara Leaf-nosed Bat (foraging)
- Pilbara Olive Python,

The Hills/Ranges/Plateaux habitat type is considered suitable dispersal habitat for Northern Quoll. Habitats for federally listed (non-migratory) species known from the region are mapped in Figure 3.15.

3.1.1 Drainage line/River/Creek (Major)

The Drainage line/River/Creek (Major) habitat occurred across the study area, but mostly to the west (Figure 3.13). This habitat supported mature *Eucalyptus victrix* trees with patches of dense mixed *Acacia* spp. shrubs and tussock grasses such as *Themeda triandra*, *Chrysopogon fallax* and/or *Cenchrus ciliaris* lining the banks. The trees of the major drainage line habitat contained varying sized hollows and an abundance of woody debris (Figure 3.13). Leaf litter was abundant on the banks and under large trees. The substrate of the major drainage line was a clay-loam on the banks and a continuous bed of smooth river pebbles in larger areas of the creek.



Figure 3.1 – Drainage line/River/Creek (Major) recorded from the study area

3.1.2 Plain (stony gibber) (includes lower slopes and midslopes)

The Plain (stony gibber) habitat type, which includes lower slopes and midslopes, was a large habitat within the study area (Figure 3.13). This habitat was the third most elevated of the habitat types following the hilltop habitat type and the gorge and gully habitat type. It was mainly found in the northern section of the study area. This habitat consisted of a very open to open shrubland of *Acacia aptaneura*, *A. pruinocarpa*, *A. binevosa* and *Senna glutinosa* over *Triodia wiseana* hummock grassland on a continuous layer of bedrock and scattered pebbles and stones (Figure 3.2). Wood litter and leaf litter was generally sparse in this habitat.



Figure 3.2 – Stony spinifex plain and hillslopes recorded from the study area

3.1.3 Plain (Cracking clay)

The cracking clay grasslands plain occupied the majority of the south of the study area (Figure 3.13). The cracking clay plains comprised a unique habitat type that contained little to no overstorey and was dominated by one or two tussock grass species (Figure 3.3). The vegetation was described as isolated shrubs of *Sida spinosa* and/or *Vachellia farnesiana* located amongst dense tussock grassland dominated by *Chrysopogon fallax*, *Themeda* sp. Hamersley Station (P3) and/or *Astrebla pectinata* grass species. The soils comprised firm cracking clays containing abundant cracks and crevices. Rocks/stones/pebbles, leaf litter and woody debris were almost entirely lacking from this habitat type.



Figure 3.3 – Cracking clay recorded from the study area

3.1.4 Hummock grassland

The hummock grassland plains habitat was limited to the south-west of the study area (Figure 3.13). The vegetation was characterised by isolated trees of *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* over sparse to medium dense *Acacia/Senna* spp. shrubs over *Triodia epactia/pungens* hummock grassland over a loam substrate (Figure 3.13). These often undulating plains consisted of firm, red, fine clay-sands with numerous loose rocks. The amount of leaf litter and woody debris was usually low within these habitats.



Figure 3.4 – Hummock grassland recorded from the study area

3.1.5 Plain (Alluvial)

This habitat type was limited to the eastern and southern Borefields of the study area (Figure 3.13). It was most often characterised by mulga open woodland to woodland, occasionally with *Acacia citrinoviridis*, over *Acacia* spp. scattered shrubs to high open shrubland over *Chrysopogon fallax* and *Eragrostis* spp. tussock grassland and/or spinifex very open hummock grassland (Figure 3.5). However, there were patches of *Triodia epactia* open hummock grassland with *Acacia xiphophylla* (snakewood) scattered tall shrubs and isolated low trees (Figure 3.6). The substrate of this habitat was observed to be firm, red-brown, loamy clay, with some surface crust and cracks with common ironstone gravel of pebbles and stones or occasionally with calcrete stones. Areas of mulga woodland had fairly sparse leaf litter accumulated under shrubs/trees and moderate wood litter. All areas were observed to be long unburnt.



Figure 3.5 – Plain (Alluvial) with Acacia (mulga) woodland recorded from the study area



Figure 3.6 – Patch of snakewood (*Acacia xiphophylla*), within the alluvial plain habitat, recorded from the study area

3.1.6 Shrubland (Open)

The open shrubland habitat was mostly recorded in the southern borefield, but also had smaller occurrences across the study area (Figure 3.13). The vegetation of this habitat was dominated by an open mixed shrubland to high shrubland of *Acacia* spp., including *Acacia aptaneura*, *Acacia atkinsiana*, *Acacia synchronicia* and other *Acacia* spp. over spinifex hummock grassland and occasionally with *Corymbia hamersleyana* or *Acacia aptaneura* isolated trees (Figure 3.7). Soils in this habitat were firm, red-brown loamy clay with continuous ironstone pebble gravel. This habitat contained only minimal woody debris and leaf litter, mostly accumulated under the larger shrubs and trees.



Figure 3.7 – Shrubland (Open) recorded from the study area

3.1.7 Hills/Ranges/Plateaux

The Hills/Ranges/Plateaux habitat was limited to the northern and central section of the study area and occupied the majority of habitat within the Solomon Mine area and the Northern Exploration tenements (Figure 3.13). This was the most elevated habitat type within the study area. Cliffs existed along the side of ridges and hills where hillslopes broke away into sheer rock faces. The crevices and caves which occur in cliff faces can provide shelter for a range of fauna species. Vegetation in this habitat was dominated by *Triodia wiseana* open hummock grasslands, with *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees and occasional shrubs including *Acacia bivenosa*, *Acacia hamersleyensis* and subspecies of *Senna glutinosa* on a continuous layer of bedrock and scattered pebbles and stones (Figure 3.8).



Figure 3.8 –Hills/ Ranges/ Plateaux habitat type recorded from the study area

3.1.8 Gorges/Gullies

The gorge and gully habitat type was limited to areas adjacent to the hills/ ranges/ plateaux habitat type (Figure 3.13). It was a minor habitat type, but due to the sheltered nature of this habitat, it provides a microclimate that is more shaded, slightly cooler and often more humid than surrounding open areas of hillslopes and plains and thus, can act as a refuge for a number of specialised vertebrate and invertebrate fauna species. Further, due to the rocky cliffs and breakaways associated with gorges and gullies, there are often crevices and caves in this habitat that can provide shelter for a range of fauna species (Figure 3.9). The vegetation of the gorges/gully habitat was broadly described as *Eucalyptus leucophloia* subsp. *leucophloia*, and/ or *Acacia citrinoviridis* low woodland over *Acacia bivenosa* and other *Acacia* spp. tall scattered shrubs to high open shrubland over *Cymbopogon ambiguus* and *Eriachne mucronata* very open tussock grassland and *Triodia wiseana* very open hummock grassland on areas of large boulders, outcropping and bedrock, with skeletal red-brown sandy clay loam soils.



Figure 3.9 – Gorge and gully habitat recorded from the study area

3.1.9 Woodland (Open Eucalypt)

The Woodland (Open Eucalypt) was a minor habitat type within the study area and was limited to the south of the study area (Figure 3.13). This habitat type consisted of moderately dense *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* trees over *Acacia* spp. shrubs over mixed tussock and hummock grasslands on loam or clay soils with pebbles present (Figure 3.10). Wood litter was usually sparse to moderately dense. Leaf litter can build up over time in denser areas which have not been subject to fire, such as the acacia thickets.



Figure 3.10 – Eucalypt woodland over grassland plain recorded from the study area

3.1.10 Plain (Stony Calcrete)

The stony calcrete plain habitat was limited to the southern and eastern Borefield and was associated with, but not limited to, the Calcrete and Coolibah Landsystems (Figure 3.13). The two areas of calcrete plains were located adjacent to major drainage lines. Vegetation of the stony calcrete plains was described as *Eucalyptus victrix* and/or *Corymbia hamersleyana* isolated low trees over *Acacia wanyu*, *A. synchronicia*, *Hakea lorea* and *Melaleuca* sp. scattered shrubs to high open shrubland over *Triodia epactia* hummock grassland, occasionally also with **Cenchrus ciliaris* open tussock grassland (Figure 3.11). The substrate of this habitat was firm red-brown clay-loam with a 30-70% cover of pebble gravel and only sparse leaf litter or woody debris.



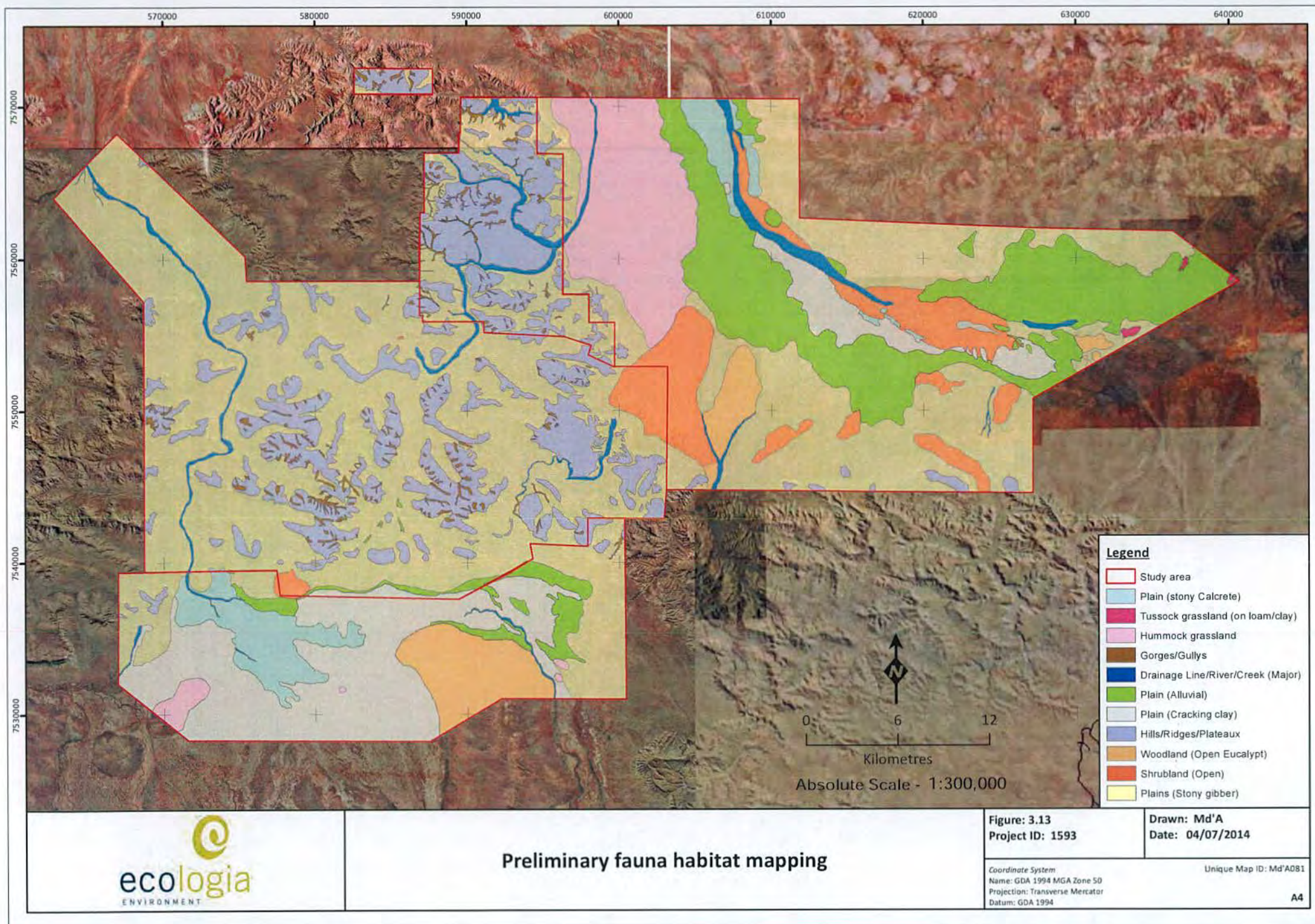
Figure 3.11 – Plain (Stony Calcrete) habitat recorded in the study area

3.1.11 Tussock grassland (on loam/clay)

The tussock grassland predominately occurred to the east of the study area and bordered the mulga woodland of the study area (Figure 3.13), which sometimes created large ecotones between the two habitat types. The vegetation within the tussock grasslands was dominated by *Eragrostis* spp., *Themada* spp., and *Astrebla* spp., with sparse *Acacia* sp. and **Vachellia farnesiana* shrubs and occasional *Eucalyptus* sp. and *Acacia* sp. trees (Figure 3.12). Soil within the area was relatively bare and contained almost no leaf litter and woody debris. The soil varied from weakly formed cracking clays to firm clay-loam. The tussock grassland habitat of the study area was heavily grazed by cattle.



Figure 3.12 – Tussock grassland habitat recorded from the study area



3.2 FAUNA ASSEMBLAGE

During the survey, 14 non-volant mammals, nine volant mammals, 81 birds, 69 reptiles and three amphibians, totalling 176 vertebrate fauna species recorded.

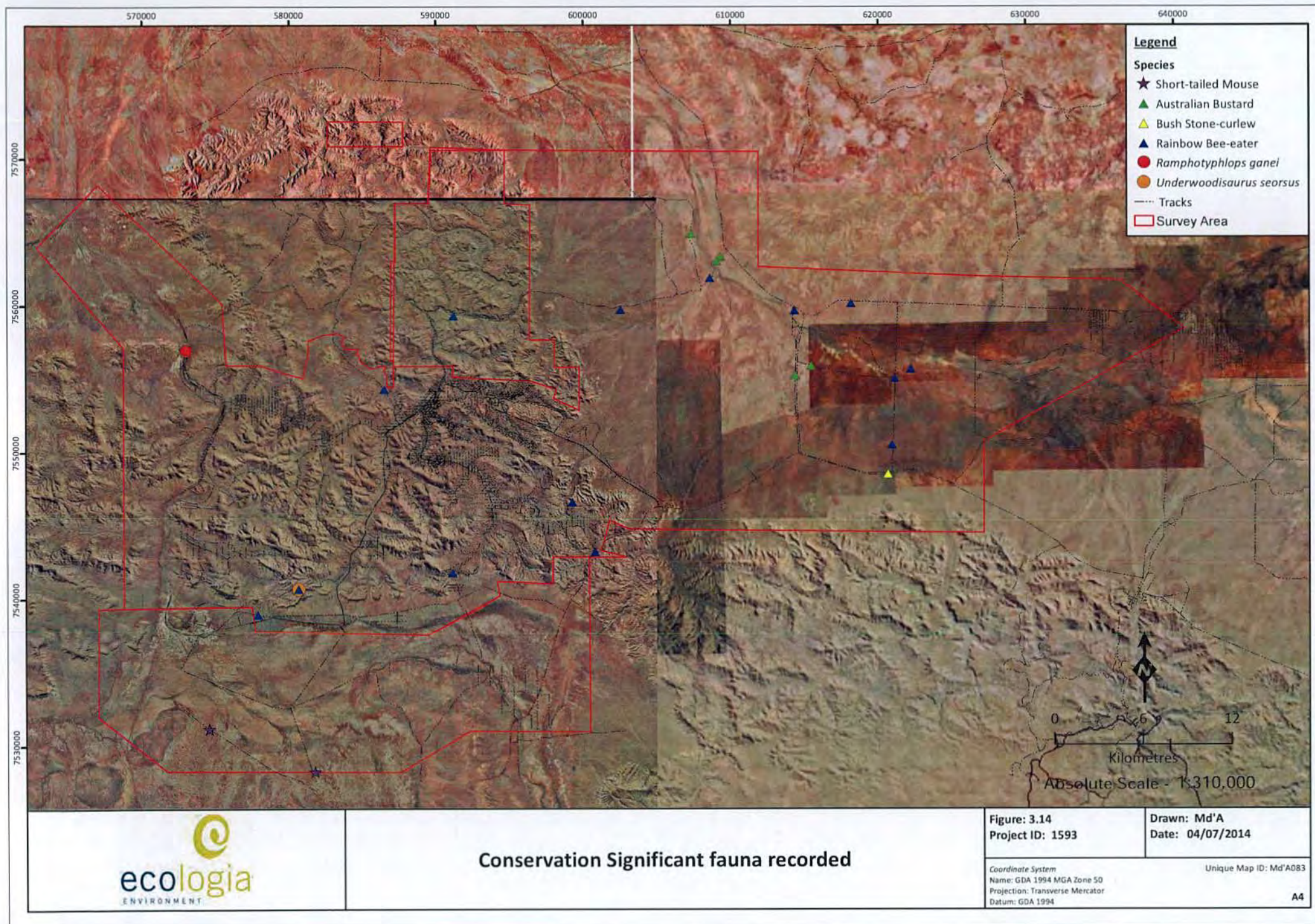
Six conservation significant species were recorded: Short-tailed Mouse (*Leggadina lakedownensis*; Priority 1), the blindsnake *Ramphotyphlops ganeii* (Priority 1), Pilbara Barking Gecko (*Underwoodisaurus seorsus*; Priority 1), Bush Stone-curlew (*Burhinus grallarius*; Priority 4), Australian Bustard (*Ardeotis australis*; Priority 4) and Rainbow Bee-eater (*Merops ornatus*; Migratory, Schedule 3). Details of each sighting are listed in Table 3.1 and all locations are mapped in Figure 3.14.

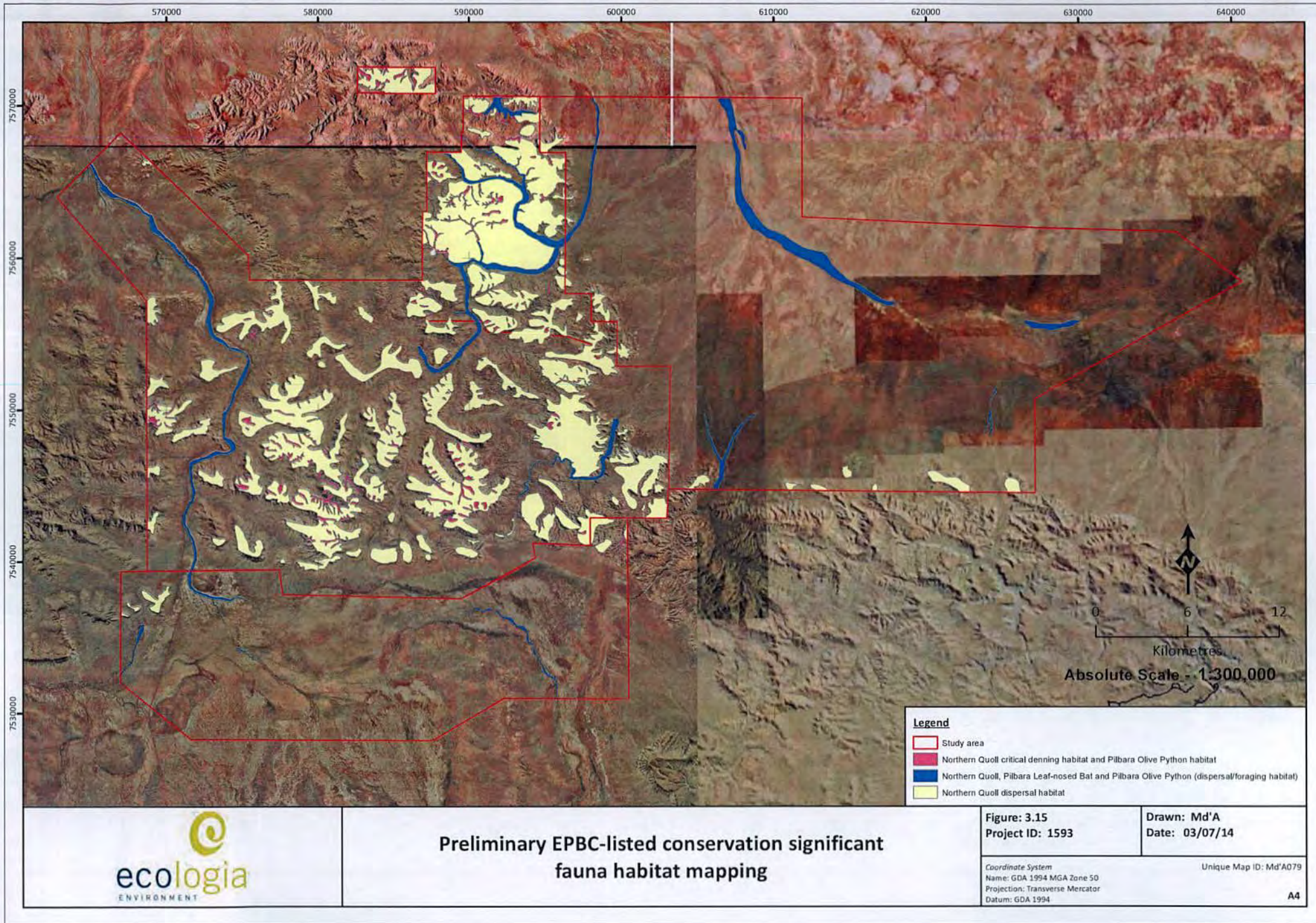
Table 3.1 – Conservation Significant fauna recorded

Species	Conservation status	Coordinates		Site	Counts
		Easting	Northing		
Short-tailed Mouse (<i>Leggadina lakedownensis</i>)	P4	574464	7531208	SLM S7	3 records
		581685	7528272	SLM S8	2 records
Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i>)	P1	580596	7540709	SLM S3	1 individual
A blindsnake (<i>Ramphotyphlops ganeii</i>)	P1	572922	7556943	SLM S2	1 individual
Bush Stone-curlew (<i>Burhinus grallarius</i>)	P4	620657	7548535	Opportunistic	2 individuals
Australian Bustard (<i>Ardeotis australis</i>)	P4	609281	7563336	Opportunistic	2 individuals
		607274	7564917	Opportunistic	1 individuals
		615413	7555905	Opportunistic	1 individuals
		614355	7555276	Opportunistic	1 individuals
		608994	7563035	Opportunistic	3 individuals
Rainbow Bee-eater (<i>Merops ornatus</i>)	M	580596	7540709	SLM S3	1 individual
		577802	7538938	SLM S5	5 records
		591100	7541803	SLM S6	2 individuals
		602506	7559729	SLM S9	3 records
		608576	7561881	SLM S11	21 records
		614304	7559688	SLM S12	2 individuals
		618131	7560148	SLM S13	1 individual
		622204	7555686	SLM S15	1 individual
		620922	7550522	SLM S16	4 records
		591173	7559308	SLM OS17	
		586468	7554328	Opportunistic	2 individuals
		621099	7555057	Opportunistic	1 individual
		600762	7543218	Opportunistic	1 individual
		599222	7546602	Opportunistic	1 individual

Zone: 50K
Datum: GDA94

SRE invertebrate samples from foraging and leaf litter collections are currently being processed. SRE wet pitfall traps will be collected during the targeted survey in July 2014 and samples will be processed and sent to external taxonomists for identification.





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APPENDIX A VERTEBRATE FAUNA SITE LOCATIONS

Site	Survey Type	Location		Habitat	Land System
		Easting	Northing		
SLM S1	Vertebrate Fauna Trapping / SRE Dry Pitfall	568867	7559252	Rocky plain	Boolgeeda
SLM S2	Vertebrate Fauna Trapping / SRE Dry Pitfall	572922	7556943	Major Drainage line	River
SLM S3	Vertebrate Fauna Trapping / SRE Dry Pitfall	580596	7540709	Hilltop	Newman
SLM S4	Vertebrate Fauna Trapping / SRE Dry Pitfall	587738	7539222	Rocky plain	Boolgeeda
SLM S5	Vertebrate Fauna Trapping / SRE Dry Pitfall	577802	7538938	Mixed shrubland	Boolgeeda
SLM S6	Vertebrate Fauna Trapping / SRE Dry Pitfall	591100	7541803	Rocky footslope/plain	Newman
SLM S7	Vertebrate Fauna Trapping / SRE Dry Pitfall	574465	7531208	Cracking clay plain	Hooley
SLM S8	Vertebrate Fauna Trapping / SRE Dry Pitfall	581685	7528272	Cracking clay plain	Hooley
SLM S9	Vertebrate Fauna Trapping / SRE Dry Pitfall	607563	7566615	Hummock grassland on loam	Urandy
SLM S10	Vertebrate Fauna Trapping / SRE Dry Pitfall	607512	7566571	Rocky plain (calcrete)	Coolibah
SLM S11	Vertebrate Fauna Trapping / SRE Dry Pitfall	608576	7561881	Major Drainage line	Coolibah
SLM S12	Vertebrate Fauna Trapping / SRE Dry Pitfall	614304	7559688	Snakewood woodland	Boolgeeda
SLM S13	Vertebrate Fauna Trapping / SRE Dry Pitfall	618131	7560148	Rocky plain	Boolgeeda
SLM S14	Vertebrate Fauna Trapping / SRE Dry Pitfall	614323	7557239	Cracking Clay	Coolibah
SLM S15	Vertebrate Fauna Trapping / SRE Dry Pitfall	622204	7555686	Rocky plain (calcrete)	Coolibah
SLM S16	Vertebrate Fauna Trapping / SRE Dry Pitfall	620922	7550522	Rocky plain	Urandy
SLM OS1	Opportunistic searches/foraging site	588658	7552502	Gorge/gully	Newman
SLM OS2	Opportunistic searches/foraging site	588574	7552430	Upper hillslope (hilltop/ridge/cliffs)	Newman
SLM OS3	Opportunistic searches/foraging site	588593	7552094	Hilltop	Newman
SLM OS4	Opportunistic searches/foraging site	588391	7551305	Hilltop	Newman
SLM OS5	Opportunistic	566189	7564168	Major Drainage line	River

	searches/foraging site				
SLM OS6	Opportunistic searches/foraging site	572800	7556134	Major Drainage line	River
SLM OS7	Opportunistic searches/foraging site	571794	7544612	Major Drainage line	River
SLM OS8	Opportunistic searches/foraging site	608973	7546363	Rocky plain	Boolgeeda
SLM OS9	Opportunistic searches/foraging site	606775	7560785	Mulga woodland	Jurrawarrina
SLM OS10	Opportunistic searches/foraging site	607518	7563783	Major Drainage line	Coolibah
SLM OS11	Opportunistic searches/foraging site	600910	7559941	Hummock grassland on loam	Urandy
SLM OS12	Opportunistic searches/foraging site	621042	7552034	Mixed shrubland	Urandy
SLM OS13	Opportunistic searches/foraging site	583545	7571553	Hilltop	Newman
SLM OS14	Opportunistic searches/foraging site	586715	7571482	Hilltop (cliff)	Newman
SLM OS15	Opportunistic searches/foraging site	591496	7569155	Hilltop (cliff)	Newman
SLM OS16	Opportunistic searches/foraging site	594317	7565745	Hilltop (cliff)	Newman
SLM OS17	Opportunistic searches/foraging site	588781	7563883	Gorge/gully	Newman
SLM OS18	Opportunistic searches/foraging site	593100	7563231	Major Drainage line	Newman
SLM OS19	Opportunistic searches/foraging site	591173	7559308	Major Drainage line	Newman
SLM OS20	Opportunistic searches/foraging site	590469	7560956	Gorge/gully	Newman
SLM OS21	Opportunistic searches/foraging site	596481	7546710	Major Drainage line	Platform
SLM OS22	Opportunistic searches/foraging site	589618	7554129	Major Drainage line	Boolgeeda
SLM OS23	Opportunistic searches/foraging site	621099	7555057	Mixed Shrubland	Coolibah
SLM OS24	Opportunistic searches/foraging site	621099	7555057	Rocky plain	Boolgeeda
SLM OS25	Opportunistic searches/foraging site	574204	7558601	Rocky plain	Newman
SLM OS26	Opportunistic searches/foraging site	574578	7550552	Cracking clay	Calcrete

SLM OS267	Opportunistic searches/foraging site	623193	7560104	Mulga woodland	Boolgeeda
SLM OS28	Opportunistic searches/foraging site	621032	7551737	Mixed shrubland	Urandy
SRE 1	SRE Foraging site	583531	7572519	Hilltop (cliff)	Newman
SRE 2	SRE Foraging site	586181	7571596	Gorge/gully	Newman
SRE 3	SRE Foraging site	591020	7568238	Hilltop (cliff)	Newman
SRE 4	SRE Foraging site	591993	7565097	Hilltop (cliff)	Newman
SRE 5	SRE Foraging site	589356	7559555	Gorge/gully	Newman
SRE 6	SRE Foraging site	589695	7565134	Gorge/gully	Newman
SRE 7	SRE Foraging site	592114	7563977	Hillslope (ridge)	Newman
SRE 8	SRE Foraging site	592927	7560658	Hilltop (cliff)	Newman
SRE A	SRE Wet pitfall	569014	7562837	Major Drainage line	River
SRE B	SRE Wet pitfall	579924	7541229	Hilltop	Newman
SRE C	SRE Wet pitfall	585688	7542144	Mulga woodland	Platform
SRE D	SRE Wet pitfall	585831	7546433	Major Drainage line	Platform
SRE E	SRE Wet pitfall	597224	7544340	Major Drainage line	Platform
SRE F	SRE Wet pitfall	594340	7544268	Major Drainage line	Newman
SRE G	SRE Wet pitfall	585789	7554811	Mixed shrubland	Boolgeeda
SRE H	SRE Wet pitfall	583343	7556920	Rocky plain	Newman
SRE I	SRE Wet pitfall	583955	7556274	Rocky plain	Platform
SRE J	SRE Wet pitfall	614335	7555614	Cracking clay	Brockman
SRE K	SRE Wet pitfall	607267	7564915	Cracking clay	Coolibah
SRE L	SRE Wet pitfall	603505	7559988	Hummock grassland on loam	Urandy
SRE M	SRE Wet pitfall	626588	7557352	Mulga woodland	Jurrawarrina
SRE N	SRE Wet pitfall	601871	7548500	Mixed shrubland	Boolgeeda
SLM NE Mc1	Motion Camera (Northern Exploration)	583601	7571483	Gorge/gully	Newman
SLM NE Mc2	Motion Camera (Northern Exploration)	583662	7571550	Gorge/gully	Newman
SLM NE Mc3	Motion Camera (Northern Exploration)	586773	7571482	Cliff face (ridge)	Newman
SLM NE Mc4	Motion Camera (Northern Exploration)	586864	7571516	Cliff face (ridge)	Newman
SLM NE Mc5	Motion Camera (Northern Exploration)	586685	7571407	Cliff face (ridge)	Newman



SLM NE Mc6	Motion Camera (Northern Exploration)	591453	7568999	Gorge/gully	Newman
SLM NE Mc7	Motion Camera (Northern Exploration)	594342	7565818	Gorge/gully	Newman
SLM NE Mc8	Motion Camera (Northern Exploration)	594308	7565810	Gorge/gully	Newman
SLM NE Mc9	Motion Camera (Northern Exploration)	594477	7565673	Gorge/gully	Newman
SLM NE Mc10	Motion Camera (Northern Exploration)	588837	7563811	Gorge/gully	Newman
SLM NE Mc11	Motion Camera (Northern Exploration)	588851	7563824	Gorge/gully	Newman
SLM NE Mc12	Motion Camera (Northern Exploration)	588769	7563928	Gorge/gully	Newman
SLM NE Mc13	Motion Camera (Northern Exploration)	588719	7563967	Gorge/gully	Newman
SLM NE Mc14	Motion Camera (Northern Exploration)	592991	7563245	Major Drainage line	Newman
SLM NE Mc15	Motion Camera (Northern Exploration)	592974	7563138	Major Drainage line	Newman
SLM NE Mc16	Motion Camera (Northern Exploration)	591099	7559313	Major Drainage line	Newman
SLM NE Mc17	Motion Camera (Northern Exploration)	591176	7559308	Major Drainage line	Newman
SLM NE Mc18	Motion Camera (Northern Exploration)	590572	7560854	Gorge/gully	Newman
SLM NE Mc19	Motion Camera (Northern Exploration)	590444	7560961	Gorge/gully	Newman
SLM NE Mc20	Motion Camera (Northern Exploration)	590457	7560965	Gorge/gully	Newman
SLM Mc1	Motion Camera	598463	7545395	Gorge/gully	Robe
SLM Mc2	Motion Camera	599220	7546602	Gorge/gully	
SLM Mc3	Motion Camera	599088	7545633	Cliff face (ridge)	Robe
SLM Mc4	Motion Camera	592187	7541620	Cliff face (ridge)	Newman
SLM Mc5	Motion Camera	592957	7542337	Cliff face (ridge)	Newman
SLM Mc6	Motion Camera	599909	7540820	Gorge/gully	Newman
SLM Mc7	Motion Camera	597218	7544765	Gorge/gully	Platform
SLM Mc8	Motion Camera	586926	7553283	Gorge/gully	Boolgeeda
SLM Mc9	Motion Camera	572897	7556401	Gorge/gully	River
SLM Mc10	Motion Camera	597163	7547444	Gorge/gully	Platform




SLM Mc11	Motion Camera	593381	7545356	Gorge/gully	Platform
SLM Mc12	Motion Camera	597780	7547808	Gorge/gully	Newman
SLM Mc13	Motion Camera	572935	7556625	Gorge/gully	River
SLM Mc14	Motion Camera	581746	7540867	Major Drainage line	Newman
SLM Mc15	Motion Camera	572771	7556129	Major Drainage line	River
SLM Mc16	Motion Camera	571509	7538868	Major Drainage line	Calcrete
SLM Mc17	Motion Camera	593400	7545372	Major Drainage line	Platform
SLM Mc18	Motion Camera	593357	7544853	Gorge/gully	Platform
Bat rec 1	SM2 Bat recorder	591496	7569155	Hilltop	Newman
Bat rec 2	SM2 Bat recorder	577803	7538938	Mixed shrubland	Boolgeeda
Bat rec 3	SM2 Bat recorder	591120	7541798	Rocky plain and footslope	Newman
Bat rec 4	SM2 Bat recorder	580567	7540704	Hilltop	Newman
Bat rec 5	SM2 Bat recorder	583486	7542205	Rocky plain and footslope	Platform
Bat rec 6	SM2 Bat recorder	614340	7559776	Snakewood woodland	Boolgeeda
Bat rec 7	SM2 Bat recorder	607498	7566563	Rocky plain (calcrete)	Coolibah
Bat rec 8	SM2 Bat recorder	595868	7560643	Major Drainage line	Urandy
Bat rec 9	SM2 Bat recorder	586715	7571482	Ridgetop	
Bat rec 10	SM2 Bat recorder	608657	7561866	cracking clay/ creekline	
Bat rec 11	SM2 Bat recorder	602615	7559675	Hummock grassland on loam	
Bat rec 12	SM2 Bat recorder	603939	7554049	Major Drainage line	
Bat rec 13	SM2 Bat recorder	587738	7539222	plain	Boolgeeda
Bat rec 14	SM2 Bat recorder	583545	7571553	Ridgetop	
Bat rec 15	SM2 Bat recorder	620977	7550403	Rocky plain	
Bat rec 16	SM2 Bat recorder	6144071	7557199	plain	
Bat rec 17	SM2 Bat recorder	572921	7556751	Major Drainage line	River
Bat rec 18	SM2 Bat recorder	568837	7559268	Rocky plain	Boolgeeda
Bat rec 19	SM2 Bat recorder	574465	7531208	Cracking clay	Hooley
Bat rec 20	SM2 Bat recorder	594317	7565745	Hilltop	
Bat rec 21	SM2 Bat recorder	618156	7560284	Rocky plain	
Bat rec 22	SM2 Bat recorder	622255	7555616	Rocky plain	




				(calcrete)	
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Datum: GDA94
 Zone: 50K

APPENDIX B VERTEBRATE FAUNA SITE DESCRIPTIONS

Vegetation and Fauna Habitat Description	Site Photo
<p>SLM 01</p> <p>Spinifex hummock grassland with scattered <i>Corymbia</i> sp. trees over an open layer of mixed shrubs over spinifex hummock grassland on firm red clay with continuous pebble gravel. Extensive areas around the site were recently burnt (< 1 year) although the site itself appeared unburnt for at least 5 years. Little wood and leaf litter were present.</p> <p>Habitat type: Stony spinifex plain and hillslopes</p>	
<p>SLM 02</p> <p><i>Eucalyptus</i> woodland over a mixed tall shrubland over tussock grassland of grazed Buffel (*<i>Cenchrus ciliaris</i>) on weak red loamy clay, with river gravel. The site had been very recently burnt (< 1 year). Large pools of water evident in 5 to 30 m wide major creek bed. Moderate leaf litter and wood litter.</p> <p>Habitat type: Major Drainage line</p>	

<p>SLM 03</p> <p>Open spinifex hummock grassland with low mixed shrubs and <i>Eucalyptus</i> and <i>Corymbia</i> spp. scattered trees on firm red loam with a surface layer of continuous pebble and stone gravel. Unburnt for > 5 years. Sparse leaf and wood litter present.</p> <p>Habitat type: Hillstops, hillslopes, ridges and cliffs</p>	
<p>SLM 04</p> <p>Spinifex open hummock grassland with patches of <i>Acacia</i> shrubs and occasional <i>Eucalyptus</i> spp. trees on firm red loamy clay with continuous pebble gravel. Sparse wood and leaf litter under shrubs and trees.</p> <p>Habitat type: Stony spinifex plain and hillslopes</p>	
<p>SLM 05</p> <p>Mulga very open trees over open Mulga and other <i>Acacia</i> spp. shrubs over Spinifex open hummock grassland on firm loamy clay soil with continuous pebble and stone gravel. Sparse wood and leaf litter under shrubs and trees.</p> <p>Habitat type: Mixed shrubland on stony plain</p>	

<p>SLM 06</p> <p>Spinifex hummock grassland with <i>Corymbia</i> spp. scattered trees and mixed low open shrubland on firm red loam with continuous pebble gravel. Fire age > 5 years. Sparse leaf and wood litter under shrubs and trees.</p> <p>Habitat type: Stony spinifex plain and hillslopes</p>	
<p>SLM 07</p> <p>Tussock grassland on firm red cracking clay, with no pebble gravel. Site grazed and with some vehicle tracks nearby, but otherwise in good condition. No leaf and wood litter.</p> <p>Habitat type: Cracking Clay</p>	
<p>SLM 08</p> <p>Tussock grassland on firm red-brown cracking clay, with no pebble gravel. Site grazed and with some vehicle tracks nearby, but otherwise in good condition. No leaf and wood litter.</p> <p>Habitat type: Cracking Clay</p>	

<p>SLM 09</p> <p><i>Triodia epactia</i> hummock grassland with Mulga and <i>Corymbia hamersleyana</i> isolated low trees and <i>Acacia bivenosa</i>, <i>A. pruinocarpa</i> and <i>A. tumida</i> mixed open shrubland, on firm red-brown loamy clay soil with 10-30% pebble cover. Sparse wood and leaf litter under shrubs and trees.</p> <p>Habitat type: Hummock grassland on loam</p>	
<p>SLM 10</p> <p><i>Acacia wanyu</i>, <i>A. synchronicia</i> and <i>Melaleuca</i> sp. high open shrubland with <i>Eucalyptus victrix</i> isolated low trees over <i>Triodia epactia</i> open hummock grassland and *<i>Cenchrus ciliaris</i> open tussock grassland on firm red-brown soil with 30-70% gravel/pebble cover. Calcrete rocky base.</p> <p>Habitat type: Stony Calcrete plain</p>	
<p>SLM 11</p> <p><i>Eucalyptus victrix</i> and Mulga low woodland over Mulga and <i>Acacia synchronicia</i> high open shrubland over *<i>Cenchrus ciliaris</i> very open tussock grassland on firm red-brown loamy clay with surface crust and no rocks. Dispersed eucalyptus leaf litter and sparse wood litter.</p> <p>Habitat type: Major Drainage line</p>	

SLM 12

Triodia epactia open hummock grassland with *Acacia xiphophylla* scattered tall shrubs and isolated low trees on firm red-brown loamy clay with continuous pebble gravel. Unburnt for > 5 years. Sparse wood and leaf litter accumulated under shrubs/trees.

Habitat type: Alluvial/floodplain with acacia (mulga) woodland



SLM 13

Triodia wiseana open hummock grassland with *Corymbia* sp. scattered low trees and *Acacia ancistrocarpa*, *A. arida* and *A. pruinocarpa* high open shrubland on firm red-brown loamy clay with continuous pebble gravel. Unburnt for > 5 years. Fairly sparse leaf litter under shrubs/trees and sparse wood litter.

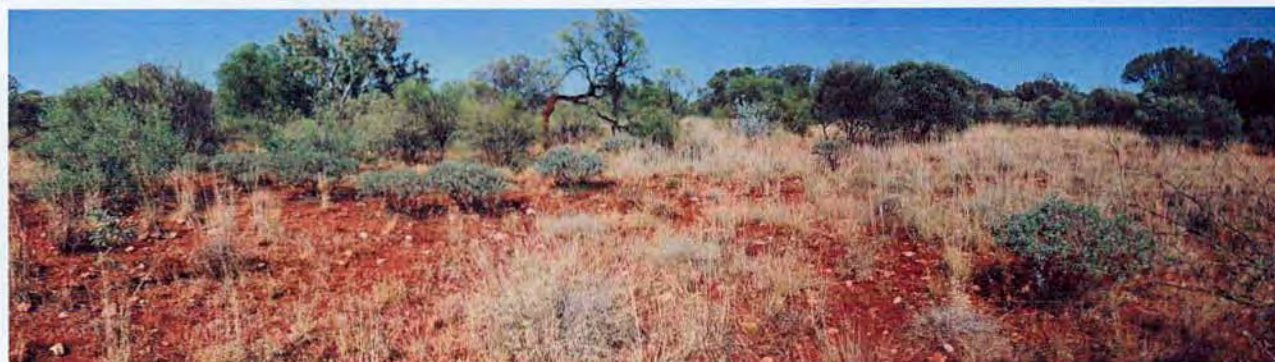
Habitat type: Stony spinifex plain and hillslopes



SLM 14

Mulga and *Acacia citrinoviridis* low open woodland over *Acacia synchronicia* high open shrubland over *Chrysopogon fallax* and *Eragrostis* spp. tussock grassland on firm red loamy clay, with some surface cracks and common calcrete stones. Unburnt for > 5 years. Fairly sparse leaf litter under shrubs/trees and sparse wood litter.

Habitat type: Cracking clay



SLM 15

Triodia epactia hummock grassland with *Corymbia hamersleyana* scattered low trees and *Acacia* spp. and *Hakea lorea* scattered shrubs on firm red-brown soil with pebble gravel. Unburnt for > 5 years. Minimal leaf litter under shrubs/trees and sparse wood litter.

Habitat type: Stony Calcrete plain





SLM 16

Triodia epactia very open hummock grassland with *Corymbia hamersleyana* scattered low trees, *Acacia inaequilatera* and *A. atkinsiana* very open shrubland on firm red-brown loamy clay with continuous pebble gravel. Moderately recently burnt (1-5 years). Sparse leaf litter under trees/shrubs and sparse wood litter.

Habitat type: Stony spinifex plain and hillslopes



APPENDIX C SRE FAUNA SITE DESCRIPTIONS

SRE Site Vegetation and Habitat Description	Site Photo
<p>SRE A</p> <p>Spinifex hummock grassland with sparse eucalypt trees and sparse <i>Acacia</i> sp. tall shrubs on firm sandy clay with some surface crust with common ironstone stones present on a negligible E facing slope. Vegetation in poor condition with moderate grazing, weeds and animal tracks. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of > 5 years. Site associated with a major creekline (5-30 m wide), with no water present and light recent rainfall.</p> <p>Habitat type: Major Drainage line</p>	
<p>SRE B</p> <p>Spinifex hummock grassland with very open eucalypt low trees and sparse acacia tall shrubs on firm brown, fine grain sand with a rocky/stony surface layer of continuous ironstone and BIF stones, on a gentle E facing slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of > 5 years. Site associated with a drainage line, with no water present and light recent rainfall.</p> <p>Habitat type: Hillstops, hillslopes, ridges and cliffs</p>	

SRE C

Mulga low woodland over acacia open tall shrubs over open spinifex hummock grassland on weak and loose red-brown fine grain sand with common ironstone gravel of pebbles and stones on a negligible North facing slope. Leaf litter cover of 40% under shrubs/ trees and moderate wood litter. Fire age of > 5 years. Site associated with depression, with no water present and light recent rainfall.

Habitat type: Floodplain/alluvial plain with acacia (mulga) woodland






SRE D

Spinifex hummock grassland with scattered *Acacia* sp. and eucalypt low trees and open acacia tall shrubs on firm red-brown coarse grain sand with some surface crust and continuous ironstone and BIF gravel or pebbles and stones on a negligible slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of > 5 years. Site associated with a major creekline (5-30 m wide), with no water present and light recent rainfall.

Habitat type: Major Drainage line



<p>SRE E</p> <p>Spinifex hummock grassland with sparse eucalypt low trees and sparse acacia shrubs on weak, red-brown, fine grain sand with many ironstone pebbles and stones on a negligible N slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of 1-5 years. Site associated with a major creekline (5-30 m wide), with no water present and light recent rainfall.</p> <p>Habitat type: Major Drainage line</p>	
<p>SRE F</p> <p>Spinifex hummock grassland with sparse eucalypt low trees and sparse tall shrubs on weak, loose, red-brown coarse grain sand with continuous ironstone gravel of pebbles and stones on a negligible North slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of >5 years. Site associated with a major creekline (5-30 m wide), with no water present and light recent rainfall.</p> <p>Habitat type: Major Drainage line</p>	
<p>SRE G</p> <p>Acacia tall open shrubland with sparse eucalypt low trees over spinifex hummock grassland on weak, loose, red-brown, fine grain sand with common ironstone pebbles and stones on a negligible E slope. Leaf litter cover of 2% under shrubs/ trees and sparse wood litter. Fire age of >5 years. Site associated with a depression, with no water present and light recent rainfall.</p> <p>Habitat type: Mixed shrubland on stony plain</p>	

SRE H

Spinifex hummock grassland with sparse *Eucalyptus* sp. and *Corymbia* sp. trees and sparse acacia tall shrubs on firm, red-brown, fine grain sand with some surface crust and continuous ironstone/BIF gravel of pebbles and stones on a negligible E slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of >5 years. Site associated with a major creekline (5-30 m wide), with no water present and light recent rainfall.

Habitat type: Stony spinifex plain and hillslopes



SRE I

Spinifex hummock grassland with sparse eucalypt trees and open grevillea shrubs on weak, loose, red-brown, fine grain sand with some surface crust with many ironstone pebbles and stones on a negligible E slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of >5 years. Site associated with a major creekline (5-30 m wide), with no water present and light recent rainfall.

Habitat type: Stony spinifex plain and hillslopes






SRE J

Tussock grassland with *Acacia synchronicia* scattered tall shrubs on weak, red-brown clay with some surface crust and cracks and ironstone gravel of pebbles on a negligible E slope. No leaf litter cover and sparse wood litter. No evidence of last fire. Site associated with a drainage line, with no water present and no recent rainfall.

Habitat type: Cracking clay



<p>SRE K</p> <p><i>Corymbia hamersleyana</i> scattered low trees over <i>Acacia</i> spp. very open shrubland over spinifex hummock grassland on firm, red-brown clay with a loose surface crust and few ironstone pebbles and stones on a negligible W slope. Leaf litter cover of 1 % under shrubs/ trees and sparse wood litter. Fire age of > 5 years. Site associated with a drainage line, with no water present and no recent rainfall.</p> <p>Habitat type: Cracking clay</p>	
<p>SRE L</p> <p>Patches of mulga very open low woodland over <i>Acacia pruinocarpa</i> and mulga very open tall shrubs over spinifex hummock grassland on firm, red-brown loam with some surface crust and common ironstone pebbles and stones on a negligible SE slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. Fire age of > 5 years. Site associated with a depression, with no water present and no recent rainfall.</p> <p>Habitat type: Hummock grassland on loam</p>	
<p>SRE M</p> <p>Mulga woodland over scattered acacia shrubs over sparse tussock grasses on a firm, red-orange loamy clay with some surface crust and a gravel of ironstone pebbles and stones on a negligible S slope. Leaf litter cover of 1% under shrubs/ trees and moderate wood litter. No evidence of previous fire. Site associated with a depression, with no water present and no recent rainfall.</p> <p>Habitat type: Floodplain/alluvial plain with acacia (mulga) woodland</p>	

SRE N

Acacia atkinsiana and *Acacia* spp. mixed shrubland over spinifex hummock grassland with *Corymbia hamersleyana* isolated trees on firm, red-brown, fine-grain sand with some surface crust and continuous ironstone gravel of pebbles and stones on a negligible E slope. Leaf litter cover of 1% under shrubs/ trees and sparse wood litter. No evidence of previous fire. Site associated with a drainage line, with no water present and no recent rainfall.

Habitat type: Mixed shrubland on stony plain



APPENDIX D FAUNA SPECIES RECORDED DURING SURVEYING

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPaW																	
DASYURIDAE																					
<i>Dasykaluta rosamondae</i>	Little Red Kaluta				1			6								4	9				1
<i>Ningau timealeyi</i>	Pilbara Ningau				3	2	5	4	1	7			5	2		1	3		2		
<i>Planigale</i> sp. (prev. <i>maculata</i>)	Common Planigale				2		1	1			3	3									
<i>Sminthopsis macroura</i>	Stripe-faced Dunnart										3	4	1		1			3		1	
MACROPODIDAE																					
<i>Macropus rufus</i>	Red Kangaroo																		1		2
PTEROPODIDAE																					
<i>Pteropus alecto</i>	Black Flying-fox										2*										
EMBALLONURIDAE																					
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat					R	R		R	R					R	R				R	R
<i>Taphozous georgianus</i>	Common Sheathtail Bat								R	R											R
VESPERTILIONIDAE																					
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				R	R		R	R	R	R		R	R	R	R				R	R
<i>Scotorepens greyii</i>	Little Broad-nosed Bat					R		R		R			R	R	R	R					R
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat					R	R	R	R	R			R	R	R	R				R	R
MOLOSSIDAE																					
<i>Chaerophon jobensis</i>	Northern Freetail Bat				R	R	R		R	R	R			R	R	R				R	R
<i>Mormopterus beccarii</i>	Beccari's Freetail Bat				R	R	R	R												R	R
<i>Tadarida australis</i>	White-striped Freetail Bat																				R

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPaW																	
MURIDAE																					
<i>Leggadina lakedownensis</i>	Short-tailed Mouse			P4							3	2									
<i>Pseudomys delicatulus</i>	Delicate Mouse					1													1		
<i>Pseudomys desertor</i>	Desert Mouse				1	2	2	2	3				3			3	3				
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse					1		1		2				1			1		3	5	
<i>Zyzomys argurus</i>	Common Rock-rat						3			1											
CANIDAE																					
<i>Canis lupus dingo</i>	Dingo																				5
INTRODUCED MAMMALS																					
<i>Mus musculus</i>	House Mouse					4	1	1										1	1	4	
<i>Felis catus</i>	Cat																				1
<i>Bos taurus</i>	Cow																				25

* = remains

Birds

Family and Species	Common Name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	Opp
		EPBC Act	WC Act	DPaW																	
CASUARIIDAE																					
<i>Dromaius novaehollandiae</i>	Emu																				8
COLUMBIDAE																					
<i>Phaps chalcoptera</i>	Common Bronzewing									1								1	1		2
<i>Ocyphaps lophotes</i>	Crested Pigeon				20			12	23			3	1	2	6	7	1	2		101	1
<i>Geophaps plumifera</i>	Spinifex Pigeon					1															12
<i>Geopelia cuneata</i>	Diamond Dove									1					6						
<i>Geopelia striata</i>	Peaceful Dove					3		8							2						
EUROSTOPODIDAE																					
<i>Eurostopodus argus</i>	Spotted Nightjar																				3
AEGOTHELIDAE																					
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				1					1											
ARDEIDAE																					
<i>Ardea pacifica</i>	White-necked Heron																				1
ACCIPITRIDAE																					
<i>Elanus axillaris</i>	Black-shouldered Kite																				1
<i>Haliastur spheurnus</i>	Whistling Kite					3		2			2		1	1		1	1	1	2	3	1
<i>Milvus migrans</i>	Black Kite												3							1	
<i>Accipiter fasciatus</i>	Brown Goshawk										1			1							
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk																				1
<i>Circus assimilis</i>	Spotted Harrier										1	1	2			2					1
<i>Aquila audax</i>	Wedge-tailed Eagle																			2	1
<i>Hieraaetus morphnoides</i>	Little Eagle																				1

Family and Species	Common Name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	Opp
		EPBC Act	WC Act	DPaW																	
FALCONIDAE																					
<i>Falco cenchroides</i>	Nankeen Kestrel										2	1								3	
<i>Falco berigora</i>	Brown Falcon				1					1											2
<i>Falco longipennis</i>	Australian Hobby																				1
OTIDIDAE																					
<i>Ardeotis australis</i>	Australian Bustard			P4																	8
BURHINIDAE																					
<i>Burhinus grallarius</i>	Bush Stone-curlew			P4																	2
CHARADRIIDAE																					
<i>Vanellus tricolor</i>	Banded Lapwing																				1
TURNICIDAE																					
<i>Turnix velox</i>	Little Button Quail												1								1
CACATUIDAE																					
<i>Eolophus roseicapillus</i>	Galah					8			7					29	3			2		31	
<i>Cacatua sanguinea</i>	Little Corella							12						8						18	
<i>Nymphicus hollandicus</i>	Cockatiel							7		2	18			20	4	23	2	3	3	13	
PSITTACIDAE																					
<i>Barnardius zonarius</i>	Australian Ringneck					9	2		4	3			1	7	7				7		
<i>Melopsittacus undulatus</i>	Budgerigar					23		55	16	10				8	11	15			5	12	
HALCYONIDAE																					
<i>Dacelo leachii</i>	Blue-winged Kookaburra					4															
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher								1	2											1
MEROPIDAE																					
<i>Merops ornatus</i>	Rainbow Bee-	M	S3				1		5	2			3		21	2	1		1	4	3

Family and Species	Common Name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	Opp
		EPBC Act	WC Act	DPaW																	
	eater																				
PTILONORHYNCHIDAE																					
<i>Ptilonorhynchus guttatus</i>	Western Bowerbird																				1
MALURIDAE																					
<i>Malurus leucopterus</i>	White-winged Fairy-wren				6			4	1				1			3	2	5	4	10	
<i>Malurus lamberti</i>	Variegated Fairy-wren				11	25		9	15								3		8	4	2
<i>Amytornis striatus</i>	Striated Grasswren						4														1
ACANTHIZIDAE																					
<i>Pyrholaemus brunneus</i>	Redthroat																		1		
<i>Smicronis brevirostris</i>	Weebill				16	85	3	8	30	12			4	8		2	9	5	13	11	7
<i>Gerygone fusca</i>	Western Gerygone								5												
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill								10					1				6			
<i>Acanthiza apicalis</i>	Inland Thornbill								3												
PARDALOTIDAE																					
<i>Pardalotus rubricatus</i>	Red-browed Pardalote						1												2		1
<i>Pardalotus striatus</i>	Striated Pardalote					13															
MELIPHAGIDAE																					
<i>Certhionyx variegatus</i>	Pied Honeyeater																				1
<i>Lichenostomus virescens</i>	Singing Honeyeater				7			11	18	5			10	4		5	6	2	6	40	5
<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater				13		24	1		30											
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater					23								17	90	1	11	6	36		7

Family and Species	Common Name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	Opp
		EPBC Act	WC Act	DPaW																	
<i>Manorina flavigula</i>	Yellow-throated Miner					6	3	4	8	13						1	5	2	5	10	12
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater							1	3									1			
<i>Conopophila whitei</i>	Grey Honeyeater								3												1
<i>Epthianura tricolor</i>	Crimson Chat																			10	
<i>Sugomel niger</i>	Black Honeyeater								1												
<i>Lichmera indistincta</i>	Brown Honeyeater					3											8				1
<i>Melithreptus gularis</i>	Black-chinned Honeyeater				1		1			3											
POMATOSTOMIDAE																					
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler					16			12					9							3
CAMPEPHAGIDAE																					
<i>Coracina maxima</i>	Ground Cuckoo-shrike																				3
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				2	1			6	2				2	3			1	1	2	2
<i>Lalage sueurii</i>	White-winged Triller								1								1				
PACHYCEPHALIDAE																					
<i>Pachycephala rufiventris</i>	Rufous Whistler					3		3	5	4			3	5	6	2	3	1	10	1	1
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				5				2	3					1						
<i>Oreocitta gutturalis</i>	Crested Bellbird				3		1	4	9	8					5	2	1	1	5	8	2
ARTAMIDAE																					
<i>Artamus personatus</i>	Masked Woodswallow																				2
<i>Artamus cinereus</i>	Black-faced Woodswallow				1			22		5		5		3	4	5		3	18	29	2
<i>Artamus minor</i>	Little				7		7			1				3						7	

Family and Species	Common Name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	Opp
		EPBC Act	WC Act	DPaW																	
	Woodswallow																				
<i>Cracticus torquatus</i>	Grey Butcherbird							1	1				1		1				2	1	
<i>Cracticus nigrogularis</i>	Pied Butcherbird				1	1	2		4			1			1					3	
<i>Cracticus tibicen</i>	Australian Magpie							1	2		1									1	
RHIPIDURIDAE																					
<i>Rhipidura leucophrys</i>	Willie Wagtail				1	2		4	5	5		2						4	3	8	4
CORVIDAE																					
<i>Corvus bennetti</i>	Little Crow															2	1			36	1
<i>Corvus orru</i>	Torresian Crow				1	4		5	3	1	3		1	3	2	1		1		8	
MONARCHIDAE																					
<i>Grallina cyanoleuca</i>	Magpie-lark					5									9	2		3	4	2	
PETROICIDAE																					
<i>Melanodryas cucullata</i>	Hooded Robin								5	1											
ALAUDIDAE																					
<i>Mirafra javanica</i>	Horsfield's Bushlark										4	7									
MEGALURIDAE																					
<i>Cincloramphus mathewsi</i>	Rufous Songlark																				1
<i>Eremiornis carteri</i>	Spinifexbird				4		2	4	4	8											
HIRUNDINIDAE																					
<i>Cheramoeca leucosterna</i>	White-backed Swallow						1														
<i>Petrochelidon nigricans</i>	Tree Martin				1																
NECTARINIIDAE																					
<i>Dicaeum hirundinaceum</i>	Mistletoebird													1							
ESTRILDIDAE																					
<i>Taeniopygia guttata</i>	Zebra Finch				26	13	19	159	93	51		15	8	26	10	10	17		31	99	41
<i>Emblema pictum</i>	Painted Finch					2	9	5		36				1						4	1

Family and Species	Common Name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	Opp
		EPBC Act	WC Act	DPaW																	
MOTACILLIDAE																					
<i>Anthus novaeseelandiae</i>	Australasian Pipit										1	1									

Reptiles

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPaW																	
AGAMIDAE																					
<i>Amphibolurus longirostris</i>						9										1		1		1	6
<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon					1		1	1				1			3	1				4
<i>Ctenophorus isolepis</i>	Central Military Dragon										2		17	1		1	3		1	8	22
<i>Ctenophorus reticulatus</i>	Western Netted Dragon										1			1							
<i>Diporiphora valens</i>								1													
<i>Pogona minor</i>	Dwarf Bearded Dragon																1	1	4		
<i>Tympanocryptis cephalus</i>	Pebble Dragon										2										
DIPLODACTYLIDAE																					
<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko				2				1				11				3			9	
<i>Diplodactylus galaxias</i>	Northern Pilbara Beak-faced Gecko													1							
<i>Diplodactylus savagei</i>							2				1		1								
<i>Lucasium stenodactylum</i>					1				1				3	7			1		5	6	
<i>Lucasium wombeyi</i>						1	1			1										1	
<i>Oedura marmorata</i>	Marbled Velvet Gecko																				1
<i>Rhynchoedura ornata</i>	Beaked Gecko								1				2	2							
<i>Strophurus elderi</i>							1		1	1			1								
<i>Strophurus jeanae</i>																				1	
<i>Strophurus wellingtonae</i>						1														1	
CARPHODACTYLIDAE																					
<i>Nephurus wheeleri</i>																	1			1	

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPaW																	
<i>Underwoodisaurus seorsus</i>				P1			1														
GEKKONIDAE																					
<i>Gehyra punctata</i>																					1
<i>Gehyra variegata</i>						9		1					2		3	2		3		5	7
<i>Heteronotia binoei</i>	Bynoe's Gecko					2				1			4			4	1			1	
PYGOPODIDAE																					
<i>Delma elegans</i>					1																
<i>Delma nasuta</i>										1											
<i>Delma pax</i>					1																1
<i>Delma tincta</i>								1	1												
<i>Lialis burtonis</i>								1								1					1
<i>Pygopus nigriceps</i>													1							1	
SCINCIDAE																					
<i>Carlia munda</i>						5	2	5	2	3				4			13	3		2	1
<i>Carlia triacantha</i>					4	1					1			3							
<i>Cryptoblepharus buehneri</i>															1						1
<i>Ctenotus duricola</i>					5			2	1	2										1	
<i>Ctenotus hanloni</i>																1	2				
<i>Ctenotus helenae</i>					4	2		3	2				1			2	6				
<i>Ctenotus pantherinus</i>	Leopard Ctenotus				23	2	1	8	13	7			6	10		2	2		1	4	1
<i>Ctenotus robustus</i>											4	5						9			
<i>Ctenotus rutilans</i>							4														
<i>Ctenotus saxatilis</i>	Rock Ctenotus				5		9	4	1	3											
<i>Ctenotus uber</i>																	1				
<i>Cyclodomorphus melanops</i>	Slender Blue-tongue													2							
<i>Egernia cygnitos</i>																					1
<i>Lerista flammicauda</i>																			1		
<i>Lerista timida</i>																		2			
<i>Menetia greyii</i>							1											1			

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPaW																	
<i>Morethia ruficauda</i>							1														
<i>Notoscincus ornatus</i>																			1		
<i>Proablepharus reginae</i>										1			1				1				
<i>Tiliqua multifasciata</i>	Central Blue-tongue						1						1						1		
VARANIDAE																					
<i>Varanus acanthurus</i>	Spiny-tailed Monitor						1									1					
<i>Varanus breviceuda</i>	Short-tailed Pygmy Monitor				1			1										1			
<i>Varanus bushi</i>	Pilbara Mulga Monitor												1								
<i>Varanus caudolineatus</i>																				1	
<i>Varanus eremius</i>	Pygmy Desert Monitor					1							5	1			1			1	
<i>Varanus panoptes</i>	Yellow-spotted Monitor																				1
<i>Varanus tristis tristis</i>	Racehorse Monitor							1													
TYPHLOPIDAE																					
<i>Ramphotyphlops ganei</i>				P1		1															
<i>Ramphotyphlops grypus</i>							1	1													
BOIDAE																					
<i>Antaresia stimsoni</i>	Stimpson's Python															1					2
ELAPIDAE																					
<i>Acanthophis wellsi</i>	Pilbara Death Adder																1				
<i>Brachyuropsis approximans</i>	Shovel-nosed Snake						1														

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 11	SLM 12	SLM 13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPaW																	
<i>Demansia psammophis</i>	Yellow-faced Whipsnake								1				1	2				3	1	1	
<i>Demansia rufescens</i>	Rufous Whipsnake						1														
<i>Furina ornata</i>	Moon Snake						1			1											
<i>Parasuta monachus</i>	Hooded Snake									1				2			1				1
<i>Pseudechis australis</i>	Mulga Snake																				1
<i>Pseudonaja mengdeni</i>	Western Brown Snake																				
	Ringed Brown Snake															2				1	
<i>Pseudonaja modesta</i>	Rosen's Snake						1														
<i>Suta fasciata</i>	Suta punctata								1												
<i>Suta punctata</i>	Spotted Snake												2								

Amphibians

Family and Species	Common name	Conservation Status			SLM 1	SLM 2	SLM 3	SLM 4	SLM 5	SLM 6	SLM 7	SLM 8	SLM 9	SLM 10	SLM 10	SLM 11	SLM 12	SLM13	SLM 14	SLM 15	SLM 16	opp
		EPBC Act	WC Act	DPa W																		
HYLIDAE																						
<i>Cyclorana maini</i>	Sheep Frog					3			1		2	1										
<i>Litoria rubella</i>	Little Red Tree Frog					2																
MYOBATRACHIDAE																						
<i>Uperoleia saxatilis</i>	Pilbara Toadlet					263																

Solomon Desktop Troglofauna Assessment

Final Report

Prepared Fortescue Metals
Group Ltd
by Bennelongia Pty Ltd

June 2014
Report 2014/219



Solomon Desktop Troglafauna Assessment

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Cover photo: Japygidae sp. B13

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Client – Fortescue Metals Group Ltd

Report	Version	Prepared by	Checked by	Submitted to Client	
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EXECUTIVE SUMMARY

Fortescue Metals Group (Fortescue) operates the Solomon iron ore mine, which is located 60 km north of Tom Price in the Pilbara region of Western Australia. The Solomon mine consists of two mining areas, Kings and Firetail, and a rail spur that joins with Fortescue's Cloudbreak-Port Hedland Railway. Kings comprises three Channel Iron Deposits (CID) called Valley of the Queens, Valley of the Kings (previously known as Valley of the Kings and Trinity) and Zion. Firetail comprises two areas of Bedded and Detrital Iron Deposit (BID and DID) that are known as Firetail North and Firetail South.

In 2011, following a Public Environmental Review (PER), the Minister for the Environment issued conditional approval for Solomon under Ministerial Statement 862 (MS862). Condition 13 of MS862 included the requirement for a troglafauna survey to be undertaken biannually at Solomon to validate predictions of habitat connectivity for troglafauna and to improve knowledge of troglafauna populations. After a series of troglafauna surveys were completed, Condition 13 was formally signed off by the EPA in 2013.

Fortescue is now investigating options to expand its operations at Solomon, including an increase in size of the mine footprint and the development of new borefields. The increased size of the mine footprint reflects a re-evaluation of the extent of the ore resource since the PER was submitted. Fortescue now proposes an overall increase in area of mine pits within Solomon from the approved 3680 ha to 4493 ha. To meet a net water deficit expected for the bulk of the project life, two new borefields are proposed: one approximately 12 km to the north-east of Firetail and one approximately 12 km to the south-east of Kings, known as the Northern Borefield and Southern Borefield, respectively.

The specific aims of this troglafauna assessment were to:

1. Summarise all previous troglafauna studies and assessment undertaken at Solomon; and
2. Assess the conservation implications of the proposed expansion of operations at Solomon for troglafauna species.

Borefield Development

Drawdown of the watertable associated with the proposed Northern and Southern Borefields is unlikely to threaten troglafauna species. The most likely mechanism for groundwater drawdown to reduce troglafauna habitat is through decreases in humidity of troglafauna habitat as the watertable is lowered. However, because small pools of water remain perched in voids as the watertable is lowered, in most situations lowering the watertable probably has little effect on humidity of troglafauna habitat. In fact, lowering of the watertable may often increase the amount of troglafauna habitat available. Therefore, in most situations dewatering is likely to be, at most, a secondary impact on troglafauna.

Pit Expansions

The proposed increase in area of mine pits at Solomon is 863 ha. This increase was divided into four components for assessment: 1) expansion of the potential Kings pits assessed in the PER; 2) additional southern pits at Kings; 3) expansion of the potential pits at Zion assessed in the PER and Condition 13 surveys; and 4) expansion of the potential Firetail pits assessed in the PER. The following conclusions are drawn:

Kings

Based on a large survey effort at Kings and the subsequent understanding of distributions of troglafauna species present in the area, it may be assumed that a modest increase of 7% in pit size at Kings would do little to alter the position of low risk to troglafauna established by the surveys undertaken to fulfil

Condition 13 of MS862. These surveys demonstrated that there is a connection for troglafauna species between habitat within the potential mine pits at Kings and habitat outside the pits. It seems likely that most, if not all, species occurring in the valleys at Kings also occur on the flanks of surrounding ranges and in those ranges.

Kings (new southern pits)

The geology of the potential mine pits south of Kings is similar to that at Kings. The alluvial and colluvial sediments of the valleys extend well beyond the areas to be mined, so that there is likely to be habitat connectivity along the valleys for any troglafauna in the sediments. Similarly, there is also likely to be good connectivity from the alluvial deposits and DID on valley flanks into the BIF and hardcap of surrounding ranges. Although no troglafauna survey has been conducted in the potential southern pits, by analogy with the troglafauna community at Kings, it is considered that the threat to the troglafauna species occurring in these areas is likely to be low.

Zion

It was concluded in the PER that there was little threat to troglafauna at Zion because 36% of outcropping CID would remain unmined. It is now proposed to increase the area to be mined at Zion by up to 68% (from 258 to 434 ha), which will remove the majority of unmined CID within Zion. However, re-evaluation of the resource has identified additional CID around the proposed mine pits. It is estimated that about 60% of the CID at Zion and its immediate surroundings will be outside the proposed pits. Three species are known only from within the proposed Zion mine pits (the schizomid *Draculoides* sp. B30, beetle *Zuphiini* sp. SOLOMON and centipede *Cryptops* sp. SOLOMON 2). While all three species were represented by single animals and there is some uncertainty about their distributions, it is considered probable that they also occur in the CID outside the pits. Consequently, it is considered there will be little threat to troglafauna at Zion as a result of the additional mining proposed.

Firetail

The proposed expansion of mine pits at Firetail is very small (8% increase in area) and it has already been demonstrated that there is habitat connectivity for troglafauna between the pits and surrounding areas. Given that the proposed area of mining is smaller than approved under MS682 and occurs almost within the original footprint, it is concluded that mining of the proposed pits is unlikely to threaten troglafauna.

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1. INTRODUCTION

The Environmental Protection Authority (EPA) usually requires that the risks to subterranean fauna are considered when assessing proposed mine developments because subterranean fauna have very limited ranges. Their small ranges make subterranean species particularly vulnerable, as a group, to extinction as a result of anthropogenic activities (EPA 2013a). About 70% of stygofauna in the Pilbara meet the criterion for being short-range endemic (SRE) species (Eberhard *et al.* 2009) and the proportion of troglifauna that are SREs is likely to be even higher (Lamoreux 2004; Halse and Pearson 2014).

Troglifauna were first recognised as occurring in significant numbers in the Pilbara when Biota (2006) collected them from pisolitic mesas of the Robe River Valley. Although there has not been a single regional-scale survey for troglifauna, such as the Pilbara Biodiversity Survey (McKenzie *et al.* 2009), there have now been many troglifauna surveys in the Pilbara for environmental impact assessments. From just some of these surveys 570 troglifauna species, nearly all undescribed, have been collected and the region is clearly rich in troglifauna at a global scale (Halse and Pearson 2014). Pilbara troglifauna belong to a wide variety of invertebrate groups, including palpi-grads, spiders, schizomids, pseudoscorpions, harvestmen, isopods, millipedes, centipedes, pauropods, symphylans, bristletails, silverfish, cockroaches, bugs, beetles and fungus-gnats.

Fortescue Metals Group (Fortescue) operates the Solomon iron ore mine, which is located 60 km north of Tom Price in the Pilbara region of Western Australia (Figure 1.1). The Solomon mine consists of two mining areas, Kings and Firetail, and a rail spur that joins with Fortescue's Cloudbreak-Port Hedland Railway. Kings comprises three Channel Iron Deposits (CID) called Valley of the Queens, Valley of the Kings (previously known as Valley of the Kings and Trinity, Subterranean Ecology [2010]) and Zion. Firetail comprises two areas of Bedded and Detrital Iron Deposit (BID and DID) that are referred to as Firetail North and Firetail South.

Following a Public Environmental Review (PER) (FMG 2010), the Minister for the Environment issued conditional approval for mining at Solomon under Ministerial Statement 862 (MS862) on 20 April 2011 (OAC 2011). The conditions included requirement for a troglifauna survey to be undertaken biannually at Solomon to validate predictions of habitat connectivity for troglifauna and to improve knowledge of troglifauna populations (Condition 13). Condition 13 of MS862 was addressed through troglifauna surveys conducted by Bennelongia (2013a, b) and was formally signed off by the EPA in 2013.

Fortescue is now investigating options to expand its operations at Solomon, including an increase in size of the mine footprint and the development of new borefields. The increased size of the mine footprint reflects a re-evaluation the extent of the ore resource since the PER was submitted. Fortescue now proposes to increase the area of the mine pits from the approved 3680 ha to 4493 ha (Figure 1.2). To meet a net water deficit expected during project life, two new borefields are proposed: one approximately 12 km to the north-east of Firetail and one approximately 12 km to the south-east of Kings, known as the Northern Borefield and Southern Borefield, respectively (Figure 1.2).

The specific aims of this troglifauna assessment were to:

1. Summarise all previous troglifauna studies and assessment undertaken at Solomon; and
2. Assess the conservation implications of the proposed expansion of operations at Solomon for troglifauna species.

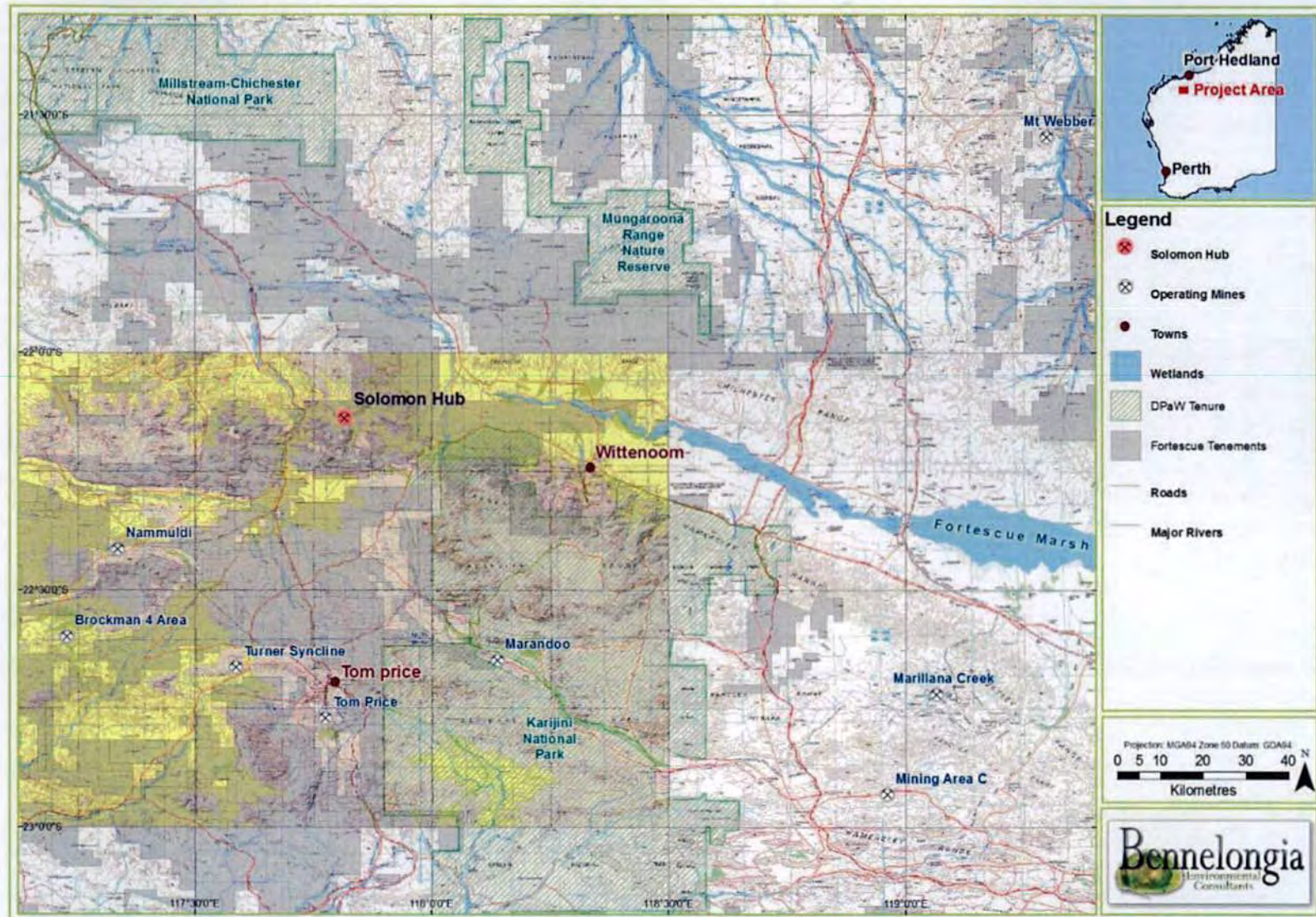


Figure 1.1. Location of Solomon in the Pilbara.

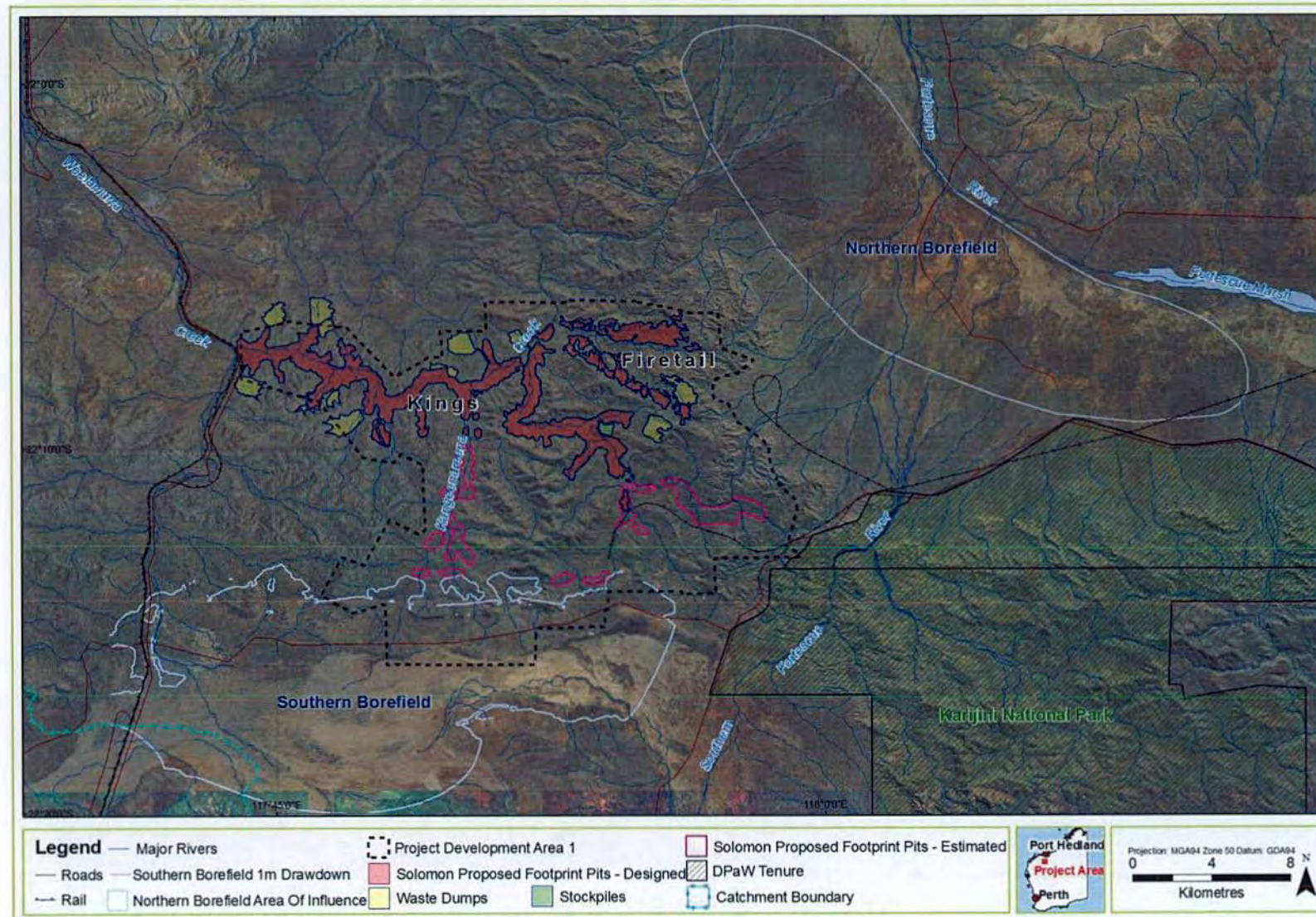


Figure 1.2. Proposed mine pits and proposed borefields within the footprint of the Solomon Project.

2. TROGLOFAUNA REVIEW

Most troglifauna surveys have focussed on areas of mining development, particularly mineralised iron formations where troglifauna have been widely recorded (e.g. Biota 2006; Bennelongia 2008a, b, c; 2009a, b). There is limited information regarding the occurrence of troglifauna in other geologies, although they have been recorded in calcrete and alluvial detrital deposits in the Pilbara (Edward and Harvey 2008; Rio Tinto 2008) and they occur widely in calcrete in the Yilgarn (Barranco and Harvey 2008; Platnick 2008; Bennelongia 2009b). In the Pilbara, troglifauna appear to be collected more frequently high in the landscape where mineralised iron and hardcap occur, and to be less common in the lower palaeovalley sediments, although this preliminary view may mostly reflect sampling effort. The communities higher and lower in the landscape may also have distinct taxonomic compositions.

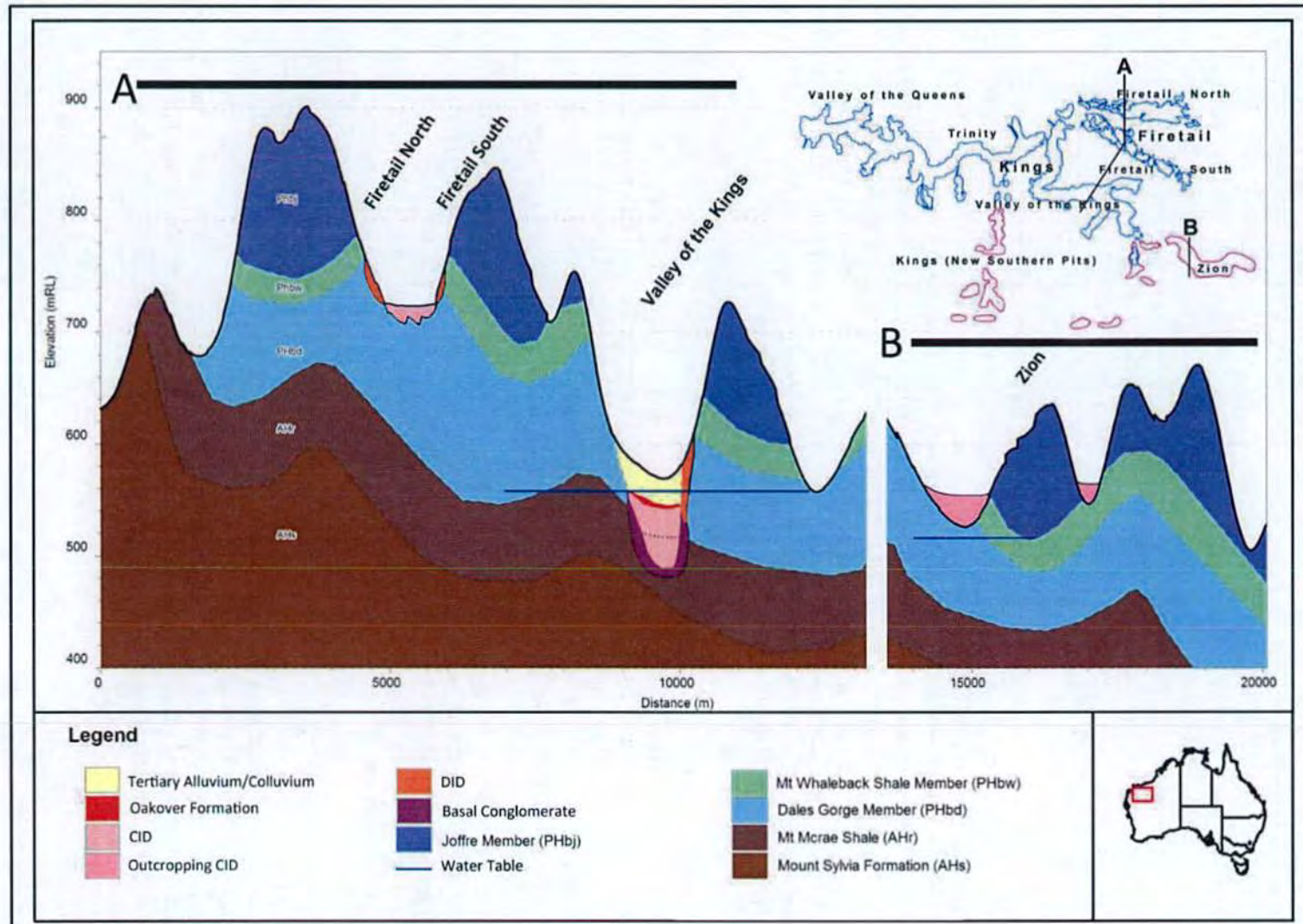
Troglifauna habitat is usually considered to occur from the lower layers of soil at the ground surface down to the interface with groundwater (Halse and Pearson 2014). Troglifauna occupy interstices, vugs, cavities and fissures within this realm where conditions of stable temperature and high humidity prevail (Culver 1982; Howarth 1983). If no fissures or voids are present, troglifauna will not occur. When subterranean spaces are present, their pattern of occurrence will largely determine the pattern of distribution and abundance of troglifauna. Vertical connectivity of voids with the surface is important for supplying carbon and nutrients to maintain populations of different species (plant roots are an important surface connection), while lateral connectivity is crucial to underground dispersal (Culver 1982; Howarth 1983). Geological features may limit habitat continuity, leading to species having highly restricted ranges (Harvey *et al.* 2008).

3. GEOLOGY

Solomon lies in the main Hamersley Range and contains a significant section of the Lower Proterozoic Hamersley Group sedimentary sequence. The landscape within the Solomon tenements is typically rugged, with prominent strike ridges and hills of outcropping Brockman Iron Formation that separate palaeochannels incised into relatively flat lying basement rocks, in which thick sequences of iron-rich infill have been locally deposited (MWH 2010).

Solomon deposits typically contain the following palaeochannel units (MWH 2010; Figure 3.1):

1. *Alluvial/Colluvial and Detrital Deposits*: valley in-fill sequence consisting clay, silt and gravel, including 10-60 m thickness of DID derived from BID.
2. *Oakover Formation*: calcrete and silcrete horizons typically overlying CID and varying in thickness from barely present to several metres.
3. *Upper CID*: hard, goethite dominated CID which has been overprinted in places by a hardcap zone of hydrated goethite up to 15 m thick.
4. *Lower CID*: vuggy, clay rich ochreous goethite dominated CID.
5. *Basal Conglomerate*: basal conglomerate and clay unit present at the base of the CID, typically within the deepest parts of the palaeochannel system.
6. *Brockman Iron Formation*: relatively flat lying, predominately unmineralised BIF (Dales Gorge and Joffre Members divided by Mt Whaleback Shale) with zones of mineralised BIF and DID occurring in the adjacent valley walls and margins of the palaeochannels.



All of the CID at Solomon is part of the same geology sequence and is referred to here as CID although it has sometimes been described as Robe Pisolite. Except at Zion, the vast majority of the CID lies below the watertable and does not represent troglifauna habitat (Figure 3.1). At Zion, the outcropping CID sits entirely above the watertable (as a plateau) with little or no overlying alluvium (Figure 3.1). Brockman Iron Formation (BIF) and the underlying Mount McRae Shale form the northern and southern valley walls, hills and ridgelines, as well as the palaeochannel valley floor.

3.1.1. Solomon as Troglifauna Habitat

All of the mineralised lithologies found at Solomon (BID/CID/DID) are known to have vugs or spaces and are recognised as troglifauna habitat in many other parts of the Pilbara (Biota 2006, Bennelongia 2009a, c, 2010, 2011, 2012). The basement lithologies that occur throughout the tenement are predominantly basal conglomerate, banded iron formation (BIF) and shales and are not recognised as prospective for troglifauna, particularly at the depths at which they occur at Solomon. On the other hand, weathered surface BIF occurring on ridgelines and hills (commonly known as the hardcap zone) is considered to be troglifauna habitat because of its almost karstic nature.

The colluvial and alluvial sediments that overlay the CID and flanking DID in the valleys are considered to be less prospective troglifauna habitat, although troglifauna have been found in alluvium (often where calcrete is present) in the Pilbara and elsewhere in Western Australia (Edward and Harvey 2008; Barranco and Harvey 2008; Platnick 2008; Bennelongia unpublished data). Alluvium and colluvium provide essentially the only troglifauna habitat, albeit poorer quality, in the valley floors at Solomon except at Zion where the CID is outcropping. The outcropping CID above the watertable at Zion represents classic troglifauna habitat (Biota 2006). The flanking valley walls and hills at Zion comprise non-commercial grade BID (Dales Gorge and Joffre Member) and hardcap. This hardcap zone is the most prospective troglifauna habitat at Zion outside the potential mine pits.

Metadolerite sills and dolerite dykes are known to cut into the BID within the regional area around Solomon (MWH 2010).

3.2. Habitat Continuity at Solomon

Quantifying habitat connectivity for troglifauna is inherently difficult and in most cases connectivity of habitat between two areas is inferred for particular species because the species occurs in both areas. Connectivity can also be inferred if no obvious barriers to troglifauna movement exist between the two areas that are connected by apparently suitable habitat but small ranges are a characteristic of most troglifauna species and species may not extend widely in an area despite lack of barriers and the occurrence of suitable habitat. Landscape features that are considered to be potential barriers for troglifauna include deep valleys, dolerite dykes and significant faulting. Such features have the potential to block the continuity of the small humid voids and spaces that are required for the presence of troglifauna. In contrast, a transition between lithology/strata (especially from commercial to non-commercial grade mineralisation) rarely indicates a barrier to troglifauna distribution (Bennelongia 2009a, c, 2011, 2012).

The patterns of species distributions recorded in troglifauna surveys have indicated there is considerable habitat connectivity between the various lithologies at Kings, Firetail and Zion (Bennelongia 2010, 2013a, 2013b). For example, more than half of the troglobitic species recorded in CID have been shown to have a whole of Solomon-scale distribution (Bennelongia 2013a). At the same time, troglifauna species do tend to have restricted distributions and sampling to date has suggested there is

some consistent turnover in species composition between areas, which means that the assemblages in each area show differences despite evidence of habitat connectivity (Bennelongia 2010, 2013a, 2013b).

3.3. Previous Troglafauna Surveys and Assessment at Solomon

3.3.1. Survey for the PER

Sampling within the Study Area was undertaken according to the general principles laid out in EPA Environmental Assessment Guideline No. 12, although the sampling preceded release of the guideline, and Guidance Statement No. 54A (EPA 2007, 2013a).

Troglafauna assessment supporting the original 2010 Solomon Iron Project PER was based on 377 samples (Figure 3.2). The 165 samples collected from Kings and Zion by Subterranean Ecology (2010) yielded 28 species, the 263 samples collected from Firetail by Bennelongia (2010) yielded 45 species, and the 49 samples collected around Kings and farther west and north-west of Solomon by Subterranean Ecology (2011) yielded 14 species. At the time Subterranean Ecology (2010) reported, 17 troglafauna species were recorded only from within potential mine pits at Kings, with 10 of these species occurring in the proposed Valley of the Kings or Valley of the Queens mine pits (some also occurred at Zion).

Conditional approval for Solomon was given in April 2011 under MS862, which incorporated the EPA's (2011) conclusions and recommendations summarised below:

- 1) It was concluded that the impact to subterranean fauna from the railway spur and mining at Firetail were unlikely to be significant and, thus stated, assessment would focus on the Kings mine;
- 2) In relation to stygofauna at Kings, the report noted some stygofauna species had been recorded only at Kings but the EPA agreed with the proponent's hypothesis that the stygofauna community extended beyond the impacted CID aquifer and concluded that the observed distributions were an artefact of sampling; and
- 3) In relation to troglafauna at Kings, the report noted the higher proportion of troglafauna species restricted to Kings Mine, agreed with the proponent's hypothesis that further survey would demonstrate that troglafauna communities extended outside the impact, and recommended such survey to validate habitat connectivity beyond the impact area.

The above findings led to development of Condition 13 of MS862 (provided in full in Appendix 1).

3.3.2. Surveys for Compliance with Condition 13

3.3.2.1. Kings

Condition 13-1 required that Fortescue survey troglafauna biannually to validate predictions of habitat connectivity and improve knowledge of troglafauna populations. Accordingly, Bennelongia conducted further surveys at Kings (Figure 3.2) in spring 2011, autumn 2012, spring 2012 and autumn 2013. These surveys and all previous work at Kings were reported in Bennelongia (2013b). Key findings of this report are summarised below.

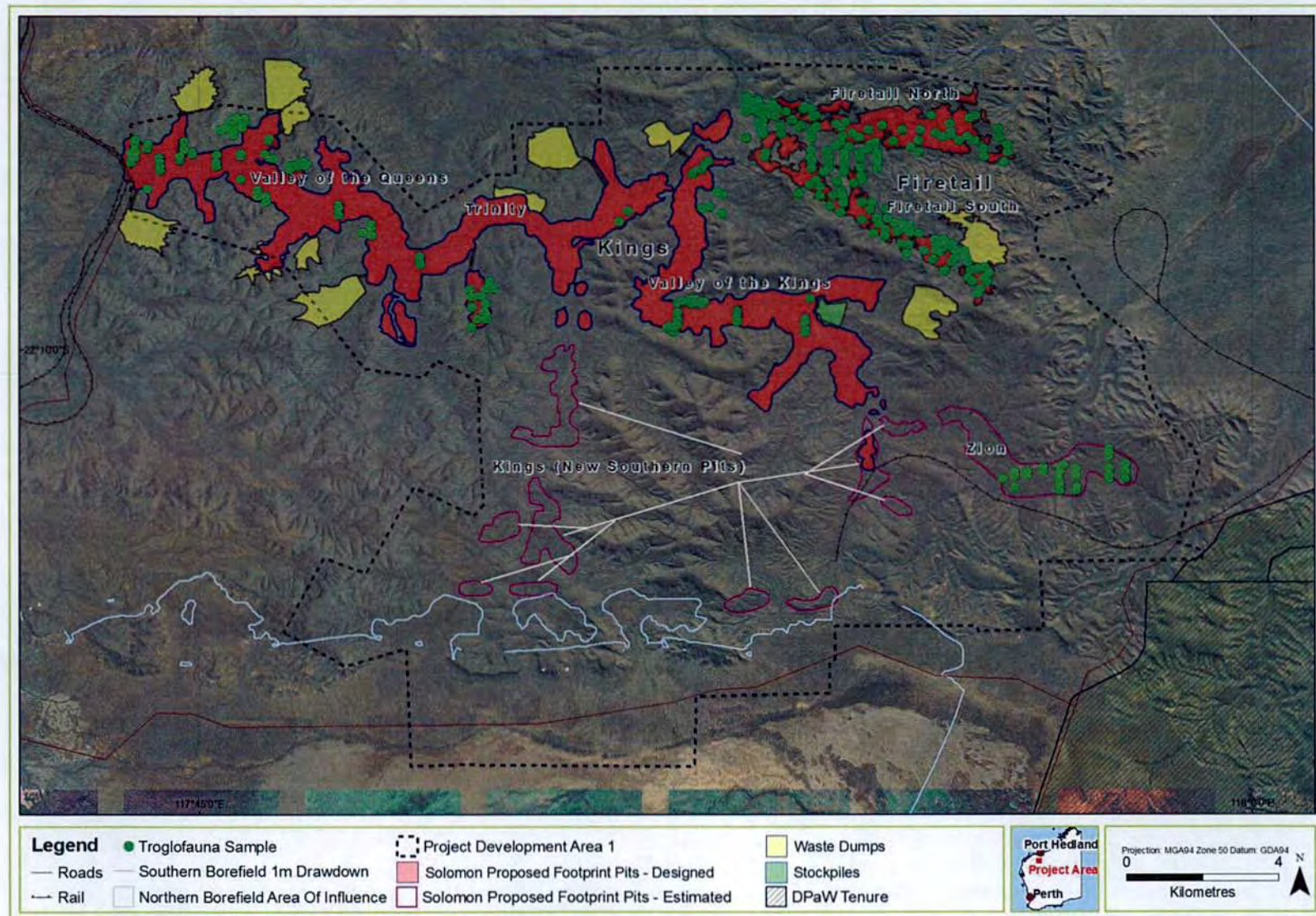


Figure 3.2. Historical sampling at Solomon, being the original 2010 Solomon Iron Project PER and surveys for compliance with Condition 13 of MS862.

Currently 68 species of troglafauna are known Kings. Both capture rates and the occurrence of species demonstrated that habitat connectivity exists between the potential mine pits and areas outside them. Furthermore, it appears that better troglafauna habitat occurs outside the potential mine pits than within them.

- At both Valley of the Kings and Valley of the Queens, more than twice as many species are known from outside compared with inside the mine pits (12 inside and 29 outside at Valley of the Kings; 15 and 41 at Valley of the Queens);
- Capture rate in the surrounding area was more than twice that in the potential mine pit at Valley of the Kings (1.91 specimens per sample versus 0.95). Capture rate in the area around Valley of the Queens was also higher than in the mine pit (1.26 specimens per sample versus 0.94).
- All Orders of troglafauna and almost all species collected within the mine pits at the Valley of the Kings and Valley of the Queens have been collected in the surrounding undisturbed areas. Most of the specimens collected outside of the mine pits have been collected on the flanks of the valleys and foothills leading into the surrounding ranges.
- This pattern of troglafauna distribution has been observed at other areas where CID is to be mined from valleys. The geologies at Blacksmith tenement, 24 km west of the Kings mining area, are the same as at the Valley of the Kings and Valley of the Queens. Survey at Blacksmith suggested that hardcap, DID and BID on valley flanks are likely to be better troglafauna habitat than the valley-infill (CID, alluvium and colluvium) that is the target of mining (Bennelongia 2012).

The existence of habitat connectivity between mine pits and surrounding areas was acknowledged by the EPA with formal sign off of Condition 13-1 and 13-3 (EPA 2013c).

3.3.2.2. Zion Deposit

Also among the conditions attached to MS862 was a requirement for survey before development of the approved Zion deposit at Kings (Condition 13-4). Bennelongia conducted surveys in 2011 and 2012 to meet the requirements of Condition 13-4 (Figure 3.2). These surveys and all previous work at Zion were reported in Bennelongia (2013a).

At present, 27 troglafauna species belonging to 14 Orders have been recorded at Zion. Seventeen of the 27 species were recorded in potential mine pits. The patterns of troglafauna species distribution observed at Zion were similar to those at Valley of the Kings and Valley of the Queens. All but three of the 17 species recorded from the potential mine pits have also been recorded in surrounding undisturbed areas, other deposits at Solomon or in the wider Pilbara and almost half of the troglabitic species found at Zion had Solomon-scale distributions. This indicated that there is considerable habitat connectivity for troglafauna in the strata surrounding the potential mine pits at Zion.

This habitat connectivity was acknowledged by the EPA with formal sign off of Condition 13-4 (EPA 2013b).

3.3.3. Species Previously Identified as Known Only from Potential Mine Pits at Solomon

In total, 81 troglifauna species have been recorded at the Kings mining area, including Zion deposit. Eleven (13%) of them are known only from the potential mine pits (Table 3.1), which is typical of the ratio of 'restricted' troglifauna species at approved mine pits (Bennelongia 2008a, c, 2009a, d, e). The proportion of 'restricted' species is slightly lower at Firetail, with four of 45 (9%) species known only from the potential mine pits (Table 3.1).

Table 3.1. Troglifauna known only from potential mine pits at Solomon Hub.

Order Species	Known from	Reference
Pseudoscorpionida		
<i>Lagynochthonius</i> sp. B7	Firetail	Bennelongia 2010
Schizomida		
<i>Draculoides</i> sp. B30	Zion	Bennelongia 2013a
Araneae		
<i>Linyphiidae</i> sp. B02	Valley of the Kings	Bennelongia 2013b
Scolopendromorpha		
<i>Cryptops</i> sp. SOLOMON 1	Valley of the Queens	Bennelongia 2013b
<i>Cryptops</i> sp. SOLOMON 2	Zion	Bennelongia 2013a
Tetramerocerata		
<i>Paupoda</i> sp. B01 (=Paupoda sp. SOLOMON 1)	Valley of the Kings	Bennelongia 2013b
Diplura		
<i>Projapygidae</i> sp. B4	Firetail	Bennelongia 2010
<i>Parajapygidae</i> sp. SOLOMON 1	Valley of the Kings	Bennelongia 2013b
<i>Parajapygidae</i> sp. SOLOMON 2	Valley of the Kings	Bennelongia 2013b
<i>Japygidae</i> sp. DPL033	Valley of the Queens	Bennelongia 2013b
<i>Japygidae</i> sp. B11	Firetail	Bennelongia 2010
<i>Japygidae</i> sp. SOLOMON 2	Valley of the Kings	Bennelongia 2013b
Coleoptera		
<i>Anillini</i> SOLOMON 1	Valley of the Kings	Bennelongia 2013b
<i>Zuphiini</i> sp. SOLOMON	Zion	Bennelongia 2013a
<i>Curculionidae</i> Genus 1 sp. B4	Firetail	Bennelongia 2010

Species may be recorded only in proposed mine pits because the species does, in fact, have a very small range that lies within the area of the pit. More commonly, however, the species appears to be restricted because it was collected in only one or two samples, which happened to be collected within the proposed pit. Reasons for this include sampling methods being ineffective for that species or the species occurring at very low abundance (Magurran and Henderson 2003; Guisan *et al.* 2006). Thus, the 'restricted' ranges of species are usually artefacts of the biology of the species and sampling inefficiency. Caution should be exercised when deciding species have small ranges unless they have been collected in many samples or a high proportion of the species collected from the mine pit are known only from that pit.

Another factor that contributes to a misleading assumption that troglifauna are restricted to potential mine pits is that often a very high proportion of the drill holes available for sampling are within the proposed mine pit. This creates bias in sampling design that makes any species collected in few samples likely to be recorded only from the mine pit.

4. ASSESSMENT

4.1. Impacts on Troglafauna

4.1.1. Borefield Development

Drawdown of the watertable associated with the proposed Northern and Southern Borefields is unlikely to threaten troglafauna species. While groundwater drawdown is a primary impact for stygofauna via loss of habitat, it is typically not considered to be a threat to troglafauna. The most likely mechanism for groundwater drawdown to reduce troglafauna habitat is through decreases in humidity of troglafauna habitat as the watertable is lowered. However, because small pools of water remain perched in voids as the watertable is lowered, in most situations lowering the watertable probably has little effect on humidity of troglafauna habitat. In fact, lowering of the watertable may often increase the amount of troglafauna habitat available. Therefore, in most situations dewatering is likely to be, at most, a secondary impact on troglafauna. Groundwater drawdown at the proposed borefields is not considered further in this report.

4.1.2. Mine Pit Expansion

Direct habitat loss is considered to be the main mining-related threat to troglafauna. In the case of proposed expansion to mining operations at Solomon, *pit excavation* is the only proposed impact resulting in significant loss of troglafauna habitat. The pit expansion areas are an extension of the CID mineralisation and it is proposed to increase the pit area by about 24%. This is considered a primary impact, and hence this is evaluated in terms of the threat posed to troglafauna species.

4.2. Threat to Troglafauna

4.2.1. Background and Rationale

Under MS862, areas of 2750 ha and 880 ha, respectively, were approved for excavation of potential mine pits at Kings and Firetail (see Appendix 2 for details). This was subsequently amended under Attachment 2 of MS862 to a combined 3630 ha of pit disturbance within the Project Development Area 1. While it was indicated approximately where the mine pits might be located, the precise location of the approved area to be excavation was to be determined later by mine planning (Figure 1.2).

In this report, the proposed increase in area of mine pit excavation is separated into four components so that uneven level of information about different areas can be accommodated more easily and results of previous survey work can be applied more effectively to areas for which extensive information is available. The four components comprise (Figure 4.1):

- Expansion of the potential Kings mine pits assessed in the PER, including deposits formally reported as Valley of the Kings, Valley of the Queens and Trinity in Subterranean Ecology (2010) and Bennelongia (2013c).
- Additional potential mine pits south of Kings.
- Expansion of the potential pits at Zion that were assessed in the PER and Condition 13 surveys (Subterranean Ecology 2010; Bennelongia (2013a,b).
- Expansion of the potential Firetail pits assessed in the PER (Bennelongia 2010).

Assessments of the expansions at Kings, Zion and Firetail are based on field survey data, while assessment of the new pits south of Kings is based on habitat characterisation and inferences about the

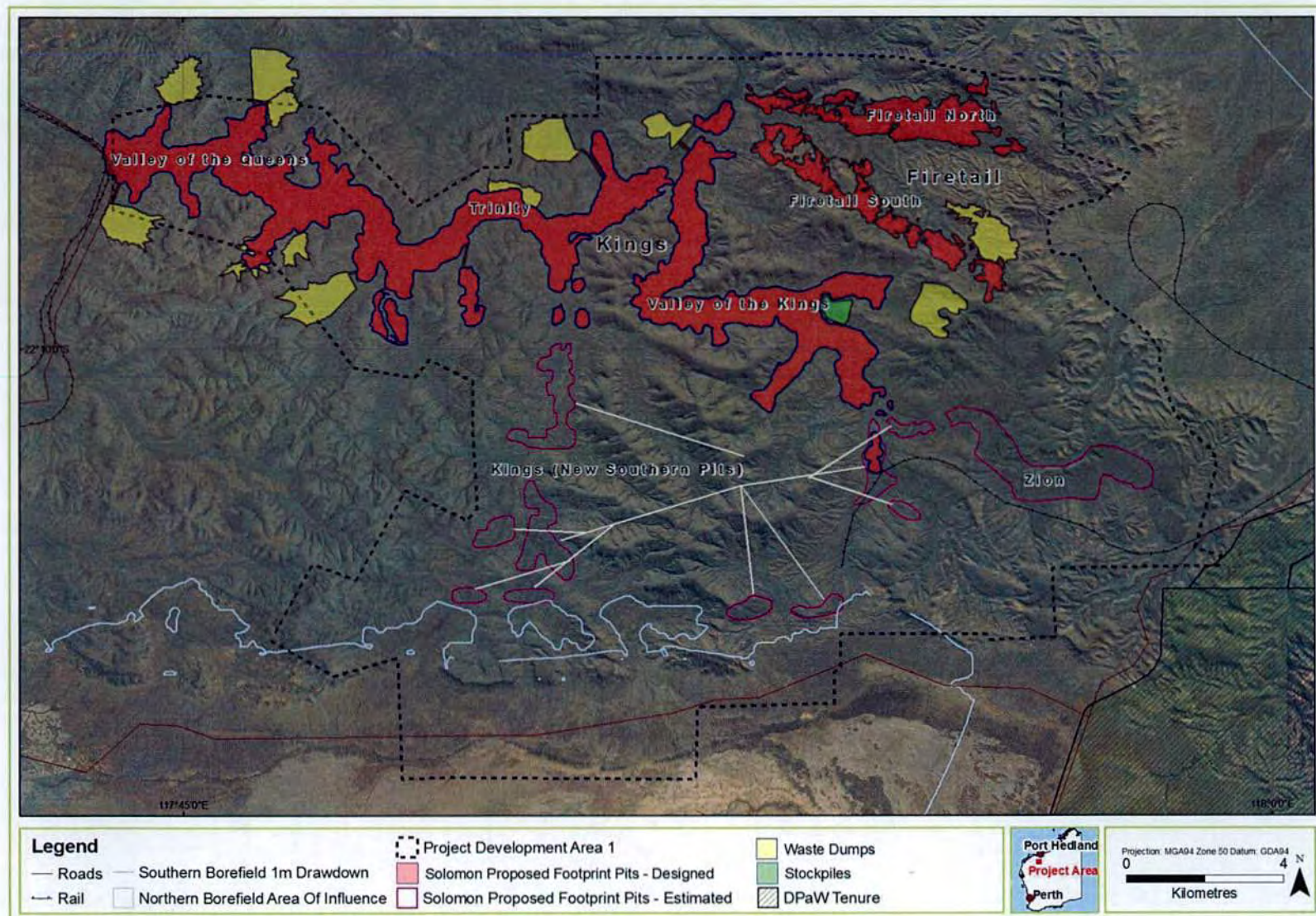


Figure 4.1. Solomon footprint.

likely troglafauna community of the area based on surveys of other areas of Solomon.

4.2.2. Kings

There has been very significant troglafauna survey effort at Kings. A total of 105 samples were collected for the original Solomon Iron Ore Project (Subterranean Ecology 2010) and 448 samples were collected to meet Condition 13 of MS862 (Bennelongia 2013b). Data from these surveys provides a good understanding of the troglafauna community present at Kings.

The most recent study assessing the impact of mine pit excavation at Valley of the Kings and Valley of the Queens was the 30-month report prepared under with Condition 13-1 and 13-3 of MS682 (Bennelongia 2013b). In this study 'potential' mine pits with an area totalling 2822 ha were used to demonstrate troglafauna communities extended outside the likely area impact at Kings. The validity of this assessment was acknowledged by the EPA with formal sign off of Condition 13-1 and 13-3 (EPA 2013c).

Fortescue now proposes a 7% increase in the area of mine pits (from 2822 to 3026 ha) at Kings compared with the area assessed by Bennelongia (2013b). This is shown in Figure 4.2 as the difference between the designed and potential mine pits, with the main variation from the Bennelongia's (2013b) boundaries being a projected increase in the area of CID to be mined along the edge of the valleys, although along some valley edges there is a decrease in area. The changes reflect ongoing re-evaluation of the extent of the commercial grade ore resource and are indicative of the area that may be mined.

Most drill-holes previously used as reference sites (on the valley flanks) are now within the potential mine pits and formal re-analysis of species distributions would result in more species now being known only from the potential mine pits than were identified as restricted by Bennelongia (2013b). In reality, this is an artefact of the ratio of impact to reference holes being very strongly skewed to impact holes. It is likely that all species known only from the potential mine pits occur more widely because there is good connectivity with surrounding areas and evidence that these areas are actually better troglafauna habitat than the mine pit areas (Bennelongia 2013b). In the current situation it is relevant to recognise that lack of reference drill holes constrained Subterranean Ecology's (2010) assessment of troglafauna at Kings, with the result that there appeared to be a high proportion of apparently restricted species. This led to Conditions 13-1 and 13-3 being imposed in MS682 but subsequent sampling by Bennelongia (2013b) showed all species were likely to be more widely distributed.

The work done under Condition 13-1 of MS682 showed wider habitat connectivity exists beyond the potential mine pits for most troglafauna species and that it is likely that most, if not all, species occurring in valleys also occur on the flanks and ridges of surrounding ranges. Consequently, it can be inferred that there is minimal threat to troglafauna from the proposed expansion at Kings.

4.2.3. Kings (New Southern Pits)

There has been no troglafauna survey in any of the new potential pit areas to the south of Kings and currently the likely pit configuration and area is only estimated (Figure 4.1).

The geology of the areas for which the southern pits are proposed is similar to that found at Kings. The potential troglafauna habitat in valleys is alluvial and colluvial sediments, with CID likely to lie below the watertable (Figure 3.1). Alluvial and colluvial sediments are less prospective troglafauna habitat than geologies such as enriched BID and hardcap on the surrounding valley flanks and ridges (Sections 2 and 3.1.1). Furthermore, the alluvial and colluvial sediments of the valleys extend well beyond the areas to

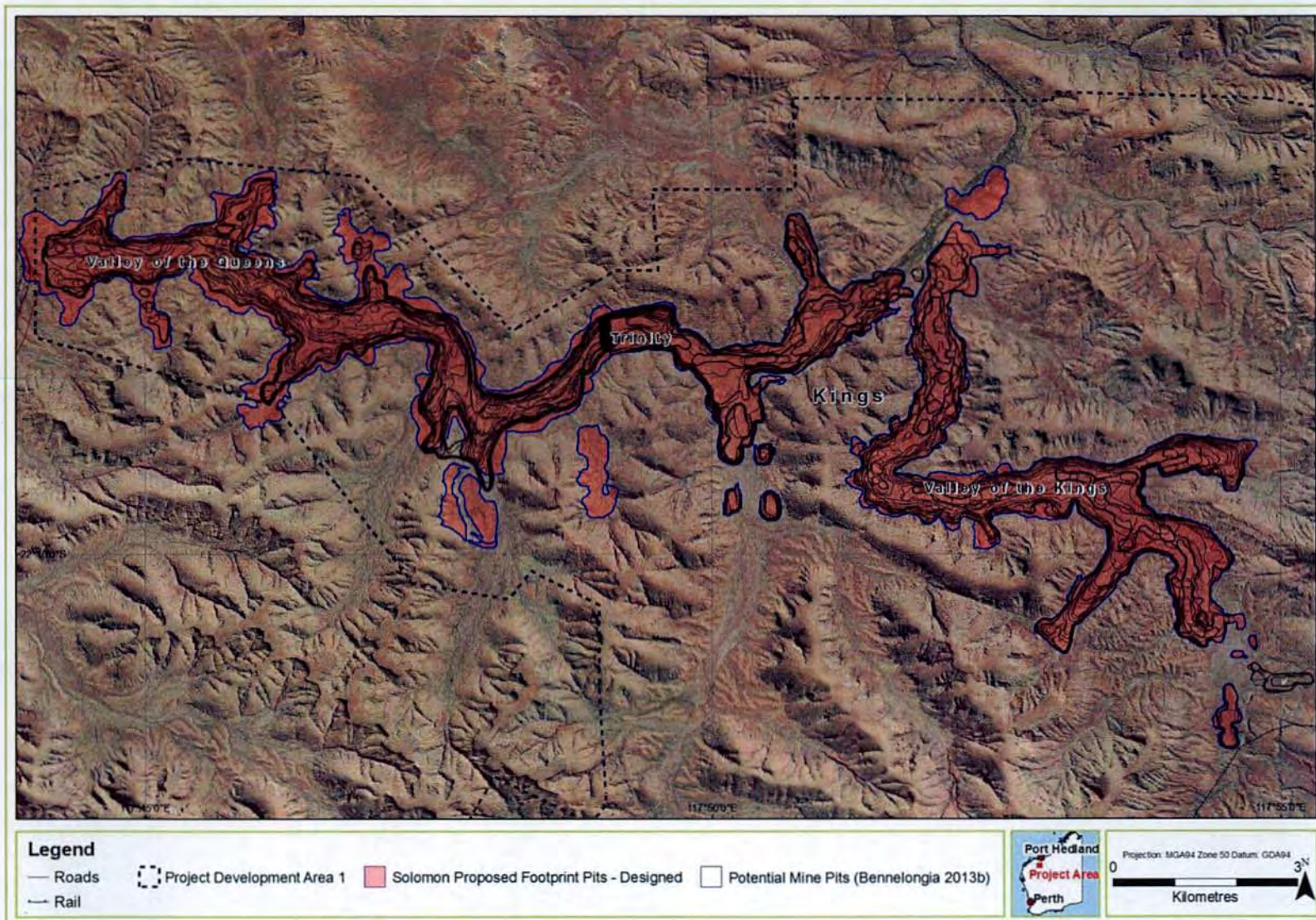


Figure 4.2. Changes in pit configuration at Kings between Bennelongia (2013b) and the proposed mine pits.

be mined and there is likely to be habitat connectivity along the valleys for any troglafauna in the sediments. Consequently, although some troglafauna species may occur in the sediments, the threat to these species from mining is likely to be low. By analogy with the well-studied Kings to the north, it is also likely there is good connectivity from the alluvial deposits into the surrounding ranges, so that the threat to species occurring in the valley flanks is also likely to be low. Accordingly, the overall impact on troglafauna of excavating new pit areas south of Kings is considered likely to be low.

4.2.4. Zion

There has been considerable troglafauna survey at Zion, with 77 samples collected for the PER and to meet Condition 13 (Subterranean Ecology 2010; Bennelongia 2013a). Data from these surveys provides a sound understanding of the troglafauna present at Zion. Furthermore, the likely impact of pit excavation at Zion was assessed by Bennelongia (2013a) for a potential mine pit area of 258 ha. It was concluded that the Zion troglafauna community extended outside the likely area of pit excavation although *Draculoides* sp. B30, *Zuphiini* sp. SOLOMON and *Cryptops* sp. SOLOMON 2 may possibly be restricted to the area of outcropping CID at Zion. This was acknowledged by the EPA by formal sign off of Condition 13-4 (EPA 2013b).

After re-evaluating the resource at Zion, Fortescue proposes to increase the area of potential mine pits from 258 to approximately 434 ha (68% increase, location of potential pits in Figure 4.3 is approximate). The conclusion in Bennelongia (2013a) that there is little threat to troglafauna at Zion continues to apply, despite the majority of outcropping CID within Zion now being mined, because it has been shown that additional CID that extends beyond the proposed mine pits (Figure 4.3). It is estimated that about 60% of CID at Zion will be outside of the pits. *Draculoides* sp. B30, *Zuphiini* sp. SOLOMON and *Cryptops* sp. SOLOMON 2 probably occur in this area of additional CID, although to date the three species have been found only in the potential mine pits, because all three species are known from single specimens and will have wider ranges than currently documented (Figure 4.4).

Therefore, there is a degree of uncertainty about whether the three aforementioned troglafauna species will persist as a result of the additional mining at proposed at Zion, although the species are probably widely enough distributed to make the level of threat low.

4.2.5. Firetail

There has been considerable troglafauna survey completed at Firetail, with 263 samples collected by Bennelongia (2010). Data from this survey provide a sound understanding of the troglafauna present at Firetail.

The potential mine pits on which the assessment of threat to troglafauna was based at Firetail in the PER had area of 741 ha. The assessment showed that troglafauna communities at Firetail extended outside this 741 ha (Bennelongia 2010). MS682 approved mining in an area of 880 ha, a slightly larger area than assessed. Following re-evaluation of the resource, the proposed mine pit now covers 797 ha (Figure 4.5), which is a smaller area than the 880 ha approved for mining under the MS862.

The proposed increase in size of mine pits at Firetail is very small and will occur in area already demonstrated to have habitat connectivity for troglafauna with surrounding areas. Given that the proposed area of mining is smaller than approved under MS682 and occurs almost entirely within the original footprint, it is concluded that mining of the proposed pits is unlikely to threaten troglafauna.

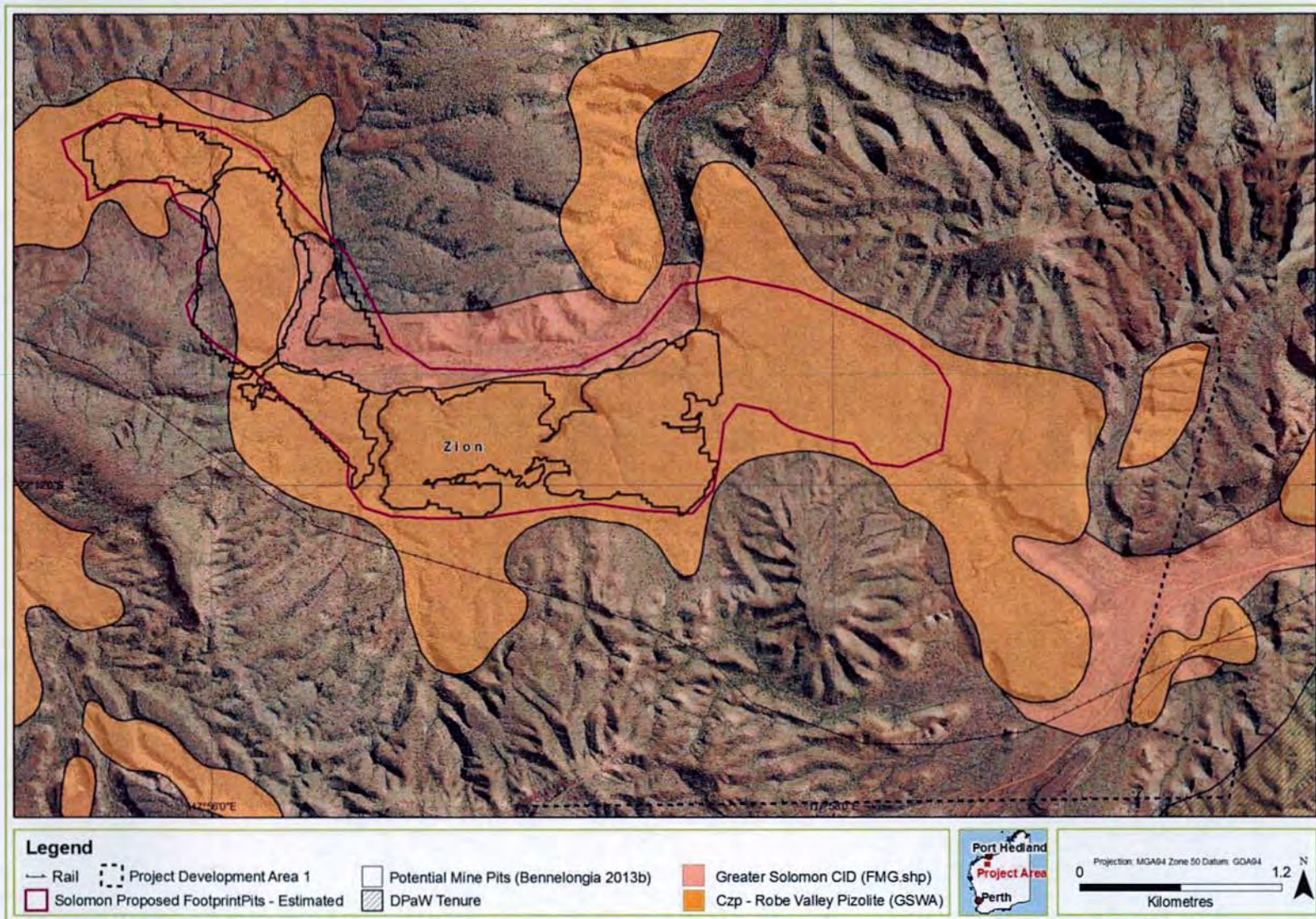


Figure 4.3. Differences in configuration of the proposed mine pit at Zion from that shown in Bennelongia (2013a).

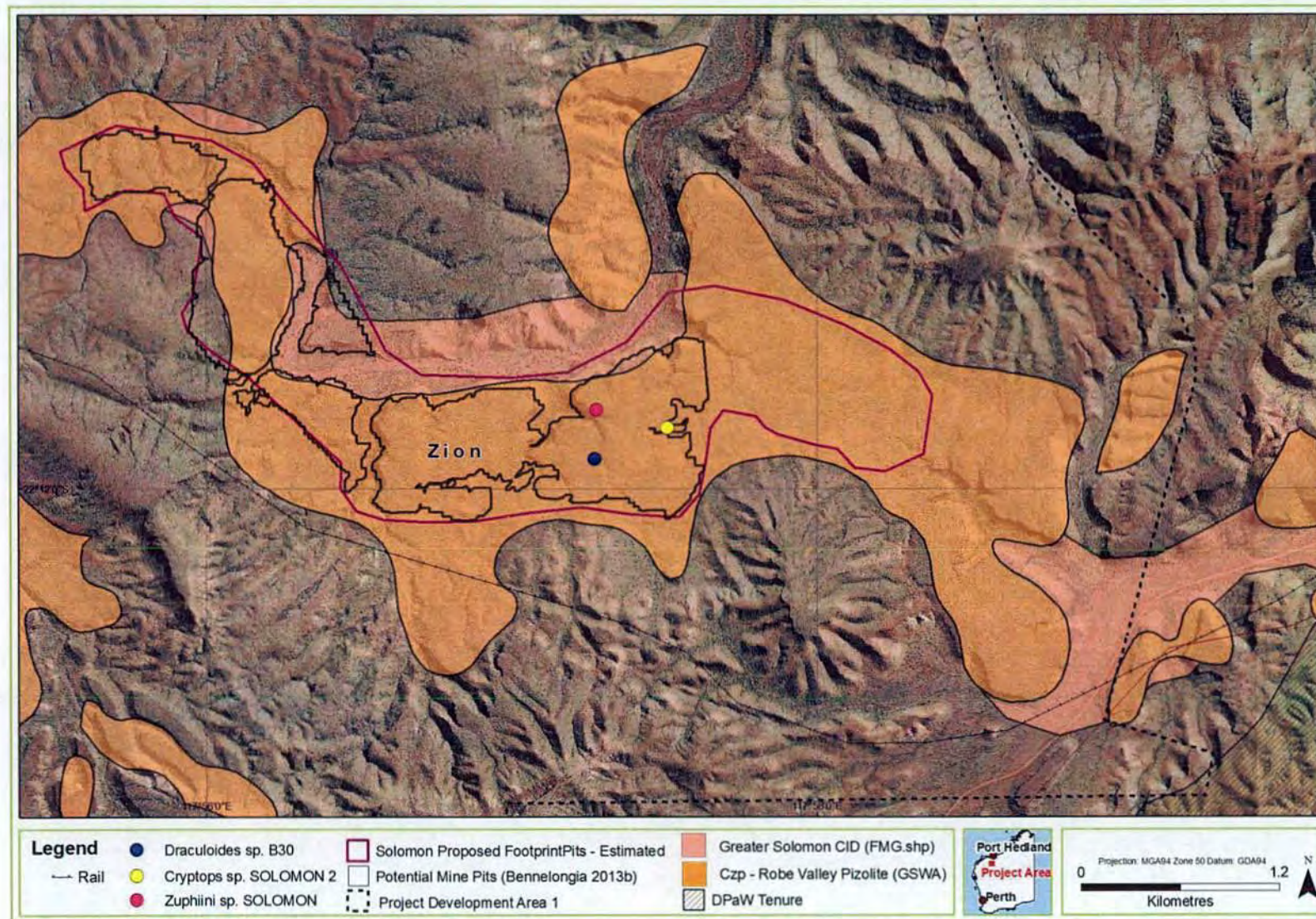


Figure 4.4. Singleton species at Zion with unknown distributions.

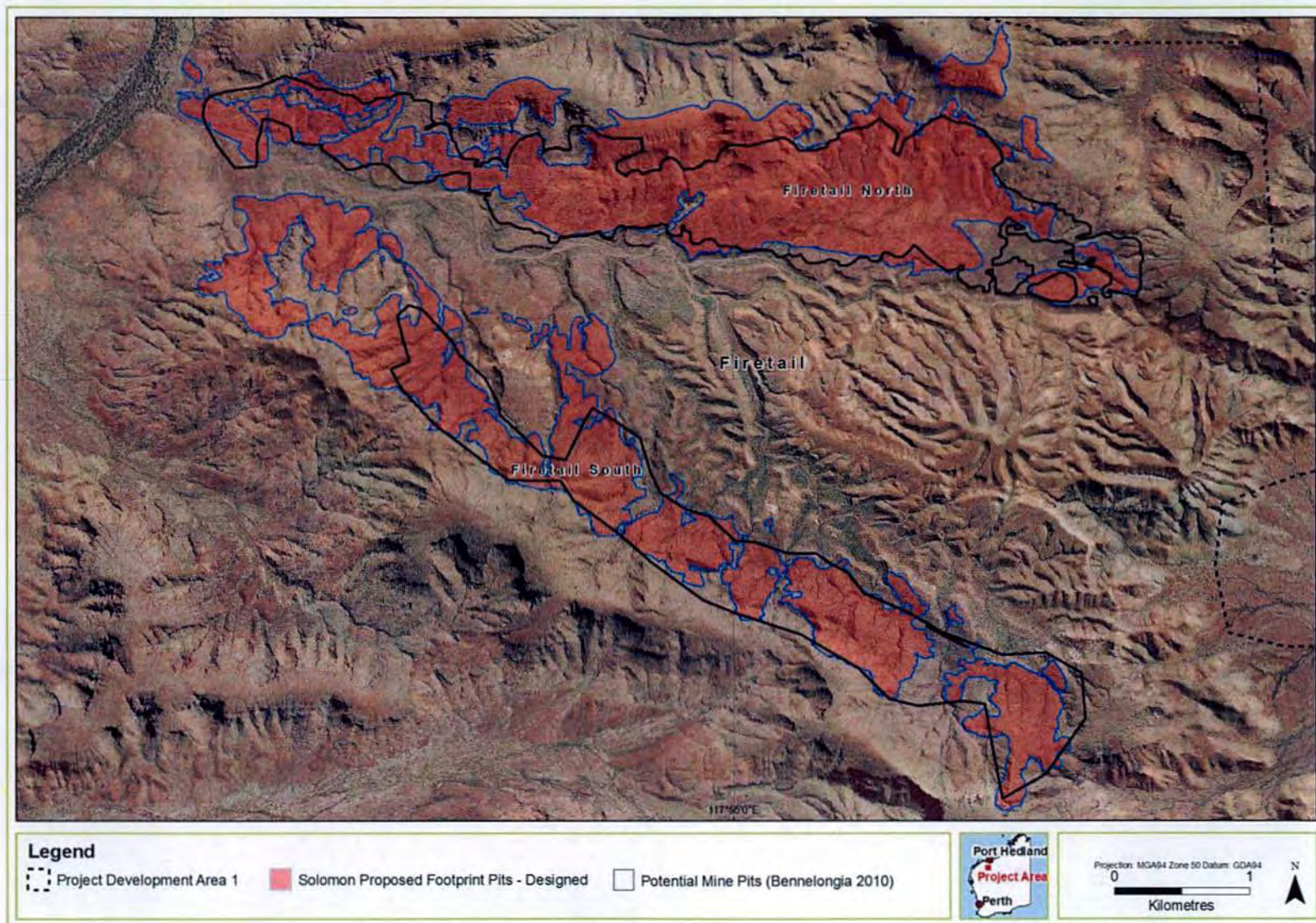


Figure 4.5. Changes in pit configuration at Firetail between Bennelongia (2010) and the proposed mine pits.

5. CONCLUSION

5.1. Borefield Development

Drawdown of the watertable associated with the proposed Northern and Southern Borefields is most unlikely to threaten troglafauna species. The most likely mechanism for groundwater drawdown to reduce troglafauna habitat is through decreases in humidity of troglafauna habitat as the watertable is lowered. However, because small pools of water remain perched in voids as the watertable is lowered, in most situations lowering the watertable probably has little effect on humidity of troglafauna habitat. In fact, lowering of the watertable may often increase the amount of troglafauna habitat available. Therefore, in most situations dewatering is likely to be, at most, a secondary impact on troglafauna.

5.2. Pit Expansions

The proposed increase in area of mine pits at Solomon is 863 ha. This increase was divided into four components for assessment: 1) expansion of the potential Kings pits assessed in the PER; 2) additional southern pits at Kings; 3) expansion of the potential pits at Zion assessed in the PER and Condition 13 surveys; and 4) expansion of the potential Firetail pits assessed in the PER. The following conclusions are drawn:

Kings

Based on a large survey effort at Kings and the subsequent understanding of distributions of troglafauna species present in the area, it may be assumed that a small increase of 7% in pit size at Kings would do little to alter the position of low risk to troglafauna established by the surveys undertaken to fulfil Condition 13 of MS862. These surveys demonstrated that there is a connection for troglafauna species between habitat within the potential mine pits at Kings and habitat outside the pits. It seems likely that most, if not all, species occurring in the valleys at Kings also occur on the flanks of surrounding ranges and in those ranges.

Kings (new southern pits)

The geology of the potential mine pits south of Kings is similar to that at Kings. The alluvial and colluvial sediments of the valleys extend well beyond the areas to be mined, so that there is likely to be habitat connectivity along the valleys for any troglafauna in the sediments. Similarly, there is also likely to be good connectivity from the alluvial deposits and DID on valley flanks into the BIF and hardcap of surrounding ranges. Although no troglafauna survey has been conducted in the potential southern pits, by analogy with the troglafauna community at Kings, it is considered that the threat to the troglafauna species occurring in these areas is likely to be low.

Zion

It was concluded in the PER that there was little threat to troglafauna at Zion because 36% of outcropping CID would remain unmined. It is now proposed to increase the area to be mined at Zion by up to 68% (from 258 to 434 ha), which will remove the majority of unmined CID within Zion. However, re-evaluation of the resource has identified additional CID around the proposed mine pits. It is estimated that about 60% of the CID at Zion and its immediate surroundings will be outside the proposed pits. Three species are known only from within the proposed Zion mine pits (the schizomid *Draculoides* sp. B30, beetle *Zuphiini* sp. SOLOMON and centipede *Cryptops* sp. SOLOMON 2). While all three species were represented by single animals and there is some uncertainty about their distributions, it is considered probable that they also occur in the CID outside the pits. Consequently, it

is considered there will be little threat to troglafauna at Zion as a result of the additional mining proposed.

Firetail

The proposed expansion of mine pits at Firetail is very small (8%) and it has already been demonstrated that there is habitat connectivity for troglafauna between the pits and surrounding areas. Given that the proposed area of mining is smaller than approved under MS682 and occurs almost within the original footprint, it is concluded that mining of the proposed pits is unlikely to threaten troglafauna.

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7. APPENDICES

Appendix 1: Condition 13, Ministerial Statement 862.

- 13-1 The proponent shall undertake troglafauna surveys biannually at a minimum in geological formations similar to the project area to validate predictions of habitat connectivity and improve knowledge of troglafauna populations in the region to inform future management of mining and associated operations, until such time as the Chief Executive Officer of the Office of the Environmental Protection Authority determines that sufficient knowledge of troglafauna populations has been acquired.
- 13-2 The troglafauna surveys shall be undertaken in accordance with the draft Environmental Protection Authority Guidance Statement 54a – *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (August 2007)* or its revisions and to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority.
- 13-3 Within 30 months of ground disturbing activities the proponent shall prepare and submit a technical report based on the results of the surveys required by condition 13-1 to the requirements of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice from the Department of Environment and Conservation.
- 13-4 Three months prior to commencement of ground disturbing activities associated with the Zion deposit, the proponent shall demonstrate that similar and connected troglafauna habitat exists outside of areas that have been or are likely to be impacted by mining to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice from the Department of Environment and Conservation.
- 13-5 The proponent shall prepare and submit annually further technical reports based on the results of the surveys required by condition 13-1 to the requirements of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice from the Department of Environment and Conservation.
- 13-6 The proponent shall make the reports required by conditions 13-3, 13-4 and 13-5 publicly available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

Appendix 2. Estimated Pit Configuration at the Time of the PER

- A) Kings mining area showing approximately 2500 ha (Section 4: FMG 2010) of mine pits. Figure from Subterranean Ecology (2010). Note that an additional 10% disturbance area was authorised by MS682.

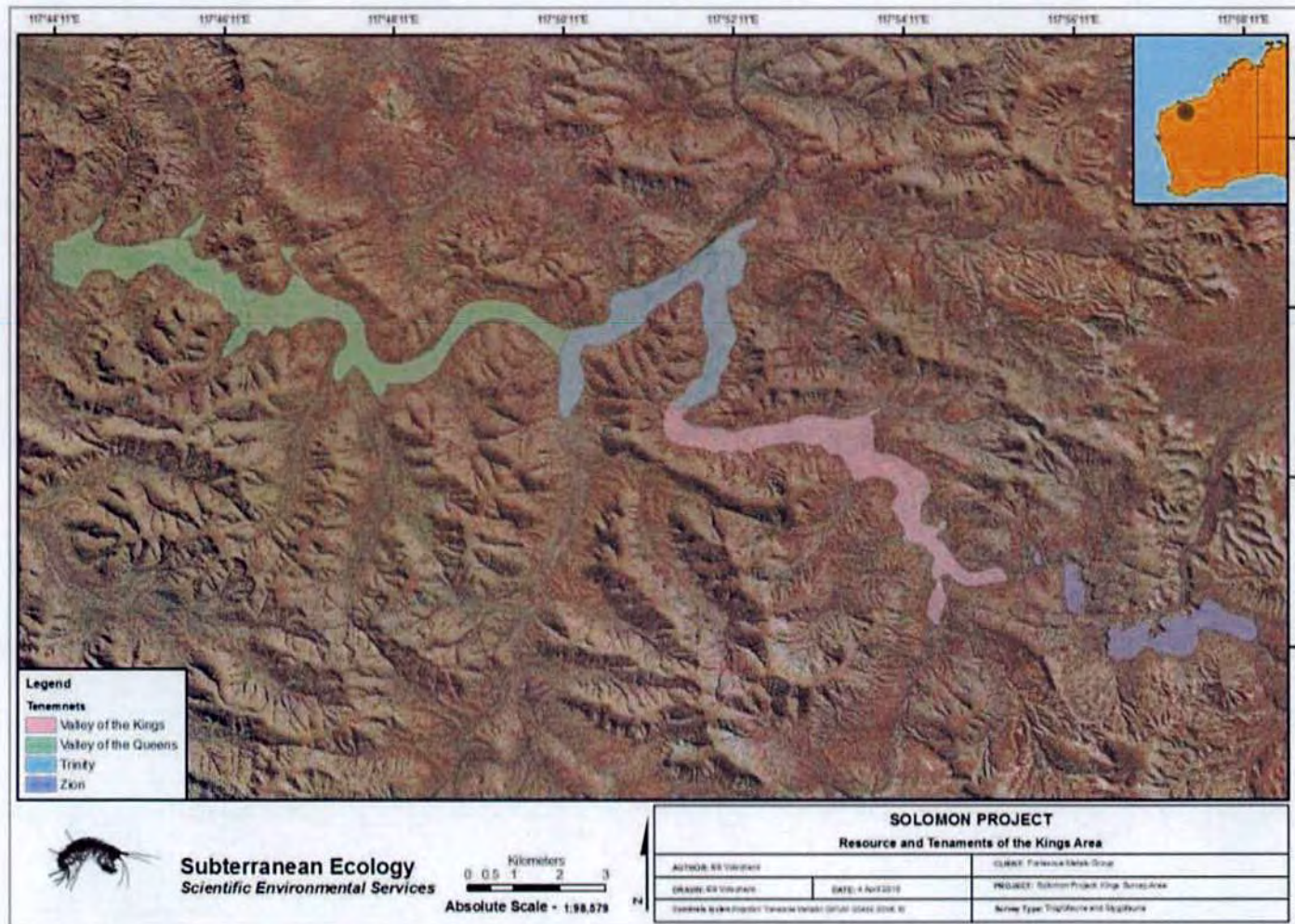


Figure 1.2 Map of Solomon Project, Kings Area, indicating resource and tenement areas.

- B) Firetail mining area showing approximately 800 ha (Section 4: FMG 2010) of mine pits. Figure adapted from Bennelongia (2010). Note that an additional 10% disturbance area was authorised by the MS682.

