



# SOUTHERN CROSS GOLDFIELDS LTD



**ENVIRONMENTAL  
REFERRAL**

**MARDA EAST GOLD  
PROJECT**



**25 AUGUST 2014**

25 August 2014

Environmental Protection Authority  
Locked Bag 10  
East Perth WA 6892

Dear Sir/Madam

**Marda East Gold Project  
Referral under Section 38(1) of the Environmental Protection Act 1986**

Southern Cross Goldfields (SXG) proposes to develop the Marda East Gold Project (the Proposal) in the Yilgarn Mineral Province of Western Australia. The Development Envelope is located approximately 140 km north of Southern Cross. The Proposal includes open pit gold mining at two locations within the Marda region:

- Red Legs; and
- Fiddleback (previously named Die Hardy).

Mining will extract oxide (weathered) ore and waste rock which is typically hosted in Banded Iron Formation (BIF) geological formations. While a portion of the Red Legs project is located within the foothills of the Die Hardy Range, no part of the project footprint infringes on the BIF ranges themselves. Conventional drill and blast, load and haul mining techniques will be used to develop the open pits. The Proposal will involve clearing of no more than 46 ha within the Development Envelope of 245 ha. Approximately 0.6 Mt of ore and 2.9 Mt of waste rock will be mined during the 2 year operational life of the Proposal.

Please find enclosed SXG's Environmental Referral and supporting documentation in accordance with Section 38(1) of the *Environmental Protection Act 1986*.

SXG is looking forward to the EPA's feedback in relation to the Proposal, particularly in relation to the forward works recommended in order that further studies may begin in Spring 2014 where relevant.

Please do not hesitate to contact the undersigned if you have any queries or require further information.

Yours faithfully



Chris Bolger  
Executive General Manager – Exploration  
SOUTHERN CROSS GOLDFIELDS LTD

Enclosed:

1. Section 38(1) Environmental Referral Form
2. Attachment 1: Figures (note: additional figures and electronic files are provided in Attachment 2)
3. Attachment 2: Environmental Referral Supporting Document and Appendices



**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).	x	
Completed all applicable questions in Part B.	x	
Included Attachment 1 – location maps.	x	
Included Attachment 2 – additional document(s) the proponent wishes to provide (if applicable).	x	
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.	x	

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 checked="" type="checkbox"/> Assessment on Proponent Information	<input type="checkbox"/> Public Environmental Review	

**PROPONENT DECLARATION** (to be completed by the proponent)

I, *Chris Bolger*, declare that I am authorised on behalf of Southern Cross Goldfields Ltd (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 (print): Chris Bolger
Position: Executive General Manager Exploration	Company: Southern Cross Goldfields Ltd
Date: 25 August 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	Southern Cross Goldfields Ltd
Joint Venture parties (if applicable)	
Australian Company Number (if applicable)	71 124 374 321
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)	PO Box 708, West Perth, 6872
Key proponent contact for the proposal: <ul style="list-style-type: none"><li>• name</li><li>• address</li><li>• phone</li><li>• email</li></ul>	Chris Bolger Southern Cross Goldfields Ltd Level 6, 344 Queen St Brisbane QLD 4000 0448 741 172 chrisb@scross.com.au
Consultant for the proposal (if applicable): <ul style="list-style-type: none"><li>• name</li><li>• address</li><li>• phone</li><li>• email</li></ul>	Renee Grogan Palaris Pty Ltd Level 7, 500 Queen St Brisbane QLD 4000 0422 683 164 rgrogan@palaris.com.au

#### 1.2 Proposal

Title	Marda East Gold Project
Description	This Proposal is to mine ore from two deposits (Red Legs and Fiddleback), 140 km north of Southern Cross. Processing and tailings will be carried out in Marda Central (outside the scope of this Proposal).
Extent (area) of proposed ground disturbance.	Disturbance footprint of no more than 46 ha within a Development Envelope of 245 ha
Timeframe in which the activity or development is proposed to occur (including start and finish dates where applicable).	2 years – 2016-2017
Details of any staging of the proposal.	Staged operation of the proposal: Red Legs – 2016 (9 months) Fiddleback – 2016 to 2017 (14 months)
Is the proposal a strategic proposal?	No
Is the proponent requesting a declaration that the proposal is a derived proposal? If so, provide the following information on the strategic assessment within which the referred proposal was identified:	No

<ul style="list-style-type: none"> <li>• title of the strategic assessment; and</li> <li>• Ministerial Statement number.</li> </ul>	
<p>Please indicate whether, and in what way, the proposal is related to other proposals in the region.</p>	<p>The Proposal is related to the Marda Central Project which has been previously referred to the EPA (EPA Ref: 14-512340)</p>
<p>Does the proponent own the land on which the proposal is to be established? If not, what other arrangements have been established to access the land?</p>	<p>Mining leases M77/1271 and M77/1272 and Miscellaneous lease L77/261</p>
<p>What is the current land use on the property, and the extent (area in hectares) of the property?</p>	<p>Conservation and mining – 245 ha</p>

### 1.3 Location

Name of the Shire in which the proposal is located.	Shire of Menzies and Shire of Yilgarn
For urban areas: <ul style="list-style-type: none"> <li>• street address;</li> <li>• lot number;</li> <li>• suburb; and</li> <li>• nearest road intersection.</li> </ul>	N/A
For remote localities: <ul style="list-style-type: none"> <li>• nearest town; and</li> <li>• distance and direction from that town to the proposal site.</li> </ul>	140 km north of Southern Cross
Electronic copy of spatial data - GIS or CAD, geo-referenced and conforming to the following parameters: <ul style="list-style-type: none"> <li>• GIS: polygons representing all activities and named;</li> <li>• CAD: simple closed polygons representing all activities and named;</li> <li>• datum: GDA94;</li> <li>• projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA);</li> <li>• format: Arcview shapefile, Arcinfo coverages, Microstation or AutoCAD.</li> </ul>	Enclosed?: Yes – Appendix L of the ERSD attached.

### 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?	N/A

### 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? If yes, please complete the table below.		Yes	
Agency/Authority	Approval required	Application lodged Yes / No	Agency/Local Authority contact(s) for proposal
DMP	Mining Proposal	No	
DER	Works Approval	No	
DOE (Cth)	EPBC Act Referral	No	

## 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)?

46 ha

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

- Yes                 No            **If yes**, on what date and to which office was the application submitted of the DEC?



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

Yes

No

**If yes**, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

**If no**, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

Appendix D to ERSD attached.

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

No

If you are proposing to clear native vegetation for any part of your proposal, a search of DEC records of known occurrences of rare or priority flora and threatened ecological communities will be required. Please contact DEC for more information.

Appendix D to ERSD attached.

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

Yes

No

**If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

Appendix D to ERSD attached.

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)

Yes

No

**If yes**, please indicate which Bush Forever Site is affected (site number and name of site where appropriate).

N/A

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

Pristine to Very Good (see Section 4.2.1 of the ERSD attached).

## 2.2 Fauna

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

- (please tick)      Yes     **If yes**, complete the rest of this section.  
                          No     **If no**, go to the next section.

Appendix G to ERSD attached.

2.2.2 Describe the nature and extent of the expected impact.

Loss of 46 ha of fauna habitat and disturbance of one active malleefowl mound.

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

- Yes      No     **If yes**, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).  
**If no**, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

Appendix G to ERSD attached.

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

- Yes      No     (please tick)

Appendix G to ERSD attached.

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

- Yes      No     **If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

Two active malleefowl mounds observed within the Development Envelope.

## 2.3 Rivers, Creeks, Wetlands and Estuaries

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

- (please tick)      Yes     **If yes**, complete the rest of this section.  
                          No     **If no**, go to the next section.

See section 4.3.1 of the ERSD attached.

2.3.2 Will the development result in the clearing of vegetation within the 200 metre zone?  
 Yes       No      **If yes**, please describe the extent of the expected impact.

N/A

2.3.3 Will the development result in the filling or excavation of a river, creek, wetland or estuary?  
 Yes       No      **If yes**, please describe the extent of the expected impact.

2.3.4 Will the development result in the impoundment of a river, creek, wetland or estuary?  
 Yes       No      **If yes**, please describe the extent of the expected impact.

2.3.5 Will the development result in draining to a river, creek, wetland or estuary?  
 Yes       No      **If yes**, please describe the extent of the expected impact.

See section 4.3.1 of the ERSD attached.

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
Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998	<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
Environmental Protection (Swan & Canning Rivers) Policy 1998	<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      **If yes**, please provide details.

The Proposal is adjacent to the proposed Class A Nature Reserve at the Die Hardy Range and the Mt Manning Conservation Park. No part of the Proposal disturbance footprint infringes upon either of these reserves.

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      **If yes**, please provide details.

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       No      **If yes**, please provide details.

The Red Legs deposit is located at the foothills of the Die Hardy BIF ranges. While no disturbance of the BIF range is proposed, there will be disturbance adjacent to the range and this will have residual impacts to the landform and amenity values. See sections 4.2.2 and 4.5.1 of the ERSD attached.

## 2.5 Coastal Zone Areas (Coastal Dunes and Beaches)

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

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

No      **If no**, go to the next section.

2.5.2 What is the expected setback of the development from the high tide level and from the primary dune?

N/A

2.5.3 Will the development impact on coastal areas with significant landforms including beach ridge plain, cusped headland, coastal dunes or karst?

Yes       No      **If yes**, please describe the extent of the expected impact.

2.5.4 Is the development likely to impact on mangroves?

Yes       No      **If yes**, please describe the extent of the expected impact.

## 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?

Yes       No      **If yes**, please describe the extent of the expected impact.

2.6.2 Is the development likely to impact on marine conservation reserves or areas recommended for reservation (as described in *A Representative Marine Reserve System for Western Australia*, CALM, 1994)?

Yes       No      **If yes**, please describe the extent of the expected impact.

2.6.3 Is the development likely to impact on marine areas used extensively for recreation or for commercial fishing activities?

Yes       No      **If yes**, please describe the extent of the expected impact, and provide any written advice from relevant agencies (e.g. Fisheries WA).

## 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       No      **If yes**, please describe what category of area.

Goldfields proclaimed groundwater area.

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)

Yes       No      **If yes**, please describe what category of area.

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       No      **If yes**, please describe what category of area.

2.7.4 Is there sufficient water available for the proposal?

(Please consult with the DoW as to whether approvals are required to source water as you propose. Where necessary, please provide a letter of intent from the DoW)

Yes       No      (please tick)

2.7.5 Will the proposal require drainage of the land?

Yes       No      **If yes**, how is the site to be drained and will the drainage be connected to an existing Local Authority or Water Corporation drainage system? Please provide details.

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.

No      **If no**, go to the next section.

Water required for construction and operation of the Proposal will come from the nearby Marda Central mine.

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

No additional extraction is proposed as part of the Marda East Proposal.

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

N/A

## 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.

No      **If no**, go to the next section.

See section 4.4 of the ERSD attached.

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       No      **If yes**, please describe what category of prescribed premise.

2.8.3 Will the proposal result in gaseous emissions to air?

Yes       No      **If yes**, please briefly describe.

The Proposal will result in additional greenhouse gas emissions from mining vehicles for a period of approximately 2 years (see section 4 of the ERSD attached).

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?

Yes       No      **If yes**, please briefly describe.

See section 4.4 of the ERSD attached. No modelling has been conducted due to the small nature of the footprint and the isolated location.

2.8.5 Will the proposal result in liquid effluent discharge?

Yes       No      **If yes**, please briefly describe the nature, concentrations and receiving environment.

See section 2.5 of the ERSD attached.

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       No      **If yes**, please describe.

N/A

2.8.7 Will the proposal produce or result in solid wastes?

Yes       No      **If yes**, please briefly describe the nature, concentrations and disposal location/ method.

See section 4.2.4 of the ERSD attached. Any remaining waste not recycled will be disposed of in the Marda Central landfill, in accordance with existing site waste management practices.

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

Yes       No      **If yes**, please briefly describe.

See section 4.5.3 of the ERSD attached.

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

Yes       No      **If yes**, has any analysis been carried out to demonstrate that the proposal will comply with the Regulations?

Please attach the analysis.

See section 4.5.3 of the ERSD attached.

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.)?

Yes       No      **If yes**, please describe and provide the distance to residences and other "sensitive premises".

See section 4.5.3 of the ERSD attached. The Development Envelope is located 15 km from the nearest sensitive environment (Windarling Mine).

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?

Yes       No       Not Applicable

**If yes**, please describe and provide the distance to the potential pollution source

## 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       No      **If yes**, please provide an estimate of the annual gross emissions in absolute and in carbon dioxide equivalent figures.

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

N/A



## 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?

Yes       No       Unsure      **If yes**, please describe.

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

Yes       No      **If yes**, please describe.

A soil survey will be included as part of forward works (see section 6.1 of the ERSD attached).

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)

Yes       No      **If yes**, please describe.

## 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       No       Unsure      **If yes**, please describe.

Aboriginal cultural heritage survey on a small pocket of land will be completed as part of forward works (see section 6.1 of the ERSD attached).

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       No      **If yes**, please describe.

A small portion of the Development Envelope is located at the foothills of the Die Hardy Range.

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

Yes       No      **If yes**, please describe.

### 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? (For information on the Principles of Environmental Protection, please see EPA Position Statement No. 7, available on the EPA website)

- |  |   |                             |
|--|---|-----------------------------|
| 1. The precautionary principle.  | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2. The principle of intergenerational equity.  | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3. The principle of the conservation of biological diversity and ecological integrity. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4. Principles relating to improved valuation, pricing and incentive mechanisms.        | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 5. The principle of waste minimisation.  | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

See section 4.1 of the ERSD attached.

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       No

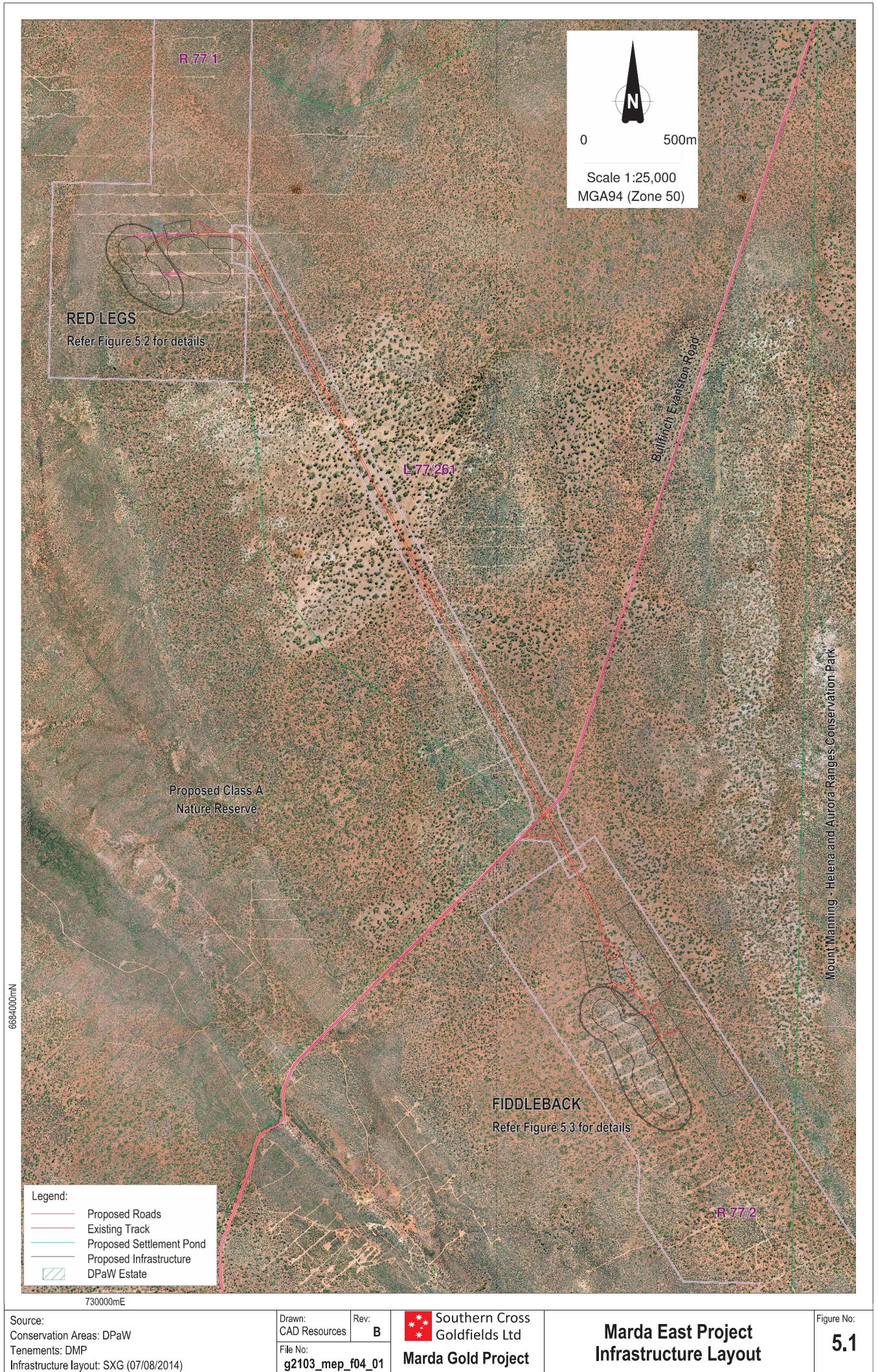
#### 3.2 Consultation

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       No      **If yes**, please list those consulted and attach comments or summarise response on a separate sheet.

**Attachment One – Location Maps**

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Source:  
 Conservation Areas: DPaW  
 Tenements: DMP  
 Infrastructure layout: SXG (07/08/2014)

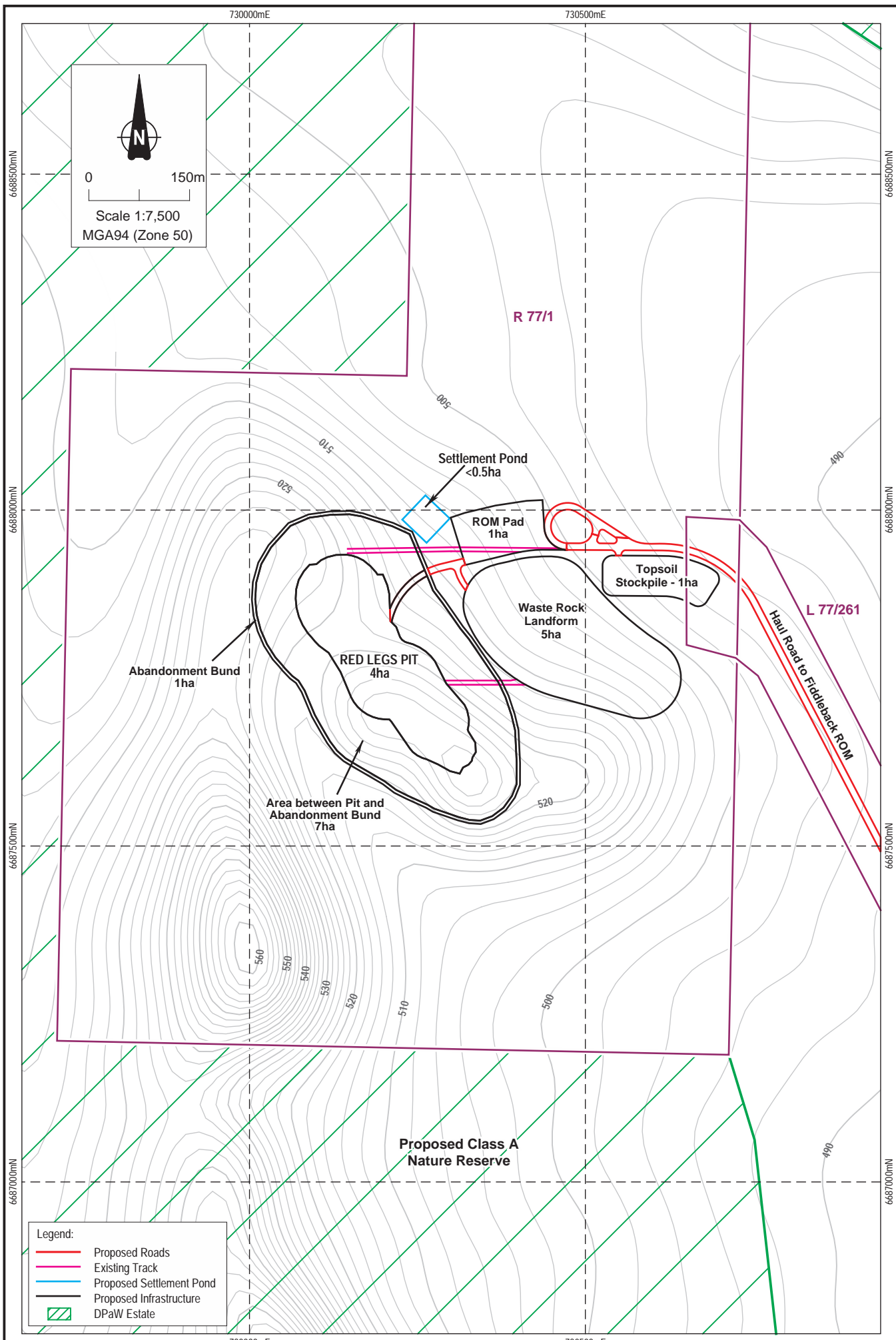
Drawn:  
 CAD Resources  
 File No:  
 g2103\_mep\_f04\_01

Rev:  
**B**

 Southern Cross  
 Goldfields Ltd  
**Marda Gold Project**

**Marda East Project  
 Infrastructure Layout**

Figure No:  
**5.1**



- Legend:**
- Proposed Roads
  - Existing Track
  - Proposed Settlement Pond
  - Proposed Infrastructure
  - ▨ DPaW Estate

Source:  
 Conservation Areas: DPaW  
 Tenements: DMP  
 Infrastructure layout: SXG (07/08/2014)

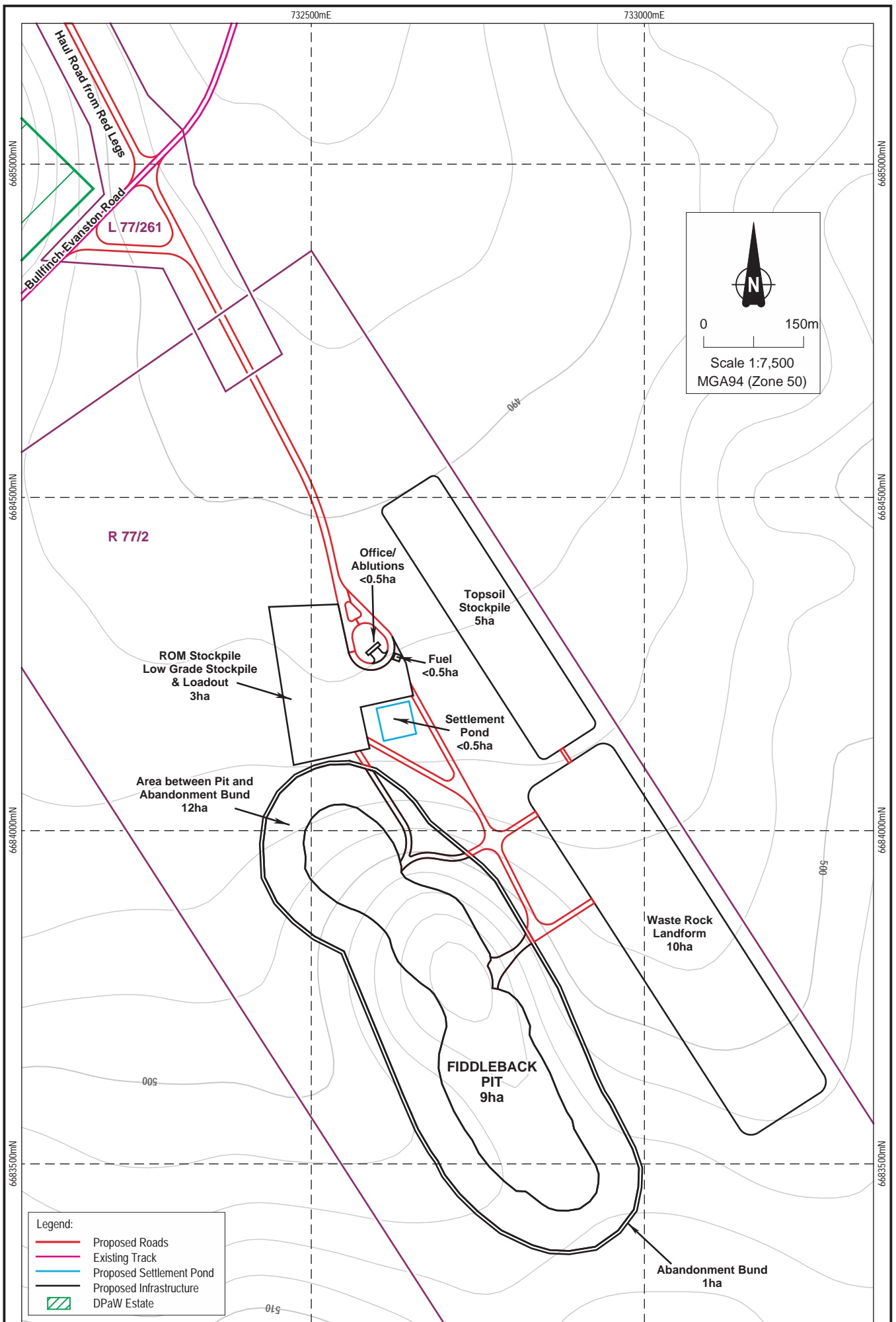
Drawn:  
 CAD Resources  
 File No:  
 g2103\_mep\_f04\_02

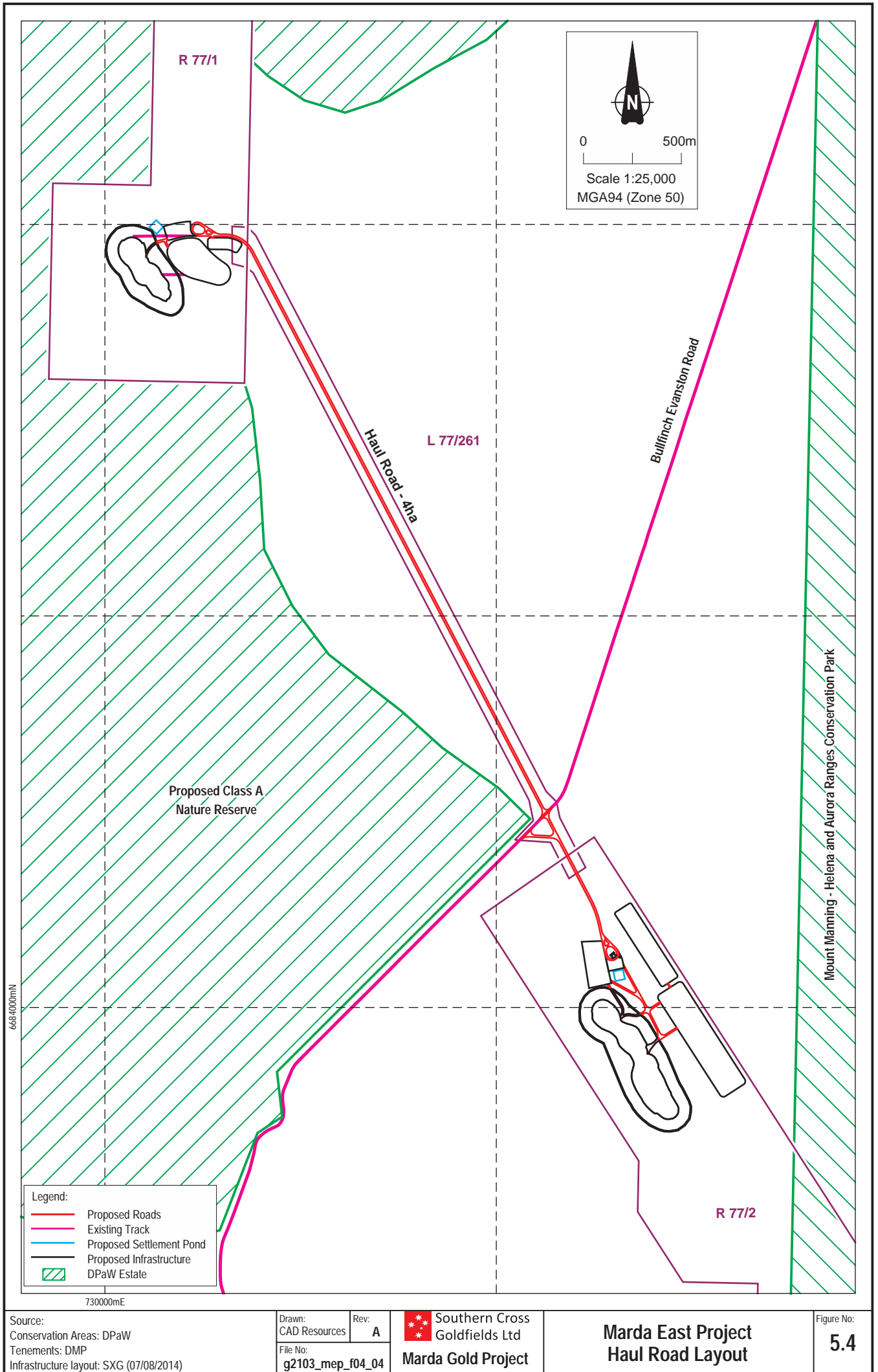
Rev: **B**

Southern Cross Goldfields Ltd  
 Marda Gold Project

**Marda East Project  
 Red Legs Layout**

Figure No:  
**5.2**





Source:  
 Conservation Areas: DPaW  
 Tenements: DMP  
 Infrastructure layout: SXG (07/08/2014)

Drawn:  
 CAD Resources  
 File No:  
 g2103\_mep\_f04\_04

Rev:  
 A

 Southern Cross  
 Goldfields Ltd  
**Marda Gold Project**

**Marda East Project  
 Haul Road Layout**

Figure No:  
**5.4**

**Attachment Two – Referral Supporting Document**

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# Report

## Marda East Gold Project - EPA Referral Supporting Document

<b>Company</b>	Southern Cross Goldfields Limited
<b>Date</b>	August 2014
<b>Doc No.</b>	SXG2047-01

Report To	Stephen Jones		
Project No.	SXG2047		
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# Contents

Executive Summary.....	7
1 Introduction.....	19
2 Proposal Overview .....	23
2.1 The Proponent.....	23
2.2 Key Characteristics .....	23
2.3 Proposal Components and Layout.....	24
2.4 Proposal Disturbance .....	29
2.5 Proposed Mining Operations.....	30
2.6 Processing.....	31
2.7 Proposed Support Infrastructure .....	31
3 Methodology.....	32
3.1 Assessment Processes .....	32
3.2 Assessment of Project Options and Alternatives .....	32
3.2.1 Infrastructure Categories.....	32
3.2.2 Roads .....	33
3.2.3 Topsoil and Vegetation Stockpiles .....	33
3.2.4 Backfilling of Pit Voids .....	33
3.2.5 Disposal of Waste Rock .....	34
3.3 Preliminary Environmental Risk Assessment .....	35
3.4 Assessment of Environmental Factors .....	35
3.5 Stakeholder Engagement.....	37
3.6 Assessment of Significance .....	45
4 Assessment of Environmental Factors .....	46
4.1 Principles of Environmental Protection .....	46
4.2 Land .....	48
4.2.1 Flora and Vegetation.....	48
4.2.2 Landforms .....	59
4.2.3 Subterranean Fauna.....	65
4.2.4 Terrestrial Environmental Quality.....	67
4.2.5 Terrestrial Fauna .....	70
4.3 Water.....	78
4.3.1 Hydrological Processes.....	78
4.3.2 Inland Waters Environmental Quality .....	84
4.4 Air .....	85
4.5 People .....	86
4.5.1 Amenity .....	86
4.5.2 Heritage.....	94
4.5.3 Human Health .....	96
4.6 Integrating Factors .....	98
4.6.1 Offsets .....	98
4.6.2 Rehabilitation and Closure .....	98

5	Significance of Environmental Factors.....	107
6	Forward Works.....	116
6.1	Further Studies.....	116
6.1.1	Hydrogeology study.....	116
6.1.2	Waste rock characterisation.....	116
6.1.3	Tailings characterisation.....	116
6.1.4	Soil characterisation.....	117
6.1.5	Aboriginal cultural heritage survey.....	117
6.1.6	Supplementary fauna survey.....	117
6.1.7	Visual impact modelling.....	117
6.1.8	Review of PEC boundary.....	117
6.2	Management Plans.....	117
6.3	EPBC Act Referral for Malleefowl.....	118
6.4	Mine Closure Plan Update.....	118
7	Conclusion.....	119
8	References.....	120
Appendix A	Environmental Referral.....	125
Appendix B	Preliminary Risk Assessment.....	126
Appendix C	Briefing Notes to Stakeholders.....	127
Appendix D	Level 2 Flora and Vegetation Survey.....	128
Appendix E	Visual Impact Assessment.....	129
Appendix F	Subterranean Fauna Risk Assessment.....	130
Appendix G	Level 1 Fauna Assessment.....	131
Appendix H	Marda East Drainage Investigation.....	132
Appendix I	Surface and Groundwater Assessment (Marda Central).....	133
Appendix J	Visual Impact Assessment Montages.....	134
Appendix K	Cultural Heritage Reports.....	135
Appendix L	Proposal Layout Electronic Files.....	136

## Figures

Figure 1.1	Locality Plan.....	20
Figure 2.1	Proposal Development Envelope.....	25
Figure 2.2	Red Legs General Arrangement.....	26
Figure 2.3	Fiddleback General Arrangement.....	27
Figure 2.4	Haul Road Layout.....	28
Figure 4.1	Vegetation Mapping Units According to Beard (1976) in the Vicinity of Marda East Development Envelope.....	50
Figure 4.2	Land Systems According to Payne <i>et al.</i> (1998) in the Vicinity of Marda East Development Envelope.....	51
Figure 4.3	Priority Flora in Red Legs.....	54
Figure 4.4	Priority Flora in the Marda East Haul Road.....	55
Figure 4.5	Priority Flora in Fiddleback.....	56

Figure 4.6	Red Legs Geology and Mineralisation .....	61
Figure 4.7	Fiddleback Geology and Mineralisation .....	62
Figure 4.8	Six Habitat Types Identified within the Development Envelope.....	73
Figure 4.9	Faunal Habitat within the Development Envelope .....	74
Figure 4.10	Active Malleefowl Mound Locations .....	77
Figure 4.11	Subcatchments in the Vicinity of the Development Envelope.....	80
Figure 4.12	Conceptual Groundwater Profile at Marda Central .....	81
Figure 4.13	Visual Amenity Viewing Locations .....	89
Figure 4.14	Bullfinch-Evanston Road View (ranges not visible) .....	90
Figure 4.15	Die Hardy Range towards Red Legs .....	90
Figure 4.16	View of Eastern Plains (distant ranges) from VIA 1 .....	91
Figure 4.17	View of the Die Hardy Range from VIA 2 (Red Legs Hill).....	91
Figure 4.18	Elevated View of the Red Legs South Hill from VIA 3 .....	92
Figure 4.19	View of the Die Hardy Range (North) to Red Legs Hill (East) from VIA 5 .....	92
Figure 4.20	Completed Aboriginal Cultural Heritage Survey within the Development Envelope.....	95
Figure 4.21	Waste Rock Landform Conceptual Closure Layout .....	106
Figure 5.1	Significance of Environmental Factors.....	107

## Tables

Table 2.1	Key Proposal Characteristics of Marda East Gold Project .....	24
Table 2.2	Proposed Proposal Duration .....	24
Table 2.3	Proposal Disturbance Breakdown.....	29
Table 2.4	Resource Development Schedule.....	30
Table 3.1	Relevant Environmental Factors .....	36
Table 3.2	Key Stakeholders .....	37
Table 3.3	Stakeholder Consultation Program and Issues Raised .....	39
Table 4.1	Principles of Environmental Protection .....	46
Table 4.2	Beard (1976) Vegetation Mapping Units Recorded within the Development Envelope .....	49
Table 4.3	Land System Units Mapped within the Marda East Development Envelope.....	49
Table 4.4	Vegetation Associations within the Development Envelope with Proposed Mine Infrastructure Areas .....	52
Table 4.5	Priority Flora Species within the Development Envelope .....	52
Table 4.6	Fauna Species of Conservation Significance within the Survey Area Based on Desktop Survey .....	71
Table 4.7	Indicative Wastewater Discharge Criteria (WQPN 68) .....	83
Table 4.8	Landscape Character Units in the Development Envelope .....	86
Table 4.9	Theoretical Views of the Proposal .....	88
Table 4.10	Closure Objectives .....	100
Table 4.11	Completion Criteria .....	101
Table 5.1	Preliminary Key Environmental Factors .....	107
Table 5.2	Proposal Environmental Factors Summary .....	109

## Executive Summary

Southern Cross Goldfields Ltd (SXG or the Company) proposes to develop the Marda East Gold Project (the Proposal) approximately 140 km north of Southern Cross, Western Australia. The Proposal includes open pit gold mining at two locations within the Marda region:

- Red Legs; and
- Fiddleback (previously named Die Hardy).

Mining will extract oxide (weathered) ore and waste rock which is typically hosted in Banded Iron Formation (BIF) geological formations. While a portion of the Red Legs project is located within the foothills of the Die Hardy Range, no part of the project footprint infringes on the BIF ranges themselves. Conventional drill and blast, load and haul mining techniques will be used to develop the open pits. Approximately 0.6 Mt of ore and 2.9 Mt of waste rock will be mined during the 2 year operational life of the Proposal.

The Key Proposal Characteristics are outlined at Table E-1 below.

**Table E-1: Key Proposal Characteristics of Marda East Gold Project**

### Summary of the Proposal

Item	Description
Proposal Name	Marda East Gold Project
Proponent Name	Southern Cross Goldfields Limited
Short Description	Mining of ore from two deposits, 140 km north of Southern Cross. Processing and tailings disposal will be carried out at Marda Central (outside the scope of this Proposal).

### Physical Elements

Element	Location	Proposed Extent Authorised
Red Legs pit	Refer to Figure E-1	Clearing of no more than 5 ha within the Proposal Development Envelope of 245 ha.
Fiddleback pit		Clearing of no more than 10 ha within the Proposal Development Envelope of 245 ha.
Associated infrastructure		Clearing of no more than 31 ha within the Proposal Development Envelope of 245 ha.
Uncleared, affected areas		An area between the pit crest and the abandonment bund, comprising 7 ha at Red Legs and 12 ha at Fiddleback (19 ha in total) that will not be cleared, but will be affected due to the alteration of natural hydraulic flows upon construction of the abandonment bund in closure.

The Proposal layout is provided at Figure E-1.

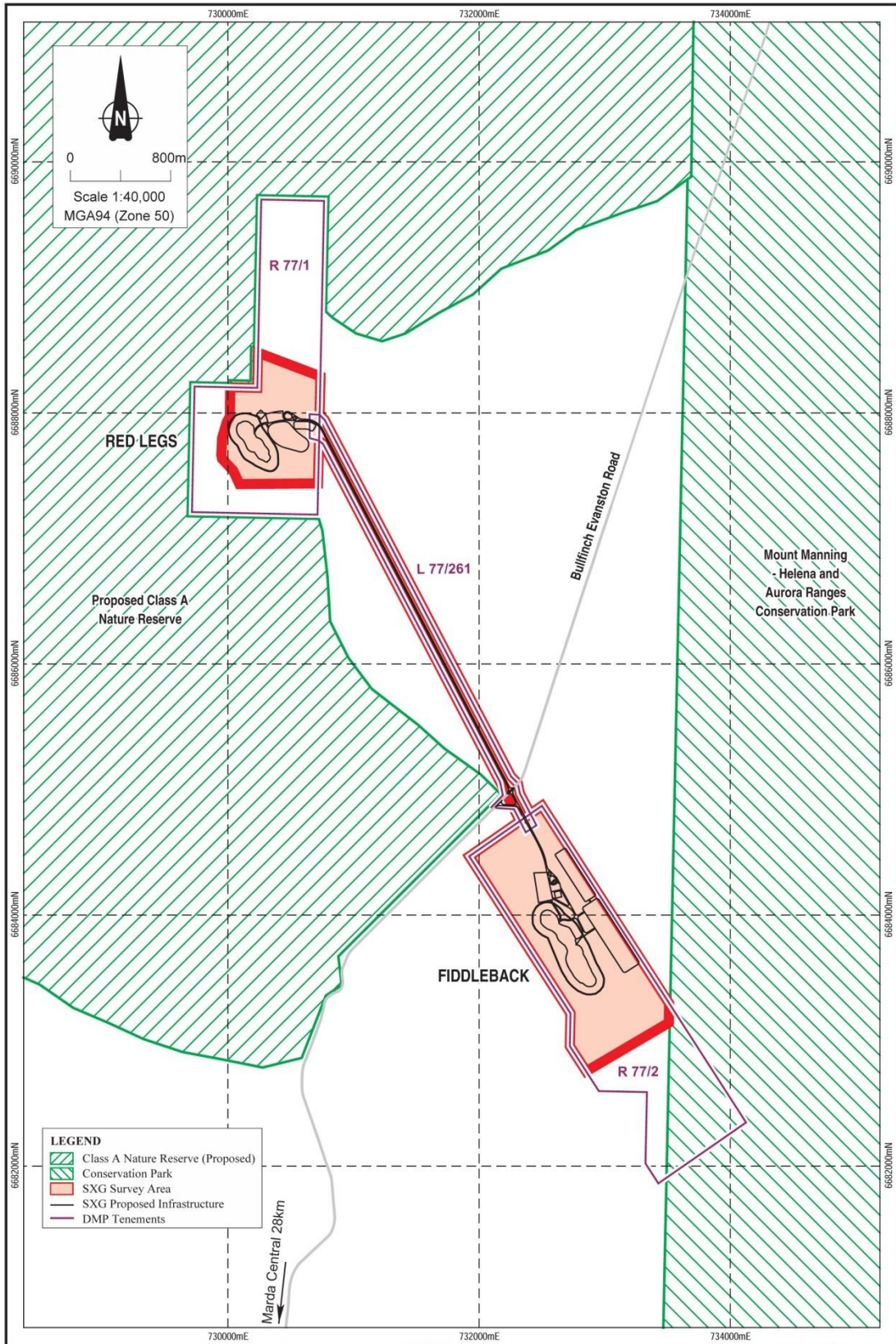


Figure E-1: Marda East Proposal Layout



## Proposal Operations Summary

The Marda East pit operations are expected to be above the water table. The water table has been nominally measured at the nearby Marda Central Project at 60 m below ground level. The maximum pit depth proposed for Marda East is 50 m below ground level. A staged hydrogeological investigation as part of forward works will confirm the groundwater levels in the Development Envelope. If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine the need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.

Gazetted public roads provide access to the Development Envelope. The Bullfinch-Evanston Road will be the main site access route. The haul road connecting Red Legs and Fiddleback will intersect the Bullfinch-Evanston Road and appropriate measures will be implemented to protect public safety in this regard.

Ore from each deposit will be transferred to Marda Central in road trains and processed in the conventional 720,000 tpa gold processing plant, for which assessment was not required under Environmental Protection Authority (EPA) Ref: 14-512340. Tailings from the processing plant will be disposed of to the previously described single-cell Tailings Storage Facility (TSF) located adjacent to the Marda Central processing plant. This facility has excess design capacity to accommodate the tailings produced from mining at Marda East.

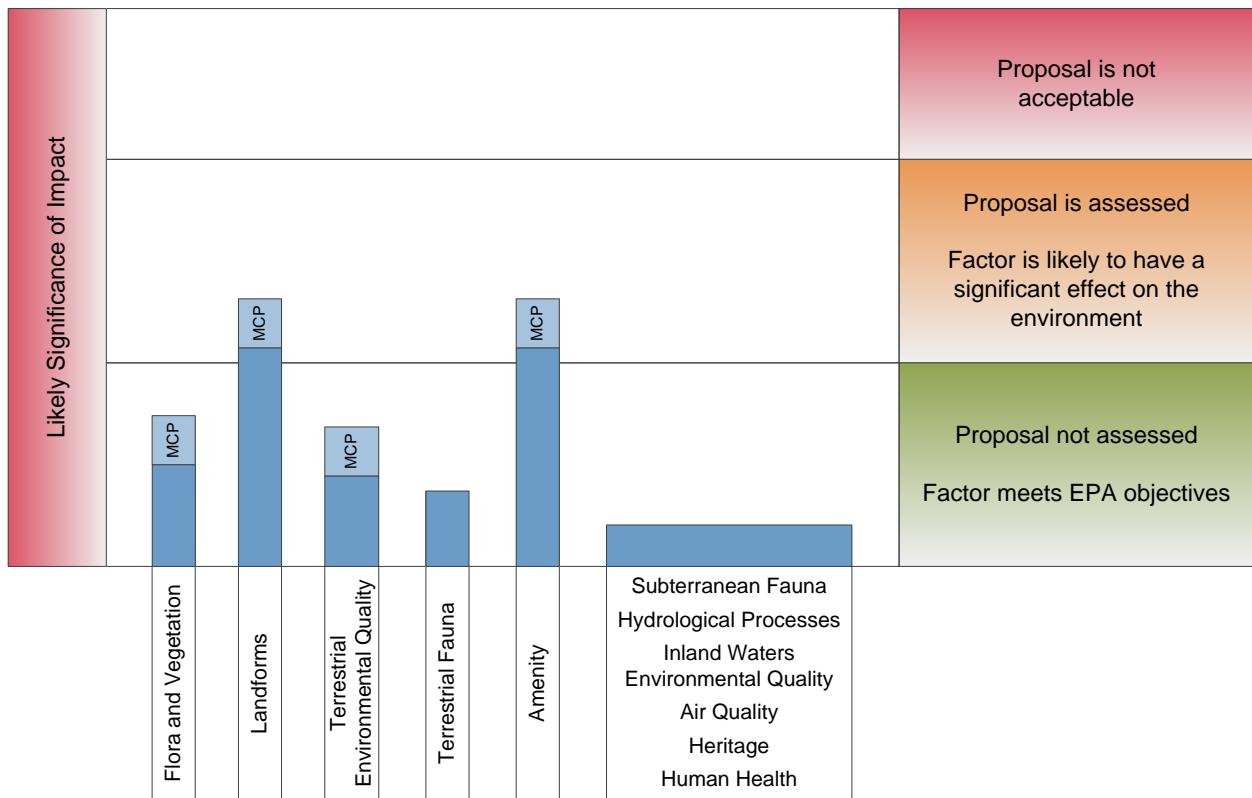
A portion of the Development Envelope (the Red Legs prospect) is adjacent to the Die Hardy Range, an area nominated for inclusion in a proposed Class A Nature Reserve. SXG has conducted extensive consultation with the Department of Parks and Wildlife (DPaW) and other stakeholders during the development of the Proposal. No part of the disturbance footprint extends into the proposed Class A Nature Reserve.

## Significant Environmental Factors

The significance of the Proposal implementation on the environmental factors was assessed in accordance with EAG 9 (EPA 2013d). Following this assessment, SXG has concluded that most environmental factors can be managed using the environmental management measures developed for the Proposal and through environmental regulation by the Department of Mines and Petroleum (DMP), Department of Environmental Regulation (DER), Department of Water (DoW), and with input from the DPaW. However, two factors do not readily meet certain EPA objectives and are likely to have residual impacts on the environment. Based on this conclusion, SXG considers it relevant for the Proposal to undergo an Assessment on Proponent Information (API) – Category A, with the following significant factors as outlined in Table E-2.

**Table E-2: Preliminary Key Environmental Factors**

Key Environmental Factor	Impact
Landforms	<p>The pit voids and waste rock landforms (WRLs) will change the landform in the disturbance footprint.</p> <p>The proposed Red Legs pit is located at the foothills of the BIF ranges and, while not likely to impact on the connectivity of the Die Hardy Range, will have residual impacts on the overall regional integrity, given the current undisturbed nature of the ranges.</p>
Amenity	<p>Visual impact of localised landscape changes due to pit voids and WRLs.</p> <p>Impact on topography due to the proposed Red Legs pit located at the foothills of the BIF ranges.</p> <p>Impact rating on identified views from along public roads is expected to be negligible at best and 'blending' at worst.</p> <p>Impact on views from elevated positions within the footslopes and some areas of the range. At present, these areas have limited public accessibility.</p>



**Figure E-1 Significance of Environmental Factors**

The additional environmental factors considered in the assessment of the Proposal are summarised in Table E-3 below.

**Table E-3: Proposal Environmental Factors Summary**

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land	Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level	<p>Clearing of no more than 46 ha of native vegetation including plant communities equivalent to 0.17% of the total Priority 1 PEC.</p> <p>Clearing of some or all of a local population of the Priority 3 and Priority 4 flora species where these occur at Red Legs and Fiddleback.</p> <p>The impacts to <i>Mirbelia ferricola</i> (P3) and <i>Grevillea georgeana</i> (P3) are considered locally significant with a significant percentage of their populations proposed to be taken. However, both species are known to be found on other BIF ranges in the region and as such, are considered well represented in an overall regional sense.</p> <p>Localised loss of vegetation condition due to:</p> <ul style="list-style-type: none"> <li>♦ dust generation, erosion and sedimentation;</li> <li>♦ saline overspray during dust suppression;</li> <li>♦ accidental bushfires, should these occur.</li> </ul> <p>Potential for increased weed infestations within disturbed areas.</p> <p>Development of “drainage shadows” in vegetation downstream of roads and other Proposal infrastructure if surface drainage is affected.</p>	<ul style="list-style-type: none"> <li>♦ Realignment of haul road, WRLs, topsoil stockpiles and other ancillary infrastructure, where feasible in the project context.</li> <li>♦ The Proposal disturbance footprint is aligned such that areas of the Dryandra Land System and the Yowie Land System that will be disturbed will not cause fragmentation of these land system units or the vegetation associations connected with the units.</li> <li>♦ Implement collection of seed from the conservation-significant species, as well as common species within the disturbance areas, prior to clearing.</li> <li>♦ Implement a Ground Disturbance Permit system.</li> <li>♦ Limit ground disturbance and clearing of vegetation to designated areas and access routes.</li> <li>♦ Carry out progressive clearing.</li> <li>♦ Restrict clearing during strong winds to reduce dust generation.</li> <li>♦ Implement standard vehicle hygiene measures.</li> <li>♦ Stockpile topsoil (and where feasible, log debris and fallen timber) for use in rehabilitation programs.</li> <li>♦ Regulate vehicle speed limits.</li> <li>♦ Liaise with DPaW to ensure that fire management is conducted in a manner consistent with the fire management plan for the Great Western Woodlands.</li> <li>♦ Minimise the risk of impact from the use of saline water for dust suppression by:               <ul style="list-style-type: none"> <li>○ Using fresh water from evaporation ponds, or brackish water from Marda Central for dust suppression;</li> </ul> </li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land (cont.)	Flora and Vegetation (cont.)			<ul style="list-style-type: none"> <li>○ Implementing water truck operating procedures and training water cart operators of the potential impact of saline water on vegetation;</li> <li>○ Installing spray bars that reduce overspray of water onto road side vegetation;</li> <li>○ Constructing road drainage so that water run-off will be contained during low to moderate rainfall events in retention sumps;</li> <li>○ Not using saline water for dust suppression during topsoil harvesting or rehandling.</li> <li>◆ Conduct and monitor mine site rehabilitation progressively.</li> <li>◆ Implement an education program for site workers in terms of environmental and community values.</li> </ul>	
Land	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils	<p>The pit voids and waste rock landforms (WRLs) will change the landform in the disturbance footprint.</p> <p>The proposed Red Legs pit is located at the foothills of the BIF ranges and, while not likely to impact on the connectivity of the Die Hardy Range, will have residual impacts on the overall regional integrity, given the current undisturbed nature of the ranges.</p>	<ul style="list-style-type: none"> <li>◆ Careful design of the WRLs to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms.</li> <li>◆ Rehabilitate the WRLs in accordance with the procedures outlined in the MCP.</li> <li>◆ Implement soil management measures identified in the soil survey (to be carried out as part of forward works).</li> </ul>	Significant
Land	Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level	No significant impacts on subterranean fauna are predicted.	<ul style="list-style-type: none"> <li>◆ No specific management measures anticipated at this stage.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected	<p>Terrestrial environmental quality will be impacted primarily through the disposal of wastes (including waste rock from mining operations, putrescible and inert waste, hydrocarbon and reagent leaks or spills, and sewage), and the alteration of landforms and soils during and after mining.</p> <p>Potential for ecological and social impacts due to the location of disturbance footprint in close proximity to the BIF ranges.</p>	<ul style="list-style-type: none"> <li>◆ The Proposal disturbance is aligned such that areas of the Dryandra Land System and the Yowie Land System that will be disturbed will not cause fragmentation of these land system units or the related vegetation associations.</li> <li>◆ Dispose waste rock to WRLs which will be rehabilitated on a progressive basis.</li> <li>◆ Design WRLs to fit with the natural terrain.</li> <li>◆ Review and finalise waste rock dump design during the assessment process, once material characterisation studies have been completed.</li> <li>◆ Reuse and recycle materials to minimise waste produced.</li> <li>◆ Dispose any remaining waste not recycled in the Marda Central landfill, in accordance with existing site waste management practices.</li> <li>◆ Store and use reagents in accordance with relevant Material Safety Data Sheets and AS1940-2004.</li> <li>◆ Store hydrocarbons in self-bunded tanks located within a fuel storage facility.</li> <li>◆ Remove spilled hydrocarbons by absorbent material and/or excavation of contaminated soil and treat at the Marda Central Bioremediation Pad.</li> <li>◆ Implement an incident reporting system for reporting and managing the clean-up of leaks and spills.</li> <li>◆ Refer to management measures for Flora and Vegetation, Terrestrial Fauna, Amenity and Rehabilitation and Closure.</li> </ul>	Not significant
Land	Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level	<p>Localised loss of fauna habitat.</p> <p>Loss of small animals that are unable to move away during the clearing process.</p> <p>Impact on fauna assemblages in the Development Envelope as a result of noise, vibration, dust, vehicle movements, accidental bushfires, etc.</p>	<ul style="list-style-type: none"> <li>◆ Clear vegetation from cleared to uncleared areas where practicable to provide escape routes for terrestrial fauna.</li> <li>◆ Regulate vehicle speed limits.</li> <li>◆ Fence ponds to exclude fauna and have fauna egress matting installed.</li> <li>◆ Implement fire control and mitigation measures.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land (cont.)	Terrestrial Fauna (cont.)			<ul style="list-style-type: none"> <li>◆ Implement a feral animal control program.</li> <li>◆ Implement an education program for site workers in terms of environmental and community values.</li> <li>◆ Adopt the management measures developed in the Marda Central Malleefowl Management Plan;</li> <li>◆ Ensure that any chicks have dug out of Mound 1 (currently active) prior to commencement of activities; and</li> <li>◆ Maintain a 250 m boundary around Mound 11.</li> </ul>	
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected	No significant impacts on surface water and groundwater are predicted.	<ul style="list-style-type: none"> <li>◆ Divert clean stormwater runoff around the mine pits and other infrastructure.</li> <li>◆ Capture rainwater falling into mine pits and other disturbed areas in sumps and use this for dust suppression in the pit areas.</li> <li>◆ Develop a surface water management plan to describe runoff diversion around mine infrastructure and sediment and erosion controls.</li> <li>◆ Ensure all hazardous chemicals including hydrocarbons are stored in self bunded storage areas that comply with Australian Standard 1940-2004.</li> <li>◆ Ensure any spills of hydrocarbons or hazardous chemicals are controlled, contained and cleaned up in accordance with the site Environmental Management System and the requirements of the EP Act.</li> <li>◆ Construct and operate washdown facilities in accordance with WQPN 68.</li> <li>◆ If groundwater table will be intersected, liaise with the DoW to obtain appropriate Groundwater Well Licences and develop and implement a site Operating Strategy.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Water (cont.)	Hydrological Processes (cont.)			<ul style="list-style-type: none"> <li>◆ If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine whether there is a need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.</li> <li>◆ Nil groundwater discharge to the environment.</li> <li>◆ Implement an Environmental Management System (including monitoring procedures, management standards, guidelines and operational procedures associated with water management).</li> <li>◆ Ensure pit access roads are rehabilitated and made inaccessible to reduce the risk of members of the public accessing the proposed pits.</li> </ul>	
Water	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	No significant impacts on surface water and groundwater are predicted.	<ul style="list-style-type: none"> <li>◆ As above (management measures for Hydrological Processes).</li> </ul>	Not significant
Air	Air Quality	To maintain air quality for the protection of the environment, human health and amenity	<p>Emission and deposition of dust around the mine and along haulage routes and potential impact on vegetation health and resultant ecosystem function in areas where dust deposition is high.</p> <p>Impacts due to generation of additional greenhouse gas, however given the short duration of the Proposal life, these are not considered significant.</p>	<ul style="list-style-type: none"> <li>◆ Water mine haul roads, processing area roads and ore stockpiles.</li> <li>◆ Implement speed restrictions to reduce road generated dust.</li> <li>◆ Avoid carrying out dust generating activities during adverse wind conditions.</li> <li>◆ Strip topsoil in discrete sections to allow windbreak between clearings.</li> <li>◆ Limit the stockpile height and slope to reduce wind pick up.</li> <li>◆ Limit drop heights from loading facilities.</li> <li>◆ Establish vegetation transects adjacent to the Development Envelope and the proposed Class A Nature Reserve to monitor vegetation health.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Air (cont.)	Air Quality (cont.)			<ul style="list-style-type: none"> <li>Promote dust generation awareness to staff by providing inductions on dust minimising practices.</li> </ul>	
People	Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable	<p>Visual impact of localised landscape changes due to pit voids and WRLs.</p> <p>Impact on topography due to the proposed Red Legs pit located at the foothills of the BIF ranges.</p> <p>Impact rating on identified views from along public roads is expected to be negligible at best and 'blending' at worst.</p> <p>Impact on views from elevated positions within the footslopes and some areas of the range but none of these areas are publically accessible.</p>	<ul style="list-style-type: none"> <li>Careful design of the WRLs to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms including adoption of regionally specific landform characteristics, vegetation types and drainage flows.</li> <li>Rehabilitate the WRLs in accordance with the procedures outlined in the MCP.</li> <li>Utilise directional lighting, light shields and natural vegetation screening to reduce visual impacts.</li> <li>Implement progressive clearing to assist in reducing visual impacts.</li> <li>Formal visual impact modelling of post mining effects will be completed as part of the forward works to determine the likely efficacy of proposed management measures and to identify any additional opportunities for reducing the impacts of the Proposal on visual amenity.</li> </ul>	Significant
People	Heritage	To ensure that historical and cultural associations are not adversely affected	No direct or indirect impacts on Aboriginal or European heritage sites are predicted.	<ul style="list-style-type: none"> <li>Prepare and implement a cultural heritage management plan including the management measures outlined below:</li> <li>Maintain open communication with Aboriginal heritage stakeholders regarding Proposal operations.</li> <li>Consult with Aboriginal heritage stakeholders for all future ground disturbing and drilling activities impacting on the site.</li> <li>Cease works should any artefacts be uncovered during the project.</li> <li>Contact the Western Australian Police should any skeletal remains be encountered.</li> </ul>	Not significant



Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
People	Human Health	To ensure that human health is not adversely affected	Potential impact on environmental and social values due to noise and vibration. Potential impact on public access within the proposed Development Envelope.	<ul style="list-style-type: none"> <li>◆ Implement a health and safety management plan to meet statutory obligations.</li> <li>◆ Reduce noise levels by using low-noise equipment, silencers and exhaust mufflers where appropriate.</li> <li>◆ Conduct blasting during daylight hours.</li> <li>◆ Consult the Shire of Yilgarn during the Mining Proposal stage.</li> <li>◆ Implement appropriate safety measures in relation to traffic along the Bullfinch-Evanston Road including project vehicle speed limits, dust suppression, signage and other restrictions.</li> </ul>	Not significant
Integrating Factors	Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets	Potential environmental impacts associated with the Proposal can be readily managed through implementation of the proposed environmental management measures and regulation by the DMP, DER and DoW with input from the DPaW.	<ul style="list-style-type: none"> <li>◆ Continue to consult with the DPaW in relation to adding value where possible to existing regional weed and feral animal control programs.</li> <li>◆ Make results of environmental studies conducted available to both government agencies such as DPaW and to NGO organisations (including Bird Life Australia, Wildflower Society of WA and Great Western Woodlands) who have so requested.</li> </ul>	Not significant
Integrating Factors	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.	Clearing of no more than 46 ha of native vegetation. Permanent features remaining after mine closure will comprise two pit voids and two WRLs.	<ul style="list-style-type: none"> <li>◆ Amend the MCP prepared for the Marda Central Project to reflect the addition of the Marda East infrastructure in accordance with the DMP schedule for mine closure and in consideration of the further studies proposed in section 6.1 including the visual impact modelling and the soil and waste rock materials characterisation.</li> <li>◆ Ensure proposed completion criteria are met and implement corresponding monitoring programs.</li> </ul>	Not significant

## Referral to the EPA

SXG has prepared an Environmental Referral for the Proposal (see Appendix A). This Environmental Referral Supporting Document (ERSD) provides additional information to assist the EPA in determining if the Proposal requires formal assessment under Part IV of the *Environmental Protection Act 1986*. This ERSD has been prepared in accordance with the EPA's Environmental Assessment Guideline (EAG) for defining key proposal characteristics (EPA 2012a), environmental factors and objectives (EPA 2013a) and application of a significance framework in the environmental impact assessment process (EPA 2013d).

SXG considers it relevant for the Proposal to undergo an Assessment on Proponent Information (API) – Category A, and will provide the outcomes of the additional studies proposed in this ESRD to the EPA (if required) in order to facilitate the assessment process.

# 1 Introduction

Southern Cross Goldfields Ltd (SXG) proposes to develop the Marda East Gold Project (the Proposal) approximately 140 km north of Southern Cross, Western Australia (WA) (Figure 1.1). The Proposal includes open pit gold mining at two locations within the Marda region:

- Red Legs, which is located approximately 35 km to the northeast of Marda Central and at which mining will be conducted at the Red Legs open pit; and
- Fiddleback (previously named Die Hardy), which is located approximately 35 km to the northeast of Marda Central and at which mining will be conducted at the Fiddleback open pit.

The Development Envelope borders the Mount Manning - Helena and Aurora Ranges Conservation Park at the south eastern corner of the Fiddleback prospect. The Development Envelope currently resides within the *Conservation and Land Management Act 1984* (CALM Act) Section 5(1)(h) proposed 'Conservation and Mining Reserve'. An area encompassing a significant proportion of the Die Hardy Range has been nominated for inclusion in a proposed Class A Nature Reserve, and this proposed reserve abuts the north western boundary of the Red Legs prospect. The Mount Manning Range Nature Reserve and Mount Manning Range Conservation Park are located approximately 10 km and 17 km east of the Development Envelope respectively. No part of the Marda East disturbance footprint infringes upon any existing or proposed nature reserves.

It should be noted that the mine tenement R77/001 had been excluded from the proposed Class A Nature Reserve on the basis that the tenement was existing at the time of the proposition. This exclusion is typical for existing mining leases and areas identified as supporting advanced development projects (Johnston 2009).

The Development Envelope intersects the Priority One (P1) Die Hardy Range / Diemels vegetation complex (banded ironstone formation), Priority Ecological Community (PEC), which follows the Banded Ironstone Formation (BIF) geology of the Die Hardy Range and the adjacent Yokradine Hills. The Development Envelope covers 107 ha of the PEC, representing 1.02% of the total PEC. The disturbance footprint includes 13 ha of Priority 1 PEC, equivalent to 0.17% of the total PEC.

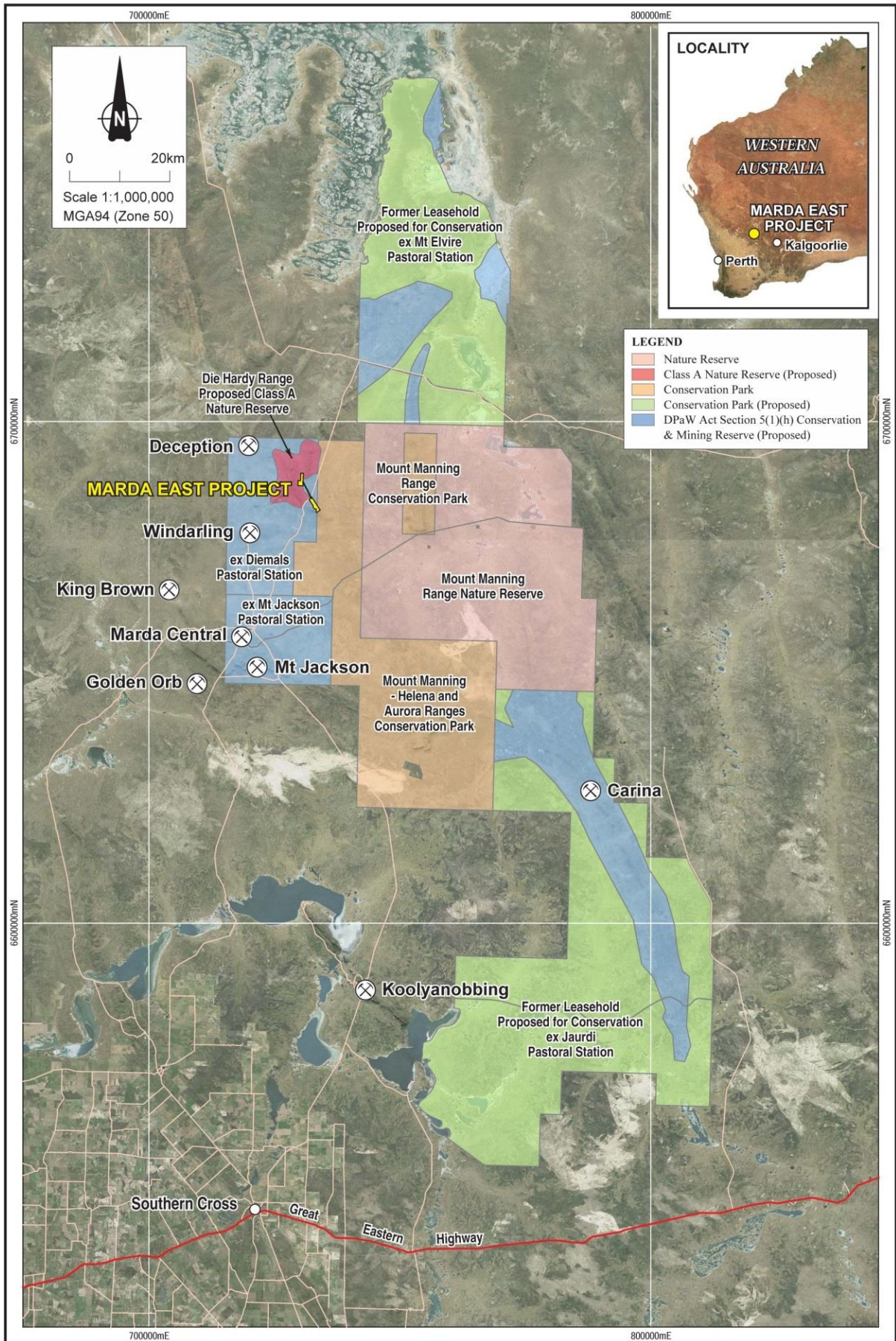


Figure 1.1 Locality Plan

Mining will extract oxide (weathered) ore and waste rock which is typically hosted in BIF geological formations. While a portion of the Red Legs project is located within the foothills of the Die Hardy Range, no part of the disturbance footprint infringes on the BIF ranges themselves. Conventional drill and blast, load and haul mining techniques will be used to develop the open pits. Approximately 0.6 Mt of ore and 2.9 Mt of waste rock will be mined during the 2 year operational life of the Proposal.

The pit operations are expected to be above the water table. The water table has been nominally measured at the nearby Marda Central Project at 60 m below ground level. The maximum pit depth proposed for Marda East is 50 m below ground level. A detailed hydrogeological investigation as part of forward works will confirm the groundwater levels in the Development Envelope (see section 6.1). Should nominal amounts of groundwater be encountered towards the end of mining, dewatering will occur via in-pit sumps to surface evaporation ponds. The Department of Water (DoW) will be consulted in order to obtain appropriate licences in this regard.

A staged hydrogeological investigation as part of forward works will confirm the groundwater levels in the Development Envelope. If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine the need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.

Ore from the Red Legs and Fiddleback deposits will be stockpiled at a run of mine (ROM) pad located at both Red Legs and Fiddleback before being loaded onto road trains for campaign transport to the Marda Central ROM pad. The Bullfinch-Evanston Road, a gazetted public road, provides access to the Development Envelope and will be used for site access and ore haulage to the Marda Central processing facility, a distance of approximately 30 km.

Ore from the two deposits will be processed at the Marda Central conventional 720,000 tpa Carbon in Leach (CIL) gold processing facility. Tailings from the processing plant will be disposed of to the Marda Central single-cell Tailings Storage Facility (TSF) located adjacent to the Marda Central processing plant. These facilities are outside the scope of this Proposal, having previously been referred to the Environmental Protection Authority (EPA) (EPA Ref: 14-512340) as part of the Marda Central Project.

The purpose of this Environmental Referral Supporting Document (ERSD) is to provide the following additional information to assist the EPA in determining if the Proposal requires formal assessment under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act):

- the Proposal and its Proponent (section 2);
- the methodology adopted to identify and assess the environmental factors relevant to the Proposal (section 3);
- the outcomes of the assessment of environmental factors including expected impacts and SXG's proposed management strategies (section 4); and
- the significance of the assessed environmental factors (section 5).

In addition to referral under Part IV of the EP Act, SXG will prepare additional approvals documents where required, including a Mining Proposal (MP), Works Approval, amended Marda Central Mine Closure Plan (MCP) to include Marda East and assessment under Part V of the EP Act. Following discussions with the Office of the Environmental Protection Authority (OEPA) on

20 May 2014, SXG herein submits an Environmental Referral to the EPA to allow the Authority to determine whether formal assessment under Part IV of the EP Act is required.

## 2 Proposal Overview

### 2.1 The Proponent

The current configuration of SXG is the result of a merger between SXG and Polymetals Mining Limited (PLY) that occurred in August 2013. As a result of the merger, PLY became a wholly-owned subsidiary of SXG. The merged company has extensive experience in mineral exploration and mining operations in WA, New South Wales (NSW), South Australia (SA) and Tasmania.

SXG holds a diversified gold and base metal portfolio in WA and NSW spanning projects at development, scoping study and exploration stage. This portfolio include exploration leases covering 4,500 km<sup>2</sup> in WA in the Southern Cross and Sandstone greenstone belts and the Pilbara region, and 200 km<sup>2</sup> in the Lachlan Fold Belt of NSW.

SXG's contact details are provided below:

<b>Company Name:</b>	Southern Cross Goldfields Ltd
<b>ABN:</b>	71 124 374 321
<b>Street Address:</b>	Level 1, 672 Murray Street, West Perth
<b>Mailing Address:</b>	PO Box 708, West Perth, 6872
<b>Telephone:</b>	+61 8 9215 7600
<b>Fax:</b>	+61 8 9485 1283

### 2.2 Key Characteristics

SXG proposes to develop the Proposal as an open pit mining operation. Gold bearing ore will be extracted from two deposits approximately 140 km north of Southern Cross in WA's Yilgarn Mineral Province. The Proposal has a 2 year operational life.

Key Proposal Characteristics are provided in Table 2.1, an estimated duration for the Proposal is provided in Table 2.2 and a Proposal layout is shown in Figure 2.1, Figure 2.2, Figure 2.3 and Figure 2.4.

**Table 2.1 Key Proposal Characteristics of Marda East Gold Project**

**Summary of the Proposal**

Item	Description
Proposal Name	Marda East Gold Project
Proponent Name	Southern Cross Goldfields Limited
Short Description	Mining of ore from two deposits, 140 km north of Southern Cross. Processing and tailings disposal will be carried out at Marda Central (outside the scope of this Proposal).

**Physical Elements**

Element	Location	Proposed Extent Authorised
Red Legs pit	Refer to Figure 2.2 and Appendix L of the ERSD.	Clearing of no more than 5 ha within the Proposal Development Envelope of 245 ha.
Fiddleback pit	Refer to Figure 2.3 and Appendix L of the ERSD.	Clearing of no more than 10 ha within the Proposal Development Envelope of 245 ha.
Associated infrastructure	Refer to Figure 2.2, Figure 2.3 and Figure 2.4 and Appendix L of the ERSD.	Clearing of no more than 31 ha within the Proposal Development Envelope of 245 ha.
Uncleared, affected areas	Refer to Figure 2.2 and Figure 2.3 and Appendix L of the ERSD.	An area between the pit crest and the abandonment bund, comprising 7 ha at Red Legs and 12 ha at Fiddleback (19 ha in total) that will not be cleared, but will be affected due to the alteration of natural hydraulic flows upon construction of the abandonment bund in closure.

\*Note: Figure 2.2, Figure 2.3 and Figure 2.4 present areas rounded to the nearest hectare. Appendix L presents areas without rounding.

**Table 2.2 Proposed Proposal Duration**

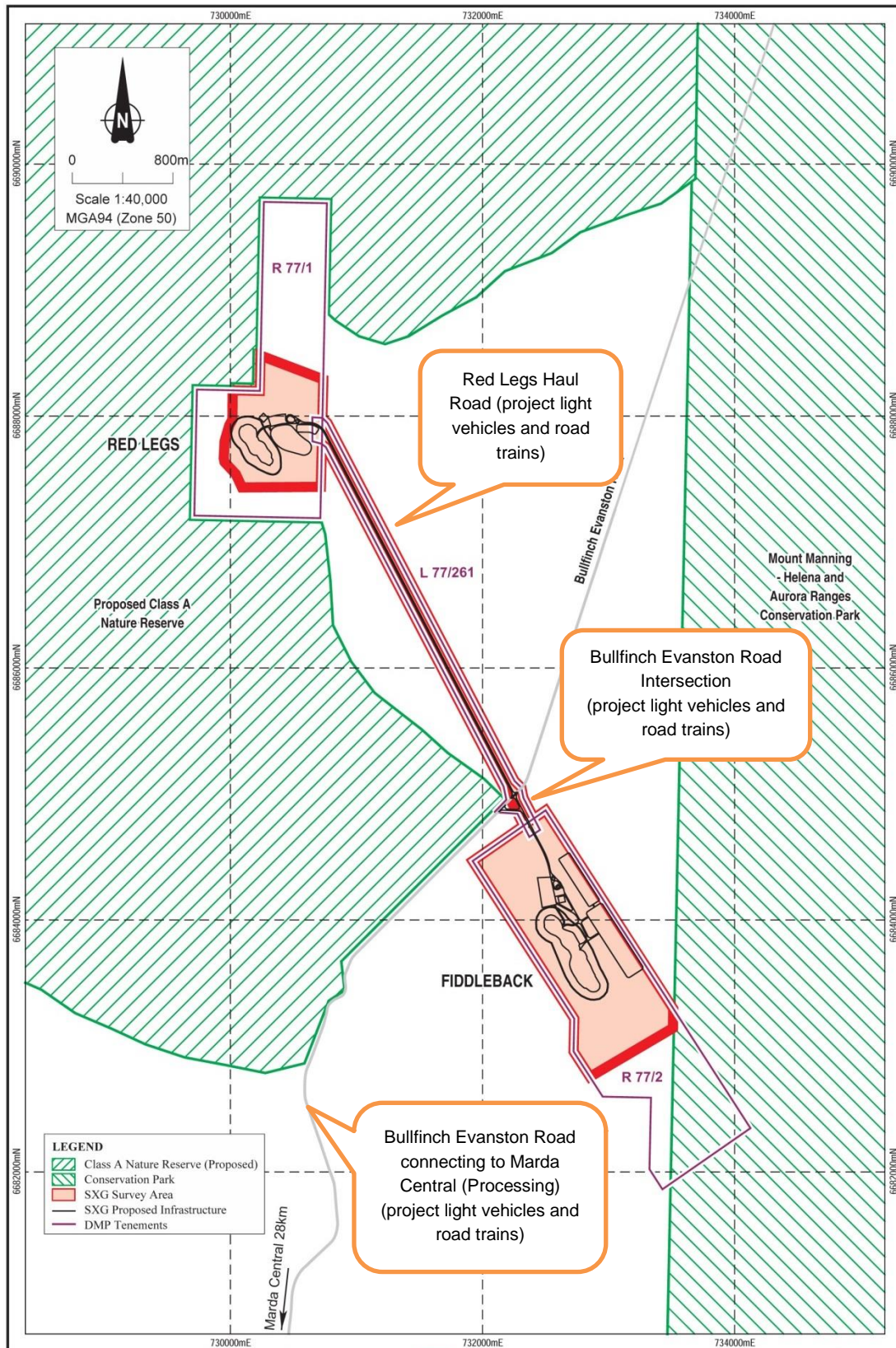
Stage	Proposed Timing
Feasibility study	Completed November 2013
Approvals and permitting	TBA following EPA assessment of Referral
Construction	2 months
Production	24 months
Decommissioning and closure	3 months for earthworks (ongoing monitoring)

## 2.3 Proposal Components and Layout

The two mines included in the Proposal are located in separate locations and include one open cut mine, ROM pad, administration facility, evaporation pond, waste rock landform (WRL) and topsoil storage dump per mine, as well as haul and service roads to link the mines with the Marda Central processing facility.

Site layout figures are provided as Figure 2.1, Figure 2.2, Figure 2.3 and Figure 2.4.





Note: SXG Survey Area is the Proposal Development Envelope

**Figure 2.1 Proposal Development Envelope**

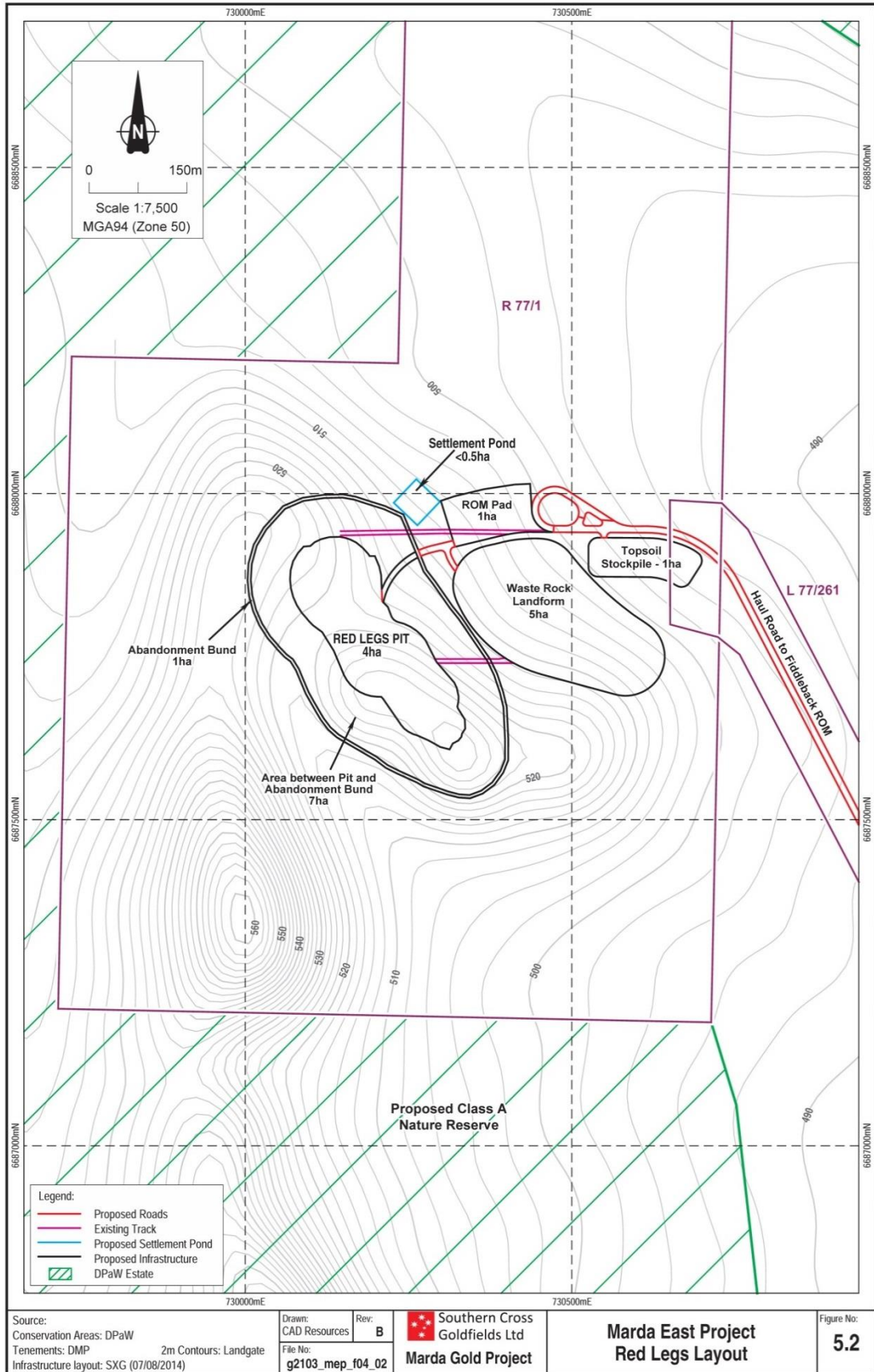


Figure 2.2 Red Legs General Arrangement

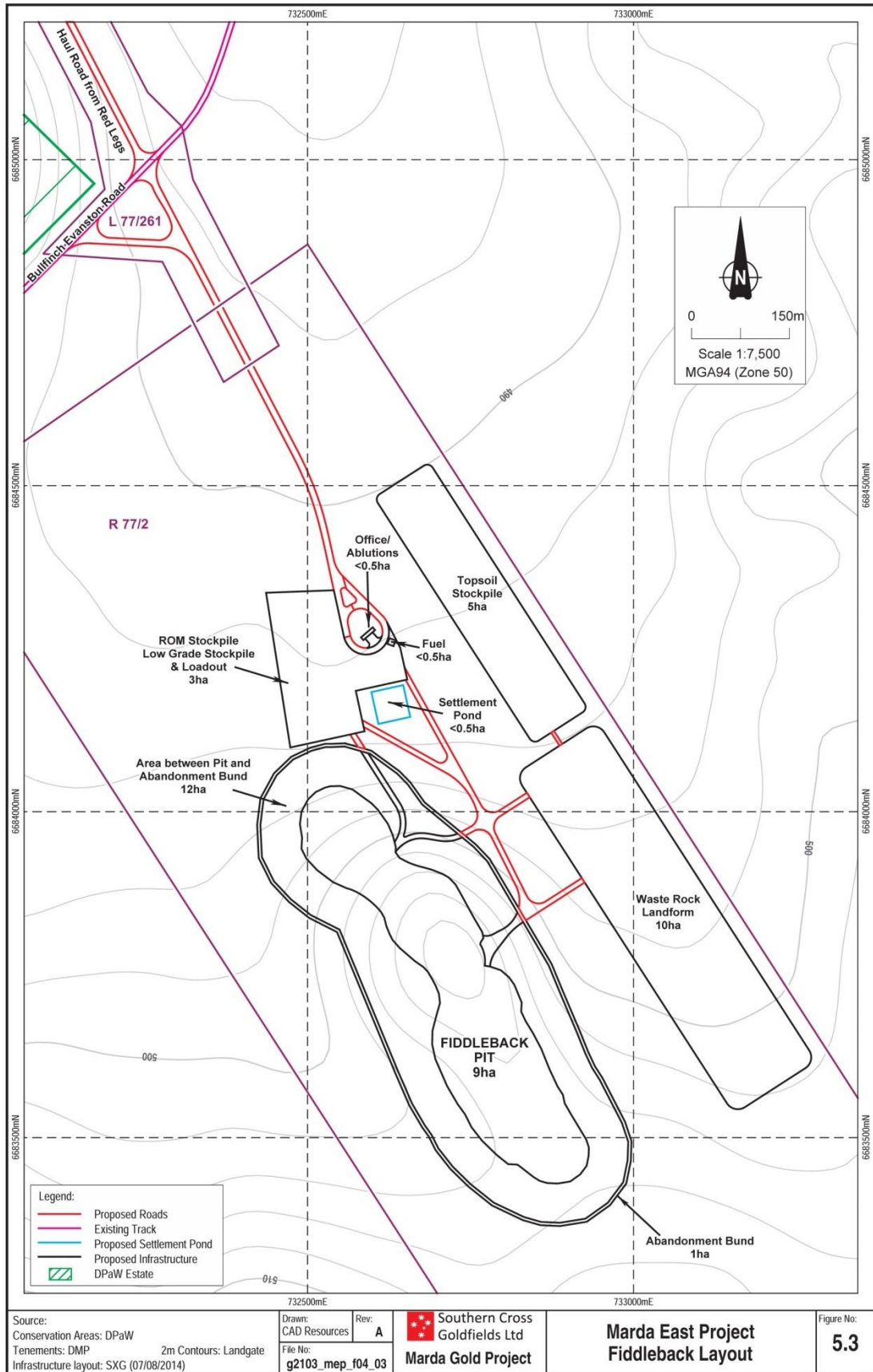


Figure 2.3 Fiddleback General Arrangement

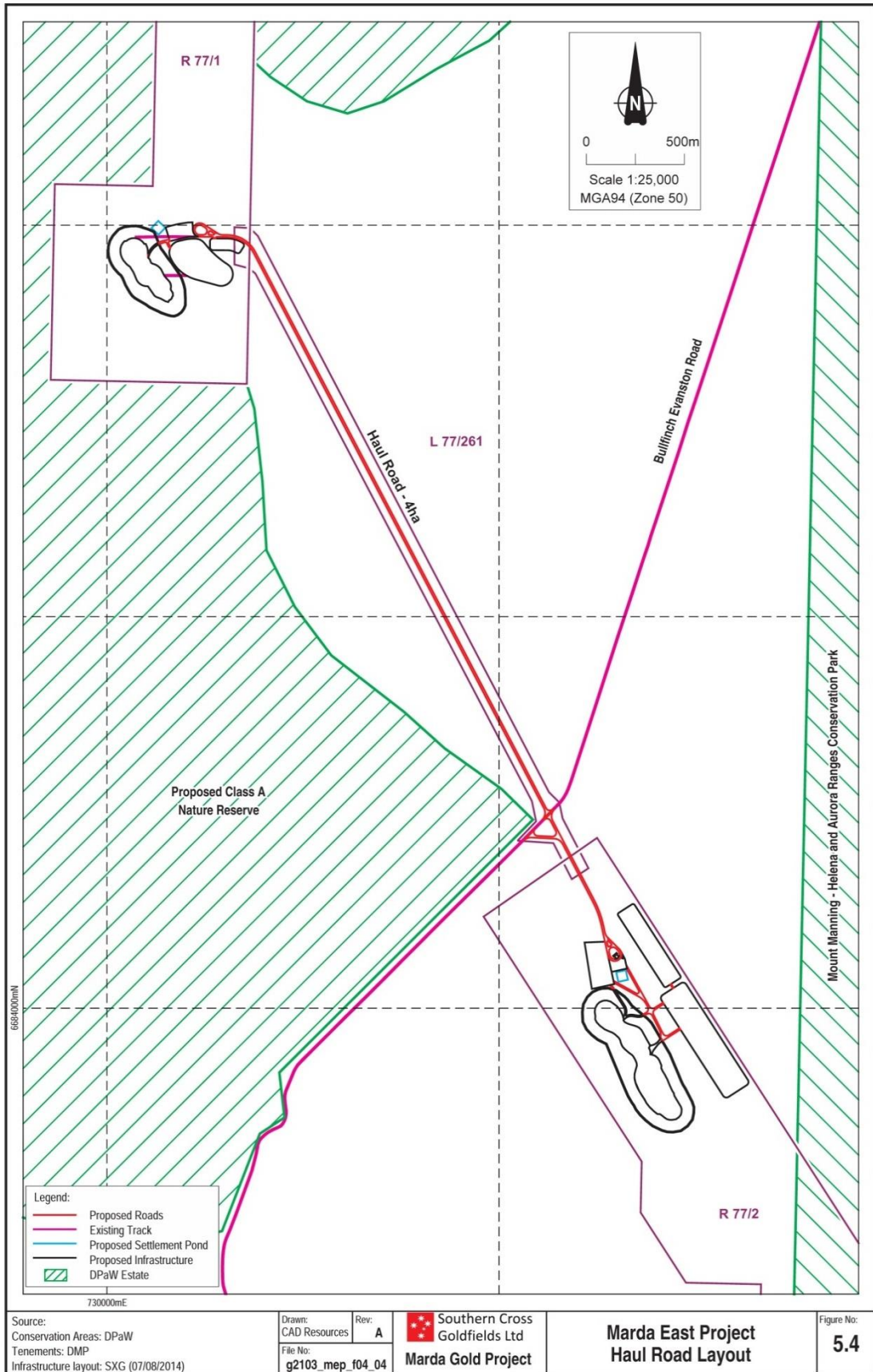


Figure 2.4 Haul Road Layout

## 2.4 Proposal Disturbance

Table 2.3 provides a detailed Proposal disturbance breakdown. The associated mapping files supporting these disturbance figures are provided in electronic format as Appendix L.

**Table 2.3 Proposal Disturbance Breakdown**

Tenement	Feature	Disturbance Area (ha)	Key Characteristic	
R77/1 (M77/1271)	Red Legs Pit	4.00	Clearing of no more than 5 ha within the Proposal Development Envelope of 245 ha	
R77/1 (M77/1271)	Abandonment bund	0.66		
R77/2 (M77/1272)	Fiddleback Pit	8.49	Clearing of no more than 10 ha within the Proposal Development Envelope of 245 ha	
R77/2 (M77/1272)	Abandonment bund	0.99		
L77/261	Haul Road	3.85	Clearing of no more than 31 ha within the Proposal Development Envelope of 245 ha	
R77/1 (M77/1271)	Haul Road	0.68		
R77/1 (M77/1271)	Settlement basin	0.25		
R77/1 (M77/1271)	Topsoil stockpile	0.99		
R77/1 (M77/1271)	Waste Rock Landform	4.95		
R77/2 (M77/1272)	Fuel Storage	0.01		
R77/2 (M77/1272)	Haul Road	1.93		
R77/2 (M77/1272)	Light Vehicle Parking	0.03		
R77/2 (M77/1272)	Offices and Ablutions	0.01		
R77/2 (M77/1272)	ROM	3.00		
R77/2 (M77/1272)	Settlement basin	0.25		
R77/2 (M77/1272)	Topsoil stockpile	4.49		
R77/2 (M77/1272)	Waste Rock Landform	9.27		
<b>Total Clearing Disturbance</b>		<b>44.86</b>		Clearing of no more than 46 ha within the Proposal Development Envelope of 245 ha
R77/2 (M77/1272)	Area between Pit and Abandonment Bund	11.18		An area between the pit crest and the abandonment bund, comprising 7 ha at Red Legs and 12 ha at Fiddleback (19 ha in total) that will not be cleared, but will be affected due to the alteration of natural hydraulic flows upon construction of the abandonment bund in closure.
R77/1 (M77/1271)	Area between Pit and Abandonment Bund	7.02		

Note: For summary tables (Table E-1, Table 2.1) disturbances are rounded up to the nearest whole hectare and therefore indicate a total of 46 ha. The above table includes disturbance areas to two decimal places. Mapping files contained in Appendix L reflect the disturbance areas in Table 2.3 above, without rounding.

## 2.5 Proposed Mining Operations

The two deposits to be mined are located as follows:

- Red Legs which will include a disturbance area of no more than 12 ha and reach a maximum depth of 45 m; and
- Fiddleback which will include a disturbance area of no more than 22 ha and reach a maximum depth of 50 m.

Conventional drill and blast, load and haul mining techniques will be used to develop the open pits. It is proposed that the mining operations will be carried out 24 hours per day, seven days per week, and will be staged across the operational life of the Proposal (Table 2.4).

**Table 2.4 Resource Development Schedule**

Deposit	2015	2016	2017
Red Legs			
Fiddleback			

The pit operations are expected to be above the water table. The water table has been nominally measured at the nearby Marda Central Project at 60 m below ground level. The maximum pit depth proposed for Marda East is 50 m below ground level. A staged hydrogeological investigation as part of forward works (see section 6.1) will confirm the groundwater levels in the Development Envelope. Should nominal amounts of groundwater be encountered towards the end of mining, dewatering will occur via in-pit sumps to lined surface evaporation ponds and for use in dust suppression where necessary. The DoW will be consulted in order to obtain appropriate licences in this regard. No groundwater will be discharged to the environment.

In addition, if groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine the need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.

Waste materials not used in the construction of haul roads will be stored in WRLs that have been designed to fit with the natural terrain. The WRLs have been nominally designed to a final rehabilitated shape with:

- 18° batter slope angles;
- 5 m berm widths;
- 10 m bench heights;
- 17° overall slope angles; and
- 20 m maximum height.

This WRL design has been adopted from the existing Marda Central Mine Closure Plan, for consistency. However, as part of the forward works plan (see section 6.1) SXG will carry out detailed soil and waste rock characterisation, and update the MCP prepared for Marda Central (to reflect the addition of Marda East) according to the information obtained in relation to soil and waste rock composition, and appropriate rehabilitation techniques.

The Proposal will exclusively mine and process oxidised and transitional (weathered) ores. The ore and waste rock are assumed to be Non-Acid Forming (NAF) on the basis that those from the

Marda Central region do not contain any unreacted sulphide minerals which are typically the main source of Potentially Acid Forming (PAF) materials (Rapallo 2013a, 2013b, 2013c). As outlined above, detailed waste rock characterisation will be carried out as part of the forward works plan (see section 6.1), to confirm the assumption that no PAF material will be encountered.

Ore will be hauled to the surface using dump trucks and stockpiled on ROM pads at Red Legs and Fiddleback, before being transported to the Marda Central processing facility by road trains.

## 2.6 Processing

Ore from Marda East will be processed at the Marda Central processing facility, which is outside the scope of this Proposal, having previously been referred to the EPA (EPA Ref: 14-512340) as part of the Marda Central Project. Ore will be crushed, slurried with water and ground in a ball mill, and passed through a leaching and carbon adsorption circuit before gold is recovered from loaded carbon via an elution circuit and smelted into gold bars.

The Marda Central processing plant is expected to produce tailings at a nominal rate of 720,000 tpa. These tailings are expected to be generally similar to other oxide gold ore tailings produced in the Eastern Goldfields of WA. A tailings geochemistry study completed by Coffey Mining (2012) concluded that:

- the tailings are not indicated as PAF;
- with the exception of arsenic, no significant leaching of elements occurs at neutral and acidic pH values; and
- arsenic leaches slightly at elevated pH but will form stable calcium arsenate with the lime pH modifier used in processing.

The tailings study will be updated to reflect the Marda East ore feed as part of the forward works plan (see section 6.1).

Tailings from the Marda Central processing plant will be disposed of to a 27 ha, above ground, side hill type TSF west of the processing plant as referred to the EPA (EPA Ref: 14-512340). The total storage capacity to the ultimate embankment crest is estimated to be 2.5 Mt with a storage life of 3.5 years at the design throughput rate of 720,000 tpa. The current TSF design has sufficient capacity to accommodate the tailings associated with processing the Marda East ore.

## 2.7 Proposed Support Infrastructure

The mining operations at Red Legs and Fiddleback will require limited support infrastructure, comprising a diesel storage and refuelling facility, ROM pads, mine dewatering equipment (in-pit sumps and pumps and evaporation ponds), a site office building and ablutions facility, and a diesel power generator and lighting plants.

## 3 Methodology

### 3.1 Assessment Processes

This ERSD has been prepared using the following processes:

- An assessment of location and design options for temporary and permanent infrastructure was conducted during development of the site layout and Project Description. See section 3.2 for further information;
- A preliminary environmental risk assessment was conducted based on the preferred site layout and Project Description (see section 2) and outcomes of the baseline studies conducted in the Development Envelope and wider region. See section 3.3 for further information;
- An assessment of environmental factors was conducted based on the outcomes of the preliminary environmental risk assessment and environmental management, mitigation and monitoring measures were developed. The methodology adopted for this assessment is described in section 3.4 and the outcomes are presented in section 4;
- Stakeholder engagement was conducted to ensure that stakeholder concerns were identified and addressed during the above processes. See section 3.5 for further information; and
- Based on the outcomes of the above processes, the significance of the environmental factors relevant to the Proposal was assessed. The methodology adopted for this assessment is described in section 3.6 and the outcomes are presented in section 5.

### 3.2 Assessment of Project Options and Alternatives

#### 3.2.1 Infrastructure Categories

Planning for the development of the Proposal has involved assessment of options relating to the location of infrastructure in a manner that minimises impacts on environmental values. Infrastructure falls into two broad categories:

- Temporary infrastructure, including roads, topsoil stockpiles, ROM pads, ablutions facilities and evaporation ponds. Placement of this infrastructure was considered during Proposal planning to mitigate potential environmental impact and facilitate progressive rehabilitation. See sections 3.2.2 – 3.2.3; and
- Permanent features, including mine pit voids and WRLs. With the exception of mine pit voids, which are located based on existing gold resource geometry, placement and design of permanent features was considered during Proposal planning to mitigate potential environmental impacts. See sections 3.2.4 – 3.2.5.

Where possible, existing infrastructure will be used, particularly in order to capitalise on the use of infrastructure at Marda Central. Closure and rehabilitation of temporary and permanent features will be completed in accordance with the MCP to reduce safety, health and environmental impacts to as low as reasonably practicable, and to facilitate the meeting of EPA objectives for each relevant factor.



### 3.2.2 Roads

Wherever possible, existing tracks and roads will be used, and upgraded where necessary, to provide access to the various site elements and infrastructure. This will include the use of the Bullfinch-Evanston Road for haulage of ore from Red Legs and Fiddleback to Marda Central, in lieu of constructing a new private haul road. A further connecting haul road of 3.7 km will be required to connect the Red Legs pit to the Bullfinch Evanston Road (see Figure 2.1).

No existing gazetted roads or tracks will be closed by the Proposal and public thoroughfare will be maintained to and between key regional features. The haul road connecting the Fiddleback and Red Legs deposits will intersect the Bullfinch-Evanston Road. The Shire of Yilgarn will be consulted during the Mining Proposal stage, and appropriate safety measures, including speed limits and other restrictions where required, will be implemented for haulage operations in order to minimise the impact of haulage trucks intersecting with, and travelling on, the Bullfinch-Evanston Road.

SXG proposes to use crushed waste rock from Marda Central in the construction of haul roads and access tracks wherever practicable. Geological investigation of waste rock in the Marda Central, Golden Orb and King Brown deposits indicates that several geological units will provide suitably competent material for crushing and use as gravel in construction and rehabilitation, to prevent the need for further disturbance in the form of gravel pits.

### 3.2.3 Topsoil and Vegetation Stockpiles

Topsoil will be cleared from the proposed locations of the open pits, WRLs and other Proposal infrastructure. This will be temporarily stockpiled in areas of sparse vegetation as close as possible to the final destination of the topsoil to facilitate spreading during progressive rehabilitation. The depth of topsoil harvesting will be determined following a field survey of soils to be conducted during the assessment process. Topsoil will be stored in stockpiles no greater than 2 m in height and stockpiles will be seeded with native grasses to provide stability.

Cleared vegetation will also be stockpiled where possible for placement on rehabilitated landforms to assist with the early development of complex habitats in closure.

### 3.2.4 Backfilling of Pit Voids

The potential for backfilling of open pits has been considered in line with Department of Mines and Petroleum (DMP) and EPA Mine Closure Guidelines (DMP and EPA 2011) and Department of Parks and Wildlife's (DPaW) requests in its position as a key stakeholder responsible for management of the CALM Act Section 5(1)(h) proposed 'Conservation and Mining Reserve'.

The primary considerations were:

- the extent of potential pit lake formation;
- sterilisation of underlying ore potential; and
- attraction and localised grazing of feral animals.

DMP and EPA Mine Closure Guidelines require that, prior to open cut mines being backfilled, a study be conducted to determine the potential for future economic mining from any resource that exists beneath or along strike of the current pit extents. SXG's resource definition data does not currently indicate a defined resource extent. Consequently, the resource implications of backfill

are yet to be determined and will be confirmed in consultation with DMP as mining and final resource definition progresses.

As discussed with DPaW during consultation on 21 May 2014, SXG is committed to minimising the occurrence of pit lakes following closure. If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine whether there is a need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW. Given evaporation is likely to exceed rainwater inflow, any pit lakes resulting from rainfall accumulation are expected to be temporary and ephemeral (Pendragon Environmental Solutions 2013). This reduces the likelihood that members of the public or fauna will try to access the pits. This will be further reduced by the presence of safety berms and abandonment bunds around the pits.

To reduce the risk of members of the public accessing the Marda East pits, SXG will ensure that any access roads to the pit will be rehabilitated and made inaccessible. The presence of a safety berm and abandonment bund around the pit will further deter public access.

### 3.2.5 Disposal of Waste Rock

The waste rock from Marda East will be stored in two WRLs, one located at each of Fiddleback and Red Legs, which will be located:

- where gold resources are absent;
- close to the pit from which it was mined to reduce haulage;
- outside of the zone of potential pit void instability;
- within the mining lease; and
- where possible, outside of any existing PEC location, or where priority flora species have been recorded.

Figure 4.3 and Figure 4.5 show the recorded location of priority flora species and PEC, and the WRLs aligned to minimise interaction with these environmental values.

The WRLs that have been designed to fit with the natural terrain and to have a final rehabilitated shape with:

- 18° batter slope angles;
- 5 m berm widths;
- 10 m bench heights;
- 17° overall slope angles; and
- 20 m maximum height.

This WRL design has been adopted from the existing Marda Central MCP, for consistency. However, as part of the forward works plan (see section 6.1) SXG will carry out detailed soil and waste rock characterisation, and update the MCP prepared for Marda Central (to reflect the addition of Marda East) according to the information obtained in relation to soil and waste rock composition, and appropriate rehabilitation techniques.

It is anticipated that Marda East waste rock and ore will comprise only oxidised and transitional (weathered) materials and is therefore likely to be NAF. As outlined above, detailed waste rock characterisation will be carried out as part of the forward works plan (see section 6.1), to confirm the assumption that no PAF material will be encountered.

The proposed WRL locations are provided in Figure 2.2 and Figure 2.3.

### 3.3 Preliminary Environmental Risk Assessment

A preliminary environmental risk assessment was conducted for the Proposal in July 2014 based on available environmental information and data for the Proposal. The assessment identified the environmental factors relevant to the Proposal and how those factors could be affected by Proposal construction, operation and closure. A summary of the risk assessment is provided in table format at Appendix B.

The outcomes of the July 2014 preliminary risk assessment along with environmental surveys and studies conducted for the Proposal were used in the assessment of environmental factors described in section 3.4.

### 3.4 Assessment of Environmental Factors

With the exception of the (not applicable) Sea factors, all the environmental factors identified in EAG 8 (EPA 2013a) and the supporting table to EAG 8 (EPA 2013b) were assessed during the preparation of the Referral document. These factors are listed in Table 3.1 along with the EPA's objectives for these factors.

The following guidance documents have been used in this assessment:

- EPA Position Statement 2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000);
- EPA Position Statement 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002a);
- EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004a);
- EPA Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems (EPA 2006a)
- Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011);
- Fire Management Plan for the Conservation of Biodiversity and Cultural Heritage Values in the Great Western Woodlands (DEC 2011a);
- EPA Guidance Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA 2007a);
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b);
- Draft EPA Guidance Statement No. 54a: Sampling Methods and Survey Considerations for Subterranean Fauna (EPA 2007b);
- Leading Practice Sustainable Development Program for the Mining Industry: Managing Acid and Metalliferous Drainage (Department of Industry, Tourism and Resources [DITR] 2007);
- Acid Rock Drainage Guide (International Network for Acid Prevention 2009);
- Australian Water Guidelines for Fresh and Marine Waters (Australian and New Zealand Environment Conservation Council and Agricultural and Resource Management Council of Australia and New Zealand [ANZECC/ARMCANZ] 2000);
- Water Quality Protection Guidelines (Water and Rivers Commission [WRC] 2000a-e);
- Water Quality Protection Note 68: Mechanical Equipment Washdown (DoW 2013);

- Operational policy no. 1.02 – Policy on water conservation/efficiency plans (DoW 2009);
- Operational policy no. 5.08 – Use of operating strategies in the water licensing process (DoW 2011);
- Australian Standard 1940-2004 (The Storage and Handling of Flammable and Combustible Liquids);
- Australian Standard 1596-2008 (The Storage and Handling of Liquid Petroleum Gas);
- Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (Department of Environment and Conservation [DEC] 2004);
- Guidance Statement No 20: Sampling of Short Range Endemic Invertebrates (SREs) for Environmental Impact Assessment in Western Australia (EPA 2009);
- EPA Guidance Statement No. 12: Minimising Greenhouse Gases (EPA 2002b);
- A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (DEC 2011b);
- Visual Landscape Planning in WA (WA Planning Commission ([WAPC] 2007);
- Guidance Notes for the Reduction of Obtrusive Light (The Institute of Lighting Engineers 2005);
- EPA Guidance Statement No. 41: Assessment of Aboriginal Heritage (EPA 2004c);
- Draft EPA Guidance Statement No. 8: Environmental Noise (EPA 2007c);
- Environmental Protection (Noise) Regulations 1997;
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (Australian and New Zealand Environment Council [ANZEC] 1990);
- EPA Position Statement 9: Environmental Offsets (EPA 2006b);
- EPA Guidance Statement No. 19: Environmental Offsets – Biodiversity (EPA 2008a);
- Environmental Protection Bulletin 1: Environmental Offsets - Biodiversity (EPA 2008b); and
- Environmental Protection Bulletin 19: EPA Involvement in Mine Closure (EPA 2013c).

The environmental factors listed in Table 3.1 have been considered by SXG with particular focus given to those factors identified as having the greatest potential impacts on the environment (see section 4).

**Table 3.1 Relevant Environmental Factors**

Theme	Factor	EPA Objective
Land	Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.
	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.
	Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.
	Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

Theme	Factor	EPA Objective
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.
	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.
Air	Air Quality	To maintain air quality for the protection of the environment, human health and amenity.
People	Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable.
	Heritage	To ensure that historical and cultural associations are not adversely affected.
	Human Health (noise and vibration)	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.
	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.

### 3.5 Stakeholder Engagement

Key stakeholders for the Proposal are listed in Table 3.2.

**Table 3.2 Key Stakeholders**

Stakeholder Group	Stakeholders
State Government	Office of the Environmental Protection Authority (OEPA)
	Department of Mines and Petroleum (DMP)
	Department of Parks and Wildlife (DPaW) – Regional Branch and Environmental Management Branch
	Department of Environment Regulation (DER)
	Department of Water (DoW)
	Department of Indigenous Affairs (DIA)
	Main Roads Western Australia (MRWA)
Local Government	Shire of Yilgarn
	Shire of Menzies
Traditional Owners and Aboriginal Heritage	Central West Goldfields People / Sambo Family
	Kelemaia Kubu(d)n / Champion Family
	Ngalia Heritage Research Council
Pastoral	Mt Jackson Station (owned by Cliffs)
	Pastoral Land Board
NGOs	Conservation Council of WA
	Wildflower Society of WA
	Malleefowl Preservation Group

Stakeholder Group	Stakeholders
	Wilderness Society (WA) Birdlife Australia (WA Branch)
Neighbouring Proponents	Cliffs Natural Resources

As part of the Referral preparation, SXG has conducted extensive stakeholder engagement. Consultation conducted to date in relation to the environmental assessment of the Proposal is summarised in Table 3.3.

**Table 3.3 Stakeholder Consultation Program and Issues Raised**

Date	Stakeholders and Consultation Type	Issues Raised	SXG Response and Actions
20 May 2014	Meeting with Office of the Environmental Protection Authority (Mark Jeffries)	EPA has a focus on the BIF ranges and is aware of the delay in converting proposed conservation areas into actual conservation areas.	SXG tenure does not infringe on proposed Class A Nature Reserve. The hydrological study completed to determine the potential for runoff into the proposed Class A Nature Reserve confirms that the proposed mine areas will not drain into the proposed Class A Nature Reserve (section 4.3.1).
		Edge effect of project on the fringe of conservation reserves - how will SXG ensure that the mine does not impact on the adjacent BIF ranges? In particular, how will SXG ensure that dust and other pollutants from the mine do not impact on the <i>Tetratheca</i> populations on the BIF ranges?	The hydrological study completed to determine the potential for runoff into the proposed Class A Nature Reserve confirms that the proposed mine areas will not drain into the proposed Class A Nature Reserve (section 4.3.1). Management measures will be identified to prevent offsite dust impacts. Monitoring of reference sites will confirm efficacy of management measures.
		The Landform aspect of the project will require particular attention given the importance of this aspect in BIF regions.	SXG notes the importance of the Landform aspect and has addressed this aspect in section 4.2.2.
		Considerable importance on the impact of the Proposal on conservation reserves and the values being protected in the reserves. <ul style="list-style-type: none"> <li>◆ Does the reserve already hold adequate similar vegetation to that described in the Project area?</li> <li>◆ How will the reserve be afforded with adequate protection?</li> <li>◆ Can it be assured that the areas outside the reserve are not needed for the integrity of the whole?</li> <li>◆ How will the Proposal operate without impacting the reserve?</li> </ul>	SXG confirms that there is no DRF within the project area that is typically associated with BIF and could be expected to occur in the proposed Class A Nature reserve (see section 4.2.1). The habitat and vegetation integrity as well as regional significance of flora and vegetation within the Development Envelope has been considered at sections 4.2.1 and 4.2.4.
		The exclusion of the mine tenement R77/001 from the proposed Class A Nature Reserve is on the basis that the tenement was existing at the time of the proposition, not because of differing conservation values. SXG should determine whether the mining tenement includes high conservation values and if it will impact on the adjacent nature reserve.	See sections 4.2.1, 4.2.2 and 4.2.5.
		SXG may choose to review the flora data with a view to refining the PEC boundary with input from the DER. SXG also needs to determine if the proposed mine infrastructure will actually impact on the PEC.	See section 4.2.1. SXG will liaise with the DER during the forward works program to determine whether the PEC boundary may be refined as a result of the data obtained during the surveys for the

Date	Stakeholders and Consultation Type	Issues Raised	SXG Response and Actions
		<p>A (very) detailed closure plan is expected and should focus on restoring values.</p> <p>How will the possible formation of pit lakes at closure be addressed?</p>	<p>Proposal.</p> <p>The MCP for Marda Central will be updated to reflect the inclusion of the Proposal.</p> <p>See sections 3.2.4, 4.3.1 and 4.6.2. If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine whether there is a need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.</p>
22 May 2014	Meeting with Department of Parks and Wildlife (Sandra Thomas, Daniel Coffey, Ian Kealley, Julie Futter)	<p>This area is likely to be subject to intense scrutiny in light of the proximal Banded Ironstone Formation. DPaW refers SXG to the 2007 EPA Annual Report and Bulletin 1256.</p> <p>At least a Level 1 fauna study will be required, with some level of field work to verify desktop studies available, given the limited nature of field work conducted off BIF ranges in the area.</p> <p>Any presence of malleefowl will require referral under the <i>EPBC Act</i>.</p> <p>One of the major issues for consideration is the landform features of the area. There are potential recreation areas in the region and this will be a focus for public engagement. DPaW encourages SXG to follow the DPaW methodology for visual assessment, and if necessary to provide a formal external visual assessment review of the project.</p> <p>The Species and Communities Branch (Perth) may be consulted in order to review the Priority Ecological Communities boundary, if it is appropriate to use survey information in order to better define the actual boundary.</p> <p>Impacts to <i>Tetratheca</i> that may occur in the proposed Class A Nature Reserve should be considered, including dust, habitat connectivity and surface water runoff.</p> <p>DPaW would like the opportunity to review the MCP, with particular reference to the proposed management of any pit lakes.</p>	<p>See section 4.2.2. SXG has reflected the issues outlined in these documents in its consideration of landform issues.</p> <p>A Level 1 fauna study has been completed, and a Level 2 spring fauna study has been included in the forward works section (see section 6.1).</p> <p>Noted. This is included in the forward works section (see section 6.3).</p> <p>The landform section (see section 4.2.2) addresses this issue and significant stakeholder engagement has been conducted in relation to landform and visual values. Finally, the forward work section 6.1 proposes specialist visual impact modelling to confirm the projected impacts and the efficacy of any proposed rehabilitation strategies.</p> <p>The forward works section 6.1 includes a proposal to liaise with the Species and Communities Branch in this regard.</p> <p>These impacts have been considered in sections 4.3.1 and 4.4.</p> <p>Closure and rehabilitation has been addressed in section 4.6.2. The forward works section includes an updated MCP which will be developed in</p>



Date	Stakeholders and Consultation Type	Issues Raised	SXG Response and Actions
			<p>consultation with stakeholders including DPaW and DMP (see section 6.4).</p> <p>DPaW recommends that SXG consult with relevant Non-Government Organisations prior to referral.</p> <p>The seasonal impacts on flora surveys should be considered. A particularly dry spring may have implications for species observed.</p> <p>DPaW has offered to review scopes of work for any works carried out in support of the assessment.</p> <p>It is important to note in the floristic community types analysis the extent to which local populations will be influenced.</p> <p>Aboriginal cultural heritage must be carefully mapped in the context that there is limited agreement on which groups have used the area in the past.</p>
10 June 2014	Letter and Briefing Note to Bird Life Australia (Liz Fox and Nick Dunlop)	Briefing note (attached as Appendix C) provided to Bird Life Australia outlining the nature of the proposal, the studies completed and planned, the key impacts and requesting to meet with representatives to understand any concerns or issues to be addressed by SXG during the proposal referral process.	Meeting scheduled with Bird Life Australia.
10 June 2014	Letter and Briefing Note to Malleefowl Preservation Group	Briefing note (attached as Appendix C) provided to the Malleefowl Preservation Group outlining the nature of the proposal, the studies completed and planned, the key impacts and requesting to meet with representatives to understand any concerns or issues to be addressed by SXG during the proposal referral process.	No response received from Malleefowl Preservation Group.
10 June 2014	Letter and Briefing Note to Conservation Council of Western Australia (Piers Verstegen)	Briefing note (attached as Appendix C) provided to the Conservation Council of WA outlining the nature of the proposal, the studies completed and planned, the key impacts and requesting to meet with representatives to understand any concerns or issues to be addressed by SXG during the proposal referral process.	No response received from Conservation Council of WA
10 June 2014	Letter and Briefing Note to Wilderness Society (WA) (Sarah Yani Vann-Sander)	Briefing note (attached as Appendix C) provided to the Wilderness Society of WA outlining the nature of the proposal, the studies completed and planned, the key impacts and requesting to meet with representatives to understand any concerns or issues to be addressed by SXG during the	No response received from Wilderness Society. Given the Society's interest in the Marda Central Project, follow up phone calls were made in a further attempt to engage with this stakeholder. No

Date	Stakeholders and Consultation Type	Issues Raised	SXG Response and Actions
		proposal referral process.	response was received.
10 June 2014	Letter and Briefing Note to Wildflower Society of Western Australia (Brian Moyle)	Briefing note (attached as Appendix C) provided to the Wildflower Society of Western Australia outlining the nature of the proposal, the studies completed and planned, the key impacts and requesting to meet with representatives to understand any concerns or issues to be addressed by SXG during the proposal referral process.	Meeting scheduled with Wildflower Society of WA
10 June 2014	Letter and Briefing Note to Department of Aboriginal Affairs (Cesar Rodriguez)	Briefing note (attached as Appendix C) provided to the Department of Aboriginal Affairs outlining the nature of the proposal, the studies completed and planned, the key impacts and requesting to meet with representatives to understand any concerns or issues to be addressed by SXG during the proposal referral process.	Meeting scheduled with Department of Aboriginal Affairs.
30 June 2014	Meeting with Wildflower Society of WA	The landscape values are likely to be changed forever, for what is a short mine life. Has SXG considered the intergenerational equity of this project?	SXG understands the significance of the Landform factor in this referral and has addressed this issue in sections 4.1 and 4.2.2.
		The lookout known as Mt Geraldine is the most accessible public access point and campers do frequent this area. Is the mine going to be visible from this point?	SXG has completed a preliminary visual assessment of the proposal (according to the guideline in Visual Landscape Planning in Western Australia (WAPC 2007)). This is referred to in section 4.5.1. Due to the proximity of other range features between Mt Geraldine and the Proposal site, it is not likely that the mine impact area will be visible from the lookout referred to in this conversation. However, the forward work section 6.1 proposes specialist visual impact modelling to confirm the projected impacts and the efficacy of any proposed rehabilitation strategies and will include an assessment of the view from Mt Geraldine.
		Historically there have been fewer bushfires on the range areas and as a result there are more mature trees. Can SXG commit to protecting the larger trees?	SXG will align ancillary infrastructure in a manner that minimises impacts to mature trees where it is possible to do so (see section 4.2.1).
		Has SXG considered the preservation of good topsoil and accurate material characterisation, including basing management practices on different material type?	SXG has committed to carrying out a detailed soil characterisation survey, and will collect and manage topsoil on the basis of values identified during this survey (see sections 4.2.2, 4.6.2 and 6.1). These commitments will be included in the MCP update (see section 6.4).
		Has SXG considered collecting seed of priority species, and utilising local	SXG has included these measures in its

Date	Stakeholders and Consultation Type	Issues Raised	SXG Response and Actions
		species that are viable long term (such as pea species) in rehabilitation?	management commitments (see sections 4.2.1 and 4.6.2).
		Has SXG considered stockpiling vegetation and timber to use as a resource to create habitats during rehabilitation and closure?	SXG has included these measures in its management commitments (see section 4.6.2).
		Has SXG designed rehabilitation structures that will be successful over dry and wet seasons?	The WRLs are designed to maximise precipitation infiltration in the context of the material characterisation and soil types, and the regional climate. The MCP will be updated to reflect the Marda East soil types and waste characterisation (see section 4.6.2).
		Has SXG considered an education program for site workers in terms of environmental and community values?	SXG has included these measures in its management commitments (see sections 4.2.1 and 4.2.5).
		The Wildflower Society is focused on the cumulative impacts to the region, and would rather the proposal did not go ahead.	SXG notes this focus and has attempted to address this view point in section 4.2.2.
30 June 2014	Meeting with Bird Life Australia / Great Western Woodlands (GWW/BLA) (Liz Fox, Brian Dunlop)	GWW/BLA is concerned with the long term cumulative effects of fragmentation across the landscape, and the impacts to ecosystem values of this fragmentation. The aim of protecting areas is to ensure that the ecosystem remains fully functional.	Section 4.2.1 indicates that the disturbance is aligned in such a manner to prevent fragmentation of the vegetation associations and landform units within the region. SXG notes the focus on cumulative impacts and has attempted to address this view point in section 4.2.2.
		GWW/BLA is concerned about the potential impact of stability of landforms in the long term, including open pits, tailings dams and waste dumps.	SXG has addressed this concern in section 4.2.2 and will update the MCP to reflect this focus as part of the forward works.
		GWW/BLA would like to see a higher standard of closure objective set than are currently accepted by regulatory authorities.	SXG has set closure objectives that are relevant at an ecosystem level. SXG will amend its closure plan as part of the forward works and has invited GWW/BLA to be involved in the review of this document before it is finalised.
		GWW/BLA is concerned about the impact that pit lakes may have on the regional ecosystem following closure.	See sections 3.2.4, 4.3.1 and 4.6.2. If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine whether there is a need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the

Date	Stakeholders and Consultation Type	Issues Raised	SXG Response and Actions
		<p>Bird Life Australia have indicated that they have a need for environmental data that is collected by mining companies.</p>	<p>DMP and DPaW. SXG has committed to providing flora and fauna data to Bird Life Australia upon request.</p>
		<p>GWW/BLA would like to see backfilling of pits.</p>	<p>If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine whether there is a need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.</p>

### 3.6 Assessment of Significance

To determine the significance of the environmental factors associated with the Proposal, the Significance Framework outlined in EAG 9 (EPA 2013d) was applied. The outcomes of this process are discussed in section 5.

In applying the concept of significance, SXG considered both the likely significance of the inherent impacts of the Proposal (i.e. without management or mitigation) and the likely significance of the residual impacts of the Proposal (i.e. following application of management and/or mitigation measures). It is noted that mitigation measures may also be referred to or detailed in other regulatory processes to which the proposal may be subjected, including:

- Mining Proposal approval under the *Mining Act 1978* (WA);
- Works Approval and Licence under Part V of the *Environmental Protection Act 1986* (WA) (EP Act);
- Groundwater licences under sections 26D and 5C of the *Rights in Water and Irrigation Act 1914* (WA);
- Dangerous Goods Licence under the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (WA);
- Native Vegetation Clearing Permit under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (if the Proposal is not subject to formal assessment under Part IV of the EP Act); and
- Package water treatment plant installation approval under the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974.

## 4 Assessment of Environmental Factors

### 4.1 Principles of Environmental Protection

In 2003, the EP Act was amended to include five principles which form the core set for the EPA in relation to environmental protection. These principles are outlined in EPA Position Statement 7 (EPA 2004d) and listed in Table 4.1, along with a summary of the way in which SXG has, or proposes to, address these principles in the development and implementation of the Proposal.

**Table 4.1 Principles of Environmental Protection**

EPA Principle of Environmental Protection	Project Application
<p><b>1. The precautionary principle</b></p> <p>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.</p> <p>In the application of the precautionary principle, decisions should be guided by:</p> <p>(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</p> <p>(b) an assessment of the risk-weighted consequences of various options.</p>	<p>SXG has undertaken a wide range of studies to ensure that the environmental risks associated with the Proposal are understood and can be managed in an environmentally acceptable manner. These include:</p> <ul style="list-style-type: none"> <li>▪ An extensive range of regional environmental studies. These include surveys or studies in relation to:               <ul style="list-style-type: none"> <li>○ geochemistry (Coffey 2012, Rapallo 2013a, Rapallo 2013b and Rapallo 2013c);</li> <li>○ soils (Soilwater Consultants 2013); and</li> <li>○ groundwater (Pendragon Environmental Solutions 2013).</li> </ul> </li> <li>▪ A suite of preliminary site-specific environmental studies, including:               <ul style="list-style-type: none"> <li>○ surface water (Palaris 2014);</li> <li>○ flora and vegetation (Western Botanical 2014);</li> <li>○ vertebrate fauna (APM 2014);</li> <li>○ SRE invertebrate fauna (APM 2014);</li> <li>○ Aboriginal heritage (Aboriginal Heritage Consultants 2012, Cecchi 2012, Cecchi 2013 and R. &amp; E. O'Connor 2012); and</li> <li>○ visual impact assessment (SXG 2014).</li> </ul> </li> <li>▪ Extensive stakeholder engagement (see section 3.5).</li> <li>▪ Preliminary environmental risk assessment, which was conducted in July 2014 (see section 3.3). This provided useful information on the potential environmental risks inherent in the proposal and how these inherent risks could be reduced through the application of environmental management and mitigation measures. No residual Proposal risks were considered to be significant.</li> <li>▪ SXG also proposes to undertake a number of further site specific studies in relation to Marda East to build on its regional knowledge, during the Mining Proposal process, including:               <ul style="list-style-type: none"> <li>○ soil survey;</li> <li>○ waste rock and tailings characterisation;</li> <li>○ hydrogeology study;</li> <li>○ targeted Level 2 fauna survey;</li> <li>○ visual impact modelling assessment;</li> <li>○ Aboriginal heritage supplementary survey over small remaining unsurveyed area; and</li> <li>○ PEC boundary review.</li> </ul> </li> </ul> <p>The scope of these proposed studies are further described in section 6.1.</p>

EPA Principle of Environmental Protection	Project Application
<p><b>2. The principle of intergenerational equity</b></p> <p>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>SXG has designed the Proposal and its layout, and has developed environmental management and mitigation measures, to minimise potential impacts on the health, diversity and productivity of the local and regional environment. See sections 4.2 - 4.6.</p> <p>SXG will progressively rehabilitate areas disturbed by the Proposal.</p> <p>SXG will amend the Marda Central MCP to incorporate the Marda East pits in consultation with the DMP and DPaW. The MCP includes closure objectives and completion criteria that address the environmental and social sustainability of the Development Envelope following cessation of mining.</p>
<p><b>3. The principle of the conservation of biological diversity and ecological integrity</b></p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<p>Four Priority Flora species have been recorded in the Development Envelope. Populations of all four species were found within the Red Legs and Fiddleback disturbance footprint. Three of the four species had significant populations outside of the disturbance footprint. The remaining Priority 3 species, <i>Mirbelia ferricola</i>, is well represented in the region, including in the nearby Mount Manning Nature Reserve (see section 4.2.1).</p> <p>Instead of developing gravel or borrow pits, SXG proposes to recover tertiary conglomerates from within the disturbance footprint and Marda Central project area (such as the processing plant and TSF) and to use NAF waste rock materials for construction purposes. This reduces the area of clearing.</p> <p>The Development Envelope will not be visible to passing motorists due to a mixture of landform and vegetation obstructions and the high degree of visual impact absorption in the road verge vegetation. Some impacts to views from elevated locations surrounding the project have been identified, however, there is limited public access to these areas at present. A comprehensive visual impact modelling will be carried out as part of forward works and will inform the mine rehabilitation strategy where relevant.</p> <p>SXG has developed environmental management and mitigation measures to conserve biological diversity and ecological integrity of the Development Envelope. These measures include alignment of Proposal infrastructure to ensure the integrity of the Die Hardy Range is preserved, weed and feral animal control, progressive rehabilitation and the use provenance-sourced seed wherever possible. See sections 4.2 - 4.6.</p> <p>The MCP for Marda Central includes closure objectives and completion criteria that address the biological diversity and ecological integrity of the Development Envelope following cessation of mining. The Marda Central MCP will be updated to include the Marda East pits in consultation with DMP and DPaW.</p>
<p><b>4. Principles relating to improved valuation, pricing and incentive mechanisms</b></p> <p>(a) Environmental factors should be included in the valuation of assets and services.</p> <p>(b) The “polluter pays” principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.</p> <p>(c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and</p>	<p>SXG is committed to a triple bottom line approach to its operations and has a prominent focus on sustainability in all aspects of mining from feasibility assessment, through operations and into closure.</p> <p>SXG is committed to the minimisation, reuse and recycling of waste materials. SXG will contribute to initiatives that promote production, use and recycling of metals and minerals in a safe and environmentally responsible manner.</p> <p>SXG will confirm the presence of NAF materials during materials characterisation as part of the Mining Proposal, and will finalise the design of the WRLs once this information is available to ensure no leaching of contaminants, and will monitor these facilities to assess the effectiveness of these measures. In the event that contaminated</p>

EPA Principle of Environmental Protection	Project Application
<p>services, including the use of natural resources and assets, and the ultimate disposal of any wastes.</p> <p>(d) Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and response to environmental problems.</p>	<p>seepage is detected, SXG will undertake remedial action.</p> <p>SXG has made provision for rehabilitation and closure of the Proposal. This includes the remediation of any contaminated sites (e.g. hydrocarbon-affected soil) remaining at mine closure.</p> <p>SXG will carry out reporting according to Energy Efficiency Opportunity (EEO), National Pollutant Inventory (NPI) and National Greenhouse and Energy Reporting's (NGER) legislation and will actively implement opportunities for improvement that are identified and determined to be feasible as part of this reporting.</p>
<p><b>5. The principle of waste minimisation</b></p> <p>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</p>	<p>SXG is committed to the minimisation, reuse and recycling of waste materials.</p> <p>SXG has determined that no water abstracted from the mine pits during pit dewatering (should nominal amounts of groundwater be encountered towards the end of mining) will be discharged to the environment.</p> <p>Infrastructure has been designed in accordance with relevant guidelines including the Water Quality Protection Notes (WQPN) 68 (see Table 4.7) to ensure capture and treatment of all contaminated water on site.</p>

## 4.2 Land

### 4.2.1 Flora and Vegetation

#### EPA Objective

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

#### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for flora and vegetation has been developed with consideration of the following:

- EPA Position Statement 2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000);
- EPA Position Statement 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002a);
- EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys ; and for Environmental Impact Assessment in Western Australia (EPA 2004a); and
- Fire Management Plan for the Conservation of Biodiversity and Cultural Heritage Values in the Great Western Woodlands (DEC 2011a).

In the event that the Proposal does not require formal assessment under Part IV of the EP Act, an application for a Native Vegetation Clearing Permit will be submitted to the DMP.

#### Existing Environment

The Development Envelope is located within the Coolgardie Botanical District which is a transition zone between the South West and Eremaean Botanical Provinces. The transition zone contains



species representative of both provinces (Beard 1976, 1990) and therefore can have significant flora and vegetation values. The Development Envelope intersects three of Beard’s vegetation units with the majority of the area mapped as the Jackson 19 unit (Table 4.2, Figure 4.1).

**Table 4.2 Beard (1976) Vegetation Mapping Units Recorded within the Development Envelope**

Beard Code	Description	Area* mapped within the Development Envelope (ha)
Jackson 141	Medium woodland; York gum, salmon gum and gimlet	22.5
Jackson 202	Shrublands; mulga ( <i>Acacia aneura</i> ) and <i>Acacia quadrimarginea</i> scrub	93.2
Jackson 19	Low Woodland: mulga ( <i>Acacia aneura</i> ) between sandridges	129

More recently Payne *et al.* (1998) conducted Land Systems (rangelands) mapping at a scale of 1:500,000 encompassing the Development Envelope. Land System mapping comprises repeating patterns of topography, soils, and vegetation. Payne *et al.* (1998) describes four Land Systems that extend over the Development Envelope; the Dryandra, Campsite, Moriarty, and Yowie Land Systems, described in Table 4.3 (Figure 4.2). The majority of the Development Envelope is mapped within the Campsite System (171 ha) followed by the Dryandra System with 61.2 ha mapped. These two Land Systems represent 94.6% of the Development Envelope (245 ha).

**Table 4.3 Land System Units Mapped within the Marda East Development Envelope**

Land System Code	Land System Unit	Description
RGECAM	Campsite Land System	Alluvial plains (very gently inclined plains receiving sheet wash from mafic hills, gently undulating calcareous stony upper plains (erosional) and occasional narrow concentrated drainage tracts). It supports eucalypt woodlands with halophytic understoreys and eucalypt-acacia shrublands.
RGEDRY	Dryandra Land System	Conspicuous banded ironstone and jaspilite ridges and hills with hill slopes of variable country rock, relief up to 150 m or more, and supporting dense mixed shrublands with emergent native pines, mallees and casuarinas.
RGEYOW	Yowie Land System	Sandy plains with negligible surface drainage features, supporting shrublands of mulga and bowgada with common mallee eucalypts and patchy wanderrie grasses.
RGEMOR	Moriarty Land System	Low greenstone rises and stony plains, with local pockets of lateritic duricrust on weathered greenstone, very gently undulating plains with stony lag and alluvial plains with texture contrast soils, supporting chenopod, halophytic and acacia shrublands with patchy eucalypt over storeys.

The Marda East Development Envelope currently resides within the CALM Act Section 5(1)(h) proposed ‘Conservation and Mining Reserve’. An area encompassing a significant proportion of the adjacent Die Hardy Range has been nominated for inclusion in a proposed Class A Nature Reserve. This proposed reserve abuts the north western boundary of the Red Legs prospect (see Figure 2.1). There is an evident continuity of vegetation communities from the proposed Class A Nature Reserve into the Red Legs Development Envelope as shown in the Vegetation Associations and Land Systems maps (Figure 4.1 and Figure 4.2).

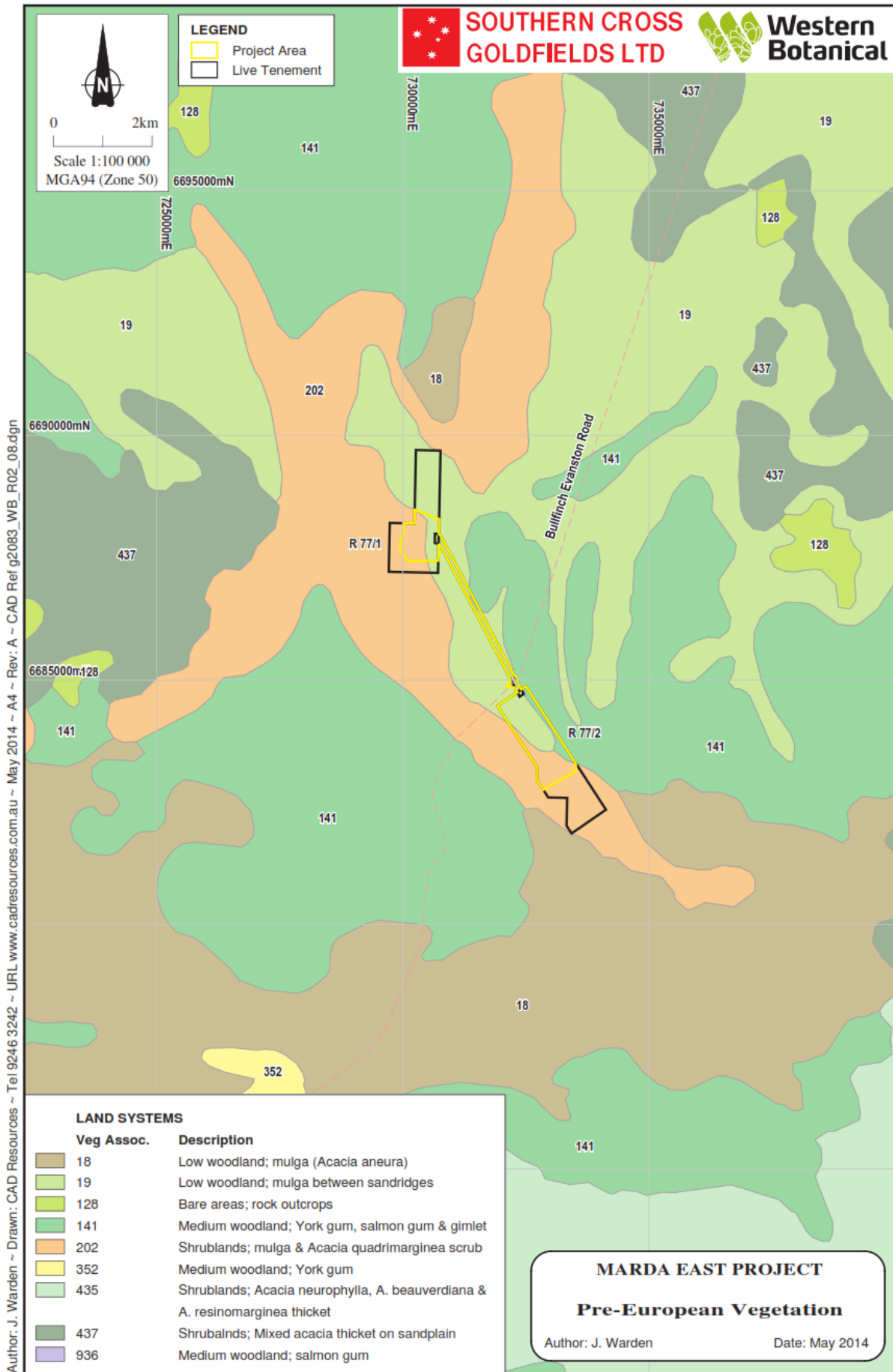


Figure 4.1 Vegetation Mapping Units According to Beard (1976) in the Vicinity of Marda East Development Envelope

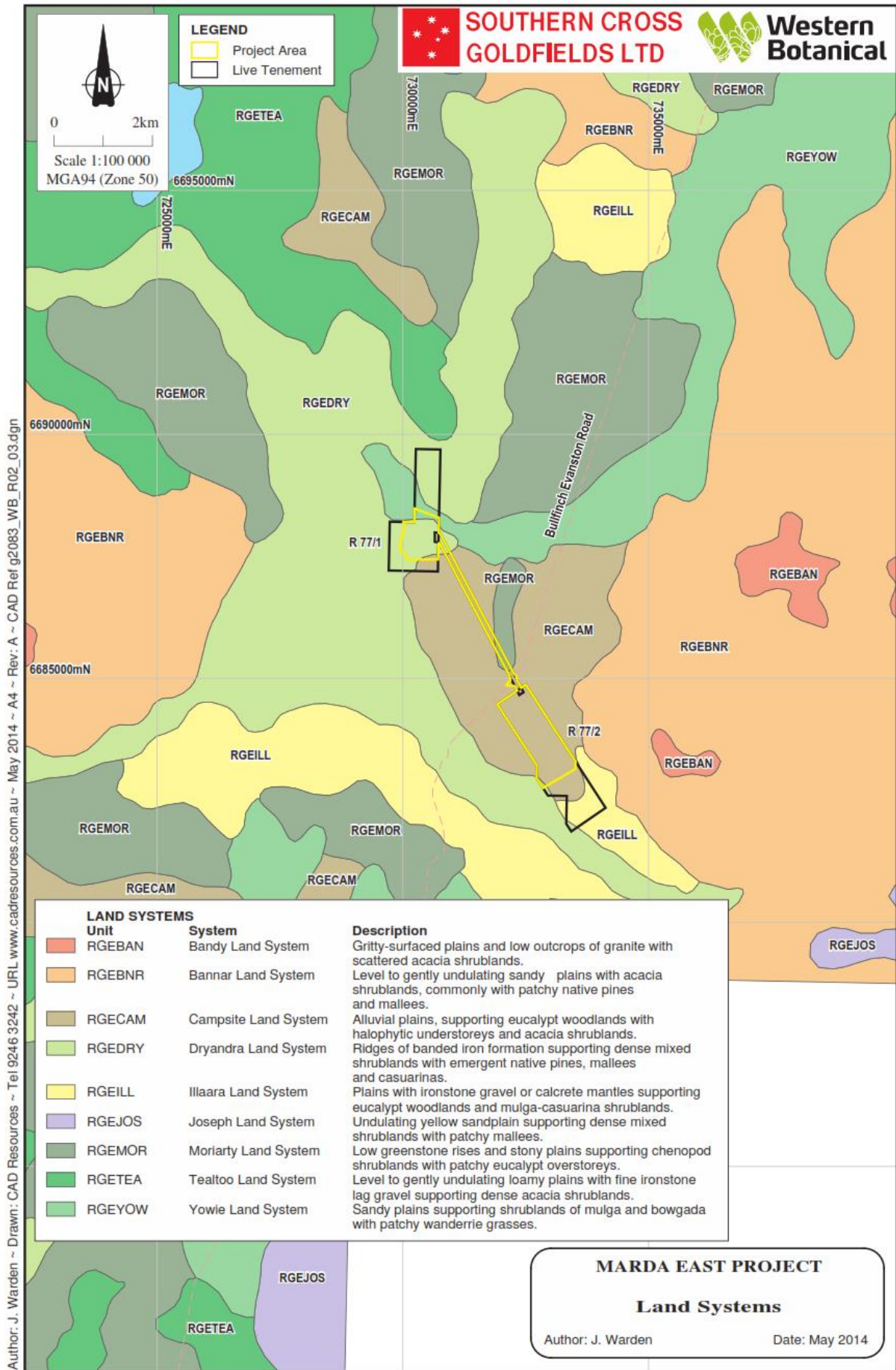


Figure 4.2 Land Systems According to Payne *et al.* (1998) in the Vicinity of Marda East Development Envelope

South-west flora and vegetation includes a large number of naturally rare and geographically restricted taxa due to the evolutionary and ecological processes unique to this region, which also supports a relatively high proportion of ancient flora (Gibson *et al.* 2007). The nearby ironstone ranges are also floristically distinct with the pattern of flora and vegetation believed to be strongly correlated with topography (Gibson *et al.* 2011).

In 2012 and 2013, a Level 2 Flora and Vegetation survey was conducted involving vegetation association mapping and the use of quadrat based sampling techniques (Appendix D). A total of 245 ha was mapped within the Development Envelope, with 12 vegetation associations identified across the area consisting of three Shrubland, six Woodland and three Thicket associations. The Red Legs prospect contained eight vegetation associations, the Fiddleback prospect four associations and the Haul Road six associations. The total and impacted area of vegetation associations in each of these three locations are given in Table 4.4.

**Table 4.4 Vegetation Associations within the Development Envelope with Proposed Mine Infrastructure Areas**

Location	Vegetation Associations	Area impacted within Development Envelope (ha)	Total area within Development Envelope (ha)	Percent impacted within the Development Envelope (%)
Fiddleback	1.1, 2.1, 2.2, 2.7	33.3	146	23.2
Red Legs	1.2, 1.4, 2.2, 2.3, 2.4, 2.6, 3.2, 3.3	11.4	65.0	17.6
Haul Road	1.1, 2.1, 2.2, 2.7, 3.1, 3.2	3.85	36.6	10.5

Across the Development Envelope, a total of 171 native flora species from 74 genera and 34 families were identified (Western Botanical 2014). Whilst the total number of taxa recorded within the Development Envelope can be considered a good representation of the regional perennial flora recorded, the poor winter rainfall conditions prior to both surveys meant the number of annual and short-lived perennial species recorded was lower than would normally be expected. Six taxa recorded within the Development Envelope represent range extensions of 50 km or greater from their current known distribution within Australia. No introduced (weed) species were encountered during the flora and vegetation surveys.

No rare flora species declared under the *Wildlife Conservation Act 1950 (WA)* or threatened flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* were recorded within the Development Envelope. There were four Priority species encountered within the Development Envelope which also occur within the disturbance footprint, as listed in Table 4.5 and shown in Figure 4.3, Figure 4.4 and Figure 4.5.

**Table 4.5 Priority Flora Species within the Development Envelope**

Priority	Name	Total population recorded	Population recorded in the disturbance footprint	% of population to be impacted in Development Envelope	Other findings
P3	<i>Grevillea georgeana</i>	2,347	477	20%	All are supported in the banded ironstone hill to the west of the Red Legs prospect (within the PEC); Found to be abundant in neighbouring areas, particularly the Polaris project area.

Priority	Name	Total population recorded	Population recorded in the disturbance footprint	% of population to be impacted in Development Envelope	Other findings
P3	<i>Mirbelia ferricola</i>	308	163	53%	All are supported in the banded ironstone hill to the west of the Red Legs prospect (within the PEC); Not recorded in other neighbouring mine surveys but known to be anecdotally present at Die Hardy Range, Mt Manning Range, Jackson Range, Koolyanobbing Range, Helena and Aurora Range and Mt Finnerty.
P4	<i>Dryandra arborea</i>	287	33	11%	281 are supported in the banded ironstone hill to the west of the Red Legs prospect (within the PEC); Substantially present outside the disturbance footprint and were also found within the Cliffs project area.
P4	<i>Eucalyptus formanii</i>	1,356	44	3%	1093 trees are located within the Red Legs prospect (23 units outside the PEC); Mostly occur outside the disturbance area.

The most significant Priority flora are located within the Red Legs prospect.

No Threatened Ecological Communities (TECs) were located within the Development Envelope.

The Development Envelope intersects the Priority One (P1) Die Hardy Range / Diemels vegetation complex (banded ironstone formation), PEC, which covers an area of 10,548 ha and follows the BIF geology of the Die Hardy Range and the adjacent Yokradine Hills. The Development Envelope covers 107.2 ha of the PEC, representing 1.02% of the total PEC, with 52.8 ha at Red Legs within the PEC boundary and 53.6 ha at Fiddleback within the PEC boundary. Each prospect represents 0.5% of the total Priority 1 PEC. Ten of the 12 mapped vegetation associations across the Development Envelope form part of the Priority 1 PEC vegetation complex. The disturbance footprint includes 13.3 ha of Priority 1 PEC, equivalent to 0.17% of the total Priority 1 PEC.

As part of the forward works program, SXG will liaise with DPaW to determine whether the information obtained during the 2014 flora survey may be used to further define the PEC boundary (section 6.1).

Vegetation condition was assessed according to the scale presented in Keighery (1994). The vegetation condition was considered across the Development Envelope to be in Pristine to Very Good condition reflecting the relatively minor historical impacts caused by the disturbance due to cleared exploration gridlines present within the Development Envelope. The vegetation structure was considered to be intact with natural regeneration of old tracks considered to be progressing well.

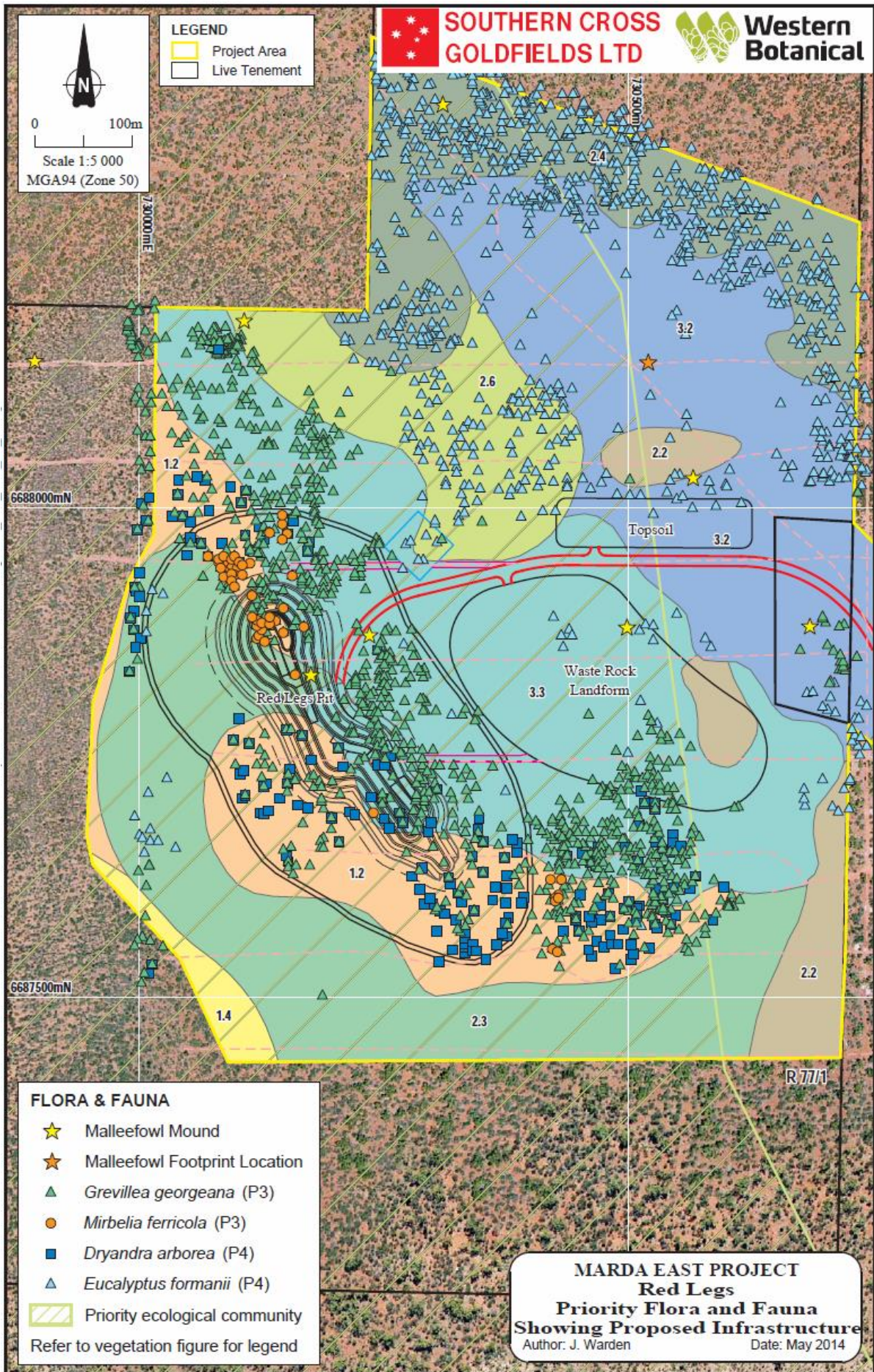


Figure 4.3 Priority Flora in Red Legs

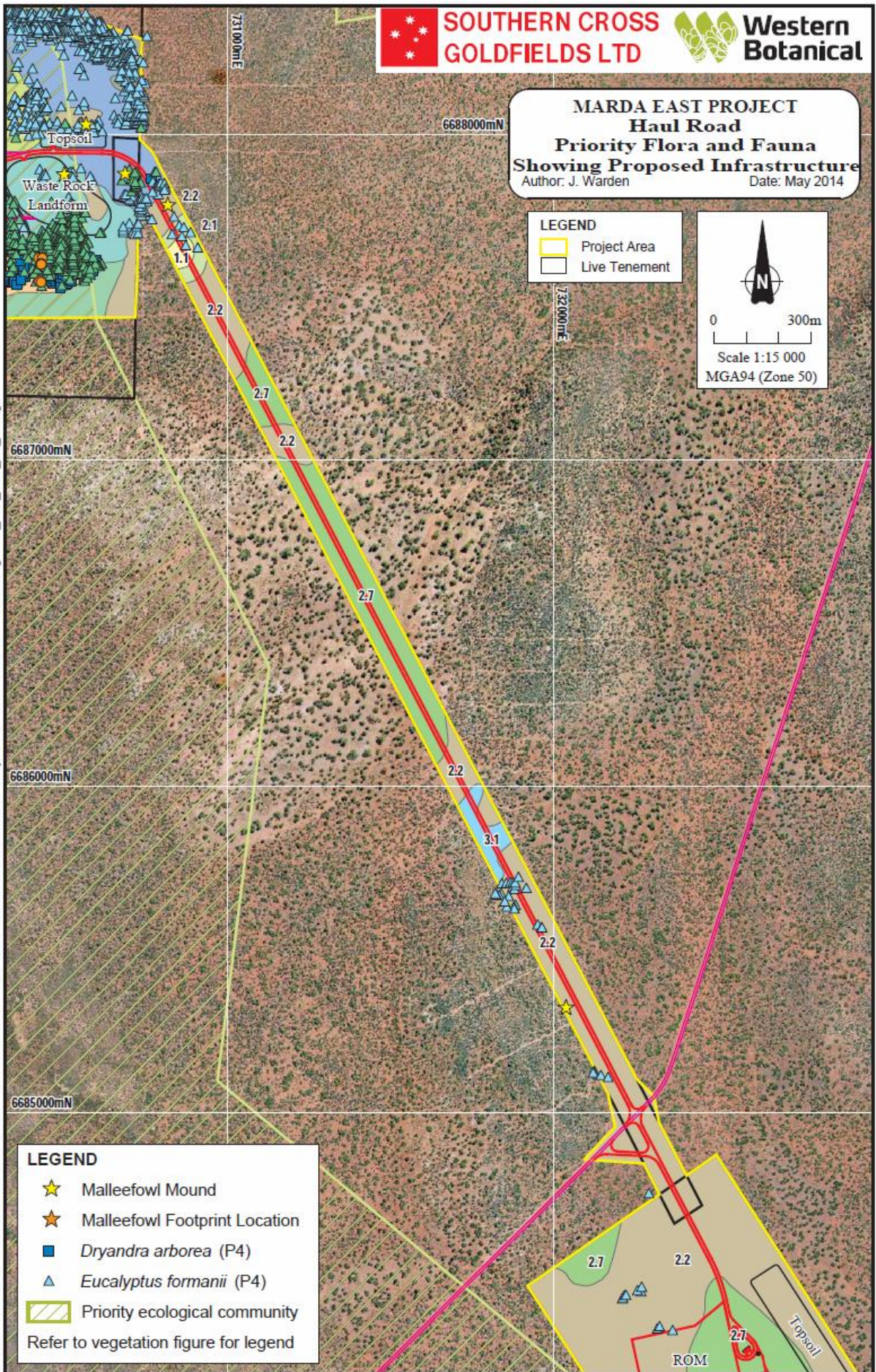


Figure 4.4 Priority Flora in the Marda East Haul Road

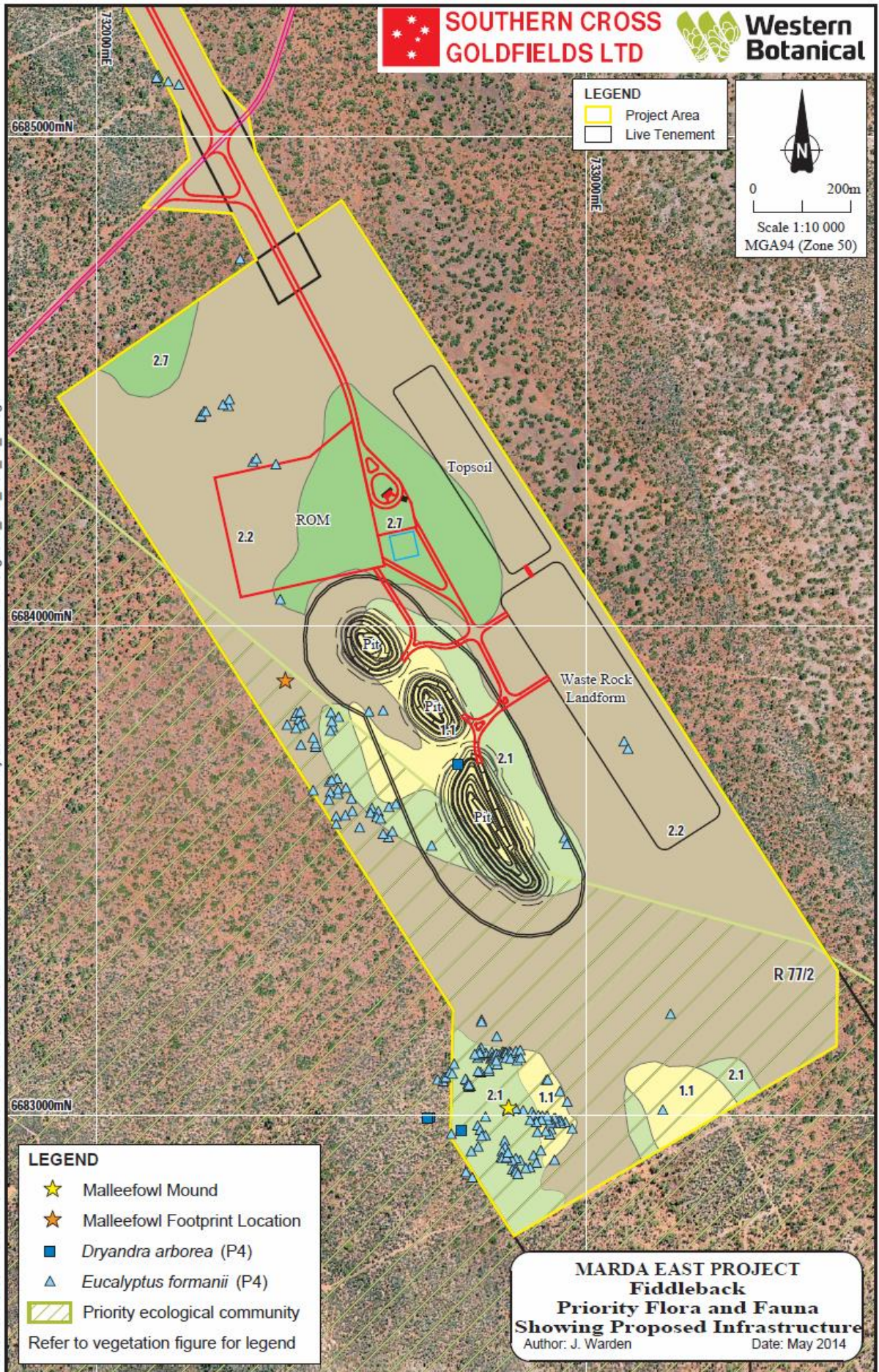


Figure 4.5 Priority Flora in Fiddleback



## Potential Impacts

The potential impacts of the Proposal on flora and vegetation within the Development Envelope include:

- Clearing of no more than 46 ha of native vegetation. This includes approximately 13 ha of plant communities within the P1 PEC, equivalent to 0.17% of the total Priority 1 PEC. Given the recorded vegetation associations are well represented regionally, the Proposal is not considered to significantly impact on vegetation associations;
- Clearing of some or all of a local population of the Priority 3 flora species *Grevillea georgeana* and *Mirbelia ferricola* and Priority 4 flora species *Dryandra arborea* and *Eucalyptus formanii* where these occur at Red Legs, and Priority 4 *Dryandra arborea* and *Eucalyptus formanii* where these occur at Fiddleback;
- The impacts to *Mirbelia ferricola* (P3) and *Grevillea georgeana* (P3) are considered locally significant with a significant percentage of their populations proposed to be taken. However, both species are known to be found on other BIF ranges in the region including the Die Hardy Range, Mt Manning Range, Jackson Range, Koolyanobbing Range, Helena and Aurora Range and Mt Finnerty. As such, in an overall regional sense, both species are well represented elsewhere including in areas of conservation reserves (Western Botanical 2014);
- Localised loss of vegetation condition due to dust generation, erosion and sedimentation on cleared areas;
- Potential for increased weed infestations within disturbed areas;
- Potential for localised loss of flora and vegetation if saline overspray occurs during watering of roads and cleared areas for dust suppression;
- Potential loss of flora and vegetation due to accidental bushfires, should these occur. It is noted that the Proposal is located in an area that is generally of low to moderate risk of ignition (DEC 2010); and
- Development of “drainage shadows” in vegetation downstream of roads and other Proposal infrastructure if surface drainage is affected.

## Proposed Management Measures

The management measures proposed to limit the impact on flora and vegetation include:

- The haul road, WRLs, topsoil stockpiles and other ancillary infrastructure have been realigned to minimise impacts to mature trees and flora species of significance where feasible in the project context (see Figure 4.3, Figure 4.4 and Figure 4.5);
- As outlined in Figure 4.1 and Figure 4.2, the Proposal disturbance footprint is aligned such that areas of the Dryandra Land System and the Yowie Land System that will be disturbed will not cause fragmentation of these land system units or the vegetation associations connected with the units;
- The collection of seed from the conservation-significant species, as well as common species within the disturbance areas, will be implemented prior to clearing for mine development in order to facilitate rehabilitation of locally impacted species;
- A Ground Disturbance Permit system will be implemented to assess and place conditions on all proposed vegetation clearing;

- Ground disturbance and clearing of vegetation will be limited to designated areas and access routes, avoiding creek lines and watercourses where possible;
- Clearing will be carried out progressively where possible in order to reduce the total area of exposed soil at any one time;
- Clearing will be restricted during strong winds to reduce dust generation;
- Standard vehicle hygiene measures will be implemented to ensure introduced (exotic) species populations do not increase within the Development Envelope;
- Topsoil (and where feasible, log debris and fallen timber) will be removed from all cleared areas and stockpiled for use in rehabilitation programs. No saline water will be used for dust suppression during topsoil recovery;
- Vehicle speed limits will be regulated to reduce dust generation on roads;
- SXG will liaise with DPaW to ensure that fire management is conducted in a manner consistent with the fire management plan for the Great Western Woodlands (DEC 2011a);
- To minimise the risk of impact from the use of saline water for dust suppression, SXG will:
  - Use fresh water from evaporation ponds, or brackish water from Marda Central, for dust suppression;
  - Implement water truck operating procedures and train water cart operators of the potential impact of saline water on vegetation;
  - Install spray bars that reduce overspray of water onto road side vegetation;
  - Construct road drainage so that water run-off will be contained during low to moderate rainfall events in retention sumps;
  - Will not use saline water for dust suppression during topsoil harvesting or rehandling as it will increase the salinity of topsoil;
- Mine site rehabilitation will be conducted progressively and monitored, with remedial works conducted as required; and
- An education program will be implemented for site workers in terms of environmental and community values.

## Conclusion

Given the regional representation of flora species of conservation significance and the small disturbance footprint, the potential impacts to flora and vegetation associated with the Proposal are not considered to be significant and that the potential impacts to flora and vegetation can be readily managed through implementation of the proposed environmental management measures.

Therefore, it is concluded that the Proposal meets the EPA objective for flora and vegetation, to maintain representation, diversity, viability and ecological function at the species, population and community level.

## 4.2.2 Landforms

### EPA Objective

To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.

### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for landforms and soils has been developed with consideration of the following:

- EPA Guidance Statement No 6: Rehabilitation of Terrestrial Ecosystems (EPA 2006a); and
- Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011).

### Existing Environment

The Development Envelope is located on the south eastern flanks of the Die Hardy Range, which is one of the many significant BIF ranges within the region. The BIF ranges of the Yilgarn Craton make up a small portion of the land in the region, which is predominantly flat. They are ancient isolated features, exhibiting different geology, soils, and biological aspects to those found in the surrounding land (Western Botanical 2014). The ranges are known for their unique compositions of flora and fauna and for supporting rare and endemic plant species (DEC 2007). Based on survey information to date, each range is distinctly different from the other sampled ranges from an ecological perspective (DEC 2007).

Findings by Gibson *et al* (2010) also confirm that high biodiversity and rapid species changeover are observed at ironstone ranges. BIF ranges are believed to have provided refugia during the Tertiary climate cycling that led to phases of localised extinction, thus becoming hotspots of species endemism with a number of taxa restricted to these ranges (Gibson *et al* 2007).

The EPA (in its Bulletin No. 1256) has highlighted the importance of intact BIF ranges in maintaining genetic diversity of endemic rare flora as well as in supporting survival in the event of adverse climates (EPA 2007d). Further, in its 2013 Annual Report, the EPA highlighted the continuing need for "providing robust information to support assessment of projects given the significant flora and vegetation and fauna values, and the challenge of assessing multiple projects on BIF ranges in the absence of an adequate and representative reserve system" (EPA 2013e).

The Marda East Development Envelope currently resides within the CALM Act Section 5(1)(h) proposed 'Conservation and Mining Reserve'. The Development Envelope borders the Mount Manning - Helena and Aurora Ranges Conservation Park at the south eastern corner of the Fiddleback prospect. An area encompassing a significant proportion of the adjacent Die Hardy Range has been nominated for inclusion in a proposed Class A Nature Reserve, where further mining is unlikely to be environmentally acceptable (EPA 2007d). This proposed reserve abuts the north western boundary of the Red Legs prospect. Additionally, the Mount Manning Range Nature Reserve and Mount Manning Range Conservation Park are located approximately 10 km and 17 km east of the Development Envelope respectively.

It is understood that the area does receive visitation from tourists, however the number of tourists visiting the local area is currently limited, due to the limited number of access roads and tracks to elevated viewing areas in the region. It is noted that this may change should the proposed Class A Nature Reserve be confirmed.

## **Geology**

The Red Legs deposit lies near the hinge of an asymmetric, west-verging, D2–D3 anticline on the eastern side of the Die Hardy Range (Figure 4.6) at the base of the major BIF-rich association that forms the middle part of the lower greenstone succession (Chen and Wyche 2001). The anticline has a shallow (10–25°) northerly plunge.

The Fiddleback gold deposit is hosted within a BIF geological unit enclosed by a sequence of ultramafic rocks. The BIF has a true thickness of approximately 30-40 m. Depth of weathering in the mineralised zone varies from 30 to 40 m below surface and in the weathered zone sulphides have been altered to iron oxides (Figure 4.7).

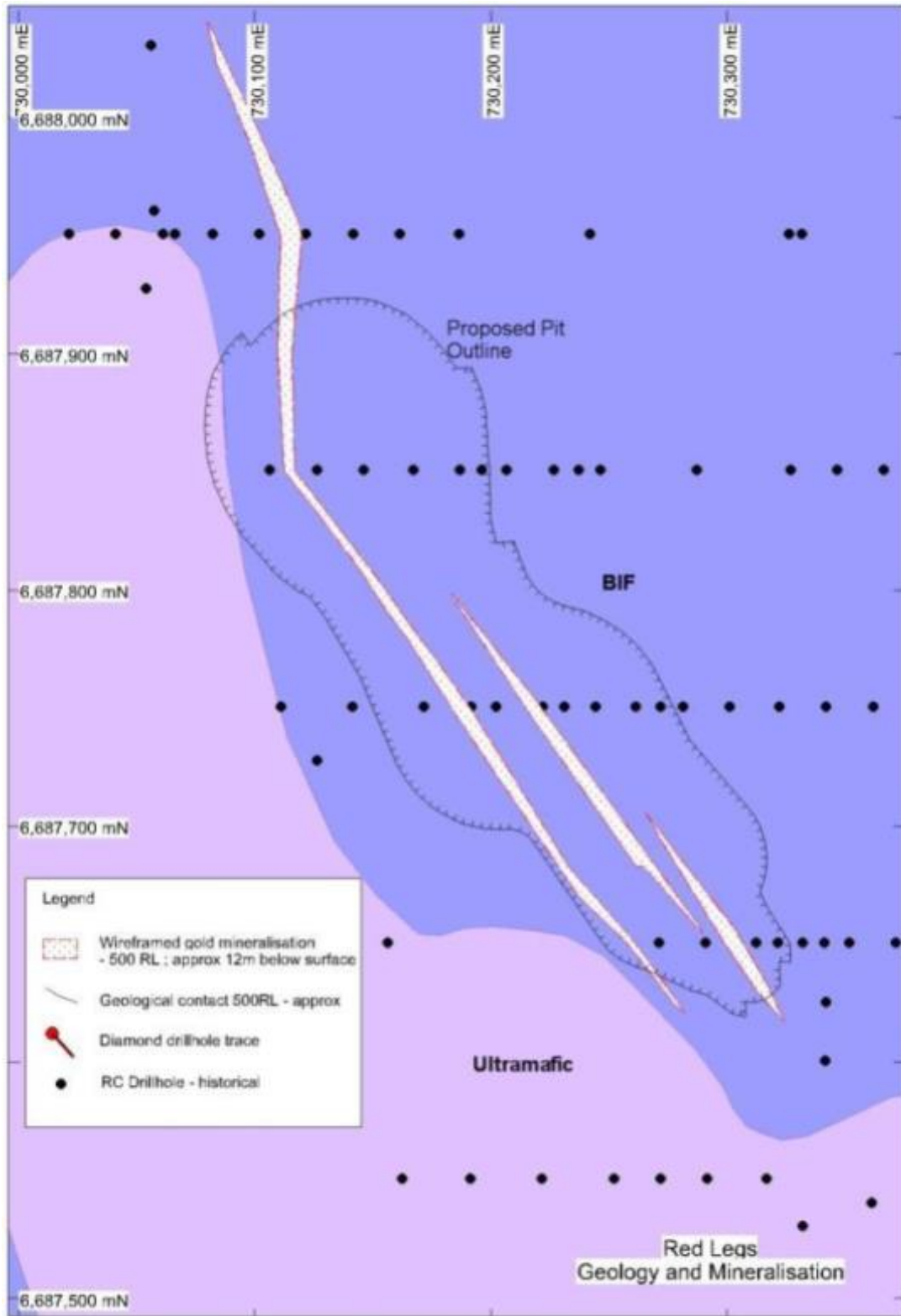


Figure 4.6 Red Legs Geology and Mineralisation

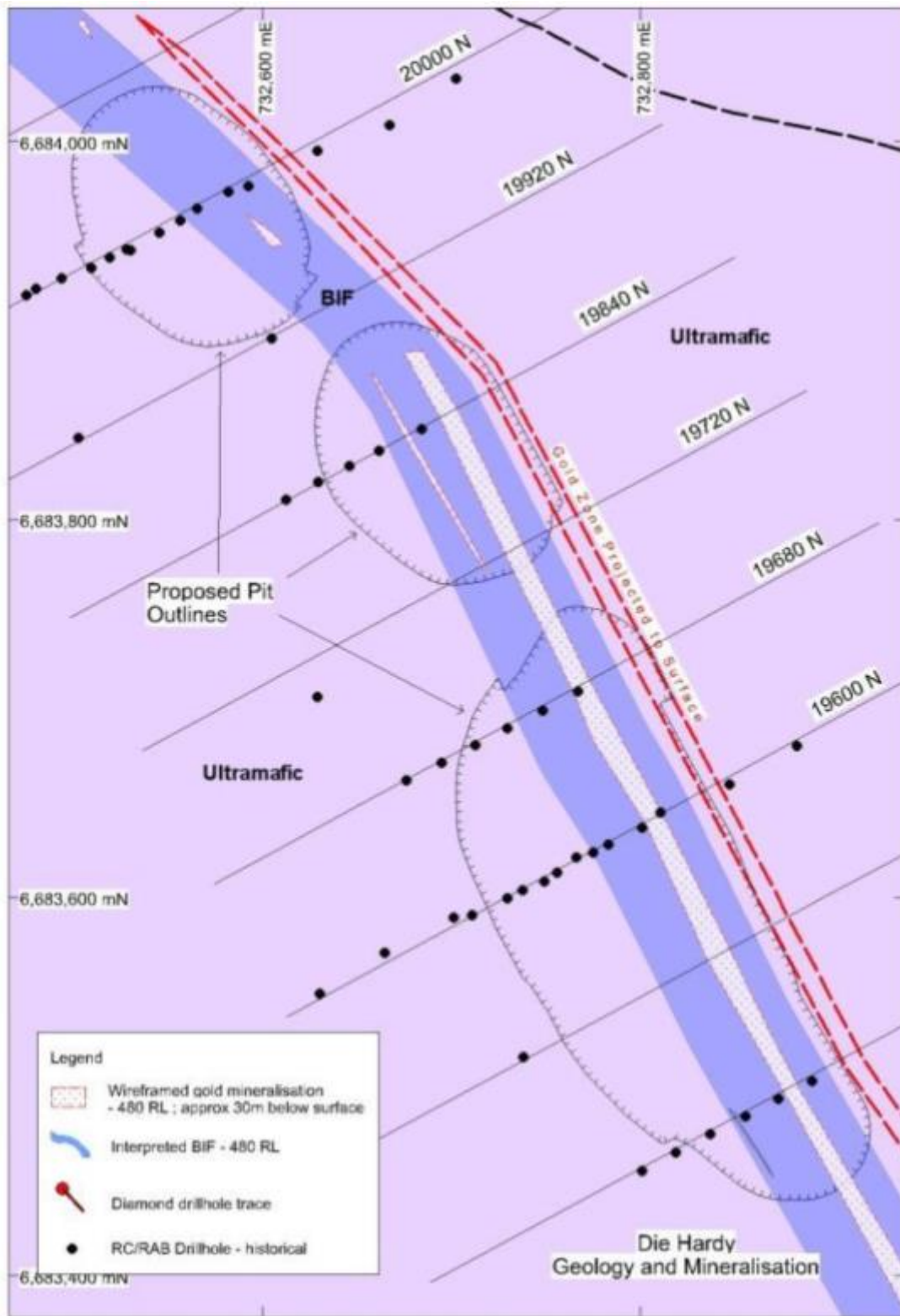


Figure 4.7 Fiddleback Geology and Mineralisation

## Soil

Soil surveys of the adjacent Marda Central project area conducted by Rapallo (2013a), Coffey Mining (2012) and Soilwater Consultants (2013) provide a regional perspective on the soil characteristics in Marda East. The most recent of these surveys identified three soil types or Soil Mapping Units (SMUs) in the Marda Central project area. These are:

- SMU 1 - skeletal soils over ironstone. The soil surface of SMU 1 features frequent ironstone outcrops and stony cover that protects the soil from excessive erosion. The soils are skeletal and have low to very low nutrient and organic carbon contents;
- SMU 2 - shallow gravelly duplex. Eluviation of fines from the surface soils has resulted in the surface of SMU 2 having a cover of coarse gravel which protects against raindrop impact and surface runoff, while illuviation of clay has resulted in a duplex soil which has an increased clay content at depth. The SMU 2 soils are highly leached and are generally non-saline and non-sodic. SMU 2 soils are potentially dispersive, but their high gravel content stabilises these soils against erosion and sediment loss; and
- SMU 3 - shallow loamy duplex. SMU 3 is associated with the flat low-lying plain areas and is the dominant soil type across the project area. SMU 3 soils typically consist of a reddish brown sandy loam overlying a dark reddish-brown sandy clay. They are generally considered to be devoid of nutrients and organic carbon, highly sodic, saline and dispersive or potentially dispersive.

Soil materials with a mobile fine silt and clay content will rapidly form dust when disturbed during vegetation clearing and earthmoving operations, or by vehicle movement.

The finer (clayey) soils of SMU 3 are highly sodic and dispersive, or will become dispersive and structurally unstable. These properties can adversely affect rehabilitation if not managed carefully (see Proposed Management Measures).

It is anticipated that soil types within the Marda East Development Envelope are similar to those at Marda Central, however this will be confirmed with a soil survey which will be conducted as part of further studies (see section 6.1). The rehabilitation strategy and MCP prepared for Marda Central will be amended to reflect the addition of Marda East, according to the results of the soil characterisation survey (see section 6.4).

### **Potential Impacts**

While the Red Legs area lies within the foothills of the BIF ranges, it does not extend into the Die Hardy Range, an adjacent (intact) BIF range (see Figure 4.13 to review the regional contours). Additionally (and importantly), no part of the proposed Marda East Proposal disturbance footprint infringes on either the proposed Class A Nature Reserve or the Mount Manning Range Conservation Park. SXG is absolutely committed to excluding these conservation areas from its disturbance footprint.

As outlined in previous sections, the values in the Marda East Development Envelope are well represented in the conservation areas regionally. Further, the habitat connectivity of the region is not likely to be impacted by the Marda East disturbance footprint (see Appendix G) given the condition and composition of surrounding vegetation assemblages, the dense nature of vegetation in parts of the survey areas, and the small disturbance footprint size relative to the extent of vegetation assemblages and connectivity at a local and regional scale. Therefore the Proposal is unlikely to have a detrimental effect on the habitat connectivity and function of the nearby conservation areas, even when considering that edge effects may occur due to dust deposition and habitat isolation resulting from vehicle activity, light and noise.

Finally, the hydrological study (see section 4.3.1) confirms that a natural watershed exists between the proposed Red Legs disturbance footprint and the proposed Class A Nature Reserve, and

therefore there are not expected to be any impacts as a result of hydrological flows from the disturbance footprint into conservation areas.

In the visual impact assessment undertaken for Marda East in 2014 (Appendix E), three landscape character units (LCU) were identified. These include:

- the Die Hardy Range;
- footslopes of the ranges; and
- gentle undulating plain.

The Proposal will have an impact on two of these LCUs, particularly the footslopes of the ranges and the surrounding plains. The main change to landforms of the Development Envelope will be the development of two pit voids and two WRLs. The proposed Red Legs pit is located at the foothills of the BIF ranges and while not likely to impact on the connectivity of the Die Hardy Range, will have residual impacts on the overall regional integrity, given the current undisturbed nature of the ranges.

These changes will be localised and will not affect the key landscape values of the region such as the Helena and Aurora Ranges. However, these changes are also considered to have impacts on other environmental factors such as hydrology and amenity (sections 4.3.1 and 4.5.1), and will particularly impact the visual amenity of the Die Hardy range adjacent to the Proposal.

### **Proposed Management Measures**

Impacts on the landscape of the Development Envelope will be minimised through careful design of the WRLs to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms. The WRLs will have:

- 18° batter slope angles;
- 5 m berm widths;
- 10 m bench heights;
- 17° overall slope angles; and
- 20 m maximum height.

This WRL design has been adopted from the existing Marda Central MCP, for consistency. However, as part of the forward works plan (see section 6.1) SXG will carry out detailed soil and waste rock characterisation, and update the MCP prepared for Marda Central (to reflect the addition of Marda East) according to the information obtained in relation to soil and waste rock composition, and appropriate rehabilitation techniques.

The soil management measures outlined below were developed for the Marda Central Project by Soilwater Consultants (2013) to ensure that:

- soil with optimal properties are maintained during the mining and rehabilitation process;
- soil materials that exhibit adverse physical and chemical properties are handled in such a way that no contamination of soil with optimal properties occurs; and
- environmental impacts are minimised through appropriate handling and placement of soil materials that exhibit adverse properties.



As the soil types at Marda East are expected to be similar to those encountered at Marda Central, the following management measures are proposed at this stage, and will be revisited upon completion of the site specific soil survey at Marda East (see section 6.1).

- Pending confirmation of the soil survey, the gravelly topsoils will be used in rehabilitation due to their optimal properties (i.e. are friable and structurally stable);
- All soils above the Tertiary conglomerate/calcrete (30-70 cm thick) will be cleared and stockpiled for use as a growth medium;
- Stockpiles of growth media will be limited to a height of 2 m to maintain the biological component of the soil and retain any nutrients. Where possible, these materials will be used in progressive rehabilitation and will be stockpiled for no more than 12 months. If growth media are to be stockpiled for more than 12 months, the stockpiles will be seeded with provenance- sourced seeds to promote biological activity;
- SXG will conduct field trials to determine the appropriate level of gravel to blend with the soils to achieve its stated rehabilitation outcomes;
- Waste materials likely to exhibit chemical properties that could adversely affect revegetation establishment and growth will be encapsulated within the centre of the WRL or backfilled to the pit, to ensure that plant roots do not encounter saline material; and
- Care will be taken when handling soil materials to prevent dust generation. Saline water will not be used for dust suppression in those areas where topsoil is being cleared and stockpiled for use in rehabilitation.

## Conclusion

These measures will be reviewed following the conclusion of the site specific survey and amended if required. The MCP for the Marda Central Project will also be amended to reflect the inclusion of the Proposal.

SXG considers that implementation of the management techniques outlined above will meet the EPA objectives of integrity and ecological functions, however it is likely that the Proposal will result in residual impacts on landforms in relation to environmental values following closure. This is likely to be due to the existence of completed pits that will remain following closure in an area that has previously been relatively undisturbed.

### 4.2.3 Subterranean Fauna

#### EPA Objective

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

#### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for subterranean fauna has been developed with consideration of the following:

- EPA Guidance Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA 2007a); and
- Draft EPA Guidance Statement No. 54a: Sampling Methods and Survey Considerations for Subterranean Fauna (EPA 2007b).

## Existing Environment

A literature review of subterranean fauna records in the vicinity of Marda Central was conducted by Bennelongia (2013) to assess the likelihood of subterranean fauna occurring within the project area. This study was based on available data within a 50 by 50 km search area surrounding the Marda Central Project and is considered to cover the Marda East Development Envelope as well. The stygofauna surveys have yielded few, if any, stygofauna and it is concluded that it is unlikely that a significant stygofauna community is present in the local area (Bennelongia 2013, Appendix F).

Information about troglifauna in the Marda region reviewed by Bennelongia (2013) suggests it is likely that a troglifauna community of low or moderate species richness exists in the local area. It is also likely that some of the species present will have localised distributions, as a number of species recorded within the search area are restricted to single rocky ranges.

Findings from a subterranean study conducted at the neighbouring Cliffs Deception Mine also indicate that no stygofauna or troglifauna were found in its vicinity (Biota Environmental Sciences 2011, EPA 2012b). However, 40 troglifaunal animals were collected in a sampling done at the Cliffs Mt Jackson Mine, comprising 14 species, all of which were known to occur regionally (Bennelongia 2008).

## Potential Impacts

Based on the study done by Bennelongia (2013) in the Marda region, it is considered unlikely that the Development Envelope supports any significant stygofauna. The main source of impact on stygofauna is likely to be groundwater drawdown due to pit dewatering. However, given the depauperate stygofauna community and the expectations that mining will occur above the groundwater table, no significant impact on stygofauna is expected to occur. The hydrogeological assessment will also confirm whether any groundwater (and as such, stygofauna habitat) impacts are likely to occur as a result of mine dewatering (see section 6.1).

There is potential for impact on any troglifauna species within the disturbance footprint due to mine pit excavation. However, given the disturbance area does not intersect the nearby BIF ranges, and the low species richness expected in the region (Bennelongia 2013), there are not expected to be any significant impacts to troglifauna as a result of the Proposal.

## Proposed Management Measures

No specific management measures are anticipated at this stage. Should the further studies (including the hydrogeological investigation outlined in section 6.1) indicate this is not the case, appropriate management measures will be agreed in consultation with the EPA and DPaW.

## Conclusion

No significant impacts on subterranean fauna are predicted and it is considered that the Proposal meets the EPA objective for subterranean fauna.

## 4.2.4 Terrestrial Environmental Quality

### EPA Objective

To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.

### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for terrestrial environmental quality has been developed with consideration of the following:

- Leading Practice Sustainable Development Program for the Mining Industry: Managing Acid and Metalliferous Drainage (DITR 2007);
- Acid Rock Drainage Guide (International Network for Acid Prevention 2009);
- Australian Water Guidelines for Fresh and Marine Waters (ANZECC and ARMCANZ 2000);
- Water Quality Protection Guidelines No 3: Liners for Waste Containment (WRC 2000a);
- Water Quality Protection Guidelines No 6: Minesite Stormwater (WRC 2000b);
- Water Quality Protection Guidelines No 7: Mechanical Servicing and Workshop Facilities (WRC 2000c);
- Water Quality Protection Guidelines No 9: Acid Mine Drainage (WRC 2000d);
- Water Quality Protection Guidelines No 10: Above-ground Fuel and Chemical Storage (WRC 2000e);
- Australian Standard 1940-2004 (The Storage and Handling of Flammable and Combustible Liquids);
- Australian Standard 1596-2008 (The Storage and Handling of Liquid Petroleum Gas); and
- Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DEC 2004).

### Existing Environment

The Marda East deposits are hosted within a highly deformed segment of the Marda BIF geological formation not connected with the general iconic BIF ranges. Generally, the weathering extends below the depth of mine. For this reason there is unlikely to be PAF material present, and in fact the majority of the material is expected to have acid neutralising capacity (Rapallo 2013b). This position will be confirmed with materials characterisation during further investigations (see section 6.1).

The Proposal is located in an area where there has been limited historical small scale mining of high grade quartz veins. There has been no modern mining and no old tailings impoundments or stamp batteries are evident in the Development Envelope. Therefore, it appears based on available information that existing site contamination is unlikely.

## Potential Impacts

Terrestrial environmental quality could be affected primarily through the disposal of wastes (including waste rock from mining operations, putrescible and inert waste, hydrocarbon and reagent leaks or spills, and sewage), and the alteration of landforms and soils during and after mining.

There is also the potential for ecological and social impacts due to the location of disturbance footprint in close proximity to the BIF ranges. However, as outlined in section 4.2.1, disturbance is aligned such that areas of the Dryandra Land System and the Yowie Land System that will be disturbed will not cause fragmentation of these land system units or the related vegetation associations.

## Proposed Management Measures

### Waste Rock

Marda East waste rock material is assumed to be similar to that of Marda Central which is not expected to produce acid despite having very low reactive carbonate levels as there is insufficient sulphur and no sulphide present to produce acid (Rapallo 2013a). Further, analyses by Rapallo (2013b) indicate that, over the medium to long term, there is likely to be significant leaching of alkali and alkaline minerals which will provide long term additional Acid Neutralising Capacity (ANC). While this does not directly apply to the Proposal, it provides good regional context and the similarity of the geological environment indicates these characteristics are likely to be observed at Marda East. Material characterisation work carried out as part of further studies proposed will confirm if this characterisation is also present at Marda East.

Waste rock will be disposed to WRLs which will be rehabilitated on a progressive basis. WRLs have been designed to fit with the natural terrain such that visual impact is minimised. Waste rock landform design will be reviewed and finalised once material characterisation studies have been completed (see section 6.1), to confirm the assumption that no PAF material will be encountered and to maximise the use of soil characteristics within the Development Envelope.

### Putrescible and Inert Waste

As outlined in section 4.1, SXG is committed to reuse and recycling of materials to minimise waste produced. Any remaining waste not recycled will be disposed of in the Marda Central landfill, in accordance with existing site waste management practices.

The Marda Central landfill facility will be regulated through a DER Works Approval and Licence, and is outside the scope of this Referral.

### Hydrocarbon and Reagents

Reagents will be stored and used in accordance with relevant Material Safety Data Sheets and Australian Standard 1940-2004 (The Storage and Handling of Flammable and Combustible Liquids).

Hydrocarbons will be stored in self-bunded tanks located within a fuel storage facility which will meet the requirements of Australian Standard 1940-2004. Spilled hydrocarbons will be removed by absorbent material and/or excavation of contaminated soil and treated at the Marda

Central Bioremediation Pad. The Bioremediation Pad will be constructed in accordance with DEC standards (2004).

An incident reporting system will be implemented for reporting and managing the clean-up of leaks and spills.

### Ecological Function of the BIF Ranges

The Proposal lies adjacent to the Die Hardy Range, which is one of many BIF ranges in the region. These BIF ranges have been recognised for the unique compositions of flora and fauna and for supporting rare and endemic plant species (DEC 2007). The EPA (in its Bulletin No. 1256) has highlighted the importance of intact BIF ranges in maintaining genetic diversity of endemic rare flora as well as in supporting survival in the event of adverse climates (EPA 2007d).

Management measures proposed to minimise the impacts of the Proposal on the ecological function of the adjacent BIF ranges are outlined in sections 4.2.1, 4.2.5 and 4.6.2.

### Social Value of the BIF Ranges

A number of stakeholders have expressed concerns in relation to the value of BIF ridges/ranges as hosts of significant biodiversity and the need to address the impacts of the Proposal on the integrity of the landform and landscape components (see section 3.5).

In the preliminary visual impact assessment, the Die Hardy Range was identified as holding key visual landscape values, mainly due to its high degree of perceived naturalness, degree of topographic variety and perceived vegetation characteristics. With the Development Envelope being located in the vicinity of the Die Hardy Range, its natural landscape is considered highly valued by the community.

SXG considers that the impact rating on landscape views from along public roads is expected to be negligible at best and 'blending' at worst, and while there are predicted impacts on views from elevated positions within the footslopes and some areas of the range, these viewing locations have limited public accessibility at present. However, despite the limited viewing locations, aspects of the Proposal will remain highly visible from elevated locations, including from inside the proposed Class A Nature Reserve

Management measures proposed to protect the social function of the BIF ranges are outlined in sections 4.5.1 and 4.6.2.

### **Conclusion**

SXG considers that all of the potential impacts on terrestrial environmental quality can be readily managed through implementation of the proposed environmental management measures and regulation through the DMP Mining Proposal and MCP, and the DER Works Approval and Licensing system. Therefore, it is concluded that the Proposal meets the EPA objective for terrestrial environmental quality.

## 4.2.5 Terrestrial Fauna

### EPA Objective

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

### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for terrestrial fauna has been developed with consideration of the following:

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

### Existing Environment

#### Regional Context

A number of vertebrate fauna studies have been conducted in the Marda Central project area between 2010 and 2013. As a result, it is understood that the vertebrate fauna habitats and assemblages of the local area (including Marda East) are typical of those in the wider region. Conservation significant vertebrate fauna of concern in Marda Central includes malleefowl and Major Mitchell's cockatoo, both of which were not sighted during field surveys at the project area and no evidence of areas being currently used as nesting sites was found. SREs were recorded in the project area including two taxa of mygalomorph spiders, one pseudoscorpion species and one land snail species.

#### Proposal Survey Area

As outlined in previous sections, an area north west of the Red Legs prospect encompassing a significant proportion of the Die Hardy Range, has been nominated as a proposed Class A Nature Reserve. There is an evident continuity of vegetation communities (and as such, habitat) from the proposed Class A Nature Reserve into the Red Legs Development Envelope as shown in the Vegetation Associations and Land Systems maps (Figure 4.1 and Figure 4.2).

In 2014, a Level 1 fauna assessment was completed by APM consisting of a desktop survey and a field survey (Appendix G). The desktop survey involved searching through the Protected Matters and NatureMap databases, which resulted in 14 species of conservation significance found that could potentially occur in the survey area. These species, comprising 10 birds, two mammals and two reptiles, were assessed using a likelihood of occurrence analysis (Table 4.6).

**Table 4.6 Fauna Species of Conservation Significance within the Survey Area Based on Desktop Survey**

Name	Conservation Status	Likelihood of Occurrence
Malleefowl <i>Leipoa ocellata</i>	EPBC Act - Vulnerable	Occurs Active mounds recorded in the survey area.
Cattle Egret <i>Ardea ibis</i>	EPBC Act - Migratory Wetland Species	Unlikely to occur Suitable habitat is unavailable.
Great Egret <i>Ardea alba</i>	EPBC Act - Migratory Wetland Species	Unlikely to occur Suitable habitat is unavailable.
Peregrine Falcon <i>Falco peregrinus</i> (inc. subsp. <i>macropus</i> )	Wildlife Conservation Act – Schedule 4 Division 2	Potential to occur This species may nest in the BIF ranges and forage over the survey area. However it would not be dependent on habitats within the survey area.
Australian Bustard <i>Ardeotis australis</i>	DPaW Priority 4	Likely to occur Species has been recorded in the local area (DPaW 2014).
Major Mitchell’s Cockatoo <i>Cacatua leadbeateri</i>	Wildlife Conservation Act – Schedule 4 Division 2	Likely to occur Species has been recorded in the local area (DPaW 2014).
Fork-tailed Swift <i>Apus pacificus</i>	EPBC Act - Migratory Marine Species	Potential to occur Could possibly utilise the local area while hawking for insects.
Rainbow Bee-eater <i>Merops ornatus</i>	EPBC Act - Migratory Marine Species	Likely to occur Species has been recorded in the local area (DPaW 2014).
Hooded (Dotterel) Plover <i>Thinornis (Charadrius) rubricollis</i>	DPaW Priority 4	Unlikely to occur Suitable habitat is unavailable.
Shy Heathwren <i>Hylacloa cauta</i> subsp. <i>whitlocki</i>	DPaW Priority 4	Likely to Occur Abundant suitable habitat in the survey area. However habitat is not limited to the survey area and is broadly available locally.
Numbat <i>Myrmecobius fasciatus</i>	EPBC Act - Vulnerable	Potential to Occur There is potential for this species to occur based on the availability of habitat. However, the likelihood of occurrence is low due to the rarity of the species.
Greater Long-eared Bat <i>Nyctophilus major</i>	DPaW Priority 4	Likely to Occur Abundant suitable habitat in the survey area. However habitat is not limited to the survey area and is broadly available locally.
Shield-backed Trapdoor Spider <i>Idiosoma nigrum</i>	EPBC Act – Vulnerable Wildlife Conservation Act – Schedule 1 Division 7	Unlikely to occur Though habitat is present the Naturemap search does not indicate the species has been recorded near the survey area.
Tree-stem Trapdoor Spider <i>Aganippe castellium</i>	DPaW Priority 4	Likely to Occur Abundant suitable habitat in the survey area. However habitat is not limited to the survey area and is broadly available locally.

The field survey identified six habitat types within the Development Envelope, as described below in terms of their representative faunal habitat attributes (Figure 4.8 (a-f)). A map showing areas of the different habitat types within the Development Envelope is also provided as Figure 4.9.

- Tall *eucalypt* woodland over halophytic understorey on alluvial plain;
  - range of vegetation strata suitable to a variety of passerine and non-passerine birds;
  - relatively dense shrubs providing cover for cryptic small geckonids;
  - termitaria in standing and fallen dead timber;
  - ground not especially suited to burrowing species;
  - halophytes may attract a small subset of the fauna assemblage that may not occur elsewhere in the survey area;
- Low *eucalypt* woodland over acacia shrubland on alluvial plain;
  - range of vegetation strata suitable to a variety of passerine and non-passerine birds;
  - relatively dense shrubs providing cover for cryptic small geckonids;
  - gravelly clay loam ideal for burrowing;
- Low *eucalypt* woodland over acacia shrubland on rocky rises;
  - fewer and smaller hollow bearing Eucalypts with a limited diameter hollows suitable for bats, some reptiles and smaller hollow nesting birds;
  - relatively dense shrubs providing cover for cryptic small geckonids;
  - patches of gravelly loam suitable for burrowing;
- Low *eucalypt* woodland over spinifex on alluvial plain;
  - substrate very well suited to a variety of burrowing invertebrates, small mammals and reptiles;
  - unique habitat due to the presence of spinifex which, alone, can support a unique fauna assemblage;
- Dense shrubland on rocky rises;
  - dendritic drainage creates incisions in the landscape that provides some crevice habitat used as refuge by small reptiles;
  - small rocky breakaways also provide rocks of suitable size for refuge for dragons and geckonids;
  - dense shrubs provide abundant habitat for small passerine birds;
  - shrubs also drop significant detritus around the base providing habitat resources for trapdoor spiders;
  - detritus combined with soil provides foraging and nesting habitat resources for malleefowl;
- Dense shrubland on alluvial plain;
  - dense shrubs provide abundant habitat for small passerine birds;
  - shrubs also drop significant detritus around the base providing habitat resources for trapdoor spiders;
  - detritus combined with soil provides foraging and nesting habitat resources for malleefowl; and
  - gravelly clay loam ideal for burrowing.



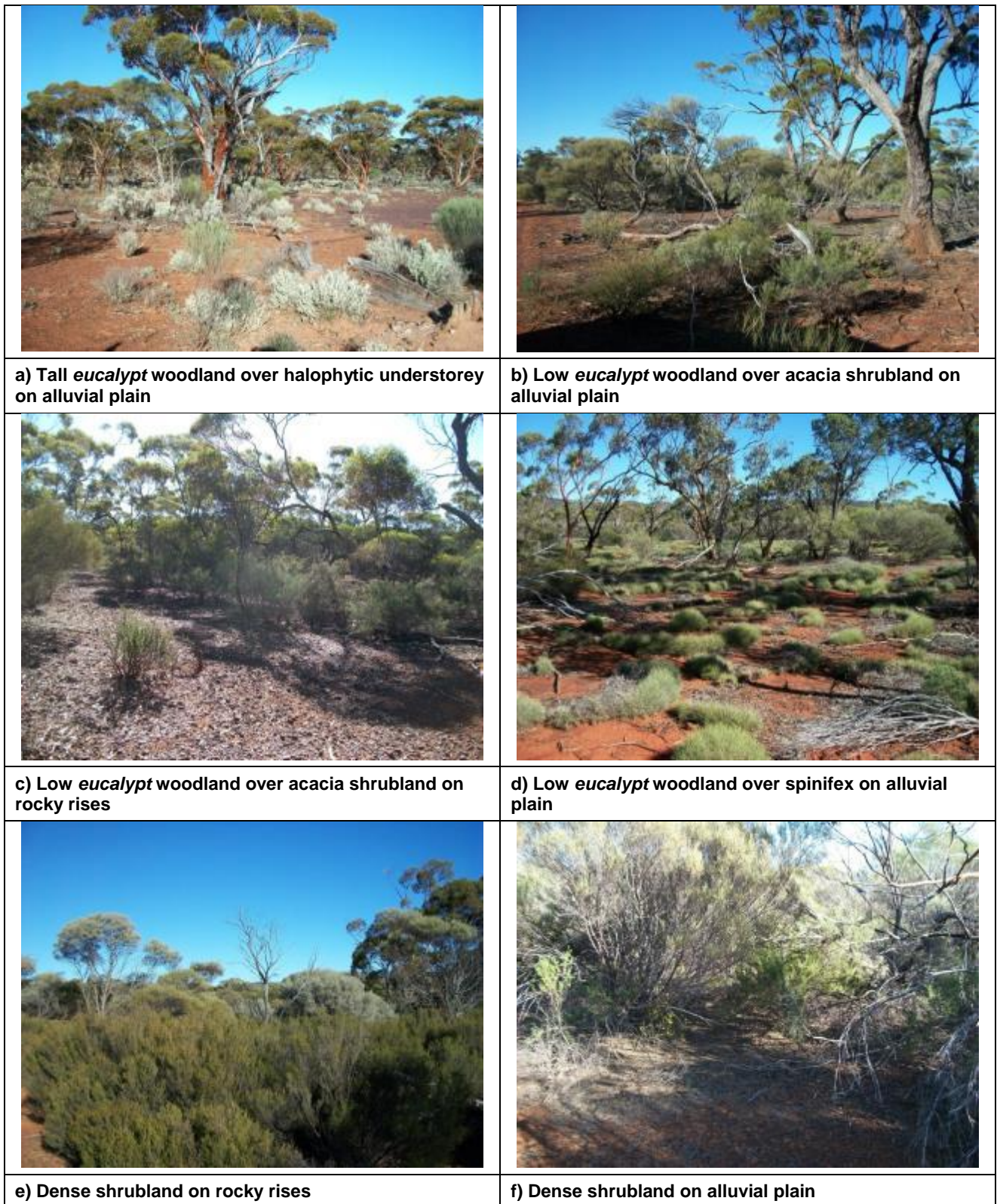


Figure 4.8 Six Habitat Types Identified within the Development Envelope

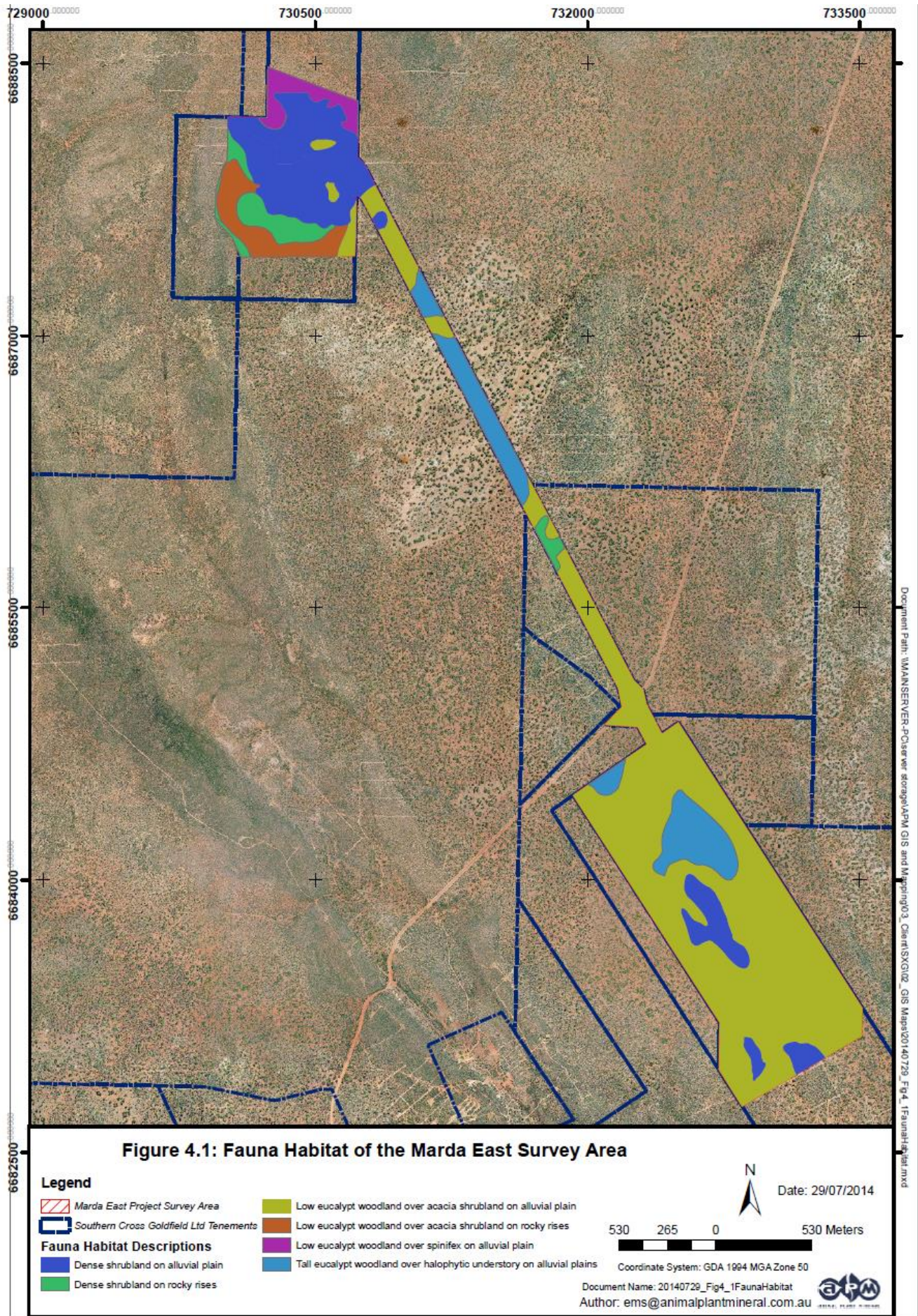


Figure 4.9 Faunal Habitat within the Development Envelope

Of the 14 conservation-significant fauna species found in the desktop survey, only 10 species have the potential to be present in the survey area, two of which are discussed below. The other eight remaining species are considered to be not specifically dependent upon the survey area (APM 2014).

- **Malleefowl** which is listed as Vulnerable under the EPBC Act and Rare under the Wildlife Conservation Act. During the flora and vegetation survey 11 Malleefowl mounds were encountered – eight within the Red Legs prospect, two within the Haul Road alignment and one at the Fiddleback prospect. Only two of the 11 mounds were classified as active during the 2014 fauna survey, both located in the Red Legs Development Envelope (Figure 4.10); and
- **Tree-stem Trapdoor Spider** which is listed as Vulnerable under the EPBC Act and Rare under the Wildlife Conservation Act. An intensive presence/absence search for this species (as well as the Sheild-backed Trapdoor Spider) at 15 sites over different suitable habitat types did not locate either spider or evidence of trapdoor burrows. Recent work has revealed that broadly disjunct populations of Tree-stem Trapdoor Spiders are not genetically distinct and therefore cannot be defined as SREs. Moreover, the survey area represents common landforms that are broadly distributed in the region with a high degree of connectivity.

There were many signs of the presence of rabbits throughout the survey area and it is suspected that the predated malleefowl found near an active mound site had been killed by a fox. Both of these species are listed as potentially occurring within the area by the Protected Matters search (APM 2014).

### Potential Impacts

Malleefowl Mound 1 is located within the pit abandonment bund area. While it will not be disturbed, it is likely to be unused in the duration of the Proposal due to light and noise impacts.

Vegetation clearing will result in the localised loss of fauna habitat. Larger mammals and reptiles as well as birds are expected to move to adjacent areas once land clearing commences, but clearing of native vegetation is likely to result in the loss of small animals that are unable to move away during the clearing process. APM (2014) concludes that it is highly unlikely that the Proposal would cause widespread disturbance to any fauna habitat that is unique or poorly represented, as all of the fauna habitats documented as present in the Development Envelope are broadly represented in the surrounding tenements and land beyond and the proposed disturbance footprint will be no greater than 46 ha.

There is also potential for impact on fauna assemblages in the Development Envelope as a result of noise, vibration, dust, vehicle movements, accidental bushfires, and an increase of feral animals and weeds as a result of anthropogenic activities.

### Proposed Management Measures

The measures proposed for the management of flora and vegetation will be of assistance in minimising the predicted impacts on vertebrate and invertebrate fauna. In addition, SXG will:

- clear vegetation from cleared to uncleared areas where practicable to provide escape routes for terrestrial fauna;

- regulate vehicle speed limits to reduce dust generation on roads and the potential for collisions with fauna;
- fence ponds to exclude fauna and have fauna egress matting installed;
- implement fire control and mitigation measures;
- implement a feral animal control program;
- implement an education program for site workers in terms of environmental and community values;
- adopt the management measures developed in the Marda Central Malleefowl Management Plan;
- ensure that any chicks have dug out of Mound 1 (currently active) prior to commencement of activities; and
- maintain a 250 m boundary around Mound 11 as provided at Figure 4.10.

In addition to the proposed management measures identified above, the Level 1 survey carried out in 2014 recommended that SXG carry out a targeted trapping program to determine the presence of any numbat (*Myrmecobius fasciatus*) populations, as well as a tree hollow search to confirm and map the habitat of the Major Mitchell's cockatoo (*Cacatua leadbeateri*). SXG is committed to achieving these outcomes (see section 6.1).

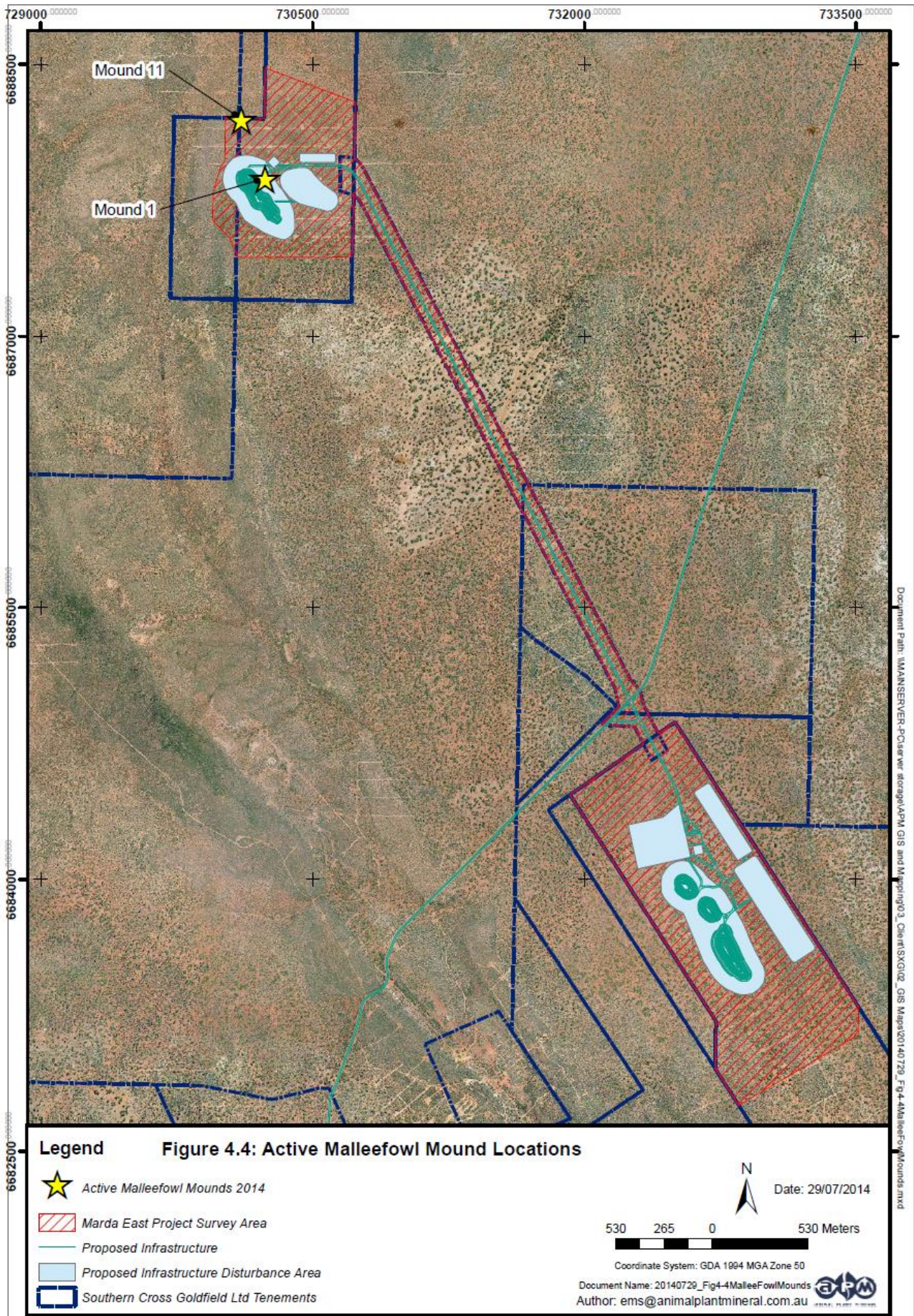


Figure 4.10 Active Malleefowl Mound Locations

## Conclusion

SXG considers that all of the potential impacts on vertebrate fauna and SREs can be readily managed through implementation of the proposed environmental management measures. Therefore, it is concluded that the Proposal meets the EPA objective for terrestrial fauna.

## 4.3 Water

### 4.3.1 Hydrological Processes

#### EPA Objective

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

#### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for hydrological processes has been developed with consideration of the following:

- Leading Practice Sustainable Development Program for the Mining Industry: Managing Acid and Metalliferous Drainage (DITR 2007);
- Acid Rock Drainage Guide (International Network for Acid Prevention 2009);
- Australian Water Guidelines for Fresh and Marine Waters (ANZECC and ARMCANZ 2000);
- Water Quality Protection Guidelines No 3: Liners for Waste Containment (WRC 2000a);
- Water Quality Protection Guidelines No 6: Minesite Stormwater (WRC 2000b);
- Water Quality Protection Guidelines No 7: Mechanical Servicing and Workshop Facilities (WRC 2000c);
- Water Quality Protection Guidelines No 9: Acid Mine Drainage (WRC 2000d);
- Water Quality Protection Guidelines No 10: Above-ground Fuel and Chemical Storage (WRC 2000e);
- Water Quality Protection Note 68: Mechanical Equipment Washdown (DoW 2013);
- Australian Standard 1940-2004 (The Storage and Handling of Flammable and Combustible Liquids);
- Australian Standard 1596-2008. The Storage and Handling of Liquid Petroleum Gas;
- Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DEC 2004);
- Operational policy no. 1.02 – Policy on water conservation/efficiency plans (DoW 2009); and
- Operational policy no. 5.08 – Use of operating strategies in the water licensing process (DoW 2011).

The Development Envelope is located within the Goldfields Groundwater Management Area proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act). Consequently, pit dewatering (should nominal amounts of groundwater be encountered towards the end of mining) requires DoW licencing under Sections 26D and 5C of the Act.

SXG will apply for licences to construct bores for hydraulic testing and water quality sampling if required, as part of the detailed hydrogeological investigating during the further studies (see

section 6.1). SXG will also apply for licences under Section 5C of the RIWI Act if required during further approvals.

## **Existing Environment**

### Surface Water

There are no significant water bodies, drainage lines, creeks or rivers within the Proposal area or the immediate region. Similar to the findings of the surface water assessment at Marda Central, the Marda East Development Envelope is considered to have shallow and ephemeral streams and experiences low rainfall coupled with high evaporation rates. The Development Envelope is within the internal drainage division of Western Australia, where surface drainage is directed to the many salt lakes and claypans that occur in the inland of the state. The drainage from the Development Envelope is within the Salt Lake River Basin and its runoff flows in the north-east direction into Lake Giles, an ephemeral salt lake located approximately 40 km north of the Proposal area (Palaris 2014, Appendix H).

The desktop drainage investigation made use of a digital elevation model (DEM) to derive flow networks and automatically generate watershed boundaries for given outlet points using GIS technology. The study confirms that a natural watershed is present between the proposed Marda East mine outline and the proposed Class A Nature Reserve adjacent to the mine (Figure 4.11).

### Groundwater

Groundwater across the region occurs in basins of weathering and local fracture systems. These vary in both vertical and lateral extent and are controlled by geological structures, which suggest compartmentalisation of groundwater resources where there is little, if any, hydraulic connection between the different compartments. Consequently, groundwater is likely to move or drain very slowly and may be considered stagnant.

Groundwater levels across the region imitate the regional and local topography. Levels at the nearby Marda Central were found to be greater than 60 m below ground surface (Figure 4.12) and its groundwater quality ranges from relatively fresh to saline with a circumneutral pH of between 7.02 and 8.41 (Pendragon Environmental Solutions 2013, Appendix I).

It is expected, given the local topography and local data available from Marda Central, that groundwater in the Marda East area will be below the depths of pits (50 m below ground level). This will be confirmed during hydrogeological investigations as part of the forward works plan (see section 6.1).

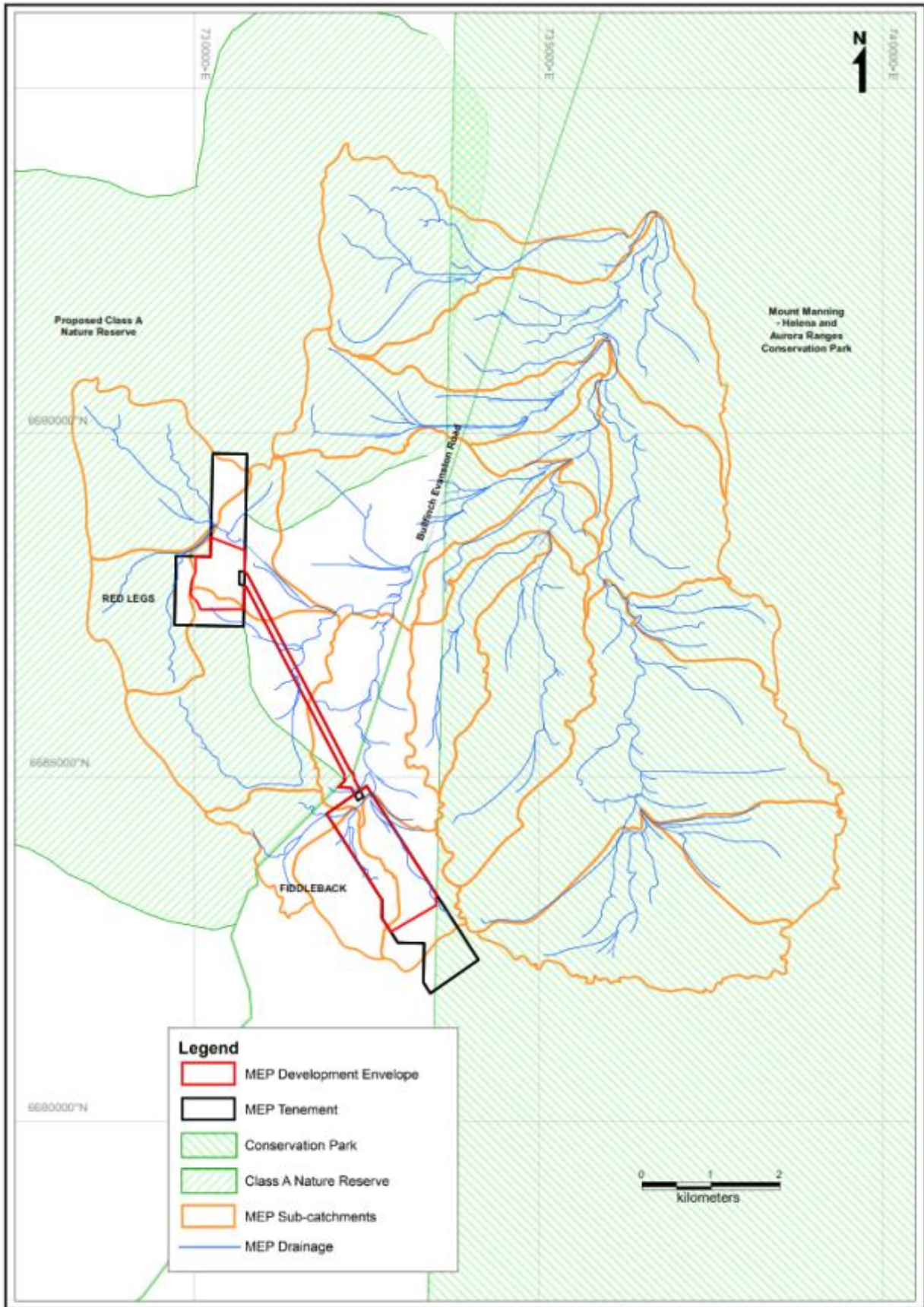


Figure 4.11 Subcatchments in the Vicinity of the Development Envelope



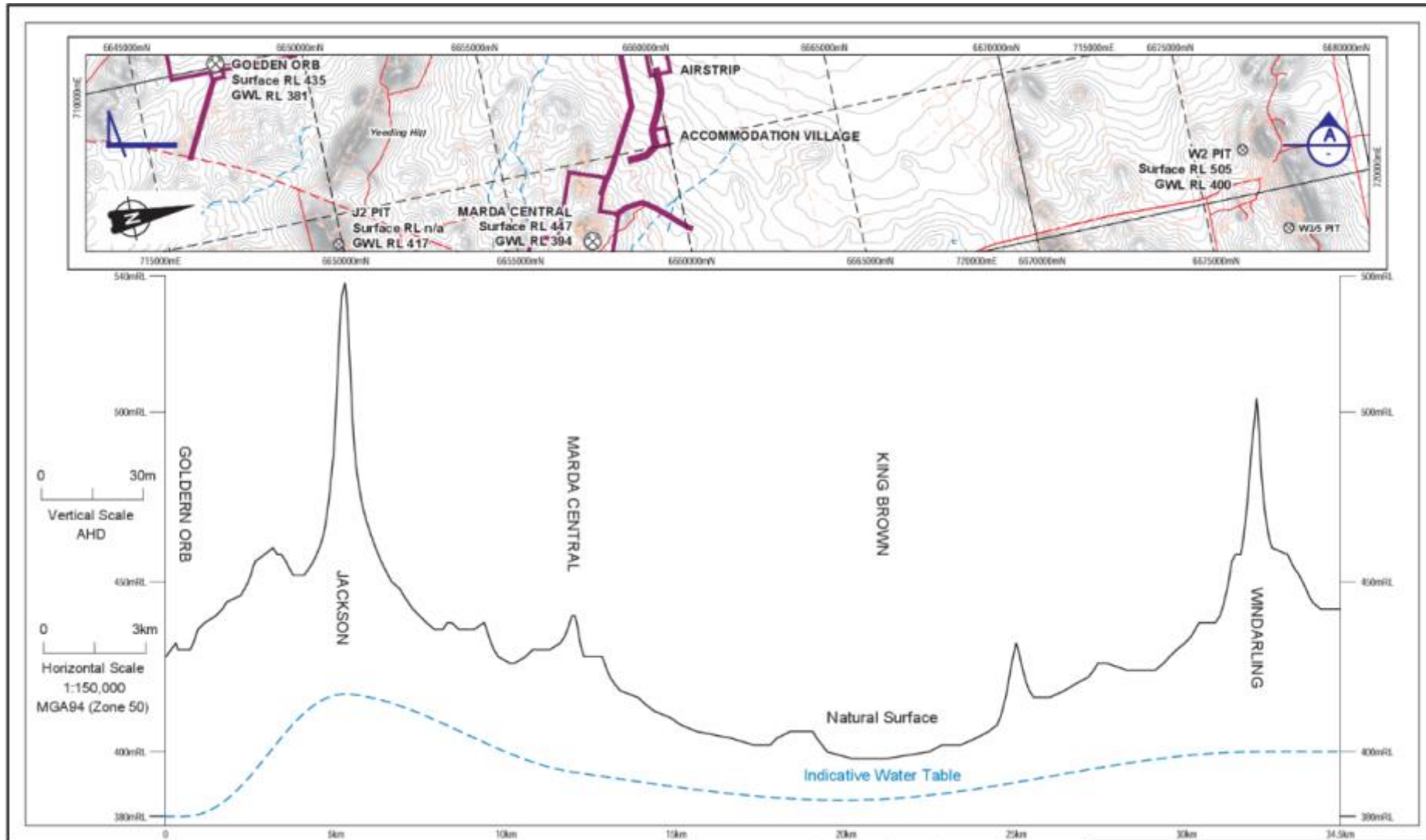


Figure 4.12 Conceptual Groundwater Profile at Marda Central

## Potential Impacts

Where relevant, drainage lines around the proposed mine infrastructure will be diverted during implementation of the Proposal in order to prevent the ingress of clean water into disturbed areas.

Drainage from disturbed areas will be collected and directed to internal water storage infrastructure (including evaporation ponds or oil water separators where relevant) in order to prevent discharge to the environment of any mine affected water. The surface water management plan to be developed as part of forward works (see section 6.2) will include detailed designs and management measures for surface water management.

The proposed mine areas will not drain into the adjacent proposed Class A Nature Reserve due to the presence of a natural watershed between the Development Envelope and the proposed reserve (Palaris 2014). The implementation of clean water diversions and containment and treatment of mine affected water will also prevent any impacts to the Mount Manning Conservation Park area.

Given it is not expected that mining will intersect groundwater, there are not expected to be any groundwater drawdowns, or any resultant impacts on any groundwater dependent vegetation. The quality of ground water is not expected to be significantly impacted by mining, given the mining activities are not expected to intersect with groundwater levels, and due to the low connectivity of groundwater aquifers regionally and the benign, weathered nature of the materials likely to be intersected during mining. These assumptions will be confirmed as part of the further studies in relation to waste rock characterisation and hydrogeology of the Marda East area (see section 6.1).

## Proposed Management Measures

To manage surface water impacts in the Development Envelope to meet the EPA's objective for hydrological processes, SXG will:

- divert clean stormwater runoff around the mine pits and other infrastructure;
- capture rainwater falling into mine pits and other disturbed areas in sumps and use this for dust suppression in the pit areas;
- capture any hydrocarbon contaminated water for treatment using an oil water separator to meet the requirements of Water Quality Protection Note 68 (DoW 2013);
- develop a surface water management plan to describe runoff diversion around mine infrastructure as well as sediment and erosion controls (see section 6.2);
- ensure all hazardous chemicals including hydrocarbons are stored in self bunded storage areas that comply with Australian Standard 1940-2004; and
- ensure any spills of hydrocarbons or hazardous chemicals are controlled, contained and cleaned up in accordance with the site Environmental Management System and the requirements of the EP Act.

Construction and operation of washdown facilities will be in accordance with the Water Quality Protection Note (WQPN) 68 (DoW 2013). The quality of treated water will comply with wastewater discharge criteria given in Table 4.7.

**Table 4.7 Indicative Wastewater Discharge Criteria (WQPN 68)**

Parameter	Limiting criteria
pH	Within the range 5.5 to 8.5
Salinity (measured as EC	1800 uS/cm (maximum)
Surfactants (detergents)	5 mg/L (maximum)
Petroleum hydrocarbons	15 mg/L (maximum)
Benzene, toluene, ethyl benzene, xylene (BTEX)	10 ug/L (cumulative maximum)
Other toxic soluble contaminants	Ten times the guideline criteria or investigation trigger for local water values published in the <i>Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000</i>

As outlined above it is not expected that Proposal operations will intersect groundwater at any stage. However, should the detailed hydrogeological investigation (see section 6.1) indicate that nominal amounts of groundwater may be intersected towards the end of mining, SXG will liaise with the DoW in order to obtain appropriate Groundwater Well Licences and to develop and implement a site Operating Strategy. The Operating Strategy, if required, will address:

- abstraction data (soon to be monthly reporting);
- upgrade of existing bore network to improve monitoring across site;
- standing water level data;
- water quality data; and
- annual review of dewatering operations and the impact of abstraction on the regional hydrology.

Should nominal amounts of groundwater be encountered towards the end of mining, dewatering will occur via in-pit sumps to lined surface evaporation ponds and for use in dust suppression where necessary. No groundwater will be discharged to the environment.

A staged hydrogeological investigation as part of further studies (section 6.1) will confirm the groundwater levels in the Development Envelope. If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine the need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.

SXG will implement an Environmental Management System which will include monitoring procedures, management standards, guidelines and operational procedures associated with water management.

To reduce the risk of members of the public accessing the proposed pits, SXG will ensure that any pit access roads will be rehabilitated and made inaccessible. The presence of safety berms and abandonment bunds around the pits will assist in deterring public access.

**Conclusion**

SXG considers that all of the potential impacts on hydrological processes can be readily managed through implementation of the proposed environmental management measures and regulation through the DMP, the DER and the DoW. Therefore, it is concluded that the Proposal meets the EPA objective for hydrological and hydrogeological processes.

## 4.3.2 Inland Waters Environmental Quality

### EPA Objective

To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.

### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for inland waters environmental quality has been developed with consideration of the following:

- EPA Guidance Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA 2007a);
- Draft EPA Guidance Statement No. 54a: Sampling Methods and Survey Considerations for Subterranean Fauna (EPA 2007b);
- Water Quality Protection Guidelines (WRC 2000a-e); and
- Water Quality Protection Note 68: Mechanical Equipment Washdown (DoW 2013).

### Existing Environment

The surface water and groundwater regimes of the Development Envelope are described in section 4.3.1. The biota of the Development Envelope is described in sections 4.2.1, 4.2.3 and 4.2.5.

There are no significant water bodies, drainage lines, creeks or rivers within the Proposal area or the immediate region. The drainage from the Development Envelope is within the Salt Lake River Basin and its runoff flows in the north-east direction into Lake Giles, an ephemeral salt lake located approximately 40 km north of the Proposal area (Palaris 2014). The study confirms that a natural watershed is present between the proposed Marda East mine outline and the proposed Class A Nature Reserve adjacent to the mine.

### Potential Impacts

The proposed mine areas will not drain into the proposed Class A Nature Reserve and impacts to the Mount Manning Conservation Park areas are expected to be minimal.

Given it is not expected that mining will intersect groundwater, there are not expected to be any groundwater drawdowns, or any resultant impacts on any groundwater dependent vegetation. No groundwater will be discharged to the environment as a result of Proposal operations.

Clean water will be diverted around the disturbance footprint using diversion channels which will be constructed prior to commencement of mining. Due to the limited and ephemeral drainage systems in the area, it is not expected that these diversions will significantly impact on regional flows.

The quality of ground water is not expected to be significantly impacted by mining (see section 4.3.1).

### Proposed Management Measures

Management measures proposed to protect the quality of inland waters are outlined in section 4.3.1.

## Conclusion

SXG considers that all of the potential impacts on inland waters environmental quality can be readily managed through implementation of the proposed environmental management measures and regulation through the DMP and DoW. Therefore, it is concluded that the Proposal meets the EPA objective for inland waters environmental quality.

## 4.4 Air

### EPA Objective

To maintain air quality for the protection of the environment, human health and amenity.

### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for air has been developed with consideration of the following:

- EPA Guidance Statement No. 12: Minimising Greenhouse Gases (EPA 2002b); and
- A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (DEC 2011b).

### Existing Environment

The Development Envelope is located in a regionally isolated area of low population density. The nearest sensitive environment to the Proposal area is the Windarling Mine, located 15 km away.

### Potential Impacts

The only significant potential impact on air quality is the emission and deposition of dust around the mine and along haulage routes. This may have an impact on vegetation health and resultant ecosystem function in areas where dust deposition is high.

In addition to the deposition of dust, the Proposal will generate additional greenhouse gases associated with the blasting, loading and hauling of ore and waste rock, and the operation of associated mining vehicles and infrastructure. Given the short duration of the Proposal life, these additional greenhouse gas impacts are not considered to be significant.

### Proposed Management Measures

To minimise dust generation, SXG will:

- water mine haul roads, processing area roads and ore stockpiles;
- implement speed restrictions to reduce road generated dust;
- avoid carrying out dust generating activities (e.g. topsoil stripping) during adverse wind conditions;
- strip topsoil in discrete sections to allow windbreak between clearings;
- limit the stockpile height and slope to reduce wind pick up; and
- limit drop heights from loading facilities.

Other dust control measures that will be implemented on site include:

- establishing vegetation transects adjacent to the Development Envelope and the proposed Class A Nature Reserve to monitor vegetation health; and
- promoting dust generation awareness to staff by providing inductions on dust minimising practices.

## Conclusion

SXG considers that the potential impacts on air quality can be readily managed through implementation of the proposed environmental management measures and regulation through the Mining Proposal, Works Approval and Environmental Licensing systems. Therefore, it is concluded that the Proposal meets the EPA objective for air quality.

## 4.5 People

### 4.5.1 Amenity

#### EPA Objective

To ensure that impacts to amenity are reduced as low as reasonably practicable.

#### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for amenity has been developed with consideration of the following:

- Visual Landscape Planning in WA (WAPC 2007); and
- Guidance Notes for the Reduction of Obtrusive Light (The Institute of Lighting Engineers 2005).

#### Existing Environment

In the visual impact assessment undertaken for Marda East (SXG 2014, Appendix E), three landscape character units (LCU) were identified at Marda East as described in Table 4.8.

**Table 4.8 Landscape Character Units in the Development Envelope**

LCU	Location and Form	Colour	Texture
Die Hardy Range	Stands distinctly out from and above the surrounding lower lying plains; Characterised by a distinctive rugged range running in a north west to south east direction. The form and line of this character unit are characterised by horizontal to sloping profiles with straight and angular lines at close range views. On the horizon, the landform is folding and curved.	Pale and generic, comprised of olive to fatigue green. Brighter flashes of ochre to orange is viewed from the exposed rocks in mid-ground views and in brighter lighting conditions. Where visible the darker soils contrast with the pale greens and yellows of the vegetation.	Ranges from the texture of the vegetation which is rounded and muted to the contrasted rough texture of the sharp cliffs and angular rocks from the BIF. Soils can be rough and angular to gravelly. Soil is not visible between vegetation at distance. Rock faces exposed between the vegetation can appear as horizontal bands on the slopes of the ranges.

LCU	Location and Form	Colour	Texture
Footslopes of the ranges	A blending of the steeper ranges to the more gentle surrounding plains; The footslopes of the ranges are more rounded in shape with no exposed rock faces.	Pale and generic, comprised of olive to fatigue green with occasional stands of brighter gold/green under certain lighting conditions and attached to certain units of vegetation.	Soils can be rough and angular to gravelly. The textures of this character unit are rounded and muted from a distance. Soil is not visible between vegetation at distance.
Gentle undulating plain	Extends away from the footslopes and for considerable distance until the next rise from the plain; The plains extend like a rolling carpet into the horizon from any elevated point.	A more uniform dark green and are muted. Some variation in colour and brightness can be observed and can be a mixture of light, vegetation and slight variations in elevation.	Soils are gravelly to sandy. The textures of this character unit are flat and hazy from a distance. Soil is not visible between vegetation at distance. Trees and shrubs grow thick throughout this unit and for a textured side wall along the roadsides impeding visibility.

The majority of the Development Envelope is located within the footslopes LCU with some portions of the project spreading lower into the plains.

The Development Envelope is entirely within a natural landscape with the historical pastoralist grazing activities having made no discernible changes to the landscape at the regional or local level. The Die Hardy Range was identified as holding key visual landscape values due to a combination of factors such as:

- a high degree of perceived naturalness;
- a degree of topographic variety or vertical relief (dramatic relief, ruggedness, rock outcropping and outstanding ridgelines); and
- perceived vegetation characteristics, such as endemic and diverse species.

The Red Legs and Fiddleback impact areas are quite small and restricted to a small area (i.e. only 4 km between them) with only one public road / viewing area and restricted points of view from surrounding elevated locations. From a simple viewshed analysis, four theoretical viewing locations were identified as having views of the Development Envelope (Table 4.9). DPI (2007) suggests the following scales to measure visibility:

- foreground (0 – 500 m);
- mid-ground (500 m – 6.5 km); and
- background (6.5 – 16.5 km).

These three categories relate to the level of detail that is visible to the observer. As distance increases, colours and textures tend to become less obvious, whereas line and form become more dominant.

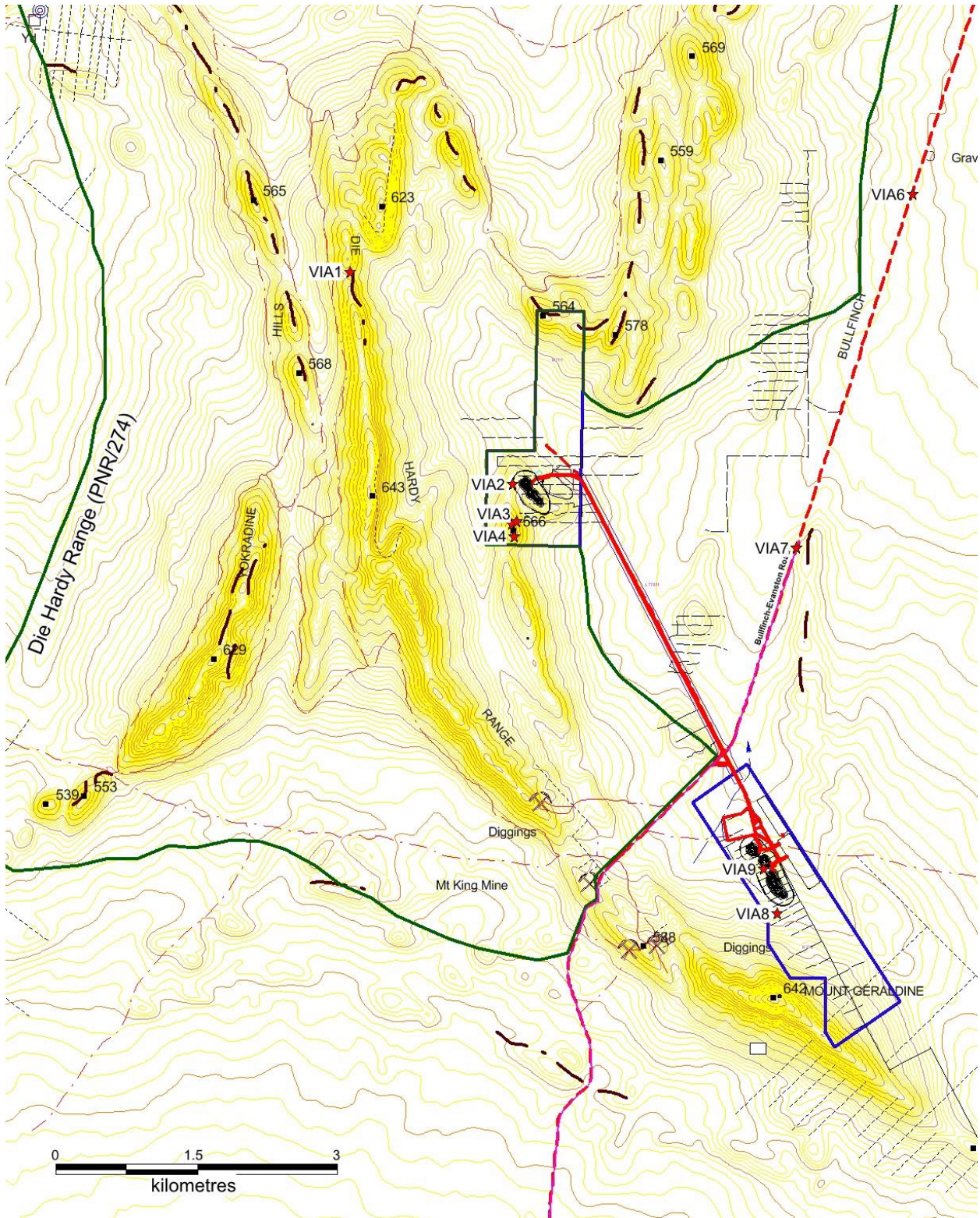
During the field visit each of these theoretical views was visited to determine both the theoretical view experience, the real view experience toward the Proposal as well as the possible impact on the real view should the Proposal proceed. A map of the viewing locations visited during the visual impact assessment is provided as Figure 4.13.

The visual absorbance capacity of the vegetation along the roads in the study area was identified to be high, relative to the proposed works, and the location and orientation of views.

**Table 4.9 Theoretical Views of the Proposal**

Name of view	Access	Visibility Measure	Theoretical view experience	Compensating factors	Real view experience
Bullfinch Evanston Road (north of the Die Hardy Pass) - VIA 7	Public vehicle access	Mid-ground Background	For a distance of some 11 km, the areas of the project are theoretically visible; Distant view to midrange views.	Obstructed by landform and vegetation; High levels of visual absorption.	Fleeting glimpses of upper levels of ranges but the vegetation and landforms restrict views.
Footslopes adjacent to Red Legs Hill – VIA 2	No public vehicle access	Foreground	Close views with feature views where elements of landform stand out.	Obstructed views by existing vegetation	Slightly obstructed views
Die Hardy Range (Eastern Limb) – VIA 1		Mid-ground	Elevated panoramic views feature views where the landform stands because it is directly in the field of view or because it is a distinctive landscape feature.		
Die Hardy Range (Mt Geraldine) – VIA 8		Mid-ground			





**Figure 4.13 Visual Amenity Viewing Locations**

From the Bullfinch Evanston Road, there are views of the Die Hardy Range on approach from the south but as the Development Envelope lies to the north east of the range there are no possible views of the Development Envelope (Figure 4.14). As the road passes through the Die Hardy Range pass there are no views beyond the sides of the pass (Figure 4.15).



**Figure 4.14 Bullfinch-Evanston Road View (ranges not visible)**



**Figure 4.15 Die Hardy Range towards Red Legs**



**Figure 4.16 View of Eastern Plains (distant ranges) from VIA 1**



**Figure 4.17 View of the Die Hardy Range from VIA 2 (Red Legs Hill)**



**Figure 4.18 Elevated View of the Red Legs South Hill from VIA 3**



**Figure 4.19 View of the Die Hardy Range (North) to Red Legs Hill (East) from VIA 5**

Montages from VIA 1 and VIA 3 showing the disturbance footprint locations are provided as Appendix J.

## Potential Impacts

The Proposal will have an impact on two of the LCUs, particularly the footslopes of the ranges and the surrounding plains. The main change to landforms of the Development Envelope will be the development of two pit voids and two WRLs. The visual impact of these localised landscape changes will be limited, particularly as the height of the WRLs will be restricted to no more than 20 m. Visual impacts resulting from the presence of the WRLs will be reduced following completion of rehabilitation and mine closure (see section 4.6.2).

The proposed Red Legs pit is located at the foothills of the Die Hardy Range and will impact on the topography of the local area. However, the disturbance area is small (a total residual disturbance following rehabilitation of 4 ha (limited to the pit void)). The proposed Fiddleback pit is located on the gentle undulating plains and well removed from range features. The disturbance area is also small (a total of no more than 31 ha at Fiddleback).

It is unlikely that the pit voids will be visible to passing motorists due to a mixture of landform and vegetation obstructions and the high degree of visual impact absorption in the road verge vegetation which impedes views to the lower portions of the ranges. Views from elevated positions within the footslopes and some areas of the range will be impacted by the Proposal location. These areas have limited public accessibility at present, however it is noted that this may change if the Proposed Class A Nature Reserve is confirmed.

## Proposed Management Measures

During operations, directional lighting, light shields, progressive clearing and natural vegetation screening will somewhat reduce the impacts of the Proposal on visual amenity.

As part of rehabilitation and closure, residual visual impacts on the landscape of the Development Envelope will be minimised through careful design of the WRLs to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms. The WRLs will be rehabilitated in accordance with the procedures outlined in the MCP including adoption of regionally specific landform characteristics, vegetation types and drainage flows, and the minimisation of pit lake voids where resource sterilisation allows (see section 4.6.2).

SXG will undertake formal visual impact modelling of post mining effects as part of the forward works outlined in section 6.1 to determine the likely efficacy of the proposed measures, and to identify any additional opportunities for minimising visual amenity impacts in closure. The results of this visual impact modelling will be used to update the MCP prepared for Marda Central to reflect the addition of the Proposal, as outlined in section 6.4.

## Conclusion

The visual management objectives identified for the management of the views from the Proposal are “the protection and maintenance of the Die Hardy Range which form a feature view on the horizon for passing motorists”. SXG considers that these objectives have been met as the impact on views from passing motorists is anticipated to be negligible. While there are expected impacts to views from elevated positions in the vicinity of the Development Envelope, these areas have limited public accessibility at present.

SXG considers that implementation of the management techniques outlined above as well as regulation through the Mining Proposal and MCP will reduce the impact to amenity, however it

is likely that the Proposal will result in residual impacts on landscape values. This is likely to be due to the existence of completed pits that will remain following closure in an area that has previously been relatively undisturbed.

## 4.5.2 Heritage

### EPA Objective

To ensure that historical and cultural associations are not adversely affected.

### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for heritage has been developed with consideration of the following:

- EPA Guidance Statement No. 41: Assessment of Aboriginal Heritage (EPA 2004c).

### Existing Environment

Four Aboriginal heritage surveys have been conducted within the Development Envelope (R. & E. O'Connor 2012, Aboriginal Heritage Consultants 2012, Cecchi 2012 and Cecchi 2013, Appendix K), covering areas shown in Figure 4.20. These survey areas include the mining tenements M77/1271 (Red Legs) and M77/1272 (Fiddleback) and L77/261 (the 3.7 km long road connecting the two sites).

A desktop search was undertaken prior to the field survey, including information on the region's archaeological and environmental background. A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Site Register for sites located within or near the survey areas, identified two relevant sites:

- Site ID 20359, named Ky-45 "Die Hardy Range", is located within both the Red Legs and Fiddleback survey areas and was a mythological site placed under Lodged Status with Open Access at the time of the field survey (February-March 2012). Following a completion of the field surveys, the Aboriginal Cultural Material Committee found that Site ID 20359 is not an Aboriginal site within the meaning of Section 5 of the *Aboriginal Heritage Act 1972*. The formal record shows that it was deemed "not a site" by Resolution Number 6842 at Meeting Number 4581 on 14 March 2012. Accordingly it has been relegated to the status "Stored Data" in the Register (R. & E. O'Connor 2012); and
- Site ID 31477, named Die Hardy 1, was recorded by Cecchi (2011, 2012) as a highly concentrated artefact scatter and reduction area housing approximately 300 artefacts, centred at 733946mE 6680647mN. This site is located outside the survey area and will not be disturbed by the Proposal (Cecchi 2012).

No Aboriginal heritage sites were identified from the four field surveys, although there were some isolated stone artefact materials found. These artefacts were not deemed by the consulted Aboriginal people as representing a significant area of Aboriginal heritage (Cecchi 2013).

There is a small pocket of land within the Development Envelope that has not been included in previous surveys. This area will be surveyed as part of the forward works (see section 6.1).

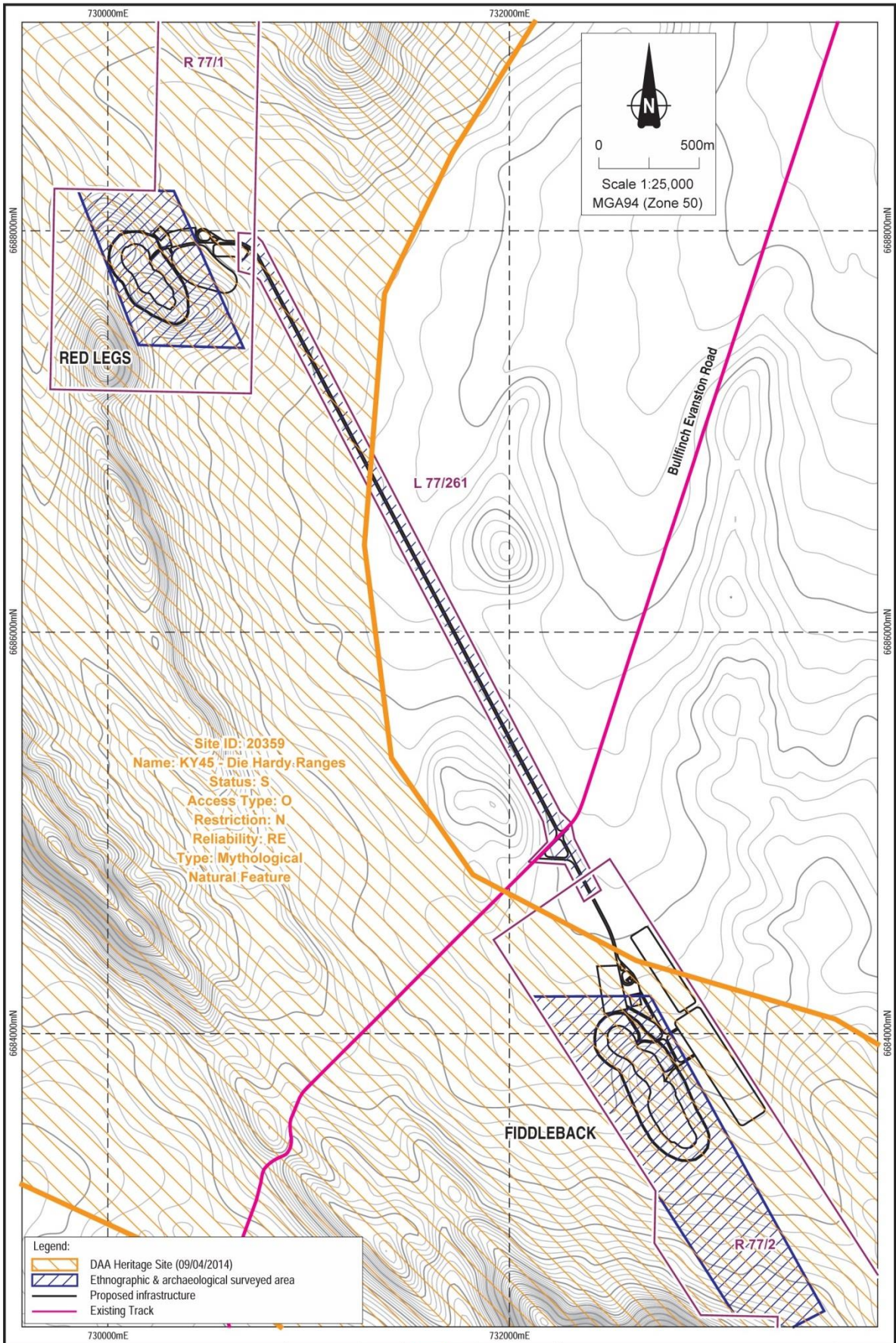


Figure 4.20 Completed Aboriginal Cultural Heritage Survey within the Development Envelope

Based on the Australian Heritage Database (Department of the Environment [DOE]), there are no Australian or European heritage sites of significance found within the Development Envelope or the region. However, a number of state heritages found regionally using the Heritage Council State Heritage Office database include:

- Mount Jackson Graves and Cemetery at Mount Jackson Station (32 km south); and
- Marda Dam.

None of these sites are within the Development Envelope.

### Potential Impacts

No Aboriginal or European heritage sites are located within the Development Envelope and no indirect impacts are predicted.

### Proposed Management Measures

No direct or indirect impacts on Aboriginal or European heritage sites are predicted so no specific management measures are required. However, employees and contractors will be trained in their obligations under the *Aboriginal Heritage Act 1972* (WA) including the requirement to report any potential heritage sites discovered during construction and operation of the Proposal.

The following measures will also be implemented in the Proposal:

- preparation and implementation of a cultural heritage management plan;
- ongoing open communication with Aboriginal heritage stakeholders regarding Proposal operations;
- ongoing consultation with Aboriginal heritage stakeholders for all future ground disturbing and drilling activities impacting on the site;
- should any artefacts be uncovered during the project, works will cease and further consultation will be undertaken; and
- should any skeletal remains be encountered the Western Australian Police will be contacted.

### Conclusion

No impacts on Aboriginal or European heritage sites are predicted and it is concluded that the Proposal meets the EPA objective for heritage.

### 4.5.3 Human Health

#### EPA Objective

To ensure that human health is not adversely affected.

#### Relevant Guidelines and Approvals

Discussion of the existing environment, potential impacts and environmental management measures for human health has been developed with consideration of the following:

- Draft EPA Guidance Statement No. 8: Environmental Noise (EPA 2007c);
- Environmental Protection (Noise) Regulations 1997; and



- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZEC 1990).

## Existing Environment

The town of Bullfinch is located approximately 110 km south of the Development Envelope and Southern Cross is located approximately 140 km south of the Development Envelope.

The region is frequented by visitors, particularly during the wildflower season, though visitor numbers are not monitored by the DPaW or Shire of Yilgarn. The Bullfinch-Evanston Road is used by tourists visiting the region.

## Potential Impacts

Noise and vibration have the potential to impact on environmental and social values within the Development Envelope and surrounds as follows:

- Noise from mobile plant such as drill rigs, excavators, haul trucks and grader; and
- Noise and vibration associated with blasting.

No existing gazetted roads or tracks will be closed by the Proposal and public thoroughfare will be maintained to and between key regional features. The haul road connecting the Fiddleback and Red Legs deposits will intersect the Bullfinch-Evanston Road and the Bullfinch-Evanston road will be subject to additional road-train traffic associated with carting ore to the Marda Central processing facility for the duration of the project (2 years).

## Proposed Management Measures

SXG will ensure that its mining and processing operations will meet statutory requirements via the implementation of a Health and Safety Management System and associated plans, procedures, guidelines and working instructions.

SXG will reduce noise levels by using low-noise equipment, silencers and exhaust mufflers where appropriate. Blasting will only be conducted during daylight hours.

The Shire of Yilgarn will be consulted during the Mining Proposal stage, and appropriate safety measures, including speed limits, signage, dust suppression and other restrictions where required will be implemented for haulage operations in order to minimise the impact of road trains intersecting with, and travelling on, the Bullfinch-Evanston Road.

## Conclusion

SXG considers that all of the potential impacts on human health can be readily managed through implementation of the proposed environmental management measures. Therefore, it is concluded that the Proposal meets the EPA objective for human health.

## 4.6 Integrating Factors

### 4.6.1 Offsets

#### EPA Objective

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

#### Relevant Guidelines and Approvals

The potential need for offsets was determined with consideration of the following:

- EPA Position Statement 9: Environmental Offsets (EPA 2006b);
- EPA Guidance Statement No. 19: Environmental Offsets – Biodiversity (EPA 2008a); and
- Environmental Protection Bulletin 1: Environmental Offsets - Biodiversity (EPA 2008b).

#### Offsets Proposed

SXG considers that all of the potential environmental impacts associated with the Proposal can be readily managed through implementation of the proposed environmental management measures and regulation by the DMP, DER and DoW with input from the DPaW. Therefore, it is concluded that environmental offsets are not required for the Proposal.

However, following consultation with stakeholders including DPaW, the Great Western Woodlands and Bird Life Australia, SXG is committed to implementing the following measures in lieu of formal offsets in order to maximise its contribution to environmental management in the region:

- Continue to consult with the DPaW in relation to adding value where possible to existing weed and feral animal control programs in the region; and
- Make results of environmental studies conducted available to both government agencies such as DPaW and to NGO organisations (including Bird Life Australia, the Wildflower Society of Western Australia and Great Western Woodlands) who have requested information sharing.

### 4.6.2 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 unacceptable liability to the State.

#### Relevant Guidelines and Approvals

The proposed rehabilitation and closure strategy and procedures were developed with consideration of the following:

- EPA Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems (EPA 2006a);

- Environmental Protection Bulletin 19: EPA Involvement in Mine Closure (EPA 2013c); and
- Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011).

## Existing Environment

The vegetation survey of the Development Envelope indicates that there are relatively minor historical impacts caused by the disturbance due to cleared exploration gridlines within the area. The natural regeneration of old tracks in the immediate area is considered to be more than a few years old, and recovering well (Western Botanical 2014). Regionally, limited small scale mining has occurred historically in the Marda Central tenement as evidenced by old shafts and sediment dumps occurring within the Dolly Pot and Goldstream pit footprints. Other disturbances on a regional scale occur from mineral exploration and tourism activities.

## Potential Impacts

Development of the Proposal will result in the clearing of no more than 46 ha of native vegetation. Much of this area will be used for temporary infrastructure which will be removed at the end of mine operations. Permanent features remaining after mine closure will comprise two pit voids and two WRLs.

## Proposed Management Measures

### Post-project Land Use

Mine closure planning for the Proposal has been extensively discussed with the DPaW and the DMP as well as with stakeholders including Bird Life Australia, the Great Western Woodlands and the Wildflower Society of Western Australia.

SXG has prepared a MCP for the Marda Central Project in accordance with DMP and EPA (2011) and this will be amended to reflect the addition of the Marda East infrastructure in accordance with the DMP schedule for mine closure (section 6.4). SXG has also received feedback from a number of external stakeholders in relation to mine closure (see section 3.5). These comments will be incorporated into the next revision of the MCP, and SXG has committed to further engagement with stakeholders such as the DPaW, the Great Western Woodlands and the Wildflower Society of WA during its amendment of the MCP. The further studies proposed in section 6.1, including the visual impact modelling and the soil and waste rock materials characterisation, will also be used to inform the MCP update.

The post-project land uses considered to be the most appropriate for the Development Envelope are:

- Mt Jackson Pastoral Lease – native vegetation to support pastoral purposes; and
- Proposed 5(1)(h) Reserve – native vegetation to support conservation.

### Closure Goal, Objectives and Completion Criteria

Based on the proposed post-project land uses, the overall closure goal for the Proposal is:

“To rehabilitate disturbed areas so that rehabilitated land surfaces function in a way that does not adversely impact on the use of the surrounding landscape for the defined post-project land uses.”

This goal requires land surfaces to be physically safe to humans and wildlife, geotechnically stable, non-polluting and to have reconstructed soil profiles with adequate capacity to sustain resilient plant communities comprising local flora species, where revegetation is conducted.

Closure objectives for the Proposal have been developed based on the EPA’s proposed standard objectives for rehabilitation (EPA 2006a). The proposed closure objectives are outlined in Table 4.10.

**Table 4.10 Closure Objectives**

Aspect	Objective
Safety	Safety issues are adequately addressed and all final landforms are considered safe.
Landforms	Final landforms are stable. Final landforms are suitable for pastoral use and contribute to the conservation land use of the region.
Water	Water quality and availability is returned to pre-mining state.
Soil	Appropriate soil profiles are maintained in closure.
Flora and Vegetation	Vegetation is resilient and self-sustaining. Plant species diversity reaches targets. Plant abundance or cover reaches targets. Reintroduce species of conservation significance. Maintain plant genetic diversity (local provenance). Restore dominant plant species.
Ecosystem	Animal habitats are present or can be expected to return. Area is sustainable without additional inputs. No ongoing impacts of pollutants. No net increase in weeds or feral animals.
Visual Amenity	Retain visual amenity as closely as possible with pre-mining values.
Heritage	Aboriginal heritage values maintained. European values maintained.
Compliance	All legally binding commitments will be met and terms and conditions of licenses adhered to.

The proposed completion criteria and monitoring programs are given in Table 4.11.

**Table 4.11 Completion Criteria**

Objectives	Infrastructure Completion Criteria	WRL Completion Criteria	Open Pit Completion Criteria	Type of Monitoring
Safety issues are adequately addressed.	Buildings, equipment, infrastructure and foundations disassembled and removed.  Camp to be scaled back and retained for rehabilitation and monitoring purposes.  Selected bores will be retained for monitoring purposes.	Safe, stable landform established.  Final landform constructed in accordance with design specifications	Pit slopes and voids are made safe with the construction of abandonment bunds and to the greatest extent feasible avoiding the creation of permanent pit lakes.	All domains visually assessed for erosion, subsidence, landslips, wall rock stability.  Audit of final WRLs against design specifications and mining proposal commitments.
Final landforms are stable.	Surfaces recontoured where necessary.  Drainage restored where necessary.	Topsoil or appropriate growth medium spread.  Surface ripped.  Erosion controls in place.  Appropriate drainage in place.	Pit slopes and voids are geotechnically stable in closure, and can be expected to remain safe over time, with the placement of abandonment bunds beyond zone of potential pit instability.	All domains visually assessed for erosion, subsidence, landslips, wall rock stability.  Site evaluation of surface/ subsurface flow pathways and diversion drains and ponds.  Topsoil stockpile monitoring throughout closure.
Suitable for end land use.	Final landforms are consistent with surrounding topography.	Final landform is consistent with surrounding topography.	Open pits do not constrain closure land use.	Audit final landforms against design specifications.
No significant problems with pollutants.	Contaminated soil treated or disposed of at an approved facility.  Hazardous materials removed and disposed of at an approved facility.	Problematic material encapsulated within the WRL, away from the surfaces.	No adverse impacts on groundwater levels/quality.	Groundwater and surface water monitoring as described below.
Water quality and availability is appropriate.	Surface water and groundwater quality does not exceed licence conditions where relevant (DoW and DER licences).			General water quality parameters (field).  General and detailed water quality parameters (laboratory).

Objectives	Infrastructure Completion Criteria	WRL Completion Criteria	Open Pit Completion Criteria	Type of Monitoring
Water quality and availability is appropriate.	Drainage controls in place.  Sedimentation within acceptable limits.	Drainage controls in place.  Sedimentation within acceptable limits as defined by DoW water quality guidelines.	Hydraulic flows and patterns of surface water flow are unimpeded.	Groundwater levels; flow rates from dewatering bores; surface water levels; groundwater cone of depression.
Construct appropriate soil profiles.	Topsoil or growth medium spread to appropriate depth.	Topsoil or growth medium spread to appropriate depth.	N/A	Soil chemical and physical properties.  Stockpile quantities and quality.
Vegetation is resilient and self-sustaining.	Rehabilitation capable of withstanding drought cycle/s.  Species are capable of post-fire recovery.	Local provenance, shallow rooted species used to revegetate the WRL.	N/A	Quadrat based monitoring of structural and functional diversity.
Plant species diversity reaches targets.	Plant species diversity at least 50% of reference site species diversity.	Plant species diversity trending towards reference sites.	N/A	Quadrat based monitoring of plant species diversity.
Plant abundance or cover reaches targets.	Plant abundance/percentage cover trending towards reference sites.		N/A	Quadrat based monitoring of percentage cover.
Reintroduce species of conservation significance.	Specific targets to be developed in consultation with DPaW.  Local provenance seeds collected and added to seed mixes if required.		N/A	To be developed in consultation with DPaW.
Adequate control of weeds and feral animals.	Presence of weed and feral animal species does not exceed abundance in reference sites.		N/A	Quadrat based monitoring of structural and functional diversity.
Maintain plant genetic diversity (local provenance).	Local topsoil used for revegetation. Local provenance seeds collected and used to augment topsoil where required.		N/A	Quadrat based monitoring of structural and functional diversity.
Restore dominant plant species.	Dominant plant species abundance trending towards target/reference sites.		N/A	Quadrat based monitoring of structural and functional diversity
Animal habitats are present or can be expected to return.	Animal habitats are present or can be expected to return.		N/A	Fauna monitoring will take place triennially following revegetation. Habitat assessments will take place annually. Monitoring will be carried out until relinquishment of

Objectives	Infrastructure Completion Criteria	WRL Completion Criteria	Open Pit Completion Criteria	Type of Monitoring
				tenements as agreed by the DMP.
Area is sustainable without additional inputs.	Rehabilitated areas do not require additional inputs.			As per flora and fauna monitoring outlined above.
Retain visual amenity.	Visual amenity meets agreed standards.			N/A
Aboriginal heritage values maintained.	Aboriginal heritage values maintained and sites undisturbed unless otherwise approved.			N/A
European heritage values maintained.	European heritage values maintained and sites undisturbed unless otherwise approved.			N/A

The closure options and techniques for the Proposal will be addressed in the Marda East Mining Proposal and amended Marda Central MCP to be submitted to the DMP and are outlined below.

- Seeds from the conservation-significant species, as well as common species within the disturbance areas, will be collected prior to clearing for mine development, and will be used for rehabilitation;
- Vegetation and timber will be stockpiled to use as a resource for creating habitats during rehabilitation and closure;
- All temporary infrastructure including the workshops, ROM pads, administration buildings and evaporation ponds will be decommissioned and removed during the closure process and the footprint of these will be rehabilitated and revegetated;
- All tracks and roads established for the Proposal will be rehabilitated and revegetated. This process will be staged as some roads will be required for access during decommissioning and rehabilitation, and for post-closure monitoring. Any remaining roads will be rehabilitated when no longer required;
- Pit voids will be bunded to prevent access by wildlife and members of the public. As outlined in section 3.2.4, if groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine the need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.

Due to the low risk of acid drainage and leachate, the WRLs will be designed to retain water on the top of the WRL, while shedding water on the slopes in a controlled manner to provide stability and prevent erosion. The objective of this design is to capture precipitation and maximise infiltration, which will in turn enhance rehabilitation success. The closure concept (Figure 4.21) is based on recommendations by Soilwater Consultants (2013) and includes the following elements:

- concave upper surface to hold water with bunding to create cells and reduce catchment size;
- back sloping berms to hold water with baffles every 50 m to reduce catchment size;
- bunds at the toe of the WRL to hold water and contain sediment while vegetation is establishing;
- bunds at the batter crests to prevent water flowing down the batters;
- preferential placement of competent material in erosion prone areas;
- placement of 200–300 mm of topsoil/growth medium and incorporation of gravelly materials to ensure stability; and
- ripping to 500 mm to create a pronounced trough crest profile perpendicular to the slope to capture sediment movement.

The above approach to WRL design will be amended where necessary following the soil characterisation and waste rock material characterisation surveys (see section 6.1). Topsoil will be collected and managed on the basis of values identified during this survey.

Lessons learned from rehabilitation trials conducted during the operations phase will be used to improve the rehabilitation and revegetation programs for the Proposal.



## **Conclusion**

SXG considers that closure and rehabilitation can be readily managed through implementation of the MCP which is regulated through the DMP and EPA Guidelines for Mine Closure Plans (DMP and EPA 2011). Therefore, it is concluded that the Proposal meets the EPA objective for rehabilitation.

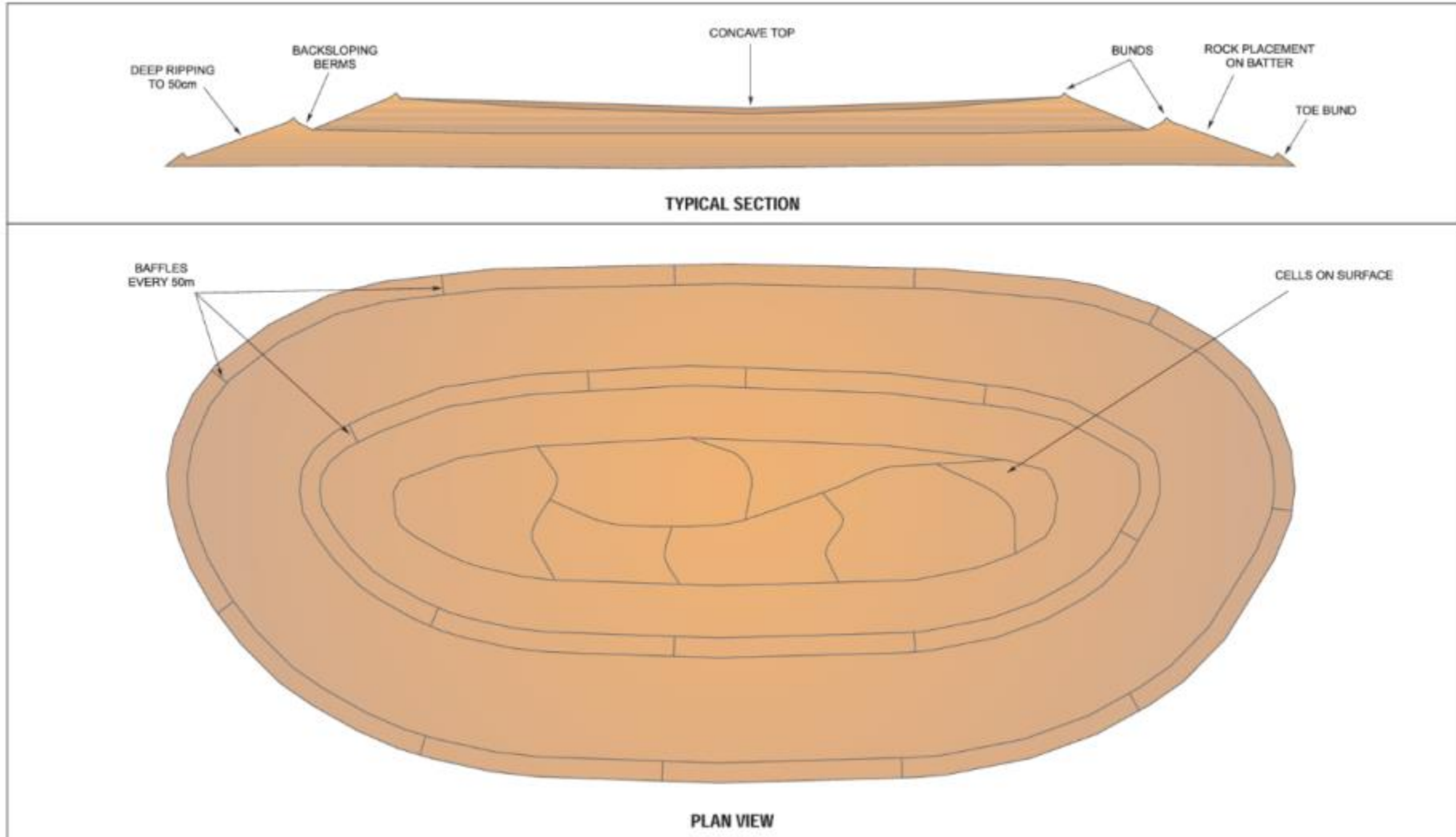
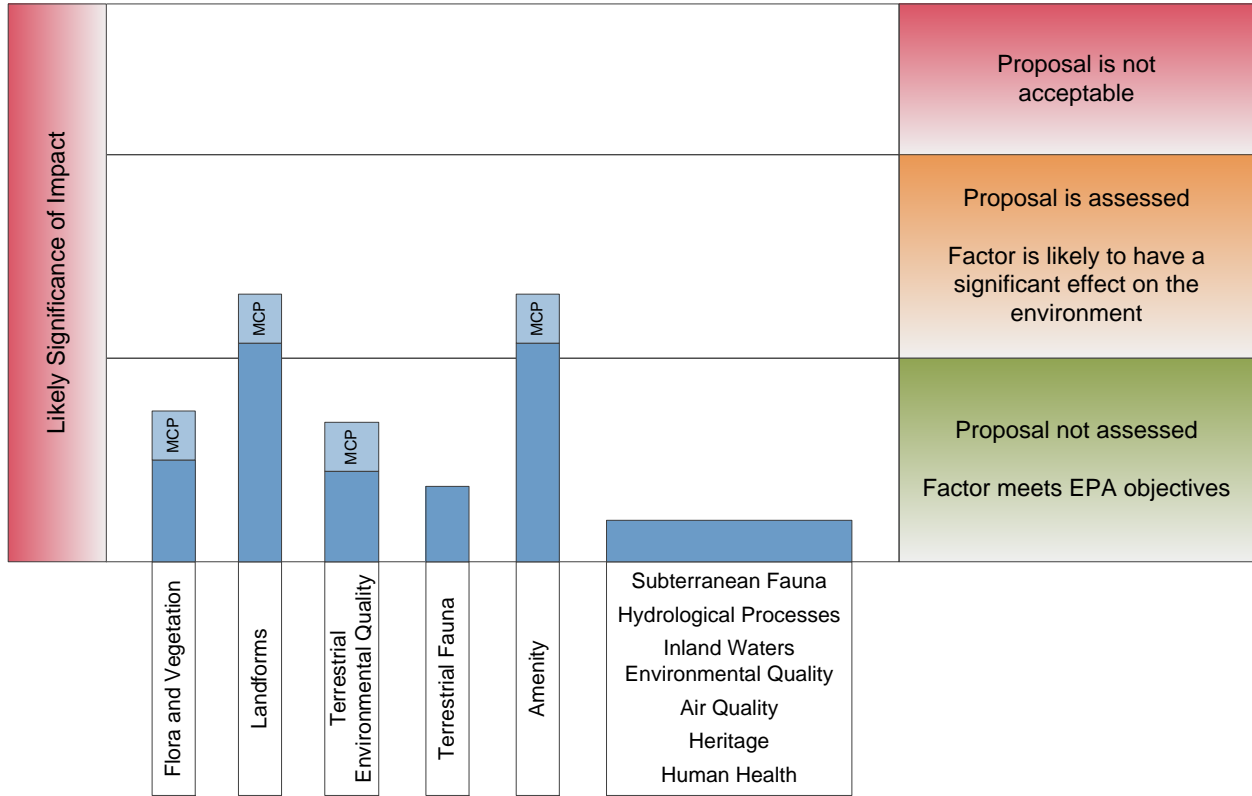


Figure 4.21 Waste Rock Landform Conceptual Closure Layout

## 5 Significance of Environmental Factors

Following the assessment discussed in section 4, SXG has concluded that most environmental factors can be managed using the environmental management measures developed for the Proposal and through environmental regulation by the DMP, DER and DoW, with input from the DPaW (Figure 5.1).



**Figure 5.1 Significance of Environmental Factors**

In the application of a significance framework, two preliminary key environmental factors were identified as outlined in Table 5.1. These factors have residual impacts exceeding the significance threshold.

**Table 5.1 Preliminary Key Environmental Factors**

Key Environmental Factor	Impact
Landforms	<p>The pit voids and waste rock landforms (WRLs) will change the landform in the disturbance footprint.</p> <p>The proposed Red Legs pit is located at the foothills of the BIF ranges and, while not likely to impact on the connectivity of the Die Hardy Range, will have residual impacts on the overall regional integrity, given the current undisturbed nature of the ranges.</p>
Amenity	<p>Visual impact of localised landscape changes due to pit voids and WRLs.</p> <p>Impact on topography due to the proposed Red Legs pit located at the foothills of the BIF ranges.</p> <p>Impact rating on identified views from along public roads is expected to be negligible at best and 'blending' at worst.</p> <p>Impact on views from elevated positions within the footslopes and some areas of the range. At present, these areas have limited public accessibility.</p>

A summary of all environmental factors considered in this assessment is provided at Table 5.2.

Due to the limited number of key environmental factors and on the basis of the environmental assessment described in this ERSD, SXG considers it relevant for the Proposal to undergo an Assessment on Proponent Information (API) – Category A.

**Table 5.2 Proposal Environmental Factors Summary**

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land	Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level	<p>Clearing of no more than 46 ha of native vegetation including plant communities equivalent to 0.17% of the total Priority 1 PEC.</p> <p>Clearing of some or all of a local population of the Priority 3 and Priority 4 flora species where these occur at Red Legs and Fiddleback.</p> <p>The impacts to <i>Mirbelia ferricola</i> (P3) and <i>Grevillea georgeana</i> (P3) are considered locally significant with a significant percentage of their populations proposed to be taken. However, both species are known to be found on other BIF ranges in the region and as such, are considered well represented in an overall regional sense.</p> <p>Localised loss of vegetation condition due to:</p> <ul style="list-style-type: none"> <li>♦ dust generation, erosion and sedimentation;</li> <li>♦ saline overspray during dust suppression;</li> <li>♦ accidental bushfires, should these occur.</li> </ul> <p>Potential for increased weed infestations within disturbed areas.</p> <p>Development of “drainage shadows” in vegetation downstream of roads and other Proposal infrastructure if surface drainage is affected.</p>	<ul style="list-style-type: none"> <li>♦ Realignment of haul road, WRLs, topsoil stockpiles and other ancillary infrastructure, where feasible in the project context.</li> <li>♦ The Proposal disturbance footprint is aligned such that areas of the Dryandra Land System and the Yowie Land System that will be disturbed will not cause fragmentation of these land system units or the vegetation associations connected with the units.</li> <li>♦ Implement collection of seed from the conservation-significant species, as well as common species within the disturbance areas, prior to clearing.</li> <li>♦ Implement a Ground Disturbance Permit system.</li> <li>♦ Limit ground disturbance and clearing of vegetation to designated areas and access routes.</li> <li>♦ Carry out progressive clearing.</li> <li>♦ Restrict clearing during strong winds to reduce dust generation.</li> <li>♦ Implement standard vehicle hygiene measures.</li> <li>♦ Stockpile topsoil (and where feasible, log debris and fallen timber) for use in rehabilitation programs.</li> <li>♦ Regulate vehicle speed limits.</li> <li>♦ Liaise with DPaW to ensure that fire management is conducted in a manner consistent with the fire management plan for the Great Western Woodlands.</li> <li>♦ Minimise the risk of impact from the use of saline water for dust suppression by: <ul style="list-style-type: none"> <li>○ Using fresh water from evaporation ponds, or brackish water from Marda Central for dust suppression;</li> </ul> </li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land (cont.)	Flora and Vegetation (cont.)			<ul style="list-style-type: none"> <li>○ Implementing water truck operating procedures and training water cart operators of the potential impact of saline water on vegetation;</li> <li>○ Installing spray bars that reduce overspray of water onto road side vegetation;</li> <li>○ Constructing road drainage so that water run-off will be contained during low to moderate rainfall events in retention sumps;</li> <li>○ Not using saline water for dust suppression during topsoil harvesting or rehandling.</li> <li>◆ Conduct and monitor mine site rehabilitation progressively.</li> <li>◆ Implement an education program for site workers in terms of environmental and community values.</li> </ul>	
Land	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils	<p>The pit voids and waste rock landforms (WRLs) will change the landform in the disturbance footprint.</p> <p>The proposed Red Legs pit is located at the foothills of the BIF ranges and, while not likely to impact on the connectivity of the Die Hardy Range, will have residual impacts on the overall regional integrity, given the current undisturbed nature of the ranges.</p>	<ul style="list-style-type: none"> <li>◆ Careful design of the WRLs to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms.</li> <li>◆ Rehabilitate the WRLs in accordance with the procedures outlined in the MCP.</li> <li>◆ Implement soil management measures identified in the soil survey (to be carried out as part of forward works).</li> </ul>	Significant
Land	Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level	No significant impacts on subterranean fauna are predicted.	<ul style="list-style-type: none"> <li>◆ No specific management measures anticipated at this stage.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected	<p>Terrestrial environmental quality will be impacted primarily through the disposal of wastes (including waste rock from mining operations, putrescible and inert waste, hydrocarbon and reagent leaks or spills, and sewage), and the alteration of landforms and soils during and after mining.</p> <p>Potential for ecological and social impacts due to the location of disturbance footprint in close proximity to the BIF ranges.</p>	<ul style="list-style-type: none"> <li>◆ The Proposal disturbance is aligned such that areas of the Dryandra Land System and the Yowie Land System that will be disturbed will not cause fragmentation of these land system units or the related vegetation associations.</li> <li>◆ Dispose waste rock to WRLs which will be rehabilitated on a progressive basis.</li> <li>◆ Design WRLs to fit with the natural terrain.</li> <li>◆ Review and finalise waste rock dump design during the assessment process, once material characterisation studies have been completed.</li> <li>◆ Reuse and recycle materials to minimise waste produced.</li> <li>◆ Dispose any remaining waste not recycled in the Marda Central landfill, in accordance with existing site waste management practices.</li> <li>◆ Store and use reagents in accordance with relevant Material Safety Data Sheets and AS1940-2004.</li> <li>◆ Store hydrocarbons in self-bunded tanks located within a fuel storage facility.</li> <li>◆ Remove spilled hydrocarbons by absorbent material and/or excavation of contaminated soil and treat at the Marda Central Bioremediation Pad.</li> <li>◆ Implement an incident reporting system for reporting and managing the clean-up of leaks and spills.</li> <li>◆ Refer to management measures for Flora and Vegetation, Terrestrial Fauna, Amenity and Rehabilitation and Closure.</li> </ul>	Not significant
Land	Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level	<p>Localised loss of fauna habitat.</p> <p>Loss of small animals that are unable to move away during the clearing process.</p> <p>Impact on fauna assemblages in the Development Envelope as a result of noise, vibration, dust, vehicle movements, accidental bushfires, etc.</p>	<ul style="list-style-type: none"> <li>◆ Clear vegetation from cleared to uncleared areas where practicable to provide escape routes for terrestrial fauna.</li> <li>◆ Regulate vehicle speed limits.</li> <li>◆ Fence ponds to exclude fauna and have fauna egress matting installed.</li> <li>◆ Implement fire control and mitigation measures.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Land (cont.)	Terrestrial Fauna (cont.)			<ul style="list-style-type: none"> <li>◆ Implement a feral animal control program.</li> <li>◆ Implement an education program for site workers in terms of environmental and community values.</li> <li>◆ Adopt the management measures developed in the Marda Central Malleefowl Management Plan;</li> <li>◆ Ensure that any chicks have dug out of Mound 1 (currently active) prior to commencement of activities; and</li> <li>◆ Maintain a 250 m boundary around Mound 11.</li> </ul>	
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected	No significant impacts on surface water and groundwater are predicted.	<ul style="list-style-type: none"> <li>◆ Divert clean stormwater runoff around the mine pits and other infrastructure.</li> <li>◆ Capture rainwater falling into mine pits and other disturbed areas in sumps and use this for dust suppression in the pit areas.</li> <li>◆ Develop a surface water management plan to describe runoff diversion around mine infrastructure and sediment and erosion controls.</li> <li>◆ Ensure all hazardous chemicals including hydrocarbons are stored in self bunded storage areas that comply with Australian Standard 1940-2004.</li> <li>◆ Ensure any spills of hydrocarbons or hazardous chemicals are controlled, contained and cleaned up in accordance with the site Environmental Management System and the requirements of the EP Act.</li> <li>◆ Construct and operate washdown facilities in accordance with WQPN 68.</li> <li>◆ If groundwater table will be intersected, liaise with the DoW to obtain appropriate Groundwater Well Licences and develop and implement a site Operating Strategy.</li> </ul>	Not significant



Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Water (cont.)	Hydrological Processes (cont.)			<ul style="list-style-type: none"> <li>◆ If groundwater is detected above the base of mining activity during operations, SXG will conduct additional studies to determine whether there is a need for partial backfill to prevent groundwater intrusion in closure. Any backfill considerations will occur in the context of sterilisation implications and in discussions with the DMP and DPaW.</li> <li>◆ Nil groundwater discharge to the environment.</li> <li>◆ Implement an Environmental Management System (including monitoring procedures, management standards, guidelines and operational procedures associated with water management).</li> <li>◆ Ensure pit access roads are rehabilitated and made inaccessible to reduce the risk of members of the public accessing the proposed pits.</li> </ul>	
Water	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	No significant impacts on surface water and groundwater are predicted.	<ul style="list-style-type: none"> <li>◆ As above (management measures for Hydrological Processes).</li> </ul>	Not significant
Air	Air Quality	To maintain air quality for the protection of the environment, human health and amenity	<p>Emission and deposition of dust around the mine and along haulage routes and potential impact on vegetation health and resultant ecosystem function in areas where dust deposition is high.</p> <p>Impacts due to generation of additional greenhouse gas, however given the short duration of the Proposal life, these are not considered significant.</p>	<ul style="list-style-type: none"> <li>◆ Water mine haul roads, processing area roads and ore stockpiles.</li> <li>◆ Implement speed restrictions to reduce road generated dust.</li> <li>◆ Avoid carrying out dust generating activities during adverse wind conditions.</li> <li>◆ Strip topsoil in discrete sections to allow windbreak between clearings.</li> <li>◆ Limit the stockpile height and slope to reduce wind pick up.</li> <li>◆ Limit drop heights from loading facilities.</li> <li>◆ Establish vegetation transects adjacent to the Development Envelope and the proposed Class A Nature Reserve to monitor vegetation health.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
Air (cont.)	Air Quality (cont.)			<ul style="list-style-type: none"> <li>Promote dust generation awareness to staff by providing inductions on dust minimising practices.</li> </ul>	
People	Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable	<p>Visual impact of localised landscape changes due to pit voids and WRLs.</p> <p>Impact on topography due to the proposed Red Legs pit located at the foothills of the BIF ranges.</p> <p>Impact rating on identified views from along public roads is expected to be negligible at best and 'blending' at worst.</p> <p>Impact on views from elevated positions within the footslopes and some areas of the range but none of these areas are publically accessible.</p>	<ul style="list-style-type: none"> <li>Careful design of the WRLs to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms including adoption of regionally specific landform characteristics, vegetation types and drainage flows.</li> <li>Rehabilitate the WRLs in accordance with the procedures outlined in the MCP.</li> <li>Utilise directional lighting, light shields and natural vegetation screening to reduce visual impacts.</li> <li>Implement progressive clearing to assist in reducing visual impacts.</li> <li>Formal visual impact modelling of post mining effects will be completed as part of the forward works to determine the likely efficacy of proposed management measures and to identify any additional opportunities for reducing the impacts of the Proposal on visual amenity.</li> </ul>	Significant
People	Heritage	To ensure that historical and cultural associations are not adversely affected	No direct or indirect impacts on Aboriginal or European heritage sites are predicted.	<ul style="list-style-type: none"> <li>Prepare and implement a cultural heritage management plan including the management measures outlined below:</li> <li>Maintain open communication with Aboriginal heritage stakeholders regarding Proposal operations.</li> <li>Consult with Aboriginal heritage stakeholders for all future ground disturbing and drilling activities impacting on the site.</li> <li>Cease works should any artefacts be uncovered during the project.</li> <li>Contact the Western Australian Police should any skeletal remains be encountered.</li> </ul>	Not significant

Theme	Factor	EPA Objective	Impact	Summary of Proposed Management	Overall Significance
People	Human Health	To ensure that human health is not adversely affected	Potential impact on environmental and social values due to noise and vibration. Potential impact on public access within the proposed Development Envelope.	<ul style="list-style-type: none"> <li>◆ Implement a health and safety management plan to meet statutory obligations.</li> <li>◆ Reduce noise levels by using low-noise equipment, silencers and exhaust mufflers where appropriate.</li> <li>◆ Conduct blasting during daylight hours.</li> <li>◆ Consult the Shire of Yilgarn during the Mining Proposal stage.</li> <li>◆ Implement appropriate safety measures in relation to traffic along the Bullfinch-Evanston Road including project vehicle speed limits, dust suppression, signage and other restrictions.</li> </ul>	Not significant
Integrating Factors	Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets	Potential environmental impacts associated with the Proposal can be readily managed through implementation of the proposed environmental management measures and regulation by the DMP, DER and DoW with input from the DPaW.	<ul style="list-style-type: none"> <li>◆ Continue to consult with the DPaW in relation to adding value where possible to existing regional weed and feral animal control programs.</li> <li>◆ Make results of environmental studies conducted available to both government agencies such as DPaW and to NGO organisations (including Bird Life Australia, Wildflower Society of WA and Great Western Woodlands) who have so requested.</li> </ul>	Not significant
Integrating Factors	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.	Clearing of no more than 46 ha of native vegetation. Permanent features remaining after mine closure will comprise two pit voids and two WRLs.	<ul style="list-style-type: none"> <li>◆ Amend the MCP prepared for the Marda Central Project to reflect the addition of the Marda East infrastructure in accordance with the DMP schedule for mine closure and in consideration of the further studies proposed in section 6.1 including the visual impact modelling and the soil and waste rock materials characterisation.</li> <li>◆ Ensure proposed completion criteria are met and implement corresponding monitoring programs.</li> </ul>	Not significant

## 6 Forward Works

This body of work is proposed in order to provide the EPA with additional information in order to assess the proposal. Guidance is sought from the EPA as soon as convenient regarding acceptance of these forward works, given the requirement to schedule some of these activities in Spring (2014).

### 6.1 Further Studies

As outlined in section 5, SXG considers that there are two significant factors related to the Proposal (namely, landforms and visual amenity), and that the remaining environmental factors assessed may be managed using the environmental management measures developed for the Proposal and through environmental regulation by the DMP, DER and DoW, with input from the DPaW. SXG therefore considers that the Proposal may appropriately be assessed by the EPA at the API-A level.

In order to confirm this outcome, SXG proposes to undertake a number of site-specific studies in relation to Marda East, and is committed to providing this information to the EPA if required, in order to for the EPA to complete its assessment of the Proposal. A summary of the further studies proposed is provided below.

#### 6.1.1 Hydrogeology study

A staged hydrogeological study including drilling and site hydrogeological investigations, will be conducted to confirm the likelihood of groundwater intrusion during mining. This study will determine the following:

- whether the proposed mining activity is likely to intersect the groundwater table and therefore, identify the need for dewatering;
- likelihood of groundwater impacts;
- the need for additional studies if groundwater intrusion is found to be likely; these additional studies will be undertaken to determine the need for partial backfill to prevent groundwater intrusion in closure.

SXG will apply for licences to construct bores for hydraulic testing and water quality sampling in consultation with the DoW if required.

#### 6.1.2 Waste rock characterisation

A waste rock characterisation study will be completed for waste rock at both Red Legs and Fiddleback in order to confirm the characteristics of waste rock at Marda East in terms of any potential acid and metalliferous drainage, as well as the competency and stability of the waste rock as a landform construction material in closure. This study will inform the Mine Closure Plan update.

#### 6.1.3 Tailings characterisation

Tailings characterisation for Marda East will be incorporated into the tailings study at Marda Central, which will be updated to reflect the Marda East ore feed.

#### 6.1.4 Soil characterisation

A soil characterisation survey of the Development Envelope will be conducted to determine the detailed soil types to be encountered during clearing. The study will also determine appropriate soil management measures to be incorporated into the Proposal, and the amended Marda Central MCP. Detailed topsoil stripping depths will be developed based on the soil types mapped during this survey, and stripping procedures will reflect these prescribed depths.

#### 6.1.5 Aboriginal cultural heritage survey

A small area of the Development Envelope remains unsurveyed for Aboriginal cultural heritage values (see Figure 4.20). Based on the regional values already identified, it is not likely that any significant cultural heritage values will be identified, however a full archaeological, anthropological and ethnographic study will be carried out including field survey with representatives of Aboriginal heritage groups active within the region (see Table 3.2).

#### 6.1.6 Supplementary fauna survey

As recommended following the L1 fauna survey completed over the Development Envelope, a supplementary targeted fauna survey will be completed in accordance with the EPA Guidance Statement No. 56 (EPA 2004b) in Spring 2014. This survey will involve a targeted trapping program to identify whether any Numbat (*Myrmecobius fasciatus*) populations are present within the Development Envelope, as well as a tree hollow search to confirm and map the habitat of the Major Mitchell's Cockatoo (*Cacatua leadbeateri*) if required to supplement the existing data.

#### 6.1.7 Visual impact modelling

To quantify the expected visual impacts of the Proposal, and in order to confirm the expected efficacy of proposed rehabilitation techniques, SXG will engage an external consultant to develop a visual impact model for the Proposal. This model will confirm the predicted impacts at the Red Legs foothills and surrounding plains and quantify the likely effectiveness of the mitigation strategies proposed.

#### 6.1.8 Review of PEC boundary

During stakeholder discussions with the DPaW and EPA (see section 3.5), government agencies recommended that SXG liaise with the DPaW to utilise flora and vegetation data obtained during surveys to review the existing PEC boundary. SXG is committed to liaising with the relevant government agencies to achieve this outcome and to making the survey data publicly available to other stakeholders (such as the Wildflower Society of WA) in order to contribute to the understanding of regional values.

### 6.2 Management Plans

Management plans will be developed during the formal assessment process to ensure that appropriate control measures are provided in order to minimise impacts from the proposals. These include:

- Amendment to the Environmental Management System and associated plans, procedures and guidelines for the Marda Central Project;

- Marda East Heritage Management Plan; and
- Marda East Surface Water Management Plan.

### 6.3 EPBC Act Referral for Malleefowl

SXG will prepare and submit a referral for the Proposal to the DoE (Cth) due to the potential impacts of malleefowl (*Leipoa ocellata*), listed as Vulnerable under the *EPBC Act*. Given the Proposal will not remove any active malleefowl mounds, is limited to no more than 46ha of disturbance and includes commitment to confirm that any chicks present in the mound adjacent to Red Legs have dug out prior to activities commencing, SXG does not consider that the Proposal is likely to be assessed as a controlled action, however will provide the relevant documentation and communication from the DoE to the EPA in relation to this referral.

### 6.4 Mine Closure Plan Update

The MCP prepared for the Marda Central Project will be amended to reflect the inclusion of the Marda East Proposal. This update will incorporate data that will be obtained from site-specific surveys such as waste rock, tailings and soil characterisation studies and the visual impact modelling. The MCP will also focus on potential impact of stability of landforms in the long term, including pits and WRLs. As outlined in section 3.5, a number of stakeholders including the DPaW, DMP, Great Western Woodlands and Wildflower Society of WA will be engaged with during the development of the MCP.

## 7 Conclusion

Due to the proposed limited key environmental factors (landforms and visual amenity), and the on the basis of the environmental assessment described in this ERSD, SXG considers it relevant for the Proposal to undergo an Assessment on Proponent Information (API) – Category A.

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## **Appendix A** Environmental Referral

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## **Appendix B** Preliminary Risk Assessment

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## **Appendix C** Briefing Notes to Stakeholders

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## **Appendix D** Level 2 Flora and Vegetation Survey

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## Appendix E Visual Impact Assessment

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## **Appendix F** Subterranean Fauna Risk Assessment

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## **Appendix G** Level 1 Fauna Assessment

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## **Appendix H** Marda East Drainage Investigation

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## **Appendix I** Surface and Groundwater Assessment (Marda Central)

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## Appendix J Visual Impact Assessment Montages

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## Appendix K Cultural Heritage Reports

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## **Appendix L** Proposal Layout Electronic Files

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