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ENVIRONMENTAL REFERRAL
MARDA GOLD PROJECT

ATTACHMENT 2: ENVIRONMENTAL REFERRAL SUPPORTING DOCUMENT

2 JANUARY 2014

bioscope environmental

EXECUTIVE SUMMARY

Southern Cross Goldfields Ltd (SXG or the Company) proposes to develop the Marda Gold Project (the Proposal) approximately 120 km north of Southern Cross, Western Australia. The Proposal includes open pit mining at three locations within the Marda region:

- Marda Central, which includes the Dolly Pot, Python, Dugite and Goldstream open pits.
- King Brown, which is located approximately 21.7 km to the northwest of Marda Central and at which mining will be conducted at the King Brown open pit.
- Golden Orb, which is located approximately 18.7 km to the southwest of Marda Central and at which mining will be conducted at the Golden Orb open pit.

Mining will extract oxide (weathered) ore and waste rock which is typically hosted in Banded Iron Formations (BIF) geological formations although no part of the Proposal is located on, or impacts, BIF ridges. Conventional drill and blast, load and haul mining techniques will be used to develop the open pits. Approximately 1.6 Mt of ore and 8.2 Mt of waste rock will be mined during the 2.5 year operational life of the Proposal.

Pit dewatering requirements vary across the Project Area due to varying depths to the water table. At the completion of mining and dewatering activities, it is anticipated that pit lakes will form in the King Brown, Golden Orb and Dolly Pot pits.

Gazetted public roads provide access to the Project Area. The Bullfinch-Evanston Road will be the main site access route, including for haulage of Golden Orb ore along a 12.2 km section of the road.

Ore from each deposit will be processed at Marda Central in a conventional 720,000 tpa gold processing plant. Tailings from the processing plant will be disposed of in a single-cell Tailings Storage Facility (TSF) located adjacent to the Marda Central processing plant.

Part of the Project Area occurs within a proposed 5(1)(h) dual purpose Conservation and Mining Reserve within land managed by the Department of Parks and Wildlife (DPaW). SXG has conducted extensive consultation with the DPaW during development of the Proposal, with DPaW recently recognising that SXG has "avoided placing infrastructure on DPaW-managed lands where possible, and this is a commendable outcome" (S. Thomas, pers. comm., 27 November 2013).

SXG has prepared an Environmental Referral for the Proposal. This Environmental Referral Supporting Document (ERSD) provides additional information to assist the Environmental Protection Authority 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 environmental factors and objectives (EAG 8) and application of a significance framework in the environmental impact assessment process (EAG 9).

The significance of Proposal implementation on the environmental factors was assessed in accordance with EAG 9. Following this assessment, SXG has concluded that the 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) and Department of Water (DoW), with input from the DPaW (see Chart ES-1). Based on this conclusion, the Proposal is not considered to be a significant proposal.

Chart ES-1: Significance of Environmental Factors

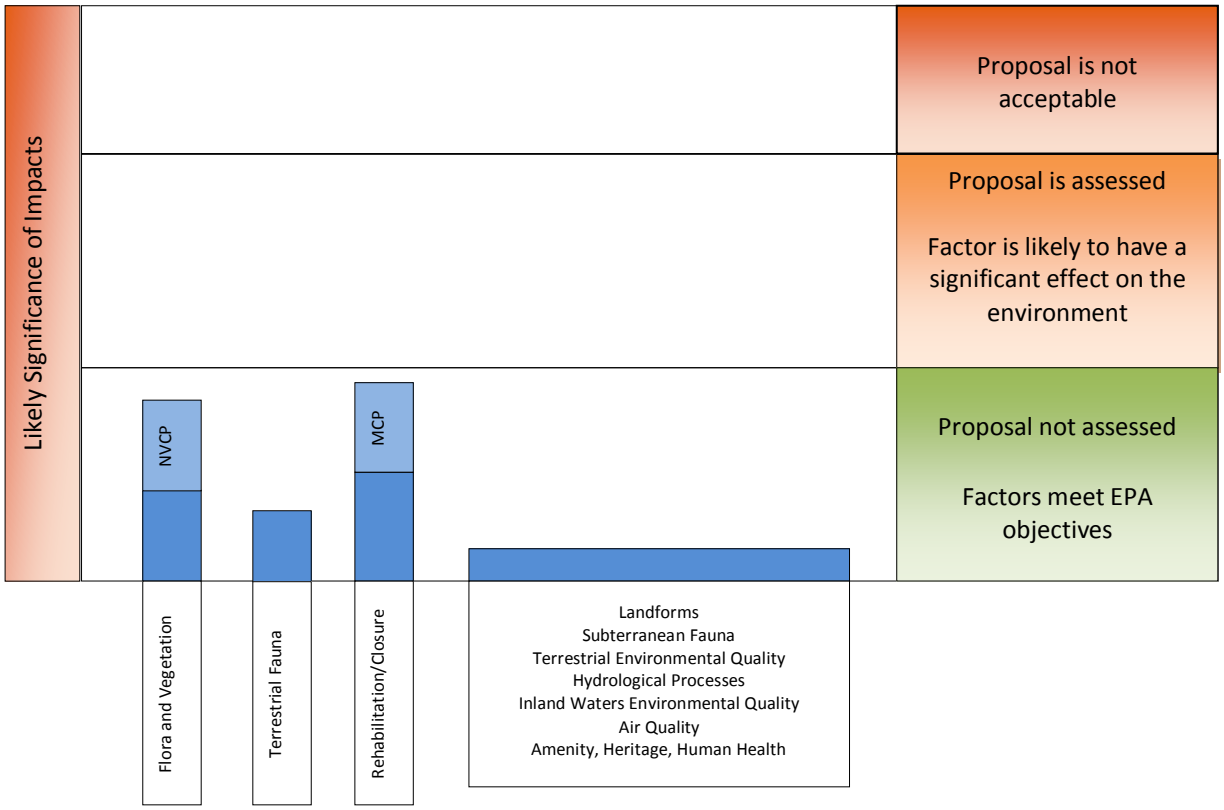

Table ES-1: Environmental Factors Summary

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.	Clearing of up to 190 ha of native vegetation including a very small portion (<2%) of a plant community analogous with the Mt Jackson Vegetation Complex Priority Ecological Community. Clearing of <8% of local populations of two Priority 3 flora species, *Stenantheum newbeyi* and *Gnephosis* sp. Norseman (K.R. Newbey 8096). Potential for localised loss of condition of vegetation due to: • dust generation, erosion and sedimentation; • changes in drainage patterns; • increased weed infestations; • saline water overspray during dust suppression; and • accidental bushfires, should these occur.	Implement and enforce a Ground Disturbance Permit system. Limit ground disturbance and clearing of vegetation to designated areas and access routes. Maintain the proposed exclusion zone west of Dolly Pot pit to prevent disturbance of Priority Flora habitat and a BIF plant community. Conduct clearing progressively to reduce the total area of exposed soil at any one time. Restrict clearing during strong winds to reduce dust generation and soil loss. Implement vehicle hygiene measures.	Mining Proposal (DMP) Mine Closure Plan (DMP) Native Vegetation Clearing Permit (DMP)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Flora and Vegetation (cont.)			Stockpile cleared vegetation for use in rehabilitation. Regulate vehicle speed limits to reduce dust generation. Implement fire management procedures consistent with the DPaW fire management plan for the Great Western Woodlands. Avoid saline water overspray during dust suppression activities. Implement progressive rehabilitation.		

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Landforms and Soils	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.	Development of six pit voids, four WRLs and a TSF. No change to landscape values of the region such as the Helena and Aurora Ranges. Dispersive soils may adversely affect rehabilitation if not managed carefully.	Design WRLs to ensure rehabilitated landforms will be as visually congruent as practicable with adjacent landforms. Implement progressive rehabilitation. Clear and stockpile topsoil and subsoil for use in rehabilitation. Limit topsoil stockpiles to 1.8 m high and seed with local species if stockpiling for more than 12 months. Avoid use of saline water for dust suppression where topsoil is being cleared and stockpiled. Incorporate (blend) gravels into SMU 3 soils prior to use in rehabilitation. Implement surface water management on WRLs and TSF.	Mining Proposal (DMP) Mine Closure Plan (DMP)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	Groundwater drawdown due to pit dewatering may impact on stygofauna. Mine pit excavation may impact on troglofauna.	No specific management measures required.	Mining Proposal (DMP)	Yes
Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.	Limited potential for seepage of contaminants into soils.	Waste rock will be disposed to WRLs which will be rehabilitated on a progressive basis. Dispose of tailings to a TSF with a compacted soil liner, underdrainage system and toe drains to capture seepage and groundwater monitoring bores. Reuse and recycle materials where practicable. Cover landfill regularly and fence with a lockable gate. Store and use reagents in accordance with relevant Material Safety Data Sheets and Standards. Store hydrocarbons in self-bunded tanks.	Mining Proposal (DMP) Mine Closure Plan (DMP) Native Vegetation Clearing Permit (DMP) Works Approval and Licencing (DER) Dangerous Goods Licence (DMP)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Terrestrial Environmental Quality (cont.)			Bioremediation of hydrocarbon contaminated soils. Implement an incident reporting system. Rehabilitate historical shafts and associated disturbances within the Marda Central tenement on a progressive basis.		
Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	Localised loss of fauna habitat including small areas of potential Malleefowl habitat and a very small area of habitat for the land snail *Bothriembryon* sp. Loss of animals unable to move away during the clearing process. Potential for localised impact on fauna assemblages due noise, vibration, dust, vehicle movements, accidental bushfires, etc.	Clear vegetation from cleared to uncleared areas where practicable to provide fauna escape routes. Regulate vehicle speed limits to reduce dust generation on roads and the potential for collisions with fauna. Regularly monitor open excavations and water ponds to ensure trapped fauna are rescued and released as quickly as possible.	Mining Proposal (DMP) Mine Closure Plan (DMP) Native Vegetation Clearing Permit (DMP)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Terrestrial Fauna (cont.)			Fence ponds to exclude fauna and install fauna egress matting. Maintain the proposed exclusion zone west of Dolly Pot pit to prevent disturbance of potential Malleefowl habitat associated with a small hill in that area.		
Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	Localised changes in sheet flow patterns. No impact on the Marda Water Reserve or Marda Dam. Groundwater drawdown due to pit dewatering and water supply. Limited potential for TSF seepage and leaks/spills in the processing plant to affect groundwater quality.	Divert clean stormwater runoff around the mine pits, processing plant, workshops and other infrastructure, and the TSF. Rehabilitate pit access roads and make inaccessible to prevent human access. Install pit abandonment bunds to deter public and animal access. Monitor and determine if Dolly Pot pit requires backfilling to above the long term standing water table.	Mining Proposal (DMP) Mine Closure Plan (DMP) Works Approval and Licencing (DER) Water Licencing (DoW) Dangerous Goods Licence (DMP)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Hydrological Processes (cont.)		Formation of pit lakes in the King Brown, Golden Orb and Dolly Pot pits which may become more saline over time, may attract members of the public, and may attract fauna, resulting in increased grazing pressures in localised areas.	See also management measures for Terrestrial Environmental Quality.		
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.	Refer to discussion on impacts on Flora and Vegetation, Subterranean Fauna, Terrestrial Fauna and Hydrological Processes.	Refer to discussion on management measures for Flora and Vegetation, Subterranean Fauna, Terrestrial Fauna and Hydrological Processes.	Mining Proposal (DMP) Mine Closure Plan (DMP) Works Approval and Licencing (DER) Water Licencing (DoW) Dangerous Goods Licence (DMP)	Yes
Air Quality	To maintain air quality for the protection of the environment, human health and amenity.	Dust generation. Very limited greenhouse gas emissions from power generation.	Use covered transfer points and chutes within the crushing circuit. Use bag house on lime silo. Water mine haul roads, processing area roads and ore stockpiles.	Mining Proposal (DMP) Works Approval and Licencing (DER)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable.	Development of pit voids, WRLs and a TSF that will be visible from different locations in the region, particularly at high-elevation locations, resulting in localised visual impact. Localised visual impacts due to Project lighting at night.	Design WRLs to ensure rehabilitated landforms will be as visually congruent as practicable with adjacent landforms. Progressive rehabilitation of WRLs and TSF. Use of directional lighting or light shields where necessary.	Mining Proposal (DMP) Mine Closure Plan (DMP)	Yes
Heritage	To ensure that historical and cultural associations are not adversely affected.	No disturbance to Aboriginal heritage sites. No impacts on Marda Dam.	Train employees and contractors in their obligations under the *Aboriginal Heritage Act 1972* including the requirement to report any potential heritage sites discovered during construction and operation of the proposed Project.	Mining Proposal (DMP) Section 18 clearances under the *Aboriginal Heritage Act 1972* (DIA)	Yes
Human Health (noise and vibration)	To ensure that human health is not adversely affected.	Noise from fixed and mobile plant, and blasting. Vibration from blasting.	Use of low-noise equipment, silencers and exhaust mufflers where appropriate. Conduct blasting operations only during daylight hours.	Mining Proposal (DMP) Mine Closure Plan (DMP) Works Approval and Licencing (DER)	Yes

Table ES-1 (cont.)

Environmental Factor	EPA Objective	Predicted Environmental Impacts	Proposed Management Measures	Regulatory Management Processes	Does the Proposal Meet the EPA's Objectives?
Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	Not applicable.	Not required.	Not applicable.	Yes
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.	Not applicable.	Progressive rehabilitation and closure of disturbed areas.	Mining Proposal (DMP) Mine Closure Plan (DMP)	Yes

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SECTION 1.0 - INTRODUCTION

Southern Cross Goldfields Ltd (SXG or the Company) proposes to develop the Marda Gold Project (the Proposal) approximately 120 km north of Southern Cross, Western Australia (WA) (Figure 1-1). The Proposal includes open pit mining at three locations within the Marda region:

- Marda Central, which includes the Dolly Pot, Python, Dugite and Goldstream open pits (Figure 1-2).
- King Brown, which is located approximately 21.7 km to the northwest of Marda Central and at which mining will be conducted at the King Brown open pit (Figure 1-2).
- Golden Orb, which is located approximately 18.7 km to the southwest of Marda Central and at which mining will be conducted at the Golden Orb open pit (Figure 1-2).

Part of the Project Area occurs within a proposed 5(1)(h) dual purpose Conservation and Mining Reserve within land managed by the Department of Parks and Wildlife (DPaW) (Figure 1-3). Consequently, SXG conducted extensive consultation with the DPaW during development of:

- the proposed site layout;
- the Company's environmental impact assessment of the proposed Project;
- environmental management measures for the proposed Project; and
- the Project's draft Mine Closure Plan (MCP).

See Section 3.5 for further information.

Mining will extract oxide (weathered) ore and waste rock which is typically hosted in Banded Iron Formations (BIF) geological formations although no part of the Proposal is located on, or impacts, BIF ridges. Conventional drill and blast, load and haul mining techniques will be used to develop the open pits. Approximately 1.6 Mt of ore and 8.2 Mt of waste rock will be mined during the 2.5 year operational life of the Proposal.

Pit dewatering requirements vary across the Project Area due to varying depths to the water table. Dewatering at Marda Central will be achieved by a small production bore field, while a combination of in-pit sumps and dewatering bore holes will be used at the King Brown and Golden Orb satellite pits. At the completion of mining and dewatering activities, it is anticipated that pit lakes will form in the King Brown, Golden Orb and Dolly Pot pits.

Ore from the Marda Central deposits will be hauled directly to a Run of Mine (ROM) pad located adjacent to the processing plant. Ore from the King Brown and Golden Orb satellite deposits will be stockpiled in a local ROM stockpile at each deposit before being loaded onto a road train for campaign transport to the Marda Central ROM pad. Gazetted public roads provide access to the

Project Area and will be used for site access. This includes haulage of Golden Orb ore along 12.2 km of the Bullfinch-Evanston Road.

Ore from all six deposits will be processed at Marda Central in a conventional 720,000 tpa Carbon in Leach (CIL) gold processing facility. The facility will largely comprise components of the existing Sandstone gold treatment plant which is owned by SXG and will be refurbished and transported to the Marda Central site. Tailings from the processing plant will be disposed of in a single-cell Tailings Storage Facility (TSF) located adjacent to the Marda Central processing plant.

Subject to approval timing, it is proposed that construction commence in the second quarter of 2014. Mining is proposed to commence in the fourth quarter of 2014 and will be completed by the first quarter of 2017.

SXG has prepared a Mining Proposal (MP), Mine Closure Plan (MCP) and Works Approval Application (WAA) for the Proposal. Following provision of a briefing on the Proposal to the Office of the Environmental Protection Authority (OEPA) on 18 December 2013, the Company has decided to submit an Environmental Referral to the Environmental Protection Authority (EPA) to allow the Authority to determine whether formal assessment under Part IV of the *Environmental Protection Act 1986* is required. The purpose of this document is to support the Environmental Referral for the proposed Project. This document provides information on the following:

- 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 (Section 4).
- The significance of the assessed environmental factors (Section 5).

SECTION 2.0 - PROJECT 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. Its experience in managing operating mine sites includes:

- Nimbus Silver Project near Kalgoorlie, WA. PLY purchased Nimbus from Barrick Mines in 2003 and operated the mine until 2007. The plant and infrastructure were sold in 2009.
- Mount Boppy Gold Mine, NSW. This open cut gold mine operated from 2002 to 2005.
- Hellyer Zinc Tailings Retreatment Project, Tasmania. PLY managed the Hellyer Tailings Retreatment Project, which produced a bulk concentrate from lead/zinc/silver tailings, from 2005 to 2008.
- White Dam Gold Project, SA. This project was an unincorporated Joint Venture between PLY and Exco Resources Limited that involved open cut mining and dump leaching of ore from 2010 to 2012.

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^2 in WA in the Southern Cross and Sandstone greenstone belts and the Pilbara region, and 200 km^2 in the Lachlan Fold Belt of NSW.

SXG's contact details are provided below:

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2.2 Key Characteristics

SXG proposes to develop the Proposal as an open pit mining operation and associated gold processing plant. Gold bearing ore will be extracted from six deposits approximately 150 km north of Southern Cross in WA's Yilgarn Mineral Province. The Proposal has a 2.5 year operational life.

Development of additional deposits and exploration targets may extend the Proposal life, but do not form part of the current Proposal.

Key Proposal characteristics are provided in Table 2-1, a timeline for the Proposal is provided in Table 2-2 and a Proposal layout is shown in Figure 1-2. Subject to approval timing, construction is proposed to commence in the third quarter of 2014. Mining is proposed to commence in the fourth quarter of 2014 and will be completed by the first quarter of 2017.

Table 2-1: Key Characteristics of Marda Gold Project

Characteristic	Value
Ore	1.6 Mt
Grade	2.23 g/t
Waste Rock	8.24 Mt
Duration of Mining Operations	2.5 years
Processing Throughput	720,000 tpa
Clearing Footprint	190 ha
Final Depth of Pits • Dolly Pot • Dugite • Python • Goldstream • King Brown • Golden Orb	 85 m 55 m 75 m 40 m 50 m 95 m
Total water consumption	2.06 GLpa
Power requirement	56.3 MWh/day
Estimated Workforce	73

Source: Rock Team (2012)

Table 2-2: Proposed Proposal Timeline

Stage	Proposed Timing
Feasibility study	Completed November 2013
Approvals and Permitting	November 2013 – May 2014
Construction	June 2014 – October 2014
Production	October 2014 – March 2017
Decommissioning and closure	2017
Post-closure monitoring and remedial works	2018 onwards

2.3 Project Components and Layout

The elements of the Proposal are located in three separate locations and include six open cut mines, a processing plant, administration and workshop buildings, accommodation camp, airstrip, Waste

Rock Landforms (WRLs), topsoil storage dumps, haul and service roads, and a TSF. The main elements include:

- Marda Central
  - Four open cut pits (Dolly Pot, Python, Dugite and Goldstream).
  - Two WRLs.
  - Four topsoil storage dumps.
  - Internal haul and service roads.
  - Explosives magazine.
  - Conventional gold processing plant.
  - Administration and workshop buildings.
  - Accommodation camp.
  - Airstrip.
  - TSF.
- King Brown
  - One open cut pit (King Brown).
  - Haul road.
  - One WRL.
  - One topsoil storage dump.
  - Satellite mine administration facility.
- Golden Orb
  - One open cut pit (Golden Orb).
  - Haul road.
  - One WRL.
  - One topsoil storage dump.
  - Satellite mine administration facility.

Site layout figures are provided as Figures 2-1 to 2-7.

2.4 Proposed Mining Operations

The six deposits to be mined are located in three separate areas:

- Four deposits at Marda Central:
  - Dolly Pot, which will cover an area of 2.75 ha and reach a maximum depth of 85 m.
  - Dugite, which will cover an area of 1.3 ha and reach a maximum depth of 55 m.
  - Python, which will cover an area of 4.32 ha and reach a maximum depth of 75 m.
  - Goldstream, which will cover an area of 1.3 ha and reach a maximum depth of 40 m.

- One satellite deposit at King Brown which will cover an area of 2.43 ha and reach a maximum depth of 50 m.

- One satellite deposit at Golden Orb which will cover an area of 6.0 ha and reach a maximum depth of 95 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, but will be staged across the operational life of the Proposal (Table 2-3).

Table 2-3: Resource Development Schedule

Deposit	2014				2015				2016				2017	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Python				X	X			X	X	X	X	X		
Dugite				X	X	X								
Goldstream				X	X									
Dolly Pot				X	X	X	X	X	X	X				
King Brown					X	X	X							
Golden Orb						X	X	X	X	X	X	X	X	

Dewatering requirements vary across the pits due to varying depths of the water table. Dewatering at Marda Central will be via production bores while in-pit sumps and dewatering bores will be used at the King Brown and Golden Orb satellite pits. Water from pit dewatering will be used for ore processing, treated to provide potable water (via reverse osmosis plant) and used for dust suppression. During normal operating conditions, the Proposal will not produce excess water and no groundwater will be discharged to the environment.

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

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

The Proposal will exclusively mine and process oxidised and transitional (weathered) ores. The ore and waste rock do not contain any unreacted sulphide minerals which are typically the main source of Potentially Acid Forming (PAF) materials (Rapallo 2013a, 2013b, 2013c).

2.5 Proposed Processing Operations

Ore from each deposit will be processed at Marda Central in a conventional 720,000 tpa CIL gold processing facility. The facility will largely comprise components of the existing Sandstone gold treatment plant which is owned by SXG and will be refurbished and transported to the Marda Central site. In order to achieve the required throughput rate, an 1,800 kW ball mill will be added to the Sandstone circuit.

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. Reagents used in the process will include sodium cyanide, quicklime, sodium hydroxide (caustic soda), hydrochloric acid and liquid oxygen. The ore treatment process is depicted in Figure 2-7.

The Marda 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.
- Arsenic leaches slightly at elevated pH but will form stable calcium arsenate with the lime pH modifier used in processing.

Tailings from the Marda processing plant will be disposed of to a 27 ha, above ground, side hill type TSF west of the processing plant (Figures 2-8 and 2-9). The starter embankment will be constructed to the crest RL 442.0 m (Figure 2-9) utilising in-situ gravelly/sandy clay from within the TSF basin and a borrow pit to be located immediately east of the TSF site. Exposed gravelly/sandy clay from within the TSF basin will be compacted to form a liner. Subsequent lifts will be constructed by the upstream construction method with either dried tailings or mine waste to the ultimate crest level of 449.5 m. Excavation for borrow material will be confined to the gravelly/sandy clay zone above the underlying rock.

The starter embankment will provide a storage life for 13 months of production or 760,000 t. 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 0720,000 tpa. A decant system, an upstream

underdrainage system, a diversion drain and provision for adequate freeboard (0.82 m) have been incorporated in the design for effective water management. In the event that seepage occurs, the design includes downstream seepage systems and a cut-off trench (Coffey Mining 2013).

2.6 Proposed Support Infrastructure

Infrastructure will be developed to support mining and processing operations in the Marda Central Project Area including:

- A diesel-fired power station to generate 56 MW/day.
- A diesel storage and refuelling facility comprising three 55 kL self-bunded diesel tanks inside a 78 m^2 bunded concrete apron.
- A mobile equipment and fixed plant workshop.
- An explosives magazine constructed and operated in compliance with the Dangerous Goods Safety Regulations 2007 (WA) and AS2187.1.
- Administration office buildings.
- Fixed plant and mobile plant workshops and stores buildings.
- A laboratory building.
- A reagent storage and handling yard.
- Up to three groundwater abstraction bores for supplying raw water to the mine and process plant facilities, each with a standalone diesel generator.
- A Reverse Osmosis (RO) plant for the production of potable water.
- A 90 person accommodation camp which will be relocated from SXG's Sandstone mine. This facility will include diesel generators, a small diesel storage and refuelling facility, a package water treatment plant with sprinkler reticulation system, and a landfill.

The satellite mining operations at King Brown and Golden Orb will require limited support infrastructure. This will comprise a diesel storage and refuelling facility, mine dewatering equipment (in-pit sumps and pumps as well as dewatering bores equipped with diesel generators), a site office building and ablutions facility, and a diesel power generator and lighting plants.

SECTION 3.0 - 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 Project Area 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.

- 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 utilisation of existing infrastructure or construction of new infrastructure. These fall into two broad categories:

- Temporary infrastructure. Temporary infrastructure includes roads, topsoil stockpiles, gravel pits, the Marda processing plant, the accommodation camp and the airstrip. Placement of this infrastructure was considered during Proposal planning to mitigate potential environmental impact and facilitate progressive rehabilitation. See Sections 3.2.1 – 3.2.7.

- Permanent features. Mine pit voids, WRLs and the TSF are the permanent features that will remain after closure of the Proposal. With the exception of mine pit voids, which are located based on existing gold resource geometry, placement and design of permanent features were

considered during Proposal planning to mitigate potential environmental impacts. See Section 3.2.8 – 3.2.10.

Where possible, existing infrastructure will be used. Where new infrastructure is required, existing disturbances will be used where possible. 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.

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 use of a 12.2 km section of the Bullfinch-Evanston Road for Golden Orb ore haulage in lieu of constructing a new private haul road.

A key concern raised during stakeholder engagement with the DPaW, Shire of Yilgarn and Wildflower Society was the potential impact on public access within the proposed Project Area. As depicted in Figure 3-1, no existing gazetted roads or tracks will be closed by the Proposal and public thoroughfare will be maintained to and between the key regional features within the Project Area. However, SXG will divert a section of track that currently traverses the main mining area on the western portion of the Marda Central tenement. Alternative routing to the north of the tenement will allow continued public access from the Mt Jackson homestead to the Bullfinch-Evanston Road (Figure 3-1).

SXG proposes to use waste rock instead of developing gravel pits in the construction of haul roads and access tracks wherever practicable.

3.2.3 Topsoil Stockpiles

Topsoil will be cleared from the proposed locations of the open pits, WRLs, processing plant, TSF and other infrastructure required for the Proposal. This will be temporarily stockpiled in cleared areas or areas of sparse vegetation as close as possible to the final destination of the topsoil to facilitate spreading during progressive rehabilitation.

3.2.4 Gravel Pits

The Proposal will require 125,000 m^3 of gravel for construction and 340,000 m^3 of gravel or rock armour for rehabilitation. A number of gravel sources have been investigated to meet these requirements. These include:

- Tertiary conglomerates under disturbance footprints.
- Waste rock materials.
- In-situ gravel, which would require development of borrow pits.
- Gravel supply from a third party.

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. Less than 7% of total waste mined will provide enough material to meet the entire gravel requirement for the Proposal, although this material is not available until mining pre-strip and operations commence. Therefore, SXG proposes to initially recover tertiary conglomerates from within the Proposal disturbance footprints (such as the processing plant and TSF). The Company expects that these footprints will provide sufficient material for six months of construction after which waste rock materials should be available for use in construction and progressive rehabilitation.

In-situ gravel sources have been assessed by Soilwater Consultants (2013), but no gravel pits are proposed for development at this stage (except for a gravel pit adjacent to the TSF) as SXG proposes to initially recover tertiary conglomerates from within the proposed disturbance footprints and thereafter use waste rock for construction purposes. Sources other than in-situ gravel may require material to be crushed to an optimal gravel size fraction.

An alternative potential source of gravel is crushed waste rock from Cliffs Natural Resources' haematite mining operations at Mt Jackson (8 km south of Marda Central) and Windarling (25 km north of Marda Central). SXG has approached Cliffs regarding the potential to utilise some of its waste material as a gravel source for Marda construction and or rehabilitation. The selection of this source of gravel will depend on commercial agreements being achieved and economic viability relative to in-situ gravel production.

3.2.5 Processing Plant

A number of possible locations were considered for the processing plant during initial Proposal scoping. The proposed location was chosen due to its proximity to the majority of early mining and the minimal impact on vegetation and other significant conservation and heritage locations.

3.2.6 Accommodation Camp

An accommodation camp is ideally located close to, but safely distanced from, the central operations. It was initially proposed that the Marda camp be located to the north of the processing plant, but after consideration of the objectives of DPaW as manager of the proposed 5(1)(h) dual purpose Conservation and Mining Reserve, it was determined that the camp location could be placed outside the boundaries of the proposed reserve.

As indicated in Section 3.5, DPaW has recognised the effort made by SXG to consult with the Department in relation to the Proposal layout and concessions made to place the accommodation camp and airstrip outside of DPaW-managed lands.

3.2.7 Airstrip

Selection of an airstrip location is influenced by a number of factors including:

- Civil Aviation Safety Authority (CASA) requirements.
- Proximity to existing infrastructure for servicing.
- Proximity to mining areas, the processing plant and camp for operational efficiencies and safety considerations (in the event that medical or emergency evacuation is required).
- Consideration of impacts on sensitive vegetation and heritage locations.
- Geophysical limitations related to the length of the airstrip and its requirement to be level.

The initial preferred location was to be at the location of a previously utilised airstrip to the northwest of the proposed Marda processing plant location. This airstrip was rehabilitated recently, but could be recommissioned. However, after consideration of the objectives of the DPaW as manager of the proposed 5(1)(h) dual purpose Conservation and Mining Reserve, it was determined that the airstrip location could be placed outside the boundaries of the proposed reserve without significant loss to the objectives of the Proposal.

SXG has also considered shared use of the Windarling airstrip, and will continue discussions with Cliffs in this regard, but is seeking approval for development of its own airstrip to meet operational requirements.

As indicated in Section 3.5, DPaW has recognised the effort made by SXG to consult with the department in relation to the Proposal layout and concessions made to place the accommodation camp and airstrip outside of DPaW-managed lands.

3.2.8 Backfilling of Pit Voids

The potential for backfilling of open pits has been considered in line with Department of Mines and Petroleum (DMP) Mining Proposal Guidelines and DPaW's requests in its position as a key stakeholder responsible for management of the proposed 5(1)(h) 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 Mining Proposal 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 indicate that the Marda Central deposits are open at depth which means that ore resources are present below the currently defined base of the pits. Consequently, backfilling of the pits may not be supported by the DMP.

Hydrological modelling by Pendragon Environmental Solutions (2013) indicates that pit lakes are likely to form in the King Brown and Golden Orb pits at depths of 44 m and 31 m, respectively. As these pits are outside of the proposed 5(1)(h) Conservation and Mining Reserve and have resources below the currently proposed pit floor, backfilling has not been considered. Safety berms and abandonment bunds will be constructed around the pits in accordance with DMP requirements.

DPaW's concern regarding the potential presence of pit lakes in the proposed 5(1)(h) dual purpose Conservation and Mining Reserve relates to:

- public safety, if members of the public access the pit areas and elect to swim in the pits; and
- potential grazing pressures, which may occur if native, domestic and/or feral animals are attracted to the pit areas by the smell of water. Even if the animals cannot reach the pit lakes, they may still congregate and graze in the vicinity of the pit. This could result in over-grazing and/or trampling of plants in areas of fauna congregation, which is of particular concern to DPaW if Priority Flora species are present in these areas.

Hydrological modelling by Pendragon Environmental Solutions (2013) indicates that there is limited potential for pit lakes to form in the Dugite and Python pits and it is expected that evaporation will exceed inflows so if lakes appear in these pits following cessation of mining, they will be shallow and quite likely to be ephemeral. 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.

SXG proposes to extract water from the aquifer below the Dolly Pot pit to provide water for ore processing which in turn will assist with dewatering this pit during mining operations. Accordingly, a pit lake is not expected to form while the processing plant is operating, although may form once processing operations have ceased and the aquifer recharges over time. Hydrological modelling by Pendragon Environmental Solutions (2013) indicates that there is potential for pit lake formation in the proposed final Dolly Pot pit void to a depth of approximately 16 m.

To reduce the risk of members of the public accessing Dolly Pot pit, 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 assist in deterring public access. No Priority Flora species are

present in the immediate vicinity of the pit, though *Lepidosperma ferricola* has been recorded within the exclusion zone approximately 300 m west of the pit.

SXG will complete the following actions during operations to determine if the Dolly Pot pit will be backfilled to above the long term standing water table:

- Determine the extent of gold resources below the pit and, dependent on the outcome of these investigations, comply with DMP requirements to gain approval prior to backfilling of the pit.
- Refine the pit lake model as further geological, hydrological and groundwater monitoring data are collected throughout the life of the Proposal.
- Liaise with DPaW to assess the potential for grazing impacts on *Lepidosperma ferricola* in the exclusion zone.

3.2.9 Disposal of Waste Rock

Rather that develop borrow pits or quarries to supply construction materials, SXG proposes to use Non Acid Forming (NAF) waste rock removed from the pits in the construction of ore haulage roads from the pits to the ROM pads and in TSF construction. This significantly reduces the disturbance footprint of the Proposal, particularly in DPaW-managed lands.

The remaining waste rock will be stored in WRLs 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; and
- within a mining lease.

As indicated in Section 2.4, four WRLs will be developed, with the four Marda Central pits utilising two shared WRLs and a separate WRL being established adjacent to the King Brown and Golden Orb pits. The WRLs that have been designed to fit with the natural terrain and to have a final rehabilitated shape with:

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

The current design heights are 15-16 m for the Marda Central WRLs, 10 m for the King Brown WRL and 21 m at the Golden Orb WRL.

The proposed WRL locations are provided on Figures 2-1 to 2-3.

3.2.10 Tailings Storage Facility

The objective of the TSF location options assessment was to identify a site that provided optimal engineering design safety factors and that could be closed effectively at the completion of the Proposal. Five sites were considered during this assessment (see Figure 3-2). Details of the assessment are provided in Table 3-1.

The preferred TSF location is shown on Figure 2-1.

3.3 Preliminary Environmental Risk Assessment

A preliminary environmental risk assessment was conducted for the Proposal in October 2012 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.

The preliminary environmental risk assessment was undertaken prior to the release of the EPA's Environmental Assessment Guideline (EAG) for Environmental Factors and Objectives (EAG 8) (EPA 2013a), but 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. None of the identified residual Proposal risks were considered to be significant.

The outcomes of the October 2012 preliminary risk assessment along with environmental surveys and studies conducted for the Proposal prior to, and following completion of, the environmental risk assessment were used in the assessment of environmental factors described in Section 3.4.

Table 3-1: TSF Location Options Assessment

Factor	TSF Site Options					
	1	2	3	4	5	6 (proposed)
Characteristics						
Type of TSF	Above-ground, side-hill type TSF	Above-ground, side-hill type TSF	Valley-type TSF	Paddock-type TSF	Paddock-type TSF	Above-ground, side-hill type TSF (combination of Options 1 and 2)
Proximity to processing plant site	0.9 km west of proposed plant site	0.5 km west of proposed plant site	1.3 km south of proposed plant site	4.9 km northwest of proposed plant site	6.0 km northwest of proposed plant site	0.6 km west of proposed plant site
Proximity to proposed 5(1)(h) Conservation and Mining Reserve	Within proposed 5(1)(h) Conservation and Mining Reserve	Within proposed 5(1)(h) Conservation and Mining Reserve	Within proposed 5(1)(h) Conservation and Mining Reserve	Outside of proposed 5(1)(h) Conservation and Mining Reserve	Outside of proposed 5(1)(h) Conservation and Mining Reserve	Within proposed 5(1)(h) Conservation and Mining Reserve
Engineering						
Suitability of ground conditions	Ground conditions vary. Duricrust present along western margin and moderately weathered bedrock material near or at surface in centre.	Ground conditions are moderately uniform across area.	Topography and ground conditions are moderately favourable.	Cohesive alluvium will reduce seepage	Presence of granular alluvium could lead to greater seepage in TSF footprint.	Ground conditions combination of 1 and 2.
Source of construction material	Site won embankment construction materials may be predominantly granular.	Site won material is likely to be adequate for embankment construction	Site won material is likely to be adequate for embankment construction.	Cohesive alluvium will provide adequate on-site embankment construction material.	Mixed granular and cohesive alluvium. Requires separation prior to use as construction materials.	Site won material is likely to be adequate for embankment construction

Table 3-1 (cont.)

Factor	TSF Site Options					
	1	**2**	**3**	**4**	**5**	**6 (proposed)**
Engineering (cont.)						
Proximity to other infrastructure	No significant infrastructure downstream of site.	Processing plant is immediately adjacent, so there is potential for operation to be at risk in the event of TSF failure.	Processing plant and pits are downstream of this site so there is potential for operation to be at risk in the event of TSF failure.	King Brown haul road and eastern end of airstrip are downstream therefore potential for infrastructure to be at risk due to TSF failure.	King Brown haul road and eastern end of airstrip are downstream therefore potential for infrastructure to be at risk due to TSF failure.	No significant infrastructure downstream of site.
Capital Costs	Reduced construction costs due to side hill type TSF.	Reduced construction costs due to side hill type TSF.	Reduced construction costs if valley-type TSF is constructed.	Higher cost due to paddock style four sided type TSF.	Higher cost due to paddock style four sided type TSF.	Reduced construction costs due to side hill type TSF.
Operational Costs	<1km km from plant site so lower pumping costs than Options 3-5.	0.5 km from plant site so lowest pumping costs.	1.3 km from plant so higher cost of pumping than Options 1, 2 and 6, but lower than Options 4 and 5.	More than 4.9 km from plant site so higher costs of pumping.	More than 6.0 km from plant site so highest cost of pumping.	<1km km from plant site so lower pumping costs than Options 3-5.
Ranking by Coffey Mining (2013) based on above factors	1	1	4	3	5	1
Potential for impact on groundwater	Not rated by Coffey	Not rated by Coffey	Not rated by Coffey	Cohesive alluvium will reduce seepage.	Presence of granular alluvium could lead to greater seepage within TSF footprint.	Not rated by Coffey
Permeability	Permeability 10^{-8}	Permeability 10^{-7}	Permeability 10^{-7}	Permeability 10^{-7}	Permeability 10^{-7}	Permeability 10^{-8}

Table 3-1 (cont.)

Factor	TSF Site Options					
	1	**2**	**3**	**4**	**5**	**6 (proposed)**
Environmental						
Potential for impact on surface water	Diversion drainage is required to protect TSF from hill run-off.	Diversion drainage is required to protect TSF from hill run-off.	Diversion drainage is required to protect TSF from hill run-off.	No diversion required other than stand TSF wall protection.	No diversion required other than stand TSF wall protection.	Diversion drainage is required to protect TSF from hill run-off.
Potential for impact on PEC	Approximately 3 km north-northwest of the northern boundary of the PEC.	Approximately 2.5 km north-northwest of the northern boundary of the PEC.	Approximately 1km north-northwest of the northern boundary of the PEC.	Approximately 6km north-northwest of the northern boundary of the PEC.	Approximately 7km north-northwest of the northern boundary of the PEC.	Approximately 2.5 km north-northwest of the northern boundary of the PEC.
Potential for impact on Priority Flora	No clearing of Priority Flora required.	No clearing of Priority Flora required.	No clearing of Priority Flora required.	No clearing of Priority Flora required.	No clearing of Priority Flora required.	No clearing of Priority Flora required.
Impact on significant fauna habitats	No clearing of significant fauna habitat required.	No clearing of significant fauna habitat required.	No clearing of significant fauna habitat required.	No clearing of significant fauna habitat required.	No clearing of significant fauna habitat required.	No clearing of significant fauna habitat required.
Risk of pipeline leaks and spills	<1km from plant site so lower risk of leaks and spills due to shorter length of pipeline.	0.5 km from plant site so lowest risk of leaks and spills due to shorter length of pipeline.	1.3 km from plant so slightly higher risk of leaks and spills than Options 1, 2 and 6 due to slightly longer length of pipeline, but much lower risk than Options 4 and 5.	More than 4.9 km from plant site so higher risk of leaks and spills due to longer length of pipeline.	More than 6.0 km from plant site so highest risk of leaks and spills due to longer length of pipeline.	<1km from plant site so lower risk of leaks and spills due to shorter length of pipeline.

Table 3-1 (cont.)

Factor	TSF Site Options					
	1	**2**	**3**	**4**	**5**	**6 (proposed)**
Operational management	Proximity to plant assists management.	Proximity to plant assists management.	Further from plant so more difficult to manage.	Well away from plant so more difficult to manage.	Well away from plant so more difficult to manage.	Proximity to operation assists management.
Potential for dust emissions	Operational control required and cap for closure	Operational control required and cap for closure	Operational control required and cap for closure	Operational control required and cap for closure	Operational control required and cap for closure	Operational control required and cap for closure
Social						
Impact on visual amenity	Screened from view by hills.	Screened from view by hills.	Screened from view by hills.	On open area visible from all directions.	On open area visible from all directions.	Screened from view by hills.
Public safety (during operation)	Proximity of TSF to Marda Central operation provides security.	Proximity of TSF to to Marda Central operation provides security.	Proximity of TSF to to Marda Central operation provides security.	TSF distant from to Marda Central operation so less secure	TSF distant from to Marda Central operation so less secure	Proximity to Marda Central operation provides security.
Closure						
Closure costs	1.8 km from pits so lower capping material costs than Options 4-5.	1.5 km from pits so lower capping material costs than Options 4-6.	1.3 km from pits so lower capping material costs than Options 1-2 and 4-6.	6.0 km from pits so highest cost due to capping material transport.	7.2 km from pits so highest cost due to capping material transport.	1.65 km from pits so lower capping material costs than Options 1, 4 and 5.
Public access post-closure	> 1 km from gazetted Mt Jackson – Marda Road	> 1 km from gazetted Mt Jackson – Marda Road	< 0.5 km from gazetted Bullfinch Evanston Road	< 1 km from gazetted Mt Jackson – Marda Road	< 1 km from gazetted Mt Jackson – Marda Road	> 1 km from gazetted Mt Jackson – Marda Road
Results						
Positive scores	10	10	8	4	1	**12**
Ranking	=2	=2	4	3	5	**1**

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 Proposal Environmental Referral to the EPA. These factors are listed in Table 3-2 along with the EPA's objectives for these factors and relevant environmental guidance documents.

Table 3-2: Relevant Environmental Factors

Theme	Factor	EPA Objective	Environmental Guidance
Land	Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.	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).
	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.	EPA Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems (EPA 2006a). Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011).
	Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	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). Note: The subterranean fauna studies for the Proposal were completed prior to the release of EAG 12 (EPA 2013c).

Table 3-2 (cont.)

Theme	Factor	EPA Objective	Environmental Guidance
Land (cont.)	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.	Code of Practice for Tailings Storage Facilities in Western Australia (DMP 2013). Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure (Australian National Committee on Large Dams [ANCOLD] 2012). 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-f).
	Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	EPA 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).

Table 3-2 (cont.)

Theme	Factor	EPA Objective	Environmental Guidance
Land (cont.)	Terrestrial Fauna (cont.)		Guidance Statement No 20: Sampling of Short Range Endemic Invertebrates (SREs) for Environmental Impact Assessment in Western Australia (EPA 2009).
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	Code of Practice for Tailings Storage Facilities in Western Australia (DMP 2013). Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure (ANCOLD 2012). 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/ARMCANZ 2000). Water Quality Protection Guidelines (WRC 2000a-f).
Water (cont.)	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.	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-f).

Table 3-2 (cont.)

Theme	Factor	EPA Objective	Environmental Guidance
Air	Air Quality	To maintain air quality for the protection of the environment, human health and amenity.	EPA Guidance Statement No. 12: Minimising Greenhouse Gases (EPA 2002b)
People	Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable.	Visual Landscape Planning in WA (WA Planning Commission ([WAPC] 2007). Guidance Notes for the Reduction of Obtrusive Light (The Institute of Lighting Engineers 2005).
	Heritage	To ensure that historical and cultural associations are not adversely affected.	EPA Guidance Statement No. 41: Assessment of Aboriginal Heritage (EPA 2004c)
	Human Health (noise and vibration)	To ensure that human health is not adversely affected.	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).
Integrating Factors	Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	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).

Table 3-2 (cont.)

Theme	Factor	EPA Objective	Environmental Guidance
Integrating Factors (cont.)	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.	EPA Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems (EPA 2006a). Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011). Environmental Protection Bulletin 19: EPA Involvement in Mine Closure (EPA 2013d).

The environmental factors listed in Table 3-2 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).

3.5 Stakeholder Engagement

Key stakeholders for the Proposal are listed in Table 3-3.

Table 3-3: Key Stakeholders

Stakeholder Group	Stakeholders
State Government	EPA and OEPA
	DMP
	DPaW – Kensington and Kalgoorlie
	Department of Environment Regulation (DER)
	DoW
	Department of Health (DoH)
	Department of Indigenous Affairs (DIA)
	CASA
	Main Roads Western Australia (MRWA)
Local Government	Shire of Yilgarn
Traditional Owners and Aboriginal Heritage	Central West Goldfields People/Sambo Family
	Blackstone Traditional Women
	Ballardong People
	Nyaki-Nyaki People
	Kelemaia Kubu(d)n/Champion Family
	Ngalia Heritage Research Council
Pastoral	Mt Jackson Station (owned by Cliffs)
	Pastoral Lands Board
NGOs	Conservation Council of WA
	Wildflower Society of WA
	Malleefowl Preservation Group
	BirdLife Australia (WA Branch)
Neighbouring Proponents	Cliffs Natural Resources

Consultation conducted to date in relation to the environmental assessment of the Proposal is summarised in Table 3-4.

Table 3-4: Consultation Program

Stakeholders	Consultation Program
OEPA	• Meeting in December 2013
DMP	• Meeting in January 2011 • Meeting in September 2012 • Meeting in January 2013 • Meeting in May 2013 • Meeting in October 2013
DPaW - Kensington	• Meeting in January 2011 • Meeting in October 2012 • Meeting in December 2012 • Meeting in May 2013 • Meeting in October 2013 • Provision of baseline reports for review in October 2013 • Letters sent in October and December 2013
DPaW - Kalgoorlie	• Teleconference in January 2011 • Teleconference in October 2012 • Site visit in December 2012 • Teleconference in December 2012 • Teleconference in October 2013
DER	• Works Approval Application Scoping Meeting in November 2013
DoW	• Various discussions by phone and emails throughout 2012 and 2103
DIA	• Meeting in March 2011
Shire of Yilgarn	• Meeting in May 2011 • Meeting in October 2013 • Meeting in December 2013
Ngalia Heritage Research Council	• Letter sent in January 2011 • Letter sent in February 2011
Central West Goldfields People/Sambo Family	• Meeting and letters in February-March 2011 • Meeting in December 2012
Blackstone Traditional Women	• Meeting and letters in February-March 2011
Ballardong People	• Meeting and letters in February-March 2011
Nyaki-Nyaki People	• Meeting and letters in February-March 2011
Kelemaia Kubu(d)n/Champion Family	• Meeting in December 2012
Mt Jackson Station (Cliffs)	• Meeting in May 2013 • Meeting in November 2013
Conservation Council of WA	• Letter sent in November 2013
Wildflower Society of WA	• Letter sent in November 2013 • Meeting in December 2013
Malleefowl Preservation Group	• Letter sent in November 2013 • Phone discussion and follow up information provided in November 2013

Table 3-4 (cont.)

Stakeholders	Consultation Program
Birdlife Australia WA	• Letter sent in November 2013
Cliffs Natural Resources	• Meeting in May 2013 • Meeting in October 2013 • Meeting in November 2013

Extensive engagement with DPaW has been viewed by SXG as a critical component of the stakeholder engagement process as the Marda Central site is located in a proposed 5(1)(h) dual purpose Conservation and Mining Reserve within DPaW-managed land (Figure 3-2). SXG has extensively consulted with the DPaW during development of:

- the proposed site layout;
- the environmental impact assessment of the Proposal;
- the environmental management measures for the Proposal; and
- the Proposal's draft Mine Closure Plan (MCP).

During consultation with DPaW, it was determined that the accommodation camp and airstrip could be placed outside the boundaries of the proposed 5(1)(h) Reserve without significant loss to the objectives of the Proposal or adverse environmental impact. DPaW recently recognised that SXG has *"avoided placing infrastructure on DPaW-managed lands where possible, and this is a commendable outcome"* (S. Thomas, pers. comm., 27 November 2013).

SXG has also provided DPaW with the Proposal's baseline environmental survey reports for the Marda Central area for review and has provided responses to its queries.

The main concerns raised by DPaW and other stakeholders are listed in Table 3-5.

Table 3-5: Key Stakeholder Concerns

Issue	Proponent's Response
An options analysis is required for infrastructure placement	An optional analysis was completed by SXG in consultation with DPaW. This assessment considered the placement of WRLs, roads, the accommodation camp, airstrip, TSF and other infrastructure.
Is it possible to move infrastructure such as the airstrip and accommodation camp to locations outside of the proposed 5(1)(h) reserve?	SXG originally proposed that the airstrip and accommodation camp be located adjacent to the Marda processing plant, but has since agreed to relocate these outside of the proposed 5(1)(h) reserve.
Will there be adverse impacts on conservation values in the region such as the BIF ranges and Priority Flora?	The Proposal will not impact on BIF ridges. Development of the Golden Orb pit and facilities will result in the clearing of approximately 8% of the local population of *Stenanthemum newbeyi* (Priority 3). Development of the King Brown haul road may result in clearing of approximately 8% of the local population of *Gnephosis* sp. Norseman (K.R. Newbey 8096) (Priority 3). These impacts are not considered to be significant.

Table 3-5 (cont.)

Issue	Proponent's Response
There is potential for impact on the proposed 5(1)(h) reserve. Main concerns relate to the potential for pit lakes to develop in mine voids post closure and associated impacts on fauna and public risk.	An assessment of whether pit lakes will form following the cessation of mining has been completed. It was concluded that shallow lakes may form in the Dolly Pot, Dugite and Python pits, though the likelihood of lakes forming in the Dugite and Python pits is low. Pit lakes are also likely to form in the King Brown and Golden Orb pit voids. SXG proposes to install safety berms and abandonment bunds at the completion of mining to restrict public access to the voids. The abandonment bunds will be placed to avoid conservation-significant species.
There is potential for impact on Malleefowl (*Leipoa ocellata*) due to the use of transport corridors traversing Malleefowl habitats.	A Malleefowl survey has been completed and a Malleefowl Management Plan has been prepared by SXG and provided to DPaW and the Malleefowl Preservation Group for review. There is potential for limited impact on Malleefowl where this occurs in the vicinity of proposed transport corridors.
Will there be sufficient competent rock for use in rehabilitation?	Adequate competent rock is available from within the Proposal footprint. This will be stockpiled separately for use in WRL and TSF rehabilitation.
Will public access to the Helena and Aurora Ranges increase as a result of roads and tracks developed for the Project?	SXG will prevent use of its haul roads and access tracks by the public during mining operations and will rehabilitate these when no longer required. Physical barriers may also be installed, if required. On this basis, public access to the ranges will not increase due to the Proposal.
Completion criteria development is important, particularly in relation to the post-project management of open pits in the proposed 5(1)(h) reserve.	Completion criteria were drafted and provided to DPaW for review. No feedback has been provided to SXG at the time that this report was prepared.

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 2013e) 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 can result from other regulatory processes to which a proposal may be subject. For the Proposal, these include:

- Mining Proposal approval under the *Mining Act 1978*.
- Works Approval and Licence under Part V of the *Environmental Protection Act 1986* (EP Act).
- Groundwater licences under sections 26D and 5C of the *Rights in Water and Irrigation Act 1914.*

- Dangerous Goods Licence under the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007.
- 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).
- Package water treatment plant installation approval under the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974.
- Landfill management under the Environmental Protection (Rural Landfill) Regulations 2002.

SECTION 4.0 - 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
1. The precautionary principle Where there are threats of serious or irreversible damage, lac of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk-weighted consequences of various options.	SXG has undertaken a wide range of studies to ensure that the environmental risks associated with the Proposal are understood as much as possible and can be managed in an environmentally acceptable manner. These include: • An extensive range of environmental and other studies. These include surveys or studies in relation to: ○ Geochemistry (Coffey 2012, Rapallo 2013a, Rapallo 2013b and Rapallo 2013c). ○ Soils (Soilwater Consultants 2013). ○ Water (Pendragon Environmental Solutions 2013). ○ Flora and vegetation (Botanica 2010a, Botanica 2010b, Botanica 2010c, Rapallo 2012a and Rapallo 2013d). ○ Vertebrate fauna (Bamford Consulting Ecologists 2013a, Bamford Consulting Ecologists 2013b, Rapallo 2012b, Terrestrial Ecosystems 2011a, Terrestrial Ecosystems 2011b, Terrestrial Ecosystems 2012) ○ SRE invertebrate fauna (Rapallo 2012c, Rapallo 2012d, Terrestrial Ecosystems 2013). ○ Subterranean fauna (Bennelongia 2013, Rapallo 2011). ○ Aboriginal heritage (Cecchi 2011, Cecchi 2012, Cecchi 2013 and O'Connor 2011). • An evaluation of options for the location of infrastructure including the TSF, backfilling of open pit voids and other aspects of the Proposal (see Section 3.2). • Extensive stakeholder engagement (see Section 3.5). • Preliminary environmental risk assessment, which was conducted in October 2012 (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.

Table 4-1 (cont.)

EPA Principle of Environmental Protection	Project Application
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	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 Section 4.2-4.6. SXG will progressively rehabilitate areas disturbed by the Proposal. As the proposed mining operations will be staged, this provides opportunities for rehabilitation to occur progressively and for "lessons learned" during early rehabilitation works to be incorporated into subsequent phases of the rehabilitation program and during mine closure. SXG is developing its MCP in consultation with the DMP and DPaW. The MCP includes closure objectives and completion criteria that address the environmental and social sustainability of the Project Area following cessation of mining.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Five Priority Flora species have been recorded in the Project Area. Populations of three species were located within the initial footprint of the Golden Orb abandonment bund and the King Brown haul road, but SXG modified the alignment of these to minimise clearing of these populations. SXG initially proposed to locate the accommodation camp and airstrip within the proposed 5(1)(h) Conservation and Mining Reserve. However, following consultation with the DPaW, this infrastructure has been relocated to outside of the reserve. This reduces the area of clearing within the reserve (see Sections 2.3.6 and 3.2.7). Instead of developing gravel or borrow pits, SXG proposes to recover tertiary conglomerates from within the Proposal disturbance footprints (such as the processing plant and TSF) and to use NAF waste rock materials for construction purposes. This reduces the area of clearing within the proposed 5(1)(h) Conservation and Mining Reserve (see Section 2.3.4). SXG has developed environmental management and mitigation measures to conserve biological diversity and ecological integrity of the Project Area. These measures include weed and feral animal control, progressive rehabilitation and the use provenance-sourced seed wherever possible. See Section 4.2-4.6. SXG is developing its MCP in consultation with the DMP and DPaW. The MCP includes closure objectives and completion criteria that address the biological diversity and ecological integrity of the Project Area following cessation of mining.

Table 4-1 (cont.)

EPA Principle of Environmental Protection	Project Application
4. Principles relating to improved valuation, pricing and incentive mechanisms (a) Environmental factors should be included in the valuation of assets and services. (b) The "polluter pays" principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. (c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets, and the ultimate disposal of any wastes. (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.	SXG is committed to the minimisation, reuse and recycling of waste materials, where practicable. SXG will contribute to initiatives that promote production, use and recycling of metals and minerals in a safe and environmentally responsible manner. The Company has designed its TSF, landfill and other waste containment facilities to minimise leaching of contaminants and will monitor these facilities to assess the effectiveness of these measures. In the event that contaminated seepage is detected, SXG will undertake remedial action. SXG has made provision for rehabilitation and closure of the Proposal , including the TSF. Any contaminated sites (e.g. hydrocarbon-affected soil) remaining at mine closure will be addressed in the MCP.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	SXG is committed to the minimisation, reuse and recycling of waste materials, where practicable. SXG has determined that no water abstracted from the mine pits during pit dewatering will be discharged to the environment.

4.2 Land

4.2.1 Flora and Vegetation

EPA Objective

The EPA objective for flora and vegetation is defined in EPA (2013b) as "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 for Environmental Impact Assessment in Western Australia (EPA 2004a).

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 Project Area 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 1990) and therefore can have significant flora and vegetation values. The boundary of the Southern Cross IBRA region (of which the Coolgardie 2 Sub district is part) follows the boundary of the Coolgardie Botanical District. The Coolgardie Botanical District is characterised by eucalypt woodlands that become more open and develop a saltbush-bluebush understorey on the more calcareous soils (Beard 1990).

The Project Area is located within the Great Western Woodlands which covers an area of nearly 16,000,000 ha (DEC 2010a) (Figure 4-1). The woodland communities in this area are highly varied, have high biological richness and are a centre for eucalypt diversity. The DPaW's management strategy for the Great Western Woodlands is to achieve sustainable outcomes that ensure conservation of biodiversity and cultural values while maintaining economic and social benefits (DEC 2010a).

A number of flora and vegetation surveys have been conducted in the Project Area (Botanica 2010a, Botanica 2010b, Botanica 2010c, Rapallo 2012a and Rapallo 2013d). During the most recent of these (Rapallo 2013d), 20 plant communities were identified and mapped (Figures 4-2 to 4-6) (Appendix A). The vegetation in the Project Area includes *Eucalyptus* woodlands, *Casuarina pauper* woodlands, *Allocasuarina* spp. woodland and shrublands, and *Melaleuca atrovidis* and *Acacia* shrublands and woodlands (Plate 4-1). The vegetation type occurring most widely across the survey area is Community 4 (*Eucalyptus* spp. open woodland over *Atriplex nummularia, Eremophila scoparia, Senna artemisioides* subsp. *filifolia* shrubland over *Olearia muelleri, Atriplex nana* low open shrubland) (Rapallo 2013d).

Vegetation in the Dolly Pot Pit Area

Vegetation in the Python Pit Area

Vegetation in the Dugite Pit Area

Vegetation in the Goldstream Pit Area

Vegetation in the Golden Orb Pit Area

Vegetation in the King Brown Pit Area

Vegetation in the Processing Plant Area

Vegetation in the TSF Area

Plate 4-1: Vegetation within the Project Area

No Threatened Ecological Communities (TECs) or Groundwater Dependent Ecosystems (GDEs) are present in the Project Area. One Priority Ecological Community (PEC) occurs within the Project Area. This is the Mt Jackson Range Vegetation Complex PEC which has a DPaW-mapped area in the region of more than 44,000 ha. The eastern corner of the Marda Central tenement overlaps with the DPaW-mapped buffer zone of this PEC, but none of the Proposal footprint occurs within the buffer zone (Figure 4-7).

One of the plant communities present at Golden Orb is considered by Rapallo (2013d) to be potentially analogous with a vegetation assemblage that forms part of the Mount Jackson Range Vegetation Complex PEC. This is the *Eucalyptus ebbanoensis* Mallee Woodland over *Olearia muelleri* and *Westringia cephalantha* Low Open Shrubland which comprises a small portion of Plant Community 5ikl as mapped by Rapallo (2013d) (Figure 4-5).

A total of 270 taxa has been recorded in the Project Area. This is comparable to the number of taxa recorded by other surveys in the region (Rapallo 2013d).

No flora species listed as DRF pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* or listed as Threatened pursuant to the *Environment Protection and Biodiversity Act 1999* (EPBC Act) have been recorded in the Project Area. A number of Priority Flora species were recorded in the Project Area, as shown on Figure 4-7 to 4-11. Of these, only the following species occur within the Proposal footprint:

- *Lepidosperma jacksonense* (Priority 1), which was collected on the King Brown haul road (Figure 4-10).
- *Gnephosis* sp. Norseman (K.R. Newbey 8096) (Priority 3), which was collected on the King Brown haul road (Rapallo 2012a) (Figure 4-10).
- *Stenanthemum newbeyi* (Priority 3), which was recorded on a hill slope and crest at Golden Orb (Rapallo 2013d) (Figure 4-11).

Potential Impacts

The potential impacts of the Proposal on flora and vegetation within the Project Area include:

- Clearing of up to 190 ha of native vegetation. This includes 0.25 ha of a plant community analogous with the Mt Jackson Vegetation Complex PEC, but this is not considered to be a significant impact.

- Clearing of some or all of a local population of the Priority 1 flora species *Lepidosperma jacksonense* where this occurs at the eastern end of the King Brown haul road. Populations of this species occur in other parts of the Project Area and in the region. SXG has already reduced the potential impact on this species by realigning the Golden Orb abandonment bund. The

Company will review the alignment of the King Brown haul road to minimise clearing of the local population.

- Clearing of less than 8% of the local population of two Priority 3 flora species. These are *Stenantheum newbeyi* and *Gnephosis* sp. Norseman (K.R. Newbey 8096). SXG has already reduced the potential impact on these species by moving the accommodation camp to an area outside of the proposed 5(1)(h) Conservation and Mining Reserve and realigning the Golden Orb abandonment bund and King Brown haul road.

- Localised loss of vegetation condition due to dust generation, erosion and sedimentation on cleared areas.

- Potential for increased weed infestations within disturbed areas. It is recognised that ten introduced plant species already occur in the Project Area.

- 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 Project Area is located in an area that is generally of low to moderate risk of ignition (DEC 2010b).

- Development of "drainage shadows" in vegetation downstream of roads and other Proposal infrastructure if surface drainage is affected.

Management Measures

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

- 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.

- An exclusion zone has been established west of Dolly Pot pit to prevent disturbance of Priority Flora habitat and a BIF plant community associated with a small hill in that area (Figure 4-8).

- 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 Project Area.

- Topsoil, log debris and leaf litter removed from all cleared areas will be stockpiled for use in rehabilitation programs. Saline water will not 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 manner consistent with the fire management plan for the Great Western Woodlands (DEC 2011).

- To minimise the risk of impact from the use of saline water for dust suppression, SXG will:

    - Use low salinity water for dust suppression where available.
    - 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.

Conclusion

SXG considers that all of the potential impacts on flora and vegetation can be readily managed through implementation of the proposed environmental management measures and regulation through the Native Vegetation Clearing Permit system. Therefore, it is concluded that the Proposal meets the EPA objective for flora and vegetation.

4.2.2 Landforms

EPA Objective

The EPA objective for landforms is defined in EPA (2013b) as “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).
- Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011).

The design, operation and rehabilitation of WRLs and the TSF, and topsoil management, are addressed in the Mining Proposal and MCP.

Existing Environment

The northern portion of the Project Area consists of sandplains (with plains and some salt lakes and mesas) on granitic rocks of the Yilgarn Craton. The southern portion is characterised by undulating plains with some hills and stony plains on the granitic rocks and greenstone of the Yilgarn Craton (Tille 2006).

Soil surveys of the Project Area have been conducted by Rapallo (2013a), Coffey Mining (2012) and Soilwater Consultants (2013). The most recent of these surveys identified three soil types or Soil Mapping Units (SMUs) in the Project Area (Figures 4-12 to 4-14). 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.

- 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 C, highly sodic, saline and dispersive or potentially dispersive.

Potential Impacts

The main change to landforms of the Project Area will be the development of six pit voids, four WRLs and a TSF. These changes will be localised and will not affect the key landscape values of the region such as the Helena and Aurora Ranges.

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 below).

Management Measures

Impacts on the landscape of the Project Area 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:

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

The WRLs and TSF will be rehabilitated in accordance with the procedures outlined in the MCP (see Section 4.6.2).

The soil management measures outlined below were developed 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.

To ensure appropriate management of soils within the Project Area, SXG will implement the following measures:

- The gravelly topsoils in SMU 1 and SMU 2 exhibit optimal properties for use in rehabilitation (i.e. are friable and structurally stable). Their high gravel content protects the rehabilitation surface against raindrop impact and erosion. These soils are not structurally sensitive so can be handled easily during mining and rehabilitation.

- Topsoils in the Project Area are typically poorly developed and nutrient deficient with only minor accumulation of organic matter. Soilwater Consultants (2013) indicates that no distinction needs to be made between topsoil and subsoil, so all soils above the Tertiary conglomerate/calcrete (30-70 cm thick) can be cleared and used as a growth medium. This soil profile is generally non-saline and has no chemical or physical limitation to plant growth.
- Stockpiles of growth media will be limited to a height of 1.8 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.

- The finer (clayey) soils of SMU 3 are highly sodic and dispersive, or will become dispersive and structurally unstable on the batter slopes of the WRL and TSF. However, these are the dominant soils across the Project Area and have good water-holding properties, so use of these soils in rehabilitation is unavoidable. Therefore, where these materials are spread on the outer surface of these landforms, gravels from SMU1 and 2 or competent waste rock will be incorporated (blended) into the material to reduce the risk of erosion. SXG will conduct field trials to determine the appropriate level of gravel to blend with the soils to achieve its stated rehabilitation outcomes (see Section 4.6.2).

- Waste materials likely to exhibit chemical properties that could adversely affect revegetation establishment and growth will not be used on the outer surface of the WRLs or TSF, or within the revegetation rooting zone, to ensure that plant roots do not encounter saline material.

- In addition to incorporating gravel and/or waste rock into the SMU 3 soils to minimise erosion, SXG will ensure that careful surface water management is conducted on the WRLs and TSF. Recommendations by Soilwater Consultants (2013) in relation to drainage design have been incorporated into the proposed WRL and TSF designs.

- 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

SXG considers that all of the potential impacts on landforms and soils can be readily managed through implementation of the proposed environmental management measures and regulation through the Mining Proposal and MCP. Therefore, it is concluded that the Proposal meets the EPA objective for landforms.

4.2.3 Subterranean Fauna

EPA Objective

The EPA objective for subterreanean fauna is defined in EPA (2013b) as "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).

- Draft EPA Guidance Statement No. 54a: Sampling Methods and Survey Considerations for Subterranean Fauna (EPA 2007b).

It is noted that the subterranean fauna studies for the Proposal were completed prior to the release of EAG 12 (EPA 2013c).

Existing Environment

A literature review of subterranean fauna records in the vicinity of the Project Area was conducted by Benneloniga (2013) to assess the likelihood of subterranean fauna occurring within the Project Area itself (Appendix B). Stygofauna surveys conducted in the vicinity of the Project Area have yielded few, if any, stygofauna and it is concluded that it is most unlikely that a significant stygofauna community inhabits the Project Area (Bennelongia 2013). Therefore, it is unlikely that the Project Area supports diverse assemblages of subterranean fauna.

Information about troglofauna in the Marda region reviewed by Bennelongia (2013) suggests it is likely that a troglofauna community of low or moderate species richness exists in the Project 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.

Potential Impacts

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 small groundwater drawdown cones predicted to be associated with the Proposal, no significant impact on stygofauna is expected to occur (Bennelongia 2013).

There is potential for impact on any troglofauna species within the Project Area due to mine pit excavation. However, Benneloniga (2013) considered it highly unlikely that the proposed mining operations would threaten the persistence of any species because of the small size of the proposed mine pits.

Management Measures

No significant impacts on subterranean fauna are predicted (Bennelongia 2013), so no specific management measures are required.

Conclusion

No significant impacts on subterranean fauna are predicted (Bennelongia 2013). Therefore, it is concluded that the Proposal meets the EPA objective for subterranean fauna.

4.2.4 Terrestrial Environmental Quality

EPA Objective

The EPA objective for terrestrial environmental quality is defined in EPA (2013b) as "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:

- Code of Practice for Tailings Storage Facilities in Western Australia (DMP 2013).
- Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure (ANCOLD 2012).
- 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 2: Tailings Facilities (WRC 2000a).
- Water Quality Protection Guidelines No 3: Liners for Waste Containment (WRC 2000b).
- Water Quality Protection Guidelines No 6: Minesite Stormwater (WRC 2000c).
- Water Quality Protection Guidelines No 7: Mechanical Servicing and Workshop Facilities (WRC 2000d).
- Water Quality Protection Guidelines No 9: Acid Mine Drainage (WRC 2000e).
- Water Quality Protection Guidelines No 10: Above-ground Fuel and Chemical Storage (WRC 2000f).
- 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).

Existing Environment

The Marda Central deposits (Dolly Pot, Python, Dugite and Goldstream) are hosted within a highly deformed segment of the Marda BIF geological formation. The deposits are characterised by strong quartz veining accompanied by silica, pyrite and sericite alteration. Complete oxidation commonly extends to depths between 45 m and 75 m, reaching depths of greater than 100 m in places. Weathering of the deposits is substantially deeper than the surrounding area and gold distribution has been modified by oxidation (Rock Team 2012).

The King Brown gold deposit is hosted by highly weathered ultramafic saprolitic clays with interspersed narrow highly degraded BIF units. Oxidation extends to at least 70 mbgl. This unit is interspersed with thin, degraded laminated cherts and BIFs which are less oxidised than their surrounds and more recognisable with depth (Rock Team 2012).

The Golden Orb deposit outcrops poorly as a grey-white, quartz veined chert. The host BIF geological unit is enclosed by a sequence of basalt, high Mg basalt, ultramafics and minor gabbro. The deposit is strongly weathered to an average depth of 80 m (Rock Team 2012).

The Proposal is located in an area where there has been limited historical small scale mining of high grade quartz veins. This has occurred mainly in the vicinity of the proposed Dolly Pot area (Plate 4-2), but also in the Goldstream pit area. There has been no modern mining and no old tailings impoundments or stamp batteries are evident in the Project Area. Therefore, it appears based on available information that existing site contamination is unlikely.

Plate 4-2: Example of Historical Small-scale Mining at Marda Central

Potential Impacts and Management

Terrestrial environmental quality could be affected primarily through the disposal of Proposal wastes. These comprise waste rock from mining operations (if potentially acid forming), tailings from the processing plant, putrescible and inert waste, hydrocarbon and reagent leaks or spills, and sewage. These aspects are discussed below.

Waste Rock

Marda Central waste rock material 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). There is also insufficient sulphur present to produce acid in the King Brown rock types to be mined (Rapallo 2013b). Further, analyses by Rapallo (2013b) indicate that, over the medium to long term, there will be significant leaching of alkali and alkaline minerals at King Brown which provides long term additional Acid Neutralising Capacity (ANC) to neutralise any potential residual sulphides from the waste rock. Similarly, any minor arsenic and sulphur that leaches from the waste rock will be neutralised by the excess of silicate and alumino-silicate ANC generated (Rapallo 2013b).

Total sulphur concentrations in rock samples from Golden Orb range from below the detection limit of <0.005% to 0.146% Total S. These concentrations are well below the minimum value of 0.3% where acid production in arid areas is considered likely to occur (Rapallo 2013c).

Waste rock will be disposed to WRLs which will be rehabilitated on a progressive basis.

Tailings

Tailings produced by the processing plant will be disposed to a TSF to be developed to the west of the plant. The TSF has been designed by Coffey Mining (2013) to:

- provide adequate tailings and rainwater storage capacity
- provide maximum return water to the plant;
- maximise drying of tailings through evaporation; and
- minimise seepage.

Coffey Mining (2012) indicates that the risk of acid generation from Marda tailings is very low due to the highly weathered nature of the ore from all the deposits proposed to be mined and the alkaline nature of the tailings produced by the conventional ore treatment process.

The TSF design incorporates a compacted soil liner, an underdrainage system and toe drains to capture any seepage. Freeboard will be maintained in accordance with DMP and DER operating licence requirements. Groundwater monitoring bores will be installed and groundwater levels and quality will be monitored in accordance with the DER operating licence and AS/NZS 5667 Water Quality Sampling.

Putrescible and Inert Waste

SXG will reuse and recycle materials as much as practicable, with remaining waste disposed to the landfill to be developed in the vicinity of the accommodation camp. The landfill facility will utilise a staged trench method with the trenches covered on a regular basis. The landfill facility will be fenced with a lockable gate to contain windblown waste, exclude fauna and control waste disposal.

The landfill facility will be regulated through a DER Works Approval and Licence.

Hydrocarbon and Reagents

Reagents will be stored and used in accordance with relevant Material Safety Data Sheets.

Hydrocarbons will be stored in self-bunded tanks located within a fuel storage facility which will meet the requirements of Australian Standard 1940-2004 (The Storage and Handling of Flammable and Combustible Liquids). Spills of hydrocarbons will be removed by absorbent material and/or excavation of contaminated soil and treated at a Bioremediation Pad to be located adjacent to the landfill facility at the accommodation camp. The Bioremediation Pad will be constructed in accordance with DEC (2004).

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

Sewage

A sewage treatment facility will be established in the vicinity of the accommodation camp. A sprinkler reticulation system will be used to dispose of treated water and will be fenced to exclude fauna. The facility will be regulated through a DER Works Approval and Licence.

Historical Disturbances

Proposed open pit mining will remove many of the historical shafts and sediment dumps occurring within the Dolly Pot and Goldstream pit footprints. SXG has committed to the clean-up and rehabilitation of the remaining old shafts and associated disturbances within the Marda Central tenement on a progressive basis.

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 Licencing system. Therefore, it is concluded that the Proposal meets the EPA objective for terrestrial environmental quality.

4.2.5 Terrestrial Fauna

EPA Objective

The EPA objective for terrestrial fauna is defined in EPA (2013b) as "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).

- Guidance Statement No 20: Sampling of Short Range Endemic Invertebrates (SREs) for Environmental Impact Assessment in Western Australia (EPA 2009).

Existing Environment

A number of vertebrate fauna studies were conducted in the Project Area between 2010 and 2013 (Bamford Environmental Consultants 2013a, Bamford Environmental Consultants 2013b, Rapallo 2012b, Terrestrial Ecosystems 2011a, Terrestrial Ecosystems 2011b and Terrestrial Ecosystems 2011c). As a result, it is understood that the vertebrate fauna habitats and assemblages of the Project Area are typical of those in the wider region. See Appendix C-1 to C-4.

A number of conservation-significant vertebrate fauna species occur, or may occur, in the Project Area. Of particular interest are the:

- Malleefowl *(Leipoa ocellata)* which is listed as Vulnerable under the EPBC Act and *Wildlife Conservation Act*. Approximately 400 ha of potential Malleefowl breeding habitat occurs within the Project Area. Most of this habitat occurs outside of the Proposal footprint except at Golden Orb (Figure 4-15). No Malleefowl have been sighted in the Project Area (Bamford Consulting Ecologists 2013b) and the old Malleefowl mounds recorded by Bamford Consulting Ecologists (2013b) appear to have been inactive for considerable time (20 to >100 years) (Appendix C-5). It is noted that most of the Malleefowl habitat actively being used by this species occurs along the Jackson Range (between Marda Central and Golden Orb).

- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) which is listed under Schedule 4 of the *Wildlife Conservation Act*. To comply with a request of the DPaW, a survey was undertaken to assess breeding habitat for Major Mitchell's Cockatoo in the Project Area (Terrestrial Ecosystems 2011c) (Appendix C-6). Terrestrial Ecosystems (2011c) reports that no Major Mitchell's Cockatoos were seen flying or nesting in the Project Area and that there was no evidence to suggest that any of these areas were currently being used as nesting sites by this species. The Project Area was considered to contain similar habitat for this species to adjacent areas (Terrestrial Ecosystems 2011c).

SRE studies have been conducted for the Proposal by Terrestrial Ecosystems (2011a, 2011b and 2013) and Rapallo (2012c, 2012d and 2013e) (see Appendix C-1, C-2 and D1-3). Four potential SRE taxa were collected during these surveys (Figures 4-16 and 4-17), as follows:

- Two taxa of mygalomorph spiders (*Aname* sp. 'MYG243' and *Aname* sp. (juv), which were recorded at Marda Central.

- A pseudoscorpion species (*Beierolpium* sp. '8/4 lge') which was recorded at Marda Central and Golden Orb.

- A land snail species from the family Bullimulidae (*Bothriembryon* sp.), which was recorded at Marda Central.

No potential SRE taxa were recorded from the King Brown tenement (Rapallo 2012d).

Potential 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. Bamford Consulting Ecologists (2013a) concludes that the impacts of the proposal on the fauna assemblage would be negligible as there would be only a small loss of habitat that is mostly continuous and wide spread in the region.

There is also potential for impact on fauna assemblages in the Project Area as a result of noise, vibration, dust, vehicle movements, accidential bushfires, etc. However, the likelihood of these impacts occurring and the potential for significant impact are low.

Of the potential SRE taxa recorded in the Project Area, only the land snail *Bothriembryon* sp. occurs in the vicinity of the Proposal footprint. This species was recorded in a shallow ephemeral drainage line that will be traversed by the Goldstream haul road. This creekline will be disturbed in only a small area by earthworks to develop the haul road. No changes to downstream drainage patterns are expected as a result of haul road development.

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.
- Regularly monitor open excavations and water ponds to ensure that any trapped fauna are rescued and released as quickly as possible. Ponds will be fenced to exclude fauna and have fauna egress matting installed.
- Maintain the exclusion zone west of Dolly Pot pit to prevent disturbance of potential Malleefowl habitat associated with a small hill in that area (Figure 4-8).
- Monitor cyanide levels in the TSF decant.

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

The EPA objective for hydrological processes is defined in EPA (2013b) as "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:

- Code of Practice for Tailings Storage Facilities in Western Australia (DMP 2013).
- Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure (ANCOLD 2012).
- 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 2: Tailings Facilities (WRC 2000a).
- Water Quality Protection Guidelines No 3: Liners for Waste Containment (WRC 2000b).
- Water Quality Protection Guidelines No 6: Minesite Stormwater (WRC 2000c).
- Water Quality Protection Guidelines No 7: Mechanical Servicing and Workshop Facilities (WRC 2000d).
- Water Quality Protection Guidelines No 9: Acid Mine Drainage (WRC 2000e).
- Water Quality Protection Guidelines No 10: Above-ground Fuel and Chemical Storage (WRC 2000f).
- 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).

- DoW Operational Policy No 1.02.
- DoW Operational Policy No 5.08.

The Project Area is located within the Goldfields Groundwater Management Area proclaimed under the *Rights in Water and Irrigation Act 1914*. Consequently, the development and maintenance of groundwater supplies and pit dewatering require DoW licencing under Sections 26D and 5C of the Act.

Bore construction licences have been granted in accordance with Section 26D in 2012 for the Marda Central and King Brown areas as follows:

- CAW175209 Goldfields Deborah Combined Fractured Rock West: Marda Central Tenement M77/394 and King Brown Tenements M77/931 and M77/646.

- CAW176670 Goldfields Deborah Palaeochannel - Fractured Rock: King Brown Tenement M77/931.

On completion of bore construction, hydraulic testing and water quality sampling, SXG will apply for licences under Section 5C of the *Rights in Water and Irrigation Act 1914*.

Existing Environment

Surface drainage in the Project Area is poorly defined and consists mainly of broad sheet wash following short duration high intensity storms. Occasional shallow, ephemeral drainage channels are present on rises but these are mostly short, running a few hundred metres down the slopes. The King Brown tenement overlies a claypan (Figure 4-18, Plate 4-3) (Pendragon Environmental Solutions 2013a).

Plate 4-3: Claypan adjacent to King Brown

The Marda Water Reserve (17009) borders the south side of Marda Central tenement M77/394 (Figure 3-3). The reserve contains the disused Marda Dam which is located approximately 2 km east of the Bullfinch-Evanston Road and 0.5 km from the boundary of M77/394.

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 suggests 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 Project Area imitate the regional and local topography, and range between 13.7 m below surface at King Brown to greater than 60 m below ground surface at Marda Central and Golden Orb (Pendragon Environmental Solutions 2013) (Figure 4-19). Groundwater quality across the Project Area ranges from relatively fresh to saline with a circumneutral pH of between 7.02 and 8.41.

Potential Impacts and Management – Surface Water

No drainage lines will be diverted during implementation of the Proposal, but drainage diversion will be installed upslope of the TSF to direct sheet flow around the facility. This will be a permanent feature to maintain the structural integrity of the TSF post closure.

Floodway road crossings will constructed to allow vehicle movements across selected drainage lines, but are not expected to adversely impact downstream environments.

No impact on the Marda Water Reserve or Marda Dam is predicted.

To manage surface water in the Project Area to meet the EPA's objective for hydrological processes, SXG will:

- Divert clean stormwater runoff around the mine pits, processing plant, workshops and other infrastructure, and the TSF.
- Capture rainwater falling into mine pits in sumps and use this for dust suppression in the pit areas.

See also Section 4.2.4.

Potential Impacts and Management – Groundwater

The potential for adverse impact on groundwater quality is similar to that for impact on terrestrial environmental quality and is discussed in Section 4.2.4. Key issues relate to the potential for seepage from the TSF and leaks or spills in the processing plant and reagent storage and handling facilities.

In relation to the potential for impact on groundwater quantity, Pendragon Environmental Solutions (2013) has predicted:

- The existing groundwater table at the proposed Dolly Pot pit (the deepest of the pits to be developed at Marda Central) is 60 mbgl, Dewatering of this pit is expected to lower the water table by around 21 m. The cone of depression may extend 550 m from Dolly Pot.

- The existing water table at the King Brown pit is 13.7 mbgl. Groundwater drawdown due to pit dewatering is expected to lower the water table by 39 m and result in a cone of depression extending 780 m from the pit.

- Golden Orb will be the deepest pit developed as part of the Proposal at 92.7 m in depth. The existing water table at this pit is 62 mbgl. Groundwater drawdown due to pit dewatering is expected to lower the water table by 30 m and result in a cone of depression extending 740 m from the pit.

The depth to the water table means that dewatering is unlikely to impact on vegetation in the vicinity of the pits.

Following the cessation of mining and water abstraction, it is expected that pit lakes will form in the King Brown, Golden Orb and Dolly Pot pits (Figures 4-20 to 4-22). Pendragon Environmental Solutions (2013) has predicted that the depth of the lake forming in the King Brown void could be up to 44 m deep, up to 31 m deep in the Golden Orb pit and up to 16 m deep in the Dolly Pot pit. Water in the pit lakes is likely to become more saline over time as the rate of evaporation exceeds the rate of precipitation and groundwater inflow. This is not considered to be a significant impact as there are no downstream users of groundwater.

DPaW has identified concern regarding the potential presence of pit lakes in the proposed 5(1)(h) dual purpose Conservation and Mining Reserve relating to:

- public safety, if members of the public access the pit areas and elect to swim in the pits; and
- potential grazing pressures, which may occur if native, domestic and/or feral animals are attracted to the pit areas by the smell of water. Even if the animals cannot reach the pit lakes, they may still congregate and graze in the vicinity of the pit. This could result in over-grazing and/or trampling of plants in areas of fauna congregation, which is of particular concern to DPaW if Priority Flora species are present in these areas.

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. No Priority Flora species

are present in the immediate vicinity of the pit, though *Lepidosperma ferricola* has been recorded within the exclusion zone approximately 300 m west of the pit.

SXG will complete the following actions during operations to determine if the Dolly Pot Pit needs to be backfilled to above the long term standing water table:

- Determine the extent of gold resources below the pit and, dependent on the outcome of these investigations, comply with DMP requirements to gain approval prior to backfilling of the pit.
- Refine the pit lake model as further geological, hydrological and groundwater monitoring data are collected throughout the life of the Proposal.
- Liaise with DPaW to assess the potential for grazing impacts on *Lepidosperma ferricola* in the exclusion zone.

See also Section 4.2.4.

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 DoW licencing. Therefore, it is concluded that the Proposal meets the EPA objective for hydrological processes.

4.3.2 Inland Waters Environmental Quality

EPA Objective

The EPA objective for inland waters environmental quality is defined in EPA (2013b) as "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-f).

Existing Environment

The surface water and groundwater regimes of the Project Area are described in Section 4.3.1. The biota of the Project Area is described in Sections 4.2.1, 4.2.3 and 4.2.5.

Potential Impacts

See Sections 4.2.1, 4.2.3, 4.2.5 and 4.3.1.

Management Measures

See Sections 4.2.1, 4.2.3, 4.2.5 and 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

The EPA objective for air is defined in EPA (2013b) as "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).

Potential Impacts and Management Measures

Air quality is not a significant issue for the Proposal. The largest potential impact on air quality is the emission and deposition of dust around the mine, along haulage routes and ore processing facilities. To minimise dust generation, SXG will:

- Use covered transfer points and chutes within the crushing circuit.
- Use a bag house on the lime silo to relieve air introduced into the silo during filling whilst retaining lime dust.
- Water mine haul roads, processing area roads and ore stockpiles.

Conclusion

SXG considers that all of 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 Licencing systems. Therefore, it is concluded that the Proposal meets the EPA objective for air quality.

4.5 People

4.5.1 Amenity

EPA Objective

The EPA objective for amenity is defined in EPA (2013b) as "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).
- Guidance Notes for the Reduction of Obtrusive Light (The Institute of Lighting Engineers 2005).

Existing Environment

The Project Area is located in a relatively flat area between the Windarling and Mt Jackson ranges and is visible from several high-elevation locations in the region.

There are a number of sources of light in the wider region including nearby mine sites. However, there are few, if any, existing light sources in the Marda area.

Potential Impacts

As discussed in Section 4.2.2, the Proposal will result in the development of pit voids, WRLs and a TSF. These changes will be localised and will not affect the key landscape values of the region such as the Helena and Aurora Ranges, but these features will be visible from different locations in the region, particularly at higher-elevation locations. 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 25 m. Visual impacts resulting from the presence of the WRLs and TSF will be reduced following completion of the SXG rehabilitation program.

Lighting will be required to provide a safe work environment during mining and ore processing operations at night. Lighting requirements for the Proposal are expected to be typical of small mines. It is likely that lights from the Proposal will be visible from different locations in the region at night, particularly at higher-elevation locations. The proposed operational life of the Proposal is relatively short at 2.5 years, so this is expected to be a short term and localised impact.

Management Measures

Visual impacts on the landscape of the Project Area 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 and TSF will be rehabilitated in accordance with the procedures outlined in the MCP (see Section 4.6.2).

Directional lighting or light shields will be utilised to reduce visual impacts, where practicable and safe.

Conclusion

SXG considers that all of the potential impacts on amenity can be readily managed through implementation of the proposed environmental management measures and regulation through the Mining Proposal, MCP and Native Vegetation Clearing Permit. Therefore, it is concluded that the Proposal meets the EPA objective for amenity.

4.5.2 Heritage

EPA Objective

The EPA objective for heritage is defined in EPA (2013b) as ”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 Project Area (Cecchi 2011, Cecchi 2012, Cecchi 2013 and O'Connor 2011). These surveys identified a number of Aboriginal heritage sites, none of which are located with the Proposal footprint.

The Marda Dam is listed in the Shire of Yilgarn's Municipal Heritage Inventory as being a 'Water Supply Place' of significance (LGA Place No. 59). The relevance of the Marda Dam to contemporary pastoral activities has diminished over time.

Potential Impacts

No Aboriginal heritage sites are located with the Proposal footprint and no indirect impacts are predicted.

No direct or indirect impacts on Marda Dam are predicted.

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* including the requirement to report any potential heritage sites discovered during construction and operation of the Proposal.

Conclusion

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

4.5.3 Human Health

EPA Objective

The EPA objective for human health is defined in EPA (2013b) as "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.
- 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 100 km south of the Project Area and Southern Cross is located approximately 120 km south of the Project Area.

The Marda Central component of the Proposal is located within DPaW-managed lands and within a proposed 5(1)(h) dual purpose Conservation and Mining Reserve (Figure 3-3). The remaining areas of the Proposal are situated within the Mount Jackson Pastoral Lease which is owned by Cliffs.

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

Potential Impacts

Noise and vibration have the potential to impact on environmental and social values within the Project Area and surrounds. The main sources of noise from the Proposal are associated with:

- mobile plant such as drill rigs, excavators, haul trucks and graders;
- fixed plant such as conveyors and ore processing facilities; and
- blasting.

The main source of vibration from the Proposal is blasting.

As discussed in Section 3.2.2, a key concern raised during stakeholder engagement with the DPaW, Shire of Yilgarn and Wildflower Society was the potential impact on public access within the proposed Project Area. The Bullfinch-Evanston Road will be the main site access route, including for haulage of Golden Orb ore along a 12.2 km section of the road. However, as illustrated in Figure 3-1, no existing gazetted roads or tracks will be closed by the Proposal and public thoroughfare will be maintained to, and between, the key regional features within the Project Area. However, SXG will divert a section of track that currently traverses the main mining area on the western portion of the Marda Central tenement. Alternative routing to the north of the tenement will allow continued public access to the Bullfinch-Evanston Road from the Mt Jackson homestead (Figure 3-1).

Management Measures

SXG will ensure that its mining and processing operations will meet statutory requirements. The Company will reduce noise levels by using low-noise equipment, silencers and exhaust mufflers where appropriate. Blasting will only be conducted during daylight hours.

All haul roads and access tracks established by SXG for use by the Proposal will be private roads with no public access for safety, security and other reasons. Where mine roads intersect public roads, vehicle movements will be controlled through the use of stop signs and other signage, where appropriate.

SXG has been consulting with the Shire of Yilgarn in relation to the use and maintenance of the Bullfinch-Evanston Road for the purposes of the proposed Project. Management measures to be implemented in relation to Project traffic along the Bullfinch-Evanston Road include project vehicle speed limits, dust suppression and signage.

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

The EPA objective for offsets is defined in EPA (2013b) as “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 2006a)
- EPA Guidance Statement No. 19: Environmental Offsets – Biodiversity (EPA 2008a).
- Environmental Protection Bulletin 1: Environmental Offsets - Biodiversity (EPA 2008b).

Conclusion

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.

4.6.2 Rehabilitation and Closure

EPA Objective

The EPA objective for rehabilitation and closure is defined in EPA (2013b) as "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 2013d).
- Guidelines for Preparing Mine Closure Plans (DMP and EPA 2011).
- Mine Void Water Issues in WA (Johnson and Wright 2003).
- Strategic Framework for Mine Closure (ANZMEC and MCA 2000).

Existing Environment

As discussed in Section 4.2.4, limited small scale mining has occurred historically in the Marda Central tenement (Plate 4-2). In addition, there has been disturbance of the Project Area due to mineral exploration and tourism activities.

Potential Impacts

Development of the Proposal will result in the clearing of up to 190 ha of native vegetation, approximately half of which will occur in the proposed 5(1)(h) dual purpose Mining and Conservation Reserve. 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 six pit voids, four WRLs and a TSF.

Management Measures

Post-project Land Use

SXG is preparing a MCP for the Proposal in accordance DMP and EPA (2011). The MCP is being prepared in support of a Mining Proposal for the Proposal. Mine closure planning for the Proposal has been discussed with the DPaW and the DMP.

The post-project land uses considered to be the most appropriate for the Project Area are:

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

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, as far as practicable, 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, as outlined in EPA (2006a). The proposed closure objectives are outlined in Table 4-2.

Table 4-2: Closure Objectives

Aspect	Objective
Safety	Safety issues are adequately addressed.
Landforms	Final landforms are stable.
	Final landforms are suitable for pastoral use.
Water	Water quality and availability is appropriate.
Soil	Appropriate soil profiles are constructed.
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 significant problems with pollutants.
	Adequate control of weeds.
Visual Amenity	Retain visual amenity.
Heritage	Aboriginal heritage values maintained.
	European heritage 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 listed in Table 4-3.

Table 4-3: Completion Criteria

Objectives	Infrastructure Completion Criteria	TSF 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.	Top surface allowed to dry sufficiently; decommissioned in accordance with design reports and operating manual.	Safe, stable landform established. Final landform constructed in accordance with design specifications.	Pit slopes and voids are safe to the public.	All domains visually assessed for erosion, subsidence, landslips, wall rock stability. Audit of final WRLs against design specifications and mining proposal commitments. Audit of final TSF against design reports, operating manual and mining proposal commitments.
Final landforms are stable.	Surfaces recontoured where necessary. Drainage restored where necessary.	Facility is structurally stable; TSF capped with benign waste rock; Topsoil or appropriate growth medium spread; Surface ripped; Erosion controls in place; Appropriate drainage in place.	Topsoil or appropriate growth medium spread. Surface ripped. Erosion controls in place. Appropriate drainage in place.	Pit slopes and voids are geotechnically stable. Abandonment bunding is in place 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.

Table 4-3 (cont.)

Objectives	Infrastructure Completion Criteria	TSF Completion Criteria	WRL Completion Criteria	Open Pit Completion Criteria	Type of Monitoring
Suitable for end land use.	Final landforms are consistent with surrounding topography.	Final landform is 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 TSF. TSF appropriately lined and monitoring of surrounding bores indicates no major contaminants from seepage.	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 (DoW and DER licences).				General water quality parameters (field). General and detailed water quality parameters (laboratory).
	Drainage controls in place. Sedimentation within acceptable limits.	Drainage controls in place. Sedimentation within acceptable limits.	Drainage controls in place. Sedimentation within acceptable limits.	Hydraulic flows and patterns of surface water flow are unimpeded.	Groundwater levels; flow rates from dewatering bores; surface water levels; groundwater cone of depression.

Table 4-3 (cont.)

Objectives	Infrastructure Completion Criteria	TSF Completion Criteria	WRL Completion Criteria	Open Pit Completion Criteria	Type of Monitoring
Construct appropriate soil profiles.	Topsoil or growth medium spread to appropriate depth.	Surface capped with capillary break (if required). 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 TSF.	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.	Presence of weed species does not exceed abundance in reference sites.			N/A	Quadrat based monitoring of structural and functional diversity.

Table 4-3 (cont.)

Objectives	Infrastructure Completion Criteria	TSF Completion Criteria	WRL Completion Criteria	Open Pit Completion Criteria	Type of Monitoring
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.
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

Closure Options and Techniques

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

All temporary infrastructure including the processing plant, workshops, accommodation camp and airstrip 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 humans and people.

Due to the low risk of acid drainage and leachate, the WRLs will be a "water-holding batter and berm design type". The objective of this design is to capture all precipitation and maximise infiltration, which will in turn enhance rehabilitation success. The closure concept (Figure 4-24) 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.
- Ripping to 500 mm to create a pronounced trough crest profile perpendicular to the slope to capture sediment movement.

Once tailings deposition into the TSF has ceased, the decant and drainage systems have been decommissioned, and the upper surface of the facility has gained some weight-bearing capacity, the TSF will be capped in order to minimise dust generation from the dried tailings, reduce infiltration into the tailings bed and provide support for the growth medium for re-vegetation. The timing between decommissioning and final capping is likely to be approximately one to two years. The capping is likely to comprise a capillary break layer with 0.8m nominal thickness and a store and release layer, also of 0.8m nominal thickness. The depth of these layers will be reviewed prior to finalisation, and field trials will be conducted if required. The MCP will be updated as the closure strategy for the TSF is refined and finalised.

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.

SECTION 5.0 - SIGNIFICANCE OF ENVIRONMENTAL FACTORS

Following the assessment discussed in Section 4, it was determined that the main environmental factors relevant to the Proposal are as follows:

- Flora and vegetation, in relation to:
  - clearing of up to 190 ha of vegetation, of which approximately half of which will be in a proposed 5(1)(h) Conservation and Mining Reserve. This includes 0.25 ha of a plant community analogous with the Mt Jackson Vegetation Complex PEC;
  - clearing of one population of the Priority 1 flora species *Lepidosperma jacksonense;* and
  - clearing of <8% of local populations of the Priority 3 flora species *Gnephosis* sp. Norseman (K.R. Newbey 8096) and *Stenanthemum newbeyi*.

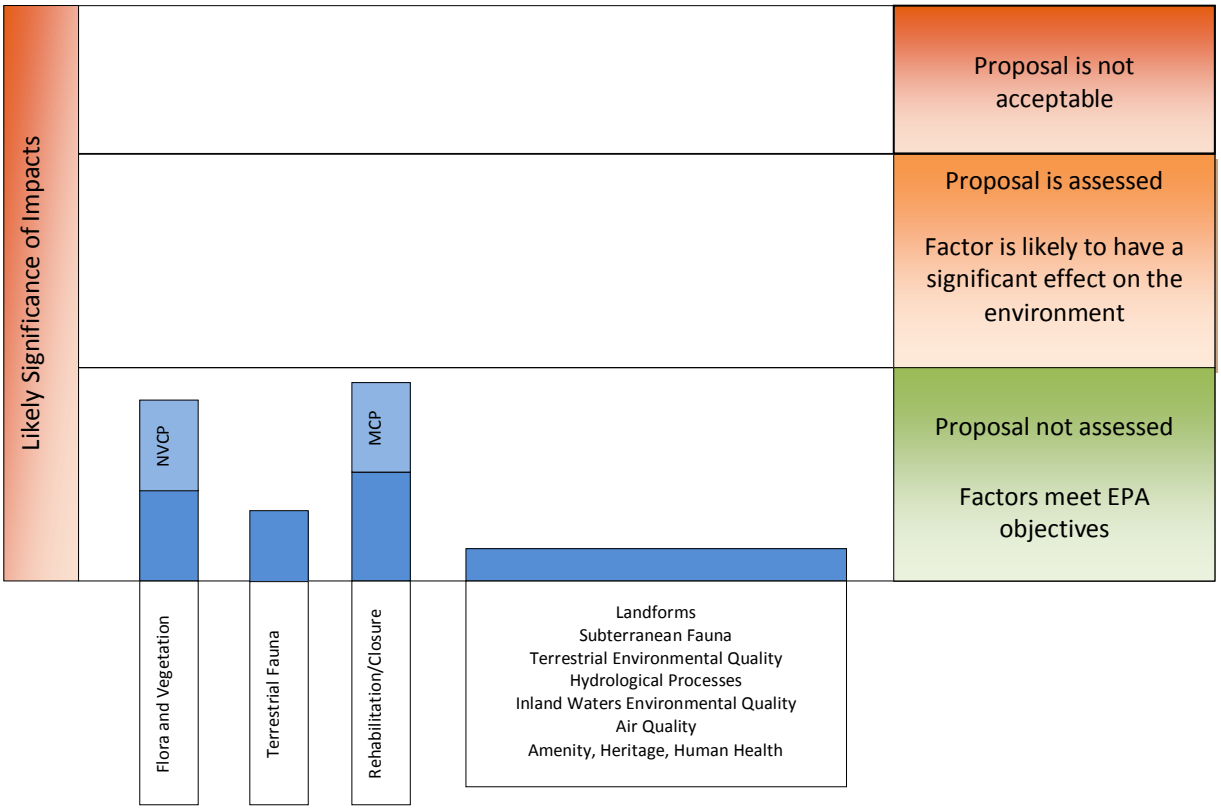
- Terrestrial fauna, in relation to:
  - clearing of potential Malleefowl (*Leipoa ocellata*) habitat; and
  - clearing of a small area of habitat of a potential SRE species of land snail (*Bothriembryon* sp.).

- Closure and rehabilitation, in relation to:
  - the presence or potential formation of pit lakes following the cessation of mining; and
  - the presence of potentially dispersive soils.

The significance of Proposal implementation on these environmental factors was assessed in accordance with EAG 9. Following this assessment, SXG has concluded that the above factors (as well as the other environmental factors associated relevant to the Proposal) 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 (see Chart 5-1).

On the basis of the environmental assessment described in this ERSD, the proposed Marda Gold Project is not considered to be a significant proposal.

Chart 5-1: Significance of Environmental Factors



SECTION 6.0 - REFERENCES

Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*

Australian and New Zealand Environment Council (1990) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration.*

Australian and New Zealand Mining Environment Council and Minerals Council of Australia (2000) *Strategic Framework for Mine Closure*.

Australian National Committee on Large Dams (2012) *Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure*. May 2012.

Bamford Consulting Ecologists (2013a) *Level 1 Fauna Assessment of Proposed Haul Roads, Camps and Airstrips*. Prepared for Southern Cross Goldfields Ltd. January 2013.

Bamford Consulting Ecologists (2013b) *Marda Gold Project Targeted Fauna Assessment*. Prepared for Southern Cross Goldfields Ltd. January 2013.

Beard, J.S. (1990) *Plant Life of Western Australia*. Kangaroo Press.

Bennelongia Environmental Consultants (2013) *Marda Gold Project (Mining Leases M77/394, 646, 931 and 962): Subterranean Fauna Risk Assessment*.

Botanica Consulting (2010a) *Level 2 Flora & Vegetation Survey of Golden Orb Project*. Prepared for Southern Cross Goldfields Ltd.

Botanica Consulting (2010b) *Level 2 Flora & Vegetation Survey of King Brown Project.* Prepared for Southern Cross Goldfields Ltd.

Botanica Consulting (2010c) *Level 2 Flora & Vegetation Survey of Marda Central Project.* Prepared for Southern Cross Goldfields Ltd.

Cecchi, J.B. (2011) *Report on an Aboriginal Heritage Survey of Southern Cross Goldfields Ltd's Marda, King Brown, Dulcie and Battler Projects, Yilgarn Region, WA.* Confidential report prepared for R. & E. O'Connor Pty Ltd on behalf of Southern Cross Goldfields Ltd. March 2011.

Cecchi, J.B. (2012) *Report on an Aboriginal Heritage Survey of Southern Cross Goldfields Ltd Marda Gold Project.* Confidential report prepared for R. & E. O'Connor Pty Ltd on behalf of Southern Cross Goldfields Ltd. September 2012.

Cecchi, J.B. (2013) *Report on an Aboriginal Heritage Survey of Southern Cross Goldfields Ltd Marda Gold Project Additional Areas and Die Hardy Road Widening.* Confidential report prepared for R. & E. O'Connor Pty Ltd on behalf of Southern Cross Goldfields Ltd. January 2013.

Coffey Mining Limited (2012) *Tailings Geochemistry, Marda Gold Project.* Prepared for Southern Cross Goldfields Ltd. October 2012.

Coffey Mining Limited (2013) *Tailings Storage Facility Preliminary Design Report , Marda Gold Project*. Prepared for Southern Cross Goldfields Ltd. November 2013.

Department of Environment and Conservation (2004) *Bioremediation of Hydrocarbon-contaminated Soils in Western Australia*.

Department of Environment and Conservation (2010a) *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands.*

Department of Environment and Conservation (2010b) *Bushfire Threat Analysis of the Great Western Woodlands.* September 2010.

Department of Environment and Conservation (2011) *Fire Management Plan for the Conservation of Biodiversity and Cultural Heritage Values in the Great Western Woodlands.* December 2011.

Department of Industry, Tourism and Resources (2007) *Leading Practice Sustainable Development Program for the Mining Industry: Managing Acid and Metaliferous Drainage*.

Department of Mines and Petroleum (2013) *Code of Practice for Tailings Storage Facilities in Western Australia.* Department of Mines and Petroleum, WA.

Department of Mines and Petroleum and Environmental Protection Authority (2011) *Guidelines for Preparing Mine Closure Plans.* November 2011.

Environmental Protection Authority (2000) *Environmental Protection of Native Vegetation in Western Australia*. EPA Position Statement No 2. December 2000.

Environmental Protection Authority (2002a) *Terrestrial Biological Surveys as an Element of Biodiversity Protection*. EPA Position Statement No 3. March 2002.

Environmental Protection Authority (2002b) *Minimising Greenhouse Gases*. EPA Guidance Statement No 12. October 2002.

Environmental Protection Authority (2004a) *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*. EPA Guidance Statement No 51. June 2004.

Environmental Protection Authority (2004b) *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*. EPA Guidance Statement No 56. June 2004.

Environmental Protection Authority (2004c) *Assessment of Aboriginal Heritage*. EPA Guidance Statement No 41. April 2004.

Environmental Protection Authority (2004d) *Principles of Environmental Protection*. EPA Position Statement No 7. August 2004.

Environmental Protection Authority (2006a) *Rehabilitation of Terrestrial Ecosystems*. EPA Guidance Statement No 6. June 2006.

Environmental Protection Authority (2006b) *Environmental Offsets*. EPA Position Statement No 9. January 2006.

Environmental Protection Authority (2007a) *Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia*. EPA Guidance Statement No 54.

Environmental Protection Authority (2007b) *Sampling Methods and Survey Considerations for Subterranean Fauna*. Draft EPA Guidance Statement No 54a. August 2007.

Environmental Protection Authority (2007c) *Environmental Noise*. Draft EPA Guidance Statement No 8. May 2007.

Environmental Protection Authority (2008a) *Environmental Offsets – Biodiversity.* EPA Guidance Statement No 19. September 2008.

Environmental Protection Authority (2008b) *Environmental Offsets – Biodiversity.* Environmental Protection Bulletin 1. September 2008.

Environmental Protection Authority (2009) *Sampling of Shore Range Endemic Invertebrates (SREs) for Environmental Impact Assessment in Western Australia*. EPA Guidance Statement No 20. May 2009.

Environmental Protection Authority (2013a) *Environmental Assessment Guideline for Environmental Factors and Objectives*. Environmental Assessment Guideline 8. June 2013.

Environmental Protection Authority (2013b) *Supporting Table to Environmental Assessment Guideline 8 for Environmental Factors and Objectives: Relationship of Factors and Objectives to Environmental Issues and Aspects of Proposals*. Environmental Assessment Guideline 8. August 2013.

Environmental Protection Authority (2013c) *Consideration of Subterranean Fauna in EIA in Western Australia*. Environmental Assessment Guideline 12. June 2013.

Environmental Protection Authority (2013d) *EPA Involvement in Mine Closure*. Environmental Protection Bulletin 19. July 2013.

Environmental Protection Authority (2013e) *Application of a Significance Framework in the Environmental Impact Assessment Process.* Environmental Assessment Guideline 9. June 2013.

International Network for Acid Prevention (2009) *Acid Rock Drainage Guide.* June 2009.

Johnson, S.L. and Wright, A.H. (2003) *Mine Void Water Issues in Western Australia*. Hydrogeological Record Series Report No HG9. Water and Rivers Commission. April 2003.

O'Connor Pty Ltd, R. and E. (2011) *Aboriginal Heritage Surveys of Marda Extension and British Hill Prospects.* Confidential report prepared for Southern Cross Goldfields Ltd. October 2011.

Pendragon Environmental Solutions (2013) *Surface and Ground Water Assessment, Mining Proposal.* Prepared for Southern Cross Goldfields. November 2013.

Rapallo (2011) *Results of Stygofauna Sampling of MPB1*. Memorandum prepared for Southern Cross Goldfields. July 2011.

Rapallo (2012a) *Level 2 Flora And Vegetation Survey and Targeted Priority Flora Survey of Marda Central, Golden Orb and King Brown*. Prepared for Southern Cross Goldfields. November 2012.

Rapallo (2012b) *Level 1 Fauna Survey of Golden Orb Project Area*. Prepared for Southern Cross Goldfields. April 2012.

Rapallo (2012c) *Short Range Endemic Fauna Desktop and Risk Assessment of the Marda Gold Project.* Prepared for Southern Cross Goldfields. January 2012.

Rapallo (2012d) *Level 2 Short Range Endemic Survey of the Marda Tenement and Level 1 Short Range Endemic Surveys of the Golden Orb and King Brown Tenements.* Prepared for Southern Cross Goldfields. June 2012.

Rapallo (2013a) *Waste Rock Characterisation, Marda Central Project*. Prepared for Southern Cross Goldfields. November 2013.

Rapallo (2013b) *Waste Characterisation, King Brown Project*. Prepared for Southern Cross Goldfields. November 2013.

Rapallo (2013c) *Waste Characterisation, Golden Orb Project*. Prepared for Southern Cross Goldfields. December 2013.

Rapallo (2013d) *Level 2 Flora and Vegetation and Targeted Priority Flora Survey of Marda Central, Golden Orb and King Brown.* Prepared for Southern Cross Goldfields. December 2013.

Rapallo (2013e) *SRE Desktop and Risk Assessment of the Haul Roads and Infrastructure for the Marda Gold Project.* Prepared for Southern Cross Goldfields. December 2013.

Rock Team (2012) *Southern Cross Goldfields Marda Gold Project Feasibility Study*. Prepared for Southern Cross Goldfields. October 2013.

Soilwater Consultants (2013) *Marda Gold Project Pre-mine Soil Characterisation*. Prepared for Southern Cross Goldfields. November 2013.

Terrestrial Ecosystems (2011a) *Level 1 Fauna Risk Assessment for Southern Cross Goldfields Marda Project Area*. Prepared for Southern Cross Goldfields. March 2011.

Terrestrial Ecosystems (2011b) *Level 1 Fauna Risk Assessment for Southern Cross Goldfields King Brown Project Area*. Prepared for Southern Cross Goldfields. March 2011.

Terrestrial Ecosystems (2011c) *Tree Hollow Assessment for Cockatoos at Battler, King Brown, Marda and Golden Orb*. Prepared for Southern Cross Goldfields. September 2011.

Terrestrial Ecosystems (2013) *SREs for Southern Cross Goldfields Multiple Project Areas*. Letter report prepared for Bioscope Environmental Consulting on behalf of Southern Cross Goldfields Ltd. January 2013.

Tille, P. (2006) *Soil-landscapes of Western Australia's Rangelands and Arid Interior*. Resource Management Technical Report 313. Department of Agriculture and Food, WA.

The Institute of Lighting Engineers (2005) *Guidance Note for the Reduction of Obstrusive Light*.

Water and Rivers Commission (2000a) *Water Quality Protection Guidelines No 2. Mining and Mineral Processing. Tailings Facilities.*

Water and Rivers Commission (2000b) *Water Quality Protection Guidelines No 3. Mining and Mineral Processing. Liners for Waste Containment*.

Water and Rivers Commission (2000c) *Water Quality Protection Guidelines No 6. Mining and Mineral Processing. Minesite Stormwater.*

Water and Rivers Commission (2000d) *Water Quality Protection Guidelines No 7. Mining and Mineral Processing. Mechanical Servicing and Workshop Facilities.*

Water and Rivers Commission (2000e) *Water Quality Protection Guidelines No 9. Mining and Mineral Processing. Acid Mine Drainage*.

Water and Rivers Commission (2000f) *Water Quality Protection Guidelines No 10. Mining and Mineral Processing. Above-ground Fuel and Chemical Storage*.

Western Australian Planning Commission (2007) *Visual Landscape Planning in Western Australia*. *A Manual for Evaluation, Assessment, Siting and Design.* Western Australian Planning Commission and Department of Planning and Infrastructure. November 2007.