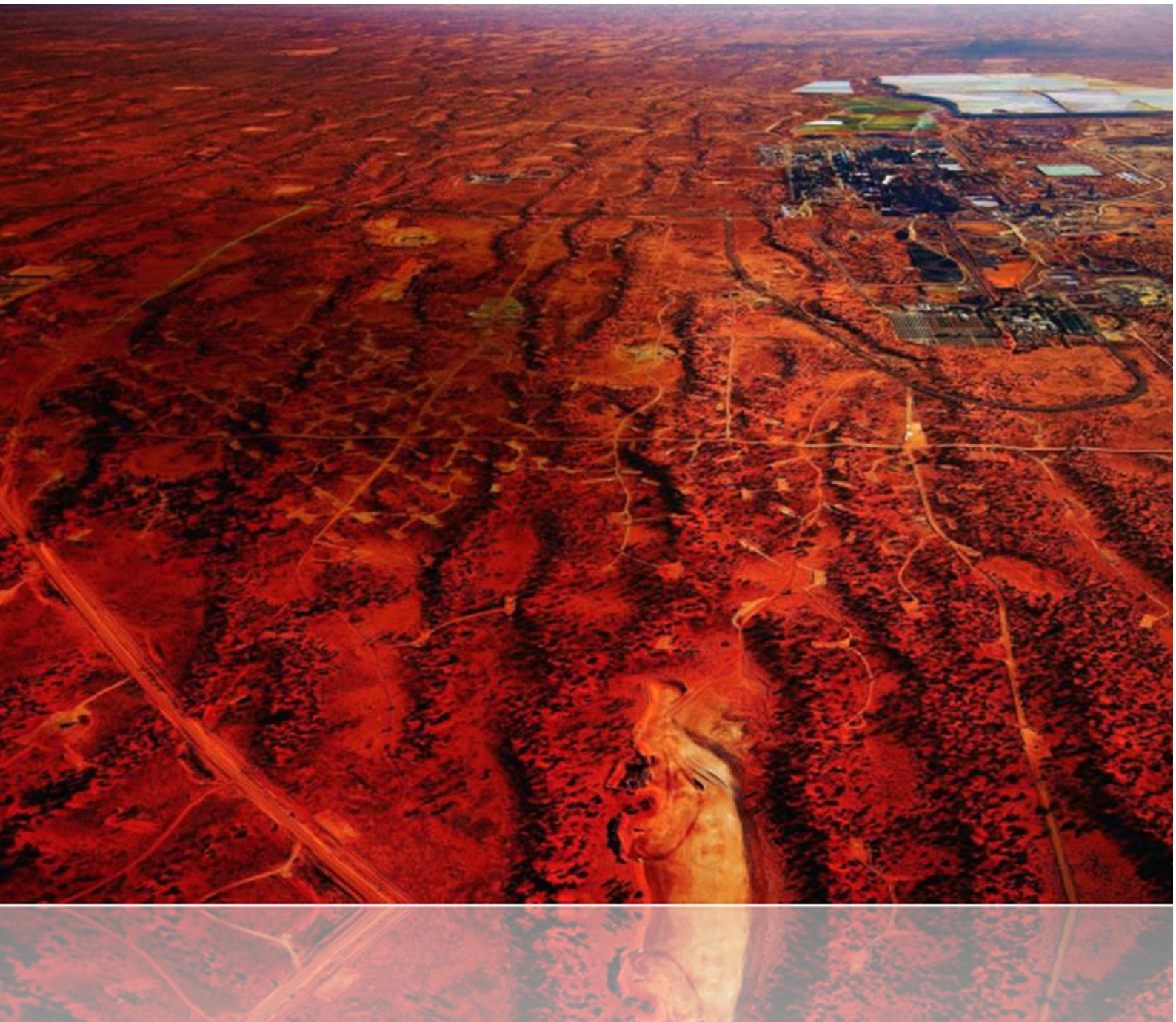
BHP

CLOSURE MANAGEMENT AND REHABILITATION PLAN

OLYMPIC DAM

May 2020



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Closure Management Plan Summary

Olympic Dam Mine	
Project	Olympic Dam
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Mining Tenements	Special Mining Lease 1
Company Name	BHP Billiton Olympic Dam Corporation Pty Ltd

Electronic Approval Record

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4		Update to 2013 document to reflect current LoA.	May 2019
5		Minor modifications as part of annual EPMP review cycle.	February 2020

Key Stakeholders

Department	Position
Integrated Operations	Manager Services
Strategic Planning	Manager Strategic Planning
Corporate Affairs	Head of Corporate Affairs SA
Land and Tenements	Manager Land Access & Approvals

Environment A&I	Manager Environment A&I

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Abbreviations

Abbreviation	Meaning
BOM	Australian Bureau of Meteorology
CAF	Cement Aggregated Fill
CMRP	Closure Management and Rehabilitation Plan
EL	Exploration Lease
FIFO	Fly-In-Fly-Out
GAB	Great Artesian Basin
GLD	Guideline
ICMM	International Council for Mining and Metals
IPCC	Intergovernmental Panel on Climate Change
LGA	Local Government Area
LoA	Life of Asset
MCA	Minerals Council of Australia
Mtpa	Million tonnes per annum
OBP	Optimised Base Plan
OD	Olympic Dam
PEL	Petroleum Exploration Licence
PELA	Petroleum Exploration Licence Application
RSF	Rock Storage Facility
SA	South Australia
SML	Special Mining Lease
TEO	Targeted Environmental Outcome
TRS	Tailings Retention System

1 Executive Summary

Olympic Dam is situated 570 kilometres (km) north of Adelaide in South Australia, and is a producer of copper, uranium, gold and silver. The current (FY19) ore reserve and mineral resource estimate indicates a life of asset to 2084 (+/- 5 years) with a subsequent planned relinquishment date of FY2104 following closure and monitoring. At that point in time, all residual mining, processing operations and associated infrastructure (e.g. wellfields) would be closed and rehabilitated, to achieve post-closure landforms and land-uses agreed with regulators and stakeholders.

The purpose of this Closure Management and Rehabilitation Plan is to describe how the Olympic Dam operation will be successfully closed and rehabilitated to achieve the agreed post-closure land-uses and the agreed environmental outcomes for identified values. The plan also outlines the performance criteria that will be used to measure successful closure and rehabilitation.

This plan also addresses the necessary radiological considerations including the safe and secure disposal of the final radioactive processing residues, contaminated plant, soils and equipment.

For closure planning purposes, the site has been broken up into closure domains. The closure requirements and implementation works are similar within each domain but may vary between domains. The various elements within each domain will be closed and rehabilitated where applicable to a specified/agreed standard. Rehabilitation and closure standard measures, closure design principles and completion criteria are documented.

Post-closure monitoring is also included in this plan to ensure these requirements are appropriately understood and costed. At this stage of planning, the monitoring requirements are generalised, but over time the post-closure monitoring program and schedule will be tailored to suit agreed completion criteria requirements. Ongoing monitoring, data collection and observation during operation are acknowledged as a key component in eventual relinquishment of the site.

This document describes aspects of the planned stakeholder engagement program. Such engagement and consultation on mine closure will only be meaningful closer to the closure date when the implications of closure on the post-closure community can be defined and understood.

This Closure Management and Rehabilitation Plan is supported by risk-based concept level (pre-feasibility) closure engineering designs that use best practice technology. The level of detail in the plan is commensurate with the early stages of planning.

The integrated closure planning system followed within BHP ensures that additional studies (and research where required) will be carried out to provide design data and to increase certainty and confidence in the design and implementation strategy well in advance of closure execution works. Outcomes from the research, study and consultation will be fed into the closure plan review as part of the continuous improvement and development of this Plan.

2 Scope and Purpose

2.1 Purpose and Process

The purpose of this Closure Management and Rehabilitation Plan (CMRP) is to define the closure objectives and commitments of Olympic Dam (OD) and how those will be met over the full life cycle of the mine. The CMRP also supports the closure cost estimate, guides progressive rehabilitation and outlines any knowledge gaps that need addressing throughout the Life of Asset (LoA). This ensures that mine closure is planned and systematic and demonstrates that risk-based closure is fully integrated into LoA planning to achieve successful closure with acceptably low post-closure risks.

The CMRP has been prepared to meet the requirements of:

- BHP's Our Requirements Closure;
- BHP's MinAus Closure Planning Standard (Version 1.0; September 2017); and
- OD's Asset Closure Planning Guideline (ASTCL-000-ENG-GUI-001) (Version 3.0 June 2018)

The CRMP also forms a portion of the approved Olympic Dam Environment Protection and Management Program (EPMP).

The CMRP will be reviewed annually for material changes and updated as required.

2.2 Exclusions

The following are out of scope for the CMRP:

- Closure of the Adelaide office facilities.
- Closure of the Port Adelaide facilities (Berth 25).

2.3 Project Overview

OD is an underground mine, mineral processing plant, copper smelter and refinery producing copper cathode, uranium, gold and silver and is located 16km north of the Roxby Downs township and 570km north-northwest of Adelaide, South Australia (SA) (Figure 2-1).

The orebody was discovered in 1975 by a WMC Resources/BP joint venture and the subsequent operation was named after a livestock watering dam on the Roxby Downs pastoral lease under which the orebody lies. The purpose-built town of Roxby Downs retains the name of the pastoral lease on which it was established. In 1982 the Indenture Agreement between the WMC Resources/BP joint venture and the South Australian Government was ratified.

Mine production at the facility commenced in 1988. A major expansion of the operation to nominal capacity of 200,000 tonnes per annum (tpa) of refined copper was completed in 1999. In 1993 WMC (Olympic Dam Corporation) Pty Ltd purchased BP Group's share, and in 2005 BHP acquired full ownership of WMC Resources. Once WMC (Olympic Dam Corporation) Pty Ltd became a member of the BHP Group, the name was changed to BHP Billiton Olympic Dam Corporation Pty Ltd. As at FY19, the current Optimised Base Plan (OBP) LoA for OD is until 2084 (+/- 5 years), with a subsequent planned relinquishment date of FY2104 after twenty years of monitoring.

The mineral deposit contains variable concentrations of iron, copper, uranium, gold, silver barium, fluorine and rare earths, although only the extraction and processing of copper, uranium, gold and silver are currently considered commercially viable. The ore body and main mine development occurs to a depth of some 650 m in Precambrian basement rocks. The basement rocks are overlain by a generally horizontally bedded overburden sequence which comprises three main units. The deepest overburden unit is an essentially impermeable shale/mudstone unit (the Tregolana Shale) immediately overlying the ore body. The Tregolana Shale is overlain by approximately 200 m of Arcoona Quartzite, which, although lacking primary porosity, can be fractured in its lower sections and can yield water to ventilation shafts, decline, haulage shafts and drill holes. In turn, the Arcoona Quartzite is overlain by the Andamooka Limestone, between 40 and 100 m thick and occasionally outcropping.

The ore, once extracted, feeds the on-site metallurgical processing plant and has an annual production rate of 10 million tonnes. The metallurgical plant includes a concentrator, hydrometallurgical plant, copper smelter, copper refinery and slimes treatment plant. Process tailings are stored in a series of tailings storage cells, and excess process liquor that cannot be re-used in the process is evaporated in evaporation ponds. The tailings cells and evaporation ponds are collectively referred to as the Tailings Retention System (TRS). Following the completion of the refinery process, product is transported by road to storage facilities at Port Adelaide for export to international markets.

2.4 Land Tenure and Environmental Authorisations

2.4.1 Land Tenure

The SML, issued to BHP pursuant to the Indenture, is the primary tenure instrument that provides for the Olympic Dam mining and processing operations. The SML is surrounded by the pastoral property of Roxby Downs for which BHP holds the pastoral lease (Lease 2338). Areas off the SML are located on various parcels of land within the Municipality and leased or owned by BHP for operational support activities (e.g. industrial areas, accommodation villages, airport etc.). In addition to various freehold properties, BHP has two Occupation Licences (OL017944 and OL018250) which provide BHP with a licence to use Crown Land within the Roxby Downs Municipality. These are annual licences with specific permitted purposes.

2.4.2 Current Mining Tenement

Table 2-1 provides detail of the existing authorised mining tenement (SML1) for OD. For the purpose of this CMRP only the Special Mining Lease (SML) and associated external facilities (such as the water supply wellfields and Roxby Downs township) are considered in any detail.

Table 2-1: Olympic Dam Mining Tenements (30 June 2019)

Lease / Area	Grant Date	Expiry Date	Tenure Holder / Applicants	Operational Land
SML 1	09 May 1986	08 May 2036	BHP BILLITON OLYMPIC DAM CORPORATION PTY LTD	Lot S1516 on Plan H833800 (WMC Olympic Dam Corporation) Pty Ltd

2.4.3 Environmental Authorisations

Table 2-2 provides details of the current environmental authorisations for the facility.

Table 2-2: Olympic Dam EPA Environmental Authorisations (30 June 2019)

Number	Type	Tenure Holder / Applicants	Address	Titles	Activities
1301	Licence	BHP BILLITON OLYMPIC DAM CORPORATION PTY LTD	Sections 1475 & 1516 Out of Hundreds Andamooka, OLYMPIC DAM, 5725, SA	CT-5140-575	Mineral works Extractive industries - Fuel burning not coal or wood Desalination plant that discharges wastewater to inland waters or land (other than to a wastewater lagoon) Hydrocarbon storage Waste Recovery Facility Wastewater treatment works (outside MLR WPA) Landfill Depot Activity producing listed waste Chemical storage and warehousing facilities Chemical works (inorganic) Abrasive blasting Concrete batching works Ferrous and non-ferrous metal melting works Metallurgical works
3054	Licence	BHP BILLITON OLYMPIC DAM CORPORATION PTY LTD	Blinman Road, OLYMPIC DAM SA 5725	CR-6017-774	Wastewater treatment works (outside MLR WPA)
31543	Exemption	BHP BILLITON OLYMPIC DAM CORPORATION PTY LTD	Sections 1475 & 1516 Out of Hundreds Andamooka, OLYMPIC DAM, 5725, SA	CT-5140-575	Exemption from section 34 of the Environment Protection Act 1993 in respect of the requirements of clause 10 of the Environment Protection (Water Quality) Policy 2015 in relation to TSF5. Subject to a number of conditions.
LM1	Licence	BHP BILLITON OLYMPIC DAM			Licence granted on 28 September 1988 under the Radiation Protection and Control Act 1982 (SA) to

Number	Type	Tenure Holder / Applicants	Address	Titles	Activities
		CORPORATION PTY LTD			mine and treat uranium bearing ores at Olympic Dam.

Figure 2-1: Olympic Dam Location Plan

2.5 Closure Features and Domains

To facilitate effective mine closure planning, OD operations have been divided into a number of physically distinct domains and features. The domains are comprised of features that have similar closure methodologies, landforms and land-uses (Table 2-3, Figure 2-2). Section 9 provides further details on the rehabilitation implementation for each domain.

Table 2-3: LoA Domains and Features

Domain	Features
Airport Facilities	• Olympic Dam Airport
Town Facilities	• Olympic Village • Olympic Dam sewage ponds • Roxby Downs town facilities
Metallurgical Plant and Administration Buildings	• Administration buildings • Processing plant and supporting infrastructure (e.g. ponds, bunds, tanks and powerlines) • Roads • Stockpile footprints • Stormwater diversion bunds and channels
Tailings Retention System	• Tailings storage cells • Evaporation ponds • Pipe trace
Pilot Plant	• Pilot Plant • Associated tailings ponds • Haul roads
Open Pit	• Clearing and grubbing area • Excavated area • Dewatering infrastructure • Mine haul roads • Stormwater diversion bunds • Topsoil stockpiles
Rock Storage Facility	• Current Storage Area • Cleared crusher pad area • Separate sand stockpiles
Wellfields and Associated Infrastructure	• Desalination plant • Water storage ponds • Pipelines • Water distribution pipelines and pump stations • Wellfields A and B • Access roads and tracks.
Contaminated Waste Disposal Facility	• Contaminated Waste Disposal Facility (only one cell currently in use)
Miscellaneous (including the underground mine and administration facilities)	• Mine administrative offices • Shafts decline, raise bores and associated surface infrastructure • Core yard • Mine roads • Stormwater diversion bunds and channels • Explosive magazine areas • Mine water settling and evaporation ponds • Stockpile including old mullock pile site • Cement Aggregated Fill (CAF) Plant and associated crushing, screening and backfilling infrastructure • Backfill limestone (for CAF) quarry and haul roads • Quarries and borrow pits • Waste management area • Exploration sites on the SML • Decommission local and regional water monitoring wells and any remaining mineral wells. • Arid Recovery area • Water and wastewater treatment facilities

Domain	Features
	• Residual Infrastructure (power lines, roads and hardstands) • Transmission lines (Davenport to Olympic Dam) and easement.

2.6 Current Disturbance

Table 2-4 and Figure 2-2 provide a summary of the current (September 2019) disturbance for the mine and town facilities.

Table 2-4: Current Disturbance

Domain	Figure 2-2 legend key	Current Unrehabilitated Disturbance (ha)	Current Partially Rehabilitated Disturbance (ha)	Total (ha)
Airport Facilities	Airport	26.4		26.4
Contaminated waste disposal facility	CWDF	1.6		1.6
Metallurgical Plant and Administration Facilities	Process	108.1		108.1
Miscellaneous (including the underground mine and administration facilities)	MISC	2397.5	70.7	2468.2
Open Pit	Open pit	34.0		34.0
Pilot Plant	Pilot	12.2		12.2
Quarry	Quarry	134.2		134.2
Rock Storage Facility	RSF	40.4		40.4
Tailings Retention System	TRS	849.3		849.3
Town and Village Facilities	Town	510.2		510.2
Wellfield Facilities	WF	360.6	379.3	739.8
Total		**4474.5**	**450**	**4924.4**

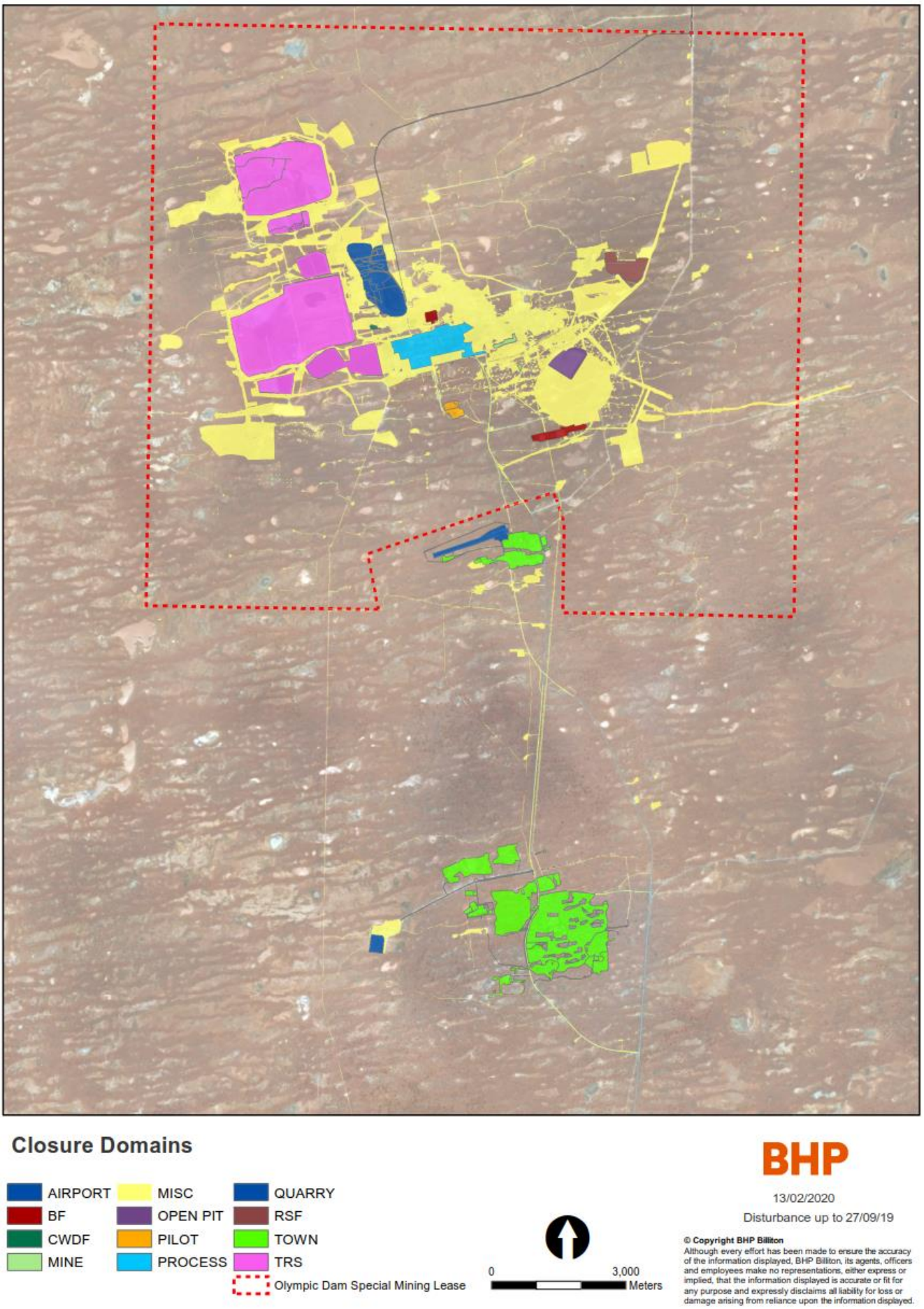


Figure 2-2: **Olympic Dam disturbance as at September 2019**

3 Roles and Responsibilities

The primary roles and responsibilities for deliverables, endorsements and approval of the CMRP are outlined in the BHP Olympic Dam Asset Closure Planning Closure Plan Guideline (ASTCL-000ENG-GUI0001) (Version 3.0 June 2018) and the MinAus Closure Planning Standard (Version 1.0; September 2017) (Table 3-1).

Management accountability for sites and associated facilities is with the operational General Manager/Head of Department, or as otherwise agreed to ensure legal obligations under state legislation are maintained including health and safety.

Table 3-1: Roles and Responsibilities

Roles / Deliverables	Closure Mgt. Plan	Regulatory Closure / Rehabilitation Plan	Closure Cost Estimate	Closure Provision	Sarbanes Oxley Controls (Closure Planning)
Manager Closure Planning	A/R	C	A/R	A	R
Manager Strategic Planning	A/R	C	A/R	A	R
Manager Environment A&I	A/C	A/R	I		
Manager ERH&S	I	C	I		
Manager Investment and Evaluation			C	A	R
Manager Accounting and Reporting			I	R	R
Principal Legal	C	C			
Head of HSE OD		C	I		
Head of Finance BP			I	I	
Head of Environment A&I	Endorse	Endorse	Endorse	I	
Head of RE/Geoscience	Endorse	Endorse	Endorse	I	
VP P&T	I		I	I	
VP HSE	Approve		I		
VP Accounting and Reporting			I	Endorse	
Asset President	Approve	Approve	Approve	Approve	

R – Responsible A – Accountable C – Consult I - Inform

4 Closure Obligations and Commitments

A critical factor in defining the scope and context of closure is to identify and evaluate applicable legal obligations, guidelines and stakeholder expectations and commitments. Legal obligations for rehabilitation are generally found in legislation and in the mine development approvals and describe 'actions' that must be completed. These legal obligations should be considered as part of the closure planning process. Other commitments and obligations can include company standards (section 2.1), legal and other commitments made to regulators, and internal and external stakeholders with respect to mine closure and tenement relinquishment. The following sections provide an overview of the commitments and obligations considered relevant for OD closure planning.

4.1 Regulatory and Other Instruments

Requirements may come to apply to rehabilitation and closure activities in two ways, being:

- through conditions of existing or future approvals regulating activity at Olympic Dam; or
- through existing or future regulatory instruments which apply to the specific subset of activities comprising the rehabilitation and closure actions themselves.

Key existing regulatory instruments, guidelines, policies and codes of practice that cover subject matter relevant to the development of this CMRP and which may apply (as amended) at closure are summarised in Table 4-1**.**

Table 4-1: **Regulatory and Other Commitments and Obligations**

Regulatory Document	Consideration
Aboriginal Heritage Act (1979) SA	The Act was never enacted but through Section 9 of the *Roxby Downs (Indenture Ratification) Act 1982*, BHP is subject to the Act (as modified by the Indenture) for its activities within the Stuart Shelf Area and Olympic Dam Area as defined in the Indenture and which are undertaken pursuant to the Indenture.
Aboriginal Heritage Act 1988 (SA)	The Act provides for the protection and preservation of the Aboriginal heritage and may need to be considered during closure for the current and surrounding lands.
Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005) (Mining Code)	The Code provides for radiation protection in mining and mineral processing industries and for protection of human health and the environment from the effects of radioactive waste from mining and mineral processing.
Environment Protection Act 1993 (SA)	In accordance with the objects of the EP Act, closure activities will need to consider the management of environmental harm and be undertaken in accordance with the general environmental duty, which may require consideration of, amongst other matters, the relevant Environment Protection Policies made under the Act during rehabilitation and closure.
Environment Protection (Waste to Resources) Policy 2010 (SA)	Closure and rehabilitation activities involving the production of waste will need to consider the waste management objectives and recording and reporting requirements in the Environment Protection (Waste to Resources) Policy.
Environment Protection (Water Quality) Policy 2015	Closure and rehabilitation activities involving works that impact surface water, groundwater or watercourses may need to comply with the general obligations and associated water quality criteria contained in the Policy.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	Provides a scheme for the regulation, control and assessment of activities of national environmental significance including actions that are or are likely to be "controlled actions". Closure and rehabilitation activities may require consideration or even approval under this legislation.
Guidelines for calculating a Significant Environmental Benefit under the *Native Vegetation Act 1991* and *Native Vegetation Regulation 2017*, Department of Environment Water and Natural Resources 2016	The *Native Vegetation Act 1991* and *Native Vegetation Regulations 2017* allow the clearance of native vegetation under certain circumstances. To prevent the further decline in native vegetation in South Australia, some clearance activities require the establishment of a Significant Environmental Benefit (SEB). An SEB is achieved through the establishment of an area of land to be managed and protected for the growth of native vegetation.

Regulatory Document	Consideration
Guide for a Significant Environmental Benefit for the clearance of native vegetation associated with the Minerals and Petroleum Industry, Native Vegetation Council (SA), August 2017.	Provides guidelines for operators who undertake mining and pipeline activities as to the Significant Environmental Benefit requirements under the *Native Vegetation Act 1991* and *Native Vegetation Regulations 2017* (SA).
Guideline - Preparation and implementation of closure and post-closure plans, EPA 1088/16, Environment Protection Authority SA, December 2016	Guideline to assist licensees who are required by conditions of an environmental authorisation to develop and implement a closure and post-closure plan (noting that these guidelines are not intended to apply to mining and resource industries).
Heritage Places Act 1993 (SA)	Provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance. Closure activities need to consider impacts on identified places and objects.
Landscape South Australia Act 2019 (SA)	In part operation and is scheduled to repeal on 1 July 2020 the *Natural Resources Management Act 2004* (SA). Provides a new legislative scheme for promoting sustainable and integrated management of the State's natural resources and makes provision for the protection of the State's natural resources.
Minerals Regulatory Guidelines MG2a and MG2b (SA)	Guidance for content related to care and maintenance, rehabilitation strategies and timing and mine completion.
Mining Act 1971 (SA)	Does not apply to the extent of any inconsistency with the Roxby Downs (Indenture Ratification) Act 1982, but contains closure and rehabilitation provisions (in Part 10A) that will apply to any components at Olympic Dam operations that are conducted under tenements issued under the Mining Act 1971 (eg. Extractive Mineral Leases, etc.).
National Parks and Wildlife Act 1972 (SA)	Provides for the establishment, management and conservation of wildlife in a natural environment. Closure may need to consider requirements for surrounding lands.
Native Vegetation Act 1991 (SA) and Native Vegetation Regulations 2017 (SA)	Provides for the preservation and enhancement of native vegetation and controls the clearance of native vegetation. Closure activities, including clearing of and rehabilitation outcomes may need to consider these requirements.
Natural Resources Management Act 2004 (SA)	Promotes sustainable and integrated management of the State's natural resources; to make provision for the protection of the State's natural resources.
Pastoral Land Management and Conservation Act 1989 (SA)	Provides for the management and conservation of pastoral land. Closure and rehabilitation objectives may need to consider the requirements of this legislation, including to ensure compliance with duties not to misuse pastoral land..
Radiation Protection and Control Act 1982 (SA)	Provides for the control of activities related to radioactive substances and radiation apparatus, and for protecting the environment and the health and safety of people against the harmful effects of radiation.
Roxby Downs (Indenture Ratification) Act 1982 (SA)	Provides statutory authority for an agreement (Indenture) between ODC and the State of South Australia. The Indenture establishes the legal framework for existing and future operations at the Olympic Dam Area and the Stuart Shelf Area and defines the roles and responsibilities of the South Australian Government and BHP. The Indenture requires ODC to implement the EPMP and comply with certain codes
'It's your place – A roadmap for managing natural resources in the SA Arid Lands Region 2017-2027', SA Arid Lands Natural Resources Management Board. Regional NRM Plan (Volume 1), 2017	10 year plan for maintaining and enhancing the natural resources of the SA Arid Lands NRM region.
South Australian Public Health Act 2011 (SA)	Promotes and provides for the protection of the health of the public of South Australia and to reduce the incidence of preventable illness, injury and disability.

4.2 Legal and Statutory Commitments and Obligations

A summary of the documents in which legal and statutory commitments and obligations were identified and which may apply at closure are summarised in Table 4-2. All statutory documentation is housed in BHP's *LandAssist* database. The list of legislation, policies, codes of practice and guidelines in this section may be updated or amended from time to time and is subject to periodic review.

Table 4-2: Legal and Statutory Commitments and Obligations

Document	Document(s) Number	Consideration
Environmental disturbance Permits (Note: these are internal BHP permits, they are not legal authorisations issued by a regulator)		Provide for the conditions of clearing on site. May contain (internally imposed) rehabilitation conditions.
Environmental Impact Statement	1982 / 1997 / 2009 / 2011	Environmental Impact Assessment completed under State and/or Federal requirements. Generally inform the state and federal environmental approvals and contain closure and rehabilitation commitments and obligations.
Environment Protection and Biodiversity Conservation Act Approval (EPBC)	EPBC 2005/2270	Federal approval under which ODX mining activities can be completed. Approval contains rehabilitation and closure related conditions.
Ministerial Approval	ODO0005	Contains conditions permitting the construction of TSF cells 4 and 5. Condition requirements and design information will need to be demonstrated at closure.
Ministerial Approval EPA approval	MEM19V1191, 26/11/2019 EPA R/807, 05/12/2019	Contains conditions permitting the construction of TSF cell 6 and evaporation pond 6 (EP6). Condition requirements and design information will need to be demonstrated at closure.
Retention Lease and Extractive Minerals Lease (Quarry Permits)	EML5357 / EML5552 / RL76	Provides the conditions that must be met to permit quarry activities. Contains conditions requiring progressive rehabilitation.

4.3 Community Agreements

A review of existing community agreements did not identify any closure related commitments. Social investments (e.g. donations) occurring during operations are managed at an asset level. A review of donations will be undertaken as OD approaches closure.

5 Stakeholder Consultation

5.1 Stakeholder Identification and Approach

Stakeholder engagement is a critical component of successful mine closure planning. Through effective stakeholder engagement, organisational and community perspectives, knowledge is gathered to inform mine closure processes and goals. Effective stakeholder engagement increases the likelihood that mine closure outcomes will be beneficial, for both the operator and the broader community, and should involve all stakeholders. Working with stakeholders throughout the project lifecycle assists in reflecting the needs of stakeholders in the rehabilitation objectives for the site.

BHP has systems in place to identify stakeholder risks and concerns related to the operations, including BHP's 'Our Requirements – Communications, Community and External Engagement', which considers the need for developing a Stakeholder Engagement Strategy. Furthermore, BHP is a signatory to the International Council for Mining and Metals' (ICMM) Sustainable Development Principles and the Minerals Council of Australia (MCA) Enduring Value, both of which require member companies to conform to actions where mines are being operated. Both industry bodies outline sustainable development principles for member companies including the requirement to 'proactively engage key stakeholders on sustainable development challenges and opportunities in an open and transparent manner (ICMM 2015) and consult with interested and affected parties to identify, assess and manage all significant social, health, safety, environmental and economic impacts associated with our activities'.

One of the primary objectives of the OD CMRP is to ensure that stakeholder needs, concerns and aspirations are taken into account for closure planning. The existing stakeholder engagement approach will be reviewed throughout the LoA and if required, adapted to meet the needs of closure planning.

The objectives of the stakeholder engagement strategy with respect to closure will include:

- Ensuring all internal and external stakeholders are identified and interests and concerns understood;
- Keeping identified stakeholders informed of relevant activities and progress at the mine, specific to the LoA and closure;
- Maintain and nurture existing stakeholder relationships;
- Identify stakeholder concerns about rehabilitation and mine closure;
- Consider and address stakeholder concerns where possible, as they arise; and
- Provide timely, accurate and credible information to the identified stakeholders up until relinquishment is achieved.

Owing to the extensive remaining life of the mine and the current consultation processes for the operation, discussions with interested parties and stakeholders about closure planning of the existing operations have not commenced. Stakeholder engagement will be held at appropriate stages during the evolution of the mine and the mine closure.

The stakeholder register (Appendix A**)** provides an overview of the identified stakeholders with respect to OD's rehabilitation and closure planning.

5.2 Five Year Engagement Goals

In addition to the regular and ongoing engagement with regulatory authorities, Table 5-1 provides a summary of the planned engagement activities with other community stakeholders identified to occur within the next 5 years:

Table 5-1: Five Year Engagement Activities

Stakeholder	Engagement
Olympic Dam employees, contractors and suppliers	Updates on demolition and progressive rehabilitation activities
Roxby Downs, Woomera and Andamooka communities	Updates on demolition and progressive rehabilitation activities

5.3 Community Profile

The resident population of the Roxby Downs Local Government Area (LGA) during 2017 was estimated at 3,979 (Australian Bureau of Statistics, 2018). The major contributor to the Roxby Downs economy is the mining resource sector with mining making up 51.8% of jobs, followed next by education (6.3%) and construction and administrative support services, both making up 5.8% of jobs (Australian Bureau of Statistics, 2018). Table 5-2 provides a summary of the key social and economic features for the Roxby Downs LGA.

Table 5-2: Roxby Downs Local Government Area Economic Features (ABS, 2018)

Economic Measure	Statistic
Resident Population	3,979 (2017)
Median Total Income	$86,357
Industry of Employment	The top five industries of employment: • Mining: 51.8% • Education and Training: 6.3% • Construction: 5.8% • Administrative and Support Services: 5.8% • Accommodation and Food Services: 5.1%
Occupation	The top five occupations of employment: • Technicians and Trade Workers: 26.6% • Machinery Operators and Drivers: 22.4% • Professionals: 13.5% • Labourers: 9.1% • Clerical and Administrative Services: 8.5%
Unemployment	Increasing since 2011 (1.8%) to 3.5% in 2016
Age Groups	The main age groups are: • 0-14 years: 26.7% • 25-34 years: 23.1% • 35-44 years: 16.7%
Education	Post School Qualification (64.6%), Certificate (33.1%), Bachelor Degree (10.3%)
Household Composition	• Total households: 1,177 • Predominantly family households (866) • Lone person households (258)
Dwelling Tenure	Renting (69.8%), Owned with mortgage (22.2%), Owned outright (5.8%),

5.4 Community Exit Strategy

OD operations are located within and near various communities. The major host community supporting OD which will be impacted as a result of OD's closure is Roxby Downs. Roxby Downs major industry of employment is mining, making up 51.8%.

It is recognized that the development of OD included construction and ongoing support of public infrastructure including roads, water supply and airports as well as a range of ancillary services and direct and indirect employment opportunities.

Planned closure activities will include the demolition and removal of all BHP buildings and structures and rehabilitation of the Olympic Village, the Olympic Dam Sewage Ponds, the Olympic Dam Airport and Roxby Downs Town Facilities. The potential to hand these facilities over to an interested party (e.g. government) will be part of the stakeholder/public consultation process leading up to final closure. The closure plan has not considered any areas or facilities which Roxby Council is responsible for operating and maintaining.

As part of the closure planning process, a Social and Economic Impact Assessment (SEIA) will be completed 10 years prior to closure to allow positive and negative impacts to be addressed. The SEIA will aim to address:

- Potential impacts of closure;
- Extent/magnitude of impacts likely to be experienced;
- Resilience of stakeholders and host communities to respond to change (e.g. without support from BHP);
- How negative impacts may be mitigated or beneficial impacts enhanced, to facilitate the closure process (e.g. transitioning ownership of assets or built infrastructure to interested stakeholders, investigating opportunities to transition local employment to closure / post closure monitoring period); and
- Opportunities for transitioning OD's current social investment to sustainable practices post closure.

5.5 Stakeholder Register

Appendix A provides an overview of the identified stakeholders with respect to OD's rehabilitation and closure planning.

6 Rehabilitation Goals, Objectives and Criteria

Rehabilitation is defined as “a process where disturbed land is returned to a stable, productive and self-sustaining condition, taking future land use into account (EPA 2006)”. The rehabilitation sequence is normally considered to comprise of the following activities:

- developing designs for appropriate landforms for the mine site;
- creating landforms that will behave and evolve in a predictable manner, according to the design principles established; and
- establishing appropriate sustainable ecosystems (DITR 2006).

6.1 Rehabilitation Goals

The general goals for OD’s rehabilitation are to create a post mine land use that is:

- Safe to humans and wildlife;
- Non-polluting;
- Stable; and
- Able to sustain an agreed post mine land use.

6.2 Final Land Use

The closure goals support the proposed final land uses, which have been defined, as far as is reasonably achievable, as:

- SML Area:
  - land use for rehabilitation at original ground level: revegetated vacant crown land with potential for restricted grazing;
  - above ground tailings retention facilities and below ground open pit: vegetation free (to the extent possible) vacant crown land with restricted public and fauna access;
  - above ground rock storage facility: naturally revegetated vacant crown land with restricted public and fauna access.
- Areas outside of SML: land use consistent with neighbouring properties.

The final closure land uses will be negotiated with the stakeholders and communities throughout the LoA, including the demolition, retention or repurposing of BHP built infrastructure such as Olympic Dam Airport, Roxby Downs Town Facilities, Olympic Village and Olympic Dam Sewage Ponds. It is possible that a variety of land uses will be discussed and negotiated in order to ensure that the post-closure land uses promote and support the viability and sustainability of the post-closure communities that will remain in the region after closure of the mining operation.

6.3 Closure Environmental Outcomes and Assessment Criteria

The high level closure outcomes and assessment criteria for OD are summarised in Table 6-1, from which site-specific, domain-specific and area-specific assessment criteria are derived. The environmental outcomes are based on post-closure, to be achieved in the long term following closure and rehabilitation activities. The activities undertaken during closure would be carried out to comply with the outcomes and compliance criteria in place during the mines operation.

Importantly the proposed indicators and criteria will be refined through ongoing trials, monitoring and investigations and in consultation with key stakeholders and regulatory authorities. A monitoring programme will be established and updated as required to track progress of rehabilitation, inform ongoing management and to demonstrate that the rehabilitation has achieved or is trending toward the rehabilitation goals (Section 10). A review of the completion criteria will be undertaken as required and refined from monitoring results as further information becomes available.

Table 6-1: Closure Outcomes and Criteria

EM Program	Environmental Outcomes	Assessment Criteria	Applicable Domain(s)
Use of Natural Resources			
Land disturbance and rehabilitation	• Rehabilitation provides a geotechnically and geochemically stable and safe environment to reduce the need for long-term monitoring and maintenance	• Rehabilitation of sites and its integration into adjacent land uses occurs as soon as reasonably practical and in accordance with the Leading Practice Sustainable Development Program for the Mining Industry. • Erosion resistant landforms achieved such that post-closure remediation works are not required. • 'Contaminated areas assessed in accordance with NEPM 1999, and assessed and where necessary remediated to SA EPA requirements under the Environment Protection Act 1993 and relevant guidelines criteria at the time of closure. • Monitoring (e.g. ecosystem function analysis) shows satisfactory rehabilitation progress with diversity and structure approaching that observed at appropriate reference areas	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and Associated Infrastructure, Contaminated Waste Disposal Facility.
Spread of pest plants and animals	• No significant increase in the areas of infestation or abundance of declared pest plants, plant pathogens or pest animal populations as a result of closure.	• No material difference in abundance of declared pest species compared to appropriate reference areas. • No introduction of new self-sustaining declared pest populations post-closure as a result of BHP activities	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and Associated Infrastructure, Contaminated Waste Disposal Facility
Aquifer level drawdown	• No significant adverse impact on third party groundwater users.	• Groundwater quality and yield, for third party users, commensurate with agreed future land use.	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and Associated Infrastructure, Contaminated Waste Disposal Facility
Operation of Industrial Systems			
Particulate emissions	• No adverse impacts to public health as a result of particulate emissions from the final landforms achieved.	• NEPM (ambient air) criteria for public exposure, or the relevant criteria at the time of closure, applied to final landforms.	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and

EM Program	Environmental Outcomes	Assessment Criteria	Applicable Domain(s)
			Associated Infrastructure, Contaminated Waste Disposal Facility
Radioactive emissions	• No adverse impacts to public health as a result of radioactive emissions from final landforms. • No significant adverse radiological impacts to ecological communities as a result of radioactive emissions from final landforms.	• A dose limit for radiation doses to members of the public of 1 mSv/y above natural background • Deposition of closed site originated 238U less than 25 Bq/m2/y at non-human biota assessment sites	Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Contaminated Waste Disposal Facility
Generation of Industry Wastes			
Embankment stability of TSF	• Final landforms geotechnically stable.	• No significant TSF embankment failure.	Tailings Retention System
Tailings and Rock Storage Facility (RSF) seepage	• No significant adverse impact on vegetation as a result of seepage from the TSF or RSF post-closure. • No compromise of existing and future land uses on adjoining areas as a result of seepage from the TSF or RSF post-closure.	• Surface and groundwater quality commensurate with agreed future land use (for third party users).	Tailings Retention System and Rock Storage Facility
Stormwater discharge	• No significant adverse impact on local drainage patterns and water quality, arising from discharge associated with the final landform, which would compromise existing water use and water-dependent ecosystems.	• All contact storm water maintained within designated storm water management areas.	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and Associated Infrastructure, Contaminated Waste Disposal Facility
Solid and liquid waste disposal	• No significant adverse impacts from solid or liquid wastes as a result of rehabilitation and closure.	• Relevant criteria at the time of closure, for surface water and groundwater and for air quality. • Landfill facility decommissioning and/or rehabilitation in accordance with SA EPA landfill guidelines and requirements.	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and Associated Infrastructure, Contaminated Waste Disposal Facility
Radioactive waste	• No adverse impacts to public health as a result of radioactive emissions from final landforms.	• A dose limit for radiation doses to members of the public of 1 mSv/y above natural background. • Deposition of closed site originated 238U less than 25 Bq/m2/y at non-human biota assessment sites	Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Contaminated Waste Disposal Facility

EM Program	Environmental Outcomes	Assessment Criteria	Applicable Domain(s)
	• No significant adverse radiological impacts to ecological communities as a result of radioactive emissions from final landforms.		
Containment of waste rock	• Maintain structural integrity of the RSF.	• No unplanned structural failure to the RSF resulting in a significant adverse impact to third party surface and groundwater users.	Rock Storage Facility
Employment and Accommodation of People			
Community interactions and workplace interactions	• Communities in which BHP operates value their relationship with us.	• Safe conditions and controls to restrict inadvertent access to unsafe environments following rehabilitation	Airport, Town Facilities, Metallurgical Plant and Administration Facilities, Tailings Retention System, Pilot Plant, Open Pit, Rock Storage Facility, Miscellaneous, Wellfields and Associated Infrastructure, Contaminated Waste Disposal Facility

7 Collection and Analysis of Closure Data

The following section provides a summary of the physical and biological environment that influence closure planning and rehabilitation decision making at OD and has been obtained from the baseline assessments completed as part of previous Environmental Impact Statements (EIS) (1982, 1997 and 2009), the Supplementary EIS (2010), operational studies and the Environmental Protection and Management Program. This knowledge base, along with the feedback from key stakeholders will be subject to review and update throughout the LoA to ensure its continued relevance and accuracy. Gaps in the knowledge base and which have the potential to influence the closure outcomes have been identified and preliminary actions identified. These actions will form future studies to close the identified gap. A consolidated list of the identified gaps and preliminary actions is included in Appendix B.

7.1 Climate

7.1.1 Existing Climate

The climate is arid with average annual rainfall of 148 millimetres (mm) and annual average evaporation of approximately 3000 mm recorded at the closest meteorological recording station (Roxby Downs Olympic Dam Aerodrome Site No. 016096). The temperature ranges from cool winters, with mean daily minima and maxima of 5°C and 19°C respectively, to hot summers with mean daily minima and maxima of 20°C and 36°C respectively (Figure 7-1). Rainfall is erratic, and most years Olympic Dam experiences periods of two to three months with no significant rainfall. Long sustained periods of intense rainfall are very rare, but large intensity and short duration storm events associated with thunderstorm activity can occur in any month. The 1-in-100 72-hour annual exceedance probability (AEP) rainfall event is 158 mm and the 1-in-500 AEP is 272 mm (12-hour duration).

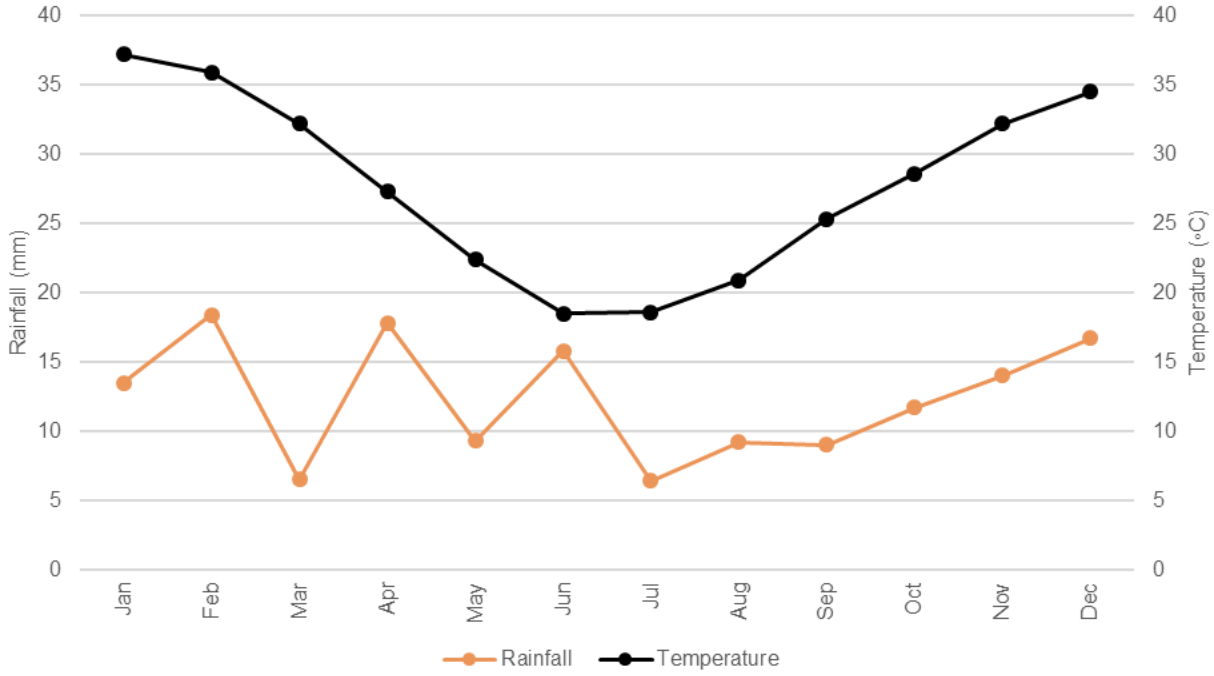


Figure 7-1: **Mean Maximum Temperature and Rainfall (Roxby Downs Olympic Dam Aerodrome Site No. 016096) (BOM 2018)**

7.1.2 Climate Change

The Intergovernmental Panel on Climate Change (IPCC) regularly undertakes an assessment of global climate change literature. BHP accepts the IPCC's current view that warming is unequivocal, human influence is clear and physical impacts are unavoidable. Australia's CSIRO has completed climate change projections to support the planning needs of Australia's natural resource management sector, and to provide information to assist climate adaptation processes. Based on this work, OD lies within the CSIRO modelled Rangelands Cluster (Watterson et al, 2015). The vast Rangelands cluster extends across much of the iconic 'Outback'. It contains varied landscapes, including the Flinders and Pilbara Ranges, salt lakes that flood sporadically (Hope et al., 2004), and the Centre (Watterson et al, 2015). The Rangelands Cluster consists of a wide range of vegetation, from tropical woodlands to shrublands, grasslands and saltbush, and it includes relatively intact ecosystems. Water features are mostly intermittent, and aside from the coastal rivers of the west, most streams drain into salty lakes, in particular Lake Eyre (Watterson et al, 2015). Change in climate conditions for the Rangelands Cluster forecast by CSIRO and which may impact OD include:

- Increase in average mean maximum and minimum temperatures;
- Hotter and more frequent hot days and fewer frosts;
- Rainfall changes are unclear, but likely less rainfall in winter and spring and increased intensity of heavy rainfall events;
- Increased evaporation rates in summer and reduced soil moisture in all seasons; and
- A harsher fire-weather climate.

7.1.3 Knowledge Gaps

Knowledge gaps and preliminary actions with respect to climate and climate change and which may have impacts on closure outcomes are outlined in Table 7-1.

Table 7-1: Climate and Climate Change Knowledge Gaps and Actions

Knowledge Gap	Preliminary Action
Suitability of rehabilitation species selection to sustain hotter and dryer climates with less soil moisture	Observation of trends from rehabilitation monitoring
Ability for landform designs (TSFs and RSF) to withstand increased intensity of extreme rainfall events	Landform evolution modelling of retained landforms Include climate change impacts in any future rehabilitation designs
Ability of capping treatments to withstand increased evaporation rates.	Closure designs to incorporate climate change predictions

7.2 Waste Material Characteristics

At Olympic Dam, material bought to the surface from the underground mine is placed in Run of Mine (ROM) stockpiles and put through the metallurgical processing circuit. The processing of the ore results in the removal of around 2-3% of the rock mass, being the mineralised component. The remainder (excluding a small portion that is used to produce cement aggregate fill (CAF) for mine backfill) comprising primarily of finely crushed rock and clay, is managed in Olympic Dam's TRS.

7.2.1 Overburden (Rock Storage Facility)

To support the proposed open pit expansion described in the 2009 EIS, the construction of an RSF for the placement of unconsolidated, freely dug overburden material commenced within the SML following approval of the project in October 2011. In August 2012 a decision was taken to place the majority of the components of the approved expansion on hold while more cost effective mining and processing technologies were explored, and all RSF construction ceased by June 2013. No potentially reactive waste material was placed and the content is currently limited to freely dug benign material extracted from the starter pit, being sands and unconsolidated clays. Although the current LoA plan does not include an RSF, there may be a requirement to store low and medium grade waste rock in long-term (potentially permanent) stockpiles. Closure requirements for these storage facilities will be addressed in future versions of this CMRP, should those storage facilities eventuate.

7.2.2 Tailings Storage Facilities

Tailings are the waste product stream from the metallurgical operations. They consist of a slurry of fine rock particles and acidic liquor from which the economically-recoverable minerals have been extracted. The slurry is pumped to the TRS and deposited within the two operating Tailings Storage Facilities (TSF). These cells are paddock type construction with upstream raises. Within the TSFs, the tailings solids settle and the tailings liquor not evaporated or retained in the tails mass is reclaimed to evaporation ponds. The tailings contain ~70-80% of the radioactive material associated with the original ore. The tailings are deposited as a slurry at about 47% solids concentrations. The tailings liquor is acidic and contains dissolved metals (BHP Billiton, 2009).

Approximately 9.1M tonnes of tailings solids and about 9-10GL of liquor from the processing operations are discharged to the TRS per annum. The individual TSF walls are raised at a rate of less than 2m per annum and are constructed of compacted tailings and local sandy clays, with an outer rock armouring. The cells have been located where there is an underlying layer of superficial clay. The whole site is underlain by a deeper limestone geology. Cells 1-3 were constructed without a geomembrane liner. TSFs 4 and 5 have a centrally located HDPE liner under the decant area in the centre of the cell that is overlain with an underdrain system. Additionally, TSF5 has an internal heel drain sand layer and a downstream toe drain to improve drainage in the embankment and to capture lateral seepage. Some hazardous materials, including process spillage material and low-level radioactive wastes are also disposed of in the TSF into assigned waste finger areas out on the tailings beach.

As at June 2019, the facility consists of five (5) cells covering approximately 640ha within the SML, with only two currently in operation. An additional tailings cell (TSF6) has been approved and construction is expected to commence during FY20. The

individual cells vary in height but have an approved raise height of 30-40m. Upon closure, the TSF will remain as a permanent land feature.

7.2.3 Knowledge Gaps

Table 7-2 outlines the knowledge gaps and preliminary actions with respect to waste material characteristics.

Table 7-2: Waste Material Characteristics Knowledge Gaps and Actions

Knowledge Gap	Preliminary Action
TSF capping and landform suitability	Complete TSF capping trials
Potential for acid forming material to be generated from permanent low and medium grade waste ore storage areas	Ensure that adequate knowledge is gathered to inform design criteria prior to any permanent storage areas being constructed

7.3 Soil Characteristics

7.3.1 Soil and Terrain

Although past erosional cycles have removed varying thicknesses of these materials, the resulting surface remains essentially flat, consisting of an extensive stony tableland. In places where extensive deep erosion has occurred, claypans, swamps and lagoons have formed at the terminal points of the internal drainage systems.

The more recent Quaternary deposits form a thin veneer of aeolian origin over much of the tableland surface. In many places these deposits form the most dominant feature of the landscape, comprising a series of east west oriented red quartz sand dunes. The dunes are highly variable, with heights of up to 10 m, widths to a maximum of 300 m, and dune spacing from about 100 m to several kilometres. When closely spaced, the interdune areas form gentle concave swales covered with sandy soil and are often well vegetated with trees and shrubs. Where dunes are more widely spaced, the tableland surface, with its more silty and clayey sandy soils, gibber and drainage features, is exposed.

The characteristics of the tableland surface vary considerably over the region, depending on the underlying rock type and the thickness of the Quaternary sediments. In the majority of the Project Area the underlying rock type is Andamooka Limestone. In some areas the bedrock is very shallow, and outcrops occur in some places. The tableland surface is generally undulating, with sandy textured soils and extensive occurrences of gibber in the swale areas. The soils contain large quantities of calcareous material, possibly derived from weathering of the underlying rock. Drainage is into claypans, vegetated shallow depressions or, occasionally, small dolines.

7.3.2 Knowledge gaps

Table 7-3 outlines the knowledge gaps and preliminary actions to with respect to soil.

Table 7-3: **Soil and Post Mine Land Suitability Knowledge Gaps**

Knowledge Gap	Preliminary Action
Long-term viability of topsoil stockpiles	Complete rehabilitation research project to better understand closure liabilities

7.4 Flora

The Olympic Dam Area of Influence extends over three bioregions, including Gawler, Stony Plains and Simpson Strzelecki Dunefields. The vegetation type over these regions range from acacia low woodlands and shrub lands with chenopod shrub lands to hummock grasslands.

The vegetation in the region is determined by the terrain structure and climate. The terrain of the Olympic Dam region consists of low parallel dunes with an east-west orientation. The dunes may be close together or separated by swales which vary in width, the narrowest in the southern parts of the Roxby Downs Municipal Lease and the broadest to the north of the mine.

Three vegetation communities are present within the OD region, namely:

- Dunefield vegetation (dune ridge, slopes and swales);
- Drainage area vegetation;
- Stoney tableland vegetation.

Of the three vegetation communities, the primary vegetation community and which is found on the SML is dunefield vegetation.

Vegetation on the dunes consists of low woodlands or tall shrublands of Northern Cypress Pine (*Callitris glaucophylla*), Horse Mulga (*Acacia ramulosa*), Narrow Leaved Hopbush (*Dodonaea viscosa*) and Sandhill Wattle (*Acacia ligulata*). The understorey consists mainly of grasses and ephemeral herbs. The pines are most common in the vicinity of Roxby Downs, becoming less common north of Olympic Village.

Swale vegetation is dominated by chenopod shrublands of Bladder Saltbush (Atriplex vesicaria) and Low Bluebush (*Maireana astrotricha*), with associated short-lived chenopods, grasses and ephemeral herbs. Some swales also contain low woodlands of Western Myall (*Acacia papyrocarpa*), with either a chenopod or grass understorey. Mulga (*Acacia aneura*) is common at the base of dunes and also on low sand rises, usually with a grassy or herbaceous understorey. The broad swales north of the mine are dominated by Bladder Saltbush, Glasswort (*Sclerostegia tenuis*) and Bristly Sea-Heath (*Frankenia serpylifolia*) with an understorey of grasses and ephemeral herbs.

Four flora species listed under the EPBC Act and 34 flora species listed under the NPW Act are recognised to potentially occur in ODC's Area of Influence. *Eriocaulon carsonii*, listed as Endangered under the EPBC Act and NPW Act, is known to occur on GAB mound springs within ODC's predicted impact zone for water drawdown. Sandalwood (*Santalum spicatum*), listed as Vulnerable under the NPW Act, has been recorded in the Olympic Dam region, however, it is not known on the SML. Similarly, Koch's saltbush (*Atriplex kochiana*) has been recorded in many locations in the Olympic Dam region, however, it is not known to occur on the SML.

Acacia aneura Low Woodland on sand plains are a listed as a threatened ecological community under the NPW Act and are known to exist in small clusters on the SML. While potential impacts to the threatened ecological community may occur on the SML, it is unlikely that this would result in a significant impact to the population and distribution overall. Regardless, the Environmental Disturbance Permit (EDP) process assists to minimise impacts to these threatened ecological communities.

7.4.1 Weeds and Declared Plants

Species declared under NRM Act 2004 (as of January 2015) that are known to be present within the Olympic Dam region are detailed in Table 7-4. The current distribution of priority species is determined during scheduled weed monitoring.

Table 7-4: **NRM Act 2004 Declared Weeds**

Scientific Name	Common Nam
Opuntia spp.	Prickly Pear
Cenchus ciliaris	Buffel Grass
Cenchrus incertus	Innocent Weed
Tribulus terrestris	Caltrop
Echium plantagineum	Salvation Jane
Tamarix aphylla	Athel Pine
Lycium ferocissimum	African Boxthorn

7.4.2 Knowledge gaps

Table 7-5 outlines the knowledge gaps and preliminary actions with respect to vegetation.

Table 7-5: **Vegetation Knowledge Gaps and Actions**

Knowledge Gap	Preliminary Action
Updated impacts on remnant vegetation based on LoA	Re-assess vegetation impacts based on current LoA
Pre-mine planned clearing vs. LoA planned clearing	Review LoA disturbance vs planned disturbance

7.5 Fauna

The mosaic of dunes and interdunal swales, woodland, shrubland, grassland and bare ground habitats in the Olympic Dam region support a diverse fauna community. Over 184 bird species have been recorded in the Olympic Dam region. These are largely bushbirds associated with the Callitris and Acacia woodlands, and chenopod shrublands. Others include waterbirds (including

some listed migratory bird species) that are attracted to the natural ephemeral and artificial waterbodies; and some vagrant species such as the Plains-wanderer (*Pedionomus torquatus*).

The local reptile community is diverse by world standards, although the regional pool of 47 species is less than that found in some other Australian arid zone habitats. Several large reptile species, including two venomous elapid snakes, are conspicuous elements of the local fauna.

By contrast, most of the 25 native mammal species recorded in the region (29 if Arid Recovery species are included) are small and nocturnal and hence rarely seen. The Desert Mouse (*Pseudomys desertor*), which has been observed on the SML, was once thought to be rare in South Australia but recent studies suggest that the rodent is widespread and secure. Notably, the Plains Rat (*Pseudomys australis*) and the Hopping Mouse (*Notomys alexis*) were recorded within the SML for the first time in 1998 and the Kultar (*Antechinomys laniger*) in 2008. Red Kangaroos (*Macropus rufus*) are common throughout the region. Introduced species, including the European Rabbit (*Oryctolagus cuniculus*), cats (*Felis. catus*) and foxes (*Vulpes vulpes*) are also common, all of which have a significant adverse impact on the local ecosystem.

The Trilling Frog (*Neobatrachus centralis*) is the only amphibian species recorded from the area, and is only found on the surface following heavy rains during warmer months.

Twenty-eight fauna species listed under the EPBC Act and 52 fauna species listed under the NPW Act are known to occur or could potentially occur in the Olympic Dam Area of Influence. Sixteen of these are listed as Migratory under the EPBC Act and the majority could be potentially impacted by the operation of the TRS. Eight mammal species listed under the EPBC Act have also been identified to potentially occur in the area, five of those have been reintroduced to the Arid Recovery reserve.

The Plains Rat listed as Vulnerable under the EPBC Act has confirmed records located on the SML. However, their population is widespread throughout South Australia and recent data indicates that Arid Recovery may act as a source for Plains Rats due to the predator exclosure fence. Therefore, the species is not likely to be significantly impacted by the Olympic Dam operation. The EDP process assists to minimise impacts to its refuge habitat.

7.5.1 Knowledge gaps

Table 7-6 outlines the knowledge gaps and preliminary actions with respect to fauna.

Table 7-6: **Fauna Knowledge Gaps and Actions**

Knowledge Gap	Preliminary Action
Updated impacts on fauna based on LoA	Re-assess fauna impacts based on current LoA

7.6 Radiation

Pathways of exposure (i.e. the mechanisms by which radiation or radioactive materials can be transported from the operation to people) are described in International Commission on Radiological Protection (ICRP) Publication 29 (ICRP 1979). The primary exposure pathways for members of the public from the operations at Olympic Dam are the inhalation of radon decay products and the inhalation of radionuclides in dust (ODC 1996a). Doses to members of the public are based on these inhalation radiation exposure pathways.

Ingestion of radionuclides from the consumption of local fauna and flora is another pathway but it has not been included in public dose assessments because it has been verified as negligible (ODC 1996b). Similarly, direct gamma radiation from the operation has also not been included because it reduces by many orders of magnitude over a distance of one kilometre and therefore results in negligible public exposure.

Radiation related impacts of the current operations have been monitored for over 25 years and can be summarised as:

- radon from the current operations is not readily discernible above natural background beyond four kilometres (km) from the operations;
- radionuclides in airborne dust at receptor sites show no changes since operations began;
- radionuclides in vegetation from current operations are statistically measurable up to about five km from the operations, but no impacts have been observed;
- a study of kangaroos showed no statistical difference in radionuclide concentrations between samples from inside the mine lease and samples from outside the mine lease;
- radionuclides in soil show no marked variation over time;
- increases in uranium concentrations have been seen in groundwater directly beneath the TSF, although this is very localised with insignificant changes elsewhere.

Overall, the environmental radiation impact is low, with measured increases observed close to the operation that are well within compliance requirements. Doses to residents of Roxby Downs are approximately 0.025 mSv/y, well below the member of the public dose limit of 1 mSv/y.

7.7 Hydrology

7.7.1 Conceptual Baseline Understanding

7.7.1.1 Surface Water

The surface hydrology in the vicinity of the OD is characterised by a mosaic of small catchments, which range in area from 10 to 300 ha. The boundaries are generally defined by the east/west trending sand dunes. Stormwater occurs only after rare heavy rain events, as ponds in inter dune swales from where it evaporates. Groundwater recharge is a very small proportion of rainfall and considered to be 0.01 to 0.06 per cent of annual rainfall which is ~160 to 170 mm per annum. The flat-lying dune field which controls surface water hydrology extends to at least 15 km from the site.

There are no features of any significance within the area of the mine, and the location of the TRS and open cut pit do not interrupt any supply flows or permanent water features (Figure 7-2). The nearest defined surface watercourses more than 15 km to the north and these drain toward saline playa lakes including Lake Torrens, located 45 km to the west. The nearest known permanent natural surface water body is Yarrawurta Spring located 50 km to the northwest and on the north side of Lake Torrens. The spring is saline (60 g/L TDS) and sustained by groundwater flow (BHP Billiton, 2009)

7.7.1.2 Groundwater

There are two important groundwater systems in the Stuart Shelf: the Andamooka Limestone aquifer and the Tent Hill aquifer. These form the overlying cover sequence at Olympic Dam and consist of Cambrian shale and limestone, and Late Proterozoic quartzite, sandstone and shale members, mostly of very low permeability.

The upper Andamooka Limestone aquifer is the shallowest of the aquifers in the Stuart Shelf and forms the regional ‘water table’ aquifer north of Olympic Dam. The water table typically occurs about 50 metres (m) below ground (i.e. 50 m Australian Height Datum (AHD), with groundwater in the aquifer moving from west of the Stuart Shelf to the northern end of Lake Torrens, where the water table typically occurs less than 10 m below ground. Groundwater salinity is typically in the range of 20,000 to 60,000 milligram per litre (mg/L) on the SML, increasing to as much as 200,000 mg/L closer to Lake Torrens.

The Tent Hill aquifer is extensive and is the most important aquifer within the southern portion of the Stuart Shelf, where the Andamooka Limestone aquifer is either very thin or absent. It includes the lower parts of the Arcoona Quartzite and the Corraberra Sandstone units of the Tent Hill Formation and is therefore sometimes referred to as the Arcoona Quartzite aquifer or the Corraberra Sandstone aquifer. The aquifer occurrences reduce north of the SML due to a deepening of the unit and reduction in permeability.

At Olympic Dam, the Tent Hill aquifer typically occurs 160 to 200 m below ground level (about -60 mAHD to -100 mAHD). The depth increases moderately to the north, west and south, with the base of the unit around 225 m below ground level (-125 mAHD) near the existing underground mine and more than 400 m below ground level (-300 mAHD) north of Olympic Dam.

Groundwater salinity in the Tent Hill aquifer is generally higher than in the Andamooka Limestone aquifer, with reported concentrations ranging from about 35,000 to more than 100,000 mg/L in the vicinity of Olympic Dam, and ranging to around 200,000 mg/L closer to Lake Torrens.

The upper section of the Arcoona Quartzite unit forms an aquitard. This is a low permeability layer that restricts the movement of groundwater between the Andamooka Limestone and Tent Hill aquifers

7.7.2 Change Assessment

Hydro-geochemical modelling of potential impacts on groundwater that may result both during operation and post-closure has been carried out (SRK, 2015). The modelling work included development of appropriate source terms for potential sources of impact on groundwater quality. Primary sources of contaminants include:

- TSF;
- Underground workings;
- Minor waste rock and low grade ore stockpiles;
- Other surface facilities that may remain after closure.

Modelling was conducted to assess mining phase and post-closure groundwater conditions, including sensitivity runs to test a range of model parameters and likely effect. The main focus of the modelling was to assess the potential for solute release and migration off-site (off the SML).

Two separate (but related) modelling assessments, or scenarios, were conducted. The first or initial assessment used a mine configuration representative of the existing site operation, including underground workings and tailings facility, with fate and transport results assessed based on immediate (i.e. “today”) closure. The second assessment extended this initial work and was based on the then (January 2015) life-of-asset plan extending to 2050, including underground workings and tailings storage schedule. For the purposes of this plan only the second scenario results are included.

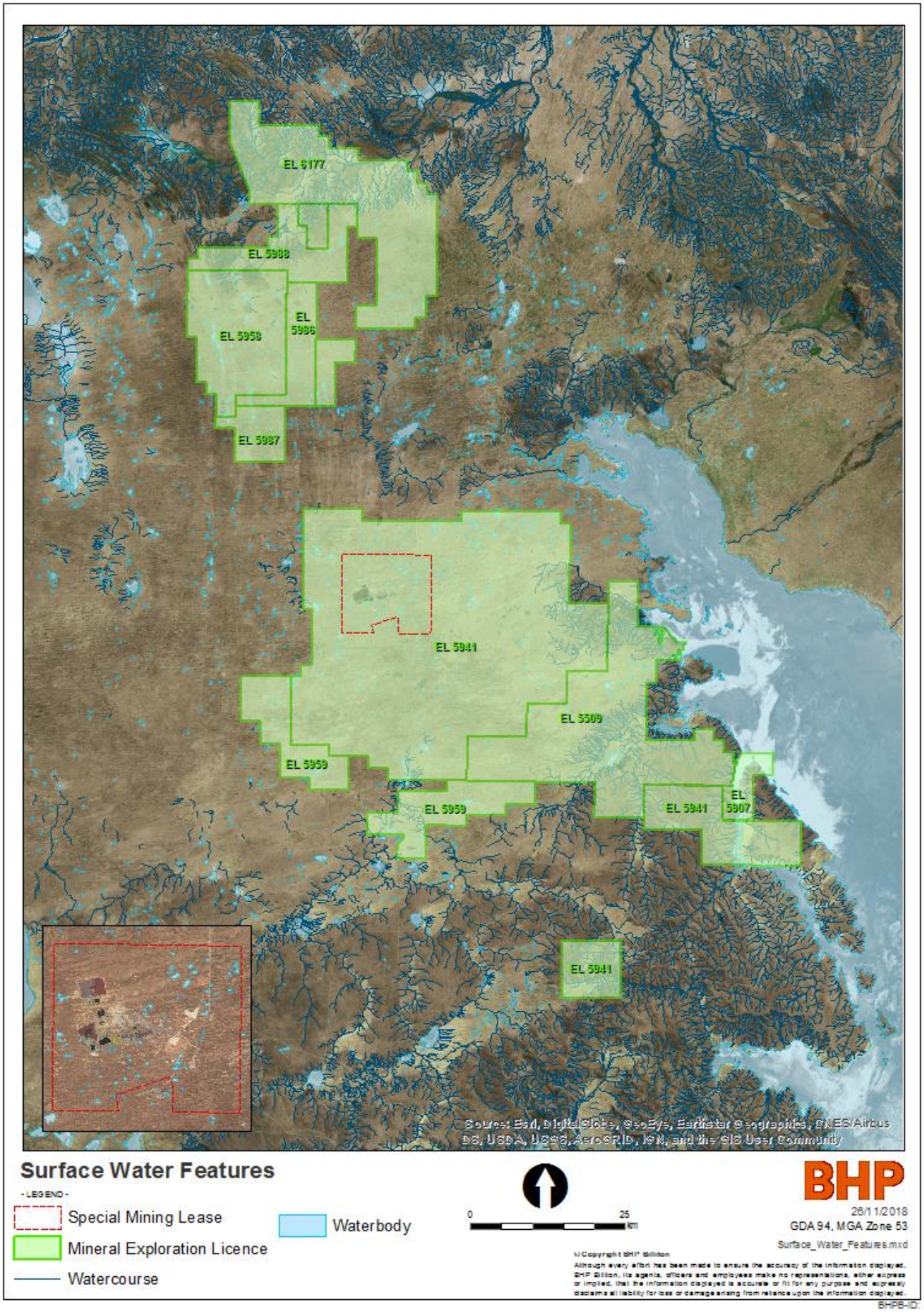
The modified model was used to predict groundwater behaviour post-closure, including the time to reflood underground workings and the possible long-term groundwater flow paths and flux. Source terms were developed for contaminant sources that may impact on groundwater quality, the two most significant being the TSF and the underground workings. Underground source terms included the exposed wall rocks, and the cement aggregate backfill (CAF; including some tailings sands) used to fill mined-out stopes.

During operations, the modelling predicted that drawdown effects would extend up to a maximum of about 10 km in the Andamooka Limestone. Groundwater mounding would occur beneath the TSF and extending beyond the site to a distance of just under nine km.

Post-closure, the model predicted that:

- the groundwater mound beneath the TSF would dissipate within 20 years of cessation of tailings deposition.
- the time taken for the underground mine to reflood is approximately 400 years, after which time groundwater flows preferentially through the open development and shafts.
- estimated steady-state travel times exceed 10,000 years for affected groundwater to flow beyond the SML boundary, although some TSF cells were outside this boundary in the modelled case.
- long term drawdown at potential environmental receptors (Yarra Wurta Spring) is less than one metre.

In summary, the findings are that few, if any, water quality impacts are expected at the expanded SML boundary for time periods of 10,000 years or above.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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Surface Water Features
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Special Mining Lease
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Figure 7-2: **Surface Water Features**

7.8 Site Contamination

OD as part of operations undertakes the storage and handling of ore, fuel (predominantly diesel), lubricants, oils, solvents and acids, and minor quantities of degreasers and domestic cleaning agents. The potential for land contamination from mining projects typically arises from these products.

Three legacy hydrocarbon spill sites exist (one on the SML and two in the wellfields area), with all being actively monitored and managed. The spill on the SML originated from a diesel tank (3ML tank) and was identified in 2002, with the tank being decommissioned shortly thereafter. A groundwater remediation system was installed and commissioned in 2006 and has recovered more than 7000L of light non-aqueous phase liquid (LNAPL). The hydrocarbon plume at the 3ML tank currently shows minor migration in a south easterly direction, and limited natural attenuation of the plume is occurring. A Detailed Site Investigation (DSI) was carried out in FY18 and the results are being assessed.

Diesel spills in the wellfields were identified at both the wellfield A pump station (PS1) and Wellfield B pump station (PS6A) in 2001, with both having undergone several phases of remediation commencing from late 2005. In the latest phase, PS1 remediation has successfully treated a groundwater volume in excess of 4 ML since commencing operation in late 2014, while PS6A remediation has treated groundwater in excess of 12 ML since commencing operation in mid-2014 and recovered approximately 39,800 L of LNAPL).

All three hydrocarbon remediation projects are expected to be completed and meet relevant regulatory requirements within the next 5 – 10 years, and as such are not expected to require any ongoing commitments at closure.

Per- and Polyfluoroalkyl Substances (PFAS) have been used across site historically for firefighting systems and training facilities. A baseline desktop assessment will be completed prior to the completion of mining to identify areas requiring further assessment and any remediation requirements (taking into account the proposed post-closure land use).

More generally, contaminated land assessment, including for radiation, will be undertaken according to National Environment Protection (assessment of site contamination) Measure 1999 and actions determined based on the outcomes of the assessment.

7.8.1 Knowledge Gaps

Table 7-7 outlines the knowledge gaps and preliminary actions with respect to contaminated land.

Table 7-7: **Contaminated Land Knowledge Gaps and Actions**

Knowledge Gap	Preliminary Action
Quantity, type and location of contaminants	Complete contaminated land assessment.
Proposed treatment method for contaminants	Outcome of contaminated land investigation reports.

7.9 Visual Amenity

OD lies within a mainly desert landscape of open woodland and shrubland on dunes and sandplains, and low shrubland on inter-dune swales and gibber plains. Much of the area is gently undulating with red sand dunes up to six meters in height, with occasional clay pans in the inter-dune swales. The dunes are orientated in an east-west direction, producing successive low ridgelines that obscure views north and south and create an enclosed visual feature. The existing OD operations are dominated visually by processing infrastructure, TSFs, Rock Storage Facility and the Roxby Downs township and to a lesser extent the small open cut pit remaining following the commencement of the open cut pit.

The largest component of the infrastructure is the constructed TSFs, reaching 20-30 m height (and potentially up to 40m in the case of TSF4). Although this is the largest feature and is visible from up to 5km away, the impact on the natural landscape is minimised by the flat profiled and natural coloured walls. From an aerial perspective however, the TSFs are clearly visible as mine infrastructure within the landscape. At closure the TSF will be capped, reducing the visual aerial impact.

Although smaller in area, the infrastructure footprint of the processing plant is visible from further afield as a result of the smelter stacks, which reach a maximum height of 90m. The stacks create a tall industrial feature on a relatively flat landscape and are visible from Roxby Downs and up to 30km away in Andamooka. The closure plan includes the demolition and removal of this infrastructure, therefore limiting the visual impact

7.9.1 Knowledge Gaps

Table 7-8 outlines the knowledge gaps and preliminary actions with respect to visual amenity.

Table 7-8: **Visual Amenity Knowledge Gaps and Actions**

Knowledge Gap	Preliminary Action
Conceptual post mine landform visualisation (TSFs)	Complete a visual assessment of the conceptual post mine landform.

7.10 Cultural Heritage

Archaeological sites are evidence of past occupation and may include camp sites, quarries or stone tools and scatters. As a result of the archaeological survey work conducted for the 1982, 1997 and 2009 EIS, 437 archaeological sites were recorded within the project area. The archaeological sites recorded in the Olympic Dam region included surface scatters of stone artefacts such as campsites, knapping floors, quarries and stone arrangements.

8 Risk Assessment

Risk assessment is an essential tool to ensure appropriate management of unplanned events that might occur on the mine site during or post closure. A structured risk-based approach allows for a systematic review and analysis of risk and cost benefit in both engineering and environmental terms as well as identification of closure associated opportunities. An iterative approach also assists with eliminating or reducing the likelihood and/or consequence of events to a level considered to be as low as reasonably practicable. For relinquishment of a closed operation, the residual risk must be considered tolerable and acceptable by stakeholders and regulators.

OD's Closure Planning Risk Assessment was reviewed and updated on Monday 23 April 2018. The review considered the current operations and the LoA and included representatives from Risk Management, Closure Planning, Environment A&I, Community Relations, Mine Planning, Legal and Projects.

The risk assessment is managed in Stature (Sphera Solutions).

The purpose of the risk assessment was to identify, analyse and evaluate the risk in line with ISO31000 Risk Management and Our Requirements Risk Management. The risk assessment assumed the following controls are in place and working:

- Management are trained and competent in their area of expertise;
- Management and employees adhere to BHP Our Requirements;
- Compliance with Federal, State and Local Legislation requirements.

The BHP risk evaluation process includes Establishing the Context, Risk Identification, Risk Analysis, Risk Evaluation and Risk Treatment. Impact types assessed include Health and Safety, Environmental, Community, Reputational, Legal / Regulatory and Financial.

Seven risk events were identified during the risk assessment that have the potential to influence the outcomes of achieving OD's closure objectives and outcomes. Within these risk assessments, 37 (non-unique) scenarios were identified as potential contributors to the risk events eventuating. The risk events included impacts related to stakeholder engagement, financial resourcing, inability to relinquish and early closure, post execution and post closure and offsite impacts.

Appendix C provides a summary of the risk assessment and the framework used to assess risk.

The Olympic Dam risk assessment is currently under review and will be to updated in FY21 to align with the new Our Requirements Risk Management. The update will also take into account group guidance on event risks that are consistent across other BHP assets.

9 Closure Implementation

For the purposes of this CMRP and to facilitate effective mine closure planning OD mining operations have been divided into a number of physically distinct domains and features. The domains comprise of features that have similar rehabilitation and closure requirements. Standard design principles relevant to the closure of these domains are outlined in Table 9-1. Domain specific rehabilitation strategies and activities are further discussed in the following sections.

Table 9-1: **Closure Design Principles**

Parameter	Design Principles
Design Life	• Landforms integrity to be maintained in perpetuity.
Design Storm	• Tailings storage surface containment - probable maximum precipitation (PMP) or 1 in 10,000 AEP if PMP data is not reliable. • Restore natural drainage lines.
Post Closure Land-use	• Native Bushland: revegetated land available for grazing e.g. areas outside SML. • Vacant Crown Land: non-revegetated, not suitable for grazing or any access e.g. TSFs, open pit.
Radiation	• All recycled material to be decontaminated (to better than the Mining Code requirements). • Radiation levels returned to levels consistent with pre-mining levels. • Radiation dose to the public < 1.0 mSv/year above natural background. • Deposition of closed site originated ^{238}U less than 25 Bq/m^2/y at non-human biota assessment sites
Surface Water	• No unacceptable impairment of surface water quality. • Regional surface flows returned to pre-mining. • Local surface water flows mimic natural analogues as far as practical.
Groundwater	• TSF or RSF seepage will not cause unacceptable off-lease impact. • No unplanned impairment of surface water or groundwater to the extent that it adversely impacts third party users or groundwater dependent ecosystems. • Mounding of groundwater table at edge of TSF will not be higher than 80 metres with respect to the Australian Height Datum (mAHD) (approximately 20 m below natural ground level), with the intent of protecting flora root systems, and will recede in time.
Seismicity	• Post-closure TSF slopes stable for Maximum Design Earthquake (MDE) 1:10,000 years under all load conditions.
Erosion	• Erosion rate on TSF slopes will not affect the cover integrity within the design lifetime. • Landforms mimic natural analogues. • Erosion rates no greater than erosion rate at natural analogue landform.
Air	• Air quality equal to or better than surrounding land-use.
Soil	• Soil quality equal to or better than analogue landform or land-use.
Safety	• Public and wildlife access appropriate to final landform/use of each domain.
Vegetation	• Vegetation in rehabilitated ecosystem sustainable and as comparable as reasonably practicable with analogue landform and land-use. • Tailings storage facilities side slopes and top surfaces will not be revegetated to avoid radiation pathway and/or the creation of concentrated flow channels (stock paths) and breaching of cover by faunal traffic. • Open pit and RSF will not be actively revegetated but rather allowed to revegetate naturally.
Terrestrial and avian wildlife	• TSF runoff and / or standing water quality not toxic to avian fauna. • Stock fencing around TSFs and open pit to minimise (not exclude) fauna visitation

9.1 Domain Closure and Rehabilitation Strategies

9.1.1 Airport Facilities

Closure of the airport will be largely dependent on the requirements for post-mine land use of the town facilities. As such any closure design requirements and activities have not been included here pending future consultation with relevant stakeholders.

9.1.2 Contaminated Waste Disposal Facility

Capping and closure of the contaminated waste disposal facility (CWDF) is expected to be similar in form to that proposed for components of the tailings retention system. Refer to section 9.1.5.

9.1.3 Metallurgical Plant and Administration

The metallurgical plant and administration comprises the administration buildings, processing plant and supporting infrastructure (e.g. tanks and powerlines), roads, stockpile footprints, stormwater diversion bunds and channels, pilot plant area including tailings trial ponds and haul roads. Table 9-2 details the decommissioning and rehabilitation design and primary activities for these areas.

Table 9-2: **Metallurgical Plant and Administration Infrastructure Closure Design Requirements and Activities**

Basis of Design	Activities
• All above ground infrastructure will be decommissioned and removed, unless agreed with the post mine landholder to retain. • Removed infrastructure will be transported off site for re-use or recycling (if considered cost effective and safe). • Retained infrastructure will be made safe and stable prior to handover to the post mine landholder. • All disturbed areas to be assessed and rehabilitated consistent with the proposed post mine land use. • All footings removed to a depth of 500mm. • Buried services >500mm to remain in-situ if they pose no environmental risk. • Road base and other contaminated material removed to a depth of 500mm. • Topsoil respread to a depth of 150mm	• Site contamination assessment • Demolish and remove all minor infrastructure (e.g. pipe racks). • Demolish all structures, buildings and concrete footings unless agreement in writing is obtained from the post mine landholder. • Seek written agreement with post mine landholder for any retained services or infrastructure. • Survey and develop register of any retained services and structures. • Complete risk assessment of any retained services and structures. • Bury demolition waste that is not safe to be taken off site for re-use/recycling in site limestone quarry, underground or TSF. • Remove road base and other obstructions from drainage lines. • Dispose contaminated road base within TSF. Non-contaminated road base disposed of within TSF and/or limestone quarry. • Deep rip compacted soil and hard-stand areas and topsoil, seed, fertilise consistent with the proposed post mine land use.

9.1.4 Miscellaneous (including the underground mine and administration facilities)

Shafts, Raise Bores and Declines

Table 9-3 details the decommissioning and rehabilitation design and primary activities for the shafts, raise bores and decline infrastructure.

Table 9-3: **Infrastructure Area Closure Design Requirements and Activities**

Basis of Design	Activities
• Seal decline portals – seal type and design will depend on inspection and drainage requirements. • Demolish raise bore fans, down casts, and associated structures and infrastructure and dispose. • Cap raise bores and down cast bores. • Remove concrete footings to a depth of around 500 mm. • Cap shafts with concrete cover and cover if appropriate to do so i.e. if inspection of the cap is not required.	• Leave shaft foundations intact. • Complete safety risk assessment. • Install any required safety measures (e.g. signs, fences). • Topsoil, seed and deep rip compacted soil left by access tracks and hard-stand areas.

Exploration Areas

The closure and rehabilitation of exploration disturbance will occur throughout the LoA in accordance with the requirements of operating licences. An exploration audit of all known bore holes and associated disturbance will be completed prior to closure to

understand what, if any historic holes require rehabilitation or rehabilitation maintenance at closure. Rehabilitation will include the removal of casing (where appropriate) and the bore holes plugged at the surface with concrete. Ancillary disturbance related to the explorations, such as tracks and pads will be rehabilitated in accordance with the rehabilitation objectives. Any rubbish found during the audit will also be removed and disposed of at the local landfill or the limestone quarry. Table 9-4 details the decommissioning and rehabilitation design and activities for exploration areas.

Table 9-4: **Exploration Design Closure Design Requirements and Activities**

Basis of Design	Activities
• All casing removed. If this is not appropriate, casing is cut down to a depth of 30 cm and removed. • Bore holes plugged at the ground level with concrete.	• Remove and access tracks and road base. • Topsoil, seed and deep rip compacted soil left by access tracks and hard-stand areas.

Water Management - Miscellaneous Ponds

Table 9-5 details the decommissioning and rehabilitation design and activities for miscellaneous ponds.

Table 9-5: **Miscellaneous Pond Closure Design Requirements and Activities**

Basis of Design	Activities
• All remaining liquor evaporated or removed to TSF. • All piping, pumps, liners, scuttle culverts removed.	• Remove contaminated materials and dispose to TSF. • Remove access tracks, push down any raised embankments and backfill base of ponds with uncontaminated material. • Batter slopes to stable erosion slope and rip along contours to relieve compaction. • Complete drainage, topsoil, seed and deep rip compacted areas.

9.1.5 Open Pit

Work on the open pit ceased prior to triggering substantial commencement and did not reach a sufficient depth to intersect the underlying groundwater aquifers. As such, the key risk for the open pit at closure is associated with the potential for injury to a member or impacts from geotechnical instability. The initial works associated with the open pit are expected to remain at the completion of mining. Any infrastructure associated with the works at the completion of mining will be decommissioned and removed. The geotechnical assessment will be conducted during the latter stages of the operation to determine the potential for surface subsidence around the perimeter of the open pit and to determine a safety exclusion zone. Based on these studies, safety measures, including the construction of berms and trenches and the installation of fences and safety signs will be completed along the length of the pit perimeter and placed outside the zone of potential pit-wall failure. A summary of the activities is included in Table 9-6.

Table 9-6: **Open Pit Closure Design Requirements and Activities**

Basis of Design	Activities
• Erection of trench/bunding/fencing/warning signs – Bund wall minimum height 2m – Bund wall minimum base 5m – Bund location minimum 10m beyond zone of failure – Security fence minimum height 3.0m – Signage (AS Compliant) minimum 100m apart	• Contoured current slopes for stability and safety. • Geotechnical assessment of high-wall FoS to determine the potential for surface subsidence around the perimeter of the open pit and to determine a safety exclusion zone • Safety risk assessment completed. • Install any required safety measures (e.g. signs, fences). • Remove contaminated road base to 500mm depth and dispose within TSF. Non-contaminated road base disposed of within TSF and/or limestone quarry. • Access roads into the pit and onto the RSF will be deep ripped to discourage vehicle access and encourage revegetation.

9.1.6 Pilot Plant

Closure of the pilot plant will be consistent with the design and activities implemented for the metallurgical plant.

Basis of Design	Activities
• All above ground infrastructure will be decommissioned and removed, unless agreed with the post mine landholder to retain. • Removed infrastructure will be transported off site for re-use or recycling (if considered cost effective and safe). • Retained infrastructure will be made safe and stable prior to handover to the post mine landholder. • All disturbed areas to be assessed and rehabilitated consistent with the proposed post mine land use. • All footings removed to a depth of 500mm. • Buried services >500mm to remain in-situ if they pose no environmental risk. • Road base and other contaminated material removed to a depth of 500mm. • Topsoil respread to a depth of 150mm	• Site contamination assessment • Demolish and remove all minor infrastructure. • Demolish all structures, buildings and concrete footings unless agreement in writing is obtained from the post mine landholder. • Seek written agreement with post mine landholder for any retained services or infrastructure. • Survey and develop register of any retained services and structures. • Complete risk assessment of any retained services and structures. • Bury demolition waste and non-contaminated road base in site waste landfill. • Remove road base and other obstructions from drainage lines. • Deep rip compacted soil and hard-stand areas and topsoil, seed, fertilise consistent with the proposed post mine land use.

9.1.7 Quarry

Closure of the quarry will be consistent with the design and activities implemented for the open pit (i.e. made safe and stable)

Table 9-7: **Open Pit Closure Design Requirements and Activities**

Basis of Design	Activities
• Erection of trench/bunding/fencing/warning signs – Bund wall minimum height 2m – Bund wall minimum base 5m – Bund location minimum 10m beyond zone of failure – Security fence minimum height 3.0m – Signage (AS Compliant) minimum 100m apart	• Contoured current slopes for stability and safety. • Geotechnical assessment to determine the potential for surface subsidence around the perimeter of the open pit and to determine a safety exclusion zone • Safety risk assessment completed. • Install any required safety measures (e.g. signs, fences). • Access roads into the quarry will be deep ripped to discourage vehicle access and encourage revegetation.

9.1.8 Rock Storage Facility

Work on the open pit and subsequent RSF ceased prior to triggering substantial commencement and no reactive material has been placed within the RSF. As such, the key risk for both of these landforms at closure is associated with the potential for injury to a member of the public or impacts from geotechnical instability. A summary of the key design requirements and activities is included in Table 9-8**.**

Table 9-8: **Rock Storage Facility Design Requirements and Activities**

Basis of Design	Activities
• Side slopes between 20° to 37° • Topsoil respread to a depth of 150mm	• Geotechnical assessment of FoS • Complete risk assessment on final landform. • Install any required safety measures (e.g. signs, fences). • Material characterization of overburden • Water management to minimize/prevent surface water impacts • Seeding conductive for the identified post mine land use • Application of fertilizer and/or ameliorants as deemed necessary • Maintenance to achieve the closure objectives and criteria

9.1.9 Tailings Retention System

Tailings Storage Facility

O'Kane Consultants Pty Ltd. was engaged to complete a robust cover system and final landform design for the TSFs. The primary objective of the project was to develop a conceptual cover system and landform designs and to determine locations for full scale cover trials on the existing TSFs. The study included an assessment of erosion to develop the final landforms and cover systems as well as soil-plant-atmosphere numerical modelling to evaluate performance of various TSF cover system designs. A water erosion prediction program was also completed to simulate current and design batter slopes. Assessments were undertaken for the 100-year storm and also extreme events (i.e. the 10,000-year storm). The full text of the report is provided in Appendix E. Table 9-9 summarises the decommissioning and rehabilitation design and primary activities for the TRS.

Table 9-9: **Tailings Retention Closure Design Requirements and Activities**

Basis of Design	Activities
• A design life of 10,000 years for the TSF cover system and final landform, including slope stability and consolidation based on ANCOLD 2012 guidelines. • A 100-year OD climatic data base with an average annual rainfall total of 166mm/year has been used for cover and landform modelling. • An acceptable net annual infiltration rate of approximately 1% of annual rainfall or about 0.3 ML/d (<0.05 m3/ha/d) through the TSF into the foundations. • Maximum TSF height equal to 40m • Breakaway style landform (20° to 37° side slopes/flat top). • No top surface waters allowed to overtop the perimeter bund. • Average erosion on slopes <5t/ha/y. • Peak erosion at any point on the slope <10t/ha/y.	• No reactive material will be placed within the outer slopes. • Decommission and remove tailings mechanical and electrical plant and infrastructure and dispose. • Allow surface pond to drain/evaporate and beaches to dry to strength required for construction vehicles (estimated one to two years on beaches and three to four years in pond areas). • Contaminated soil around TSFs removed and disposed within TSF. • Decant outfall pipes and underdrain outfall pipes grouted/sealed. • Cover tailings with appropriate soil/rock fill cover to: – achieve final radiation, air quality (including radon), surface runoff quality, seepage, erosion and runoff closure performance criteria. – Prevent vegetation growth (to the extent possible) as a radiation pathway. • Complete risk assessment on final landform. • Install any required safety measures (e.g. signs, fences).

Evaporation Ponds

Closure of the evaporation ponds (EPs) is expected to be similar in form to that proposed for components of the tailings retention system, with a cover system and landform design modelled for a design life of 10,000 years, although alternative closure designs may be employed. Some analysis has been undertaken, with further studies to be completed to determine EP closure design requirements and activities.

9.1.10 Town and Village Facilities

Planned closure activities may include the demolition and removal of all BHP buildings and structures and rehabilitation of these areas located within the township of Roxby Downs. The facilities consists a small housing, shopping centres, clubs, libraries schools, medium industrial facilities and community centres. An assessment of infrastructure requirements associated with the post mine land use will be undertaken in consultation with the stakeholders to determine the potential to hand these facilities over to an interested party (e.g. government) or the extent of removal. Similar closure activities will be undertaken for Olympic Dam and Roxby Villages and the Olympic Dam sewage facilities.

If required, infrastructure will be decommissioned and demolished. Materials such as heavy gauge steel and non-ferrous scrap will be cut to size and trucked offsite for recycling if considered cost effective or disposed of in the limestone quarry and/or town landfill. Bitumen surfaces, road base, concrete kerbing and footpaths will be removed and disposed with the limestone quarry and/or Town landfill. Below ground infrastructure that is to be left in place will be made safe (e.g. de-pressurizing, draining and sealing of pipelines) and the location of all infrastructure and other components will be recorded. Contaminated soil assessments will be conducted as required to understand the extent of contamination and any contaminated materials will be removed and disposed of within a suitable landfill or the TSF.

The main rehabilitation treatments will involve de-compacting the surface through deep ripping prior to topsoil application and seeding and the removal of any vegetation that is non indigenous to the area.

The design requirements for infrastructure areas are listed in Table 9-10.

Table 9-10: **Town Facilities Closure Design Requirements and Activities**

Basis of Design	Activities
• Infrastructure removed and / or made safe to be safe for the required post mine land use. • Topsoil placement to a depth of approximately 150mm • Contour ripping to a depth of approximately 500mm • Identification and removal of contaminated material	• Site contamination assessment • Seek written agreement from post mine landholder/stakeholders for retention of infrastructure • Risk assessment for retained infrastructure • Water management to minimize/prevent surface water impacts for rehabilitated areas • Seeding conductive for the identified post mine land use • Application of fertilizer and/or ameliorants as deemed necessary (identified as part of the topsoil testing requirements) • Maintenance to achieve the closure objectives and criteria

9.1.11 Wellfields and Associated Infrastructure

Table 9-11 details the decommissioning and rehabilitation design and activities for the wellfields.

Table 9-11: **Wellfield Design Closure Design Requirements and Activities**

Basis of Design	Activities
• All above ground infrastructure (e.g. including breather valves, pump stations, powerlines and above ground piping) removed and decommissioned, unless agreed with the post mine land holder to retain. • All disturbed areas rehabilitated consistent with the proposed post mine land use. • Production bores decommissioned and capped, unless agreed with post mine land holder to retain. • Below ground infrastructure (pipelines) to remain in ground. • Road base and other contaminated material removed to a depth of 500mm. • Drainage lines reinstated	• Leave monitoring bores in place for post-closure monitoring (if identified as a requirement) • Bury inert demolition debris and pond liners in pond excavation, local landfill, or on site (backfill limestone quarry, underground or TSF). • Remove hard-stand from pumping stations to adjacent borrow pits. • Remove road base and other obstructions from drainage lines and dispose within TSF or limestone quarry. • Backfill ponds with any available wall materials and re-contour to blend with sand dunes or local landforms. • Topsoil, seed and deep rip compacted soil left by access tracks and hard-stand areas.

9.2 Progressive Rehabilitation

The implementation of a successful, planned progressive rehabilitation program of disturbed areas ensures that the obligations and liability associated with completing closure activities is progressively reduced consistent with MAu Closure Planning Principals.

Progressive rehabilitation offers a number of benefits in that it:

- may mitigate existing risk issues associated with the disturbed land (e.g. dust or seepage);
- provides information, data, knowledge and experience that may assist in successfully rehabilitating land;
- reduces the residual disturbance to be rehabilitated at final closure; and
- provides evidence to stakeholders that BHP is committed to, and is capable of, successfully closing and rehabilitating the mining operation to achieve the stated post-closure land use.

The Olympic Dam operation has rehabilitated several disturbed areas that are no longer required by the mining or processing operations as well as exploration sites, and will continue to progressively rehabilitate lesser disturbances as the opportunity arises.

Given the ongoing use of the SML for mining and processing purposes, there is a high likelihood that progressively rehabilitated land will be re-used during life of mine to support ongoing mining and processing activities. To accommodate this, progressive rehabilitation will typically be undertaken to a level that is suitable for ongoing industrial use whilst final rehabilitation will be undertaken to support the final land-use.

Opportunities for progressive rehabilitation in the next five years and the associated schedule are currently under review. Approximately $10M has been committed by BHP to complete the required studies for the Surface Closure Project, which includes the following three areas;

- Old Pilot Plant and 3 Mega Litre Bulk Fuel Tank
- Old Solvent Extraction Plant
- Smelter 1

Upon completion of the Surface Closure Project studies an informed decision can be made regarding the closure of the three areas including timing. Table 9-12 outlines an indicative rehabilitation schedule for mine closure.

Table 9-12**: **Proposed Rehabilitation Schedule (Based on 2085 mine closure)

Domain	*Year Rehabilitation Commences (Proposed)*	*Year Rehabilitation Ceases (Proposed)*	*Year Rehabilitation Monitoring Ceases (Proposed)*[1]	*Years of Rehabilitation Monitoring*
Airport Facilities	*2085*	*2087*	*2104*	*20*
Contaminated Waste Disposal (CWDF)	*2046*	*2087*	*2065*	*20*
Metallurgical Plant and Administration Facilities	*2085*	*2087*	*2104*	*20*
Miscellaneous	*2085*	*2087*	*2104*	*20*
Open Pit	*2085*	*2087*	*2104*	*20*
Pilot Plant	*Under review*	*-*	*-*	*-*
Quarry	*2085*	*2087*	*2104*	*20*
Rock Storage Facility	*2085*	*2087*	*2104*	*20*
Tailings Retention System				
• *TSF 1,2 and 3*	*2028*	*2029*	*2047*	*20*
• *TSF 4*	*2036*	*2038*	*2056*	*20*
• *TSF 5*	*2039*	*2041*	*2058*	*20*
• *TSF 6*	*2049*	*2051*	*2068*	*20*
• *Evaporation Ponds*	*2028*	*2090*	*2047*	*20*
• *Subsequent TSFs and associated facilities as per schedule.*				
Town and Village Facilities	*2085*	*2087*	*2104*	*20*
Wellfield Facilities	*2085*	*2087*	*2104*	*20*

[1.] *Based on years of rehabilitation monitoring from year of commencement of rehabilitation. For some facilities ongoing monitoring will likely extend beyond this date.*

TSF cover trials

Prior to commencing full closure and capping of TSFs (specifically TSFs 1, 2 and 3) a capping trial is intended to be carried out as per the recommendations of previous studies (see section 9.1.9). The capping trial will allow testing of both the implementation and effectiveness of the proposed cover.

To date the closure trial studies are progressing and preliminary designs have been completed. These designs are now being evaluated by the Engineer of Record to determine:

- whether or not it is safe to undertake the cover trials (e.g. not likely to trigger a dam failure).
- the stability of the TSFs under closure.

Modelling is ongoing to confirm some aspects such as:

- the required cover thickness.
- the need for a capillary break or spillway.

On the assumption that design evaluation and modelling is acceptable, implementation is scheduled in FY21 and FY22.

9.3 Implementation Schedule

Detailed planning for final mine closure execution (i.e. residual demolition, disposal and earthworks) will commence 5 years before the scheduled closure date for the mining and processing operations.

The current closure plan nominally allows for a post-closure care and maintenance and monitoring period leading up to relinquishment of 20 years. While this may appear to be a short duration in terms of demonstrating the stability of landforms and tailings closure covers, it is reasonable given that evidence for these will be gathered from the studies, research, implementation and monitoring throughout the LoA as progressive rehabilitation is implemented.

Table 9-13 provides an overview of the proposed schedule of closure works, including progressive rehabilitation of identified closure domains over the life of mine.

Table 9-13: **Proposed Closure Works Schedule (Based on LoA)**

Activity	Start	End
Progressive Rehabilitation	Ongoing	2080
Closure Works Pre-Planning	2080	2084
Contractor Mobilisation	2085	2087
Decommissioning, Demolition and Disposal	2085	2104

10 Post Closure Monitoring and Maintenance

The following section describes monitoring and maintenance activities planned to be undertaken post closure. Information collected during the operational life of OD will be used to support the data collected post closure. The data collected during operations and throughout the post closure monitoring period will ensure:

- sufficient and appropriate monitoring is in place to be able to track and demonstrate the achievement of closure performance criteria for the various closure landforms;
- management plans are in place to model the post-closure performance to provide predictive assessments of the post-closure landforms e.g. drain-down of the TSFs;
- sufficient resources are allocated to ensure that all required inspections and monitoring is carried out, and that any care and maintenance activities required are carried out promptly and to the desired standard;
- adequate financial provisions to carry out the above activities, with a contingency allowance for post-closure 'risk events' (i.e. as per those discussed in Section 8).

The post-closure monitoring timeframe will depend on the complexity of the closure landforms, the post-closure land-use, and the completion criteria. The current proposed post closure monitoring is estimated to occur for 20 years.

Post-closure monitoring activities and the proposed monitoring schedule are detailed in Appendix D**.**

10.1 Rehabilitation Monitoring

Post closure rehabilitation monitoring will employ an amended Ecosystem Function Analysis (EFA) methodology encompassing soil profile reconstruction and nutritional status, vegetation, and erosion. EFA monitoring will be completed annually for the first three years then 5 yearly until relinquishment. Seven monitoring events will occur during the post closure period (1st, 2nd, 3rd, 5th, 10th, 15th and 20th years).

10.2 Tailings Retention System

Post closure monitoring and inspection of the TRS will be completed annually for the first three years then 5 yearly until relinquishment. Seven monitoring events will occur during the post closure period (1st, 2nd, 3rd, 5th, 10th, 15th and 20th years).

The post-closure monitoring will include:

- geotechnical inspections and assessment of the TSFs and EPs by a competent geotechnical engineer to validate:
    - medium-term and long-term stability of the TSF and EP slopes;
    - long-term integrity of the tailings cover.
- groundwater levels and quality (i.e. to ensure the groundwater mound beneath the TSF is reducing); and
- radiation levels.

An inspection and monitoring report will be compiled after each inspection, including follow up of any care and maintenance work recommended in previous reports. The report will be submitted to the appropriate regulatory agency responsible for the confirmation of TRS closure completion criteria.

10.3 Open Pit and Rock Storage Facility

A geotechnical assessment will be conducted prior to closure to determine the potential for surface subsidence around the perimeter of the open pit and to determine a safety exclusion zone. Based on these studies, an abandonment bund and/or fencing will be constructed around the perimeter of the pit outside the zone of potential pit-wall subsidence.

Post closure geotechnical assessments of the RSF and open pit will be completed annually for the first three years then 5 yearly until relinquishment. Seven monitoring events will occur during the post closure period (1st, 2nd, 3rd, 5th, 10th, 15th and 20th years).

10.4 Surface Water Monitoring

Surface water monitoring will be completed annually for the first three years then 5 yearly until relinquishment. Seven monitoring events will occur during the post closure period (1st, 2nd, 3rd, 5th, 10th, 15th and 20th years).

The monitoring program will include an assessment of rainfall runoff from TSFs and rehabilitation to demonstrate:

- No unacceptable impairment of surface water quality;
- Regional surface flows returned to pre-mining; and
- Local surface water flows mimic natural analogues as far as practical.

An assessment of the current operational surface water monitoring program will be completed as OD approaches closure to ensure it meets the closure monitoring requirements. Any data available from the operational monitoring program will also be reviewed and used for closure if considered suitable.

10.5 Groundwater Monitoring

Groundwater monitoring will be completed annually for the first three years then 5 yearly until relinquishment. Seven monitoring events will occur during the post closure period (1st, 2nd, 3rd, 5th, 10th, 15th and 20th years).

The monitoring program will be conducted to demonstrate deep drainage from the rehabilitated areas, including that the TSFs meet the water quality objectives, including:

- TSF or RSF seepage will not cause unacceptable off-lease impact.
- No unplanned impairment of surface water or groundwater to the extent that it adversely impacts third party users or groundwater dependent ecosystems.
- Mounding of groundwater table at edge of TSF will not be higher than 80 metres with respect to the Australian Height Datum (mAHD) (approximately 20 m below natural ground level), with the intent of protecting flora root systems, and will recede in time.

An assessment of the current operational groundwater monitoring program will be completed as OD approaches closure to ensure it meets the requirements for closure monitoring. Any data available from the operational monitoring program will also be reviewed and if considered suitable, used for closure.

10.6 Fauna Monitoring

Fauna monitoring will be completed annually for the first three years then 5 yearly until relinquishment. Seven monitoring events will occur during the post closure period (1st, 2nd, 3rd, 5th, 10th, 15th and 20th years).

Fauna monitoring will be undertaken to demonstrate the recolonization of fauna species, where appropriate and that there are no adverse impacts to fauna from the rehabilitated landscape, including the TSFs. Fauna monitoring will also assist in the identification and management of pest populations as a result of OD' activities.

10.7 Weed and Feral Animal Monitoring

Weed and feral animal monitoring and control will be conducted quarterly for the first 12 months then twice yearly until relinquishment and will be completed in all parts of the SML and adjacent land covered by the CMRP. A total of 42 monitoring events will occur during the post closure period.

The objective of the weed and feral animal control is to manage the land in accordance with the requirements of relevant legalisation and to ensure the rehabilitation objectives and criteria are achieved. The existing site pest and weed management plan will be used at closure or modified as required.

10.8 Radiation

Radionuclide monitoring will be completed annually (20 monitoring events) until relinquishment to demonstrate the rehabilitation objectives of no adverse impacts to public health as a result of radioactive emissions from final landforms and that no significant adverse radiological impacts to ecological communities as a result of radioactive emissions from final closure.

An assessment of the current operational Radionuclides monitoring program will be completed as OD approaches closure to ensure it meets the requirements for closure monitoring. Any data available from the operational monitoring program will also be reviewed and if considered suitable, used for closure.

10.9 Air Quality

Continuous air quality (dust) monitoring will be undertaken for first 5 years, coinciding with the major demolition, decommissioning and rehabilitation activities. The monitoring program will be used to demonstrate the post closure rehabilitation objectives, that air quality is equal to or better than surrounding land-use.

10.10 Great Artesian Basin (GAB) Recovery Monitoring

The GAB water supply for Olympic Dam, and the associated townships and accommodation villages (including Andamooka), is obtained from wellfields located on the south-western edge of the GAB. Most of the recharge to the GAB aquifer is from distant rainfall, and apart from springs, natural discharge in SA is by diffuse upward flow and eventual evaporation. There are numerous GAB springs in the vicinity of the Olympic Dam Wellfields A and B, which support an array of important flora and fauna adapted to these aquatic habitats. GAB springs occur near the margins of the basin where the aquifer is shallow and the shale aquitard is thin, enhanced by structural weaknesses (faults) providing low-conductivity conduits that transmit the pressurised GAB groundwater upwards. Several pastoral properties, which rely on the GAB for water supply, also operate in the vicinity of the wellfields. These properties rely on artesian pressure to distribute water along extensive piping systems. Management of the GAB is closely aligned with the management of aquifer pressure of the GAB, pastoral bore flow and flow at GAB springs.

The aim of the current monitoring program is to measure and assess the environmental impacts associated with water abstraction from the wellfields by:

- Delineating the drawdown induced by the wellfields, and particularly any impact on pastoral water supplies and environmental flows;
- Identifying possible changes in water chemistry that may occur;
- Enable assessment of compliance with legal requirements for the operation of the GAB water supply in the annual Wellfield Report;
- Enable assessment to ensure that impacts are within predictions and expectations in the annual Wellfield Report;
- Increase the understanding of the hydrogeological dynamics of the GAB in the wellfields region.

An assessment of the current GAB monitoring program will be completed as OD approaches closure to ensure it meets the requirements for closure monitoring. Any data available from the operational monitoring program will also be reviewed and if considered suitable, used for closure.

GAB monitoring will be completed quarterly for the first 12 months, then annually until relinquishment (23 monitoring events).

10.11 Safety Monitoring

Periodic inspections will be conducted during mine closure to verify that the safety measures identified and installed as part of the risk assessment process are maintained and effective. Inspections may include, but not be limited to, safety bunds and/or fences erected around final voids, sealing of underground working entrances, boundary fences and infrastructure that has been retained.

11 Unplanned or Temporary Closure

11.1 Unplanned Closure

There are many reasons why mines may close prematurely, that is, they have closed for reasons other than the exhaustion or depletion of reserves (Australian Government, 2016). Some common examples listed by the Australian Government (2016) why mines may close unexpectedly include:

- Economic reasons, such as low commodity prices or high costs that may lead a company into voluntary administration or receivership;
- Geological reasons, such as an unanticipated decrease in grade or size of the ore body;
- Technical reasons, such as adverse geotechnical conditions or mechanical or equipment failure;
- Regulatory direction, due to safety or environmental breaches;
- Policy changes, which occur from time to time, particularly when governments change;
- Social or community pressures, particularly from NGOs;
- The closure of downstream industry or markets;
- Unforeseen flooding of the mine.

Unexpected closure, combined with inadequate or immature closure planning practices can have significant impacts on the business, not only financially, but also on the company's reputation and can also lead to poor environmental outcomes. The impacts may lead to ongoing challenges for the company including gaining access to new land or developments, or the expansion of existing assets. In addition to company impacts, industry impacts can include (Australian Government, 2016):

- Reputational;
- Reactive and unreasonable implementation of regulations;
- Political reaction in response to community outrage, resulting in bad publicity.

In the event of unexpected or unplanned closure, the mining operations would continue to be treated as an operational asset under the BHP Group Standards, with the necessary resources being provided to meet all existing health, safety, environment and community standards until closure, rehabilitation and relinquishment are complete.

As part of this CMRP and by addressing BHP's Our Requirements Closure, a range of risks including unexpected or unplanned closure are addressed in the closure risk assessment (Section 8) and closure provision (Section 12).

11.2 Temporary Closure (Care and Maintenance)

In the unlikely event that the operation is required to be shut down on a temporary basis (i.e. there is an assumption that the operation would recommence once economic or other issues had been resolved) similar management controls would be put in place as described for unplanned closure. Temporary closure would also trigger a thorough risk assessment, the development of a care and maintenance plan, and a full review of the Mine Closure and Rehabilitation Plan in the light of an increased risk of early closure.

12 Closure Provision

BHP recognises that where mining and processing activities give rise to an obligation for site closure and rehabilitation, financial provision for the closure activity must be recognised at the time that the environmental disturbance is made. The basis by which BHP accounts for closure provisions and the Group wide closure provision is described in the publicly accessible BHP Annual report.

The main objective of financial provisioning for closure is to ensure adequate funds are assigned for closure to satisfy relevant legal and other requirements and to mitigate future risks associated with an inaccurate accounting provision. The development of closure plans and related financial provisions are required from the outset of a mining development. The OD closure cost estimate has been completed in accordance with all BHP requirements.

BHP implements several key controls to ensure that all assets and operations within the Group are able to meet their closure obligations and commitments including the integration of closure planning into LoA planning. If the asset (project) is shut suddenly, BHP would be fully aware of the obligations and costs required to keep the site in care and maintenance or to close and rehabilitate the site. As part of this CMRP and by addressing BHP's Our Requirements Closure, a range of risks including unexpected or unplanned closure are addressed in the closure risk assessment (Section 8) and included in the cost estimate.

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14 Appendices

Appendix A: Stakeholder Engagement Register

Stakeholder
Internal
BHP Board
MAu Corporate Employees
OD Site Employees
Roxby Downs and Surrounds
Roxby Downs and Olympic Village Communities
Roxby Downs Council
Woomera Community (including Woomera Board, Defence)
Andamooka Community
Service Providers (Health, Police and Education)
Roxby Downs and Woomera Community Board
Andamooka Progress and Opal Miners Association
Outback Areas Authority (Andamooka governance body)
Arid Recovery partners (the South Australian Department for Environment & Natural Resources, the University of Adelaide and Friends of Arid Recovery)
Non-Government Organisations
SA Chamber of Mines and Energy
Australian Uranium Association
Friends of the Earth
South Australian Conservation Council
Wilderness Society
External – suppliers and contractors
Transport and Freight Companies
Local contractors (small, medium and large)
Investors, Banks, Financial Institutions
Government Entities
State Government Elected Representatives
Federal Government Department responsible for the Environment
Federal Government Elected Representatives
Relevant Australian and South Australian Government Departments and Agencies
Great Artesian Basin Coordinating Committee
South Australian Arid Lands NRM Board
Northern and Yorke NRM Board
Eyre Peninsula NRM Board
Indigenous Groups
Arabana Aboriginal Corporation

Barngarla Aboriginal Corporation
Dieri Aboriginal Corporation
Kokatha Aboriginal Corporation
Kuyani Aboriginal Corporation
Nukunu Aboriginal Corporation
Andamooka Aboriginal Corporation
Port Augusta Native Title Working Group.
Native Title Parties Representative Corporation (NTP-RC)
Upper Spencer Gulf
Regional Development Australia – Far North
Regional Development Australia – Whyalla and Eyre Peninsula
Regional Development Australia – Yorke and Mid North
Upper Spencer Gulf Common Purpose Group
City of Port Augusta
City of Whyalla
Pt Pirie Regional Council
Pastoral Communities
SA Pastoral Board
Anna Creek Station
Arcoona Station
Billa Kalina Station
Bosworth Station
Callanna Station
Cariewerloo Station
Clayton Station
Dulkaninna Station
Etadunna Station (BHP)
Farina Station
Hesso Station
Kootaberra Station
Millers Creek Station
Mt Arden Station
Muloorina Station
Mundowdna Station
Murnpeowie Station
Oakden Hills Station
Parakylia Station
Roopena Station
South Gap Station
External – media

Media – Local, State and National

Appendix B: Knowledge Gaps and Preliminary Actions

Knowledge Gap	Preliminary Action
Suitability of rehabilitation species selection to sustain hotter and dryer climates with less soil moisture	Observation of trends from rehabilitation monitoring
Ability for landform designs (TSFs and RSF) to withstand increased intensity of extreme rainfall events	Landform evolution modelling of retained landforms Include climate change impacts in any future rehabilitation designs
Ability of capping treatments to withstand increased evaporation rates.	Closure designs to incorporate climate change predictions
TSF capping and landform suitability	Complete TSF capping trials
Potential for acid forming material to be generated from permanent low and medium grade waste ore stockpiles	Ensure that adequate knowledge is gathered to inform design criteria prior to any stockpiles being constructed
Long-term viability of topsoil stockpiles	Complete rehabilitation research project to better understand closure liabilities
Updated impacts on remnant vegetation based on LoA	Re-assess vegetation impacts based on current LoA
Pre-mine planned clearing vs. LoA planned clearing	Review LoA disturbance vs planned disturbance
Updated impacts on fauna based on LoA	Re-assess fauna impacts based on current LoA
Quantity, type and location of contaminants	Complete contaminated land assessment
Proposed treatment method for contaminants	Outcome of contaminated land investigation reports.
Conceptual post mine landform visualisation (TSFs)	Complete a visual assessment of the conceptual post mine landform

Appendix C: Risk Assessment

The following table defines the actual and/or credible potential impact events associated with closure and post closure activities. The risk analysis identifies the:

- Risk Event – the aspect of the closure planning or closure activities that may cause an undesirable or unforeseen impact, e.g. groundwater contamination.
- Cause – the reason for the risk event being realised.
- Preventative controls – controls that are or will be in place that reduce the chance of the risk event occurring or the severity of the impact.
- MFL – maximum foreseeable loss. The MFL is the impact sustained in a worst case scenario assuming that all preventative control are ineffective. The MFL is assessed on a scale of 1 to 7 (where 7 is the most severe) against a number of impact criteria (health and safety, environment, community, reputation, legal and financial).
- MFL impact description – the assessed worst case scenario leading to the MFL rating.
- Severity rating – the severity rating is assigned based on the assessed MFL (Table 14-1)
- Likelihood rating – the chance of the MFL impact occurring, taking into account the effectiveness of existing preventative controls.
- RRR – residual risk rating. Represents the level of residual risk associated with the risk after taking into account the preventative controls. The RRR is calculated as the product of the severity rating and likelihood rating.

Table 14-1: **MFL and severity rating table**

MFL	Severity rating
7	1000
6	300
5	100
4	30
3	10
2	3
1	1

Table 14-2: **Likelihood rating table**

Uncertainty	Example assessment	Likelihood factor
Almost certain	Could be incurred more than once in a year.	10
Likely	Could be incurred over a 1 - 2 year period.	3
Possible	Could be incurred within a 5 year period.	1
Unlikely	Could be incurred within a 5 - 20 year timeframe.	0.3
Rare	Could be incurred in a 20 - 50 year timeframe.	0.1
Very rare	Has not happened in the industry in the last 50 years, or for natural hazards the predicted return period for a risk of this strength/magnitude is one in 100 years or longer.	0.03

Risk Event and Contributing Scenarios

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
1	Financial resourcing requirements are insufficient	CA1. Inadequate or poor closure planning, stakeholder engagement, engineering & design, pre-& post-closure risk management CA2. Uncertainty around TSF closure CA3. Uncertainty around evaporation pond closure CA4. Inadequate/poor closure execution &/or post-closure cost estimates CA5. Change of internal mining or design requirements CA6. Inadequate provision for indirect closure costs e.g. HR redundancies CA7. Quantity/cost of suitable TSF cover materials underestimated CA8. Quantities of contaminated solids to be excavated & disposed underestimated	1. Engage regulators to understand & document closure & relinquishment process (CA9, CA12) 4. Stakeholder Engagement Plan (CA1, CA12) 5. Update Mine Closure Plan and submit to regulators in the event of any material changes (CA1, CA5, CA9, CA12) 6. Closure Management and Rehabilitation Plan as per Our Requirements Closure (CA1, CA5, CA6, CA9, CA10, CA12) 7. Active engagement in policy and regulation change to manage new policy requirements (CA1, CA9, CA12) 8. Document closure commitments & obligations (CA9) 11. Progressive Rehabilitation (CA10) 12. Historic waste placement knowledge (CA2) 13. Integrated Closure Planning (CA1, CA5) 14. Pre-closure costs include engineering and design work, test work, studies & associated management (CA1, CA4) 15. Conservative design assumptions for TSF cover (SRK) (CA2, CA7) 16. TSF cover trials and progressive rehabilitation of TSFs to prove up cover design, construction & performance (CA2, CA7)	5	Health and Safety: During the C&M period, despite security measures, interaction with underground facilities (e.g. portals/shafts) occurs by general public access resulting in a potential multiple fatality.	100	0.3	30

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
		CA9. Closure commitments and/or obligations not adequately considered or known. CA10. Early closure - unplanned issues CA11. Inability to use current landfill facilities in township to dispose demolition debris leading to cost increase CA12. Change in regulatory requirements or changing stakeholder expectations	17. Climate change included in hydrological modelling predictions (CA2) 18. Geochemistry stability impacts input into geotech analysis (CA2) 19. Waste characterisation (CA2) 20. Tailings closure design in accordance with ANCOLD guidelines (CA2) 21. Track cost for rehabilitation and closure execution and use to inform cost estimates (CA2, CA4) 22. Ranging used to quantify potential scope and rate (CA2, CA4, CA5, CA7, CA8, CA10, CA11) 23. Design and implementation of TSF capping trials (CA2) 24. Risk assessment completed on post mine landform designs (CA2) 25. Evaporation pond rehabilitation and closure design study (CA3) 26. Evaporation pond operating strategy (CA3) 27. Compliance with" Our Requirements Major Capital Projects - Scope Definition, Schedule and Cost Estimating Classifications" (CA4) 28. Include cleaning where required & all study, project management & execution costs in closure provision (CA4) 29. Calculations audited against BHP project cost estimating requirements (CA4) 30. SOX Controls (CA4, CA6, CA10) 31. Corporate and external finance governance and auditing (CA4, CA6, CA10) 32. Closure commitments and obligations register (CA4) 33. Identification & management of material closure risks (CA5) 34. Post closure costs include ongoing community costs, monitoring and maintenance (CA6) 35. Maintain contaminated and hazardous waste registers for classifying and quantifying different wastes requiring treatment &/or disposal (CA8) 36. Cost estimate includes allowance for post-closure events - clean up & repairs by BHP (CA8) 37. Contaminated land assessment (CA8) 38. CAP cycle to review closure risk (cost curve) (CA10) 39. Price TARP for each operation reviewed quarterly (CA10)					
2	Closure studies and execution works are not managed adequately	CA1. Poor or inadequate closure planning. CA2. Closure planning not integrated into LOA planning.	4. Stakeholder Engagement Plan (CA5) 5. Update Mine Closure Plan and submit to regulators in the event of any material changes (CA1, CA2, CA4) 6. Closure Management and Rehabilitation Plan as per Our Requirements Closure (CA1, CA2, CA3, CA4)	5	Community: Closure execution not completed according to agreed plan resulting in impact to	100	0.3	30

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
		CA3. Closure risks not well understood or managed. CA4. Inadequate progressive closure planning and/or execution. CA5. Inadequate or poor management of closure planning.	11. Progressive Rehabilitation (CA3) 13. Integrated Closure Planning (CA1) 16. TSF cover trials and progressive rehabilitation of TSFs to prove up cover design, construction & performance (CA3) 24. Risk assessment completed on post mine landform designs (CA3) 40. Closure plan - schedule, closure actions etc. - aligned with the LoA Optimised Base Plan (CA1, CA2) 41. Preliminary closure designs and materials or specifications for key closure cost driver - TSF cover (CA1) 42. Closure design and performance criteria defined in Closure Plan (CA1) 43. Address BHP Our Requirements, Corporate Alignment Planning, Appendix 1 Closure Plan Scope (CA1, CA2, CA4) 44. 5YP CAP process for rehabilitation (CA2, CA4) 45. Closure provision funding model (CA2, CA4) 46. Annual closure planning workshop with quarterly risk/action review & tracking meetings (CA3) 47. Regular state government disclosure/reporting (CA3) 48. Consideration of specific risks in Our Requirements, Corporate Alignment Planning, Appendix 1 Closure Plan Scope (not achieving closure plan objectives; adverse post-closure events; potential changes to regulations; immediate or unplanned closure) (CA3) 49. Annual review of closure planning risks (CA3) 50. Progressive rehabilitation plans (CA4) 51. Preliminary monitoring & care & maintenance plan - cost provision in estimate (CA4) 52. Preliminary relinquishment plan (CA4) 53. Deconstruction, demolition and demobilisation cost estimate/quotation for plant and equipment (CA5)		Roxby Downs community.			
3	Early closure is not considered in closure planning.	CA1. Poor or inadequate closure planning. CA2. Poor or inadequate closure risk management i.e. risk management does not include early closure. CA3. Incorrect assessment of asset value and/or life. CA4. Loss of licence to operate through major HSEC incident or breach of operating licence.	1. Engage regulators to understand & document closure & relinquishment process (CA4) External – media 5. Update Mine Closure Plan and submit to regulators in the event of any material changes (CA1, CA4) 6. Closure Management and Rehabilitation Plan as per Our Requirements Closure (CA1, CA2, CA4) 11. Progressive Rehabilitation (CA2) 13. Integrated Closure Planning (CA1) 16. TSF cover trials and progressive rehabilitation of TSFs to prove up cover design, construction & performance (CA2) 24. Risk assessment completed on post mine landform designs (CA2) 30. SOX Controls (CA3)	5	Reputation: Loss of social licence would likely result in national and international negative media attention	100	0.3	30

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
			31. Corporate and external finance governance and auditing (CA3) 39. Price TARP for each operation reviewed quarterly (CA3) 43. Address BHP Our Requirements, Corporate Alignment Planning, Appendix 1 Closure Plan Scope (CA1) 44. 5YP CAP process for rehabilitation (CA1) 45. Closure provision funding model (CA1, CA3) 46. Annual closure planning workshop with quarterly risk/action review & tracking meetings (CA2) 48. Consideration of specific risks in Our Requirements, Corporate Alignment Planning, Appendix 1 Closure Plan Scope (not achieving closure plan objectives; adverse post-closure events; potential changes to regulations; immediate or unplanned closure) (CA2) 49. Annual review of closure planning risks (CA2) 54. Provision for early closure incorporated into LoA cost estimate as a risk event (CA1) 55. Early closure risk assessment using early closure risk bowtie - risk associated with early closure is low (CA2) 56. Risk status reviewed annually in consideration of Tier 1 asset requirements - long life, large, low-cost, high-margin, expandable (CA3) 57. Community relations plan (CA4) 58. Engagement of regulators in closure trials & progressive rehabilitation observations, monitoring & continuous improvement (CA4) 59. Public consultation an engagement - demonstration of success of progressive rehabilitation (CA4)					
4	BHP is unable to relinquish the mining tenements and leases	CA1. Poor or inadequate closure planning CA2. Poor or inadequate closure risk management i.e. risk management does not include early closure. CA3. Incorrect assessment of asset value and/or life. CA4. Loss of licence to operate through major HSEC incident or breach of operating licence	1. Engage regulators to understand & document closure & relinquishment process (CA4) 2. Engage stakeholders prior to closure to agree on post-closure land-uses & to address any gaps or uncertainties in closure objectives and criteria (CA4) 3. Develop plans for community programs leading up to and after closure. (CA4) 5. Update Mine Closure Plan and submit to regulators in the event of any material changes (CA4) 6. Closure Management and Rehabilitation Plan as per Our Requirements Closure (CA1, CA2, CA4) 11. Progressive Rehabilitation (CA2) 13. Integrated Closure Planning (CA1) 16. TSF cover trials and progressive rehabilitation of TSFs to prove up cover design, construction & performance (CA2) 24. Risk assessment completed on post mine landform designs (CA2)	2	Legal: Closure ultimately completed per the approved closure plan but legal negotiations required to resolve matter.	3	1	3

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
			30. SOX Controls (CA1, CA3) 31. Corporate and external finance governance and auditing (CA1, CA3) 39. Price TARP for each operation reviewed quarterly (CA3) 45. Closure provision funding model (CA1, CA3) 46. Annual closure planning workshop with quarterly risk/action review & tracking meetings (CA2) 48. Consideration of specific risks in Our Requirements, Corporate Alignment Planning, Appendix 1 Closure Plan Scope (not achieving closure plan objectives; adverse post-closure events; potential changes to regulations; immediate or unplanned closure) (CA1, CA2) 49. Annual review of closure planning risks (CA2) 55. Early closure risk assessment using early closure risk bowtie - risk associated with early closure is low (CA2) 56. Risk status reviewed annually in consideration of Tier 1 asset requirements - long life, large, low-cost, high-margin, expandable (CA2, CA3) 58. Engagement of regulators in closure trials & progressive rehabilitation observations, monitoring & continuous improvement (CA4) 59. Public consultation an engagement - demonstration of success of progressive rehabilitation (CA4) 60. Established baseline information e.g. natural radiation levels (CA1) 61. Closure plan contains detailed proposed completion criteria to be used in progressive and final closure (CA1) 62. Research, studies, closure trials and progressive rehabilitation demonstrating achievement of closure performance objectives and criteria (CA2)					
5	Failure of TSF cover resulting in exposure & release of tailings	CA1. Inadequate planning - design, trials, improvements CA2. Poor/inadequate cover design: CA3. Inadequate drying/dewatering of tailings before placement CA4. Cover constructed poorly/incorrectly CA5. TSF cover thickness not adequate for long term radiation safety &/or tailings containment	12. Historic waste placement knowledge (CA1, CA2) 15. Conservative design assumptions for TSF cover (CA1, CA2) 16. TSF cover trials and progressive rehabilitation of TSFs to prove up cover design, construction & performance (CA1, CA2) 17. Climate change included in hydrological modelling predictions (CA1) 18. Geochemistry stability impacts input into geotech analysis (CA1, CA2) 20. Tailings closure design in accordance with ANCOLD guidelines (CA1, CA2) 63. Progressive rehabilitation planning - research, design, execution planning 2 to 5 years before execution due to commence - is integrated into LoA & 5 year planning & 2Y budget (CA1, CA5)	4	Financial:	30	1	30

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
			64. Studies and planning includes cover trials - prior to full scale cover works (CA1) 65. Regulatory engagement in short, medium and long term observation / monitoring / improvement of trials, construction, leading indicators (erosion, seepage, stability etc.) (CA1) 66. Geotechnical review to understand FOS of post mine landform (CA1, CA2) 67. Design criteria set to highest standards (CA2) 68. Post TSF filling drying/consolidation period - 2 to 4 years - monitor and verify tailings consolidation prior to cover placement (CA3) 69. Material characterisation (CA4) 70. Compliance to plan (CA4) 71. Ensure clear communication of requirements (CA4) 72. Design execution survey control (CA4) 78. Trials and monitoring of progressively rehabilitated TSFs (CA5) 83 Use suitably qualified and experienced personnel in the design and construction of TSF capping (CA5).					
6	Post closure risk events - earthquakes, storms, droughts	CA1. Post-closure earthquake beyond design parameters (e.g. Richter Magnitude 9) causes slumping of embankments CA2. Post closure event exceeds TSF design parameters CA3. Post-closure flood events CA4. Climate change	15. Conservative design assumptions for TSF cover (CA2) 17. Climate change included in hydrological modelling predictions (CA2, CA4) 18. Geochemistry stability impacts input into geotech analysis (CA2) 20. Tailings closure design in accordance with ANCOLD guidelines (CA2) 66. Geotechnical review to understand FOS of post mine landform (CA2) 73. Risk assessment completed on post mine landform designs (design failure mode analysis) (CA1. CA3) 74. Conservative design assumptions (CA2) 75. Monitoring of physical stability (CA2) 76. Cover design to promote drain down of TSG water & strength gain of tailings (CA2) 77. Monitoring of progressively rehabilitated TFSs (CA2)	5	Reputation: Despite having relinquished the tenement and having completed capping and rehabilitation of the TSFs per the required standards, a TSF failure would likely result in national and international negative media attention and public and NGO adverse reaction. Likely also result in interest from regulators with respect to reviewing evidence of rehabilitation standards.	100	0.1	10
7	Off-lease ground water seepage originating from TSF or other contaminated sources.	CA1. Model underestimates or incorrectly predicts post closure seepage and movement/migration of seepage plume CA2. Incorrect estimate of water seepage and infiltration into tailings from water on beaches and pond.	78. Trials and monitoring of progressively rehabilitated TSFs (CA1, CA3) 79. Closure groundwater model correlated to many years of pre-closure groundwater level and quality data (CA1) 80. Groundwater model rechecked in 2015 confirming very low probability of off-lease migration of solutes (CA1) 81. Design and management of TSFs to minimise seepage (CA2)	4	Reputation: Although the groundwater aquifer is known to be localised and with limited beneficial use, the perception of causing environmental harm to a groundwater	30	1	30

	Risk Event	Cause name	Preventative controls	MFL level	MFL Impact description	Severity rating	Likelihood rating	RRR
		CA3. Inappropriate TSF design and operation prevents adequate closure outcomes (i.e. low evaporation and high seepage).	82. Cover design (shedding) to minimise post closure infiltration of incident water (CA2) 83 Use suitably qualified and experienced personnel in the design and construction of TSF capping. (CA3)		aquifer would likely result in national media attention.			

Appendix D: Post Closure Monitoring Schedule

Item	Number Monitoring Events	Monitoring Year Post Closure (Years Post Closure)																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ecosystem Function analysis	7	■	■	■		■					■					■					■
Surface water monitoring and analysis	7	■	■	■		■					■					■					■
Groundwater monitoring and analysis	7	■	■	■		■					■					■					■
Geotechnical Monitoring TSF	7	■	■	■		■					■					■					■
Geotechnical Monitoring RSF	7	■	■	■		■					■					■					■
Fauna survey	7	■	■	■		■					■					■					■
Weed/feral animal control & inspect	42	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Radionuclide's monitoring	20	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
GAB recovery monitoring	23	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Appendix E: Tailings Investigation