

MINE CLOSURE PLAN

THUNDERBIRD MINERAL SANDS PROJECT

M04/459, L04/82, L04/83, L04/85 AND L04/86

Document ID: TBMCP Version: 1.0

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THUNDERBIRD MINERAL SANDS PROJECT MINE CLOSURE PLAN

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DMP MINE CLOSURE PLAN CHECKLIST

Q No	Mine Closure Plan (MCP) checklist	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)	Y	NA		NA		
Public Availability							
2	Are you aware that from 2015 all MCPs will be made publicly available?	Y	NA				
3	Is there any information in this MCP that should not be publicly available?	N	NA				
4	If "Yes" to Q3, has confidential information been submitted in a separate document/ section?	NA	NA				
Cover Page, Table of Contents							
5	Does the MCP cover page include:						
	project Title	Y	NA		NA	NA	NA
	Company name	Y	NA		NA	NA	NA
	Contact Details (including telephone numbers and email addresses)	Y	NA		NA	NA	NA
	Document ID and version number	Y	NA		NA	NA	NA
	Date of submission (needs to match the date of this checklist)	Y	NA		NA	NA	NA
Scope and Purpose							
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements).	Y	1	Section 1	NA	NA	NA
Project Overview							
7	Does the project summary include:						
	Land ownership details (include any land management agency responsible for the land/reserve and the purpose for which the land/reserve [including surrounding land] is being managed).	Y	3	Section 2.1	NA	NA	NA

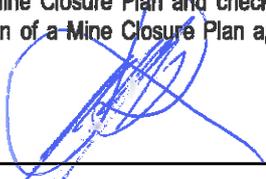
Q No	Mine Closure Plan (MCP) checklist	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
	Location of the project.	Y	3	Section 2.1	NA	NA	NA
	Comprehensive site plan(s).	Y	6	Section 2.3	NA	NA	NA
	Background information on the history and status of the project.	Y	1	Section 1	NA	NA	NA
Legal Obligations and Commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	20	Section 3	NA	NA	NA
Stakeholder Engagement							
9	Have all stakeholders involved in closure been identified?	Y	25	Section 4	NA	NA	NA
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	29	Section 4.3	NA	NA	NA
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	28	Section 4	NA	NA	NA
Post-Mining Land Use(s) and Closure Objectives`							
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	31	Section 5	NA	NA	NA
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y	61	Section 8	NA	NA	NA
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the <i>Contaminated Sites Act 2003</i> ?	NA	NA	NA	NA	NA	NA
Development of Completion Criteria							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	32	Section 6	NA	NA	NA

Q No	Mine Closure Plan (MCP) checklist	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
Collection and Analysis of Closure Data							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	37	Section 7	NA	NA	NA
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	48	Section 7.6	NA	NA	NA
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	N	NA	Conceptual plan; similar sites to be determined.	NA	NA	NA
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	61	Section 8	NA	NA	NA
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	65	Section 9	NA	NA	NA
Identification and Management of Closure Issues							
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	61	Section 8	NA	NA	NA
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	61	Section 8	NA	NA	NA
Closure Implementation							
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	63	Section 9	NA	NA	NA
24	Does the MCP include a closure work program for each domain or feature?	Y	67	Section 9.2.2	NA	NA	NA

Q No	Mine Closure Plan (MCP) checklist	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Y	7	Section 2.3	NA	NA	NA
26	Does the MCP contain a schedule of research and trial activities?	Y	63	Section 9	NA	NA	NA
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	63	Section 9	NA	NA	NA
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	70	Section 9.3 and 9.4	NA	NA	NA
29	Does the MCP contain a schedule of decommissioning activities?	Y	67	Section 9.2.2	NA	NA	NA
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	72	Section 10	NA	NA	NA
Closure Monitoring and Maintenance							
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	72	Section 10	NA	NA	NA
Financial Provisioning for Closure							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	75	Section 11	NA	NA	NA
33	Does the MCP include a process for regular review of the financial provision?	Y	76	Section 11.2	NA	NA	NA
Management of Information and Data							
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	78	Section 12	NA	NA	NA

Corporate Endorsement:

I hereby certify that, to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Mines and Petroleum.

Name: Bruce McFadzean Signed: 

Position: Managing Director Date: 14 November 2016

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APPENDICES

Appendix 1: Closure Risk Assessment

1. SCOPE AND PURPOSE

The Thunderbird Mineral Sands Project (the project) is a greenfields mineral sands project located on the Dampier Peninsula in the west Kimberley region of Western Australia. It is located approximately 75 km west southwest of Derby and 95 km northeast of Broome. The current life of mine is expected to be 40+ years.

This Mine Closure Plan (MCP) has been prepared for submission in support of applications to develop the project under:

- The *Environmental Protection Act 1986 (EP Act)* Part IV, through a Public Environmental Review (PER) document, submitted to the Environmental Protection Authority (EPA).
- The *Mining Act 1978 (Mining Act)*, through Mining Proposals submitted to the Department of Mines and Petroleum (DMP).

This MCP addresses the planned closure and rehabilitation of the project, including all disturbed areas, mining landforms, plant and other built infrastructure within the project tenements. It also addresses contingencies for temporary suspension of operations and unplanned closure. This MCP is conceptual in nature, reflecting the planning status of the project.

This MCP has been prepared according to the joint DMP/EPA *Guidelines for Preparing Mine Closure Plans* (May 2015 revision) (DMP/EPA 2015).

A MCP is a dynamic document that recognises that both the project and industry closure requirements are constantly evolving. As such, this MCP will be revised on a regular basis with detailed rehabilitation outcomes and relinquishment criteria developed progressively, in consultation with stakeholders, over the life of project. Upon completion of approval stages of the project, the MCP will be updated if required to ensure the working document captures all facets of the project as approved. The detailed MCP will be developed during the operational phase of the project to reflect the greater understanding and detail of specific mining activities. The final step is the evolution of the MCP into a Decommissioning Plan for final implementation of project closure activities, culminating in submission of a Relinquishment Report.

The scope and structure of this MCP is as follows:

- Section 1: **Scope and Purpose** - outlines the scope and purpose of the MCP.
- Section 2: **Project Overview** - provides an overview of the project, including land ownership, tenure, location, planned operations and main mine components.
- Section 3: **Identification of Closure Obligations and Commitments** - summarises the legal obligations and specific legally binding closure commitments relating to the project.
- Section 4: **Stakeholder Engagement** - describes the process used to identify stakeholders relevant to mine closure, lists the stakeholders identified, and provides a summary of how each has been, and will continue to be, consulted in relation to mine closure.
- Section 5: **Post-Mining Land Use and Closure Objectives** - identifies post-mining land use and closure objectives based on the proposed land use.
- Section 6: **Development of Completion Criteria** - describes the development of site specific completion criteria by which success of closure will be measured.
- Section 7: **Collection and Analysis of Closure Data** - provides environmental data relevant to closure, including a summary of baseline studies completed prior to project commencement and how these aspects impact on closure of the project.
- Section 8: **Identification and Management of Closure Issues** - outlines the risk assessment process for identifying the key closure issues, and provides a summary of key risks and management measures.

- Section 9: **Closure Implementation** - provides a closure implementation plan that includes planned closure, suspension, and early closure.
- Section 10: **Closure Monitoring and Maintenance** - describes the proposed environmental monitoring program and maintenance response requirements.
- Section 11: **Financial Provision for Closure** - describes the process used to estimate the closure financial provision, including the internal calculations and third-party review.
- Section 12: **Management of Information and Data** - provides a description of how relevant information and data will be managed during ongoing closure planning and implementation.

Closure planning progress will be reported annually as part of the Annual Environmental Report (AER). This MCP will be updated and submitted for review every three years, or as required by project approval and tenement conditions.

2. PROJECT OVERVIEW

2.1 LOCATION AND TENURE

The project is located on the Dampier Peninsula in the west Kimberley region of Western Australia (Figure 2). The project comprises two geographically separate locations; the Mine Site Development Envelope (including Site Access Road) and the Derby Port Development Envelope. There are no other mining projects located on the Dampier Peninsula. Derby Port is an operational port and has been previously used for export of mineral products but is currently not being used for this purpose.

The Mine Site Development Envelope is located approximately 75 km west of Derby and 95 km northeast of Broome (Figure 1). It is accessed from the Great Northern Highway via a proposed 30 km long Site Access Road.

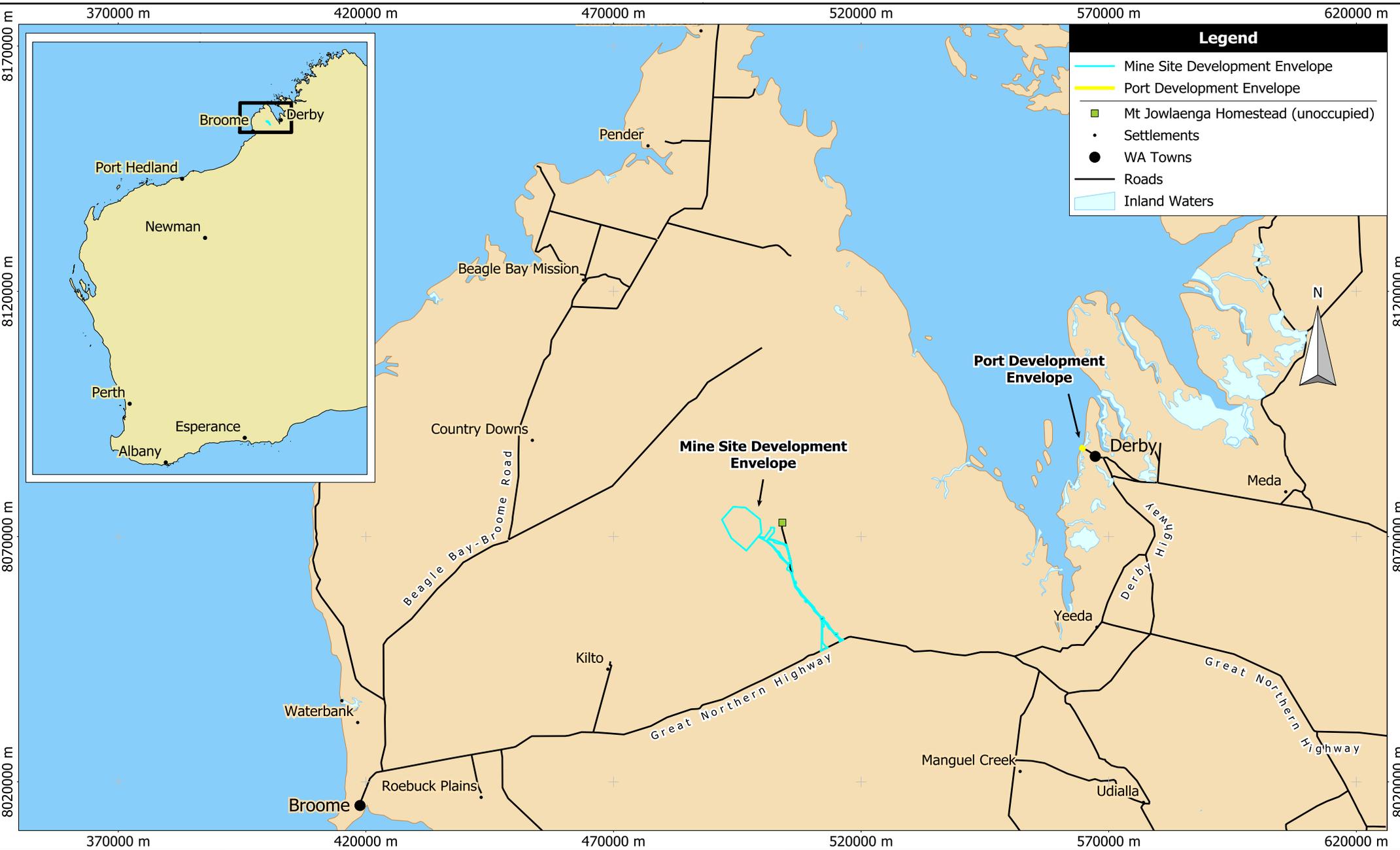
The Mine Site Development Envelope is located within the Mt Jowlaenga Pastoral Lease (H910623), held by the Yeeda Pastoral Company Pty Ltd. An existing pastoral road that connects the Great Northern Highway to the abandoned Mt Jowlaenga Homestead will be upgraded to form part of the Site Access Road for the project. The Site Access Road intersects the Great Northern Highway approximately half way between Broome and Derby; the intersection is approximately 110 km to Derby and 100 km to Broome by road.

Several tenements are held by Sheffield for the Mine Site Development Envelope; these are detailed in Table 1 shown in Figure 2.

Table 1: Project Tenements

Tenement	Area (hectares)	Holder	Granted	Expiry
M04/459	4,525	Sheffield Resources Pty Ltd	Pending	N/A
L04/82	633	Sheffield Resources Pty Ltd	Pending	N/A
L04/83	219	Sheffield Resources Pty Ltd	Pending	N/A
L04/84	120	Sheffield Resources Pty Ltd	23/04/2015	22/04/2036
L04/85	237	Sheffield Resources Pty Ltd	23/04/2015	22/04/2036
L04/86	191	Sheffield Resources Pty Ltd	23/04/2015	22/04/2036

Bulk mineral sands products will be transported by road haulage from the Mine Site to Derby Port, located 2 km northwest of the Derby Township, where they will be stored prior to export. Smaller volumes of packaged product will be exported from the Port of Broome using existing facilities. No additional development of facilities is proposed for the Port of Broome.



Scale: 1:1000000
 Original Size: A4
 Grid: MGA94(51)

0 40 km

Sheffield Resources Limited
 Thunderbird Mineral Sands Project

Figure 1
Project Location

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 West Perth WA 6005
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 Fax: (08) 9226 3177
 info@mbsenvironmental.com.au
 www.mbsenvironmental.com.au

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500000 m

510000 m



8070000 m

8070000 m

8060000 m

8060000 m

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500000 m

510000 m

M 04/459

L 04/85

L 04/84

L 04/86

L 04/82

L 04/83

Legend

-  Mine Site Development Envelope
- Thunderbird Tenements**
-  MINING LEASE
-  MISCELLANEOUS LICENCE
-  Great Northern Highway
-  Mt Jowlaenga Homestead (unoccupied)

Scale: 1:140000
 Original Size: A4
 Air Photo Date: 2015
 Grid: Australia MGA94 (51)

0 4 km



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 Thunderbird Mineral
 Sands Project

Figure 2

Tenement Plan

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 Fax: (08) 9226 3177
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2.2 CONTACT DETAILS

The project will be developed by Sheffield Resources Limited (Sheffield) (ACN 125 811 083). Sheffield is mineral sands focused explorer and developer, headquartered in Perth, Western Australia. It is listed on the Australian Securities Exchange (ASX). Sheffield is the owner of all tenements associated with the project.

The proponent can be contacted at: Sheffield Resources Limited
Level 2, 41 - 47 Colin Street
West Perth WA 6005

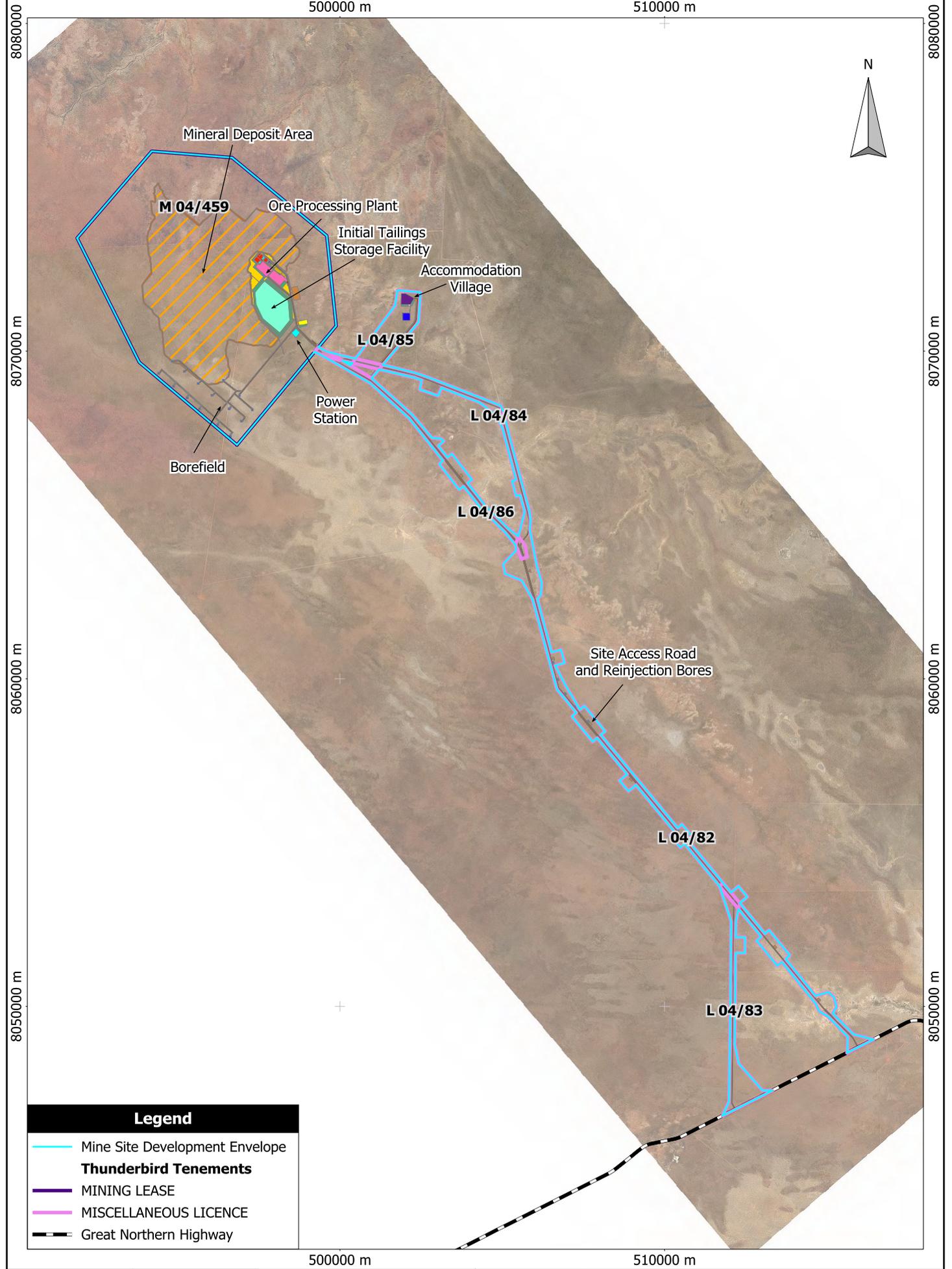
The key contact for the project is: Mr Bruce McFadzean
Managing Director
Telephone: (08) 6555 8777
Email: info@sheffieldresources.com.au

2.3 PROJECT DESCRIPTION

The project is a greenfields project comprising:

- Mining of heavy mineral sands over a 40+ year period from the mine deposit area. The initial rate of mining will allow processing of a nominal 7.5 Mtpa of ore for the first four years, before increasing to a nominal 15 Mtpa of ore for the remainder of the project life.
- Onsite primary and secondary processing of ore to produce a range of saleable mineral products (ilmenite, primary zircon, zircon concentrate, titano-magnetite and HiTi88 Leucoxene Leucoxene). Construction of processing facilities will be staged with production doubled to 15 Mtpa after year four.
- Development of infrastructure to support the project, including power generation facilities, accommodation village, administration and maintenance buildings, internal roads, communications infrastructure, and waste storage and disposal facilities.
- Upgrade and extension of the existing pastoral track (Mt Jowlaena Road) from the Great Northern Highway to form a 30 km Site Access Road.
- Abstraction and injection of groundwater from the Broome Sandstone Aquifer to allow mining and supply ore processing needs.
- Transport of bulk and packaged mineral products from the Mine Site via the Site Access Road and Great Northern Highway to Derby Port or the Port of Broome respectively for storage prior to export.
- Export of bulk mineral products from Derby Port via King Sound and packaged mineral product from the Port of Broome to international customers.

The project, its construction, and operation are described in greater detail in the Thunderbird Mineral Sands PER document and Mining Proposal which this preliminary MCP accompanies. Some details of the project provided in this MCP are subject to final design confirmation, but are not expected to vary substantially from the project as described herein, or affect closure planning in any material way. The site layout is shown in Figure 3.



Scale: 1:150000
 Original Size: A4
 Air Photo Date: 2015
 Grid: Australia MGA94 (51)

0 4 km

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 Thunderbird Mineral Sands Project

Figure 4
 Mine Site Development Envelope Infrastructure Layout

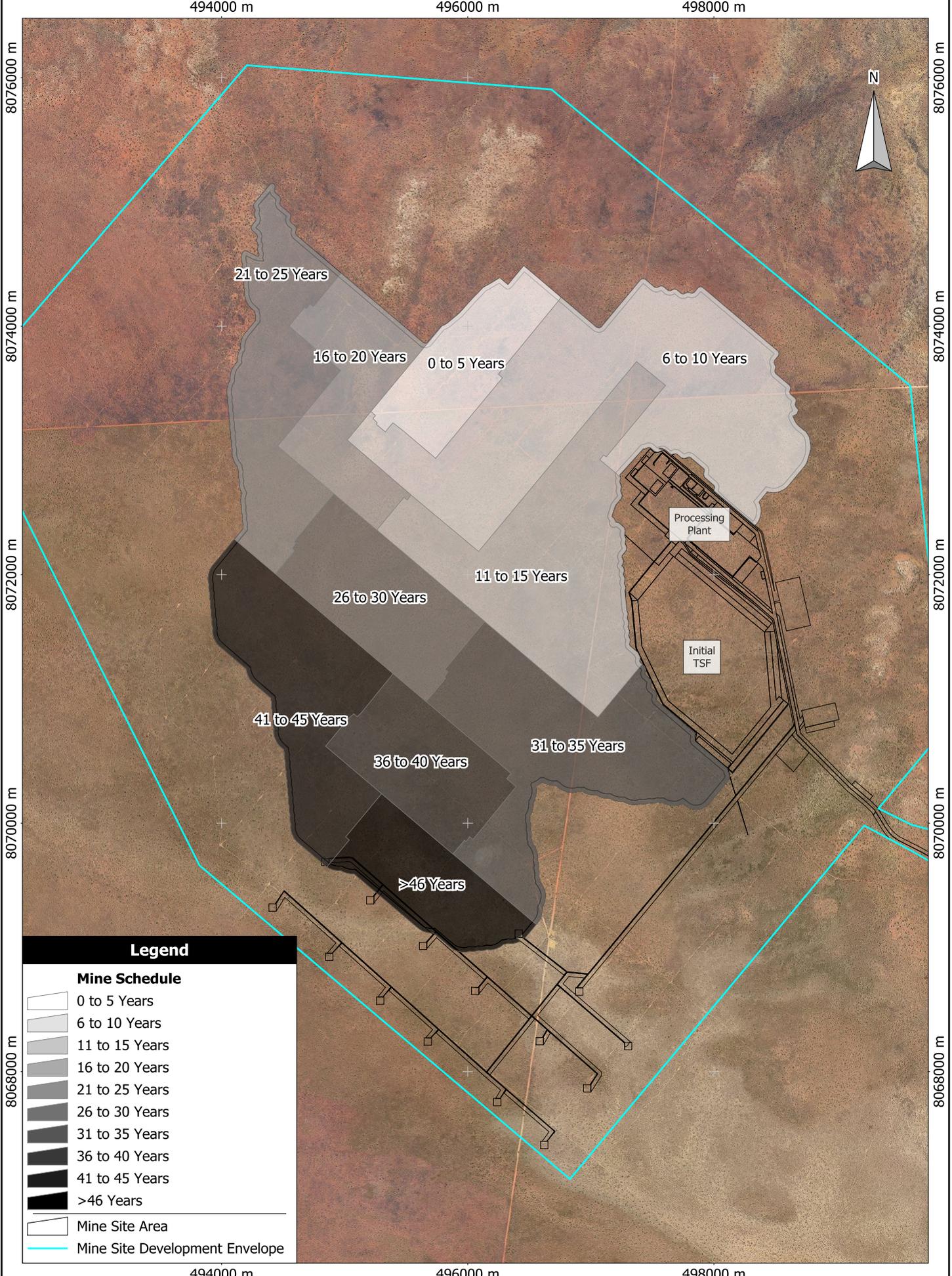
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2.3.1 Mineral Deposit Area

Mineralisation of the Thunderbird deposit is in a thick, broad anticlinal sheet-like sedimentary unit striking northwest; the top of mineralisation starts at the surface in the northern-most section of the deposit area and dips towards the southwest. As a result, pit depth will be approximately 10 – 12 m at the northeastern end of the deposit, with depth increasing as the ore body dips to a maximum of 100 m at the southwestern end of the deposit.

Mining occurs within a continually moving mining excavation of approximately 200 hectares, with progressive backfilling and rehabilitation following behind. The mining schedule for life of mine is shown in Figure 4.



Scale: 1:40000
 Original Size: A4
 Air Photo Date: 2015
 Grid: Australia MGA94 (51)

0 1000 m

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 Limited
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Figure 4
Mining Schedule

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For a given area, it is anticipated mining, primary backfilling and stabilisation can occur within three to four years. The period of time between mining and completion of backfill will depend on the thickness of overburden, ore and depth of final pit. Final rehabilitation earthworks (recontouring, topsoil placement, ripping) will be completed as soon as practicable after landforms are shaped. Seeding (if required), which is seasonally dependant, will occur during the most optimal periods of the year.

The mining sequence is typical of mineral sand mining in Western Australia, shown schematically in Figure 5. The orebody is not linear; hence the mine path will meander rather than progressing continually in a single direction as shown.

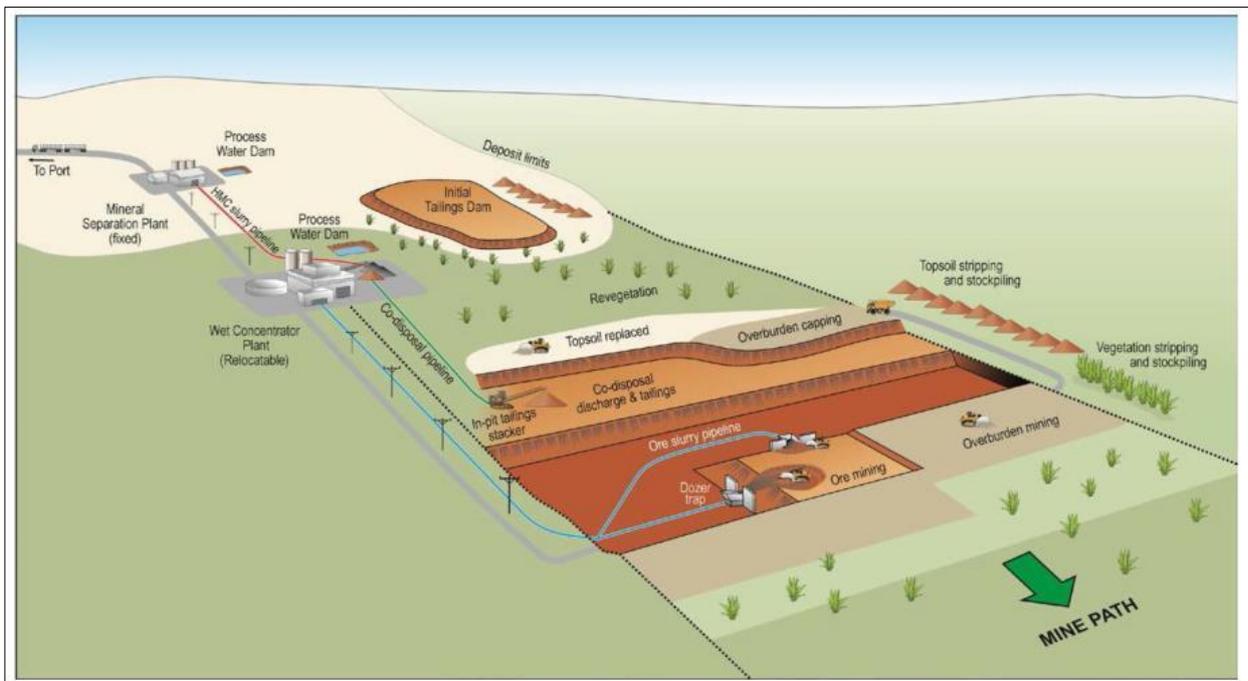


Figure 5: Conceptual Mining Method Schematic

The majority of the Thunderbird deposit occurs above the water table (35 - 40 m below ground level), with the remainder below the water table requiring dewatering to lower the water table to enable safe mining (Figure 6). As such, pit dewatering will be required from approximately Year 15 onwards. Dewatering will be undertaken using external bores with drainage sumps located in the floor of the pit to recover in-pit seepage and runoff water. All in-pit seepage water will be considered mine waste water and kept within a closed process water circuit supplying mining and processing operations. Bore dewatering may be utilised for re-injection in the later stages of the project.

Whilst there are no well-defined water courses traversing the mineral deposit area, a series of temporary pit bund walls (expected to be around 2 m in height) will be constructed around the active pit to prevent surface stormwater runoff from entering. Any surface water sheet flow will be directed around the active mining area. These drainage controls will be constructed, removed, and rehabilitated as the mine proceeds along path. These features will also ensure no inadvertent access to the active mine area.

2.3.1.1 Mine Waste Management and Backfilling Process

Initially mine waste material and tailings will be placed in a paddock-style tailings storage facility (TSF) after which mine overburden, and some screened oversize, will be either directly tipped into mine void or stored temporarily on mine path before backfilling as presented in Figure 6.

The final mine pit at the end of mine life will be located at the deepest part of the deposit and constitute a relatively large mine void that will require post-mining backfilling. A material balance will determine whether any form of final mine void remains.

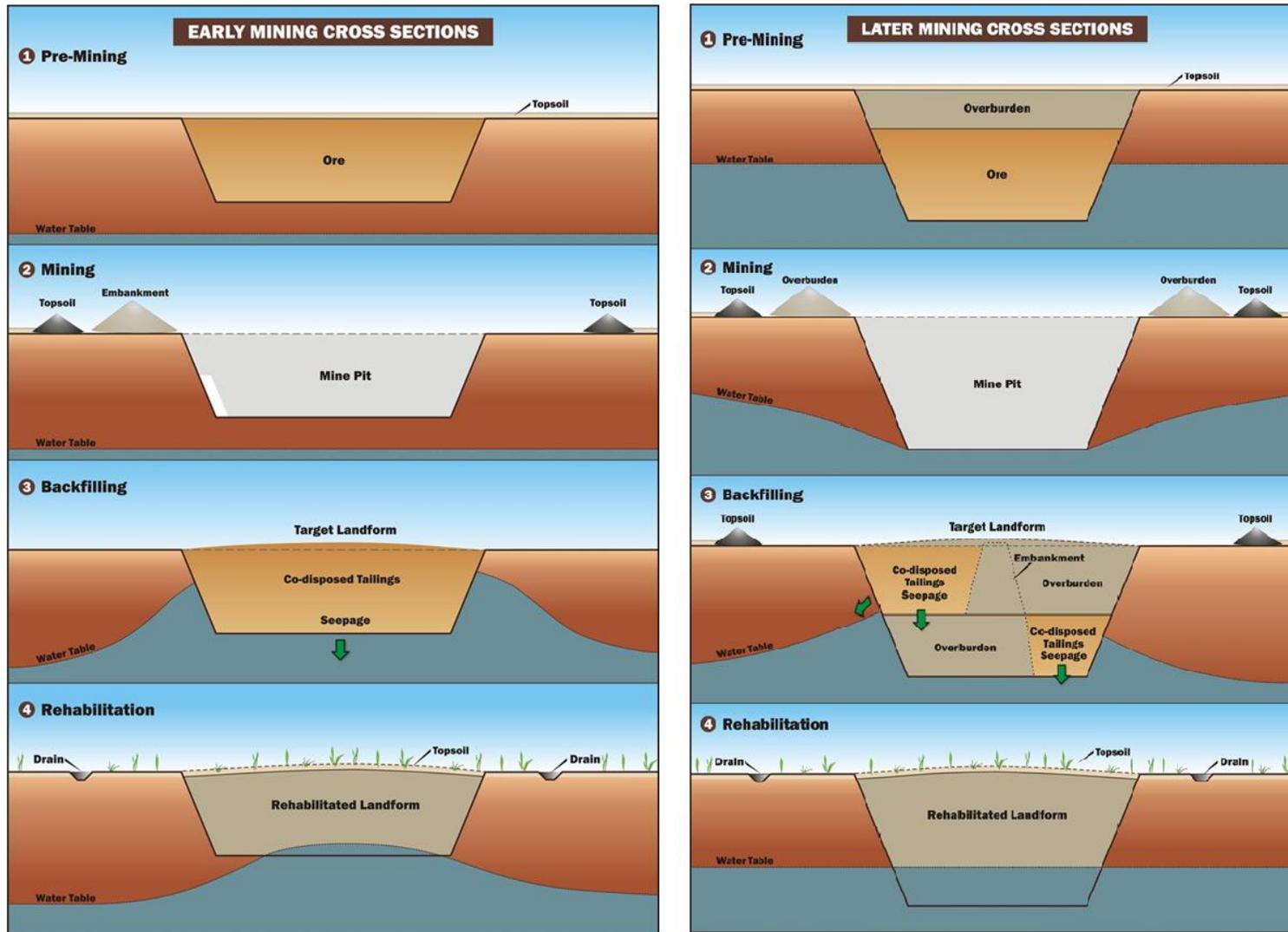


Figure 6: Mine Waste Management and Backfill Process

2.3.2 Ore Processing

Ore will be processed in a standard two stage mineral sands processing plant (Figure 7):

- Primary processing – undertaken by a Wet Concentrator Plant (WCP).
- Secondary processing – undertaken by a Mineral Separation Plant (MSP).

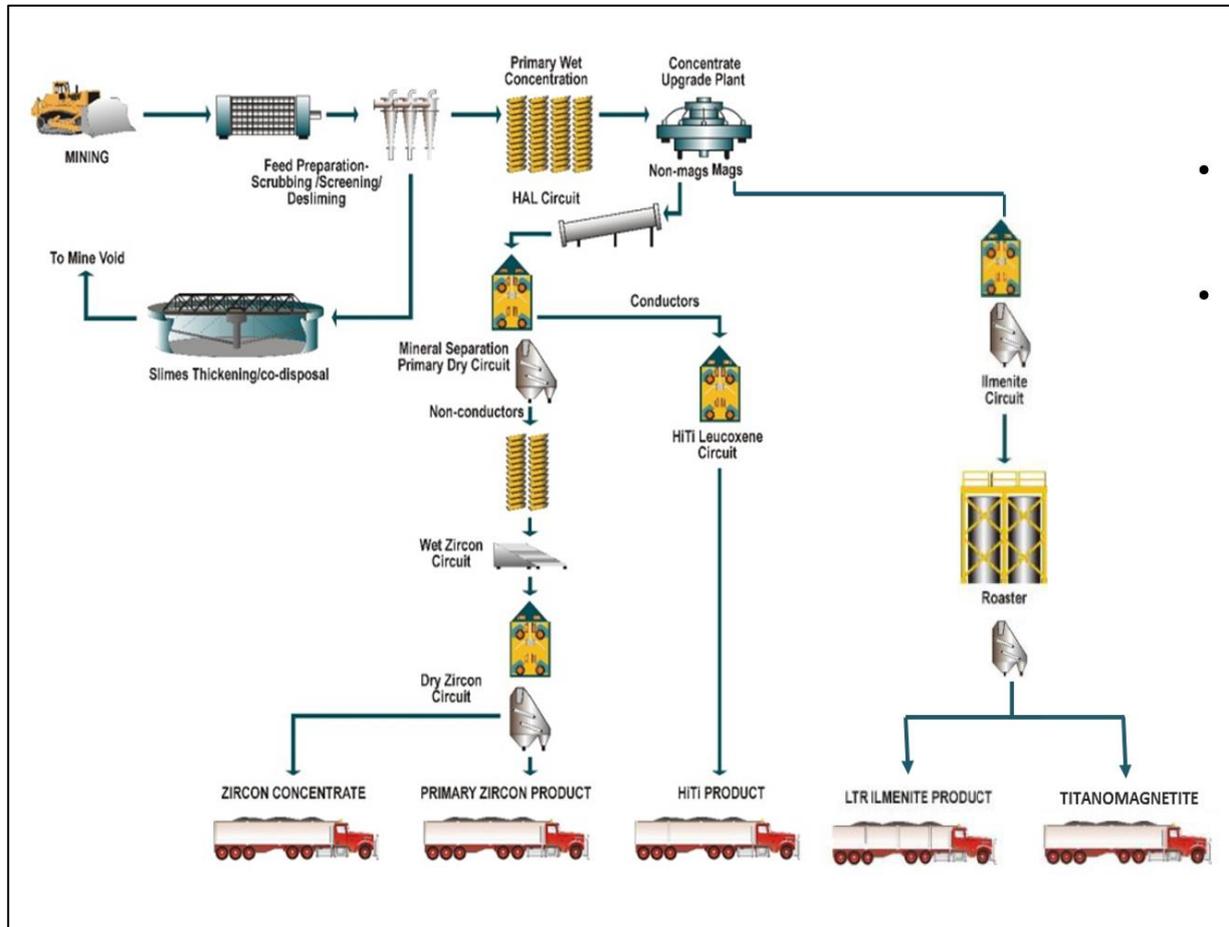


Figure 7: Ore Processing Process Flow Sheet

2.3.2.1 Wet Concentrator Plant

The WCP separates heavy mineral sands from ore using gravitational processes.

The slurry pipelines from the Mining Unit Plants (MUPs) will transfer material less than 5 mm diameter to the WCP where it will enter a Desliming circuit containing cyclones. Cyclone underflow is transferred to spiral circuits where heavy minerals are separated from the lighter minerals through gravity separation. Four spiral stages include roughers, middlings, cleaners and cleaner-scavengers. Concentrate from rougher and middlings spirals are screened at a 425 µm aperture prior to the second two spiral stages.

The concentrate is then further processed through a re-cleaning stage in spirals which are specifically designed for fine material. The Heavy Mineral Concentrate (HMC) resulting from this stage is dewatered via cyclones, then stockpiled and allowed to drain so that the moisture content in the feed to the MSP is approximately 6% by weight.

Waste material (tailings) from all four spiral stages will be transferred to a single hopper and pumped via a dewatering cyclone to the final tails hopper. Waste material from the WCP will initially report to the TSF until such time as sufficient storage capacity is created to allow for in-pit disposal.

2.3.2.2 Mineral Separation Plant

A secondary processing plant will be used to separate out the different minerals within the HMC. This plant will be located away from the mining area and incorporate a combination of gravity, magnetic, chemical, low temperature roasting, and electrostatic separation processes.

Initial processing of the HMC is through the Concentrate Upgrade Plant (CUP) which uses magnetic separation to separate magnetic ilmenite from the HMC. The ilmenite is then roasted and re-screened (magnetic) to produce primary ilmenite. Non-magnetic zircon and HiTi88 leucoxene/rutile from the CUP will undergo a hot sulfuric acid leach (HAL) process to leach iron (including iron cemented coatings) from the concentrate. The waste acid from this process is neutralised using agricultural lime to produce a relatively small quantity of gypsum (calcium sulfate) residue. Acid leached zircon and HiTi88 leucoxene/rutile are then separated by dry electrostatic separation in the Zircon Separation Plant (ZSP).

2.3.2.3 Final Products

Five final products (ilmenite, primary zircon, zircon concentrate, titano-magnetite and HiTi88 Leucoxene) are expected to be consistently produced. Other minor mineral sands products may be produced at various stages of mine life. The products will be stored in individual product storage bins from which they will be fed to either a bagging plant on a batch or campaign basis as required, or transported and exported as a bulk product.

2.3.3 Process Waste Disposal

The ore from the project contains a relatively low proportion (approximately 16%) of slimes, which enables the use of normal mineral sands tailings management procedures.

Co-disposal has been selected as the disposal method for the recombined coarse and fine particle streams, and is a standard mineral sands tailings management procedure. Co-disposal will combine the waste clay and quartz sand tails from the WCP and MSP streams. If required, a portion of sand materials can be segregated out and dry stacked to reduce the volume of combined tailings.

Tailings will be disposed of in one of two ways; deposited within a TSF or returned as co-disposed tailings to form backfill into the mined out areas. As the orebody dips to the southwest; there is less overburden in the northeast of the deposit (the ore emerges to surface in some areas). At the commencement of operations, there will be insufficient space for simultaneous backfilling of waste, placement of overburden and direct return of topsoil and a TSF will be constructed to contain the initial tailings streams. The TSF will be retained and used as a landform for rehabilitation, providing an opportunity to refine rehabilitation procedures on co-disposed tailings. Once the mining area is large enough, standard mining operations and backfilling will be undertaken. Flocculants will be used to aid the settling of fine particles during tailings co-disposal.

More details about these waste disposal methods are provided in the following sections.

2.3.3.1 Tailings Storage Facility

During the first few years of operation, all tailings will be pumped as high density slurry (40%) into a purpose-built starter TSF. The initial TSF will be located on an area of approximately 106 ha immediately adjacent and to the east of the deposit. The TSF will be an unlined paddock-style structure with purpose-built embankments.

The proposed starter TSF will be located in an area of Pindan sands with rock located approximately 2m below the surface in the northwestern end, becoming deeper towards the south. The Pindan sands will be used to

construct perimeter embankment walls. Geotechnical advice has recommended that downstream batter slopes of 1:3 and upstream batter slopes 1:2.5 should be adopted for the preliminary design of embankment, subject to a more detailed analysis of stability. The detailed design will comply with the Code of Practice for Tailings Storage Facilities in Western Australia (DMP 2013) and ANCOLD Guidelines on Tailings Dam Planning, Design, Construction, Operation and Closure (ANCOLD 2012).

2.3.3.2 Co-disposal within Mining Area

In-pit tailings disposal is an efficient means of backfilling the mine void and provides for tailings storage over the majority of the life of mine. After the initial TSF has been filled to capacity, tailings are expected to be returned directly to mine areas and stored in a series of internal storage areas formed by bund walls to be constructed within the pit. The internal bund walls may be constructed from overburden material or consolidated processed materials to provide the necessary stability. The tailings are expected to be approximately 40% solids, with entrained water being either recycled back to the process or lost to seepage and evaporation. Tailings bleed water will be recycled into the process water supply and will significantly reduce the demand on make-up water from the borefield.

In-pit tailings disposal is an efficient means of backfilling the mine void and provides for tailings storage over the majority of the life of mine. Following a period of consolidation, overburden will be placed over the co-disposed tailings where required to bring the landform up to designed post-mine levels. Alternatively, overburden may be direct hauled as backfill into a mine void (to avoid stockpiling and double handling). In this case, tailings may be placed over partially filled areas to backfill to design levels. As with other mineral sands operations using fresh processing water, the co-disposed tailings are expected to represent a suitable rehabilitation substrate without the need for overburden cover. The initial TSF provides an opportunity to test this early in the mine life as part of rehabilitation trials (refer Section 9.1.4).

2.3.4 Water

Approximately 1 GL/yr of water will be required for construction activities at the Mine Site over the two year construction schedule. Project water requirements during steady-state operations will be up to 10.7 GL/yr.

Process water will be sourced from the water supply borefield and the mine dewatering borefield within the Mine Site Development Envelope. As mining is above the water table for the first 15 years, process water will initially be sourced largely from a water supply borefield located south of the mining area. A separate, dedicated bore will provide the potable water supply for the accommodation village.

Bores will generally be constructed to target the Broome Sandstone Aquifer. For the first 15 years, up to 15 bores will be required to achieve sufficient process water supply. The water supply will progressively incorporate near-pit dewatering bores as below-water table areas of the deposit are included in the mining schedule. In peak dewatering years (after Year 32), a number of individual bores may be required to maintain dry mining conditions. The dewatering borefield will be linked to other water infrastructure and the ore processing facility via a 12 m wide, 40 km long pipeline corridor. Polyethylene pipe will be up to ~650 mm nominal diameter.

Modelling predicts that mine dewatering will exceed project water demand from about year 32 onwards. Excess mine dewater will then be reinjected into the Broome Sandstone Aquifer downgradient of the Mine Site. Excess water will be pumped to a surface storage to buffer supply prior to transfer to the reinjection bores. Up to 15 reinjection bores will be constructed and connected to a water reticulation pipeline located next to the Site Access Road. Reinjection bores will be about 50–120 m deep, with screen intervals targeting the Broome Sandstone Aquifer.

The project area experiences distinct wet and dry seasons and sub-tropical downpours. This may result in significant quantities of water being captured within the active mine area during the wet season, particularly following cyclones. Excess water will be pumped from the active mine area via dedicated in-pit sumps to the Process Water Dam or other water holding facility to be reused in ore processing. This mine waste water will not be released to any local surface water drainages.

2.3.5 Project Traffic and Access

The Mine Site Development Envelope is located approximately 75 km west of Derby and 95 km northeast of Broome. It is accessed from the Great Northern Highway via the existing Mt Jowlaenga Road, which is an unsealed road. Parts of the existing road will be upgraded and new sections will be formed to provide safe, all-weather access to the Mine Site. The upgraded Site Access Road will be approximately 30 km long.

Bulk mineral product from the Mine Site will be loaded on to road trains and transported by road to Derby Port for export. Bulk product is expected to be transported using a fleet of quad road trains, each completing two trips per 12 hour shift.

Packaged mineral sands products (zircon concentrates and HiTi88) will be transported by road train to the Port of Broome for export as Derby Port facilities do not allow for efficient transfer of packaged materials to ocean-going vessels. Existing port facilities including storage sheds will be used for storage and export of packaged products. Bulk products will be loaded into bulka bags or containers at the Mine Site prior to road transport.

The transport route from the Mine Site to Derby Port is approximately 145 km long with approximately 6 km of the transport route located in residential or commercial areas of Derby, with the remaining 139 km located in unpopulated areas. The Great Northern Highway forms the longest portion of the transport route to Derby Port.

The transport route from the mine site to the Port of Broome is approximately 150 km long with approximately 12.5 km of the transport route using the dedicated heavy vehicle bypass route (Gubinge Road and Port Drive) to access the Port. The Great Northern Highway forms the longest portion of the transport route to the Port of Broome.

2.3.6 Other Ancillary Infrastructure and Services

Ancillary infrastructure and services to be associated with the project are:

- **Power Supply and Distribution:** a power plant will be constructed at the Mine Site to provide power for all mining and ore processing activities, and associated facilities. The power station will be 35 MW capacity and will utilise generators running on either gas or diesel/LNG. The power plant will be located southeast of the TSF and will include all necessary fuel facilities for its own supply. Gas and/or diesel will be delivered by truck to the Mine Site and no piping of gas to the project is required. A reticulated electrical system for the project will be based on 11 kV distribution and 415 V working voltage. Power line corridors will typically align roads and alongside established pipeline corridors to minimise land disturbance.
- **Fuel Facilities:** diesel fuel will be delivered to site in fuel tankers and stored in purpose-built self-bunded 100,000 L bulk storage tankers, with a total storage capacity of 600,000 L.
- **Maintenance Areas and Workshops:** for maintenance of heavy and light mining vehicles, and fabrication works. Associated facilities will include bulk diesel storage tanks, clean and waste oil storage tanks, and washdown bay with oily water / sediment treatment.
- **Accommodation Village:** will be constructed to support the long term operation of the project, including kitchen, dining room, wet mess, laundries, medical room, gym, office and parking areas. The village will be located approximately 3.5 km from the mine site and designed to accommodate up to 500 people at peak times such as during planned shut downs and maintenance. Due to the mine remoteness, the kitchen diner will be designed as a cyclone refuge for workers and rated to an importance level 4 building. The accommodation village access road will be used as a corridor for services including power, communications, water, and sewage.
- **Borrow Pits:** borrow material will be required for road construction, and will be sourced from borrow pits to the side of the proposed road and other construction areas.
- **Waste Water Treatment Plant:** two waste water treatment plants (WWTPs) will be required. One will service the accommodation village and the second will service the Mine Site facilities. Both will comprise package treatment systems with final effluent disposed by land irrigation.

- **Landfill:** a Class II landfill site will be constructed across the Site Access Road from the Initial TSF and will be managed in accordance with Department of Environmental Regulation (DER) Works Approval and Environmental Licence conditions. The design incorporates a costean/trench of approximately 40 m long by 10 m wide by 4 m deep. The design length of 40 m incorporates a ramp down into the trench where the waste can be place and then compacted prior to more waste being deposited.
- **Bioremediation Facility:** a bioremediation pad will be constructed adjacent to the landfill facility. The proposed bioremediation pad will be 0.25 ha in size (50 m by 50 m), and will be made up of two cells consisting of one active cell for immediate use and one inactive cell to be used for the process of bioremediation.
- **Other Buildings and Services:** including administration offices, communications services, laboratory, warehouse / stores building, medical room, and emergency response facilities.
- **Pipelines:** purpose-built pipelines will connect water and waste storages as required. Pipelines will be co-located in infrastructure corridors where possible, with appropriate access to enable regular inspections and maintenance.

2.3.7 Drainage Diversions

The Mine Site Development Envelope is on sandy soils with low runoff generation and no well defined watercourses within the main mine development areas. The nearest watercourses are minor tributaries of a branch of the Fraser River South tributary. The drainage line becomes more defined approximately 8 km downstream of the deposit and ore processing area, where it cuts through the 'Dampier Hill'. During extreme rainfall events some surface sheet flows may occur and will be managed to avoid concentration and erosion of the natural ground surface. The key surface drainage features that may be constructed are:

- **TSF Drain:** This will capture runoff from TSF embankments with water directed to a sump.
- **WCP Drain:** This will capture runoff from WCP areas with water directed to sumps.
- **MSP Drain:** This will capture runoff from MSP areas with water directed to sumps.
- **Pit Bund:** The location of the pit bund will move as the active mining areas changes over time. The pit bund will minimise surface water flow into the pit.

2.3.8 Disturbance and Landforms at Completion

The expected maximum disturbance footprint of major and ancillary built infrastructure is summarised in Table 2, with reference to Mining Rehabilitation Fund (MRF) categories, and shown on Figure 3.

Table 2: Infrastructure Disturbance by MRF Category at Closure

MRF Category	Includes	MRF Class	Footprint (ha)
Borefield	Bores for extraction and reinjection and associated, access tracks, power and pipelines	C	15
Borrow pit or shallow surface excavation < 5m	Borrow pits for access road construction material	C	5
Building (other than workshop) or camp site	Accommodation Village, Offices, Crib Rooms,	C	12
Dam - fresh water	Transfer and storage dam	B	4
Dam - saline water or process liquor	Process water dams	A	1

MRF Category	Includes	MRF Class	Footprint (ha)
Diversion channel or drain	Plant area drains, stormwater berm and sediment ponds	B	5
Fuel storage facility	Fuel storage facilities at processing plant area.	B	<1
Landfill	Landfill site (also used as borrow pit for plant construction)	B	9
Laydown or hardstand area	Laydown areas, process plant surrounds, parking areas, effluent irrigation area.	C	55
Mining void (with a depth of at least 5 metres) - below ground water level	Mineral deposit area (less than 200ha open at any time)	B	1631
Plant site	Mineral separation and wet concentrate plants, power station and associated infrastructure.	B	37
Sewage Ponds	Accommodation Village sewage treatment plant.	C	1
Tailings or residue storage facility (class 2)	Initial TSF	B	106
Topsoil stockpile	Topsoil stockpiles for infrastructure areas.	E	42
Transport or service infrastructure corridor	Access roads and powerline corridors other than borefield.	C	364
Workshop	Workshops.	B	1

The mineral deposit area will be progressively mined, backfilled and rehabilitated during operations. The only remaining landform at closure will be the initial TSF, as detailed in Table 3, and shown on Figure 3.

Table 3: Mining Landforms Disturbance by MRF Category at Closure

Landform	Footprint (ha)	MRF Category	MRF Class
TSF	106	Tailings storage facility class 2	B

3. IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

3.1 OVERVIEW

DMP is the lead regulator and decision-making authority for mining projects in Western Australia under the *Mining Act*, and has particular responsibility for mine closure. However where mining projects are of a scale or nature that is considered “significant”, they are referred to the EPA for assessment under Part IV of the *EP Act*, in accordance with a Memorandum of Understanding (MoU) between the two agencies.

A brief summary of the principal relevant instruments and legislation, and current or expected obligations for closure of the project, is provided in the sections below. A register of obligations relevant to project closure will be incorporated into future revisions of this MCP, once all regulatory approvals have been obtained.

3.2 NATIVE TITLE MINING AGREEMENT

The mining lease is located within the Mt Jowlaenga Polygon #2 (Native Title Claim WC2014/005 registered on 15/12/2014) and the southern parts of the Site Access Road are located within the Nyikina Mangala Consent Determination Area (National Native Title Tribunal Reference Number WCD2014/003).

Sheffield is seeking an agreement with the Mt Jowlaenga Polygon #2 Claimant Group to facilitate granting of M04/459. This agreement provides for the Claimant Group’s input into cultural awareness programs, cultural and environmental management and monitoring, as well as for employment and contracting opportunities in addition to upfront and production-based payments. Sheffield has also consulted with Native Title parties and Traditional Owners whose interests may be affected by the Miscellaneous Licences covering the Site Access Road.

3.3 PER COMMITMENTS AND MINISTERIAL CONDITIONS

The project was referred to the EPA by the proponent on 20 November 2015. On 21 December 2015, the level of assessment was set as PER with a four week public review period. The PER incorporates commitments and measures to protect the environment, including commitments to mine closure and rehabilitation.

If the project is approved under Part IV of the EP Act, Ministerial Conditions will likely be applied to the approval.

3.4 TENEMENT CONDITIONS

Tenements for the project are issued under the *Mining Act*, subject to conditions administered by the DMP Minerals Environment Branch. Conditions relevant to closure are typical of tenements granted in Western Australia, and broadly incorporate obligations to:

- Cap, fill, or otherwise make safe all exploration drillholes immediately after completion.
- Rehabilitate exploration disturbances within six months of completing the exploration program, except where otherwise authorised by DMP.
- Remove topsoil ahead of construction or mining, and stockpile it.
- Except where otherwise authorised by DMP, at the completion of operations or progressively where possible:
 - Replace stockpiled topsoil.
 - Remove all wastes, equipment, structures, and installations.

- Cover all wells and holes in the ground to a degree of safety approved by DMP.
- Plant trees, shrubs or other plants on areas cleared of natural vegetation, to conform to the general pattern and type of natural vegetation in the area as directed by DMP, and maintain these areas until DMP advises that regrowth is self-supporting.

Sheffield expects that at project approval, DMP will also place conditions on the tenements requiring an AER to be submitted each year, detailing the extent of disturbance and rehabilitation (if any) on the tenements and progress on closure planning. Disturbance and rehabilitation on the project tenements will also be subject to reporting and payment of contributions under the MRF (Section 3.7).

3.5 MINES SAFETY AND INSPECTION ACT

The *Mines Safety and Inspection Act 1994 (MSIA)* and *Regulations 1995 (MSIR)*, administered by the DMP Resources Safety Branch, regulate mine worker and public safety at minesites, not only during construction and normal operations, but also during any suspension of operations, decommissioning and rehabilitation works, and following mine abandonment. While safety on mines is primarily regulated under the *MSIR*, operations are also subject to the broader *Occupational Health and Safety Regulations 1996 (OHSR)*.

Under *MSIA* s42, *MSIR* r3.14, and *MSIR* r3.16, Sheffield will be required to notify DMP of any intention to suspend or abandon operations at Thunderbird. Sheffield must also prepare and submit a plan addressing how the site will be:

- Cared for and maintained during any period of suspension.
- Kept safe for any remaining workers, through maintenance of emergency and other services.
- Made safe for the public, by preventing unauthorised or inadvertent access to hazardous areas, preventing post-mining subsidence, and removing hazardous plant, equipment, and materials.

Suspension (care and maintenance) and unplanned closure are addressed in Section 9.

3.6 MINING PROPOSAL COMMITMENTS

The project tenements require that a plan of proposed operations and measures to safeguard the environment, in the form of a Mining Proposal, is authorised by DMP before any development or operation begin. On approval, conformance to the measures set out in the Mining Proposal becomes a tenement condition. Since 2010, the *Mining Act* has required that Mining Proposals are accompanied by a MCP (this document), to address measures related to closure and rehabilitation.

While the details of closure and rehabilitation measures are left to the MCP, the Mining Proposals incorporates several broad commitments related to closure and aligned with the MCP.

3.7 MINE REHABILITATION FUND

The *Mining Rehabilitation Fund Act 2012* was passed to replace the system of bonds previously used in Western Australia, and requires tenement holders to report current areas of exploration and mining disturbance every year to the MRF, administered by DMP. DMP then invoices the tenement holder for a contribution to the MRF, based on rates set by the *Mining Rehabilitation Fund Regulations 2013*, reflecting expected typical closure costs for different types of disturbance (DMP 2013).

Disturbances on which rehabilitation works have been completed, and completion criteria have been met, attract a much lower contribution rate, providing an incentive for early or progressive rehabilitation. Once verified by DMP, such areas require no further contribution. Sheffield acknowledges that DMP reserves the right to request bonds

for sites considered high risk, for instance due to a poor history of compliance or inadequate progress on mine closure.

3.8 WORKS APPROVALS, LICENCES AND CLEARING PERMITS

Sheffield will apply for a Works Approval and Environmental Licence to construct and operate infrastructure prescribed under Part V of the *EP Act*; which is administered by the Department of Environmental Regulation (DER). Such instruments however only regulate the construction and operation of infrastructure with regard to the prevention or control of discharges with the potential to cause pollution, and do not usually include specific conditions for closure.

Monitoring data typically required by operating licences may be relevant to closure. Part V also allows DER to issue a “closure notice” requiring ongoing management and monitoring of a licenced premises, even after operations cease and the licence is relinquished, if it believes that there are still hazards to human health or the environment from past activities permitted under the licence.

Clearing Permits issued under Part V to permit disturbance of native vegetation typically set conditions for revegetation when the disturbed land is no longer required for the intended purpose, however as clearing for the project will be assessed, and any revegetation conditions set, under Part IV of the *EP Act*, no Clearing Permits will be required for the proposed project.

3.9 CONTAMINATED SITES ACT

Sheffield is obliged to report any known or suspected contamination on its tenements that may present a material hazard to human health or the environment, as defined by the *Contaminated Sites Act 2003 (Contaminated Sites Act)*, to DER. DER may then require Sheffield to investigate the contamination, and depending on the outcome of the investigation, remediate it.

If contamination does not present an immediate threat, remediation may often be left until closure, subject to consultation with DER. Liability for any contamination under the *Contaminated Sites Act* is separate to obligations under the *Mining Act*, and can remain even after the site is relinquished and tenements extinguished.

The Thunderbird site is “greenfield” and existing contamination is unlikely. However, several aspects of project construction and operation have potential to create liabilities under the *Contaminated Sites Act* if not properly managed; these include spills of fuels, other hydrocarbons, reagents, process solutions, and dust from the TSF. Sheffield will manage these aspects during construction and operations through measures to prevent contamination such as standard work procedures, maintenance, spill reporting and cleanup, and monitoring.

3.10 GROUNDWATER LICENCES

Ground Water Licences (GWL) are issued under the *Rights in Water and Irrigation Act 1914 (RIWI Act)* and administered by the Department of Water (DoW).

No obligations directly related to closure and rehabilitation are typically imposed by such licences or permits, however Sheffield is required to notify DoW of any significant changes to the approved project water scheme, including decommissioning or transfer of water supply bores or related infrastructure at closure, or changes to tenure or ownership. DoW has adopted national standards for the decommissioning of water bores (NUDC 2012).

Water abstraction and use under the licence will be managed and monitored according to an approved Groundwater Operating Strategy to assure that environmental values including vegetation, subterranean fauna, and features of cultural significance are appropriately protected from the impacts of abstraction. Monitoring will

incorporate abstraction volumes, levels and quality at the mine and borefields, and while this is primarily for operational purposes, the data collected will be relevant to closure.

3.11 CORPORATIONS ACT AND AUSTRALIAN SECURITIES EXCHANGE RULES

Sheffield, as a company registered in Australia and regulated under the *Corporations Act 2001* (Cth) (*Corporations Act*), is required to maintain accounts and prepare financial statements in accordance with the standards set by the Australian Accounting Standards Board (AASB). These standards require liabilities of uncertain timing or amount to be treated in the company's financial statement as "provisions"; and such liabilities are typically taken to include decommissioning and rehabilitation obligations. The *Corporations Act* is administered by the Australian Securities and Investments Commission. Provisions for closure obligations are discussed in Section 11. Sheffield will adopt relevant aspects of the International Financial Reporting Standards for mine closure costs, where consistent with AASB standards.

In addition, as a public company limited by shares and listed on the ASX, Sheffield is bound by periodic disclosure rules, including quarterly, half-yearly and annual reports to the market with financial statements listing all significant assets and liabilities according to AASB standards, as well as continuous reporting rules for changes in circumstance with a material effect on the expected value of the company; such circumstances may include suspension of operations, changes to the expected life of mine, or early closure. Should Sheffield raise additional capital through further issue of securities, prospectuses released to the market will disclose and explain current and potential closure liabilities.

3.12 OTHER INSTRUMENTS AND LEGISLATION

Other instruments or legislation with a bearing on the closure of the project will include:

- *Land Administration Act 1997*, administered by the Department of Lands, and governing overall land tenure and access in Western Australia, including the management or transfer of Pastoral Leases. Proposed amendments to this Act may present opportunities for alternative post-closure land uses; however these amendments have yet to be passed in their current form.
- *Aboriginal Heritage Act 1972*, administered by the Department of Aboriginal Affairs for the protection of sites, places and artefacts of significance to Aboriginal culture in Western Australia. Surveys to date indicate that no known Aboriginal sites of significance will be disturbed by the proposed project; however Sheffield is required to report and take steps to protect any sites that come to light in the course of project construction, operation, or closure.

Sheffield will monitor changes in relevant legislation, and incorporate any new or changed obligations with a substantial bearing on closure into the obligations register and this MCP.

3.13 VOLUNTARY STANDARDS

3.13.1 Strategic Framework for Mine Closure

Sheffield intends to adopt as far as practicable the principles for mine closure as set out in the *Strategic Framework for Mine Closure* (ANZMEC/MCE 2000) and recognised by DMP in the MCP guidelines. These broad principles state that closed mines should be left:

- *Safe*, with no substantial public risk remaining.
- *Stable*, with mining landforms resistant to mass movement like landslips, and surface erosion reduced to a practicable minimum.

- *Non-polluting*, with sources of pollution like metalliferous tailings or acid-forming waste rock appropriately contained.
- *Empathetic to the surrounding landscape*, with post-mining landforms blending in with the natural landscape.

In addition, the principles state that post-mining landforms should be *economic to construct* and *require minimal ongoing maintenance*, reducing closure costs while meeting regulatory obligations and standards.

Sheffield will consider these principles in setting closure objectives and developing completion criteria for the project.

3.13.2 Sheffield Human Resources Policies

Sheffield will develop human resources policies for the project, including policies to address the suspension or closure of the operations and mitigate the impact on its workforce. Sheffield will as far as is practicable and reasonable:

- Keep project workers informed of any potential decision to suspend or close the operations before the expected end of the life of mine, and any changes to the expected life of mine schedule.
- Retain mine workers for decommissioning and rehabilitation works, although it is recognised that many may chose to leave for longer-term employment once the decision to close has been announced.
- Provide counselling, support and advice where appropriate on job-seeking, re-training and financial management.
- Advise workers on their rights and benefits payable under relevant employment legislation, contracts of employment, and Sheffield policies.
- Minimise environmental impacts and ensure disturbed areas are rehabilitated in accordance with site specific plans, permits and regulations.

4. STAKEHOLDER ENGAGEMENT

4.1 PRINCIPLES

Sheffield has been proactive with its stakeholder consultation since establishment of the project. Consultation has involved all parties holding a significant stake in the closure and rehabilitation of the project, so that these stakeholders are properly informed, and their concerns and interests properly addressed from as early as possible in the mine closure planning process. Sheffield will maintain a list of stakeholders that will be periodically reviewed, to ensure that all relevant parties have been identified, and will consider all reasonable requests from other parties that declare an interest and ask to be consulted on matters related to the closure of the project.

Stakeholder consultation for the proposal commenced in 2014 when Sheffield introduced the project to the Traditional Owner groups. This consultation continued and developed throughout the exploration phase of the project and will form an integral part of the project's closure.

Details of the stakeholder consultation process are provided below, including consultation objectives, identification of key stakeholders, consultation held to date, and ongoing consultation

4.2 PRINCIPAL STAKEHOLDERS

The principal stakeholders identified to date, their main interests and concerns, and the primary means of engagement or communication are summarised in Table 4 and discussed in the following sections. In addition to the primary and formal means of engagement, Sheffield may engage with stakeholders on closure issues through special meetings or workshops, and other forms of correspondence.

Table 4: Principal Stakeholders and Engagement

Stakeholder	Main Interests or Concerns	Primary Means of Engagement
Nyikina Mangala People Yawuru People	<ul style="list-style-type: none"> Compliance with NTMA. Protection of sites or features of heritage significance. Visual impact of post-mining landforms. Post closure land use and management. Employment, financial and other benefits to local community. 	<ul style="list-style-type: none"> Provision of draft approval documents for review and comment, including MCP. Involvement in environmental monitoring programs. Consultation and engagement in seed selection and collection for rehabilitation.
EPA	<ul style="list-style-type: none"> Conservation of biological diversity and ecological integrity. Ecologically sustainable construction, operation, decommissioning and rehabilitation of minerals operations. Protection of species, communities and landforms of conservation significance. 	<ul style="list-style-type: none"> Referral under <i>EP Act</i> Part IV. Submission of PER for assessment under <i>EP Act</i> Part IV. Submission of MCP under Ministerial Conditions, if required. Reporting under Ministerial Conditions, if required.

Stakeholder	Main Interests or Concerns	Primary Means of Engagement
DMP	<ul style="list-style-type: none"> • Compliance with <i>Mining Act</i> and tenement conditions. • Conformance to MCP and Mining Proposals. • Rehabilitation standards and closure criteria. • Payment of MRF contributions. • Relinquishment of tenements. • Compliance with <i>MSIA</i> and <i>MSIR</i>. • Protection of mine worker health and safety during suspensions, decommissioning and rehabilitation. • Protection of public safety during suspensions and after closure. • Maintaining records of closed mine workings for safety of future mining operations. 	<ul style="list-style-type: none"> • Submission of Mining Proposals and MCP for assessment under <i>Mining Act</i>. • Annual reporting of closure planning and rehabilitation under tenement conditions. • Submission of triennial and other updates of MCP for review under tenement conditions. • Annual submission of disturbed and rehabilitated areas under MRF. • Annual inspections and related correspondence. • Submission of mines safety notices under <i>MSIR</i> including commencement, suspension, recommencement and closure, mine plans, and related information. • Submission of project management plan (PMP) and subsequent updates addressing suspension, decommissioning and rehabilitation. • Annual inspections and related correspondence. • Incident, exposure and health reporting under <i>MSIR</i>.
DoW	<ul style="list-style-type: none"> • Compliance with <i>RIWI Act</i>. • Sustainability of abstraction and management of drawdown impacts during operations. • Recovery of groundwater systems at mine and borefield after closure. • Impacts on groundwater resources from pit lake and mine waste landforms. • Restoration of surface water flows after closure. • Decommissioning or handover of bores. 	<ul style="list-style-type: none"> • Application for groundwater licences under <i>RIWI Act</i>, and submission of supporting Groundwater Operating Strategy. • Annual groundwater monitoring reports under groundwater licence conditions. • Invitation to comment on MCP and any related groundwater modelling. • Invitation to comment on post-closure groundwater monitoring. • Bore decommissioning reports and/or applications to transfer licence.
DER	<ul style="list-style-type: none"> • Compliance with <i>EP Act</i> Part V, and Works Approval and Prescribed Premises Licence conditions (primarily operational). • Prevention, monitoring and remediation of pollution. • Compliance with <i>Contaminated Sites Act</i>. • Reporting, investigation, remediation and validation of contaminated sites. • Maintenance of contaminated sites records. 	<ul style="list-style-type: none"> • Submission of Works Approval and Licence applications. • Annual reporting of pollution monitoring and compliance under licence conditions. • Contingency notification of major spills and clean-up. • Submission of contaminated sites notices and investigation reports under <i>Contaminated Sites Act</i>, if required. • Submission of remediation and validation reports under <i>Contaminated Sites Act</i>, if required.

Stakeholder	Main Interests or Concerns	Primary Means of Engagement
DPaW	<ul style="list-style-type: none"> Visual amenity and tourism, in particular at Yeo Lake campsite. 	<ul style="list-style-type: none"> Invitation to comment on MCP.
GSWA	<ul style="list-style-type: none"> Maintenance of geological records for future explorers/ miners. 	<ul style="list-style-type: none"> Submission of geological data and resource sterilisation reports.
Department of Lands	<ul style="list-style-type: none"> Transfer of assets, infrastructure and tenure. 	<ul style="list-style-type: none"> Invitation to comment on final MCP. Other correspondence as required.
Workforce	<ul style="list-style-type: none"> Employment and preservation of benefits. Transition to other operations or roles at closure. 	<ul style="list-style-type: none"> Company newsletters. Meetings with workforce representatives.
Shire of Broome, Derby and West Kimberly	<ul style="list-style-type: none"> Benefits to local economy and community. Safety of locals and passers-by during suspensions and after closure. Payment of rates. Visual amenity and tourism. 	<ul style="list-style-type: none"> Invitation to comment on MCP and AERs. Notification of planned or unplanned suspension or closure.
Security Holders	<ul style="list-style-type: none"> Effect of closure obligations on company balance sheet and cashflow. Company image and reputation. Outstanding environmental, social and legal liabilities. 	<ul style="list-style-type: none"> Submission of feasibility studies to lenders, including details of expected closure liabilities and impact on net present value (NPV) and cashflow over life of project. Release of prospectuses to market for capital or debt raisings, including details of expected closure liabilities. Periodic and continuous disclosure to market under ASX rules, including itemisation and explanation of closure provisions.
Pastoral and Land Owners	<ul style="list-style-type: none"> Land management (weeds, feral animals, fire). Air and noise emissions at Mine Site. Interaction with pastoral activities. Post mining land use. 	<ul style="list-style-type: none"> Invitation to comment on MCP and AERs. Notification of planned or unplanned suspension or closure. Other correspondence as required.
NGO's	<ul style="list-style-type: none"> Interest in impacts to flora and fauna, particularly species of conservation significance such as Bilby. Radiation safety. Water abstraction and use and impacts on wetlands. National heritage values. Noise issues associated with product transport. Impacts on marine environment due to product export. Post mining land use and rehabilitation. Visual amenity of Mine Site area. Impacts on ecotourism ventures. 	<ul style="list-style-type: none"> Invitation to comment on MCP and AERs. Notification of planned or unplanned suspension or closure. Other correspondence as required.

Stakeholder	Main Interests or Concerns	Primary Means of Engagement
Local Business	<ul style="list-style-type: none"> Impacts on ecotourism ventures. Contracts and business opportunities 	<ul style="list-style-type: none"> Notification of planned or unplanned suspension or closure. Other correspondence as required.

A summary of ongoing stakeholder consultation to be undertaken by Sheffield is provided in Table 5.

Table 5: Proposed Ongoing Stakeholder Consultation

Stakeholder	Consultation Requirements
Mt Jowlaenga No.2 Claim Groups	Regular consultation during project feasibility, construction, operation and closure phases.
Nyikina Mangala People	Consultation during project feasibility and construction, operation phases.
Kimberley Traditional Owners	Ongoing consultation during construction, operation phases regarding business and employment opportunities.
West Kimberley community	Ongoing consultation during construction, operation phases regarding business and employment opportunities.
DPaW	Report as required during construction, operation and closure.
EPA	Report during construction, operation and closure as required by licence conditions and legislation.
DMP	Regular reporting during construction, operation and closure as required by licence conditions and legislation.
DoW	Regular reporting during construction, operation and closure as required by licence conditions and legislation.
Shire of Derby-West Kimberley	Communicate as required regarding activities on Shire of Derby/West Kimberley land.
Shire of Derby/West Kimberley Port	Communicate as required regarding activities on Shire of Derby/West Kimberley Port land.
MRWA	Construction of intersection with Great Northern Highway.

4.3 ENGAGEMENT TO DATE

4.3.1 Overview

To date, engagement and consultation on closure planning has been part of the broader approvals process and there has been relatively little specific consultation on closure, as at this stage of the project it is assumed that mine closure planning will be addressed in keeping with relevant regulations, guidelines, and industry conventions. Stakeholder consultation to date is summarised below. As the project matures, Sheffield will undertake progressively more specific consultation on closure issues.

Under the State “Lead Agency Framework”, DMP is the lead agency responsible for coordinating approvals for mining projects such as Thunderbird, where multiple agencies may be involved. Thunderbird has been classified as a “Level 2” project under the framework, i.e., a moderate to large-scale or complex proposal with substantial capital investment and likely to provide a significant number of jobs over a long period of time. DMP has assigned a case officer to the project, and will be responsible for assisting with project scoping, approval planning, inter-agency coordination, monitoring the progress of approvals and assisting with any problems that may hinder progress.

4.3.2 Native Title Holders and Traditional Owners

As discussed under Section 3.2, the mining lease is located within the Mt Jowlaenga Polygon #2 (Native Title Claim WC2014/005 registered on 15/12/2014) and the southern parts of the Site Access Road are located within the Nyikina Mangala Consent Determination Area (National Native Title Tribunal Reference Number WCD2014/003).

Sheffield is seeking an agreement with the Mt Jowlaenga Polygon #2 Claimant Group to facilitate granting of M04/459. This agreement provides for the Claimant Group's input into cultural awareness programs, cultural and environmental management and monitoring, as well as for employment and contracting opportunities in addition to upfront and production-based payments. Sheffield has also consulted with Native Title parties and Traditional Owners whose interests may be affected by the Miscellaneous Licences covering the Site Access Road.

4.3.3 Environmental Protection Authority

Engagement and consultation between Sheffield and the EPA including the Office of the EPA (OEPA) to date has broadly involved:

- Pre-referral meetings to provide an overview of the proposed project and identify potential key environmental factors.
- Identifying the likely level of assessment and information required for referral under Part IV.
- Submitting draft, final and revised Environmental Scoping Documents for review and determination of level of assessment and key environmental factors to be addressed in submissions.
- Discussing specific environmental factors as identified in the Environmental Scoping Documents.

4.3.4 DMP Environmental Minerals Branch

Engagement and consultation between Sheffield and DMP to date has broadly involved:

- Confirming DMP as the lead agency for project approvals.
- Identifying an appropriate approvals framework, pathway and timeframe for the proposed project.
- Discussion of studies completed to date.
- Scoping significant issues to be addressed in studies and submissions for approval.

Consultation with DMP to date has focussed on the construction and operation of the project, with no specific issues related to closure raised; the current MCP guidelines are expected to provide adequate guidance for this level of MCP, and substantial consultation on closure will effectively begin with submission of this MCP for review.

4.3.5 Department of Water

Engagement and consultation between Sheffield and DoW to date has broadly involved:

- Applications for "26D" Licences to Construct or Alter Wells for installing existing water supply bores, water exploration bores, test pumping bores, and monitoring bores for hydrogeological assessment.

4.3.6 Other Stakeholders

Other stakeholders or potential stakeholders engaged or consulted by Sheffield to date include:

- DER – Industry Regulation: including a briefing on the proposed project with a view to identifying Works Approval and Licensing requirements and supporting information under Part V of the *EP Act*.

- Shire of Derby/West Kimberly: including invitation to comment on the proposed project, identification of Shire approvals required, and consultation on the use of or changes to public roads.
- Shire of Broome: including invitation to comment on the proposed project, identification of Shire approvals required, and consultation on the use of or changes to public roads.
- Department of Parks and Wildlife (DPaW) and Western Australian Museum: including applications for licences to take fauna for subterranean fauna surveys, and consultation on surveys for short range endemics (SREs).
- Main Roads: Utilisation of the road network to transport product to the Derby Port.

5. POST MINING LAND USE AND CLOSURE OBJECTIVES

5.1 POST MINING LAND USE

The project, located as it is within the Mt Jowlaenga Pastoral Lease, is expected to be returned to a pastoral post-mining land use. The aim will be, to as best possible, return the land to a condition similar to that surrounding the project at the time of closure. Other uses may be determined through stakeholder engagement particularly with the pastoral lease holder and Traditional Owners.

5.2 CLOSURE OBJECTIVES

The broad closure objective for the project, in line with the Australian and New Zealand Minerals and Energy Council (ANZMEC) / Minerals Council of Australia (MCA) principles will be to close the project in a cost-effective and efficient manner, and leave the site safe, stable, non-polluting, and capable of supporting the agreed post-closure land use, in a cost-effective and efficient manner. Sheffield intends to pursue closure outcomes that provide the greatest net benefit to all stakeholders and commensurate with the value of the land for agreed post-closure uses.

More specific objectives are to:

- Incorporate the concerns and interests of all relevant stakeholders into mine closure planning.
- Meet all legal obligations for mine closure; or where appropriate agree alternatives through stakeholder consultation.
- Ensure that adequate financial provision is in place for all current closure liabilities.
- Minimise the cost of meeting closure objectives through effective planning and management.
- Protect the health and safety of mine workers during suspensions of operations, decommissioning and rehabilitation.
- Protect public safety and livestock during suspensions, and leave the site free of hazards to the public or livestock after closure.
- Leave mine waste landforms, notably the TSF and mineral deposit area, acceptably stable and resistant to erosion, so that any runoff will not materially affect surface waters, vegetation, habitat, or heritage sites.
- Ensure that any seepage from the mine waste landform will not materially affect groundwater resources, vegetation or habitat.
- Reinstate natural surface water flows as far as practicable.
- Confirm that any significant impacts of water abstraction will attenuate over time.
- Rehabilitate disturbed areas to support, as far as practicable, self-sustaining vegetation and habitats similar to surrounding areas.
- Minimise the visual impact of post-mining landforms.
- Relinquish the site with no outstanding legal or social liability.

6. DEVELOPMENT OF COMPLETION CRITERIA

6.1 PRINCIPLES

Completion criteria are the basis for determining whether closure objectives have been met, or are likely to be met. Sheffield will adopt the DMP/EPA (2015) and ANZMEC/MCA (2000) principles for development of completion criteria, which state that such criteria, should be:

- Developed in consultation with key stakeholders.
- Specific enough to address the unique environmental, social and economic circumstances of each site.
- Achievable and realistic.
- Relevant to the closure objectives.
- Based on performance indicators that allow trends to be identified.
- Flexible enough to adapt to changing circumstances, while still meeting agreed objectives.
- Measured over appropriate timeframes and, where necessary, projected over a long term.
- Subject to periodic review, and where appropriate modified in light of improved knowledge, or changed circumstance.
- Developed from the commencement of project planning, and refined over the life of the project.

6.2 INTERIM CRITERIA

Interim completion criteria to address closure objectives for the project are summarised in Table 6. As the project is, at the time of this revision, still at a planning stage, the criteria are considered indicative. Where detailed criteria have not been established, reference is made to broad standards for guidance. As further information becomes available, these criteria will be refined in later revisions of this MCP.

Table 6: Interim Closure Criteria

Objective / Completion Criteria	Standards or Targets (Interim)	Measurement Tools / Evidence
Incorporate the concerns and interests of all relevant stakeholders into mine closure planning		
All relevant and significant stakeholders identified, and all consultation obligations and commitments met.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans). Native Title Mining Agreement (NTMA) consultation obligations.	Stakeholder register. Obligations register. Stakeholder consultation register.
Meet all legal obligations for mine closure, or where appropriate; agree alternatives through stakeholder consultation		
All closure obligations and commitments complied with, or alternatives negotiated.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans).	Obligations register. Internal compliance inspections. Regulatory compliance inspections (DMP, EPA). Stakeholder consultation register.
Ensure that adequate financial provision is in place for all current closure liabilities		
Current closure provision addresses all current obligations and associated costs, including studies and monitoring, and includes appropriate risk provisions.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans).	Obligations register. Closure task register. Closure cost model. Competent persons' assurance review. External audit assurance.
Current closure provision reviewed at least every two years and as required in light of changes of circumstances; updated provisions disclosed and explained in financial statements.	ANZMEC/MCA 2000 (Framework for Mine Closure). Corporations Act / AASB 137. ASX Listing Rules.	Updated closure cost model. Periodic and special reports to ASX.
Expected accuracy of closure cost forecasts improves over life of operations towards $\pm 15\%$ within two years of closure.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans).	Independent review of closure cost model by competent closure cost estimator.
Minimise the cost of meeting closure objectives through effective planning and management		

Objective / Completion Criteria	Standards or Targets (Interim)	Measurement Tools / Evidence
Agreements in place to transfer assets and infrastructure to third parties as far as practicable by time of closure.	Site-specific targets to be determined.	Asset register. Stakeholder consultation register. Legal agreements and associated schedules. Permit / title transfer confirmations.
All economically salvageable / recyclable parts and materials taken from site at or before closure rather than disposed of.	Site-specific targets to be determined.	Asset register Auctioneers / valuer's assessments. Expressions of interest.
All rehabilitation works completed to specification.	Site-specific targets to be determined.	Surveyor's interim and final reports. "Punch lists" for completion of works and signoff.
All decommissioning works completed to specification.	Site-specific targets to be determined.	Final closure task register. Surveyor's interim and final reports. "Punch lists" for completion of works and signoff.
Protect mine worker health and safety during suspension, decommissioning and rehabilitation		
No lost-time injuries, high-potential incidents, or significant exposures during suspensions, decommissioning or rehabilitation.	MSIR & OSHR. Various DMP-RSB / Worksafe WA guidelines.	Hazard and incident reports. Industrial hygiene and health monitoring records.
No non-compliances with relevant occupational / mining health and safety regulations and standards, suspensions, decommissioning or rehabilitation.	MSIR & OHSR. Various DMP-RSB / Worksafe WA guidelines.	Internal OHS compliance inspections. Regulatory OHS compliance inspections (DMP)
Protect public safety and livestock during suspensions, and leave the site free of hazards to the public or livestock after closure		
All unused fixed and mobile plant made safe / isolated/ immobilised during suspensions; access to hazardous areas prevented with temporary fences or bunds; warning signs in place	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans). AS/NZS 1319 (Safety signs).	Mine plans. Electrical plans. Asset register. Care and maintenance inspections.

Objective / Completion Criteria	Standards or Targets (Interim)	Measurement Tools / Evidence
All unused structures demolished or made safe, all hazardous materials removed or made safe; all slopes pushed down to safe angle at closure.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans).	Mine plans. Electrical plans. Asset register. Hazardous materials register. Contaminated site register and reports. Post-closure inspections.

Objective / Completion Criteria	Standards or Targets (Interim)	Measurement Tools / Evidence
Leave waste landforms stable and resistant to erosion, and ensure that any runoff will not materially affect surface waters, vegetation, habitat or heritage sites		
Rates and extent of erosion and deposition from TSF expected to remain at or below acceptable threshold over long term.	Site-specific targets to be determined.	Stakeholder consultation register. Pre-closure landform monitoring. Studies, models and trials. Ecological risk assessment of sediment impacts. Final landform designs and earthworks contracts. As-built earthworks survey and acceptance. Post-closure landform monitoring.
Rates and extent of slumping, slipping, or deflation on TSF to remain at or below acceptable threshold over long term	DMP 2013b (Code of practice for TSFs). Other site-specific targets to be determined.	Stakeholder consultation register Pre-closure landform monitoring. Studies, models and trials. Final landform designs and earthworks contracts. As-built earthworks survey and acceptance. Post-closure landform monitoring.
Ensure that seepage from the TSF and in-pit tailings disposal will not materially affect groundwater resources, vegetation or habitat		
Rate, extent and quality of seepage from TSF and in-pit tailings disposal expected to remain at or below acceptable threshold over long term; any operational impacts attenuating.	Site-specific targets to be determined.	Pre-closure groundwater monitoring. Studies, models and trials. Post-closure groundwater monitoring. Stakeholder consultation register.
Reinstate natural surface water flows and drainage lines as far as practicable		
Site drainage post-closure prevents artificial flooding and restores flows to downstream environment to an acceptable extent.	Site-specific targets to be determined.	Post-closure drainage design. Stakeholder consultation register.
Confirm that any significant impacts of water abstraction or re-injection will attenuate over time		
Aquifer shows trend to recovery where any significant impacts to ecological or heritage values have been identified and remain at closure.	Site-specific targets to be determined.	Pre-closure groundwater and vegetation monitoring. Groundwater modelling. Post-closure groundwater and vegetation monitoring

Objective / Completion Criteria	Standards or Targets (Interim)	Measurement Tools / Evidence
Rehabilitate disturbed areas to support, as far as practicable, self-sustaining vegetation and habitats similar to surrounding undisturbed areas		
Revegetation over mineral deposit area has acceptable density, variety and structure of native species; expected to be self-sustaining over long term.	Site-specific targets to be determined.	Studies and trials. Post-closure revegetation monitoring. Stakeholder consultation register.
Revegetation on other disturbed areas supports density, variety and structure of native species similar to surrounding areas; expected to be self-sustaining over long term.	Site-specific targets to be determined.	Studies and trials. Post-closure revegetation monitoring. Stakeholder consultation register.
Minimise the visual impact of post-mining landforms		
Revegetation on TSF embankments reduces visual impact of landforms to an acceptable extent.	Site-specific targets to be determined.	Studies and trials. Post-closure revegetation monitoring. Stakeholder consultation register.
Relinquish the site with no outstanding legal or social liability		
All assets and infrastructure removed and adequately rehabilitated except where transferred to third party.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans). DMP 2015 (Annual Environmental Reports). DMP 2013 (Mining Rehabilitation Fund).	Stakeholder consultation register. Annual Environmental Reports. MRF reports and audits. DMP post-closure verification inspections.
Legally binding agreements in place to re-assign all liability for any assets or infrastructure transferred to third party.	ANZMEC/MCA 2000 (Framework for Mine Closure). DMP/EPA 2015 (Mine Closure Plans).	Stakeholder consultation register. Legal agreements and associated schedules for transfer. Permit / title transfer confirmations.
All contaminated sites remediated to extent required by expected final land use; certified under Contaminated Sites Act.	DER Contaminated Sites guidelines.	Records of operational spills and clean-up. Contaminated sites investigations and reports. Ecological risk assessments, where required.

7. COLLECTION AND ANALYSIS OF CLOSURE DATA

7.1 BACKGROUND

In support of regulatory approvals for the project, a number of environmental studies have been undertaken over the project area, including soil and landform characterisations, flora and fauna (including subterranean fauna and short range endemic fauna) surveys, mine waste and tailings characterisations, and Aboriginal heritage surveys. These studies are listed and described in detail in the project PER document and Mining Proposals, and discussed with regard to closure planning in the following sections.

7.2 REGIONAL SETTING

The Mine Site Development Envelope is located on the Dampier Peninsula in the western part of the Kimberley region, within the Dampierland bioregion and Pindanland subregion as defined by the Interim Biogeographic Regionalisation of Australia classification system (Graham 2001). The Pindanland subregion (5,198,904 ha) is described as a fine-textured sand-sheet with subdued dunes, comprised of the sandplains of the Dampier Peninsula and western part of Dampierland, including the Fitzroy River paleodelta. The climate is semi-arid and vegetation is primarily described as Pindan. Broad scale vegetation mapping of the Pindanland subregion describes the following components:

- Mangroves around coastal areas.
- Coastal dune communities.
- Ephemeral herblands and/or grasslands with scattered low trees.
- Mixed species tussock grasslands or sedgelands.
- Various Eucalypt and Melaleuca woodlands.

The topography largely consists of flat, sandy plains with some small rock hills approximately 50 m high. The rocky hills are confined to an area of approximately 3 km² between the proposed operations and accommodation village areas. The gradient of the plains is flattest to the west of the Mine Site Development Envelope (averaging approximately 0.75%) tending to increase to approximately 1% to the east (MBS 2016a).

7.3 CLIMATE

7.3.1 Temperature, Evaporation and Humidity

The climate of the mine site development envelope is classified as grassland, hot (winter drought) under the modified Köppen classification for Australia (Stern et. al. 2000). It has summer dominant rainfall, with hot humid summer conditions (BoM 2016a).

Most rainfall occurs during the wet season between November and April. Potential evapotranspiration is very high, averaging 1,980 mm per year, and varies moderately across seasons. Evapotranspiration generally remains higher than rainfall even in the wet season, resulting in water-limited conditions for vegetation.

Weather data has been collected from an automatic weather station at the Mine Site Development Envelope since November 2014. Monthly maximum and minimum temperatures, and mean humidity are shown in Chart 1. Maximum temperatures are generally between 33°C and 45°C, with minimum temperatures rarely dropping below 15°C during the dry season. Average humidity is around 40% in the dry season and approaches 80% in the wet season. Days with maximum humidity over 90% were observed in all months.

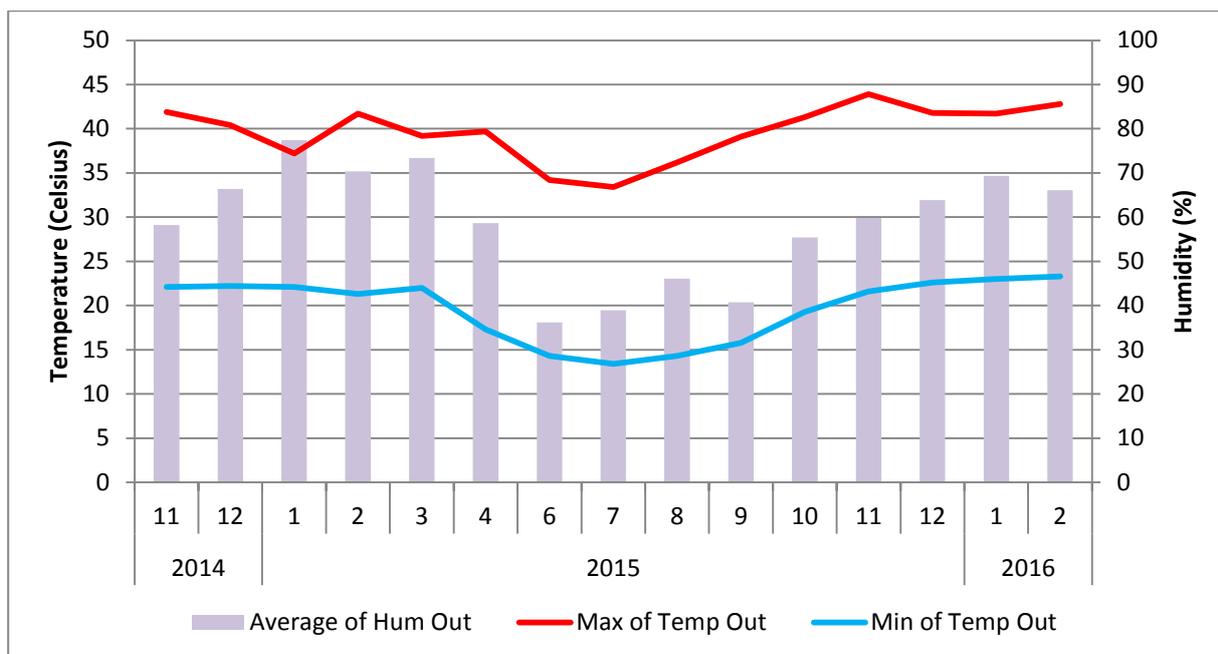


Chart 1: Temperature and Humidity at Mine Site Development Envelope

7.3.2 Rainfall

Spatially extrapolated rainfall data is available for the Mine Site Development Envelope from the SILO Data Drill data set (Queensland Government, 2016). This data is calculated by extrapolation from all available Bureau of Meteorology (BoM) data including the closest BoM sites (Thunderbird, Mount Jowlaenga, Country Downs, Beagle Bay, Yeeda and Derby Aero) to give a continuous estimated record for a specific location. Comparison with local stations shows that the Data Drill closely matches Mount Jowlaenga rainfall records (when available), and is similar to Country Downs and other nearby stations at other times. It is recommended this dataset be used for long term rainfall patterns.

Monthly rainfall statistics for the Mine Site Development Envelope based on the Data Drill dataset from 1889 to 2015 are shown in Table 7 and Chart 2, with annual figures based on a rainfall year from September to August. Mean annual rainfall is 694 mm, however, is very variable with a lowest annual rainfall of 153mm and highest of 1,503 mm. Median annual rainfall is 675 mm. Median monthly rainfall is 1.2 mm or less during the dry season from May to October. Very low or zero rainfall may occur in any month.

Table 7: Rainfall Statistics for Mine Site Development Envelope 1889 to 2015 (Data Drill)

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Annual
Mean	1.0	3.9	17.8	92.4	193.1	181.0	128.9	29.9	23.4	14.9	6.5	3.5	695.3
Highest	48.5	53.9	229.1	668.5	1031.8	556.9	535.1	261.7	308.4	159.4	157.6	56.1	1502.7
Decile 9	1.1	12.0	44.3	181.4	365.3	334.9	288.1	73.5	80.6	53.7	19.8	5.9	1003.6
Median	0.0	0.3	8.4	66.1	156.6	164.7	96.7	12.4	0.9	0.3	0.0	1.2	675.2
Decile 1	0.0	0.0	0.3	10.8	54.7	47.0	26.0	0.0	0.0	0.0	0.0	0.7	401.2
Lowest	0.0	0.0	0.0	1.1	21.0	12.7	1.8	0.0	0.0	0.0	0.0	0.5	152.6

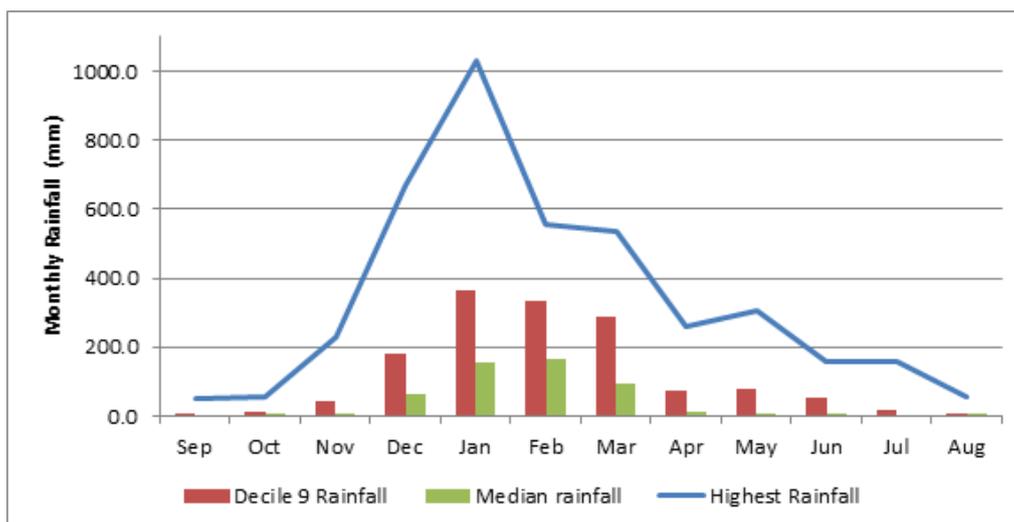


Chart 2: Monthly Rainfall Statistics for Mine Site Development Envelope

7.3.2.1 Wind Speed and Direction

The closest BoM site with wind speed records is Derby Aero (Site 003032). A summary of wind speeds for the Derby BoM site and Thunderbird weather station are presented in Table 8. Mean wind speeds at the Thunderbird weather station were found to be significantly lower than at Derby, likely attributable to its inland location.

Morning wind directions tend to be from the east between April and August and from the northwest between September and March. Afternoon wind directions are predominantly from the northwest all year round with the exception of May and June when wind from the southeast is also likely (BoM 2016c).

Table 8: Mean Wind Speeds (km/h)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Derby Aero (BoM Site 003032)													
9 am	13.1	11.8	11.2	10.9	13.7	14.6	14	13	12.9	13	12.7	12.7	12.8
3 pm	18.6	16.5	15.1	14.8	14.8	14.7	15.4	16	19.1	23	24.1	22	17.8
Thunderbird Weather Station													
9 am	8.0	5.6	5.8	5.9	-	7.2	8.5	8.7	8.5	7.1	8.4	7.8	7.4
3 pm	6.2	7.2	6.5	8.4	-	7.7	8.0	7.9	9.6	8.3	7.8	8.2	7.8

7.3.3 Tropical Cyclones

Across the Kimberly region, widespread rainfall event total volumes in excess of 100 mm are commonly associated with tropical lows and cyclones. Such rainfalls can occur well to the east of the cyclone due to moisture laden north westerly monsoon winds. Rainfall is not directly related to the intensity of the cyclone and some of the largest flood events have been associated with tropical lows below cyclone intensity.

Although rainfall associated with tropical cyclones is a likely contributor to flooding in the inland Mine Site Development Envelope, cyclone risk with respect to wind is much lower than for Broome and coastal Pilbara towns due to fewer cyclones, including severe cyclones, impacting on the area. On average, for the northwest coast as a whole, approximately five cyclones occur each year, two of which cross the coast with one rated as severe (BoM 2016b). When taken in isolation, the risk of a cyclone occurring at any particular location inland from the coast is much lower. Figure 8 shows the tracks of some notable cyclones affecting the Dampier Peninsula (BoM 2016a).

The cyclone season officially runs between November and April, although cyclones only rarely occur in November and have been observed as late as May. The highest risk of category 4 or 5 cyclones is late in the season during March and April. The impact of early cyclones on flooding is also likely to be lessened due to dry catchment conditions.

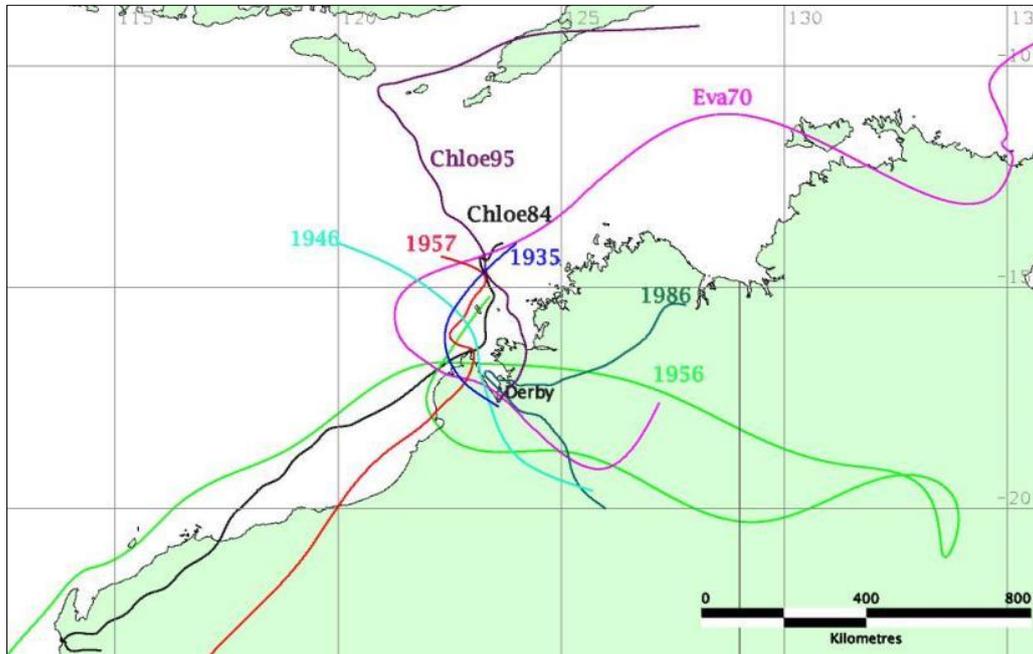


Figure 8: Tracks of Notable Cyclones Affecting the Mine Site Development Envelope

7.4 GEOLOGY

The Mine Site Development Envelope is located in the west Kimberley on the Dampier Peninsula, located within the Fitzroy Trough in the north of the Phanerozoic Canning Basin, an intracratonic basin covering 640,000 km² with a dominant onshore area of 530,000 km².

The Fitzroy Trough is bounded by the Beagle Bay Fault in the north and the Fenton Fault in the south (Figure 9), which are near-vertical normal faults (Searle 2012). The faults extend through the Triassic and older sediments. The faults' prevalence in younger sediments is unknown. The major fold within the Trough is the Baskerville Anticline, in the centre of the Dampier Peninsula. The anticline strike east-west and plunge to the west. Strata on the southern limb dip gently to the south-west and strata on the northern limb dip gently to the north-west.

The main geological units of interest for the Dampier Peninsula are the Broome Sandstone and the Mowanjum Sand (Table 9). The Broome Sandstone is mainly concealed at the surface by the younger units; however it does outcrop at some locations across the Peninsula, mostly along the shoreline. Outcrops of various facies of the Broome sandstone have been mapped near the Mine Site Development Envelope Figure 9.

Table 9: Stratigraphy of the Dampier Peninsula

Age	Formation	Maximum Thickness (m)	Lithology	Extent
Quaternary	Mowanjum Sand ('Pindan')	10	Fine grained (very fine to medium) silty sand.	Widespread across the peninsula
Late Cretaceous	Emeriau Sandstone	30	Fine to coarse grained poorly sorted sandstone, minor conglomerate, commonly ferruginous.	North-west of the peninsula only near Bobbys Creek and Lollywell Springs
Early Cretaceous	Broome Sandstone	384m*	Fine to coarse grained sandstone, gravel, some siltstone, mudstone and conglomerate. Heavy minerals near top & base.	West and central part of the Dampier Peninsula, except where it has been eroded away towards the east.
Late Jurassic	Jarlemai Siltstone	240	Shallow marine laminated pink and purple siltstone with a sugary texture, massive and partly sandy mudstone, limestone. Includes thin coal seams.	Underlies the whole of the study area.

* The unit follows Towner and Gibson's (1980) usage and includes the "Jowlaenga Formation" basal transitional unit.

Source (after Rockwater 2016)

7.4.1 Local Geology

Mowanjum Sand

The Mowanjum Sand (Searle 2012) occurs at the surface or beneath a veneer of other superficial units within Dampier Peninsula. It is a widespread sheet deposit of Quaternary age and unconformably overlies a weathered contact on the Broome Sandstone and is overlain itself in places by thin younger deposits. Various other unconsolidated deposits of sand, limestone, silt, clay, gravel and conglomerate occur along beaches, tidal flats and are associated with the dunes. The unit consists of red-brown, fine grained (very fine to medium) silty sand (colloquially termed 'Pindan'), and is generally between 8 and 14 m thick (maximum 29 m) in the holes drilled by Wright (2013) near the Broome townsite. At the Mine Site Development Envelope it is typically 6 to 12 m thick and unsaturated.

Emeriau Sandstone

The Emeriau Sandstone consists of fine- to coarse-grained, poorly sorted sandstone and conglomerate. It is of Late Cretaceous age and is only present in the north-west of the Dampier Peninsula, about 60 km north-west of the Mine Site Development Envelope and overlies the Broome Sandstone.

Broome Sandstone

The Broome Sandstone is present over the west and central part of the Dampier Peninsula, except where it has been eroded away towards the east and over the nose of the Baskerville anticline. To the west, the Broome Sandstone extends offshore beneath the Indian Ocean. The unit described here follows Towner and Gibson's (1980) usage and includes the basal transitional unit known as the Jowlaenga Formation. The sediments of the Broome Sandstone and basal Jowlaenga Formation are of Early Cretaceous age. They are overlain by superficial units comprising shoreline, aeolian and alluvial deposits; mainly the Mowanjum Sand ('Pindan sand'). The contact with the Mowanjum Sand is weathered and is frequently difficult to recognise in drill cuttings. The Broome Sandstone is underlain by the Jarlemai Siltstone, which is of Late Jurassic to Early Cretaceous age and has a maximum onshore recorded thickness of 388 m (DMP 2016).

Broome Sandstone (Upper)

The Broome Sandstone consists of weakly cemented, fine- to coarse-grained quartzes sandstone, with minor

beds of siltstone and claystone, thin coal seams, and minor pebble conglomerate (Laws 1991). Vogwill (2003), reports that these lithologies are contained within four subfacies, three upper deltaic facies ('Broome Sandstone 1–3') and a lower fluvial subfacies ('Broome Sandstone 4') in the south-west of the Peninsula. The fluvial facies comprises mainly coarse grained sand and granule-sized particles with minor siltstone and claystone, while the upper deltaic facies is mainly medium- to coarse-grained sand with abundant silt. The Broome Sandstone is characterised in geophysical logs by low gamma radiation and high resistivity where the formation is saturated by fresh groundwater. Gamma-radiation signatures have higher intensity where there are intercalated siltstone and claystone beds. Gamma-radiation signatures have lower intensity where pebble conglomerate beds are present.

Heavy Mineral Sands

At the Mine Site Development Envelope, the lower part of the Broome Sandstone comprises high grades of fine-grained heavy mineral sands (HMS), containing valuable heavy minerals ilmenite, zircon, leucoxene and rutile. Mineralisation is in a thick, broad anticlinal sheet-like body striking northwest. The HMS section of the Broome Sandstone Mine Site Development Envelope is relatively thick (35–55 m) and is characterised by very high gamma radiation counts. The HMS lithology of the Broome Sandstone is comparably finer-grained to that of the upper section of the Broome Sandstone. The areal extent, width, grade, geological continuity and grain size of the Thunderbird deposit are interpreted to indicate an off-shore sub-wave base depositional environment.

Basal Transitional Unit

The Broome Sandstone basal transitional unit (also referred as the Jowlaenga Formation) is very similar lithologically to the upper part of the Broome Sandstone although it contains more silts and clays. It can be difficult to differentiate in drill cuttings, however, the transition is recognisable in geophysical logs by a progressive increase in gamma-intensity and a decrease of resistivity with depth. Resource exploration drilling data show an increased concentration of very-fine grained sediment (slime) in the basal transitional unit.

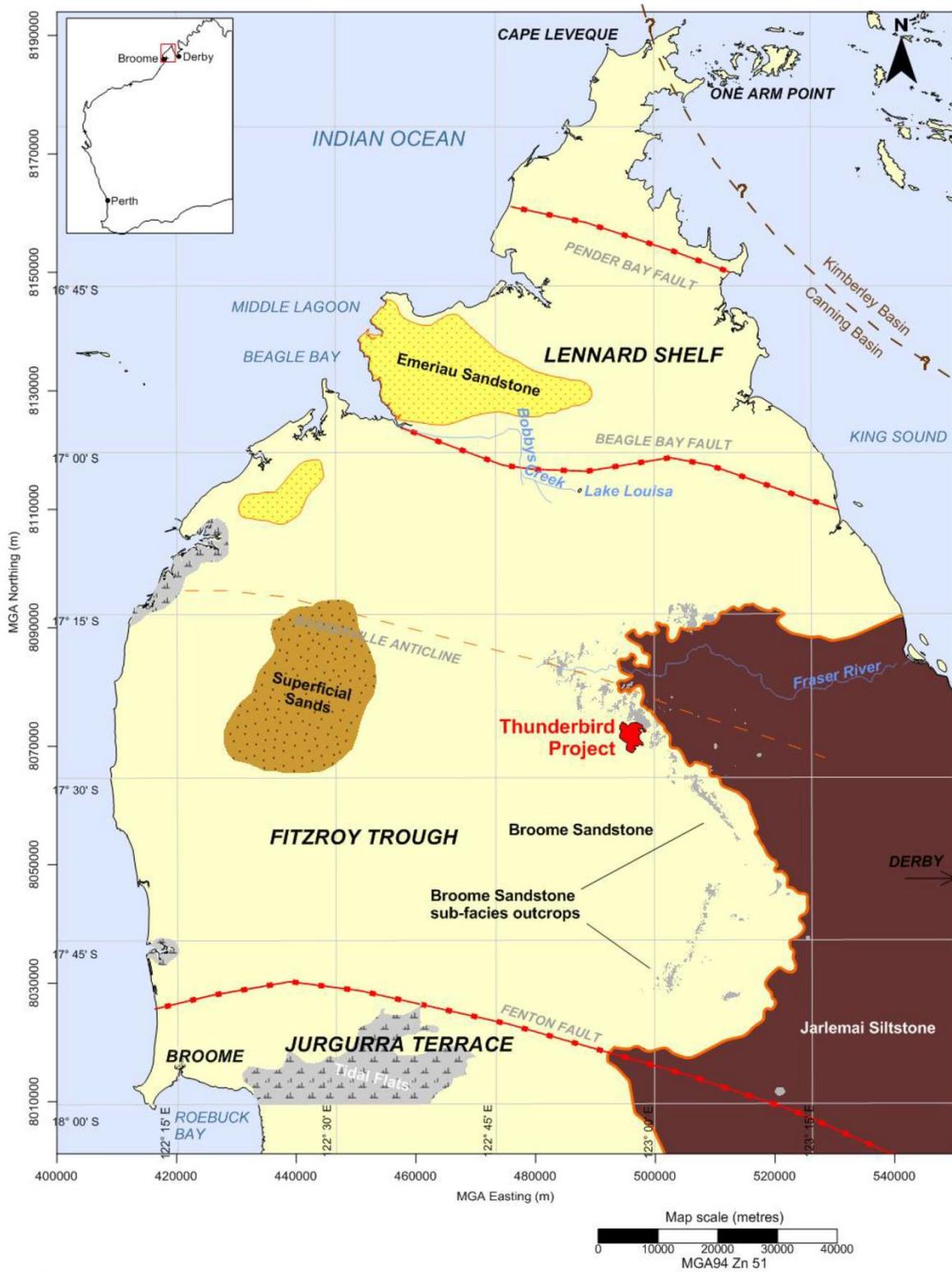
The transitional unit has been interpreted as generally 15–30 m thick (Rockwater 2016), in general agreement with the maximum recorded thickness of 40 m for the Jowlaenga Formation in Geoscience Australia's online geological database.

Jarlemai Siltstone

The Jarlemai Siltstone is a shallow marine deposit of early Cretaceous to late Jurassic age that is unconformably overlain by the Jowlaenga Formation (Gibson 1983). The formation is up to 218 m thick (in the bore Fraser River 1) and has an average thickness of about 100 m in the Dampier Peninsula.

The formation is primarily a mudstone, consisting of silty claystone, sandy and fossiliferous siltstone, and clayey sandstone. The siltstone and claystone are micaceous and pyritic. They are generally medium to dark grey, brownish grey, and light brown, but can be oxidised dark red-brown, purple, and yellow. Sands are light grey, coarse- to medium-grained, loose to friable, sub-rounded to rounded. Shell fragments, including pelecypods, brachiopods and foraminifera are common, and the formation is calcareous through the middle portion.

Structure contours on the top of the Jarlemai Siltstone indicate an asymmetric east-west trending anticline that probably developed over the pre-existing Baskerville anticline (Laws 1991). Some erosion may also have occurred, particularly south of the Mine Site Development Envelope, but the overall structure is an anticline-like feature.



0:\Surf\16_02\Figure 4.tif

Figure 9: Regional Geology

7.5 LAND SYSTEMS, LANDFORMS AND SOILS

A baseline soil and landform assessment was undertaken for the Mine Site Development Envelope.

7.5.1.1 Land Systems

Nine land systems have been identified within the eastern Dampier Peninsula (Payne and Schoknecht 2011; Australian Soil Resources Information System [ASRIS] 2016), four of which are located within the Mine Site Development Envelope:

- The Fraser land system (ASRIS mapping unit 335Fz) - characterised by sandplains and dunes with Pindan woodlands and spinifex/tussock grasslands.
- The Reeves land system (ASRIS mapping unit 335Re) - characterised by sandplains, scattered hills and minor plateaux.
- The Wanganut land system (ASRIS mapping unit 335Wa) - characterised by low-lying sandplains and dunefields with through-going drainage.
- The Yeeda land system (ASRIS mapping unit 335Ye) - characterised by sandplains and occasional dunes.

Summaries of geomorphology, surficial geology and vegetation characteristics of these land systems are presented in Table 10.

The sensitivity of land systems to damage or degradation has been considered. The Wanganut and Yeeda land systems are subject to frequent fires, but generally not prone to degradation or erosion (Payne and Schoknecht 2011). The Reeves land system contains Pindan vegetation, which is subject to frequent fires. The sandplains and sand dunes are moderately susceptible to wind erosion after fire, but stabilise after rain (Payne and Schoknecht 2011). Similar to the Reeves land system, the Fraser land system is generally stable with low susceptibility to erosion except for sand dunes, which are moderately susceptible after fire but stabilise after rain.

The land systems are generally not prone to degradation or erosion by pastoral activities, provided grazing pressure is controlled and frequency of burning is maintained. As livestock will be excluded from the project area, risk of degradation within undisturbed areas will be reduced.

Table 10: Characteristics of Major Regional Land Systems (ASRIS 2016)

Land System	Geomorphology	Geology	Vegetation	Land Management	Significant Values
Fraser	Sandplain and dunefields with through-going drainage, sandplain with irregular dunes, plains with thin sand cover and local outcrop, low-lying sandplain flanking drainage features. Relief less than 9 m.	Quaternary aeolian sand and minor outcrops of gently dipping Cretaceous sandstones.	Pindan woodlands and spinifex/tussock grasslands.	Generally stable with low susceptibility to erosion except for sand dunes, which are moderately susceptible after fire, but stabilise after rain.	No known scientific or evolutionary values associated with this land system.
Reeves	Formed by dissection of the Kimberley surface - scattered hills, dip slopes with thin sand cover and local outcrop and sandplain. Sparse branching drainage pattern. Relief to 60 m.	Subhorizontal or gently dipping sandstone, silty sandstones and silicified sandstones of Cretaceous age. Quaternary aeolian sand.	Pindan woodlands and spinifex/tussock grasslands.	Pindan vegetation subject to frequent fires. Sandplains sand dunes are moderately susceptible to wind erosion after fire, but stabilise after rain.	No known scientific or evolutionary values associated with this land system.
Wanganut	Sandplain and dunefields with through-going drainage, sandplain with stable dunefields, scattered pans and depressions. Sparse to moderately dense branching drainage pattern. Relief less than 9 m.	Quaternary aeolian sands.	Pindan woodlands and spinifex/tussock grasslands. Dense wattle scrub.	Subject to frequent fires, but generally not prone to degradation or erosion.	No known scientific or evolutionary values associated with this land system.
Yeeda	Sandplains and dunefields with little organised drainage.	Quaternary aeolian sands.	Shrubby spinifex grasslands and Pindan woodlands.	Subject to frequent fires, but generally not prone to degradation or erosion.	No known scientific or evolutionary values associated with this land system.

7.5.1.2 Landforms

Local Assessment Unit

The EPA's definition of landform is a distinctive, recognisable physical feature of the earth's surface having a characteristic shape produced by natural processes (EPA 2015). For the purpose of defining the local assessment unit (LAU), the landforms in the area within and surrounding the Mine Site Development Envelope were derived through the use of contour line data and development of a GIS digital elevation model.

From an initial review of regional contours surrounding the Mine Site Development Envelope (up to 30 km away), it is clear that the most distinctive landforms in relation to the Mine Site Development Envelope are a north-west to south-east trending band of low hills parallel to the Mine Site Development Envelope associated with the Reeves Land System. This area was therefore selected as the focus of the LAU. The distinctive landform features within the band are Reeves Hill, Dampier Hill, Mt Jowlaenga and several unnamed smaller hills to the east and north of the Mine Site Development Envelope. None of these landforms will be impacted by the project.

The remainder of the LAU comprises flat or gently undulating sandplain areas within the Fraser, Wanganut and Yeeda Land Systems, which will be impacted by the project. The geomorphology of all three of these land systems is described as sandplains and dunefields. These land systems are widely represented within the Dampier Peninsula and in the broader Kimberley Region. The Reeves land system, associated with the distinctive hills located in the LAU, is relatively underrepresented in the Kimberley Region and predominantly occurs on the Dampier Peninsula. The area of these land systems contained in the Kimberley Region is as follows (Payne and Schoknecht 2011):

- Yeeda = 21,308 km².
- Wanganut = 6,973 km².
- Fraser = 728 km².
- Reeves = 428 km².

7.5.1.3 Regional Soils

The four main soil types within the Land Systems of the region described in Table 10 are:

- Red earthy sands with associated hummocks of siliceous sands.
- Red earthy sands associated with soils on the plains, with dunes and hummocks of red sands. Some soils in lower sites often have a heavy surface layer of ferruginous gravel.
- Neutral red earths and sandy neutral red soils on plains with minor sandstone residuals overlain by extensive rocky outcrops.
- Neutral red earths and red earthy sands within sand plains with irregular dunes/active drainage systems.

7.5.1.4 Local Soils

Soils in the Mine Site Development Envelope are dominated by red sands (Pindan) of aeolian origin, which are widespread throughout the Dampier Peninsula. Soil profiles are typically deep (greater than 1 m), although relatively shallow profiles were recorded at several locations where Cretaceous sandstone sedimentary rocks or silcrete hardpan were present within 1 m of the natural soil surface. Minor soil types included deep yellow sand and shallow bleached sand over clay or loam, usually associated with drainage lines or depressions. As such, four soil types were identified within the Mine Site Development Envelope (Table 11):

- Shallow red Pindan sands over sandstone.
- Deep red sandy Pindan soil.
- Yellow sandy soils.
- Bleached Sands Over Clay/Loam.

Table 11: Assessed Soil Type Characteristics

Soil Type	Characteristics
Shallow red Pindan Sands over sandstone	Uniform fine to medium red sandy soil Similar to Deep red Pindan sands, but with limited B-horizon due to sandstone less than 1 m from the surface. Abundant leaf litter. Absence of gravels (surface and subsoil). Uniform characteristic red colour, no visible distinction between A and B horizons.
Deep red Pindan Sands	Uniform fine to medium red sandy soil Abundant leaf litter. Absence of gravels (surface and subsoil). Uniform characteristic red colour, no visible distinction between A- and B- horizons. At least 1 m deep uniform fine to medium sand B-horizon. Deeper subsoil may be more yellowish or grey.
Yellow Sands	Yellow coloured B-horizon and pale surface A-horizon. Absence of gravels (surface and subsoil). Limited in extent – restricted to topographical lows.
Bleached Sands Over Clay/Loam	Shallow distinctively coloured bleached grey loamy sand over a compact grey clay or loam. Associated with shallow depressions or drainage lines - expected to be prone to seasonal waterlogging. Abundant termite mounding.

All four soil types displayed uniform physical and chemical properties throughout the depth of their sandy profiles. Laboratory analysis indicated that:

- Soils are non-saline with low sodicity apart from one saline soil collected from a depression with restricted drainage.
- Soils have low cation exchange capacity values, with calcium being the dominant exchangeable cation.
- Soils have low concentrations of organic matter, major plant nutrients, and some minor nutrients.
- Soils have very low concentrations of environmentally significant metals and metalloids.
- Soils have low coherence and limited wet strength.
- Soils exhibit no evidence of uranium enrichment despite the presence of elevated uranium concentrations in ore and mineralised waste materials.
- pH was variable, however the majority (70%) were circum-neutral or slightly alkaline.

While local soils have low coherence and limited wet strength and are not favourable for rehabilitation of steep surfaces, the soils are well suited for rehabilitation of flat or gently sloping surfaces, such as those in the mineral deposit area.

Low nutrient availability, coupled with an environment of strong leaching associated with free-draining sandy soils and moderate to high rainfall means that nutrient cycling is critical for sustaining healthy vegetation communities. Woody debris, leaf litter and termite mounds are important repositories of nutrients and organic matter. Frequent fires and soil biological activity, especially by termites, are essential for efficient nutrient recycling in this environment.

7.5.1.5 Acid Sulfate Soils

The Mine Site Development Envelope is characterised in the ASRIS Acid Sulfate Soil mapping as having 'Extremely Low' probability (low confidence) of occurrence within 2 m of the natural soil surface.

Geochemical assessment of mine waste samples for Mine Site Development Envelope indicate that the majority of waste is Non Acid Forming. Two of the deepest samples assessed were classified as Potentially Acid Forming, and may be reached in the final years of proposed mining.

7.6 WASTE CHARACTERISATION

7.6.1 Residues

Geochemical assessment of process waste residue (tailings) samples for the project was undertaken by MBS and results indicated the following (MBS 2016):

- The vast majority (96%) of samples contained very low concentrations of total sulfur or acid neutralising capacity and were all classified as non-acid forming - Barren, having neither acid forming nor acid neutralising capacity.
- The two deepest samples assessed at or below 53.5 m below the natural water table (approximately 88.5 m below surface) were found to contain 0.22% and 0.96% sulfur respectively and were classified as potentially acid forming (PAF).
- Natural pH values for samples other than the two PAF samples described above were circum-neutral to slightly acidic (pH 5.1 to 7.2) and very low in soluble salts and soluble alkalinity. Overall this indicates seepage from non-sulfidic project mine waste by rainfall or interaction with groundwater is expected to have very low levels of soluble salts/salinity and be slightly acidic (pH 6 to 6.5) which is very consistent with natural groundwater from the site (pH 5.8 to 6.3). The two sulfidic PAF samples were already partially oxidised upon receipt and had elevated salinity/EC values resulting from acid sulfate formation.
- Thorium was the most significantly enriched element associated with orebody samples and mineralised waste samples below the orebody. Thorium concentrations in these samples ranged from 110 to 160 mg/kg (GAI 3) versus a crustal abundance of 10 mg/kg. Thorium enrichment is considered to be associated with naturally elevated concentrations of monazite present in the Thunderbird deposit. Both water and dilute acid leachate testing indicated these total concentrations will not be mobilised under any expected mining conditions.
- Minor enrichment in selenium in orebody and mineralised waste samples below the orebody was also noted (2.6 to 3.8 mg/kg, GAI 3 to 4) versus the average soil concentration of 0.2 mg/kg. Both water and dilute acid leachate testing indicated these total concentrations will not be mobilised under any expected mining conditions.
- Concentrations of all other environmentally significant metals and metalloids tested were low to very low indicating a low risk to the environment.
- Concentrations of water soluble elements of environmental significance in mine waste samples were generally very low to non-detectable and below ANZECC livestock drinking water guidelines for all samples selected which is the only current beneficial use of groundwater. Overall, results indicate there is an extremely low risk of mine waste leachates from circum-neutral waters adversely impacting the surrounding environment by rainfall or groundwater interaction.
- Dilute acid leach results confirmed negligible levels of calcium and magnesium carbonates were available for buffering capacity/acid neutralisation. Low levels of aluminium and iron were the primary elements solubilised, which is consistent with a natural presence of hydrated aluminium and iron oxides from weathering and groundwater interactions. Concentrations of all other environmentally significant metals and metalloids (including geochemically enriched thorium and selenium) were very low and below corresponding ANZECC livestock drinking water guidelines.

- Particle size analysis indicated all samples had approximately 10% clay content with clay and silt fractions (<20 µm) together combining for approximately 50% by weight of material. Cation exchange capacity measurements indicated samples of overburden were non-sodic to marginally sodic with a lower risk of dispersion. Remaining sample types were moderately to highly sodic with orebody samples being highest in sodicity (Exchangeable Sodium Percentage values of 10.9 to 26.8%) and higher risk of dispersion. These mine waste materials are therefore expected to have a dispersive tendency and make water turbid by remaining suspended in the low salinity water of the project. As processing involves the use of flocculants, slurries of these materials should still reasonably settle upon placement in the mine void or initial TSF.

Overall, results indicate that mine waste at depths less than 48.5 m below the natural water table (approximately 83.5 m below surface) will be non-acid forming and Barren with essentially no capacity for acid generation or acid neutralisation. Levels of soluble salts, metals and metalloids in any seepage from these materials will be extremely low, even under mildly acidic conditions.

An apparent demarcation of sulfidic, PAF material was found to occur at depths between 48.5 m (non-sulfidic) and 53.5 m (sulfidic) below the natural water table which potentially may be reached or impacted by mine dewatering (Rockwater 2016) in the final years of proposed mining (at 15 Mtpa). Further confirmation of the exact depth of this sulfidic material intercept by additional, more intensive soil sampling and analysis, groundwater monitoring and subsequent development of an appropriate mining strategy and acid sulfate soil management plan (refer DER 2015 and 2015b), would be required before any disturbance of material at this depth occurs. This includes consideration of the cone of depression resulting from mine dewatering.

7.6.2 Overburden

Geochemical assessment of mine waste (overburden) samples for the project was undertaken by MBS and results indicated the following (MBS 2016):

- The vast majority of samples contained very low concentrations of total sulfur or acid neutralising capacity (ANC) and were all classified as NAF-Barren, having neither acid forming nor acid neutralising capacity.
- The two deepest samples assessed at or below 53.5 m below the natural water table (approximately 88.5 m below surface) were found to contain 0.22% and 0.96% sulfur respectively and were classified as potentially acid forming (PAF). These samples were identified basement material or mineralised waste below the orebody and are not intended for excavation.
- Natural pH values for samples other than the two PAF samples described above were circum-neutral to slightly acidic (pH 5.1 to 7.2) and very low in soluble salts and soluble alkalinity. Overall this indicates seepage from non-sulfidic project mine waste by rainfall or interaction with groundwater is expected to have very low levels of soluble salts/salinity and be slightly acidic (pH 6 to 6.5) which is very consistent with natural groundwater from the site (pH 5.8 to 6.3).
- Thorium was the most significantly enriched element associated with orebody samples and mineralised waste samples below the orebody. Thorium concentrations ranged from 110 to 160 mg/kg versus a crustal abundance of 10 mg/kg. Thorium enrichment is considered to be associated with naturally elevated concentrations of monazite present in the Thunderbird deposit. Both water and dilute acid leachate testing indicated these total concentrations will not be mobilised under any expected mining conditions.
- Minor enrichment in selenium in orebody and mineralised waste samples below the orebody was also noted (2.6 to 3.8 mg/kg) versus the average soil concentration of 0.2 mg/kg. Both water and dilute acid leachate testing indicated these total concentrations will not be mobilised under any expected mining conditions.
- Concentrations of all other environmentally significant metals and metalloids tested were low to very low indicating a low risk to the environment.
- Concentrations of water soluble elements of environmental significance in mine waste samples were generally very low to non-detectable and below ANZECC livestock drinking water guidelines for all samples

selected which is the only current beneficial use of groundwater. Overall, results indicate there is an extremely low risk of mine waste leachates from circum-neutral waters adversely impacting the surrounding environment by rainfall or groundwater interaction.

- Dilute acid leach results confirmed negligible levels of calcium and magnesium carbonates were available for buffering capacity/acid neutralisation. Low levels of aluminium and iron were the primary elements solubilised, which is consistent with a natural presence of hydrated aluminium and iron oxides from weathering and groundwater interactions. A sample of overburden in a ferricrete zone 4 m above the natural groundwater table released the highest concentrations of aluminium and iron upon contact with acid, with aluminium (6.25 mg/L), marginally above the ANZECC livestock drinking water guideline of 5 mg/L under these artificially acid conditions. Concentrations of all other environmentally significant metals and metalloids (including geochemically enriched thorium and selenium) were very low in all samples and below corresponding ANZECC livestock drinking water guidelines.
- Particle size analysis indicated all samples had approximately 10% clay content with clay and silt fractions (<20 µm) together combining for approximately 50% by weight of material. Cation exchange capacity measurements indicated samples of overburden were non-sodic to marginally sodic with a lower risk of dispersion. Remaining sample types were moderately to highly sodic with orebody samples being highest in sodicity and higher risk of dispersion.

Overall, results indicate that mine waste at depths less than 48.5 m below the natural water table (approximately 83.5 m below surface) will be NAF and Barren with essentially no capacity for acid generation or acid neutralisation. Levels of soluble salts, metals and metalloids in any seepage from these materials will be extremely low, even under mildly acidic conditions.

7.7 HYDROGEOLOGY

7.7.1 Setting

The water table on the Dampier Peninsula is deep inland and becomes progressively shallower on the coastal plain where discharge occurs at coastal springs in the mud flats around Broome. The Baskerville anticline divides groundwater flows, with water flowing northward north of the anticline and south to southwest in areas south of the anticline. The Mine Site Development Envelope is on the southern limb of the anticline where the hydraulic gradient is very low (1.2×10^{-3}) and flattens towards the coast (Laws 1991).

7.7.2 Broome Sandstone Aquifer

The Broome Sandstone Aquifer is hosted in the Broome Sandstone and the saturated parts of the overlying Emeriau Sandstone and Mowanjum Sand, which generally are in hydraulic continuity. It is a major unconfined to semi-confined aquifer that supplies groundwater to the Broome townsite, rural subdivisions, horticultural areas, and pastoral properties. The Jarlemai Siltstone underlies the Broome aquifer and acts as a major aquiclude between it and the Alexander Formation (part of the Wallal aquifer) below.

7.7.2.1 Regional Groundwater Levels and Flow

Groundwater levels in the Broome aquifer range from about 75 m AHD near the centre of the Dampier Peninsula to about 0–1 m AHD at the coast (Figure 10). Groundwater level data are most concentrated in the Broome townsite region. In the northern and eastern parts of the study area there are regions with sparse groundwater monitoring data. The contours (Figure 10) imply that regional groundwater flow is towards the coast under an average hydraulic gradient of 0.00085 (that is, 0.85 m per km).

Variations in groundwater levels in monitoring bores for the Broome townsite, although within close proximity to production bores, appear to closely correspond to variations in rainfall. Groundwater levels vary by about 3 m in response to inter-decadal variations in rainfall. This is evident when comparing the cumulative rainfall variation with the groundwater levels. The groundwater-level trends closely match the trends in cumulative-deviation-from-

mean annual rainfall, with an apparent lag of 2 to 3 years as observed in other studies (CSIRO 2009; Rockwater 2013, 2014).

7.7.2.2 Groundwater within the Mine Site Development Envelope

Groundwater Levels

The water table elevation over the mineral deposit area ranges from about 62 m AHD in the south to about 75 m AHD at its northern edge, with groundwater in the Broome Sandstone Aquifer flowing to the south. The hydraulic gradient is steep across the deposit (0.0016; that is, 1.6 m per km) and decreases to the south (0.0007; that is, 0.7 m per km) where the upper Broome Sandstone is the main component. Interpreted groundwater level contours are shown in Figure 11. Groundwater levels trends in selected monitoring bores in the mine area appear to closely match the trends in cumulative deviation from mean annual rainfall. The depth to groundwater is in excess of 20 m over most of the area.

Hydraulic Parameters

Test pumping for the HG-series of bores near the Broome town water supply indicates that hydraulic conductivity of the Broome aquifer ranges from 12–23 m/d, averaging 15 m/d (after Rockwater 2016). Searle (2012) reported hydraulic conductivities ranging from 2–42 m/d (generally about 15 m/d) over the entire Dampier Peninsula. The Broome aquifer therefore has moderately high hydraulic conductivity, although significant variability occurs.

Results from test pumping of bores within the Mine Site Development Envelope generally agrees with reported hydraulic conductivity data for the Broome aquifer sandstone and suggest that the HMS have a comparatively lower hydraulic conductivity value (around 1 m/d) whereas the Broome aquifer basal transitional unit has an intermediate hydraulic conductivity (around 5–10 m/d).

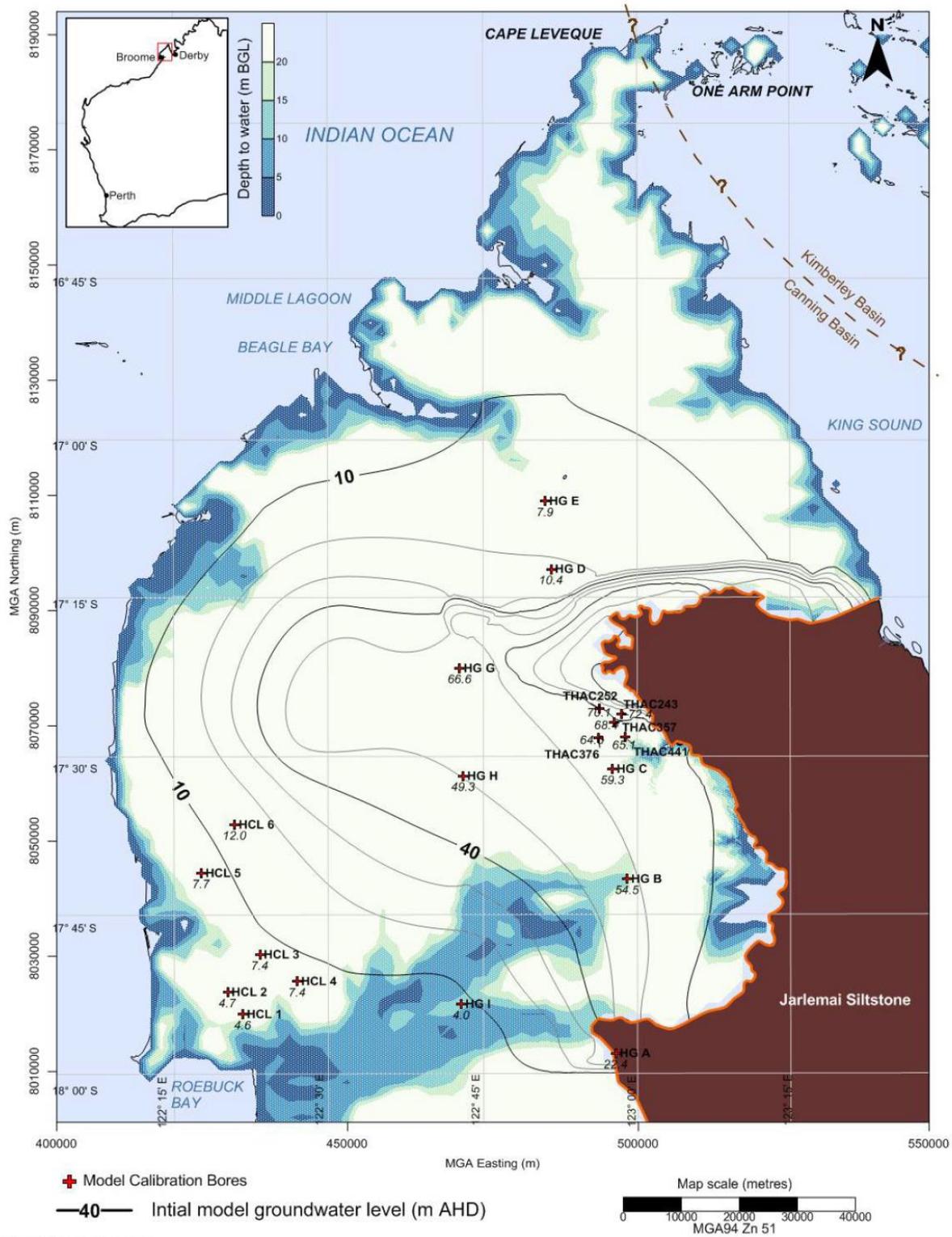


Figure 10: Broome Sandstone Aquifer Groundwater Levels 1997 – 1998

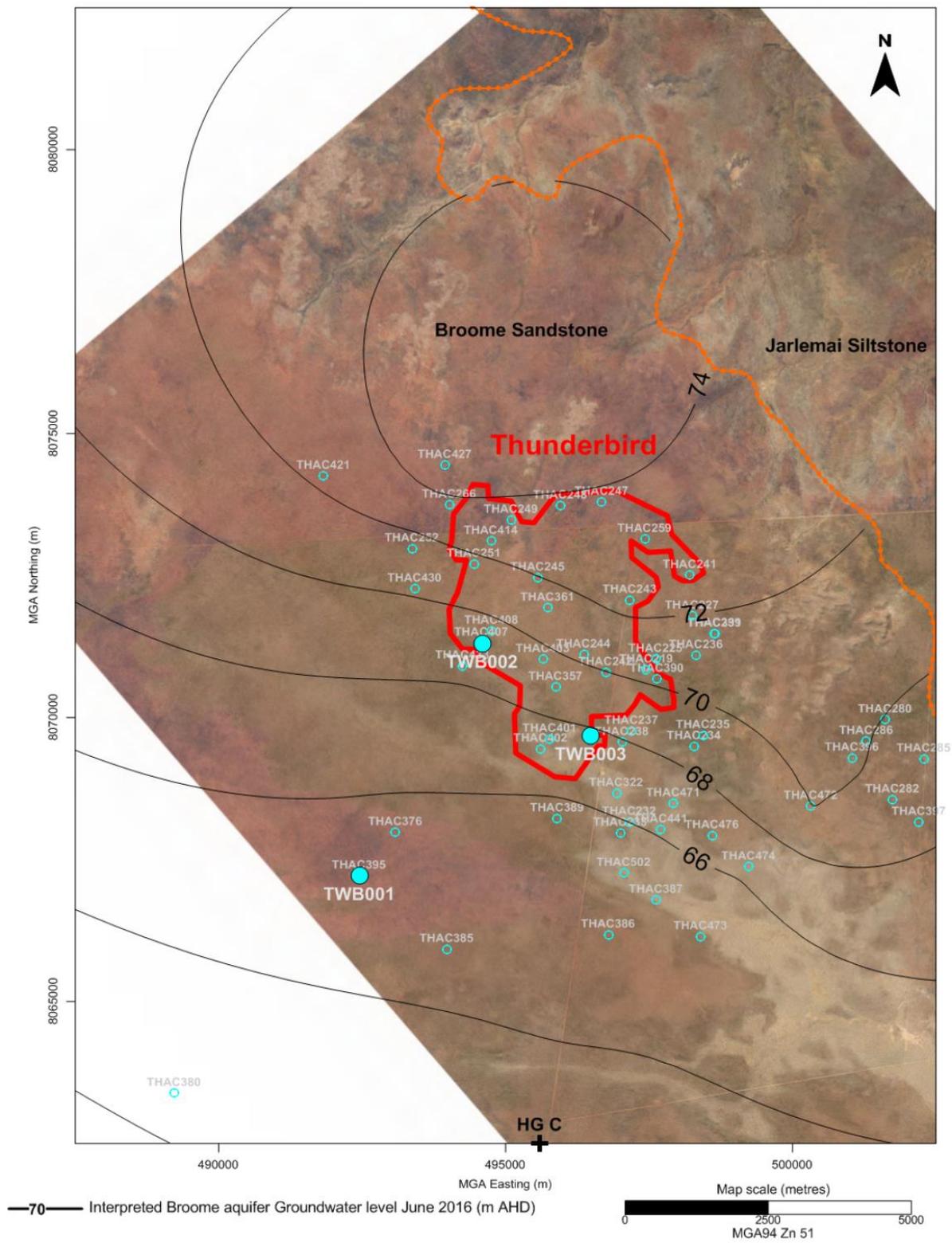


Figure 11: Mine Site Development Envelope Interpreted Groundwater Levels (2016)

7.7.3 Recharge

The Broome Sandstone Aquifer is recharged mainly by the direct percolation of rainfall, which falls mostly during summer. Coastal dunes north of Broome are a significant local source of groundwater recharge to the Broome Sandstone Aquifer, which is apparent from the groundwater flow pattern and chemistry (Laws 1991). Recharge rates of 4% to 5% of rainfall were estimated from chloride ratios and flow net interpretations (Laws 1987). This corresponds to groundwater recharge rates of 22 mm to 52 mm from an average annual rainfall of 780 mm/year.

Minor seasonal surface water ponding areas may occur locally in the overlying Pindan sand.

7.7.4 Groundwater Quality

The salinity of groundwater in the Broome Sandstone Aquifer is low, and is often less than 500 mg/L, but increases near the coastline and Roebuck Plains. Groundwater salinity values of 110 mg/L to 200 mg/L were obtained from the aquifer test boreholes (Pennington Scott 2014).

A saltwater interface occurs within the Broome Sandstone aquifer along the coastline. The Department of Water areal electromagnetic survey indicates it is typically situated about 3 km inland, but can also extend much further inland beneath the Roebuck Plains.

Groundwater in the Broome Sandstone Aquifer is predominantly of sodium – chloride type, with elevated levels of bicarbonate in some areas (Laws, 1991). Silica levels are high, with reported values of 18 to 119 mg/L. Nitrate levels are frequently over 40 mg/L, probably as a result of nitrate fixation by native acacias and termite activity. Areas of saltwater intrusion and tidal inundation tend to have elevated magnesium and sulphate (Laws, 1991).

7.8 HYDROLOGY

The Mine Site Development Envelope is located on sandy soils with low runoff generation and there are no defined watercourses within the main mine development areas. The nearest watercourses are the Fraser River South, which has a visible channel from approximately 10.5 km downstream of the mineral deposit area. There are no year-round surface water bodies within the Mine Development Envelope. The nearest semi-permanent pools are approximately 25 km downstream on Fraser River South.

7.9 FLORA AND VEGETATION

A total of 255 vascular plant taxa, representative of 129 genera and 44 families were recorded in the Mine Site Development Envelope survey area (Mattiske 2016). The majority of taxa recorded were representative of the Poaceae (46 taxa), Fabaceae (45 taxa), Malvaceae (18 taxa), Cyperaceae (14 taxa), Myrtaceae (14 taxa), Amaranthaceae (12 taxa) and Convolvulaceae (10 taxa) families.

No Threatened flora pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* or *EPBC Act* were recorded within the Mine Site Development Envelope (Mattiske 2016).

Two Priority taxa were recorded within the flora survey area by Mattiske (2016), *Triodia caelestialis* (P3) and *Pterocaulon intermedium* (P3) (Mattiske 2016) (Figure 12). *Triodia caelestialis* was recorded widely; with *Pterocaulon intermedium* (P3) recorded infrequently. Both taxa were not associated with any specific landforms, soil types or vegetation communities.

Three other Priority flora taxa were recorded infrequently in the Mine Site Development Envelope survey area by Ecologia (2012, 2014, 2015) (Figure 12). These taxa were *Fuirena incrassata* (P3), *Fuirena nudiflora* (P1), and *Tephrosia valleculata* (P3). *Eriachne sp. Dampier Peninsula* (K.F. Kenneally 5946) was previously reported as a

Priority 3 (Ecologia 2014), however, is no longer listed as a priority taxon (DPaW 2016g). None of these three taxa were recorded during the Matiske (2016) survey of the Mine Site Development Envelope.

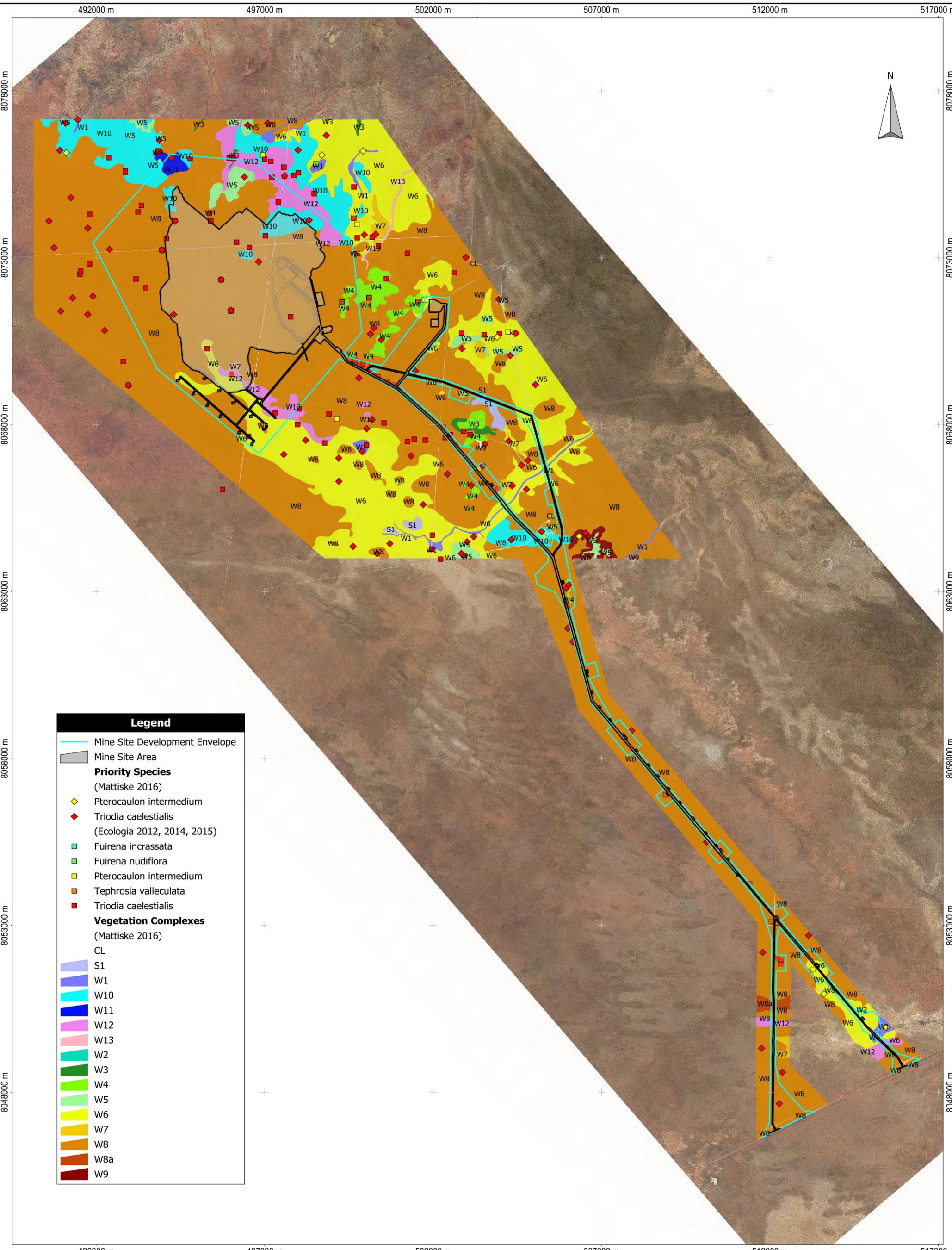
Poor rainfall conditions prior to the 2016 survey may have precluded *Fuirena incrassate* (P3), an annual species, from being recorded. However, according to DPaW (2016c), the distribution of *Fuirena nudiflora* (P1) is restricted to the Victoria Bonaparte and Central Range IBRA regions, near to the borders of the Northern Territory and South Australia. Its presence in the Mine Site Development Envelope survey area would represent a range extension of approximately 1,000 km to the west (DPaW 2016c). No specialist taxonomic identification was undertaken in 2014 to confirm its presence within the Mine Site Development Envelope survey area.

A total of 14 vegetation communities were defined and mapped, based on a statistical analysis of the combined data from (Ecologia 2012, 2014a and 2015a) and Matiske (2016) (Figure 12).

Two of the Pindan vegetation (low sparse eucalypt woodlands over *Acacia tumida* shrubland over *Triodia/Chrysopogon* grasslands) vegetation communities, W6 and W8, accounted for approximately 86% of the surveyed area and were considered the most representative of the Mine Site Development Envelope (Matiske 2016). The other main communities mapped were associated with the drainage channels (*Melaleuca viridiflora/Melaleuca alsophila* woodland) and rocky hills. Vegetation associated with the hills and drainage channels within the Mine Site Development Envelope were statistically different from the vegetation communities defined on the flats.

In broad terms, the vegetation of the Mine Site Development Envelope consists of vegetation, where there is a sparse overstorey of *Eucalyptus/Corymbia* species – typically *Corymbia greeniana/Eucalyptus tectifera* – over a mid-storey of *Acacia* species, dominated by *Acacia tumida* var. *tumida*, and a ground storey of mixed grasses, with *Triodia caelestialis* (P3), *Triodia schinzii*, and *Chrysopogon* species (*C. pallidus*, *C. timorensis*) being dominant. Other common species in the upper storey included *Brachychiton diversifolius*, *Corymbia zygophylla*, *Erythrophleum chlorostachys*, and *Eucalyptus flavescens*. *Atalaya hemiglaucata*, *Bauhinia cunninghamii*, *Dolichandrone heterophylla*, *Ehretia saligna*, *Gardenia pyrifolia* subsp. *keartlandii*, *Grevillea pyramidalis*, *Hakea arborescens*, and *Hakea macrocarpa* were common midstorey species. Some of these, such as *Bauhinia cunninghamii*, were often of sufficient size as to form a component of the upper storey. The vegetation is essentially pindan and is common and widespread through the broader Kimberley region.

Overall, the vegetation communities mapped and species recorded in the wider area surrounding and including the Mine Site Development Envelope are consistent with the historical mapping of Beard (1976) and the more recent land systems mapping of Kimberley by Schoknecht and Payne (2010).



Legend

- Mine Site Development Envelope
- Mine Site Area
- Priority Species**
(Mattiske 2016)
- ◆ Pterocaulon intermedium
- ◆ Triodia caelestialis
(Ecologia 2012, 2014, 2015)
- Fuirena incassata
- Fuirena nudiflora
- Pterocaulon intermedium
- Tephrosia valleculata
- Triodia caelestialis
- Vegetation Complexes**
(Mattiske 2016)
- CL
- S1
- W1
- W10
- W11
- W12
- W13
- W2
- W3
- W4
- W5
- W6
- W7
- W8
- W8a
- W9

Scale: 1:100000
 Original Size: A3
 Air Photo Date: 2015
 Grid: Australia MGA94 (51)

0 4 km

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Figure 12
**Vegetation Communities and Conservation Significant
 Flora**

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MBS
 ENVIRONMENTAL

7.10 FAUNA AND HABITATS

Surveys recorded a total of 20 mammals, 118 birds, 44 reptiles, and eight amphibians in the Mine Site Development Envelope and surrounding areas. Of these, nine were of conservation significant, however only three of these were found within the impact area of the Mine Site Development Envelope. These were the Short-tailed Mouse, Greater Bilby, and Rainbow Bee-eater.

Three broad fauna habitats were identified within the Mine Site Development Envelope, namely:

- Pindan Shrubland.
- Savannah Woodland.
- Sandstone Range.

The Pindan Shrubland habitat is most extensive, covering the majority of the central and southern region. The Sandstone Range habitat is the second most widespread within the area found mainly across the northern region of the survey area, but also extends partly down into the east. The Savannah Woodland habitat is the least extensive, characterised by plains in the low-lying areas to the south and east of the survey area.

Most of the conservation significant species identified during the database searches were either marine or migratory fauna.

7.10.1 Short Range Endemics

Surveys undertaken for SRE's yielded a total of 200 invertebrate specimens with a total of six orders, 11 families and 31 taxa. Of these species, 22 were identified as being potential SRE, with one species (the land snail *Rhagada bulgana*) confirmed as a SRE.

Of the 23 confirmed and potential SREs:

- 17 were found in similar habitats outside the Mine Site Development Envelope.
- Three (*Olpidae* 'genus indet. (Juvenile)', *Aname* 'sp. Indet.' and *Aname* 'sp. Juv.') were represented by juveniles and due to a lack of morphological data and sub adult stage could not be identified to species level. Given that all three of these specimens were collected from the extensive Pindan Shrubland habitat throughout the impact area, they are likely to have distributions that extend well beyond the boundary of the impact area.
- One (*Urodacus* sp. Indet) was unable to be identified to species level based on morphological characteristics, however based on distribution patterns of *Urodacus* 'kraepelini' and given this species was collected from the extensive Pindan Shrubland habitat, its distribution is expected to extend well beyond the boundary of the impact area.
- One (*Aname* 'MYG387?') was represented by a single female specimen. It is possible that this female is conspecific with the male species of *Aname* 'MYG387' which would indicate that its habitat preferences includes both the extensive Pindan Shrubland and Sandstone Range habitats, and is therefore widespread in the area.
- One (*Lychas* 'JPP2') was restricted to the impact area, however utilising *Lychas* 'JPP', 'JPP1' and 'JPP3' as species surrogates and based on their distribution within the extensive Pindan Shrubland and Savannah Woodlands habitats it can be inferred that *Lychas* 'JPP2' will have a home range that extends well beyond the impact area.

Based on the above as well as the habitat preferences for the invertebrate taxa recorded within the Mine Site Development Envelope and surrounding area, no potential SRE taxa are expected to be restricted to the proposed Mine Site Development Envelope.

7.11 SUBTERRANEAN FAUNA

Subterranean surveys identified a low diversity and abundance of subterranean fauna with no stygofauna being recorded during the survey.

Similarly to stygofauna, there appears to be a low diversity and abundance of troglifauna. This is potentially due to the habitat being dominated by Pindan sand plains which have little or no cavernous or vuggy habitat space. Only a single specimen (*Staphylinidae* sp. Indet) was recorded from within the Mine Site Development Envelope. As such, it is likely that habitat occurs within the Mine Site Development Envelope but given the relatively continuous and expansive geology outside of this area and with no obvious dispersal barriers, this species is unlikely to have a restricted distribution and may occur within the extensive sandstone habitats in the ranges to the east and north of the project.

7.12 FIRE

The Mine Site Development Envelope is located within the Mt Jowlaenga pastoral lease and is subject to regular burning by pastoralists, other stakeholders, and as a result of lightning strikes. The burning pattern within the Mine Site Development Envelope is reflective of controlled burning by land users to reduce the amount of combustible fuel in the area rather than sporadic and localised burning caused by wet season thunderstorms (Ecologia 2015c).

7.13 HERITAGE

A search of the Mine Site Development Envelope and surrounds was undertaken using the Department of Aboriginal Affairs 'Aboriginal Heritage Inquiry System' to identify:

- Aboriginal Heritage Surveys over or near the Mine Site Development Envelope.
- Registered Heritage Places within or near the Mine Site Development Envelope.
- Other Heritage Places within or near the Mine Site Development Envelope.

No registered Aboriginal sites or other heritage places of significance are located within the Mine Site Development Envelope. The nearest registered heritage place is approximately two kilometres from the project and well away from any possible effect of the project.

Engagement with Traditional Owners and their representatives, the Kimberley Land Council (KLC) and KRED Enterprises' (KRED) subsidiary EHSIS (Environmental Heritage Social Impact Services), has been ongoing for five years. In 2011, Sheffield entered into a Native Title, Heritage Protection and Mineral Exploration Agreement, which has governed the undertaking of surveys and exploration work programs.

Aboriginal heritage surveys to support exploration activities have been undertaken in consultation with Traditional Owners annually since 2012. In 2016, an Aboriginal heritage survey was carried out with Traditional Owners through KRED's subsidiary EHSIS. This survey focussed on the areas of the mineral deposit footprint and Development Envelope, identifying and evaluating any potential impacts to Aboriginal heritage from the proposed project. The results of this survey have been used to inform project feasibility and detailed planning for the project.

All surveys have been undertaken using aerial (helicopter) and pedestrian (on ground) methods, utilising the existing knowledge of Traditional Owners and targeting on-ground investigations especially to locations considered to have most potential for Aboriginal sites to exist, such as rocky outcrops, water sources and areas of good ground surface visibility. Over the past five years these surveys have covered the entire Mine Site Development Envelope.

The outcomes of the surveys were:

- The project area has been extensively and comprehensively surveyed, and all areas considered sensitive to Aboriginal cultural values in the Mine Site Development Envelope and surrounds have been covered.
- Aboriginal sites and areas of Aboriginal cultural value have been identified and mapped (AHA 2016).
- Avoidance buffer zones have been determined by Native Title claimants.

Further detail regarding the results of the Aboriginal heritage surveys are subject to a confidentiality agreement between Sheffield and the Native Title claimants at the claimant's request. As such, Sheffield is unable to disclose to the location of the Aboriginal heritage sites for public review.

8. IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

8.1 PRINCIPALS

A preliminary assessment of the principal closure risks identified for the project, and mitigations or management measures in place or proposed for each risk, is provided in Appendix 1. The risk assessment is based on principles set out in AS/NZS ISO 31000:2009 *Risk Management - Principles and Guidelines*, and adopts definitions of likelihood and consequence that have been used to evaluate each risk as it stands, and determine whether it is tolerable (requiring no further management), or requires further management.

The risk assessment considers how, and to what extent, the aspects discussed in Section 4 threaten the objectives and post-mining land uses discussed in Section 5, and the obligations discussed in Section 3, and considers what controls or mitigations are already present. The risk of each hazard is determined by identifying the worst realistic consequence (for health, safety, environment, cost, or reputation) and the likelihood of that consequence. The risk is then classified according to a risk classification matrix, included in Appendix 1.

Where a risk is not considered tolerable, additional controls are proposed, and the residual risk after these additional controls is evaluated and classified according to the same method. These controls are integrated into implementation plans (Section 9), schedules of studies, monitoring and maintenance (Section 10) and accounted for in financial provisioning (Section 11). Where a risk relates to uncertainty or lack of information, it is identified as a knowledge gap, and incorporated into implementation plans for the relevant closure area (Section 9). Risk provisions will be made to allow for residual risks or uncertainty after control (Section 11).

As the project is at a planning stage and its organisational structure is yet to be confirmed, responsibilities for closure risk management measures have not been assigned to particular positions, and only very broad timeframes set. More specific responsibilities and timeframes will be established in subsequent revisions of this MCP.

8.2 PRINCIPAL RISKS

The most significant current risks identified for closure of the project, before future controls, are:

- Closure obligations prove impractical, and cannot be met. Principal controls include studies, stakeholder consultation and engagement, and re-negotiation of closure obligations and criteria over the life of the operations. The risk is considered “low” after controls.
- Premature closure of the mine, potentially leading to exposed tailings material both in the TSF and mine pits that remains unrehabilitated. This risk and proposed mitigations are addressed further in Section 9.4.
- Injury or illness caused to workers in the course of decommissioning and rehabilitation work. Principal controls include provision for and maintenance of adequate OHS management and emergency response services following operational closure. The risk is considered “medium” after control, but as low as reasonably practicable (ALARP).
- Injury caused to a member of the public, from accessing unsafe or unstable decommissioned infrastructure, landforms, or voids. Principal controls include proper demolition of structures, warning signs, and bunds across access roads and around unstable areas. The risk is considered “low” after implementation of controls.
- Stormwater ponding or runoff on any remaining mine waste landforms such as the TSF or mineral deposit area, leading to instability and/or erosion and sediment transport over the long term. Principal controls include studies to confirm the stability and resistance of rehabilitation designs informing a final landform

design incorporating surface water controls, and diversion/containment structures for runoff and sediment. The risk is considered “medium” after implementation of controls, but ALARP.

- Insufficient mine waste material to backfill final mine void and need to engineer safe final void environment with potential formation of mine pit lake with increasing salinity trends. As a surplus of material is anticipated following mining and backfill, the resulting landscape is expected to be slightly mounded. Principal controls for this will include ongoing updates to the mine plan and materials balance over the life of mine. The risk is considered “low” after the implementation of controls.
- Ineffective co-disposal of mine waste material streams in mine pits could result in changed hydrogeological parameters. Principal controls include the proper co-disposal of materials as per approved plans and procedures as well as trials early in the life of mine. The risk is considered “low” after the implementation of controls
- Over-estimation of material swell factor resulting in excessive consolidation of backfilled material within mine pits and formation of local depressions and seasonal surface water ponding. Principal controls will be the monitoring of rehabilitated areas as the project proceeds and amending swell factor calculations should slumping be noted. Remedial works may be undertaken to remedy areas where slumping is noted. The risk is considered “low” after the implementation of controls
- Failure to stockpile sufficient topsoil and growth medium to support revegetation objectives. Principal controls include preparing and implementing a plan to harvest identified topsoil and growth medium resources from the disturbance footprint. The risk is considered “low” after implementation of controls.
- A legacy of contaminated sites, accumulated from spills over the life of mine. Principal controls include spill prevention, cleanup and remediation over the course of operations, and validation of cleanup according to Contaminated Sites guidelines (progressively or at closure). The risk is considered “low” after implementation of controls.

9. CLOSURE IMPLEMENTATION

This section details closure implementation activities, which include research and field trials to assist in refining the proposed closure and decommissioning tasks for each closure group and landform feature.

9.1 GENERAL CLOSURE AND REHABILITATION MANAGEMENT MEASURES

9.1.1 Planning

Rehabilitation and closure outcomes are heavily influenced by actions and decisions made early in the mine life. To ensure that successful closure and rehabilitation outcomes are achieved, Sheffield will ensure that:

- Planning shall identify post-mining land uses and aim to ensure that the rehabilitated mine site post-mining management can be integrated into the surrounding areas.
- Adequate resources (topsoil, capping material for landforms, seed and vegetative material) are identified and available for successful rehabilitation.
- Studies and research trials are undertaken early in the mine life to ensure rehabilitation processes are based on sound science.
- The life of mine plan is updated annually and integrated with rehabilitation requirements, annual landform and rehabilitation plans are prepared, monitoring and research results are reviewed and incorporated into rehabilitation procedures.
- Stripping of mining areas is planned such that the potential for significant runoff and erosion is limited by considering:
 - Timing in relation to wet season.
 - Drainage protection such as bunds, drains and sumps.
 - Planning for water storage within the open area to minimise the risk of needing to release excess water from the mine directly offsite.
- Planning for direct replacement of topsoil is undertaken wherever practicable.

9.1.2 Management of Topsoil and Growth Medium

During project development, vegetation and topsoil resources will be stripped from permanent infrastructure areas and appropriately stockpiled to minimise rehandling costs at closure. Prior to commencement of mining, vegetation will be removed and stockpiled for later use in rehabilitation of the mineral deposit area. The depth of potentially recoverable soil from the mineral deposit area is expected to be very deep, however there is little development of the nutrient rich topsoil layer of the local Pindan soils, therefore harvesting of topsoil will be restricted to approximately 100 mm (MBS 2016). This will provide sufficient topsoil for rehabilitation of mined areas. Where practicable, Sheffield will undertake direct replacement of topsoil to backfilled and reprofiled areas.

Generally, topsoil resources will be placed at the periphery of the areas from which they were stripped, or close to where they will be finally deployed. These resources will be protected from use, disturbance, contamination or erosion over the life of the operations. Topsoil stockpiles will be stockpiled no more than 2 m deep, to preserve inherent nutrients and seed bank.

9.1.3 Management of Seed

Sheffield will collect local native seed over the life of the project, to supplement the seed bank in topsoil and growth media stockpiles. The quantity available may vary from year to year, depending on rainfall and drought. The most suitable and efficient seed mixes to collect will be determined from studies, and the quantities determined from estimates of viable seed bank established in growth medium stockpiles. Different seed mixes may be selected for different natural and artificial landforms, depending on closure criteria.

Local people will be engaged in seed collection where practicable. Seed will be treated as a valuable asset, and stored in appropriate climate-controlled containment where necessary to ensure it remains viable until used. Any unused seed at relinquishment will be sold at local market rates, if possible.

9.1.4 Progressive Rehabilitation and Trials

Prior to commencing any rehabilitation works in the mineral deposit area, Sheffield will undertake rehabilitation field trials on the initial TSF. These will help refine the proposed rehabilitation methodology, including the required depth of growth medium, topsoil and target vegetation species.

The mineral deposit area will be progressively backfilled and rehabilitated as mining moves in a “forward direction”. Sheffield will establish monitoring sites on progressively rehabilitated areas over the life of the operations to determine the likely performance of post-closure rehabilitation, or to test the success of different treatments such as seed mixes, in order to establish a substantial history of rehabilitation monitoring ahead of closure and support relinquishment at the earliest reasonable time.

9.2 PLANNED CLOSURE

9.2.1 Overview

Operations will be managed over the life of mine to avoid a legacy of issues such as unnecessary disturbance, contamination, weeds, or feral animals that will have to be addressed at or before closure (e.g. through control of clearing, prevention and recovery of spills, vehicle hygiene, and management of food wastes).

At the end of the scheduled mine life, once the exploitable resource has been exhausted, suitable elements of the mining fleet (such as loaders, excavators and haul trucks) will be directed to rehabilitation and decommissioning works where practicable; the remainder will be demobilised. Additional equipment may be mobilised where required for specialist tasks or where efficiencies will be realised that outweigh mobilisation costs.

Once processing ceases, decommissioning works will begin on the processing plant and ancillary infrastructure. Remaining bulk quantities of process reagents will be sent off-site for use at another operation, returned to the supplier, or disposed of at a licenced disposal. All economically salvageable structures and parts will be dismantled and loaded out; the remainder will be demolished. Some facilities such as accommodation, power, water, and other services will be retained as required to support the decommissioning and rehabilitation crews, and progressively closed as works reach completion and crews are demobilised (unless appropriate and binding agreements are in place for transfer to a third party).

Any other salvageable equipment or parts will be set aside for collection by a third party. Scrap metal and other economically recyclable materials will be set aside and taken off site to a recycler. Any un-remediated contamination identified in the course of operations or at closure will be treated in place or appropriately disposed of. Hazardous wastes or contaminated materials will be collected for disposal off-site by a licenced contractor, where necessary.

All disturbed areas, aside from the TSF and any infrastructure transferred to third parties, will be re-contoured to restore the natural surface drainage as far as practicable. Stockpiled topsoil and vegetation will be re-spread over

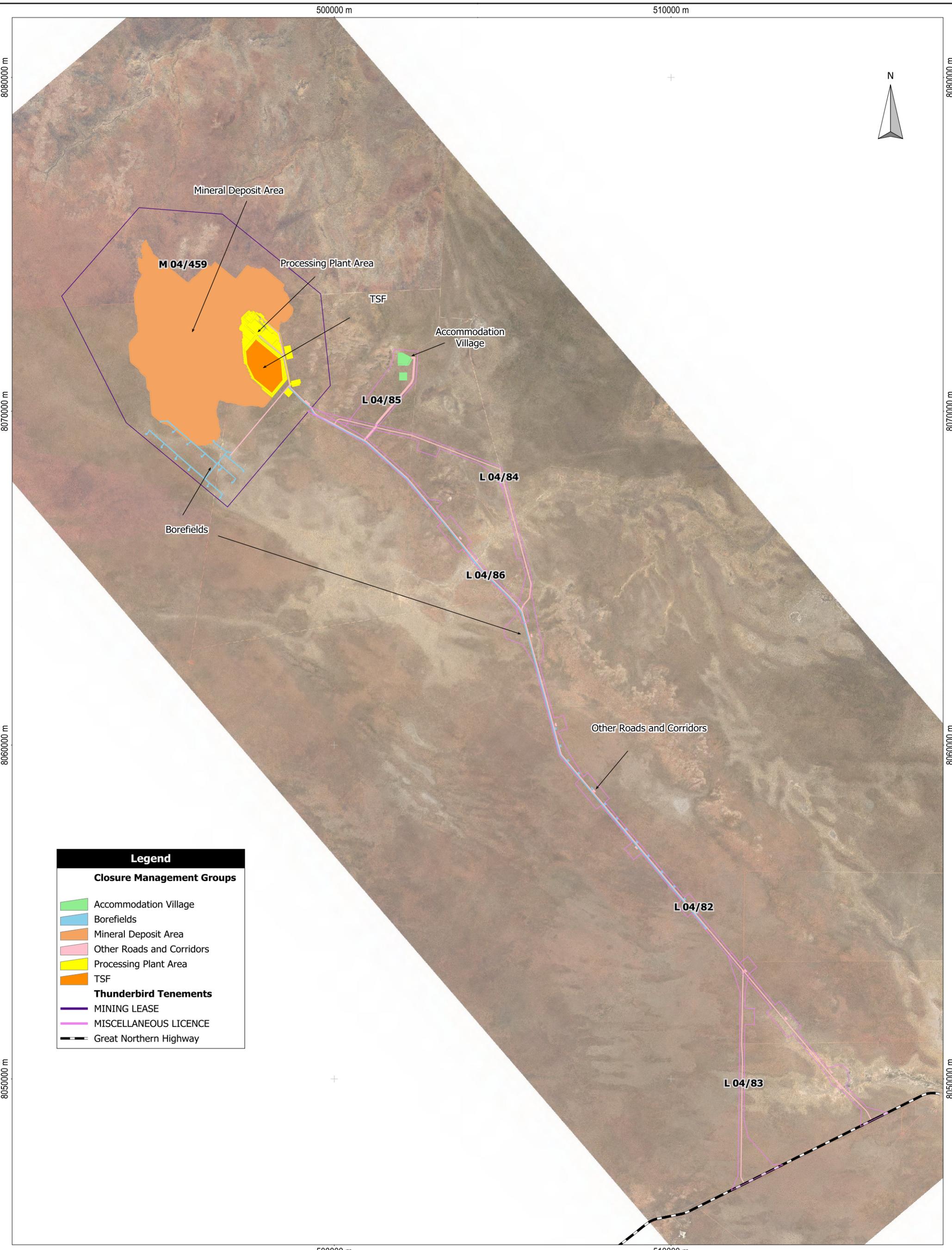
disturbed areas to prevent erosion and promote revegetation, and disturbed areas ripped to an appropriate depth to promote rain infiltration.

Where necessary and appropriate, reinstated disturbances will be spread with a supplementary mix of local provenance native seed. The seed mix may vary according to the natural landform or soil association.

For closure management purposes, the features or areas of a minesite may be put in groups (referred to by DMP as “domains”) depending on the types of decommissioning and rehabilitation works required at closure. Closure groups for the project are summarised in Table 12 and shown on Figure 13. General measures, prescriptions and closure tasks for each group are summarised in the following sections and form the project’s closure task register, as required by the Guidelines for Preparing Mine Closure Plans (DMP, EPA 2015). This closure task register will be progressively updated and refined in future iterations of the MCP. Sheffield will prepare a detailed plan for implementation no less than two years before the expected end of the life of operations.

Table 12: Closure Management Groups

Grouping	Main Features	Maximum Footprint Over Life of Mine (ha)
Mineral Deposit Area	Mineral deposit area including in-pit tailings disposal, perimeter roads, slurry pipelines, dewatering infrastructure.	1,711
TSF	Tailings surface, outer embankments, tailings and return water lines, misc. associated disturbance.	106
Borefields	Water supply bores, reinjection bores, pumps and generators, pipelines, power lines, access roads.	117
Processing Plant Area	Wet and dry processing plant, bulk stores, product storage and handling areas, sediment ponds, process water ponds. This domain also includes all services such as workshops, power station, bulk fuel storage, offices, stores warehouse, laydown / salvage areas, pipelines, and landfill.	146
Accommodation Village	Accommodation units, kitchen, sewage treatment plant, associated offices and buildings.	19
Other Roads and corridors	Roads and services corridors not included in above areas including site access road.	182



Legend	
Closure Management Groups	
	Accommodation Village
	Borefields
	Mineral Deposit Area
	Other Roads and Corridors
	Processing Plant Area
	TSF
Thunderbird Tenements	
	MINING LEASE
	MISCELLANEOUS LICENCE
	Great Northern Highway

Scale: 1:100000
 Original Size: A3
 Air Photo Date: 2015
 Grid: Australia MGA94 (51)

Sheffield Resources Limited
 Thunderbird Mineral
 Sands Project

Figure 13
Closure Management Groups

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9.2.2 Closure Task Register

9.2.2.1 Mineral Deposit Area

Mined areas within the mineral deposit area will be progressively backfilled and rehabilitated throughout the life of mine. Significant closure and rehabilitation works are not likely to be required upon closure. During operations, Sheffield will:

- Undertake progressive back filling of mined areas with tailings and overburden.
- Profile the post-mining landform such that it remains consistent with the surrounding landscape and allows free drainage.
- Apply topsoil/growth medium.
- Deep rip/scarify as required.
- Apply local provenance seed, as required.
- Rehabilitate any roads or tracks that are no longer required.

Sheffield will also undertake the following to refine rehabilitation practices within the mineral deposit area:

- Ongoing studies and observations of backfilled mine waste material consolidation.
- Trials and/or studies to determine appropriate topsoil/overburden cover thicknesses.
- Ongoing rehabilitation materials balance.

9.2.2.2 TSF

To close the TSF Sheffield will:

- Construct the TSF embankments to form a final, single outer slope at closure of about 15°.
- Manage tailings deposition over the life of the TSF to ensure that an even final tailings surface is obtained, sloping inwards towards the centre at the settled beaching angle of approximately 1° to 2°.
- Ensure that the TSF cover design provides adequate, long term protection against wind and water erosion.
- Flush tailings and return water pipelines out to the TSF, and cut up and remove for disposal and collection by an HDPE recycler.
- Spread stockpiled topsoil and vegetation on the TSF surface and batters, to an appropriate depth to support revegetation objectives.
- If indicated as appropriate by further studies and/or trials, apply a suitable mix of supplementary native seed to the TSF surface.
- Where appropriate, construct internal and peripheral bunds to control the flow of surface water over the rehabilitated landform and minimise erosion, including a crest bund around the upper perimeter. The crest bund will be sufficiently high to provide adequate freeboard for most storm events. If required, a contingency spillway will be constructed to provide a controlled discharge during extreme storm events.

Prior to closure of the TSF, Sheffield will undertake trials to ascertain the most appropriate rehabilitation methodology, with consideration to tailings cover requirements and seed mixes.

9.2.2.3 Borefields

To close the borefield, except where binding arrangements are in place for transfer of water supply infrastructure to a third party, Sheffield will:

- Pull up bore pumps for salvage or disposal.
- Disconnect and dismantle overhead powerlines, setting aside cables and steel for salvage or scrap.
- Decommission generators or fuel tanks for salvage or disposal; clean out containment bunds and treat or appropriately dispose of contaminated soil; remove and dispose of bund liners.
- Cut up and remove HDPE pipelines for shredding and collection by an HDPE recycler.
- Push in any pipeline containment bunds and scour pits.
- Remove the HDPE liner from the transfer and storage dam, and push the pond walls in to reinstate the natural ground surface; empty any intermediate or final water tanks, and set aside for salvage, scrap or disposal.
- Fully decommission bores in accordance with DoW standards; some monitoring or production bores may be left in place for post-closure monitoring.
- Rehabilitate access tracks and pipeline corridors as set out in Section 9.2.2.6.

Bores and pipelines will be retained as necessary to support the decommissioning and rehabilitation work (e.g. potable / village use, dust suppression, washdown) and progressively closed once no longer needed. Temporary minor facilities, such as transportable water tanks, may be brought in if required as works draw to a close.

The closure of the borefield presents no unconventional challenges, and no particular knowledge gaps are identified at this stage. Monitoring of abstraction over the life of mine can be used to confirm initial drawdown modelling, or revise the modelling if necessary; abstraction will be managed to avoid or mitigate impacts. Post-closure monitoring should confirm that the aquifer is following the predicted trend to recovery.

9.2.2.4 Processing Plant

Infrastructure

To close the processing plant area and related infrastructure, Sheffield will:

- Export all remaining product. Any residual product and potentially contaminated soil will be scraped up and disposed of appropriately.
- Clean down and flush the plant, tanks and pipelines of residual process slurries and reagents, and discharge as in-pit tailings.
- Terminate and make safe water, power and other services. Below-ground services will be terminated well below ground level and left in place.
- Remove unused reagents for return to the supplier or sale to another site, if possible, or disposal by a licenced contractor.
- Remove any components for salvage, then dismantle and/or demolish the plant, reagent stores and associated structures; set aside steel for scrap collection, or dispose of in the open pit.
- Break up concrete slabs, containment bunds, and footings to about 0.4 m below ground level. Broken-up concrete will be buried in place, in nearby disposal pits.
- Identify and demarcate all potentially contaminated soils for investigation and remediation.
- Re-contour the disturbed footprint to restore the natural surface drainage as far as practicable, deep rip to promote infiltration, and respread stockpiled topsoil and vegetation to promote revegetation.

The closure of the processing plant area presents no unconventional challenges, and no particular knowledge gaps are identified at this stage. Spill response and (if necessary) contaminated sites investigations over the life of mine will remediate and/or identify any potential areas of contamination requiring remediation.

Services

To close other ancillary services within the processing plant area, including workshops, stores, and associated laydown and parking areas, Sheffield will:

- Reduce stores of lubricants, fuels, chemicals, parts and other materials to the minimum required for decommissioning and rehabilitation works.
- Drain and clean remaining tanks, plant, and equipment of hydrocarbons.
- Terminate and make safe water, power and other services. Below-ground services will be terminated well below ground level and left in place.
- Dismantle and load out all economically salvageable equipment, plant, buildings, structures and parts, and demolish the remainder, unless appropriate agreements are in place for handover to a third party.
- Set aside any scrap metal and other economically recyclable materials, and send off-site to a recycler.
- Identify and demarcate known or potential contamination, and remediate in place or excavate and dispose of appropriately, and backfill with clean, inert material.
- Clean up general rubbish for disposal in landfill.
- Segregate waste hydrocarbons, chemicals and other hazardous wastes or contaminated materials for collection and disposal off-site by a licenced contractor, where necessary.
- Dispose of any demolition or remaining materials in pits dug for the purpose.
- Remove signs and fences where no longer required.
- Break up concrete slabs, footings, and containment bunds to about 0.4 m below ground level. Broken-up concrete will be buried in place, in nearby disposal pits.
- Re-contour the disturbed footprint to restore the natural surface drainage as far as practicable, deep rip to promote infiltration, and respread stockpiled topsoil and vegetation to promote revegetation.

Facilities such as workshops, washdown and hydrocarbon storage, and services such as power and water will be retained as required to support the decommissioning and rehabilitation fleets and progressively decommissioned as work is completed. Temporary minor facilities, such as transportable workshops, fuel tanks, and generators, will be brought in if required to service requirements once major facilities are decommissioned.

9.2.2.5 Accommodation Village

To close the accommodation village, except where binding arrangements are in place for transfer of facilities to a third party, Sheffield will:

- Remove furniture (beds, chairs, etc.) and equipment (washing machines, kitchen appliances, etc.) for salvage or disposal, and clean up general rubbish for disposal in the landfill.
- Terminate and make safe water, power and other services. Below-ground services will be terminated well below ground level and left in place.
- Progressively disconnect and load out accommodation units and other demountable buildings for return to the leasing company, or sale to another party. Where buildings cannot be returned or sold, they will be demolished for disposal.
- Flush and clean down the waste water treatment plant, and arrange for accumulated sludges to be disposed of by an appropriate contractor; remove and salvage or dispose of tanks and other parts; push in any settling/ evaporation ponds. Sewage irrigation areas will generally remain uncleared during operations, and will be left at closure for any accumulated nutrients and salts to dissipate.
- Break up concrete slabs and footings to about 0.4 m below ground level. Broken-up concrete will be buried in place, in nearby disposal pits, or the open pit.

- Re-contour the disturbed footprint to restore the natural surface drainage as far as practicable, deep rip to promote infiltration, and respread stockpiled topsoil and vegetation to promote revegetation.

Some accommodation units, basic kitchen and mess facilities, power, water, sewage treatment, and other services will be retained as necessary to support the decommissioning and rehabilitation crews, and progressively closed once no longer needed.

The closure of the village presents no unconventional challenges, and no particular knowledge gaps are identified at this stage. Monitoring of progressively rehabilitated areas over the life of mine should confirm that disturbed areas can be adequately rehabilitated by conventional methods, or identify where additional measures such as supplementary seeding may be required.

9.2.2.6 Roads and Service Corridors

To close roads and service corridors, including the site access road and except where binding arrangements are in place for transfer of liabilities, Sheffield will:

- Remove culverts and reinstate any drainage line crossings, where appropriate, and re-contour the road or service corridor alignment to restore the natural surface drainage as far as practicable.
- Deep rip to promote infiltration (deeper in areas of heavy traffic and/or high compaction), and respread windrowed topsoil and vegetation to promote revegetation.
- Construct substantial bunds across the entry to the rehabilitated corridor to prevent vehicle access.
- Place signs showing “TRACK UNDER REHABILITATION – KEEP OFF”, or similar.

Roads and service corridors will be retained as required by the decommissioning and rehabilitation crews, and progressively closed as and when no longer required. A narrow track will be maintained to provide access to the site for post-closure monitoring and maintenance, and rehabilitated at final relinquishment.

The closure of the other roads and service corridors presents no unconventional challenges, and no particular knowledge gaps are identified at this stage. Monitoring of progressively rehabilitated areas over the life of mine should confirm that disturbed areas can be adequately rehabilitated by conventional methods, or identify where additional measures such as supplementary seeding may be required.

9.3 SUSPENSION

A variety of unexpected events, such as a ground failure in the mineral deposit area, a safety incident, or failure of plant, infrastructure or supply lines may require a temporary suspension of operations; such suspensions will tend to be relatively brief in the life of mine, and Sheffield will control such hazards as far as possible to reduce the likelihood of interruptions to operations.

However, other circumstances, such as adverse commodity market conditions, or a combination of circumstances, may require a prolonged suspension of operations, well before the end of the scheduled life of mine. Such circumstances are beyond the control of Sheffield, however Sheffield will develop a detailed plan for the care and maintenance of the site in the event that a substantial suspension becomes necessary, to protect the environment, public safety, and project assets.

If it appears that a prolonged suspension may be necessary, Sheffield will:

- Conduct safety and environmental reviews of the site, and prepare a plan to address any particular hazards identified for suspension.
- Notify DMP as required, and other regulators as appropriate, and provide details of arrangements for the care and maintenance of the site.

- Move all mobile or transportable plant and equipment out of the mine, to be cleaned down, made safe, and parked up and immobilised at a suitable location within the processing plant area.
- Flush the plant and tailings lines with water, and clean down the plant, storage and handling areas.
- Return bulk quantities of reagents to the supplier or another site, if possible, and reduce volumes of lubricants, fuels and chemicals to the minimum required for care and maintenance.
- Shut down and make safe services, including power and water supply, except where required for care and maintenance.
- Return rented equipment, except where required for care and maintenance.
- Demobilise most of the site personnel, to leave a small care and maintenance crew.
- Install fences with locked gates if necessary, to prevent unauthorised access to mine property and equipment.

During suspension, Sheffield will:

- Maintain adequate emergency and other support services for the care and maintenance crew.
- Inspect any active dewatering or other saline water lines and ponds for leaks, and repair where necessary.
- Take measures to suppress dust from the tailings surface if necessary, including use of water sprays and/or application of a binding agent.
- Inspect the TSF to identify any unacceptable erosion or sediment transport, and carry out remedial or containment earthworks if necessary.
- Care for and maintain the plant, equipment, buildings, borefields, access roads and other infrastructure, to protect the value of the assets and facilitate an eventual return to operations
- Continue monitoring and reporting to relevant regulators as required under current licences and permits.

In the event of any suspension of or return to operations, Sheffield will notify DMP and provide all required site plans and other information, as required under *MSIR*.

9.4 PREMATURE CLOSURE

A variety or combination of exceptional circumstances, such as an error in resource modelling or extraordinarily poor and prolonged market conditions, with little or no hope of recovery, may sometimes cause mines to close early, and well before the expected end of the life of mine.

Whilst Sheffield considers the likelihood of such circumstances extremely low, it will incorporate appropriate risk provisions for premature closure and the additional works that may be entailed when reviewing and setting current closure provisions. In most other substantial respects, the decommissioning and rehabilitation works required for unplanned closure will be the same as for planned closure. Sheffield will notify DMP and other relevant agencies in the event of any decision to close the mine substantially ahead of the expected life of mine.

10. CLOSURE MONITORING AND MAINTENANCE

10.1 OVERVIEW

Sheffield will conduct post-closure monitoring to address the risks identified in Section 6, and confirm that the objectives and criteria set out in Sections 5 and 6 are being met. An important function of this monitoring is to identify any need for remedial or maintenance works as early as possible, so that they can be carried out in a timely, well-organised, and cost-effective manner, before problems become worse and more difficult and expensive to correct.

For closure budgeting, it is generally accepted that key rehabilitation indicators will be monitored for at least 10 years after closure, except where sufficient progress toward completion criteria is demonstrated sooner, and it is agreed with the appropriate regulator that the relevant monitoring can be reduced or discontinued. The frequency of post-closure monitoring will generally decrease over time, once trends have been confirmed. To expedite this process, Sheffield will undertake trials and will commence monitoring on the rehabilitated TSF early on in the life of mine.

10.2 PUBLIC AND LIVESTOCK SAFETY

Post-closure monitoring for public and livestock safety will primarily comprise annual inspections to check that:

- Safety bunds and signs preventing access remain in place and in good repair.
- No new or unexpected areas of instability or subsidence have developed.

Contingency maintenance or remedial actions may include:

- Repairing safety bunds or fences, and re-installing signs.
- Extending safety bunds around new areas of instability or subsidence.

10.3 LANDFORM STABILITY

Techniques to monitor landform stability after closure are expected to include:

- Annual landform inspections for:
 - Signs of instability such as deflation, water ponding, slumping and erosion, with qualitative assessment of severity, and determination of causes.
 - Failures of surface water management structures on the TSF, including internal and crest bunds, rip lines, drains, sumps and contingency spillway.
- If considered appropriate and cost-effective, use of remote or automated sensing techniques such as photogrammetry or LiDAR, to periodically detect changes such as landform deflation, gully formation, and sediment deposition, as complementary or alternative to ground-based surveys.

Contingency maintenance or remedial actions, if indicated by monitoring, may include:

- Filling in and/or bunding off deflated surfaces or low points to prevent unwanted water ponding, especially at the periphery of landforms.
- Repairing, protecting or armouring bunds, drains, berms and other surface drainage and sediment controls.

10.4 REVEGETATION

Post-closure revegetation monitoring is expected to be an extension of pre-closure monitoring of progressive rehabilitation, and principally comprise assessment of aspects such as:

- Seed germination, recruitment and root formation.
- Vegetation density, cover, structure, diversity and disturbance, with reference to standard indices.
- Formation and density of vegetative litter.
- Presence and significance of weeds.
- Evidence and severity of grazing.
- Factors affecting revegetation performance.

Revegetation monitoring on post-mining landforms will generally be combined with landform stability monitoring. Inspections will also confirm that bunds and signs protecting revegetated areas remain in place and in good repair.

Revegetation will be assessed with reference to suitable local undisturbed analogue sites, to control for regional effects such as fire, drought, grazing, and weeds. For the post-mining landforms it may be difficult to find local or regional analogues, in which case the most similar local analogues or nearest regional analogues will be used, in so far as the analogy is reasonable.

Contingency maintenance or remedial actions may include:

- Where poor revegetation is due to erosion, landform instability, or poor control of drainage, maintenance or remedial actions as set out in Section 10.3.
- Supplementary seeding with appropriate local native species, and application of fertiliser, if appropriate.
- Treatment of weeds.
- Fencing to prevent grazing.

10.5 GROUNDWATER

Post-closure groundwater monitoring is expected to essentially be an extension of monitoring conducted during operations, but with progressively reduced frequencies once operations cease. Groundwater conditions and trends should be well established from monitoring completed during operations, and either support or be used to refine initial hydrogeological assessments and models.

Post-closure groundwater monitoring for the initial TSF and backfilled mineral deposit area will largely comprise an extension of the operational monitoring program, and incorporate water levels and quality in monitoring bores around project landforms. The monitoring will be used to demonstrate when seepage impacts from operations stabilise and contract as any groundwater mounding subsides and to monitor the recovery of the groundwater cone of depression. Water quality parameters will include salinity, pH, major ions, and any metals of concern as identified through geochemical characterisation of tailings wastes.

10.6 RAINFALL

Sheffield will continue to maintain a weather station at the Mine Site, to maintain a record of rainfall that can be correlated with:

- Landform monitoring, to help assess stability and resistance to erosion from rain events of differing intensity.
- Revegetation monitoring, to help assess the effect of rain and drought on revegetation performance.

- Groundwater monitoring, to help interpret changes in post-mining groundwater levels and assess any seepage response from the initial TSF.

10.7 QUALITY ASSURANCE

All post-closure monitoring will be carried out by competent persons, following documented monitoring procedures. Monitoring data will be checked, reviewed and reported on by suitably qualified persons following appropriate QA/QC procedures. Inspections and monitoring rounds will typically include photographs from established points to verify reports and build up a photographic record over time.

All water or soil samples taken for pre and post-closure monitoring will be collected, preserved, stored, handled and transported in accordance with relevant Australian standards, and submitted to an appropriately accredited laboratory for analysis. Monitoring data and supporting laboratory certificates will be maintained in a well-organised database.

10.8 REPORTING

Sheffield will report any monitoring and remedial or maintenance works associated with this MCP to DMP, in the AER for the project tenements and according to DMP (2015) guidelines, until the project tenements are relinquished. Any post-closure reporting obligations to the EPA under the Ministerial Statement for the project will be also be addressed. Disturbed areas will also be reported in annual submissions to the MRF, until signed off by DMP as meeting completion criteria.

Sheffield will continue to report any monitoring required under the Prescribed Premises Licence to DER until the licence is relinquished; reporting may continue if DER imposes a Closure Notice at relinquishment, although this is considered highly unlikely if relevant management measures are taken and licence conditions are fulfilled. Sheffield will continue to report any monitoring required under the Licences to Take Water to DoW, until the licences are relinquished or transferred. Any outstanding contaminated sites investigations and remediation efforts will be reported to DER, until the sites are formally classified consistent with the ongoing post-closure land use.

10.9 FINANCIAL SUPPORT

Appropriate provision for monitoring will be included in the closure provision as discussed in Section 11, allowing for a post-closure acceptance period of at least 10 years, and including all labour, equipment, travel consultancy, laboratory and reporting costs. Appropriate risk provision will be made for maintenance contingencies; including mobilisation, accommodation, management, and other support costs for equipment and people should substantial remedial works be required.

As the site is remote, maintenance or remedial actions such as earthworks requiring substantial mobilisation of resources will generally not be carried out piecemeal as and when the need is identified, but as part of a scheduled campaign of work, unless considered urgent. If a substantial campaign of works is required, temporary facilities such as fuel storage, ablutions and an office may be established at the site.

11. FINANCIAL PROVISION FOR CLOSURE

11.1 PRINCIPLES

As part of its financial risk management, Sheffield intends to always have sufficient liquidity to meet its obligations as they fall due, under both normal and stressed conditions, and without incurring unacceptable losses or damaging the company's reputation, by monitoring its cash reserves and forecast spending.

The financial provisioning will incorporate all obligations related to closure of the project arising as a result of its development. Sheffield will determine the likely cost and likely timing of all closure obligations, for evaluation of net present value and cashflow forecasting as part of feasibility studies for the proposed project.

Once the project commences, Sheffield will maintain financial provisions (liabilities of uncertain timing or amount) sufficient to cover incurred closure obligations, in a manner consistent with Australian Accounting Standards Board (AASB) Standard 137 *Provisions, Contingent Liabilities and Contingent Assets*. The closure provisions will be shown on the companies' financial statement, disclosed as a requirement of its public listing.

Such provisions will address all probable closure obligations arising from the development and operation of the project to date, including:

- Decommissioning and removal of built infrastructure.
- Investigation and, where necessary, remediation of contaminated sites.
- Rehabilitation earthworks and restoration of natural drainage.
- Mobilisation, accommodation and maintenance of decommissioning and rehabilitation crews and equipment.
- Closure studies and stakeholder consultation.
- Seed collection and distribution.
- Alteration or servicing of infrastructure, if required as part of any agreement for handover.
- Post-closure monitoring and reporting.
- Project management, consultancy and legal fees.

In addition, the provisions will incorporate appropriate risk adjustment (risk provision or contingency) for:

- Uncertainty in closure obligations, criteria, designs and methods.
- Care and maintenance, and unplanned closure.
- Potential delays or setbacks to decommissioning and rehabilitation works, due to unpredictable events.
- Post-closure maintenance or repairs.

Financial statements will disclose the nature of the closure obligations provided for, the expected timing of expenditure (for the most part, at or shortly after the end of the life of mine), and any significant uncertainties or assumptions in the cost estimates. Provisions will be set in "today's" dollars, based on current estimated closure costs.

Any expected gains on disposal of assets at closure will be recognised separately in accordance with AASB standards, and will not be used to offset closure provisions. No gains from the sale of assets, salvage, or scrap at closure will be assumed, until a binding agreement for sale has been reached. Sheffield will not assume that any infrastructure can be left in place, until a binding agreement for transfer of liability has been reached, and necessary approvals obtained.

Sheffield will account for MRF contributions as an annual operating expense, separate to the closure provision, and contributions will not be used to offset the provision. Accrued redundancy, leave and termination liabilities, that may become payable for a variety of reasons including mine closure or suspension, will be recognised separately from closure provisions in the company statements, in accordance with separate AASB standards.

11.2 REVIEW

The Sheffield Group Accountant will be responsible for commissioning an annual review of current closure obligations and cost estimates for provisioning on the company financial statements. As part of this, the closure task register (Section 9) will be reviewed and updated to consider any changes to:

- The site, including any increase in disturbance, accumulation of mine wastes, new infrastructure, or new (suspected or actual) contaminated sites.
- Closure obligations and criteria, arising from studies and consultation that may affect the decommissioning and rehabilitation works required.

The review of the task register will also consider any closure obligations completed to date, including:

- Topsoil, vegetation and growth medium stockpiled.
- Seed collected.
- Studies completed.
- Contaminated sites remediated or shown to be safe.
- Progressive rehabilitation earthworks completed.
- Agreements reached for transfer of infrastructure and associated closure liabilities.

Sheffield will also determine whether since the last review there have been any substantial changes to:

- Applicable rates for any of the closure tasks, and if necessary recalculate the cost of the affected tasks.
- Uncertainty in closure obligations, criteria, designs or methods, and if necessary adjust risk provisions correspondingly.

The total cost of outstanding closure tasks and risk adjustments on the register will be used to set the current closure provision. The movement in provision for each reporting period, and any expenditures set against the provision for closure tasks, will be given in financial statements. Only expenditures for closure tasks included in the closure provision will be set against it; the provision will not be used for expenditures unrelated to closure obligations. The provision and underlying cost estimates will be subject to annual external assurance as part of public listing requirements.

Sheffield will periodically review the expected timing of closure obligations as part of cashflow forecasting; obligations that will be incurred by planned future development of the project will also be considered in forecasting, although most of the footprint will be developed, and most closure obligations incurred, progressively throughout the life of the project.

11.3 COST ESTIMATION METHODOLOGY

The closure task register will become progressively more detailed over the life of the operations, to allow more detailed and accurate closure cost estimates to be developed. Preliminary estimates for rehabilitation earthworks on disturbed areas and the TSF may initially be based (like MRF relative liability estimates) on typical aggregate dollar cost per hectare rates for similar works, where such rates can be supported by adequate, recent data from other sites or quotes from earthworks contractors.

As closure planning progresses, closure tasks will be broken down into sub-tasks that can be costed individually. Costs for earthworks tasks that are primarily a factor of area, such as grading and ripping, may be estimated from typical flat dollars-per-hectare rates. Costs that are primarily a factor of volume, such as loading, hauling, and dumping rock and growth medium, may be estimated from typical flat dollars-per-cubic-metre rates.

As planning progresses further, earthworks cost estimates initially based on flat rates for areas or volumes can be refined with estimates that consider:

- Selection of the optimum fleet and labour force for the work, which may incorporate elements of the existing mining fleet to minimise mobilisation costs.
- Development of an optimum schedule for the work, including load-haul-dump movements.
- Site-specific material and landform properties such as densities, gradients and slope lengths, affecting production rates, such as grading and bulk dozer pushing.
- Separate mobilisation, hire, maintenance, fuel, labour, accommodation, management and other cost factors for the selected fleet and labour force.

Sheffield will collect data (time taken, resources used, and expenses incurred) on earthworks completed over the life of the operations, based on progressive rehabilitation, to verify and refine rehabilitation estimates. In line with International Financial Reporting Standards, estimates will generally assume that all closure works will be done by a third party at current local rates for labour and equipment hire, and not assume that any work will be done in-house.

As the site approaches closure, Sheffield may engage specialist decommissioning and mining / earthworks engineers to assist with refining final closure cost estimates. While a relatively small part of total closure costs, Sheffield will also seek advice from relevant practitioners on costs for closure studies, contaminated site investigation, and post-closure monitoring and reporting.

12. MANAGEMENT OF INFORMATION AND DATA

Sheffield will maintain, within a suitable document/data management system, a library of documents relevant to the closure of the project, including:

- This MCP and each of its revisions.
- Technical reports from baseline and closure studies, including materials characterisations.
- Annual environmental and monitoring reports to regulators.
- Correspondence, minutes of meetings, and other records of engagement and consultation with regulators and other stakeholders.
- Decommissioning and closure works cost estimates, and (when developed) schedules.
- Site plans and landform designs.
- Life of mine schedules and current mine plans.
- Plans of electrical, water, gas, and other buried services.
- Contaminated sites investigations and reports, if any.
- Journal papers, conference proceedings and other publications with relevant lessons learned at other sites.

Sheffield will also maintain, within suitable information management systems, datasets relevant to the closure of the project, including:

- Aerial photographs.
- Areas of disturbance.
- Inventories of rehabilitation materials available, required and used.
- Records of significant spills, and details of clean-up.
- Data from baseline studies, operations monitoring, closure studies, contaminated sites investigations, and post-closure monitoring, including laboratory certificates where relevant.
- Photographs from pre- and post-closure inspections and monitoring rounds.

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APPENDICES

APPENDIX 1: CLOSURE RISK ASSESSMENT

Sheffield Risk Assessment Framework

Consequence					
Consideration of the degree of possible severity of the event outcome consequences					
	Catastrophic	Major	Moderate	Minor	Insignificant
Safety and Health	Fatality	Permanent disabling injury or condition	Lost time injury	Medical treatment required	First aid treatment required
Environment	Regional impact. Serious long term effects and major loss of flora and fauna.	Large impact but with reinstatement of loss.	Localised impact but a breach of Department of Environment conditions.	Localised impact. No long term damage but significant clean up required.	No impact or only localised impact. No long term damage, minimum clean up.
Financial Project (TEC)	>\$50M, >10% balance sheet	<\$50M, <10% balance sheet	<\$5M, <1% balance sheet	<\$500k, <0.1% balance sheet	<\$50,000, <0.01% balance sheet
Schedule	>2 months	1 month - 2 months	1 week - 1 month	3 days - 1 week	Up to 3 days
Production	>1 month	1 week - 1 month	4 - 7 days	1 - 3 days	1 day
Reputation	Long term regional impact / national level	Localised, long term impact with unmanageable outcomes / state level	Localised, long term impact but manageable	Localised, short term impact	Localised temporary impact
Business Impact	Events which lead to serious damage to market confidence in GOR	A critical event which requires extraordinary management effort	A serious event which requires additional management effort	An adverse event which can be absorbed with some management effort	Impact can be absorbed through normal activity

Likelihood		Probability that the stated consequence will occur
Almost Certain	Incident is very likely to occur on this project, possibly several times (>1 in 2 chance of occurring)	
Likely to happen	Incident is likely to occur on this project (1 in 2 chance of occurring)	
Possible	Incident has occurred on a similar project (1 in 10 chance of occurring)	
Unlikely	Given current practices and procedures, this incident is unlikely to occur on this project (1 in 100 chance of occurring).	
Rare	Highly unlikely to occur on this project (1 in 1000 chance of occurring)	

RISK RANKING MATRIX							
	High	Level	Likelihood Scale (LS)				
	Medium		Almost Certain	Likely	Possible	Unlikely	Rare
	Low		10	8	6	4	3
Consequence Scale (LS)	Catastrophic	10	100	80	60	40	30
	Major	8	80	64	48	32	24
	Moderate	6	60	48	36	24	18
	Minor	4	40	32	24	16	12
	Insignificant	2	20	16	12	8	6

Objective / Threats	Current Status/ Controls/ Mitigations	Current			Proposed Additional / Future Controls	Residual		
		Cons.	Prob.	Risk		Cons.	Prob.	Risk
Incorporate the concerns and interests of all relevant stakeholders into mine closure planning.								
Significant stakeholder concerns not identified, or misunderstood, leading to failure to meet expectations, loss of trust and reputation, and potential regulatory/civil action.	<ul style="list-style-type: none"> Extensive stakeholder engagement and consultation completed to date as part of project approvals and NTMA negotiation, but little specific consultation on closure. Conceptual MCP for project approvals incorporates stakeholder engagement and consultation program. Conceptual MCP to be reviewed by key stakeholders including and refined based on feedback. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Maintain and refine stakeholder engagement program over life of operations. Maintain register and records of stakeholder consultation over life of operations. Invite all relevant stakeholders to review and comment on AER, detailing progress on closure planning and progressive rehabilitation. Invite all relevant stakeholders to review and comment on periodic MCP revisions. 	Mod	Unlik	24 Low
Meet all legal obligations for mine closure, or where appropriate, agree alternatives through stakeholder consultation.								
Obligations not identified, misunderstood, or change over life of project, leading to noncompliance.	<ul style="list-style-type: none"> Review of closure obligations incorporated into conceptual MCP. Conceptual MCP incorporates stakeholder engagement and consultation program, including regulators and parties to NTMA. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Review relevant legislation and instruments and update obligations register as part of regular MCP updates. Maintain stakeholder engagement program over life of operations. 	Mod	Unlik	24 Low
Obligations prove impracticable, leading to noncompliance / breach of agreement.	<ul style="list-style-type: none"> Current closure obligation consistent with local industry practice, but yet to be demonstrated practicable for this project. Conceptual MCP incorporates program of proposed studies intended to determine practicability of rehabilitation objectives and set appropriate criteria. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Progress program of studies to determine practicability of rehabilitation objectives and set appropriate criteria. Where obligations, objectives or criteria appear impracticable, negotiate alternatives through stakeholder engagement and consultation. Maintain appropriate risk provisions where uncertainty remains over closure criteria. 	Mod	Unlik	24 Low
Ensure that adequate financial provision is in place for all current closure liabilities.								
Site goes into planned or unexpected closure without adequate liquidity to complete outstanding closure obligations.	<ul style="list-style-type: none"> Closure costs estimated for net present value and cashflow forecasts as part of project feasibility studies. Topsoil and growth medium resources identified within project footprint; plan prepared for harvesting and stockpiling as part of project development. Early closure may leave the mining excavation open and tailings exposed without sufficient overburden to cover; additional mining may be required. Resource modelling and geotechnical assessment carried out to high standard to reduce possibility of early closure due to invalid resource model or pit failure. Market volatility and other financial risks priced into project feasibility and present value. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Implement plan to harvest and stockpile topsoil and growth medium as part of project development. Review current and outstanding obligations and associated costs every year; make and disclose adequate provisions in line with accounting standards and ASX rules. Make adequate risk provisions for current residual risks or uncertainties, including mining of overburden for rehabilitation in event of early closure. 	Mod	Unlik	24 Low
Increases in closure costs not identified, leading to inadequate provision.	<ul style="list-style-type: none"> Conceptual MCP sets out costing methodology to take account of factors influencing closure costs, including current rates for labour and equipment. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Review closure cost estimates every year over life of operations, including current industry rates. Engage decommissioning and earthworks / mining engineers to assist with refining closure cost estimates as site approaches closure. 	Minor	Poss	24 Low
Minimise the cost of meeting closure objectives through effective planning and management.								
Rehabilitation materials double-handled or inefficiently moved, leading to unnecessary cost.	<ul style="list-style-type: none"> Topsoil and growth medium resources identified within project footprint; plan prepared for harvesting and stockpiling outside of the mineral deposit area as part of project development. Mining sequence supports progressive rehabilitation of the mining excavation with stockpiled materials. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Implement plan to harvest and stockpile topsoil and growth medium as part of project development; identify best stockpile locations / arrangements to minimise handling and haulage costs. 	Minor	Poss	24 Low
Assets or infrastructure demolished or rehabilitated, that could have been transferred to a third party, leading to unnecessary cost.	<ul style="list-style-type: none"> Site very remote, but some assets including roads, borefield, camp and airstrip may be of value to third parties including pastoral station, local community, or future explorers. No specific assets or infrastructure identified for transfer at this early stage. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Actively pursue opportunities for transfer of assets and associated liabilities as part of stakeholder engagement and consultation program over life of operations. 	Mod	Unlik	24 Low
Assets demolished, or parts or materials disposed of that could have been sold or taken, leading to unnecessary cost.	<ul style="list-style-type: none"> Major plant components such as mill, cyclones, tanks, and other parts may have significant residual value to another operation at closure. Other facilities including fuel tanks, generators and demountable buildings (if not leased) may have residual value to third party at closure. Scrap from plant and other structures or other recyclables may have enough value to at least cover cost of collection. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Maintain asset register over life of operations. Progressively send parts and materials off site for salvage, scrap or recycling over life of operations, where economic to do so. Engage industrial/ mining auctioneers / scrap merchants / recyclers to visit operations as closure approaches, to identify items of value and potential buyers. Plan decommissioning to carefully salvage parts of value before demolition begins. Set aside parts, scrap, and other recyclables for collection as part of demolition works, if cost-neutral compared to disposal on site. 	Minor	Poss	24 Low

Objective / Threats	Current Status/ Controls/ Mitigations	Current			Proposed Additional / Future Controls	Residual		
		Cons.	Prob.	Risk		Cons.	Prob.	Risk
Decommissioning and rehabilitation works not completed to specification, leading to failures to meet closure obligations or objectives, and need for remedial works.	<ul style="list-style-type: none"> Expected decommissioning and rehabilitation works generally straightforward and typical for similar mining operations. Rainfall during summer wet season expected to create erosive conditions. Low relief throughout the mine area should preclude development of erosion features, small discontinues or deviations from contour can lead to water ponding, slumping, failure and erosion. Constructed landforms such as the Initial TSF will require stabilisation to prevent erosion. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Include clear specifications based on approved MCP in tenders and contracts for decommissioning and rehabilitation works. Closely supervise rehabilitation works and survey to confirm conformance to design before acceptance by Sheffield. 	Minor	Poss	24 Low
Seed inventory inadequate at closure, leading to need to purchase seed at market rate (if available); seed mix not optimised to balance cost of collection with revegetation criteria.	<ul style="list-style-type: none"> Obligations under NTMA and tenement conditions to stockpile topsoil separately to preserve seedbank. Obligation under NTMA to seed growth medium stockpiles as soon as possible with locally collected native seed to boost seedbank in stockpiles by end of mine life. Local native seed production dependent on rains, which can vary greatly from year to year. 	Mod	Poss	36 Low	<ul style="list-style-type: none"> Stockpile topsoil as part of project development to preserve seedbank; protect stockpiles from disturbance, weeds or contamination over life of operations; seed growth medium stockpiles as soon as possible after harvesting. Determine seed collection requirements and make provisional schedule over life of mine; be prepared to collect seed in any year with good rains. Determine most efficient species to target for seed collection that will support appropriate closure criteria. 	Minor	Poss	24 Low
Protect mine worker health and safety during suspension, decommissioning and rehabilitation.								
Inadequate OHS management and emergency response services maintained during suspension, contributing to occupational illness or injury.	<ul style="list-style-type: none"> Conceptual MCP addresses suspension, but does not include detailed C&M plan at this stage. PMP to be developed for project under MSIR. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Prepare detailed C&M plan, addressing OHS/ER requirements. Develop project PMP to address suspension, C&M, and recommencement. Maintain adequate OHS/ER resources throughout C&M, according to PMP and C&M plan. 	Mod	Poss	36 Med
Inadequate OHS management and emergency response services maintained during decommissioning and rehabilitation works, contributing to occupational illness or injury.	<ul style="list-style-type: none"> PMP to be developed for project under MSIR. Decommissioning of airstrip could delay access to RFDS/ medivac. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Update project PMP to address decommissioning and rehabilitation works as closure approaches. Maintain adequate OHS/ER resources throughout decommissioning and rehabilitation, according to PMP; including alternative arrangements for medivac once airstrip decommissioned. Ensure that tenders for decommissioning and rehabilitation work address OHS/ER requirements. Plan to decommission emergency response facilities, including first aid room and comms tower last; establish temporary facilities for last stages of closure works where necessary. Ensure that closure provisions allow for OHS and emergency response services throughout decommissioning and rehabilitation. 	Mod	Poss	36 Med
OHS risks for decommissioning and rehabilitation works not properly identified, leading to occupational illness or injury.	<ul style="list-style-type: none"> PMP to be developed for project under MSIR, including risk assessment for all works to be carried out on site. Demolition works may introduce new hazards, such as use of shears or demolition balls, or exposure to contaminated materials. Rehabilitation earthworks generally similar to mining, but may introduce new hazards such as operating on slopes. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Review and update OHS risk assessment in PMP to address decommissioning and rehabilitation works. Implement all controls for decommissioning and rehabilitation works as identified in PMP risk assessment. Conduct JHAs on site before commencing decommissioning and rehabilitation tasks. 	Mod	Poss	36 Med
Protect public safety and livestock during suspensions, and leave the site free of hazards to the public or livestock after closure.								
Public or livestock enter site during suspensions, leading to accident and injury.	<ul style="list-style-type: none"> Remote site, off main routes; passers-by and casual visitors unlikely. Mining lease de-stocked and fenced ahead of mine construction and operations. 	Major	Unlik	32 Med	<ul style="list-style-type: none"> Set up and maintain temporary bunds, fences, and warning signs around hazardous areas and across access roads during suspensions. Isolate and make safe fixed plant and equipment during suspensions. Park up, immobilise and make safe mobile plant and equipment during suspensions. Maintain at least a small caretaker staff on site during suspensions. Construct and maintain perimeter fence. 	Mod	Unlik	24 Low
Public or livestock enter into hazardous areas after closure, leading to accident and injury.	<ul style="list-style-type: none"> Remote site, well off main routes; passers-by and casual visitors unlikely. Expected return to pastoral grazing land use after closure. 	Major	Unlik	32 Med	<ul style="list-style-type: none"> Dismantle or demolish hazardous structures at closure. Remove or safely bury hazardous or contaminated materials at closure. Determine long-term zone of potential subsidence or instability around mine voids. Place abandonment bunds around voids and areas of potential subsidence / instability at closure. Push waste landforms batters, sides of borrow pits, etc. down to safe, stable angle, or bund off. Install signs deterring access and warning of hazards at closure. Rehabilitate site access roads and close off with substantial permanent bunds at closure. 	Mod	Unlik	24 Low

Objective / Threats	Current Status/ Controls/ Mitigations	Current			Proposed Additional / Future Controls	Residual		
		Cons.	Prob.	Risk		Cons.	Prob.	Risk
Civil aircraft attempts landing at un-maintained or decommissioned airstrip, leading to accident and injury.	<ul style="list-style-type: none"> Airstrip to be certified for operations and notified to CASA under Civil Aviation Regulations for inclusion in aviation maps and NOTAMs. 	Cat	Rare	30 Med	<ul style="list-style-type: none"> Notify airstrip suspension or decommissioning under Civil Aviation Regulations for NOTAMs and update of aviation maps. 	Minor	Rare	12 Low
Leave waste landforms stable and resistant to erosion, and ensure that any runoff will not materially affect surface waters, vegetation, habitat or heritage sites								
Water ponding on TSF, leading to sinkholes/ tunnels on top of landform and/or slips/ slumps on outer faces, leading to unstable / unsafe landform and/or exposing / releasing geochemically/ geotechnically adverse materials.	<ul style="list-style-type: none"> Tailings were characterised as geochemically benign but potentially dispersive. Overburden is expected to be mined in sufficient quantities to adequately cover the TSF. Rainfall may cause water to accumulate on landforms. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Complete studies to confirm stability / resistance of rehabilitation materials and final waste landform design over life of operations. Encapsulate tailings by cover of overburden at closure. 	Mod	Poss	36 Med
Water flowing on TSF, leading to rill and/or gully erosion on batters, and spread of sediments into surrounding environment.	<ul style="list-style-type: none"> Tailings were characterised as geochemically benign but potentially dispersive. Overburden is expected to be mined in sufficient quantities to adequately cover the TSF. Rainfall during summer wet season may be highly erosive. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Encapsulate tailings by cover of overburden at closure. Complete studies to confirm stability / resistance of rehabilitation materials and final waste landform design over life of operations. Form bunds/ drains / sediment basins at toe of TSF as landform is constructed to capture sediment in runoff during life of operations and after closure. 	Mod	Poss	36 Med
Dust blown from tailings surface or other unrehabilitated surfaces, leading to downwind contamination of soils or smothering of vegetation.	<ul style="list-style-type: none"> Tailings geochemically benign. 	Minor	Poss	24 Low	<ul style="list-style-type: none"> Begin covering tailings surface as soon as practicable after it becomes trafficable; manage final tailings deposition to allow progressive covering if possible. Apply dust suppression during rehabilitation earthworks as appropriate. 	Minor	Unlik	16 Low
Ensure that seepage from the waste landforms or mining excavation will not materially affect groundwater resources, vegetation or habitat.								
Seepage from TSF leads to adverse impacts on groundwater and/or vegetation and habitats.	<ul style="list-style-type: none"> Tailings characterised as geochemically benign. No nearby users of groundwater resources near TSF. No vegetation, habitats or heritage sites of particular significance near TSF. TSF design and operating strategy incorporates decant return to minimise seepage. Groundwater Management Plan developed to mitigate any impacts from seepage. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Minimise TSF seepage through decant return over life of operation to mitigate any legacy seepage plume at closure. Monitor groundwater around TSF over life of operations to delineate and quantify any seepage impacts. Establish overburden, topsoil and vegetation cover on tailings surface at closure to store captured rainwater and release through evapotranspiration, reducing amount of infiltration into tailings pile. Conduct studies over life of operations to demonstrate effectiveness of proposed tailings cover. Monitor groundwater around TSF after closure, to confirm that any seepage impacts from operations continue to dissipate after tailings covered. 	Minor	Poss	24 Low
Seepage from mining excavation backfill leads to adverse impacts on groundwater resources.	<ul style="list-style-type: none"> Mine waste and residues characterised as geochemically benign, however, demarcation of Potentially Acid Forming materials found below ore body which may be disturbed by mine dewatering. Groundwater Management Plan developed to mitigate any impacts from seepage. 	Minor	Poss	24 Low	<ul style="list-style-type: none"> Development of an Acid Sulphate Soils management plan at least 12 months prior to any disturbance of PAF materials. Monitor dewatering abstraction volumes, groundwater levels and groundwater quality around mine over life of operations to confirm behaviour of groundwater system; use to refine post-closure seepage plume if necessary. 	Minor	Poss	24 Low
Reinstate natural surface water flows and drainage lines as far as practicable								
Drainage lines blocked by mine landforms, or other disturbances, leading to flooding and/or downstream areas being starved of water.	<ul style="list-style-type: none"> Drainage in project area poorly defined; project design includes major interception drains to take surface water around operations. Other disturbances including roads and airstrips will locally disrupt surface water flows, managed through culverts, drains, bunds and other controls. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Develop final surface drainage plan to maintain diversions around post-mining landforms and reinstate natural drainage as far as practicable at closure. Remove, retain, modify and/or armour drains and bunds at closure to remain stable for the long term, prevent flooding, and return diverted water to natural drainage as far as practicable. Re-contour other disturbances to reinstate natural surface flows as far as practicable. 	Minor	Poss	24 Low
Rehabilitate disturbed areas to support, as far as practicable, self-sustaining vegetation and habitats similar to surrounding undisturbed areas.								
Inadequate growth medium resources available at closure leading to need to mine additional growth medium to support revegetation objectives	<ul style="list-style-type: none"> Topsoil and growth medium resources identified within project footprint; plan prepared for harvesting and stockpiling as part of project development. 	Major	Poss	48 Med	<ul style="list-style-type: none"> Implement plan to harvest and stockpile topsoil and growth medium as part of project development. Protect topsoil and growth medium stockpiles over life of operations. 	Minor	Poss	24 Low
Topsoil and growth medium does not contain adequate seedbank at closure, leading to poor revegetation and/or need to collect supplementary seed.	<ul style="list-style-type: none"> Obligations under NTMA and tenement conditions to stockpile topsoil separately to preserve seedbank. Obligation under NTMA to seed growth medium stockpiles as soon as possible with locally collected native seed to boost seedbank in stockpiles by end of mine life. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Strip vegetation from areas to be disturbed, and stockpile for rehabilitation use. Protect vegetation and topsoil stockpiles over life of operations, from erosion, dust, disturbance, saline water, contamination, etc.; arranges stockpiles to avoid surface water flows. Strip topsoil to isolate seedbank, and stockpile to no more than 2 m thick to preserve seedbank. Spread native seed mix over growth medium stockpiles as soon as possible to establish seedbank. Collect and store local native seed over life of operations for supplementary seeding of rehabilitated areas if required. 	Minor	Poss	24 Low

Objective / Threats	Current Status/ Controls/ Mitigations	Current			Proposed Additional / Future Controls	Residual		
		Cons.	Prob.	Risk		Cons.	Prob.	Risk
Revegetation criteria for landforms prove impracticable, leading to unmet stakeholder expectations.	<ul style="list-style-type: none"> Conceptual MCP sets broad criteria for revegetation on landforms; NTMA includes obligation to reduce visual impact by establishing vegetation on TSF batters. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Conduct studies over life of operations to determine practicable revegetation criteria for waste landforms, and most effective seed mix. Refine seed collection strategy over life of operations to align with revegetation criteria. 	Minor	Poss	24 Low
Minimise the visual impact of post-mining landforms.								
Post mining landforms conspicuous, out of keeping with natural landscape.	<ul style="list-style-type: none"> Landforms to be built over generally flat terrain with low relief and may be visible from a long distance. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Stockpile topsoil for spreading on landform surfaces. Carry out studies to determine appropriate and practicable vegetation criteria and supplementary seed mix (if necessary) for TSF outer batter cover. 	Minor	Poss	24 Low
Relinquish the site with no outstanding legal or social liability								
Insufficient evidence that closure criteria will be met in the long term, preventing or delaying tenement relinquishment.	<ul style="list-style-type: none"> No unusual closure issues identified for the project to date; challenges generally likely to be similar to other similar sites in WA. Some closure process such as landform evolution may take hundreds of years, impractical to monitor to completion. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Conduct studies over the life of operations to determine practicable criteria, commensurate with the degree of associated risk. Conduct revegetation trials over as many years as possible to assess performance in a variety of rainfall scenarios. Collect sufficient data and conduct sufficient modelling for long-term processes to have confidence in predictions. Design and conduct post-closure monitoring that aligns with and can demonstrate sufficient progress toward agreed closure criteria within a reasonable time. Ensure adequate provision made for pre-closure studies and post-closure monitoring. Maintain stakeholder engagement over life of operations to renegotiate practicable closure criteria where appropriate. Maintain appropriate risk provisions where uncertainty remains over ability to meet closure criteria. 	Minor	Poss	24 Low
Assets / infrastructure handed over without full transfer of all associated liabilities, leading to unexpected costs or legal actions against Sheffield.	<ul style="list-style-type: none"> No specific assets or infrastructure identified for transfer at this early stage of project development and stakeholder consultation. 	Mod	Poss	36 Med	<ul style="list-style-type: none"> Engage legal consultants to assist with legal framework and binding agreements for transfer of liability, as and when opportunities for transfer are identified. Conduct technical and legal risk assessment for handover of assets/ infrastructure to ensure that all potential risks are identified and liabilities (including financial, community, safety, environment and monitoring) are clearly transferred. Ensure that transfer agreements clearly set out preconditions and responsibilities for handover (e.g., works to be completed or modifications made, transfer of licences, etc.) 	Minor	Poss	24 Low
Contaminated sites remain unidentified or unresolved at closure, leading to ongoing liability under CS Act.	<ul style="list-style-type: none"> Greenfields site with no known pre-existing contamination. Minor spills of hydrocarbons and process reagents likely to occur over life of project, with substantial cumulative effect if not well managed. Investigation and remediation of some sites may be impracticable until after decommissioning, due to buried services, ongoing operations, etc. Remote site with pastoral land use, no likely future use such as residential or recreational that may require higher standards of remediation. 	Mod	Likely	48 Med	<ul style="list-style-type: none"> Implement measures to avoid creating a legacy of contaminated sites during life of operations, including spill prevention, cleanup, remediation and validation. Report and investigate contamination according to CS guidelines. Investigate and remediate contaminated sites progressively where practical and necessary, leave others till final closure if demonstrably safe to do so. Determine closure criteria for contamination in line with CS guidelines and expected future land use. 	Insig	Poss	12 Low